Pursuant to Court's Instructions the Record on Appeal in this matter was condensed. Pages were not renumbered, therefore it appears there are missing pages, however, counsel has confirmed all pertinent information is included in the condensed record.

THE STATE OF SOUTH CAROLINA
In The Supreme Court

APPEAL FROM LEE COUNTY
Court of Common Pleas

Thomas W Cooper, Jr , Circuit Court Judge

Case No 93-CP-31-169

Abbeville County School District, Allendale County School District, Bamberg County School District 1, Bamberg County School District 2, Barnwell County School District 19, Barnwell County School District 29, Barnwell County School District 45, Berkeley County School District, Chesterfield County School District, Clarendon County School District 1, Clarendon County School District 2, Clarendon County School District 3, Dillon County School District 1, Dillon County School District 2, Dillon County School District 3, Florence County School District 1, Florence County School District 2, Florence County School District 3, Florence County School District 4, Florence County School District 5, Hampton County School District 1, Hampton County School District 2, Jasper County School District, Laurens County School District 55, Laurens County School District 56, Lee County School District, Lexington County School District 4, Marion County School District 1, Marion County School District 2, Marion County School District 7, Marlboro County School District, McCormick County School District, Orangeburg Consolidated School District 3, Orangeburg Consolidated School District 5, Saluda County School District and Williamsburg County School District, *(caption continued on second page)*

RECORD ON APPEAL (CONDENSED),
VOL XIV OF XXVIII

Lena Manning, individually, and as a taxpayer residing in Allendale County and as Guardian ad Litem of

Courtney V , Courtney V , a minor, by and through Lena Manning, as Guardian ad Litem, William L Mills, individually, and as a Taxpayer residing in Allendale County and as Guardian ad Litem of Waylon P , Waylon P , a minor, by and through William Mills,

as Guardian ad Litem, Betty Bagley, individually, and as a taxpayer residing in Bamberg County and as a parent and Guardian ad Litem of Tyler B , Tyler B , a minor, by and through Betty Bagley, as Guardian ad Litem, Evert Comer, Jr , individually, and as a taxpayer residing in Bamberg County and as parent and Guardian ad Litem of Kimberly C , Kimberly C , a minor, by and through Evert Comer, Jr , as Guardian ad Litem, Marla Q Jameson, individually, and as a taxpayer residing in Barnwell County, and as a parent and Guardian ad Litem of Eleanor J , Eleanor J , a minor, by and through Marla Q Jameson, as Guardian ad Litem, Victor M Lancaster, Sr , individually, and as a taxpayer residing in Barnwell County, and as parent and Guardian ad Litem of Christie L , Christie L , a minor, by and through Victor M Lancaster, Sr , as Guardian ad Litem, Dr Charles Clark, individually, and as a taxpayer residing in Chesterfield County, and as parent and Guardian ad Litem of Candace C , a minor, by and through Dr Charles Clark, as Guardian

ad Litem, Colonel Larry Coker, individually, and as a taxpayer residing in Clarendon County, and as a parent and Guardian ad Litem of Corrie C , Corrie C , a minor, by and through Colonel Larry Coker, as Guardian ad Litem, Pamela Williams, individually, and as a taxpayer residing in Dillon County, and as parent and Guardian ad Litem of Katisha W , Kathisha W , a minor, by and through Pamela Williams as Guardian ad Litem, Eddie Wright, individually, and as a taxpayer residing in Florence County, and as parent and Guardian ad Litem of Brandon F , Brandon F , a minor, by and through Eddie Wright as Guardian ad Litem, John Whiteside, individually, and as a taxpayer residing in Florence County and as Parent and Guardian ad Litem of Joel W , Joel W , a minor, by and through John Whiteside as Guardian ad Litem, Dr Francis Mills, individually, and as a taxpayer residing in Hampton County and as a parent and Guardian ad Litem of Amy M , Amy M , a minor, by and through Dr Francis Mills, as Guardian ad Litem, Brenda Brooks, individually, and as a taxpayer residing in Hampton County, and as parent and Guardian ad Litem of Tyrin B , Tyrin B , a minor, by and through Brenda Brooks as Guardian ad Litem, Marva Tigner, individually, and as a taxpayer residing in Jasper County, and as parent and Guardian ad Litem of Bryan T and Bradley T , Bryan T , a minor, by and through Marva Tigner as Guardian ad Litem, Bradley T , a minor, by and through Marva Tigner as Guardian ad Litem, Robert Elisha Short, individually, and as a taxpayer residing in Laurens County and as parent and Guardian ad Litem of Robert B S , Robert B S , a minor, by and through Robert Elisha Short, as Guardian ad Litem, Dr Keith A Bridges, individually, and as a taxpayer residing in Laurens County and as parent and Guardian ad Litem of Jorgana Ranson B , Jorgana Ranson B , a minor, by and through Dr Keith A Bridges, as Guardian ad Litem, Gail Y Harriott, individually, and as a taxpayer residing in Lee County and as parent and Guardian ad Litem of Rashade H , Rashade H , a minor, by and through Gail Y Harriott, as Guardian ad Litem, Linda Carraway, individually, and as a taxpayer residing in Marion County, and as parent and Guardian ad Litem of Kimberly W , Kimberly W , a minor, by and through Linda Carraway as Guardian ad Litem, Dr John Nobles, individually, and as a taxpayer residing in Marlboro County and as parent and Guardian ad Litem of Erin N , Erin N , a minor, by and through Dr John Nobles, as Guardian ad Litem, Patricia Hampton, individually, and as a taxpayer residing in McCormick County and as parent and Guardian ad Litem of Krystle H ,

Krystle H , a minor, by and through Patricia
Hampton, as Guardian
ad Litem, Bernice Profit, individually, as a
taxpayer residing in Orangeburg County and as
parent and Guardian ad Litem of Russell H ,
Russell H , a minor, by and through Bernice
Profit, as Guardian ad Litem, Matlin P Brown,
individually, and as a taxpayer
residing in Orangeburg County and as parent and
Guardian ad Litem of Tanisha P B , Tanisha P
B , a minor, by and through Matlin P Brown, as
Guardian ad Litem, James Berry, individually,
and as a taxpayer residing in Orangeburg County
and as parent and
Guardian ad Litem of Dondrea B , Dondrea B , a
minor, by and through James Berry, as Guardian
ad Litem, Gerald Smith, individually, and as a
taxpayer residing in Orangeburg County and as
parent and Guardian ad Litem of Brenda S ,
Brenda S , a minor,
by and through Gerald Smith, as Guardian ad
Litem, Thomas Shealy, individually, and as a
taxpayer residing in Saluda County and as parent
and Guardian ad Litem of Thomas S , Jr ,
Thomas S , Jr , a minor,
by and through Thomas Shealy, as Guardian ad
Litem,

Of whom

Allendale County School District,
Dillon County School District 2,
Florence County School District 4,
Hampton County School District 2,
Jasper County School District,
Lee County School District,
Marion County School District 7,
Orangeburg School District 3,
Lena Manning, individually, and as a taxpayer
residing in Allendale County and as Guardian ad
Litem of Courtney V , Courtney V , a minor, by
and through Lena Manning, as Guardian ad
Litem, Pamela Williams, individually, and as a
taxpayer residing in Dillon County, and as parent
and Guardian ad Litem of Katisha W , Katisha
W , a minor, by and through Pamela Williams as

Plaintiffs,

Guardian ad Litem, Eddie Wright, individually, and as a taxpayer residing in Florence County, and as parent and Guardian ad Litem of Brandon F , Brandon F , a minor, by and through Eddie Wright as Guardian ad Litem, Brenda Brooks, individually, and as a taxpayer residing in Hampton County, and as parent and Guardian ad Litem of Tyrin B , Tyrin B , a minor, by and through Brenda Brooks as Guardian ad Litem, Marva Tigner, individually, and as a taxpayer residing in Jasper County, and as parent and Guardian ad Litem of Bryan T and Bradley T , Bryan T , a minor, by and through Marva Tigner as Guardian ad Litem, Bradley T , a minor, by and through Marva Tigner as Guardian ad Litem, Gail Y Harriott, individually, and as a taxpayer residing in Lee County and as parent and Guardian ad Litem of Rashade H , Rashade H , a minor, by and through Gail Y Harriott, as Guardian ad Litem, Linda Carraway, individually, and as a taxpayer residing in Marion County, and as parent and Guardian ad Litem of Kimberly W , Kimberly W , a minor, by and through Linda Carraway as Guardian ad Litem, Bernice Profit, individually, and as a taxpayer residing in Orangeburg County and as parent and Guardian ad Litem of Russell H , Russell H , a minor, by and through Bernice Profit, as Guardian ad Litem, are

Appellants-Respondents,

v

Glenn F McConnell, as President *Pro Tempore* of the Senate and as a representative of the South Carolina Senate, Robert W Harrell, Jr , as Speaker of the House of Representatives and as a representative of the South Carolina House of Representatives,

Respondents-Appellants,

and

The State of South Carolina, Mark C Sanford, as Governor of the State of South Carolina,

Respondents

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cultural perspectives To the extent possible content is also selected for relevance to "real life" situations students may encounter in the future As appropriate competent professional teachers plan to provide content in multiple formats that will enable students to interact with information in a variety of ways (e g , see hear, and manipulate) To accomplish this teachers select adapt, or develop varied combinations of appropriate written materials (e g texts, periodicals, and handouts) resources (e g manipulatives and displays) and technologies (e g audio/visual aids and computers) Whenever commercially developed materials or resources are to be used, teachers review them for accuracy and appropriateness as well as adapt or revise them as necessary Materials and resources developed by teachers are clear, free of errors and designed to be easily understood and/or used by students

As appropriate for the unit objectives the content to be covered and the ability and developmental levels of students competent professional teachers plan a variety of instructional strategies to facilitate learning The strategies are logically sequenced and provide sufficient opportunities for initial learning application practice, and review As appropriate the sequence of strategies promotes varied levels of student thinking and problem-solving skills, as well as includes provisions for different rates of learning that ensure that all students will remain engaged in learning throughout the unit Strategies are matched to the learning styles of students and provide an appropriate balance of opportunities for independent and collaborative learning In addition the strategies provide opportunities for the teacher and students to vary their roles in the instructional process (e g instructor facilitator coach and audience)

Competent professional teachers are reflective practitioners who regularly evaluate the effects of their plans and decisions As such they evaluate the effectiveness of individual lessons (e g instructional strategies materials resources and technologies) within instructional units to determine the extent to which students' needs are being met and what objectives are being achieved As appropriate evaluations are based on information from a variety of sources including assessment results observations feedback from students and discussions with colleagues As needed adjustments are made during units to better serve the needs of students

Performance Dimension 3
Short-Range Planning, Development, and Use of Assessments

Dimension Description

This dimension covers responsibilities related to planning developing and using assessments during instructional units Assessments are considered any tools activities assignments or procedures used to evaluate students' progress toward and achievement of the learning and developmental objectives of an instructional unit Examples of assessments include such things as observations of students, traditional paper-pencil tests and exercises, authentic performance tasks projects, and portfolios The frequency and types of assessments planned for instructional units may vary considerably depending on a number of factors including the ability and developmental levels of students the number and types of learning and developmental objectives of the unit the themes content or skills covered during the unit and the instructional strategies used during the unit The key elements of the dimension include the ability and disposition of teachers to

- plan and schedule a variety of appropriate assessments of students' progress and achievement as needed during instructional units,
- select adapt and/or develop assessments which are appropriate for the ability and developmental levels of students, appropriate for the objectives of instructional units appropriate for the content or skills covered during instructional units, and consistent with the instructional strategies used during instructional units,
- determine appropriate criteria for evaluating students' progress and achievement based on assessment results,
- analyze assessment results to make judgments about students' progress and achievement,
- analyze assessment results to determine the need for instructional feedback,
- analyze assessment results to evaluate the extent to which instruction met all students' needs and
- maintain accurate records of student progress and achievement

Competent Performance Description

As needed during the school year competent professional teachers conduct short-range planning of instructional units scheduled in their LRPs A significant part of the short-range planning process focuses on developing and using a variety of informal and formal assessments of student progress and achievement As appropriate the planning process involves a combination of independent and collaborative efforts to plan and schedule assessments select and/or develop assessment strategies and materials formulate criteria for evaluating student performances analyze assessment results and maintain records of student progress and achievement

Competent professional teachers develop a plan that reflects an understanding of the importance of integrating assessment strategies throughout the instructional process The frequency of the scheduled assessments is appropriate for the complexity and length of the unit as well as for the ability and developmental levels of students Informal assessment strategies (e g observing and questioning students individual and group performance tasks, quizzes, and homework assignments) are planned to routinely monitor students' understanding and progress More formal assessment strategies (e g paper-pencil tests projects portfolios, and research papers) are planned to evaluate the extent to which students have achieved learning and developmental objectives at key points during instructional units

Competent professional teachers select and/or develop assessment strategies based on generally accepted principles of measurement and evaluation Assessment strategies and tasks are consistent with unit objectives, content and instructional strategies as well as appropriate for the ability and developmental levels of students Competent teachers are not over-reliant on assessments provided in commercially produced materials such as textbooks and workbooks However when such sources are to be used they are reviewed for appropriateness and revised if needed Teacher-made assessments are designed to be easily used by students and are free of errors or procedures that would affect the quality and appropriateness of the assessment results All assessment strategies or tools include verbal and/or written directions that clearly define what students are expected to do As appropriate assessment strategies also include explicit criteria for evaluating students' performances Criteria may include such things as scoring rubrics vignettes standards answer keys scales and grading curves Criteria are appropriately matched to types of assessments and allow for reliable and valid interpretations and judgments about students progress and achievement

Competent professional teachers analyze and interpret assessment results for a variety of appropriate purposes Results of informal assessments are used to determine students understanding of key concepts and skills, as well as progress toward accomplishing unit objectives Based on these results, teachers plan instructional feedback and they evaluate the extent to which the overall instructional plan is addressing the needs of all students Results from formal assessments are analyzed to determine the extent to which students have accomplished the learning and developmental objectives of the unit Competent professional teachers maintain accurate records of assessment results that provide a clear picture of student progress and achievement Records are well-organized, current and easily summarized

Performance Dimension 4
Establishing and Maintaining High Expectations for Learners

Dimension Description

This dimension covers responsibilities related to establishing and maintaining appropriately high expectations for student learning and development throughout the school year Expectations provide the focus for student learning and may be communicated and clarified in various forms and at various times as needed by students Expectations may be related to general overall performance and participation specific learning and developmental objectives of instructional units performance and participation in specific instructional activities and events, and completing instructional assignments and tasks The key elements of the dimension include the ability and disposition of teachers to

- establish at the beginning of the year appropriately high expectations for the overall performance and participation of students
- use strategies to create in students a sense of responsibility for their own performance and participation
- maintain and reinforce the overall expectations for student performance and participation throughout the school year,
- establish specific and appropriate objectives for student learning and development at the beginning of instructional units,
- clarify unit objectives in such ways that students receive clear explanations of what they are expected to learn and be able to do
- ensure that the expectations are appropriate for the ability and developmental levels of students and that they challenge all students to achieve at appropriately high levels
- clarify unit objectives in such ways that students understand the relevance of the objectives to previous and/or future objectives for learning
- clarify unit objectives in such ways that students understand the importance of achieving the unit objectives
- reclarify objectives for learning and development during instructional units as needed by students
- establish appropriate expectations related to participating in instructional activities and events during lessons and
- establish appropriate expectations for completing instructional assignments and tasks in and out of the classroom

Competent Performance Description

Throughout the school year, competent professional teachers take steps to establish and maintain appropriately high expectations for learners The expectations are related to achieving long-range learning and developmental goals achieving specific learning and developmental objectives of instructional units participating in instructional activities, and completing instructional assignments

At the beginning of the school year competent professional teachers set the tone for an engaging and productive experience for all students As appropriate, long-range learning and developmental goals are clarified so students have a clear understanding of what they will be expected to learn and be able to do by the end of the school year The goals are appropriately challenging for the ability and developmental levels of all students Teachers also ensure that students understand that accomplishing the goals will require a collaborative effort with the teacher as well as the students themselves having important roles and responsibilities in the learning process These expectations, roles, and responsibilities are maintained consistently during the year through appropriate modeling actions and statements

As appropriate during instructional units competent professional teachers establish clear and appropriate expectations for student achievement by presenting and clarifying specific learning and developmental objectives Because instructional units may vary in length and in the number of objectives covered objectives may be presented or clarified at various times, as necessary for the students For example, objectives may be presented at the beginning of a long-term project during the first lesson of a series related to common objectives or subject matter or during lessons on a daily basis As appropriate for the nature of the objectives as well as for the ability and developmental levels of the students competent professional teachers establish objectives in a variety of oral and/or written forms For example teachers may present objectives orally have students present them orally, or present them orally and in writing Whenever objectives are presented or clarified the content and/or skills to be covered and what students are expected to learn and to be able to do are clear Teachers also ensure that students understand why it is important to accomplish the objectives and as appropriate, how the objectives relate to previous and/or future learning The expectations are appropriately high for the ability and developmental levels of all students Competent professional teachers maintain students focus on learning and development by reviewing objectives as needed

As needed during instructional units competent professional teachers establish appropriate expectations for how students are to participate in instructional activities and complete instructional assignments The expectations clearly communicate how activities and assignments are relevant to accomplishing specific learning and developmental objectives, as well as what students are to do

Performance Dimension 5
Using Instructional Strategies to Facilitate Learning

Dimension Description

This dimension covers responsibilities related to orchestrating instructional strategies during lessons and units to facilitate learning Instructional strategies are considered any methods techniques activities or assignments used by teachers to help students to acquire knowledge or skills and to achieve the learning and developmental objectives of instructional units The key elements of the dimension include the ability and disposition of teachers to

- use varied instructional strategies in a logical sequence,
- use varied instructional strategies that are appropriate for the learning and developmental objectives of instructional units,
- use varied instructional strategies that are appropriate for the content and skills being learned by students,
- use varied instructional strategies the are appropriate for the ability and developmental levels of students
- use varied instructional strategies that accommodate for different rates of learning
- use varied instructional strategies that are appropriate for the learning styles of students,
- use varied instructional strategies that are appropriate for students' stage of learning (i e initial application practice and review)
- use varied instructional strategies that actively engage students in instruction and learning,
- use instructional strategies that promote varied levels of thinking and problem-solving skills and
- use varied instructional strategies that promote independent and collaborative learning

Competent Performance Description

During lessons throughout the school year competent professional teachers draw from a substantial repertoire of instructional strategies (e g methods techniques activities and assignments) to facilitate student learning and development As appropriate, instructional strategies are varied within lessons and instructional units to accommodate different types of learning and developmental objectives Strategies are orchestrated in logical sequences that provide all students with appropriate and sufficient opportunities for initial learning application practice and review

Competent professional teachers have a thorough understanding of the backgrounds needs and interests of their students as well as the many factors that influence how they learn Accordingly, teachers use instructional strategies that are appropriately matched to students' ability and developmental levels and that build on students' interests and prior learning In addition, strategies are appropriately varied to accommodate for students with special needs as well as different styles and rates of learning The strategies maximize the likelihood that all students will remain actively engaged in learning and achieve appropriate levels of success

Competent professional teachers also have a thorough understanding of the subject matter they teach and the instructional strategies that are most effective in assisting students to accomplish relevant learning and developmental objectives Accordingly they effectively use strategies that engage students in a wide range of meaningful activities and assignments designed to help them acquire the knowledge and skills necessary to accomplish unit objectives As appropriate the activities and assignments provide students with opportunities to express their ideas knowledge and skills in a variety of ways (e g orally in writing and through performances and products) Also as appropriate activities and assignments promote the development of students critical thinking and problem-solving skills

Competent professional teachers effectively use strategies that vary their roles as well as those of the students in the learning process (e g instructors facilitators coaches, and observers) These strategies encourage varied types of positive and productive interactions among teachers and students as well as provide an appropriate balance of opportunities for both independent and collaborative learning Strategies involving independent activities and assignments promote in students a sense of responsibility for their own work and progress Other strategies requiring collaborative activities and assignments promote team work, cooperation, and an understanding of the importance of working with others to achieve success

Performance Dimension 6
Providing Content for Learners

Dimension Description

This dimension relates to the appropriateness of content provided during lessons and the manner in which it is presented to students Teachers are responsible for all subject matter presented to students during instructional units however information may be drawn from or delivered by a number of sources including the teacher or other educators students and various instructional materials, resources and technologies (e g texts, displays videotapes, and computer software) The key elements of the dimension include the ability and disposition of teachers to

- provide content that is appropriate for the objectives of the instructional unit
- provide content that is appropriate for the ability and developmental levels of students
- provide content that is current and accurate,
- provide content in a logical sequence
- provide content at an appropriate pace for all students,
- provide content from multiple sources that reflects varied intellectual social and cultural perspectives
- provide content in varied formats,
- include in presentations of content sufficient and appropriate explanations examples, and demonstrations, and
- place appropriate emphasis on the key elements of subject matter as needed by students

Competent Performance Description

Competent professional teachers have a thorough command of the subject matter they teach and during lessons throughout the school year ensure that students are provided with content that is current accurate and free of errors that would impede learning Content is appropriate for the learning and developmental objectives of instructional units, as well as for the ability and developmental levels of students

Competent professional teachers are not over-reliant on standard textbooks and workbooks they provide students with additional information using a variety of other commercial or teacher-made materials and resources All supplementary written materials are clear and free of errors Additional resources such as manipulatives special supplies and other instructional products are safe and designed to be easily used by students Competent professional teachers also effectively use a variety of media/communication resources such as overhead projectors, audio-tapes, videotapes and computers as appropriate and available to provide content in multiple formats that enable students to interact with information in numerous ways (e g read observe hear and manipulate) Competent professional teachers provide content from multiple sources and in varied formats that expose students to a variety of intellectual social, and cultural perspectives As appropriate content is provided through explanations and demonstrations by teachers and students, written materials manipulatives visual and auditory aids and computers

As needed by students, competent professional teachers provide effective explanations and demonstrations of key concepts relationships and skills to assist students in accomplishing the learning and developmental objectives of instructional units Explanations and demonstrations are clear logical and appropriately paced for the complexity of the material as well as for the ability and developmental levels of students Explanations include numerous examples drawn from a variety of sources designed to establish the relevance of concepts and relationships to students' personal lives, local communities and events in the world at large During explanations competent professional teachers promote critical and reflective thinking by presenting information from varying majority and minority viewpoints Teachers encourage discussion and discourse by soliciting ideas and opinions from students through effective questioning and probing As needed by students competent professional teachers provide effective demonstrations of skills or procedures being learned by students Steps in procedures or tasks are broken down in sequence and explained through varied and relevant applications Competent professional teachers also ensure that at appropriate times emphasis is placed on the key elements of content or skills being learned As appropriate, key elements are emphasized in a variety of ways including stating or displaying them throughout presentations eliciting them from students during discussions and identifying them during reviews

Performance Dimension 7
Monitoring and Enhancing Learning

Dimension Description

This dimension covers responsibilities related to monitoring and enhancing student learning and development during instructional units Monitoring is defined as any methods teachers may use to collect information about students understanding of instruction and content as well as information about students progress toward and achievement of specific learning and developmental objectives Enhancing learning is defined as actions taken by teachers based on information collected from monitoring students to correct misunderstandings reinforce learning or to extend learning The key elements of the dimension include the ability and disposition of teachers to

- monitor learning and development through observations of students' general performance and reactions during lessons
- monitor learning and development through appropriate questioning techniques,
- monitor learning and development through observations of students specific performances during activities (e g speeches recitals performance tasks and collaborative tasks)
- monitor learning and development by reviewing work completed by students (e g homework projects and portfolios)
- use information from monitoring students to adjust the types and sequences of instructional strategies as needed,

- use information from monitoring students to adjust the pace of lessons, as needed,
- use information from monitoring students to provide sufficient and informative instructional feedback to enhance learning and development,
- provide appropriate and sufficient reviews and summaries of content and skills and
- extend students' learning and development through appropriate enrichment activities

Competent Performance Description

Competent professional teachers have a thorough understanding of the important relationship between instruction and assessment. During lessons throughout the school year, they use a variety of informal assessment strategies to monitor students' understanding of instruction to monitor students' progress toward accomplishing learning and developmental objectives, and to determine the extent to which the needs of all students are being addressed The assessment strategies require students to communicate in a variety of oral, written, and kinesthetic forms

Competent professional teachers maintain a constant awareness of students' understanding and progress through observation and listening During explanations demonstrations, and other presentations of content teachers observe students' reactions to information as well as listen to students' comments to recognize non-verbal and verbal cues that suggest students are experiencing confusion or difficulty Teachers also observe and listen to students during instructional activities or assignments that require collaborative interactions or performances of tasks

Competent professional teachers use appropriate questioning techniques to solicit information from students during presentations of content and during instructional activities and assignments Questions are addressed to a representative cross-section of students Questions vary in difficulty and level of thinking required to respond as appropriate for the students' stage of learning for their ability and developmental levels and for the nature of the content activities and assignments Students are provided with an appropriate amount of time to respond and, as needed teachers use appropriate probing techniques such as rephrasing or giving clues to elicit responses

As appropriate competent professional teachers use a variety of informal performance assessment strategies to monitor students' understanding and progress These include non-written independent and collaborative activities or assignments such as role-playing recitations musical or athletic performances using manipulatives, and producing products They also include periodic written assignments such as essays paper-pencil quizzes journals, and note-taking

As appropriate competent professional teachers use strategies that develop in students the ability to assess and evaluate their own progress Students are encouraged to identify their strengths, as well as areas in which they need improvement. In addition, and as appropriate teachers develop in students the ability to evaluate other students' opinions and ideas to offer constructive critiques of other students' work and to positively receive peer critiques of their own opinions ideas and work

Competent professional teachers use information from informal assessments to enhance student learning and development As needed by students during presentations of content teachers provide additional explanations and demonstrations of key concepts relationships and skills New examples along with additional relevant applications of procedures, are designed to correct misunderstandings or reinforce learning During instructional activities or soon after evaluating assignments completed by students, competent professional teachers provide informative feedback to correct misunderstandings or errors and to enhance or reinforce learning Students who are behind in progress are provided with special assistance that is effective in accelerating their learning and development

Competent professional teachers adjust the pace of lessons to accommodate the needs of students When students are easily acquiring knowledge and skills, teachers quicken the pace to maintain students' attention and active involvement When students are experiencing difficulty with concepts and skills teachers slow the pace to provide more time for information processing and learning Competent professional teachers also use information from informal assessments to adjust or provide alternative instructional activities and assignments, as needed by students

At appropriate times, and as needed by students competent professional teachers provide informative reviews of knowledge and skills learned by students The reviews actively involve students in recapping the key elements of content or steps in procedures prior to moving to other learning and developmental objectives or instructional units

Performance Dimension 8
Maintaining an Environment That Promotes Learning

Dimension Description

This dimension covers responsibilities related to creating and maintaining a student-centered environment that promotes and sustains learning and development. The dimension covers only those environmental factors that one would reasonably expect teachers to control The key elements of the dimension include the ability and disposition of teachers to

- create and maintain a physical environment that is engaging and interesting to students
- create and maintain an environment that provides an inviting place to learn
- maintain a room arrangement that allows all students to see hear and participate in instructional events
- promote cooperation teamwork, and respect among students
- convey appropriately high expectations for the general participation and performance of students,
- convey confidence in their knowledge of the content and skills being learned by students
- convey confidence in their ability to teach and to assist students in accomplishing learning and development objectives
- create in students a sense of responsibility for teaching themselves and their peers
- convey respect for the feelings ideas and contributions of students
- convey an understanding of and a sensitivity to the social and cultural backgrounds of students
- maximize positive and productive interactions with students and
- provide or promote appropriate rewards and incentives for learning and development

Competent Performance Description

Competent professional teachers understand the important role that a quality physical and psychological environment plays in facilitating student learning and development During lessons throughout the school year, competent professional teachers strive to establish and maintain a safe and positive environment that encourages and motivates all students to achieve high levels of success

To the extent possible competent professional teachers create and maintain a physical environment that provides an inviting and stimulating place to learn Classrooms contain displays of educational materials (e g , bulletin boards, posters, and examples of student work) that are of interest to students and relevant to the subject matter and skills being learned Available instructional materials and resources (e g , periodicals, reference books maps computers, manipulatives art supplies, and athletic equipment) are maintained in good working condition Potentially hazardous materials such as lab chemicals are stored properly for safety Classrooms are not cluttered to an extent that would impede learning and desks are arranged so that all students can see, hear and participate in instructional events

Competent professional teachers convey confidence in their ability to teach their subject matter and are comfortable trying new or alternative instructional strategies as well as allowing student input and suggestions to guide instructional events They also convey confidence in their ability to work with heterogeneous groups of students They are comfortable in providing assistance for students with special needs as well as patient and poised in teaching students with varying ability and developmental levels

Competent professional teachers convey an enthusiasm for teaching Their positive interactions with students comments and mannerisms (e g facial expressions, body language, animated behavior and pleasure in seeing students succeed) show a genuine love for working with young people Students are encouraged to be creative as well as to be unafraid to explore and experiment with new ideas and skills

Competent professional teachers show an awareness of and sensitivity to individual differences among students as well as their social and cultural backgrounds All students are equally encouraged to participate learn and develop and to achieve high levels of success Competent professional teachers create and maintain an environment in which cooperation and teamwork is valued and students learn to respect and appreciate differences among individuals The beliefs ideas opinions and other contributions of all students are given thoughtful consideration

Performance Dimension 9
Managing the Classroom

Dimension Description

This dimension covers responsibilities related to managing student behavior non-instructional routines transitions between instructional events and instructional materials and resources Non-instructional routines are procedures for handling important functions that facilitate efficiency in the classroom (e g taking roll and collecting homework) Transitions between instructional events are periods of time during which teachers and students leave one activity and prepare for another (e g moving from whole group instruction to learning centers or cooperative groups) The key elements of the dimension include the ability and disposition of teachers to

- establish clear and appropriate rules for student behavior;
- maintain and enforce rules for student behavior in a fair and consistent manner
- use appropriate preventive discipline techniques,
- create in students a sense of responsibility for their own behavior
- establish appropriate and effective routines for completing essential non-instructional tasks,
- manage transitions between instructional events in a manner that maintains a smooth flow of activity during lessons and minimizes loss of instructional time and
- effectively manage instructional materials, resources and technologies

Competent Performance Description

Competent professional teachers understand that an important key to successful teaching is effectively managing student behavior and classroom events At the beginning of the school year, competent professional teachers establish a clear set of rules for classroom operations and student behavior Rules and procedures for completing non-instructional routines necessary for efficient classroom operations are explained and clarified for students As needed routines are rehearsed or practiced to ensure complete understanding Such routines may include procedures for calling roll collecting or turning in assignments, obtaining instructional materials from storage areas and keeping work stations or lab areas in order Rules for appropriate classroom behavior and consequences for inappropriate behavior are presented, clarified and if possible posted in clear view Rules are appropriate for the age level of the students and are consistent with school and district policies

Throughout the school year competent professional teachers maintain a sense of order in the classroom and minimize loss of instructional time Transitions between lesson segments are smooth and efficient Instructional materials and resources are organized, available, and easily accessible when needed Non-instructional routines are completed or supervised in a timely manner and in general the classroom is characterized by a smooth flow of activity and instruction

Competent professional teachers keep behavioral disruptions to a minimum by maintaining a constant awareness of classroom events and by using preventive discipline techniques (e g , eye contact facial expressions, and proximity) When necessary, class rules and consequences are enforced so disruptions are not allowed to increase in severity or significantly interfere with the instructional process Rules and consequences are used in a fair and consistent manner Disciplinary actions focus on the inappropriate behaviors and not on the students themselves and consequences for violating rules are consistent with the severity of infractions

Performance Dimension 10
Fulfilling Professional Responsibilities Beyond the Classroom

Dimension Description

This dimension covers teachers' responsibilities beyond their individual classrooms While teachers' primary responsibilities are related to addressing the needs of their students as members of the teaching profession, teachers also have responsibilities to broader education organizations (e g schools and districts) which must serve the needs of all learners in the community The key elements of the dimension include the ability and disposition of teachers to

- actively participate in collegial activities designed to make the entire school a productive learning environment (e g department and faculty meetings)
- work with teams or committees of educators and other citizens to achieve organizational goals
- participate in organizations that promote the well-being of students (e g PTA and School Improvement Councils)
- collaborate with other teachers to plan and provide appropriate learning experiences for students
- establish cooperative and productive relationships with other student-oriented professionals in the school or district (e g , librarians media-specialists counselors social workers and nurses),
- support extracurricular activities that contribute to the overall learning and development of students (e g , clubs, student councils, athletics, and cultural/artistic events),
- establish respectful and productive relationships with parents and/or guardians of students,
- establish productive relationships with agencies businesses and community groups that promote the well-being of students and
- actively seek out and participate in activities which will promote their continued growth as professionals

Competent Performance Description

Beyond their individual classrooms teachers practice their profession within the contexts of schools school districts and entire communities All of these organizations have goals objectives, and concerns for the education and well-being of young people Accordingly competent professional teachers serve as advocates for students beyond the classroom and remain actively involved in and supportive of these broader missions

Within the contexts of their schools and districts competent professional teachers work with peers to coordinate planning instruction, and assessment They are open to and appreciative of advice from colleagues as well as willing to provide suggestions and assistance to others when requested They establish positive and productive relationships with other student-oriented professionals (e g counselors librarians curriculum specialists and nurses) and seek their advice and assistance in attempting to address the needs of students Competent professional teachers also participate in collegial activities for the purpose of making the entire school a positive and productive learning environment for students They regularly attend and contribute to departmental meetings faculty meetings and strategic planning sessions They also actively support the efforts of organizations such as the parent/teacher groups and school improvement councils In addition to the extent possible competent professional teachers actively support extra-curricular activities that contribute to the overall learning and development of students (e g , academic clubs student council athletics and cultural/artistic events) Competent professional teachers are also aware that they work within organizations that have standard rules and procedures for completing various administrative tasks They abide by these rules and complete any required tasks in a timely and effective manner

Within the context of their communities competent professional teachers establish positive and productive relationships with the parents or guardians of their students As needed they communicate with parents and guardians about students' progress and offer advice for supporting students' learning and development at home They also listen to and to the extent possible address parents' and guardians' concerns Competent professional teachers serve as advocates for students in relationships with other agencies businesses, and community groups that support and promote the well-being of young people

Competent professional teachers value opportunities for professional growth and strive to learn new ways to improve their effectiveness in serving the educational needs of young people They regularly participate in and contribute to staff development activities offered by their schools and districts

CAPITAL OUTLAY/SCHOOL BUILDING HISTORICAL DATA

FY	APPROPRIATED GF 30/15	BUDGET REDUCTION ADJUSTMENT	APPROPRIATED EIA 30/15	APPROPRIATED EIA ADM	EIA REALLOCATION LAPSED FUNDS	BARNWELL REVENUE	OTHER	SCHOOL FACILITIES BOND ACT	TOTAL FOR FY	DISTRICT EXPENDITURES
1985	$18 083 730	$0	$0	$55,738 138	$0	$0			$73 821,868	$123 411 848
1986	18 083 730	(4 003,512)	0	35,306,814	0	0			$49,387 032	145 608 712
1987	18 083 730	(7 135,748)	0	14 080,218	4,921 400	0			$29,849 600	180 974 703
1988	16,492,991	0	0	4,820 000	7 659 837	0			$27 972,828	158,550 833
1989	17,892,905	0	0	6,940 000	3,138,100	0			$27 771 005	141 912,583
1990	17 780,798	0	0	1 412,000	5,295 994	0			$24 488,792	229 676,140
1991	17 782,000	0	0	1 850,130	13,263 489	0			$32,895,819	256 143 667
1992	0	0	17 799,968	3,562,172	0	0			$21,362,140	218 325 204
1993	0	0	17 935,568	0	0	0			$17 835,566	179 016 656
1994	0	0	15 416,909	0	10,390 139	0			$25,807 048	198 264 183
1995	0	0	16 418,909	0	15 000,000	0			$30,416 909	188 337 267
1996	0	0	16 416,909	0	13 762,658	0			$29 179 565	285 436 723
1997	0	0	15 416,909	0	0	89,394 960			$104,811,869	389 469 060
1998	0	0	15,416,909	0	0	41 783 048			$57 199 957	512,588 195
1999	0	0	15,416,909	0	0	32,431 466			$47,848,375	607 497 388
2000	0	0	13 991,245	0	5 842,302	28,317 045		250 000 000	$298 150,592	623 610 107
2001	0	0	0	0	8,787 401	40 799 395	5,000,000	250 000 000	$304,586 796	752,176 292
2002	0	0	0	0	0	16 789,885	0	250 000 000	$266 789 885	881 049 107
2003	0	0	0	0	0	21 417 211	0	0	$21,417,211	
TOTAL	$122,999 884	($11 139,260)	$142,228,233	$123,809 470	$88,061,318	$270,933 010	$5,000 000	$750 000 000	$1 491,892 655	$8 092,048,378

NOTES

IN FY 1988 $2,640 389 OF EIA WAS USED TO MEET THE 30/15 REQUIREMENT
** SOURCE. ANNUAL FINANCIAL REPORTS OF FY FUNCTION 253 FACILITY ACQUISITION/CONSTRUCTION

PLAINTIFF'S EXHIBIT
6108

Student Data Status of the Class

STUDENT	AUGUST MAT 7 Spring 2002	SEPTEMBER MAT 7 Fall 2002
A	8-2	36-4
B	33-4	84-7
C	43-5	86-7
D	30-4	40-5
E	24-4	25-4
F	DNA	17-3
G	16-3	60-6
H	5-2	51-5
I	6-2	32-4

6112A

Student Data Status of the Class

cont.

Student	August MAT 7 Spring 2002	September MAT 7 Fall 2002
J	4-2	36-4
K	17-3	72-6
L	17-2	44-5
M	1-1	23-4
N	3-1	61-6
O	15-3	44-5
P	6-6	32-4
Q	8-2	24-4

6-19B

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PLT_6127

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Certificate Descriptions
District Representatives
Report Card
Teacher Qualifications
Guidance

Descriptions of Certificates Required In South Carolina

Certificates that meet the *highly qualified* certificate requirement

Initial
Issued to graduates of teacher education programs who have passed the required Praxis II content area exam(s)

Critical Need
Issued to participants in the Program for Alternative Certification (PACE) who have passed the required Praxis II content area exam(s) and participated in the preservice institute

Professional
Currently issued to teachers with three years of public school experience who have passed the Principles of Learning and Teaching and successfully completed the induction program and the formal evaluation of ADEPT Regular/Grade A certificates issued to some teachers prior to 1970 are the equivalent to the current professional certificate

Certificates that do not meet the *highly qualified* certification requirement

Out-of-State Temporary
Issued to teachers from other states who have not taken or passed the required Praxis II content area exam(s) This type of certificate is issued for one academic year

Transitional
Issued to graduates of teacher education programs who have not passed the required Praxis II content area exam(s) This type of certificate is issued for one academic year

Temporary Proviso
Allows an out of state teacher or a recent graduate of a teacher education program who has not passed the required Praxis exams to renew their temporary or transitional certificate for two additional times

Interim
Issued to participants in the Program for Alternative Certification (PACE) who have not passed the required Praxis II content area exam(s) and/or have not participated in the preservice institute This type of certificate is issued for twelve months

Out-of-field Permit
Issued to a certified teacher who has 12 hours in an additional area of certification to allow him/her to

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PLAINTIFF'S EXHIBIT 6127

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teach out of their field of preparation Renewed by taking six hours per year and/or the required Praxis II content area exam(s)

Permit Proviso
Allows a teacher with an out of field permit who has not taken the required six hours or the Praxis II content area exam(s) to renew their out of field permit for two additional times

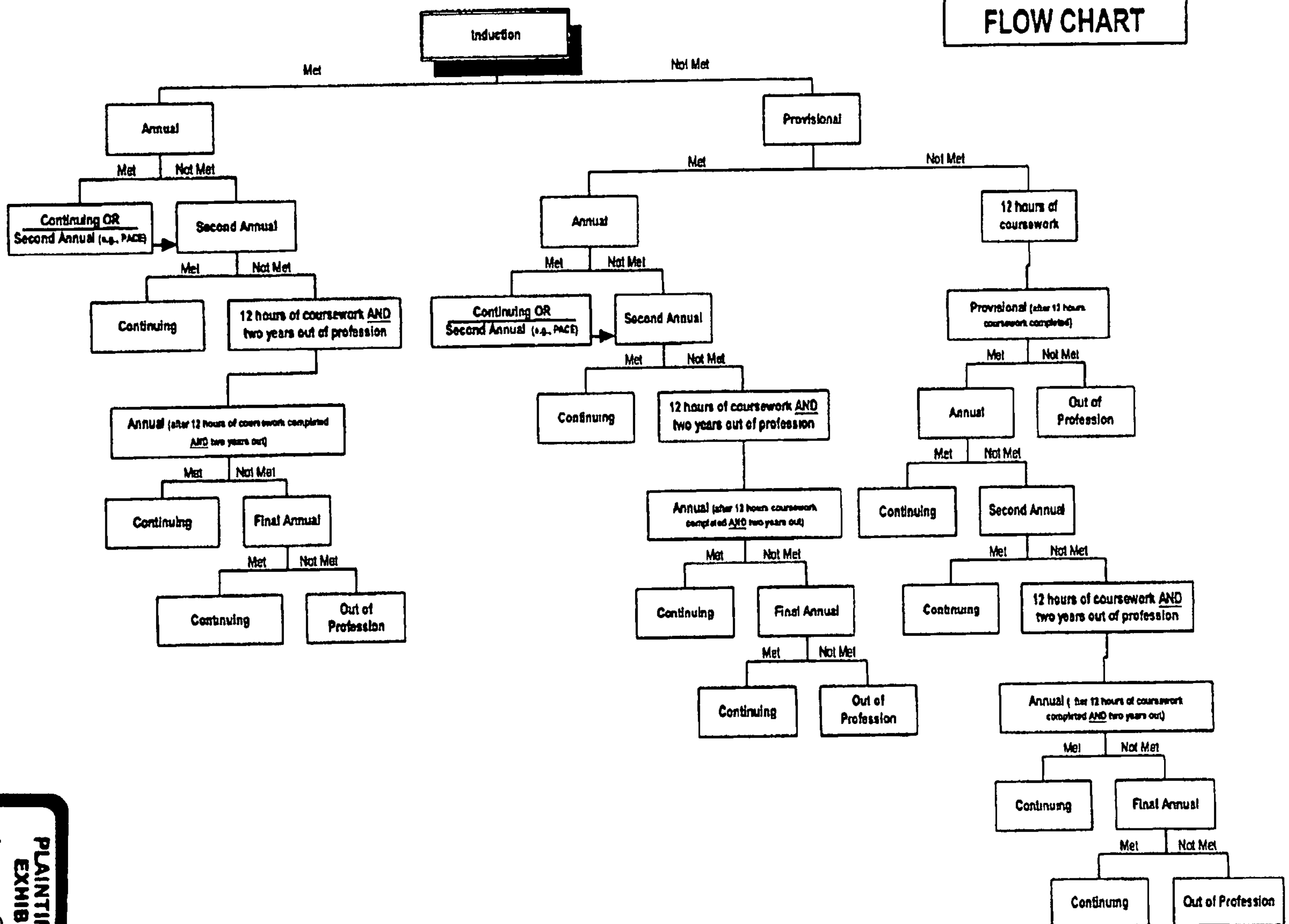
Special Subject
Issued to individuals who have expertise in a subject taught in the public schools It is renewed at the request of the school district

Graded/Regular
Issued to teachers who made a grade of B,C, or D on the NTE or to teachers who did not take or pass a specialty area exam Discontinued issuing this type of certificate in 1971

Warrant
Issued to teachers who did not pass the required teaching exams or who did not have the required professional education courses Discontinued issuing this type of certificate in 1976

REC030268

CONTRACT FLOW CHART



Count of foreigners who are listed with a certificate validity period of 070102 - 063003

Count	District	
2	Abbeville 60	0160
10	Aiken 01	0201
1	Allendale 01	0301
1	Anderson 02	0402
4	Bamberg 02	0502
4	Beaufort 01	0701
11	Berkeley 01	0801
46	Charleston 01	1001
1	Cherokee 01	1101
1	Clarendon 01	1401
1	Colleton 01	1501
2	Darlington 01	1601
9	Dorchester 02	1802
6	Fairfield 01	2001
2	Florence 01	2101
2	Florence 03	2103
1	Florence 04	2104
2	Georgetown 01	2201
12	Greenville 01	2301
6	Hampton 02	2502
3	Horry 01	2601
15	Jasper 01	2701
2	Lancaster 01	2901
1	Laurens 55	3055
6	Lee 01	3101
4	Lexington 01	3201
1	Lexington 04	3204
3	Lexington 05	3205
1	Marion 07	3407
1	Marlboro 01	3501
7	Orangeburg 03	3803
7	Orangeburg 05	3805
42	Richland 01	4001
3	Richland 02	4002
1	Spartanburg 02	4202
1	Spartanburg 07	4207
8	Sumter 02	4302
1	Sumter 17	4317
231		

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South Carolina
Teacher Salary Ranges
2003 04

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$25 184 - $29 468	$26 317 - $30 793	$28 836 - $33 741	$31 354 $36 687	$33 873 $[illegible]9 634
5	$28 [illegible]09 - $33 358	$29 768 - $34 831	$32 613 $38 160	$35 132 - $41 107	$38 910 - $[illegible]5 528
10	$31 984 - $37,424	$33 243 - $38 897	$36 391 - $42 581	$38,910 - $45 528	$43 947 - $[illegible]1 422
15	$35 434 - $41,460	$36 693 - $42,934	$40 169 $47 001	$42 687 - $49 948	$43 984 - $[illegible]7 315
22	$38 697- $46 343	$40 021- $47 848	$43 806 - $52 348	$46 453 $55 426	$5[illegible],600 - $[illegible]4 398

Allendale

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$25 949	$27 090	$29 625	$32 159	$34 695
5	$29 295	$30 562	$33,427	$35,962	$39 765
10	$32 793	$34 060	$37 229	$39,765	$44 834
15	$36 266	$37 533	$41 032	$43,566	$49,904
22	$39 550	$40 883	$44,692	$47,356	$54 550

Dillon 2

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$25 349	$26 490	$29 025	$31 559	$34 096
5	$28,695	$29 962	$32 827	$35 362	$39 165
10	$32 193	$33 460	$36 629	$39 165	$44 234
15	$35 005	$36 933	$40,432	$42,966	$49,304
22	$38,960	$40 283	$44 092	$46 756	$53 950

Florence 4

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$26 594	$27 735	$30 270	$32 804	$35,340
5	$29 195	$30 462	$33 327	$35 862	$39 665
10	$32,693	$33 [illegible]	$3[illegible] 129	$39 665	$44,734
15	$36,16[illegible]	$37 433	$40 932	$43 456	$49 804
22	$3[illegible] 45[illegible]	$40 [illegible]3	$44 592	$47 256	$54 450

PLAINTIFF'S EXHIBIT
6138

Hampton 2

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$27 123	$28 344	$31 057	$33 768	$36 482
5	$30,704	$32,059	$35 125	$37 837	$41 907
10	$34 447	$35 802	$39 193	$41 907	$47 330
15	$38,163	$39,518	$43 262	$45 974	$52 755
22	$41 677	$43 103	$47 178	$50 029	$57 727

Jasper

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$27 032	$28 226	$30 880	$33 532	$36,185
5	$30,534	$31 860	$34 859	$37 512	$41 492
10	$34 195	$35,521	$38 838	$41 492	$46 797
15	$37 831	$39 156	$42 818	$45 471	$52 104
22	$41,783	$43,157	$47,178	$49 957	$57 782

Lee

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$25 649	$26 790	$29 325	$31 859	$34 395
5	$28 995	$30 262	$33 127	$35 662	$39 465
10	$32,493	$33,760	$36 929	$39 465	$44 534
15	$35 966	$37,233	$40 732	$43 266	$49 604
22	$39 350	$40 683	$44 492	$47,156	$54 350

Marion 7

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$25 349	$26 480	$29 025	$31 559	$34 095
5	$28 695	$29,962	$32 827	$35 362	$39 165
10	$32 193	$33 460	$36 629	$39 165	$44 234
15	$35 666	$36 933	$48 432	$42 966	$49 304
22	$38 950	$40 703	$44 092	$46 756	$53 950

Orangeburg 3

Years of Experience	Bachelors	Bachelors + 18	Masters	Masters + 30	Doctorate
0	$27 867	$29 121	$31 908	$34 694	$37 482
5	$31 545	$32 938	$36 088	$38 875	$43 055
10	$35 391	$36 784	$40,267	$43 055	$48 628
15	$39 209	$40 632	$44 [illegible]48	$47 234	$54 202
22	$42 819	$44 284	$48 472	$51 400	$59 309

THE SOUTH CAROLINA TEACHER LOAN PROGRAM

Annual Review

by the

Education Oversight Committee

September 2003

PLAINTIFF'S EXHIBIT
-6142

THE SOUTH CAROLINA TEACHER LOAN PROGRAM
Annual Review
2001-2003

The Teacher Quality Act of 2000 provides that the South Carolina Education Oversight Committee shall review the [SC Teacher] loan program annually and report to the General Assembly (§59 26-20 (j) SC Code of Laws of 1976 as amended)

The initial review of the program covering the years 1984 2001 was issued in May 2002 and covered four areas (1) described the program historically (2) described the applicant and recipient populations (3) examined the repayment patterns and (4) examined the degree to which teacher loan recipients are represented in SC s active teaching force The findings and recommendations of the initial review were

<u>Findings</u>

1 The Teacher Loan Program is fulfilling the statutory mission to attract individuals into the teaching profession and into areas of critical need
2 The Student Loan Corporation has managed the program and the assets of the program well
3 Approximately half of the loan recipients teach at least a minimum number of years to repay the loans
4 The number of areas of critical need has increased since the inception of the program
5 The vast majority of loan recipients are white females
6 The collection of and sharing of data among the various partners in the program could be improved

<u>Recommendations</u>

1 There needs to be better communication and sharing of data among the various partners of the program
2 Additional data on why individuals who receive the loans but do not teach need to be collected
3 Vigorous recruitment of African Americans and males into the program is needed
4 The impact on the program from South Carolina s multiple scholarship options needs to be studied
5 Data on whether loan recipients teach in rural critical needs schools versus urban critical needs schools need to be collected and studied
6 The General Assembly should develop long range goals and objectives for the Teacher Loan Program

In keeping with the recommendations from the initial review the review of the Teacher Loan Program (TLP) for the last two fiscal years focused on the following questions

1 How did the statistics of the last two fiscal years compare to previous years?
2 Where geographically did the teachers whose loans were being canceled during the last two fiscal years teach and in what critical need subject areas?
3 What connection did the recipients of the TLP have with the Life Scholarship Program?
4 How can the TLP contribute to the Technical Assistance programs that are part of the Accountability System?

Prior to the completion of the review for the 2001-2002 school year the present study was expanded to include the 2002-2003 school year and move the report date from May to September in an effort to bring the review in line with the budget development process Thus this study will cover two years Subsequent studies should cover only one year

Summary of the Teacher Loan Program

The Teacher Loan Program is established within the Education Improvement Act of 1984 The program is intended to provide loans enabling qualified state residents to attend public or private colleges and universities for the purpose of becoming certified teachers employed in areas of critical need Critical need is defined as either a critical geographic or certification area in accordance with actions of the State Board of Education A percentage of the loan is cancelled by fulfillment of the teaching requirement The Teacher Loan Program is exemplary of programs offered in almost every state and is linked historically to similar efforts by the federal government A summary of programs in other states is presented in Appendix A The South Carolina Student Loan Corporation (SLC) administers the program The SLC is a private entity that administers several federal loan programs

With funds from the Education Improvement Act Trust Fund the General Assembly has appropriated monies to support the loan program in the amounts shown in Table 1 Data in the table also include the administrative costs of the program and the amount of funds received from repayments

Table 1

SC Teacher Loan Program Revenues and Loans Over Time

Year	Appropriation	Legislatively Mandated Transfers	Revolving Funds from Repayments	Total Dollars Available	Administrative Costs	Percent of Total Dollars Spent on Administration	Amount Loaned
1984-85	1 500 000	0	0	1 500 000	124 033	8 3	300 000
1985 86	1 250,000	0	0	1,250,000	71 214	5 7	1,008 115
1986-87	1 943 059	75 000	0	1,943 059	84 376	4 3	1 776 234
1987-88	2,225,000	75,000	100 000	2,325,000	98,976	4 3	2,277,402
1988-89	2 925 000	75 000	350 000	3 275 000	126 941	3 9	2 889 955
1989 90	3 300,000	0	300 000	3 600,000	154,927	4 3	3 284 632
1990 91	4,600,000	1 000,000	300,000	4,900,000	210,741	4 3	3 978,476
1991 92	4,600,000	1,000,000	900,000	5,500,000	217,981	4 0	4,350 908
1992 93	4 775 000	1 175 000	1 350 000	6 125 000	248 703	4 1	4 628 259
1993 94	4 775 000	1,175,000	1,350,000	6,125,000	254,398	4 2	4 805,391
1994 95	5 016 250	1 233 750	1 135 000	6 151 250	272 260	4 4	4 761 397
1995 96	3,016 250	0	1 885,000	4 901 000	219 058	4 5	3,999,053
1996 97	3 016 250	0	1 108 500	4 124 500	222 557	5 4	3 936 538
1997 98	3 016,250	0	2 067,000	5 083 000	248 704	4 9	4 393,679
1998 99	3 016 250	1 000 000	2 565 000	4,581 250	295 790	6 5	4 423 446
1999 2000	3 016,250	1,000,000	2 550,000	4,566,250	272,115	5 0	4,240 693
2000 2001	3 916 250	0	3 000 000	6 916 250	279 800	4 1	5 556 854
2001 2002	3,016 250	145,216	3,265 000	6,136,034	321,058	5 2	5,815 382
2002 2003	2 863 826	144 471	2 950 000	5 669 355	346 601	6 1	5 332 946
2003 2004	2 863 826	0	3 000 000	5 863 826			

Source SC Student Loan Corporation 1995 2003 See Appendix B for explanation of transfers mid-year budget cuts

To be eligible for a teacher loan the applicant must be (1) a United States citizen (2) a resident of South Carolina (3) enrolled in good standing at an accredited public or private college or university on at least a half time basis and (4) enrolled in a program of teacher education or have expressed an intent to enroll in such a program (SC SLC 2001) Loans are made to eligible applicants who have not defaulted on any other student loan The academic criteria specify that entering freshmen must be in the top 40 percent of their high school graduating class and have an SAT or ACT score equal to or greater than the SC average for the year of graduation from high school or the most recent year for which data are available Enrolled undergraduate students including enrolled college freshmen must have taken and passed the Praxis II (which replaced the SC Educator Entrance Examination (EEE)) and have a cumulative grade point average of at least 2 75 on a 4 0 scale Entering graduate students must have at least an undergraduate grade point average of 2 75 on a 4 0 scale Graduate students who have completed at least one term must have a grade point average of 3 5 or better on a 4 0 scale and must be seeking initial certification in a critical subject area if the applicant already holds a teaching certificate

In 2001 the General Assembly approved and funded an additional appropriation of $2 000 000 from the General Fund for the Career Changers program Participants in the South Carolina

Program for Alternative Certification for Educators (PACE) also are eligible to receive loans from these funds to support completion of the courses required for certification This program is designed to recruit individuals who have possessed a baccalaureate degree for at least three years or are instructional assistants in the SC public school system and have been employed on a full-time basis for a minimum of three years (or the part-time equivalent of three years) The budget for the Career Changers was reduced in 2002 2003 to $1 659 800 but the appropriation was increased to $1 814 933 for 2003-2004 The Career Changers program will be included in the review beginning with the 2003-2004 annual review after the receipt of three years of data

The amount of loan awarded varies depending upon student status College freshmen and sophomores may borrow up to $2 500 per year Juniors seniors and graduate students may borrow up to $5 000 per year PACE participants may borrow up to $1 000 per year not to exceed an aggregate maximum of $5 000 Career Changers may borrow up to $15 000 per year and up to an aggregate maximum of $60 000

Loans may be cancelled by fulfilling teaching requirements or repayments Loans may be cancelled at the rate of 20 percent or $3 000 whichever is greater for each full year of teaching in a critical subject or critical geographic school within South Carolina Should the recipient teach both in a critical subject and a critical geographic school the loan is cancelled at the rate of 33 percent or $5 000 whichever is greater If the recipient chooses to repay the loan the payment schedule includes an interest rate that is set 2 percent higher than the federal Stafford loans but the rate is not to exceed 10 25 percent

The General Assembly assigned the duty of defining the critical need areas to the State Board of Education in the Education Improvement Act Areas of critical need shall include both rural areas and areas of teacher certification and shall be defined annually for that purpose by the State Board of Education Beginning in the fall of 1984 the State Board of Education has defined the certification and geographic areas considered critical and subsequently those teaching assignments eligible for cancellation Only two subject areas – mathematics and science were designated critical during the early years of the programs but recent teacher shortages have expanded the number of certification areas To determine the subject areas the South Carolina Center for Teacher Recruitment conducts a Supply and Demand Survey of all 85 South Carolina school districts Beginning in 2002-2203 subject areas with twenty percent or higher vacancy and/or are filled with candidates who are not fully certified in the subject area are designated critical need The certification areas designated critical for 2001-2002 includes

- Art
- Business Education
- Early Childhood Education
- Elementary Education
- English/Language Arts
- Family and Consumer Science
- Foreign Languages (Spanish French and Latin)
- Guidance
- Industrial Technology
- Mathematics
- Media Specialist
- Science
- Special Education (all areas)

In December 2001 the State Board of Education approved a new list for 2002-2003 eliminating Early Childhood Education and Elementary Education as critical subject areas and adding Music The categories remain the same for 2003-2004

The State Board of Education considers multiple factors in designating rural critical geographic areas These criteria include the following degree of wealth distance from shopping and entertainment centers and faculty turnover In 1984-85 69 of the 91 school districts qualified as critical geographic districts Over the life of the program the designation of critical geographic area has changed In 1994 schools in urban districts that had one of the fifteen highest average teacher turnover rates over the previous three years were as designated critical geographic need schools The most recent information identifies the following fifteen districts with the highest teacher turnover in alphabetical order Laurens 55 is new to the list for 2003-2004 replacing Clarendon 1 The remainder of the list has been steady the last three years

Allendale	Florence 4	Lexington 4
Anderson 3	Hampton 2	Marion 7
Bamberg 2	Jasper	McCormick
Barnwell 29	Laurens 55	Richland 1
Florence 3	Lee	Saluda

At the beginning of the 2000-2001 school year the State Board of Education adopted the criteria established for the federally funded Perkins Loan Program as the criteria for determining critical need schools The Perkins Loan Program uses free and reduced lunch figures to determine schools eligible for loan forgiveness For 2002 2003 124 schools were added to list on the basis of free and reduced lunch and eligibility for Medicaid For the 2002-2003 and 2003 2004 school years 993 of the 1115 or South Carolina public schools (89%) will qualify for critical geographic need

The change in how schools are designated critical geographic needs schools severely hampered the attempt to determine where geographically the teachers whose loans were being canceled during the previous two fiscal years were teaching and in what critical need subject areas The process of matching the data files from the TLP to the Professional Certification files from the South Carolina Department of Education became too cumbersome to complete the question as originally formed Instead the question has been revised and will become a part of the study of the TLP for the 2003-2004 fiscal year The new research question will focus on individual teachers and their migration pattern during and after the repayment or cancellation of the loan Of utmost interest is whether the TLP is providing long term solutions to staffing in critical geographic need schools or whether teachers are staying in the schools just long enough to completely cancel their loan If the teachers are moving at the end of the cancellation period or migrating from school to school on a frequent basis then the TLP is not meeting one of the goals of the program to help solve the staffing needs of critical geographic need schools on a stable basis

Update on Applicant Populations

During the first ten years of the Teacher Loan Program 11 387 individuals received a loan through the Teacher Loan Program (duplicated count SLC) Specific demographic information is not available for these recipients but information on applicants since 1994-1995 is available Those records were reviewed to gain an understanding of who applied for and who received the teacher loans Since 1994-95 the SLC received 16,687 applications for the Teacher Loan Program The number of applicants is a duplicated count as one applicant could have applied for loans in multiple years Of the 16 687 applications 66 6 percent were approved 26 percent were denied and 7 4 percent cancelled the application Applications generally were denied for failure to meet the academic grade point criteria (47 3 percent) or for having not passed the EEE or Praxis II (17 3 percent) The data presented in Table 2 indicates some applications in 1994 95 1995 96 2001-02 and 2002-03 were denied because of inadequate funds available for the program (approximately 10 to 24 percent the first two years but less than seven percent the last two years)

Table 2
Application Status of Applicants 1994 95 through 2002-03

Year	Total Applied*	Approved # (%)	Application Cancelled # (%)	Denied # (%)	Reason for Denial				
					Credit Problem	Academic Reason	No EEE Praxis	Other**	Inadequate loan funds
1994 95	2 242	1 416 (63 2)	176 (7 8)	650 (29)	48	241	69	52	240
1995 96	2 024	986 (48 7)	176 (8 7)	862 (42 6)	8	229	115	20	490
1996 97	1 446	982 (67 9)	118 (8 2)	346 (23 9)	5	262	51	28	
1997 98	1 545	1 117 (72 3)	119 (7 7)	309 (20)	3	201	63	42	
1998 99	1,569	1 138 (72 5)	128 (8 2)	303 (19 3)	10	182	54	57	
1999-00	1 532	1 121 (73 2)	85 (5 5)	326 (21 3)	6	206	69	45	
2000-01	2 028	1 495 (73 8)	112 (5 5)	420 (20 7)	16	244	86	74	
2001-02	2,297	1 536 (66 9)	106 (4 7)	655 (28 5)	8	312	122	56	157
2002-03	2 004	1 332 (66 5)	110 (5 5)	562 (28)	3	219	139	73	126
TOTAL 1995 2003	16 687	11 123(66 6)	914 (7 4)	4 433 (26)	107 (2 4)	2 096 (47 3)	768(17 3)	447(10 1)	1 013 (22 8)

*This is a duplicated count of individuals because the same individuals may apply for loans in multiple years
** Other' reasons include (1) not a SC resident, (2) enrollment less than half time (3) ineligible critical area (4) not seeking initial certification and (5) received the maximum annual and/or cumulative loan

Source SC Student Loan Corporation 1995-2003

Applicants for the program remain overwhelmingly white and/or female However the percentage of students failing to report their gender and/or race has increased over the past few years a trend that many institutions of higher learning have experienced as well The percentage of male applicants decreased the last two years and overall has decreased during the last two years from fifteen per cent to fourteen percent

Table 3
Distribution of Applicants to the Teacher Loan Program by Gender
1994-95 through 2002 2003

Year	Number Applied	Gender					
		Male		Female		Unknown	
		#	%	#	%	#	%
1994-95	2,242	246	11	1 476	66	520	23
1995 96	2,024	305	15	1 692	84	27	1
1996 97	1 446	195	13	1 189	82	62	4
1997 98	1 545	247	16	1 241	80	57	4
1998 99	1 569	261	17	1 267	81	41	3
1999-00	1 532	263	17	1 212	79	57	4
2000 01	2 028	299	15	1 628	80	101	5
2001 02	2 297	288	13	1 769	77	240	10
2002-03	2 004	246	12	1 599	80	159	8
TOTAL	16 687	2350	14	13 073	78	1 264	8

Source SC Student Loan Corporation 1995- 2003

Neither the program enabling legislation nor related regulations establishes a program objective addressing different demographic groups Twice, however money from the program was earmarked for minority recruitment From 1986-87 through 1988-89 $75 000 was earmarked for South Carolina State University to recruit minority students And in 1995-96 a proviso set aside up to $5 000 00 per district for qualified minority students Neither recruitment program appears to have impacted the Teacher Loan Program South Carolina State University receives a separate allocation for minority student recruitment The allocation was $467 000 in 2002-2003

Table 4

Distribution of Applicants to the Teacher Loan Program by Race/Ethnicity
1994 95 through 2002-2003

Year	Number Applied	Ethnicity							
		African American		Other		White		Unknown	
		#	%	#	%	#	%	#	%
1994 95	2 242	210	9	20	1	1 580	70	432	19
1995 96	2 024	271	13	31	2	1 664	82	58	3
1996-97	1 446	236	16	14	1	1 115	77	81	6
1997 98	1 545	258	17	12	1	1 195	77	80	5
1998 99	1 569	301	19	9	1	1 193	76	66	4
1999-00	1 532	278	18	14	1	1 164	76	76	5
2000-01	2 028	310	15	25	1	1 555	77	138	7
2001 02	2 297	361	16	15	1	1 630	71	291	13
2002-03	2 004	280	14	14	1	1 506	75	204	10
TOTAL	16 687	2 505	15	154	1	12 602	76	1 426	8

Source SC Student Loan Corporation 1995- 2003

The TLP continues to appeal overwhelmingly to undergraduate applicants Table 5 showcases applicant patterns by academic status Although only 20 percent of program participants are freshmen consistently 60 percent are continuing undergraduates This may reflect that students are more willing to commit to a professional program after their initial year of post-secondary education Another factor could be that many freshmen do not commit to any major Interviews with potential graduate student loan applicants identified a hesitancy to participate in the program because they were uncertain about where they might be living after completing their degrees (due to marriage or impending marriage)

Table 5

Distribution of Applicants to the Teacher Loan Program by Academic Level Status 1994-95 through 2002-2003

Year	Number Applied	Academic Level Status									
		Freshman		Continuing Undergrad		1st Semester Graduate		Continuing Graduate		Unknown	
		#	%	#	%	#	%	#	%	#	%
1994 95	2 242	491	22	1 403	60	76	3	171	8	101	5
1995 96	2 024	435	21	1 280	60	92	4	155	8	62	3
1996 97	1 446	261	18	897	60	73	10	164	11	51	4
1997 98	1 545	272	18	876	60	138	10	202	13	57	4
1998 99	1 569	295	19	856	60	146	10	224	14	48	3
1999 00	1 532	331	22	863	60	135	10	196	13	7	<1
2000-01	2 028	440	22	1 087	50	194	10	300	15	7	1
2001-02	2,297	545	24	1,241	54	215	9	291	13	5	<1
2002-03	2 004	336	17	1 183	59	205	10	277	14	3	<1
TOTAL	16 687	3 406	20	9 686	58	1 274	8	1 980	12	341	2

Source SC Student Loan Corporation 1995-2003

The Center for Educator Recruitment Retention and Advancement of South Carolina (CERRA) formerly the SC Center for Teacher Recruitment coordinates the Teacher Cadet Program a program to interest high school students in the teaching profession Participants in the program account for slightly more than one third of TLP applicants As reported by CERRA the mission of the Teacher Cadet Program is to encourage academically talented or capable students who possess exemplary interpersonal and leadership skills to consider teaching as a career An important secondary goal of the program is to provide these talented future community leaders with insights about teaching and school so that they will be civic advocates of education " In 2001 2002 the program was in 144 South Carolina high schools and enrolled 2 278 academically talented high school juniors and seniors In 2002-2003 2 302 students were enrolled in Teacher Cadet in 140 schools CERRA reported that for the 2002 2003 school year they were able to recruit one new school to the program revive he program at six additional schools but lost the program at eleven schools due to staffing issues connected to budget constraints Teacher Cadets must have at least a 3 0 average in a college preparatory curriculum be recommended in writing by five teachers and submit an essay on why he/she wants to participate in the class (CERRA 2003)

Table 6

Distribution of Applicants to the Teacher Loan Program by Teacher Cadet Program Participation 1994-95 through 2002-2003

Year	Number Applied	Teacher Cadets	%	Not Teacher Cadets	%	UNKN OWN	%
1994 95	2 242	761	34	1 348	60	133	6
1995-96	2 024	751	37	1 203	59	70	3
1996-97	1 446	537	37	864	60	45	3
1997 98	1 545	545	35	946	61	54	4
1998 99	1 569	577	37	939	60	53	3
1999 00	1 532	560	37	896	58	76	5
2000-01	2 028	685	34	1 245	61	98	5
2001-02	2 297	773	34	1 269	60	155	7
2002-03	2 004	727	36	1 209	60	68	3
TOTAL	16 687	4416	36	7 441	60	752	4

Source SC Student Loan Corporation 1995-2003

Other factors continue to influence who applies for a Teacher Loan Interviews with staff members of the Commission on Higher Education and former education majors people familiar with college admissions and financial aid procedures indicate that financial aid officers focus on finding students grant opportunities before pursuing loans Obviously a grant of money is better for a student than taking out a loan but by steering students away from the Teacher Loan Program financial aid officers may be affecting the number of students who become teachers Another factor affecting applications from enrolling freshmen is that many high school guidance counselors do not know about and/or do not tell graduating seniors about the Teacher Loan Program More often than not students learn about the Teacher Loan Program through the schools of education at their institutions of higher learning after they have started taking education classes

One important factor with the potential to influence the application pool for the TLP is the economy and the budget situation of the institutions of higher learning Applications increased thirteen percent from 2000 01 to 2001-2002 The spring of 2001 saw a five percent budget cut by the state and the state supported institutions of higher learning raised their tuition The increase came late in the financial planning process for many students and therefore more students may have applied for the loans The budget expectations and impending tuition increases were expected by students for the 2002 03 school year and the rate of applications returned to the same virtual rate as 2000-01

An issue raised in the Initial Annual Review in May 2002 was whether the newly created scholarship programs for colleges and universities in the state were adversely affecting the TLP The four scholarship programs in question include the Teaching Fellows Program created in 1999 to recruit up to 200 high achieving high school seniors each year into teaching the Palmetto Fellows Program the Life Scholarships and the Hope Scholarships

Students who receive a Teaching Fellows award go through a rigorous selection process and are awarded up to $6000 per year as long as they continue to meet minimum criteria Recipients agree to teach in South Carolina at least one year for each year they receive an award and they sign a promissory note that requires repayment of the scholarship should they not teach In addition to being an award instead of a loan the Teaching Fellows Program differs from the Teacher Loan Program in that recipients do not have to commit to teaching in a critical need subject or geographic area to receive the award

The Palmetto Fellows Program and the Life Scholarships both award students scholarships based on academic achievement but neither has any direct connection to teacher recruitment Palmetto Fellows meet rigorous selection criteria to receive an award of up to $6 700 per year depending on available funding Students keep their awards as long as they maintain minimum requirements Recipients of Life Scholarships a program created in 1998 receive up to $5 000 per year depending on available funding and tuition at the receiving institution The $5 000 award includes $300 for books and $4 700 towards tuition Students are eligible to receive a Life Scholarship if they meet two of three criteria 1 100 or better on the SAT a 3 00 grade point average and/or rank in the top 30% of their graduating class Students may not receive both a Palmetto Fellows and Life Scholarship at the same time but they may receive a Teaching Fellows award simultaneously Hope Scholarships created by the legislature in 2001 are presented to students who do not qualify for the Life Scholarships and are good for the freshman year only The program has no direct connection to teacher recruitment

Concern was raised in the previous report about whether these scholarship programs directed students away from the teaching profession Working with the Commission on Higher Education the Student Loan Corporation and the South Carolina Department of Education specific data files from the three organizations were merged and cross-referenced to determine how the scholarship programs were interacting with the TLP and affecting the teaching pool Table 7 shows the number of teachers in South Carolina over the last five years who have participated in either the Hope Life or Palmetto Fellows programs There have been no graduates of the Teaching Fellows Program yet the first class will be the class of 2004 Nor have there been any graduates of the Hope Scholarship program The merged data found 503 recipients of the Life Scholarship teaching in South Carolina public schools in 2002-03 and two Palmetto Fellows recipients Considering the short time the Life Scholarship program has been in place the number is impressive and encouraging The Life Scholarships are awarded only to South Carolina residents and are awarded to high achieving students thus the state is keeping some of its brightest students in state and they are entering the field of education The Palmetto Fellows numbers are not as encouraging but perhaps the number will increase in the future

Table 7

Loan Recipients serving in South Carolina schools in 2002-03 matched with the Scholarship file

Scholarship	CAT_CODES	1998	1999	2000	2001	2002	Grand Total
LIFE	Public Senior Inst	259	205	138	75	1	678
	Reg Campuses of USC	7	3				10
	Technical Colleges	11					11
	Independent Senior Inst	132	98	63	34		327
Palmetto Fellows	Public Senior Inst				2		2
Grand Total		409	306	201	111	1	1028

Another issue raised by the creation of the programs revolved around how many students in each program were majoring in education Table 8A shows the number of scholarships recipients each year that declared as Education majors It is a duplicated count and it should be remembered that students can lose and regain their scholarships based on academic performance

Table 8A

Students that received scholarships for each fall term and had declared an Education Major

Scholarship	1998	1999	2000	2001	2002	Grand Total
Hope					298	298
LIFE	1 051	1 255	1 225	2 144	2 659	8 334
Palmetto Fellows				154	179	333
Total	1 051	1 255	1 225	2 298	3 136	8 965

Table 8B
Number of Scholarships Recipients

Scholarship	1998	1999	2000	2001	2002	Grand Total
Hope					2 082	2 082
LIFE	14 618	16 374	16 560	19 464	23 315	90 331
Palmetto Fellows				2 606	2 914	5 520
Total	14 618	16 374	16 560	22 070	28 311	97 933

Source Commission on Higher Education 2003

In the first year of the Life Scholarships 7 4 percent of the recipients declared as Education majors The next year the percentage increased slightly then fell again in 2000 but over the last two years has grown to over 11 4 percent The percentage of the first recipients of the Hope Scholarships was even greater at 14 3 percent though the percentage of the recipients of the Palmetto Fellows has remained steady for the two years data was available at around 6 percent Though the number of student scholarship recipients majoring in Education is encouraging the fact remains that the 3 136 candidates even with the 1 332 TLP recipients will not provide enough new classroom teachers to meet the needs of South Carolina

One positive trend about TLP loan applicants may be attributed to the various scholarships programs a significant increase in the average SAT score for loan applicants As stated above applicants for the TLP are required to have an SAT or ACT score equal to or greater than the SC average for the year of graduation from high school or the most recent year for which data are available Concern over many of South Carolina s brightest students to schools outside the state was one reason for the creation of the various scholarship programs yet it was unknown whether the scholarships would adversely affect who applied and received loans through the TLP specifically would the SAT scores of TLP recipients increase decrease of remain stagnant As Table 9 shows the average SAT score for TLP applicants has increased from slightly over 961 in 1998 1999 to over 1024 in 2002 2003 This last average score is above the national SAT average for 2002 Perhaps the loan program is benefiting from the scholarship programs by keeping the better students in state keeping them in state to work will be a greater challenge

Table 9

Average SAT Scores of Loan Applicants

ACAD_YR	1998-99	1999-00	2000 01	2001 02	2002 03	Average
Average SAT score	961 1	960 9	971 3	997 9	1024 1	986 3

Repayment Patterns

The Teacher Loan Program allows recipients to have their loans cancelled by teaching or to repay the loan through monthly payments with interest In the Initial Review of the TLP repayment data indicated that about half of the loan recipients repay their loan in monthly payments more than 30 percent are canceling by fulfilling the teaching requirements while about 10 percent of them are using a combination of teaching and monthly payments These repayment patterns continued through the 2002 2003 fiscal year In the future this area of interest should be researched more fully to determine why the people who end are repaying the loan through monthly payments did not enter the teaching field or taught at a school that did not qualify for cancellation status

Loan Recipients Who Serve Currently in SC Public Schools

After merging of the data files from Student Loan Corporation (SLC) and State Department of Education (SDE) 3 826 loan recipients between the years of 1994-1995 and 2002-2003 were identified as serving in the South Carolina public school system in Fall 2002 Among the 3 826 individuals 86 9 percent are female 11 1 percent male and 2 percent are unknown About 82 percent of them are Caucasians 12 percent African Americans and 6 percent Asian Hispanic American Indian or unknown More than one quarter of them (1 217) were in the process of paying back the loan by teaching about 40 percent of them (1 802) already had their loans cancelled by fulfilling the teaching requirements

Table 10

Loan Recipients in South Carolina Schools by Gender and Ethnicity

Gender	Number	Percent
Male	426	11 1
Female	3,324	86 9
Unknown	76	2 0
Ethnicity		
African American	478	12 5
Caucasian	3,153	82 4
Asian	9	0 24
Hispanic	16	0 42
Unknown	168	4 39
Total	3 826	

Another 1 040 loan recipients who received loans prior to 1994-1995 were still teaching in South Carolina public schools

Table 11
Loan Status of Recipients in South Carolina Schools as of 2002-2003

Loan Status Code	Loan Status	Number	Percent
D10	In school deferment	1	0 02
D15	In school deferment/First loan after 7/01/93	3	0 06
D42	Teaching cancellation (in process)	1,571	32 28
F12	No pay forbearance	16	0 33
F20	Administrative forbearance	3	0 06
FA1	No Pay	10	0 21
FA2	Administrative deference	1	0 02
FDR	No Pay 20% Debt Ratio	1	0 02
FFT	No Pay Non-Guarantee Teacher Group	13	0 27
FVN		2	0 04
I30	In school	18	0 37
I40	In grace	15	0 31
P30	Repaying the loan by borrower	280	5 75
P80	Claim filed	1	0 02
P90	Paid in full by borrower	1 172	24 09
P92	Paid in full by teacher cancellation	1,735	35 65
P96	Paid in full due to consolidation	19	0 39
P97	Paid in full by claim	5	0 10
P98	Written off	1	0 02
Total		4,866	

Source SC Student Loan Corporation records

The following table presents areas of certification for the 3 826 loan recipients since 1994-1995 who were serving in SC public schools as of 2002-2003 school year Just under 48 percent (1 829) are certified in elementary education 7 percent (260) in mathematics 5 percent (174) in English 10 percent (397) in early childhood education 2 percent (85) in science and about 10 percent (385) in special education Nearly 95 percent (3 624 of 3 826) of the individuals primary certification is as classroom teachers child development or kindergarten teachers or special education teachers

Table 12

Loan Recipients Serving in SC Public Schools as of 2000-2001
Primary Area of Certification

Certification Code	Certification Subject	Number certified	Percent certified	Certification Code	Certification Subject	Number certified	Percent certified
			0	21	HISTORY	5	0 13
AU	DRAFTING	1	0 03	26	PSYCHOLOGY	2	0 05
1H	MIDDLE LEVEL SS	1	0 03	27	SOCIOLOGY	0	0 00
GT	GIFTED AND TALENTED	12	0 31	29	IND TECH EDUC	2	0 05
01	ELEMENTARY	1,829	47 80	30	AGRICULTURE	2	0 05
02	GENERIC SPEC EDUC	130	3 40	32	DISTRIBUTIVE ED	2	0 05
03	SPEECH CORRECTIONIST	130	3 40	35	HOME ECOMOMICS	10	0 26
04	ENGLISH	174	4 55	36	INDUSTRIAL ARTS	0	0 00
05	FRENCH	26	0 68	40	OFFICE OCCUPATIONS	1	0 03
06	LATIN	1	0 03	44	ACCOUNT & RE BUS	0	0 00
07	SPANISH	49	1 28	46	DATA INFO PROCESS	1	0 03
08	GERMAN	5	0 13	47	BUSINESS EDUCATION	39	1 02
1A	MID SCH LANG ARTS	0	0 00	53	MUSIC EDUCATION VOICE	1	0 03
1C	MID SCHOOL SCIENCE	0	0 00	50	ART	51	1 33
1D	MID SCH SOC STU	1	0 03	51	MUSIC ED CHORAL	32	0 84
10	MATHEMATICS	260	6 79	54	MUSIC ED INSTRUMENT	19	0 50
11	GENERAL MATHEMATICS	4	0 10	57	SPEECH & DRAMA	2	0 05
12	SCIENCE	85	2 22	60	MEDIA SPECIALIST	46	1 20
13	GENERAL SCIENCE	9	0 23	63	DRIVER TRAINING	1	0 03
14	BIOLOGY	45	1 18	64	HEALTH	1	0 03
15	CHEMISTRY	5	0 13	65	HEALTH & PHYS ED	0	0 00
2A	SP/ED ED MEN RET	100	2 61	67	PHYSICAL EDUCATION	38	0 99
2B	SP/ED VIS HAND	2	0 05	71	PRINCIPAL – ELEM	5	0 13
2C	SP/ED TR MEN RET	3	0 08	81	READING CONSULTANT	0	0 00
2D	SP/ED HEARING HAND	3	0 08	84	SCHOOL PSYCH II	0	0 00
2E	SP/ED EMOT HAND	49	1 28	85	EARLY CHILDHOOD ED	397	10 38
2F	SP/ED ORTH HAND	0	0 00	86	GUID COUN – ELEM	13	0 34
2G	LEARNING DISABIL	98	2 56	72	PRINCIPAL HIGH	2	0 05
20	SOCIAL STUDIES	104	2 72	89	GUIDANCE SECOND	6	0 16
MISSING		**18**					
TOTAL		**3,826**	**100**				

Table 13

Loan Recipients Serving in SC Public Schools as of 2002-2003
Positions

Position Code	Position	Number	Percent
1	PRINCIPAL	13	0 34
2	ASST PRIN , CO-PRIN CURR COORD	41	1 07
3	SPECIAL EDUC (ITINERANT)	20	0 52
4	CHILD DEVELOPMENT	47	1 23
5	KINDERGARTEN	148	3 87
6	SPECIAL EDUC (SELF-CONTAINED)	284	7 42
7	SPECIAL EDUC (RESOURCE)	315	8 23
8	CLASSROOM TEACHER	2,591	67 72
9	OTHER PROFESSIONAL INSTR STAFF	15	0 439
10	LIBRARIAN/MEDIA SPECIALIST	126	3 29
11	GUIDANCE COUNSELOR	50	1 31
12	OTHER PROFESSIONAL INSTRUCTIONAL ORIENTED STAFF	18	0 47
17	SPEECH THERAPIST	117	3 06
19	TEMPORARY INSTRUCTIONAL-ORIENTED PERSONNEL	3	0 08
29	OTHER PERSONNEL POSITIONS	1	0 03
33	DIRECTOR, TECHNOLOGY	1	0 03
35	COORDINATOR FEDERAL PROJECTS	1	0 03
41	DIRECTOR, STUDENT SERVICES	2	0 05
43	OTHER PROFESSIONAL NON INSTR STAFF	5	0 13
44	TEACHER SPECIALIST	14	0 37
65	ENGLISH COORDINATOR	1	0 02
75	EDUCATION EVALUATOR	1	0 03
78	SPECIAL EDUCATION COORDINATOR	2	0 05
82	EARLY CHILDHOOD COORDINATOR	2	0 05
85	PSYCHOLOGIST	3	0 08
89	TITLE I, INSTRUCTIONAL PARAPROFESSIONALS	1	0 03
94	GENERAL TEACHER AIDES	1	0 03
97	LITERACY COACH	3	0 08
99	OTHER COUNTY OFFICE/DISTRICT OFFICE STAFF	1	0 03
TOTAL		3,826	100

Table 13 indicates the actual position the 3 826 individuals who received loans between 1994-1995 and 2002 2003 were serving in the public schools Almost 90 percent of the recipients were involved in direct classroom instruction (3 440 of 3 826) another fourteen individuals were serving as Teacher Specialists Less that 2 percent of the individuals were building level administrators and another 5 percent were media specialists or guidance counselors

Providing Technical assistance to Low-performing schools

The final question before this review of the TLP is How can the TLP contribute to the school needing technical assistance? Some organizations have proposed that teachers participating in the TLP be allowed to cancel their loans by serving in schools that received an Unsatisfactory or Below Average Absolute Rating on the school report card These schools would be deemed critical geographic need schools for the purpose of paying back the loan The proposal was based upon the knowledge that many of the low-performing schools have a high teacher turnover rate and that designating the schools as critical geographic need schools would perhaps help stabilize the turnover rate

While the reason for this proposal is laudable analyses of student and school performance demonstrate strong correlations between teacher experiences or advanced degrees and high performance Most individuals participating in the TLP are new teachers who have little or no experience in the classroom if they are canceling their loan by teaching they should have the loan cancelled by the time they have five years of experience

What appears to be a more reasonable expectation of the TLP is to have the program assist teachers in obtaining a masters degree Correlations have shown that students who have teachers with higher degrees achieve at a higher level Instead of putting new teachers where experience is needed the program could serve the public education system better by helping experienced teachers obtain a master's degree in exchange for teaching in a low-performing school over a certain number of years This proposal would necessitate a change in the enabling legislation for the program but the change could result in higher achievement for South Carolina students

Findings and Recommendations

Findings

1 The Teacher Loan Program continues to fulfill the statutory mission to attract individuals in to the teaching profession and into areas of critical need
2 White females constitute the vast majority of the applicants
3 The sharing of information among the various agencies involved with the Program has improved
4 The scholarship programs established by the General Assembly have not negatively impacted on the TLP
5 There was a significant increase in the average SAT score of TLP applicants between 1998 1999 and 2002 2003

Recommendations

1 The General Assembly should develop long range goals and objectives for the Teacher Loan Program

2 The General Assembly should amend the enabling legislation for the Program to allow the Program to assist teachers in obtaining advanced degrees in exchange for service in critical geographic need schools

3 Service in Unsatisfactory and Below Average Schools should not become a classification for designation of critical geographic need schools

4 Movement of teachers educated with funds from the TLP from school to school should be studied to determine if the program has an impact on providing long term solutions to critical geographic need schools

5 A study should be conducted to determine why roughly half of the loan recipients pay back the loans in monthly installments instead of through cancellation

Appendices

State by State Summary

Explanation of Transfers

Appendix B

State	Program Name	Offered by	Criteria	Method	Repayment and forgiveness
South Carolina	SC Teacher Loan Program	SC Student Loan Corporation Freshman or sophomore may borrow up to $2 500 Junior senior or graduate students may borrow up to $5 000	Citizen SC resident enrolled at least half time in teacher education or expressed intent to enroll Enrolling freshman top 40% of HS the class and SAT /ACT above state average Enrolled undergraduate passed the EEE with 2 75 GPA Entering graduates 2 75 GPA and have completed at least one semester with 3 5 GPA or better	Application deadline June 1 Contact SC Loan Corporation	The loan is cancelled at a rate of 20% or $3000 whichever is greater for each full year of teaching in a critical subject or critical subject area If teaching in both areas the loan can be cancelled at a rate of 33% or $5000 whichever is greater The loan will be repaid with interest no higher than 10 25%
	SC Teaching Fellows	SC Center for Teacher Recruitment Up to $5 700 for tuition and board annually $300 for summer enrichment programs	SC resident awarded to up to 200 high school seniors annually attendance at one of eleven selected colleges	Selected through an application process that includes a written assessment and an oral interview documentation of academic achievement and a commitment to teaching Applications due in November decisions made in February	Students must commit to teaching in South Carolina public school classrooms one year for each year they receive the fellowship
Alaska	AL Teacher Scholarship Loan Program	AK Commission on Post secondary Ed Up to $ 75 000 with $ 37 500 lifetime borrowing maximum	HS graduates Plan to enroll in a four year Bachelor's degree in elementary or secondary schools in the state	Each Jan the Commission sends nomination package to rural school districts The districts select nominees based high school academic performance and student intent	As a teacher in a rural elementary and secondary school he/she may be eligible for up to 100% forgiveness of total loan Borrowers are required to repay their loans and subsequently apply for each forgiveness increment as it earned
Arkansas	Emergency Secondary Education Loan Program	State Department of Education Award amount $2 500	ESL is designed to assist students who have completed their freshman year of college and pursuing a course of study in language math science and special ed Must be full time 2 5 GPA 3 0 in their major for Junior or seniors	Students submit an application and college transcript by April 1 The loan is renewable for up to 3 years	The loan will be forgiven at the rate of 20% per year for each year's service in a private/public sec school in a approved subject areas listed
	Freshman/Sophomore Minority Grant Program	$1,000	Minority students full time freshman or sophomore considering teacher education	Students must perform pre-service internship in public school and sign a statement of interest in teaching	

Arkansas	Minority Teacher Scholarship Department of Education	$5 000	African American Hispanic and Asian college students enrolled full time 2 5 GPA have completed 60 semester hours		5 year full time teacher in state to receive full forgiveness of loan 3 year if guidance counseling critical area/subjects
California	Assumption Program for Loans Education Retaining teachers	California Student Aid Commission Up to $11 000	Complete at least 60 units of undergraduate study Enroll at 10 semester units each term In good academic standing cannot be in default of a loan	March 1 Participants are selected by schools School nominations are due to the Commission by June 30 Each year the CSAC selects up to 4000 new applicants who were nominated by participating institutions	To receive benefits must provide 3 consecutive years of full time teaching in CA in a critical area/subject You continue to pay monthly payment. Once a year the Commission makes a lump sum payment to t he lender after verifying your teaching service
	Forgivable Loan/Doctoral Incentive Program	California State University Up to $30 000	Open to applicants who will be new or continuing full time in doctoral program anywhere in United States Potential in faculty position at a CSU campus		
	Graduate Forgiveness Programs of Loans for Education CA Student Aid Commission	California Student Aid Commission Up to $6 000	US citizen or an eligible non citizen CA resident Bachelor's degree leading to graduate level degree Faculty position		
Colorado	Loan Forgiveness for Teachers Retaining teachers	Colorado Student Loan Program Amount not specified	1 borrower must be a new borrower after 10 1 1998 2 2 Must be employed full time for 5 consecutive years 3 in at least one of the 5 academic years of service for loan cancellation for Perkins Loan recipients who teach in such schools		The department will repay on behalf of a qualified borrower no more than $5 000 of the borrower's outstanding Stafford loan balances at the end of 5th complete year of teaching
Delaware	Christa McAuliffe Teacher Scholarship Loan	Delaware Higher Education Commission $1 000 minimum	Full time students enrolled at DL leading to a teacher certification and 1 high school senior ranking in upper half of class 2 1050 SAT or 2 75 GPA	Application available from DHEC accepted 1 1 due by 3 1 Minimum $1 000 renewable	With service repayment provisions

Florida	Critical Teacher Shortage (CTS) Forgiveness Loan	Department of Education $4 000 $8 000	1 enrolled in teacher preparation program leading to certification in a critical subject area 2 Undergraduate students 40th percentile or better on SAT or ACT 2 5 GPA 3 Graduate students 4 Renewal criteria?	Loan applications must be submitted to the dean or director of the institution s college of education by march 15 The dean or director then sends the applications to office of student financial assistance by April 1	The loan must be repaid either through teaching service or cash
	Critical Teacher Shortage Student Loan Forgiveness	$10 000 maximum	Provide financial assistance to teachers for the repayment of undergraduate or graduate loans which lead to certification in a critical teacher shortage subject area		
	Teacher of Tomorrow Scholarships	Florida Retired Educators Foundation inc $500	A graduating high school senior Commitment to service etc Economic needs No restriction on sex race or national origin	Application obtained from local high school Application accompanied with high school transcript SAT or ACT scores	Discontinuation of training or interruption of teaching during the obligatory period for reasons other than health will cause the notes to become payable with interest on demand
Idaho	Idaho Education Incentive Loan Forgiveness	Idaho Board of Education Not specified	Graduated from an Idaho high school within the previous two years Rank at the 15th percent of the class or with 3 0 or higher GPA full time students		Must pursue teaching or nursing career in Idaho for a minimum of two year
Massachusetts	Attracting Excellence to Teaching	Department of Education Up to $1 800	Full time teacher began teaching after 7 1 94 Top 15th of undergraduate class No loan deferment forbearance or grace		Qualified loans include Perkins Stafford loan Eligible loan payment are those made by a participants toward the balance of a qualified loan in the months during which the participants is an eligible teacher
Mississippi	Graduate Teacher Summer Loan/Scholarship Program				
	William Winter Teacher Scholar Program	MS Office of State Student Financial Aid Up to $3 000	based on scholastic performance entering freshman with GPA 3 0 or higher and ACT 21 Seniors seeking second degree must have GPA 2 5 Must maintain 2 5 GPA to continue	Application priority date 3 31 for renewal and new awards Can obtain application by phone or write	Loan to service obligation can discharged on the basis of one year service for one year of loan received Repayment of principal and interest is required if fail to serve
Missouri	Missouri Minority Teacher Education	Dept of Elementary and Secondary Education $3 000	MI resident, AA Asian Hispanic Native American High school graduate or college students Individuals with B A returning to an	See counselor financial aid office or college advisor to request an application Application on Webster	Must teach 5 years in MS upon completion of certification program Those who fail the program or fail to teach in public schools for 5 year after graduation must

Missouri	Scholarship Missouri Teacher Education Scholarship	Dept of Elementary and Secondary Education $2 000	approved teacher education program Rank top 25% or 75th on ACT or SAT or 30 hours with a 3 0 GPA High school graduates or college students a student at community college with 60 hours Rank in the top 15% of class or score in the top 15 of SAT or ACT Attend teacher training program at a 4 yr institution	Submit the application by 2 15 the Department of Secondary Education will notify in April	repay the amount The scholarship will convert to a loan if do not compete the training and fulfill the 5-yr teaching requirement The obligation of repayment is reduced one fifth for each year of teaching
New Mexico	Minority Doctoral Assistance Loan For Service Program	New Mexico Commission on Higher Education	$25 000 doctoral students The program is to increase the number of ethnic minorities and women available to teach in disciplines in which minority and women are underrepresented		
New York	Federal Stafford Loan Forgiveness for Teachers *Rewarding and retaining*	NYS Education Department Up to $5 000	Have borrowed a Stafford Loan Have no outstanding loan balance by 10 1 1998 not default on the loan for which you seek forgiveness Have worked as a full time teacher for 5 consecutive years in a school that qualifies for loan cancellation under the Perkins Loan program Must not teach out of area of your certification	Call or write HESC directly	The program forgives up to $5 000 of outstanding loan amount that remain after you finish the 5th complete year of teaching
North Carolina	North Carolina Teaching Fellows Program	Funded by NC General Assembly governed by NC Teaching Fellows Com administered by Public School Forum of NC $6 500	High school seniors NC resident1100 SAT HS GPA3 6 or more rank in the top ten percent of the graduating class Special consideration is given to male minority also geographic balance is considered in granting the awards Maximum 400 scholarships awarded each year	Application may be obtained after Labor Day from his guidance offices and upon request from TFP office a Application form 2 Transcript, SAT/ACT scores and a writing sample three reference letters	Teaching fellows must participate in program activities Participants are obliged to pay back their loan through four years teaching in public schools otherwise repay principal and interest

North Carolina	Perspective Teacher Scholarship Loan	Public School of NC Up to $2 500 Award given 200 Funded by NC General Assembly	Legal NC resident without teacher licensure may have a 4 yr degree not in teaching SAT 900 GPA 3 0 for high school applicants Full time student, 3 0 GPA for college/non traditional applicants Maintain 2 5 GPA	Applications may be obtained in October from school counselors Deans of school education and financial aid administrators	Required to teach for four years Three year for teaching in a school system designated as low performing at the time of the recipient employment with that system
	Teacher Assistance Scholarship Loan	Public School of NC $1 200	Currently employed full time teacher assistant in public schools Must get endorsement from the superintendent and formally admitted into teacher licensure program		Required to teach for four years Three year for teaching in a school system designated as low performing at the time of the recipient employment with that system
Oklahoma	Future Teacher Scholarship	OK State Regents of HE $1 500	Top 15 of HS class **or** 85th ACT **or** admitted to a professional education program **or** Achieved an undergraduate record of outstanding success as defined by the institution	OK resident intend to teach in a critical shortage area OK higher ed institutes submit nominees to OK State Regents for Higher Ed for consideration	Teach in a shortage area for a minimum of 3 consecutive years
Pennsylvania	Early Childhood Education Professional Loan Forgiveness	PN Higher Education Assistance Authority $2 500	For early childhood education professionals		
Tennessee	TN Teacher Scholars Program	TN Student Assistance Corporation $3 000	Forgivable loan for college juniors seniors and post-baccalaureate students admitted TN teacher education program in HE US citizen resident of TN with GPA 2 75	Contact TSAC for application	Must pledge to teach at the public preschool ele or sec level in TN one year for each the award is received
Utah	Terrel H Bell Teaching Incentive Loan	Utah System of Higher Education Number awards 365	UT residents enrolled in a program leading to teacher certification in a state high ed Institution	Application can be obtained from financial aid offices College of education or high school	Students must repay monies received from the program either through teaching or with money
Virginia	Virginia Teaching Scholarship Loan Program	Virginia Department of Education $3 720	Student must be nominated by the institutions they attend Sophomore level with GPA 2 7 Virginia resident enrolled **in a critical shortage field** **Males** enrolled in ele teacher prog **All minority** students are eligible if nominated by the college with 2 7 GPA and resident of VI	Application obtained at college of ed In the institution	Not specified

West Virginia	Underwood Smith Teacher Scholarship	WV Higher ED Policy Commission Up to $5 000 Number 55	WV resident pursuing under or graduate teacher education (full time) in WV 3 25 GPA after completing two year of course work Top 10% essay and proof of ability		Recipients must teach two years in WV public schools for each year the award is received
Wisconsin	Minority Teacher Loan Program	WI Higher ED AIDS Board $250 $2 500 Overall maximum of $5000	Resident **minority** undergraduate junior or senior enrolled at least part time in teacher education Must agree to teach in school district in which minority at least 29%	FAFSA and nomination by Student Financial Aid Department	Each the student teaches in an eligible district **25%** of the loan is forgiven
	Teacher Education Loan	WI Higher ED AIDS Board $2000	In service or pre service programs at (WTEC)		
	Teacher of the Visually Impaired Program	WI Higher ED AIDS Board $250 $10 000	For visually impaired		

Appendix C

Explanation of Transfers

1986-87	$75 000 transferred to South Carolina State University for minority recruitment
1987-88	$75 000 transferred to South Carolina State University for minority recruitment
1988-89	$75 000 transferred to South Carolina State University for minority recruitment
1990-91	$1 000 000 to the Governor's Teaching Scholarship Program
1991-92	$1 000 000 to the Governor's Teaching Scholarship Program
1992-93	$1 175 000 to the Governor s Teaching Scholarship Program
1993 94	$1 175 000 to the Governor's Teaching Scholarship Program
1994-95	$1 233 750 to the Governor's Teaching Scholarship Program
1998 99	$1 000 000 to the State Department of Education $650 000 for technology for school districts $350 000 for gifted and talented student identification
1999 00	$1 000 000 to the State Department of Education $650 000 for technology for school districts $350 000 for gifted and talented student identification

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STATE OF SOUTH CAROLINA
DEPARTMENT OF EDUCATION

Inez Moore Tenenbaum
State Superintendent of Education

December 28, 1999

Dr Everette M Dean
Superintendent
Rains-Centenary School District Three
Post Office Drawer 1439
Rains, South Carolina 29589

Dear Dr Dean

Thank you for expressing your concerns regarding the proposed changes in the ADEPT Regulation 43-205 1 The feedback was overwhelming regarding the items relating to the required members of evaluation teams for formal evaluations

As a result of these responses from the field the State Department of Education is currently working on a modification of the proposed regulation language to recommend to the State Board of Education at its January meeting

Your letter will be shared with the State Board of Education I appreciate your careful outline of the details of your concerns and the implications for districts with regard to the regulation changes

Sincerely,

Leonard McIntyre

Leonard A McIntyre Ph D
Deputy Superintendent
Professional Development and School Quality

LAM/sgr

PLAINTIFF'S EXHIBIT
6143

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EVERETTE M DEAN, JR., Ed. D
Supenntendent

JANE G PULLING, Ed D
Assistant Supenntendent
VICTORIA BELIN
Coordinator of Special Services

December 16, 1999

Dr Sandra G Rowe, Director
Office of Teacher Education and Certification
1600 Gervais Street
Columbia, South Carolina 29201

Dear Dr Rowe

A proposed ADEPT regulation (R43-201 1) addition requires districts to place a teacher on formal evaluation teams for provisional (IV B 2) and annual (V B 2) contract levels We do not understand why this language is being added back when, in the ADEPT legislation and regulation development, a strong case was made for why this was not acceptable as a requirement rather than a local choice based on available resources Legislation and regulation subsequently passed with this and several other restrictive elements of the ADEPT regulations removed

While we understand that neither Angela Bain nor you were with the State Department during the ADEPT legislative and SBE approval processes many districts scrutinized all points during the input stages to assure that the smaller poorer, and more rural districts could manage implementation of the formal evaluation programs As with the case then and continues to be the case, we strongly feel that teachers belong in classrooms serving the children they are charged to teach We also respect the feelings of districts that choose the option of using teachers on evaluation teams It has, however, been just that – an option We strongly believe it should continue as a local option based on the resources of the district, needs of the teachers involved, and the best interests of the children rather than specified in State Board regulation If teachers participating in the evaluation process as evaluation team members result in different evaluation results, it would follow that our districts that are not using teachers on evaluation teams would produce evaluation results that indicate discrepancies with the statewide results This is not the case Therefore the arguments for the NEED to have a teacher on the team are not valid

Further, some of the other proposed additional language is specific to the state-developed instrument, TEAM, rather than generic to also address State Board approved locally developed systems (e g IV D 8 - Preliminary Evaluation Consensus Report)

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The law, as well as the SBE regulations, allows for locally developed and approved systems that were approved by the SBE based on the initial regulations While we wish to follow not only the intent but also the spirit of the State Board ADEPT regulations, we cannot deal with the continued attempts to change the "flight pattern" while we are 'in the air"

As was communicated prior to passage of the ADEPT legislation and initial SBE regulation approval back in 1997, the points that follow outline the reasons teachers should NOT be required to be on evaluation teams Now that an accountability law is in place these reasons have grown The reasons we feel that a teacher serving on the formal evaluation team should be an option rather than a requirement are as follows

- The financial costs of having a teacher evaluator on an evaluation team include substitutes for the teacher to be out of class, stipends for them for the additional work, and extensive training costs for stipends, materials, and follow-up The number of teacher evaluators that would be required is also extensive since the teacher evaluator must be in the same area as the teacher being evaluated The process would require <u>each</u> teacher evaluator to be out of class from 2-5 days for each teacher they are evaluating Since it is cost prohibitive to train enough teacher evaluators so that a different evaluator is available for every teacher s evaluation team, the time out of class for teacher evaluators is multiplied by the two or three teachers each may be assigned to evaluate In the initial ADEPT executive summary back in 1996-1997, when it was stated that there would be no additional costs, districts reacted with the evidence clearly showing this to be totally incorrect We should not be required to bear the additional costs that requiring teacher evaluators would incur This would be another unfunded mandate that poorer districts should not be required to bear

- The cost of lost instructional time for the students of teacher evaluators is incalculable Wrth accountability requirements, it is vitally important that ALL teachers be in their classrooms teaching their children as much as possible rather than constantly out to complete administrative tasks For districts with the high PACT scores, it might be an 'affordable" cost to student learning For most, however the priorities for the children of the district cannot allow such

- Most teachers do not want to be a part of this process if they are being held accountable for the progress and performance of their own students This feeling will increase exponentially as the report cards are published especially in districts where results need to be improved While no one will argue that the right teachers can do a good job on an evaluation team, the questions are 1) should teachers be required to fill this position 2) should they be away from their classes for such administrative tasks and 3) is this time requirement fair to the children the teacher evaluator teachers?

- In small districts, there are often not two teachers in the same area (i e business foreign language etc) In cases where there ARE multiple teachers in an area, many times these are not ones that would/could do a good job as an evaluator Large districts would not have this problem Also, small districts cannot share teachers from other schools since we have only one school with each grade level and only one high school Further sharing teachers between districts would only increase the time these teacher evaluators would have to be away from their own students

- Most small poor, rural districts have a high turnover rate since many teachers leave to go to higher paying districts We are, therefore, faced with provisional and annual evaluations at a much much higher rate than the larger more affluent districts This would then disproportionately cost poorer districts much more in time personnel, and financial resources The unfunded mandate would again be disproportionate to these districts

- With such vast teacher shortages, especially in poor and rural districts, finding teachers is hard enough Teachers are already beginning to question the time it takes to formally serve as a mentor for an induction teacher These mentors now are even saying they do not wish to help in the induction program if they are asked to have an evaluative rather than a support/feedback role We continue to assure them their role is supportive and not evaluative, but we would be unable to find enough teachers beyond those induction mentors to serve as teacher evaluators if the regulation addition passes The mentors are already out of class more than we wish for mentor observations They would rebel with these additional responsibilities We would NOT have enough teachers to fill the induction mentor and evaluation team member roles if this regulation revision passes In small communities, teachers are not willing to take on evaluation roles Further, many say this is NOT what they are paid to do The sense of community would often override their ability or choice to be completely honest in this role

- Parents already complain that teachers are out of their children s classrooms to do other 'school" requirements far too much This requirement would add valid fuel to this issue Strong teachers already serve on curriculum committees strategic planning teams seek additional specialized training above and beyond what the school requires How can we ask these same good teachers to fill an additional role? There aren't enough to go around now in small districts for all the required needs AND the children in each classroom MUST come first

Many of the districts in the STEP consortium do use teachers on evaluation teams when the situation is appropriate, resources are available for substitutes, and students will not suffer due to extended time from class by the teacher evaluator However this is a local decision based on individual student, teacher, school, and district needs We strongly oppose the regulation addition to require teachers to be an ADEPT evaluation team member Look at the PACT test scores from our district and justify how this is appropriate to meet our children's needs Therefore, we ask that this portion of the proposed ADEPT regulation addition be deleted Our teachers MUST concentrate on the standards since our scores are lower than the state averages! Also, if you would look at the number of districts which have sought alternatives to the state-developed TEAM instruments, most of the reasons cited center around the excessive amounts of time to complete the process and missed class time for the teachers to serve on TEAM teams

While it may not be the intention, the circumstantial evidence indicates this to be one or more attempts to require all districts to use TEAM, making local development option as provided for in the law null and void We CANNOT successfully implement regulations that put additional personnel and financial constraints on our district Any evaluation system will fail if it is not manageable within the resources locally available Please do not force us into such a situation by adding this requirement Again, we strongly feel that teachers serving on evaluation teams should be a local decision and not an addition to State Board ADEPT regulation 205 1

Your sincere consideration of our input and deep beliefs about what is best for our children is greatly appreciated

Sincerely,

Everette M Dean, Jr , Ed D
Superintendent

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Chapter Three

Are States Doing Enough to Produce Highly Qualified Teachers? Lessons from the Title II Reporting System

In Chapter Two, a more promising model of teacher preparation and certification was presented that relies upon high standards for verbal ability and content knowledge and streamlined certification requirements Alternate routes to certification were identified as promising examples of this model In this chapter we shall examine what states are doing in these important areas We will also consider the consequences of the failure of today's certification system staggering numbers of classrooms filled with unprepared teachers who are teaching on waivers

Raising Standards for Verbal Ability and Content Knowledge Are States Doing Enough?

If one were to judge states' commitment to academic standards by counting the number of tests offered for teacher certification, the picture would be quite impressive. Most states offer more than 50 different types of credentials, spanning grades K-12 (Alaska leads the way with 229) [25] Certification exams are focused on tests of basic skills, professional knowledge and academic content, to name a few areas While some states like Alabama have streamlined testing systems, other states have dozens of different certification exams Florida offers 71 different tests, Oregon, Maryland and other states offer 51, and Iowa offers 43

Obviously, though, what matters is not the number of tests but their rigor This is where states fall far short All too often states set the passing rates or "cut scores," on certification tests well below national averages Equally troubling, only 24 states to date have implemented teacher standards tied to their respective academic content standards for grades K-12 (Figure 4)

States typically use licensure examinations to ensure that teachers have a minimum level of knowledge But what states consider "minimum" is often shockingly low For example, California requires all teachers to at least pass the California Basic Educational Skills Test, or CBEST Unfortunately, the test is set at roughly the 10th grade level [26] According to the Education Trust, which examined the states licensure and certification exams, the lack of demanding content is not confined to just California.

> Most of the content on licensing examinations is most typically found in high school curricula. On the few occasions that tests addressed content beyond high school, it was at the level of the first or second year of college, never at the level of a bachelor's degree Such low levels of content are insufficient.[27]

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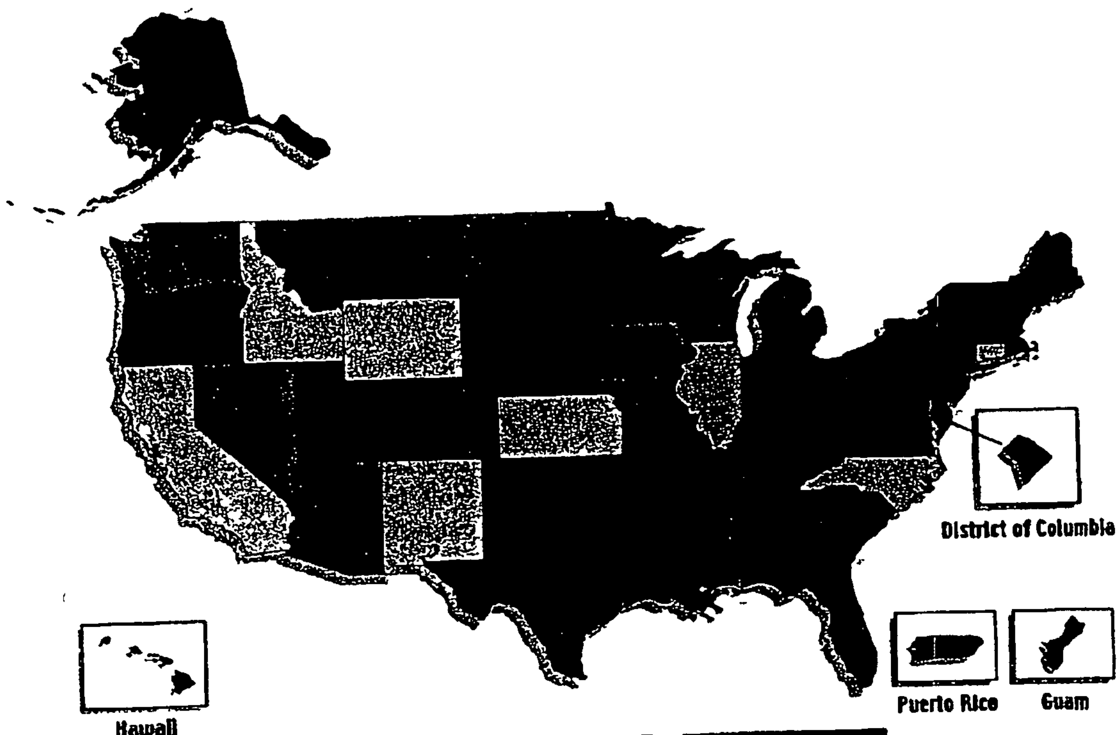
Figure 4: Number of States That Have or Are in the Process of Implementing Policy That Links Teacher Certification and Student Content Standards: 2001



Standards In Place	
Alabama	In place
Colorado	2001
Florida	2002
Georgia	2001
Hawaii	2001
Louisiana	2002
Maryland	2001
Massachusetts	2001
Minnesota	2001
Missouri	1998
Nebraska	2002
New Hampshire	1999
New York	1993
Ohio	1998
Oklahoma	1997
Oregon	1998
Pennsylvania	2002
South Carolina	2001
South Dakota	2000
Texas	1999
Utah	2000
Virginia	2000
West Virginia	2001
Wisconsin	2001

In process	
California	2004
Connecticut	2003
Idaho	2003
Illinois	2003
Kansas	2003
New Mexico	2004
North Carolina	2003
Wyoming	2003

Standards Not Set
Alaska
Arizona
Arkansas
Delaware
District of Columbia
Indiana
Iowa
Kentucky
Maine
Michigan
Mississippi
Nevada
New Jersey
North Dakota
Rhode Island
Tennessee
Vermont
Washington
Guam
Puerto Rico

Total States In Place/In Process. 32

Source: Title II Data Collection System 2001

States use a variety of different examinations, but one of the more common tests is the Praxis Pre-Professional Skills Test (PPST), which assesses prospective teachers in the areas of math, reading and writing Of the 29 states that use the PPST, Virginia set a passing rate closest to the national average in reading All other states had cut scores below the 50th percentile and 15 of the 29 set passing rates below the 25th percentile Nine states, including larger states like Florida and Texas, and the District of Columbia, set cut scores below the 20th percentile (Figure 5)

In math, only Virginia set its cut score at the national average The majority of the 29 states set cut scores around the 20 30th percentile range (Figure 6) In writing, again only Virginia had a cut score at or above the national average Maine set its passing rate at the sixth percentile level, meaning 94 percent of test takers would pass this portion in that state (Figure 7)

Not surprisingly then, according to data reported by the states as required by Title II of the *Higher Education Act*, the vast majority of teacher preparation program completers are passing the assessments required by their states for certification (Figure 8) During the 1999 2000 school year, 93 percent of prospective teachers passed various state examinations necessary for initial certification Virginia, with the highest standards, had the lowest overall pass rate of 80 percent However, six states posted pass rates of 100 percent, suggesting that academic standards for teachers, in far too many states, are extremely low

However, there is *some* good news to report For example, 38 states now require a bachelor's degree with a major or minor in an academic content area for certification, usually for middle or high school teachers (Figure 9) NCES data reveal that half of the nation's newest teachers (with three or less years of teaching experience) have an academic major compared to 32 to 41 percent of more experienced teachers [28]

Some states, like Pennsylvania, have aggressively raised teacher standards Since the 1999 2000 school year, state teaching candidates must obtain a GPA of at least 3 0 in college-level liberal arts and sciences courses, not including education classes, before they are eligible to enter a training program Candidates must also take the same courses as majors in their respective academic subjects and obtain a 3 0 GPA to graduate Passing scores in Pennsylvania are also gradually increasing on certification tests.[29]

What's the lesson to be learned? While academic standards for teachers are too low in most states, change is possible in those states with the will to make it happen Virginia and Pennsylvania are laudable examples

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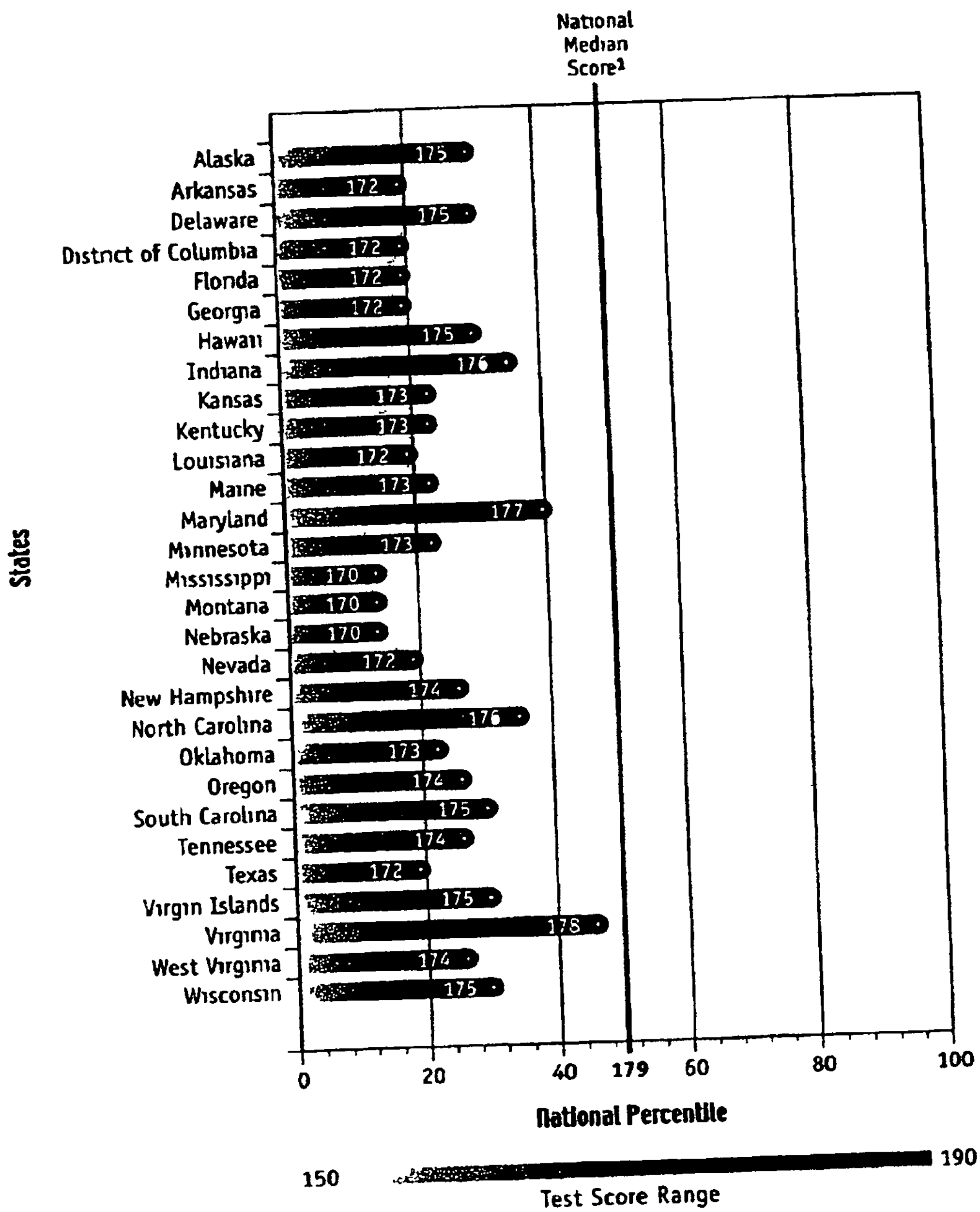
Figure 5: State minimum passing scores, preprofessional skills test: reading, 1999–2000



1 National median score is defined by the score realized by the 50th percentile test taker

Note: States not listed did not participate in Praxis Pre Professional Skills Testing Program in 1999 2000.

Source: Educational Testing Service. Analysis by Westat, March 2002.

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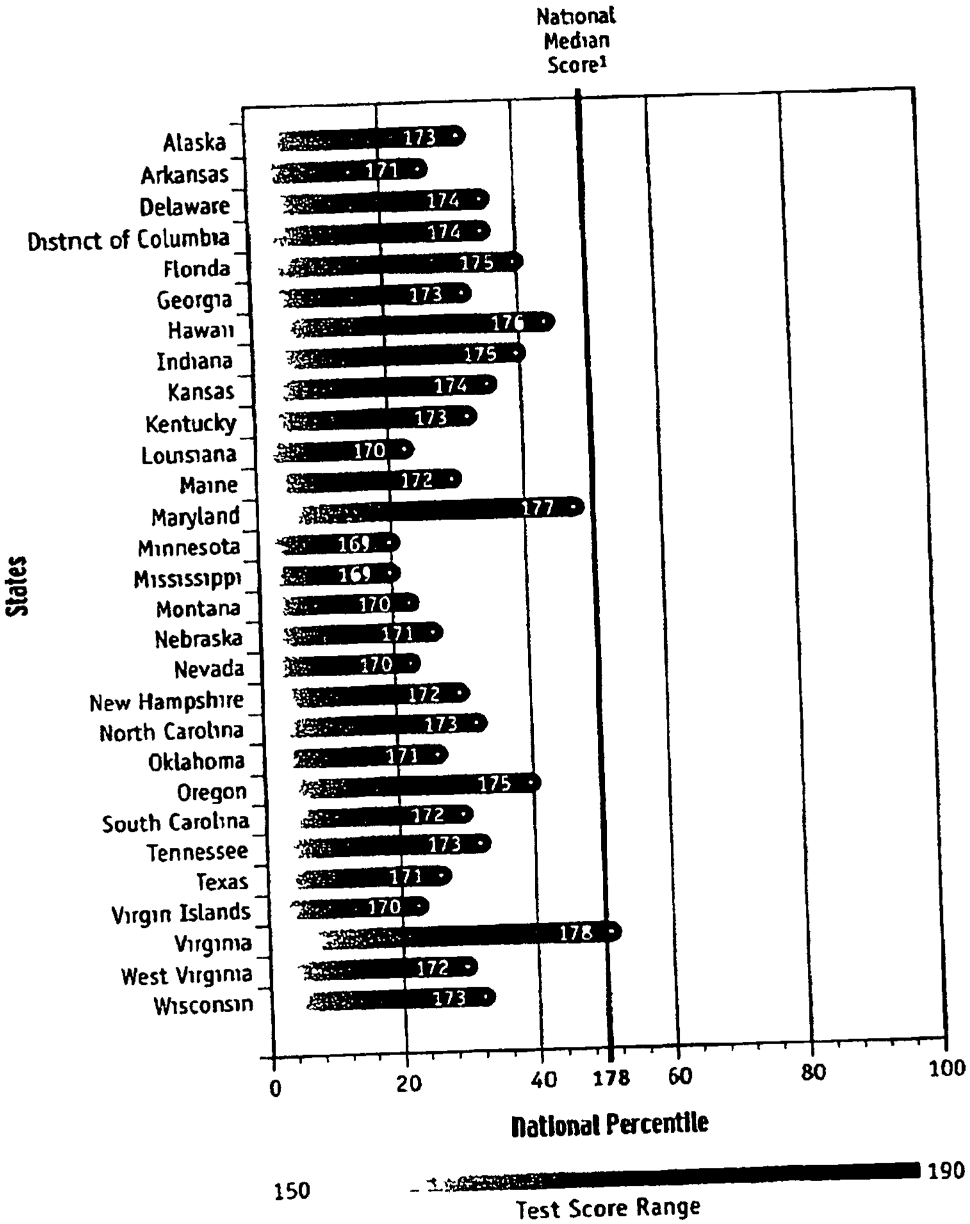
FIGURE 6: STATE MINIMUM PASSING SCORES, PREPROFESSIONAL SKILLS TEST: MATHEMATICS, 1999-2000

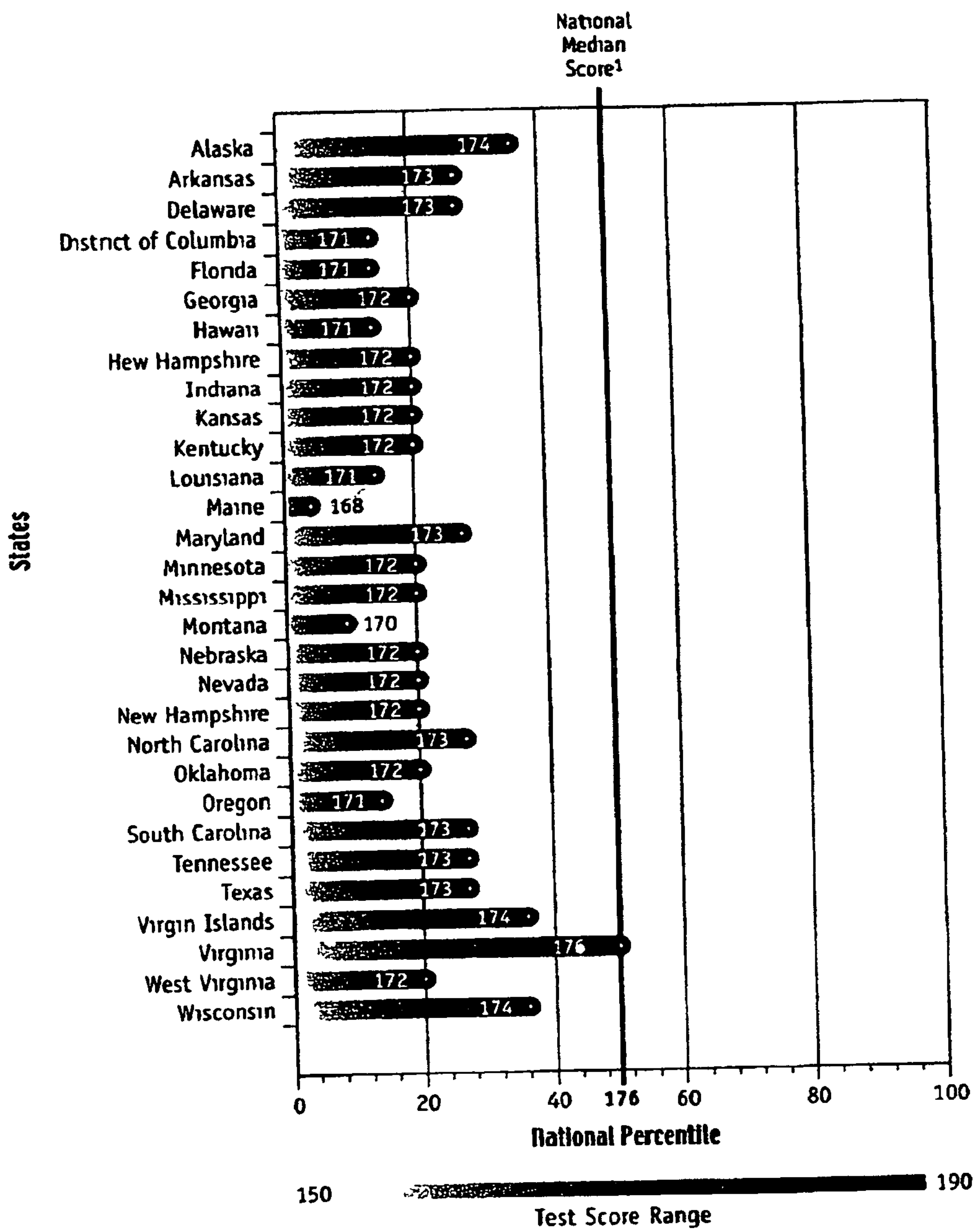


1 National median score is defined by the score realized by the 50th percentile test taker

Note: States not listed did not participate in Praxis Pre Professional Skills Testing Program in 1999-2000

Source: Educational Testing Service Analysis by Westat March 2002

FIGURE 7: STATE MINIMUM PASSING SCORES, PREPROFESSIONAL SKILLS TEST: WRITING, 1999–2000

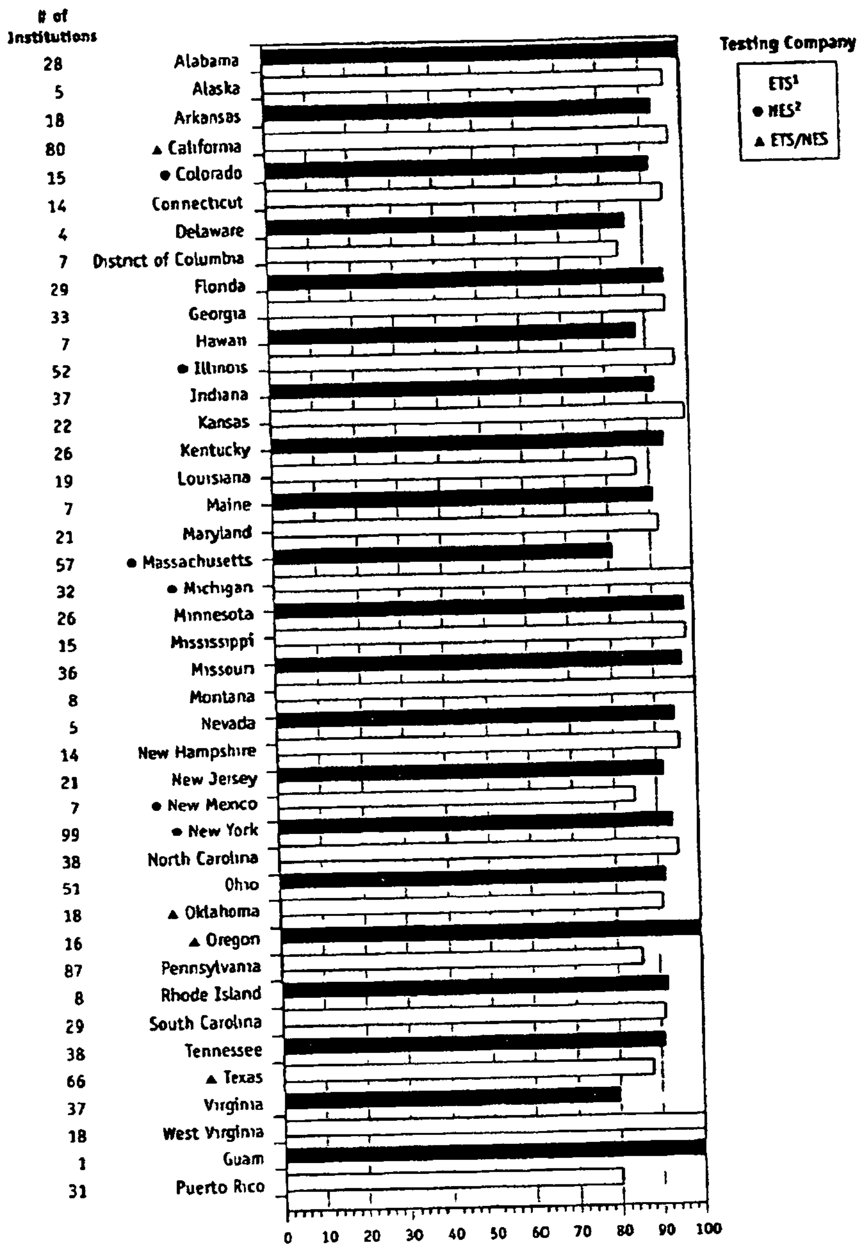


1 National median score is defined by the score realized by the 50th percentile test taker

Note States not listed did not participate in Praxis Pre Professional Skills Testing Program in 1999-2000

Source Educational Testing Service. Analysis by Westat March 2002.

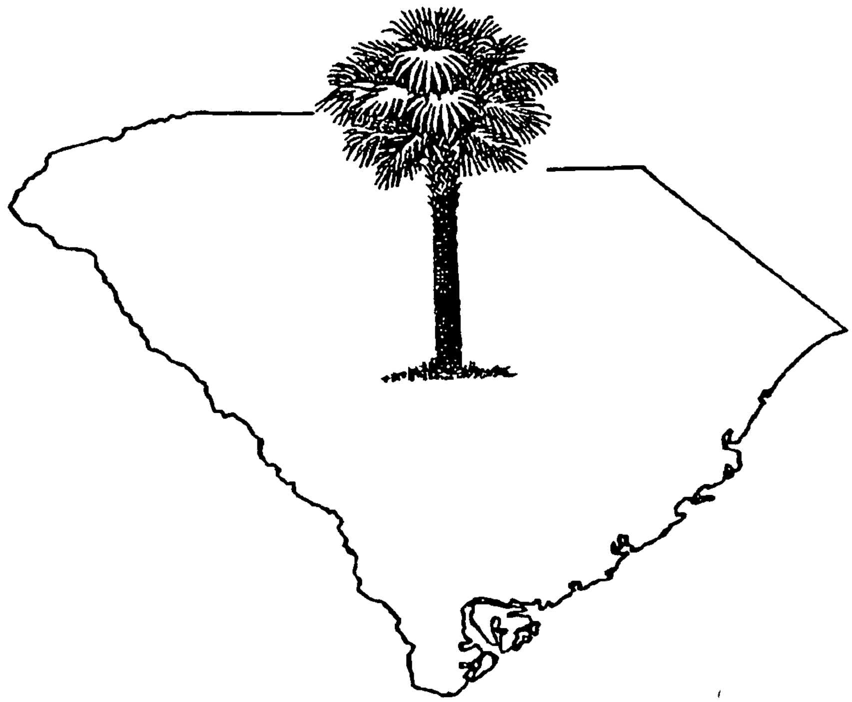
FIGURE 8: SUMMARY PASS RATES BY STATE AND TESTING COMPANY: 1999–2000



1 Educational Testing Service (ETS)

2 National Evaluation Systems (NES)

South Carolina Professional Development Standards



State Department of Education
Office of Professional Development
Columbia, South Carolina

South Carolina
State Department of Education

Inez Moore Tenenbaum
State Superintendent of Education

Leonard McIntyre, Deputy Superintendent
Professional Development and School Quality

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October 2001

Professional Development Standards for South Carolina

> *What Matters Most Teaching for America s Future* the highly regarded report of the National Commission on Teaching and America s Future asks this nation to get serious about standards for both student and teacher performance and calls for the reinvention of teacher professional development as a means to that end To play its central and essential role in standards based reform professional development for educators must be designed and based on standards representing the best available knowledge in the field The standards point out that effective staff development not only includes high-quality training programs with intensive follow up but that it must also employ other growth promoting processes such as study groups action research teacher networks and peer coaching The standards also make it clear that staff development is not something that is reserved exclusively for teachers Everyone who affects learning—from the Board of Education to classified/support staff—must continually improve their knowledge skills and attitudes in order to ensure high levels of learning for all students
>
> *(Standards-Based Reform Requires Standards-Based Staff Development by Dennis Sparks and Stephanie Hirsh June 1998)*

Background

Section 59-24-50, Education Accountability Act of 1998 required the South Carolina Department of Education to develop or adopt programs that meet national standards for professional development and focus on the improvement of teaching and learning Programs funded with state resources must meet these standards and must provide training, modeling and coaching on instructional leadership and school based improvement

In October 1999 in response to the state legislation, the Office of Professional Development in the State Department of Education enlisted the National Staff Development Council to support the implementation of professional development standards for our State Over 250 educators from South Carolina s school districts the State Department of Education and the Executive Board of the South Carolina Staff Development Council met to craft professional development standards and indicators for South Carolina

The South Carolina Professional Development Standards are based upon national standards for professional development The national standards for staff development were developed by the National Staff Development Council (NSDC) in collaboration with American Association of School Administrators (AASA) Association for Supervision and Curriculum Development (ASCD) National Education Association (NEA) National Association of Elementary School Principals (NAESP) National Association of Secondary School Principals (NASSP) National Middle School Association (NMSA), and representation from higher education foundations and school district staff members from across the country The South Carolina Professional Development Team gratefully acknowledges the framework and standards developed by the National Staff Development Council

Organization

Effective staff development that produces results for adults and students addresses organizational culture processes of adult learning and content for learning

> The standards are divided into three categories
>
> a) **CONTEXT** standards address the organization system, and culture in which the new learning will occur and be implemented
>
> b) **PROCESS** standards refer to the design and delivery of staff development They describe the processes used to acquire new knowledge and skills
>
> c) **CONTENT** standards refer to the actual skills and knowledge that effective educators need to possess to produce higher levels of student learning

The rubric contains the statement of the **standard,** which is a succinct statement of the expectation for professional development It establishes the level of performance to which all organizations should aspire Accompanying the standards are **indicators** that describe the ways that the standard might be implemented The indicators provide examples of evidence that the standard has been met

These standards were designed to be used by educators across the State at all levels of the educational system–the State Department of Education, school districts schools and state-operated programs These tools provide direction for planning, monitoring, and assessing professional development While they may resemble a checklist, they will have the greatest impact on organizational and individual learning if the standards are accessed during

- initial planning phases of state district and school level professional development,
- review of the state test scores and mid-course corrections in school improvement
- evaluation of individual staff development efforts
- writing of comprehensive school plans and
- assessment of professional development plans

These standards provide an opportunity to assess your current practice and use the standards and indicators to improve your practice The implementation of these standards will support the far-reaching objectives of improved teaching and learning throughout South Carolina

South Carolina Standards for Professional Development

AREA	STANDARDS	SAMPLE INDICATORS
CONTEXT **Context addresses the organization system or culture in which new learning will be implemented**	1 **Effective professional development fosters the norm of continuous improvement.**	a) Educators constantly revisit and renew their organizational goals b) Staff can articulate the kinds of learning opportunities they access throughout the year c) Staff use the ADEPT* performance appraisal process to assess progress and influence continuous improvement *ADEPT—South Carolina s comprehensive performance appraisal process for staff designed to promote excellence in teaching.
	2 **Effective professional development requires strong leadership for continuous improvement.**	a) Administrators, teacher leaders, school board members, community leaders and others advocate for quality professional development. b) School and district leaders participate with staff in professional development activities c) Morale increases as a result of staff empowerment and effectiveness
	3 **Effective professional development is aligned with the organization's mission and strategic plan is linked to student achievement, and is adequately funded by the budget.**	a) Professional development resources are coordinated to ensure that the professional development activities are aligned with the school improvement plans. b) Professional development is adequately funded. Priorities are set. c) Effective professional development is perceived as essential for achieving the purposes of the organization is valued as an integral part of the strategic plan, and is seen as a key factor in improving student learning
	4 **Effective professional development provides adequate time for staff members to learn and work together to accomplish the organization s mission and goals**	a) Time for professional development activities is provided during the workday (e g peer coaching mentoring, and common planning time) b) Additional days for coordinated professional development efforts are built into the school calendar c) Schedules are designed to ensure time for the adults in the system to learn together and improve practice

South Carolina Standards for Professional Development

AREA	STANDARDS	SAMPLE INDICATORS
PROCESS **Process standards refer to "how" we implement or deliver professional development. These standards describe the processes used to acquire new knowledge and skills**	**5 Effective professional development provides decision makers with information about organization development and systems thinking**	a) All stakeholders are involved in the professional development The stakeholders (at the state district or school level) complete a self study of their effectiveness each year b) Barriers to effective professional development within the organization are addressed c) Site based management teams use shared decision making processes to determine professional development priorities
	6 Effective professional development is based on knowledge about adult learning and models this understanding in all activities	a) The learning climate is collaborative informal and respectful The providers of all professional development are credible b) Professional development emphasizes how the learning can be used/applied c) Professional development relates the learning to the learners goals and allows the learners to make choices linking their individual growth plans with school goals
	7 Effective professional development provides for three phases of the change process initiation, implementation, and institutionalization	a) Appropriate assessments occur at each phase and appropriate interventions occur b) All critical phases of the change process are addressed in the planning design implementation and evaluation of programs c) Collaboration is occurring among teachers to support change or innovation
	8 Effective professional development priorities are established following a careful analysis of disaggregated data regarding goals for student learning	a) Data is provided that links staff development initiatives and intended adult and student results b) Gaps in achievement among all groups are addressed c) The district strategic plan school improvement plans and individual improvement plans incorporate goal setting using all available data

South Carolina Standards for Professional Development

AREA	STANDARDS	SAMPLE INDICATORS
PROCESS **Process standards refer to "how" we implement or deliver professional development. These standards describe the processes used to acquire new knowledge and skills**	5. **Effective professional development provides decision makers with information about organization development and systems thinking**	a) All stakeholders are involved in the professional development The stakeholders (at the state district or school level) complete a self study of their effectiveness each year b) Barriers to effective professional development within the organization are addressed c) Site based management teams use shared decision making processes to determine professional development priorities
	6 **Effective professional development is based on knowledge about adult learning and models this understanding in all activities**	a) The learning climate is collaborative informal and respectful The providers of all professional development are credible b) Professional development emphasizes how the learning can be used/applied c) Professional development relates the learning to the learners goals and allows the learners to make choices linking their individual growth plans with school goals
	7 **Effective professional development provides for three phases of the change process initiation implementation and institutionalization**	a) Appropriate assessments occur at each phase and appropriate interventions occur b) All critical phases of the change process are addressed in the planning, design implementation, and evaluation of programs c) Collaboration is occurring among teachers to support change or innovation
	8. **Effective professional development priorities are established following a careful analysis of disaggregated data regarding goals for student learning**	a) Data is provided that links staff development initiatives and intended adult and student results b) Gaps in achievement among all groups are addressed c) The district strategic plan school improvement plans and individual improvement plans incorporate goal setting using all available data

South Carolina Standards for Professional Development

AREA	STANDARDS	SAMPLE INDICATORS
PROCESS Process standards refer to "how" we implement or deliver professional development These standards describe the processes used to acquire new knowledge and skills	9 **Effective professional development provides a framework for integrating and relating innovations to the mission of the organization**	a) Improvement plans include a carefully and thoughtfully designed framework for integrating the innovations to be implemented b) All implementation efforts include descriptions of how each innovation relates to other ongoing programs and to the mission of the organization c) Successful practices are maintained and unsuccessful practices are abandoned when decisions are made to change goals or strategies
	10 **Effective professional development programs require an ongoing evaluation process.**	a) Evaluations are designed to assess a variety of program outcomes, including participants reaction to the program participants learning participants use of new knowledge and skills impact on student outcomes and impact on the organization b) Evaluation is considered an integral part of staff development program planning and implementation c) Evaluation data include multiple sources of information and focus on all levels of the organization Teachers use classroom assessments to measure immediate impact of professional development investments
	11 **Effective professional development uses multiple approaches to improve student success**	a) Multiple formats are evident action research study groups curriculum development self-study use of technology and training Methodology is appropriate to the intended outcomes b) Training includes theory demonstration practice feedback, and coaching c) A variety of readiness and professional development activities occur at each school site rather than uniform activities throughout a system

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South Carolina Standards for Professional Development

AREA	STANDARDS	SAMPLE INDICATORS
PROCESS **Process standards refer to "how" we implement or deliver professional development. These standards describe the processes used to acquire new knowledge and skills.**	**12 Effective professional development provides the follow up necessary to ensure improvement**	a) All training designs include plans for follow up Follow up is monitored and supported with human and financial resources b) Desired changes in on the job behavior improve student performance c) The ability of staff members to analyze and self-correct their performance improves d) Opportunities to network and share ideas and resources are promoted
	13 Effective professional development uses the stages of group development to build effective, productive and collegial teams.	a) Faculty and administration develop the skills to work collaboratively b) Staff members know about and use interdisciplinary team organization and instruction c) Staff share responsibility to conduct meetings, make shared decisions, solve problems and work collegially
CONTENT **Content standards refer to the actual skills and knowledge that educators need to possess or acquire through professional development**	**14 Effective professional development increases administrators' and teachers' understanding of how to provide school environments curriculum, and instruction that are responsive to the needs of all students.**	a) School improvement occurs as educators see the discrepancy between the needs of children and the school s current practices b) Teachers adopt research based programs and instructional strategies that are appropriate and effective for all children c) Student work is used to inform the staff about student progress and is used as a means by which to adjust instruction
	15 Effective professional development facilitates schoolwide and classroom based management strategies that maximize student learning	a) Educators develop the ability to respond to the uniqueness of each child and each situation They implement effective classroom management strategies. b) Students self-esteem increases their success in the classroom c) There is a comprehensive schoolwide guidance plan incorporating student documentation d) Data on student attendance suspension disciplinary referrals and expulsions are reported and used to inform planning

South Carolina Standards for Professional Development

AREA	STANDARDS	SAMPLE INDICATORS
CONTENT **Content standards refer to the actual skills and knowledge that educators need to possess or acquire through professional development.**	**16. Effective professional development addresses diversity to ensure an equitable and quality education is provided to all**	a) Populations are identified by gender ethnicity socioeconomic status and special needs. b) Effective strategies to engage diverse learners and learning styles in the educational process are identified c) Professional development incorporates diversity issues into all programs.
	17 Effective professional development prepares educators to demonstrate high expectations for student learning	a) Increasing numbers of students experience a challenging core curriculum and improve their achievement b) Staff participates in training about academic and professional development standards c) Evidence of high expectations exists in lesson plans unit plans performance assessments, school improvement plans, and district strategic plans d) Teachers and administrators believe students can learn at high levels
	18 Effective professional development helps teachers and administrators engage families and communities in improving all children s academic achievement.	a) Active school/business partnerships support student learning. Volunteers and mentors are available to support student learning b) School staff and parents/families increase communication about student academic progress and a partnership plan for student progress is created c) Participation of parents/families in educational activities at school and home increases
	19 Effective professional development prepares teachers to use various types of performance assessment in their classrooms.	a) Professional development on the design and use of assessments is provided b) Modifications and accommodations are made to meet special needs of students c) Assessment strategies are shared among teachers schools and districts

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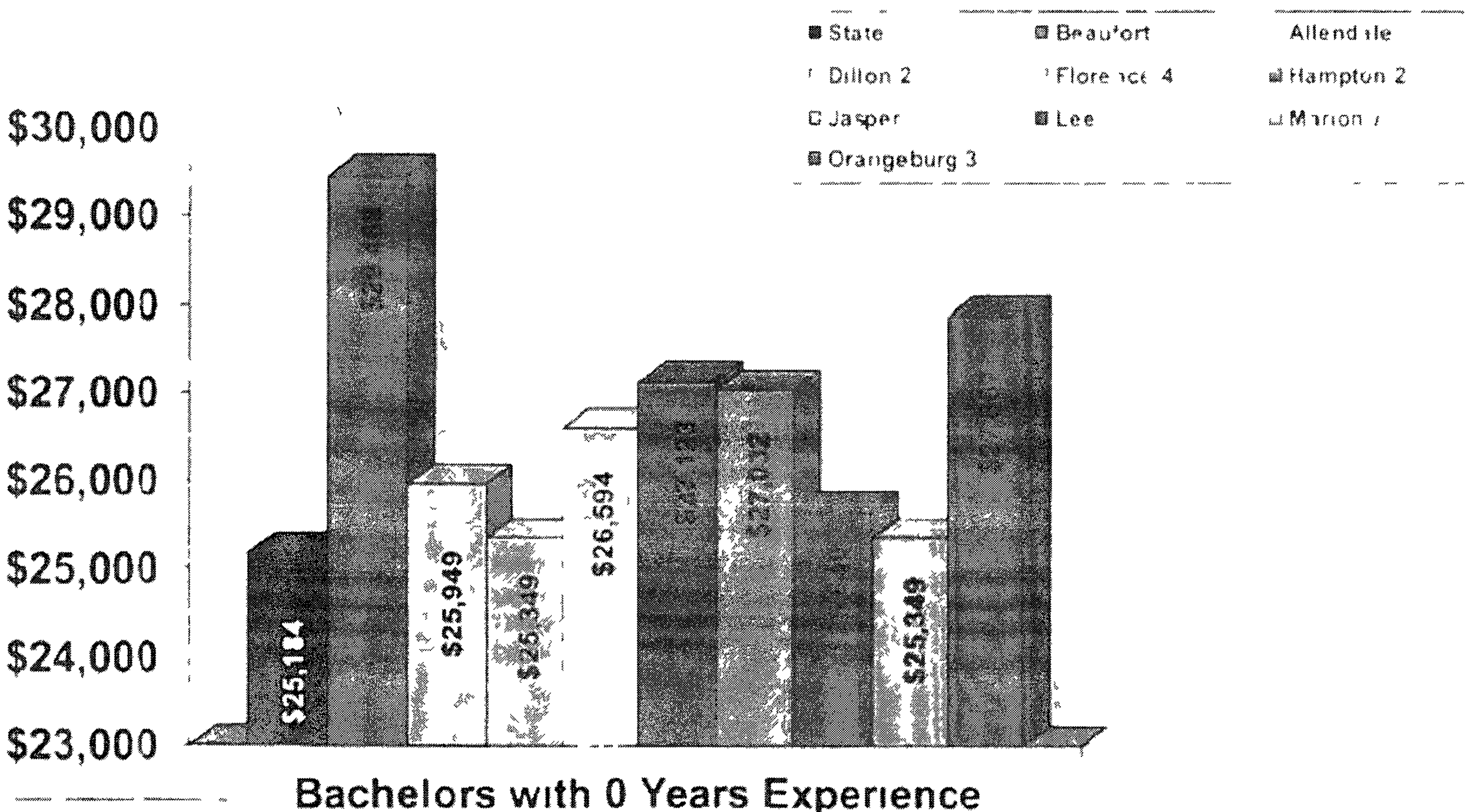
Professional Development
Training Opportunities

http //myscschools com/tracks/educators/training htm

Salary – Bachelor's Degree – 0 Years Experience



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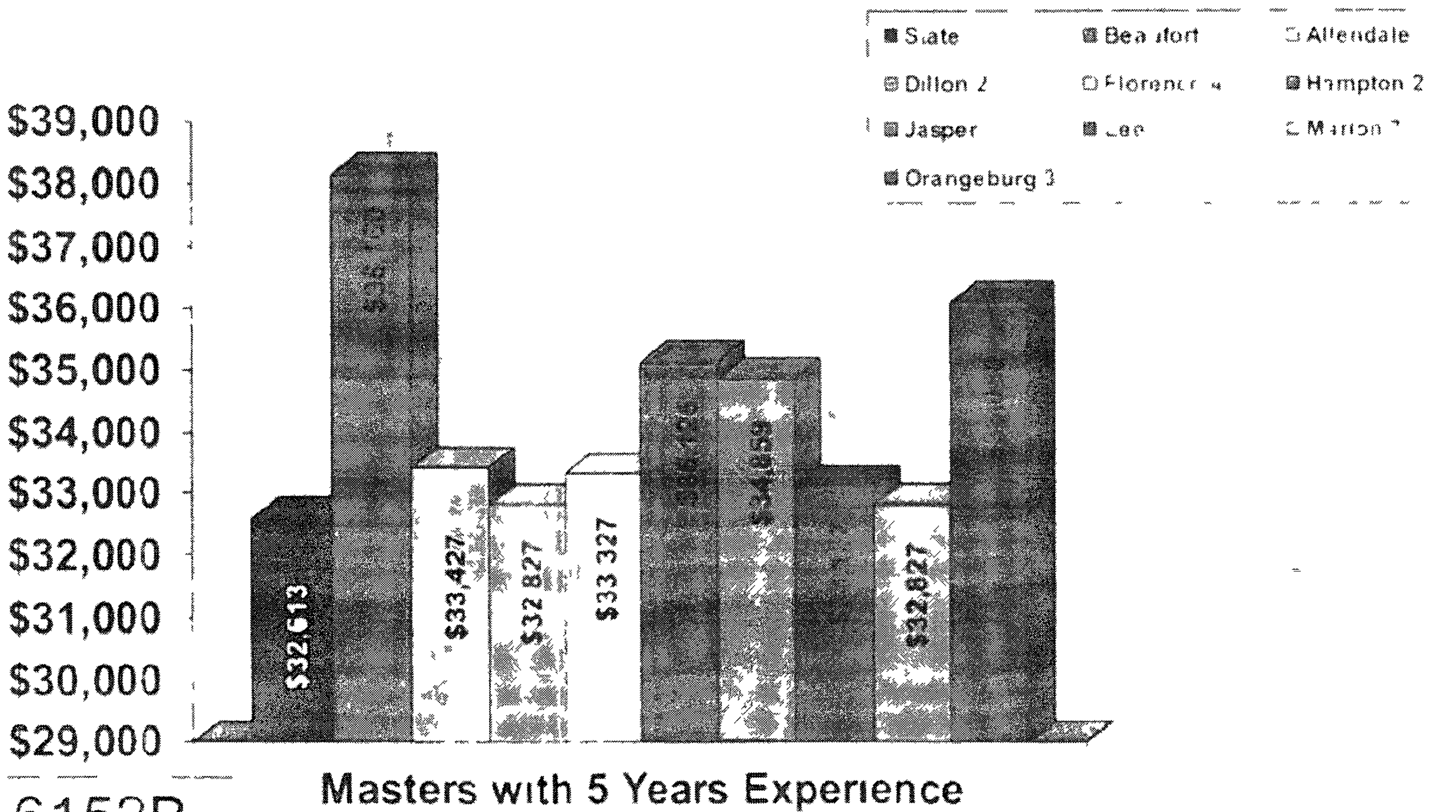
Salary – Master's Degree – 5 Years Experience



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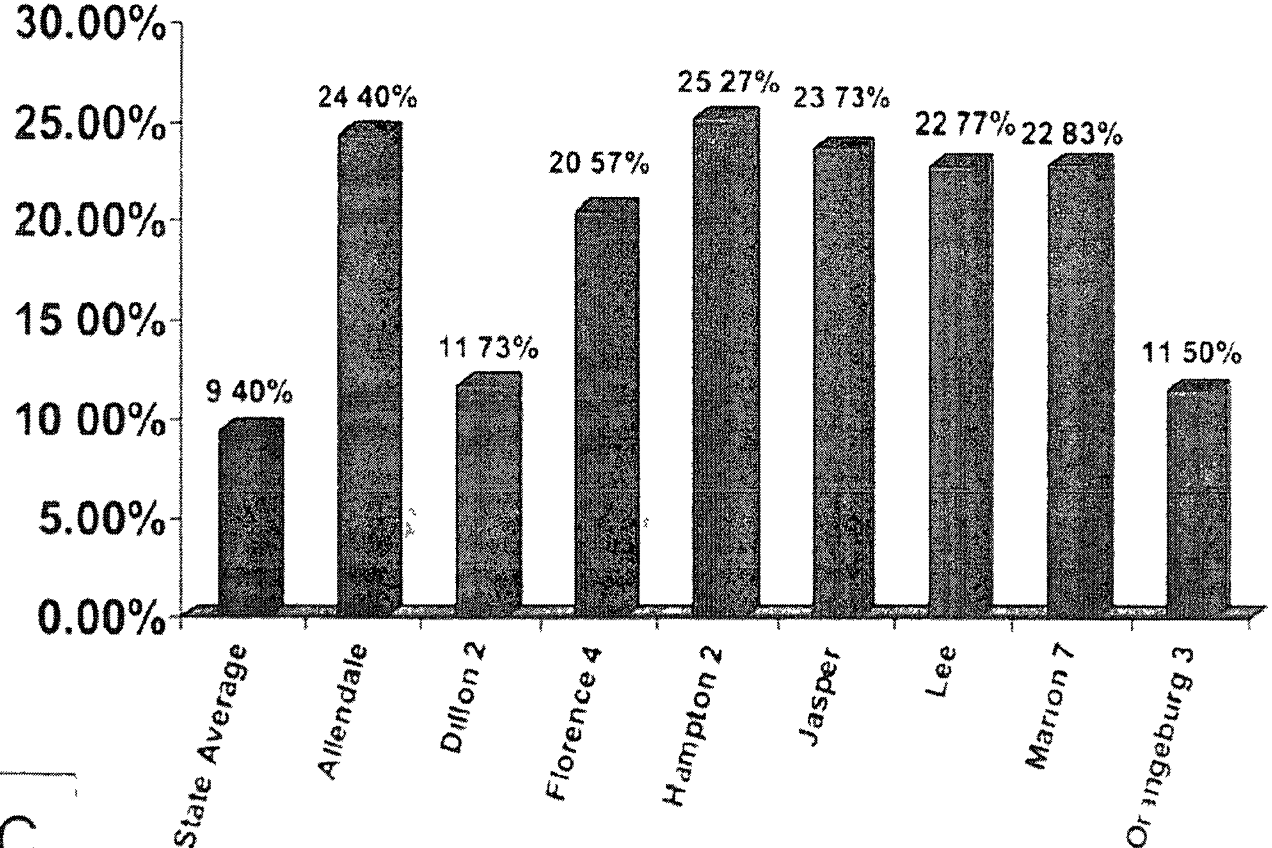
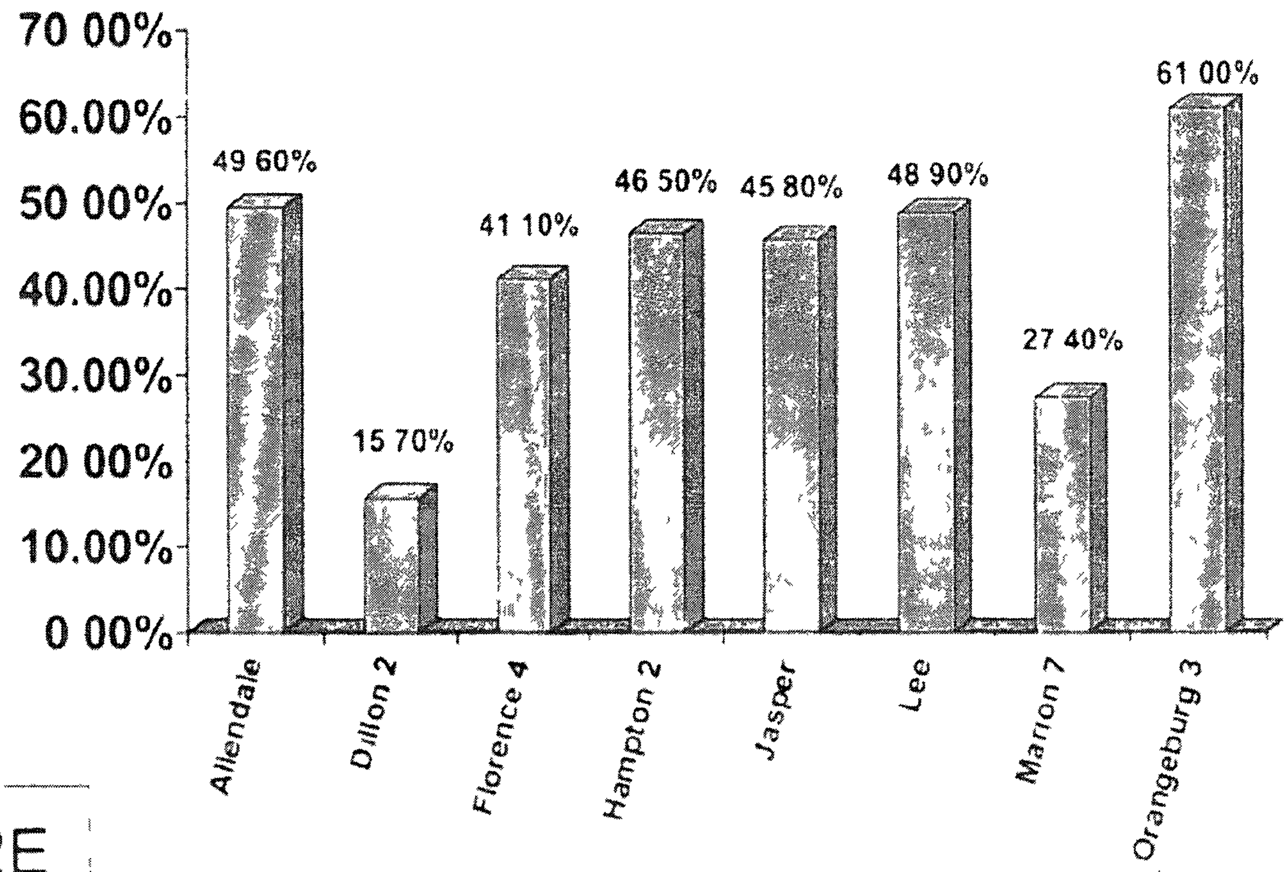
Three Year Average Teacher Turnover Rate



Percentages of Teachers Graduating from Non-Competitive Colleges



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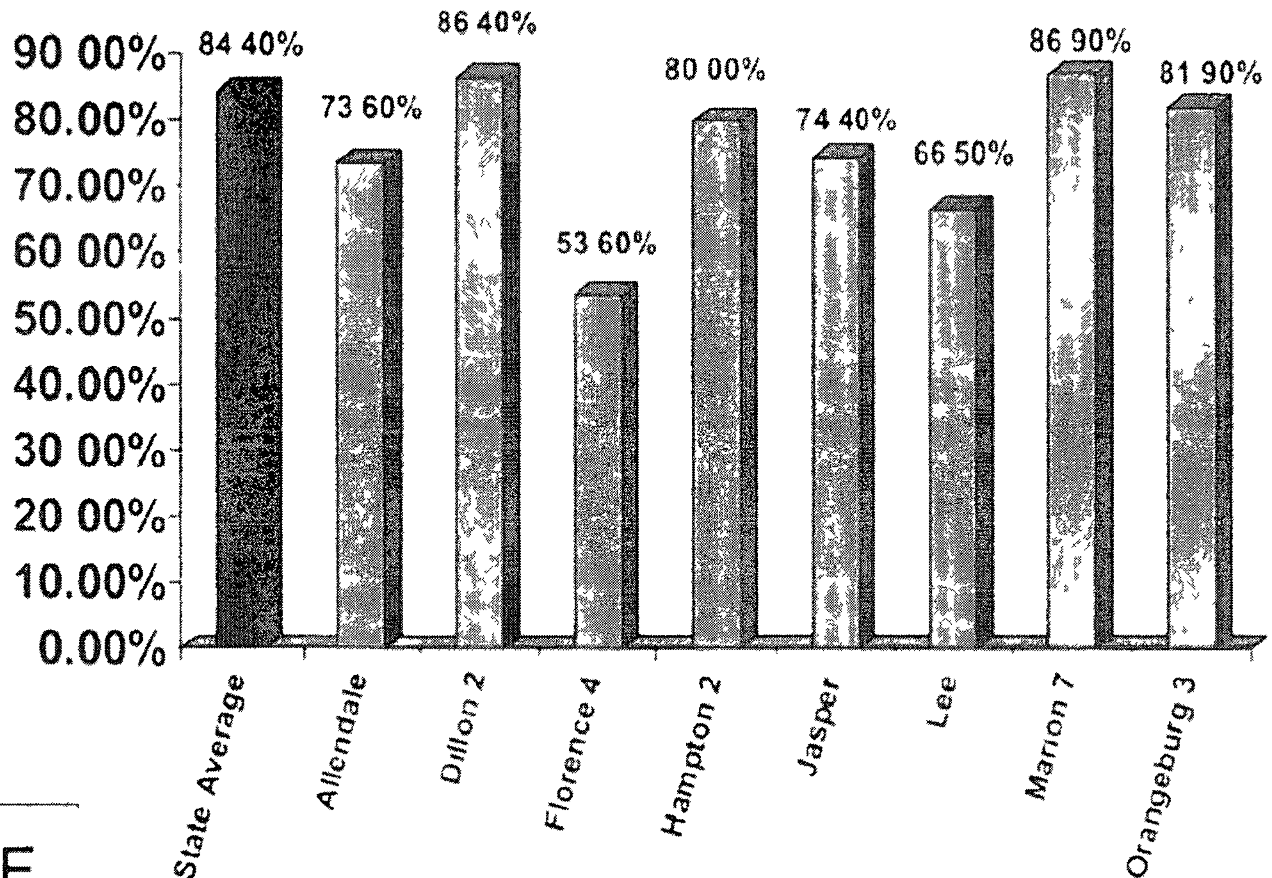
Percentages of Continuing Contract Teachers By District



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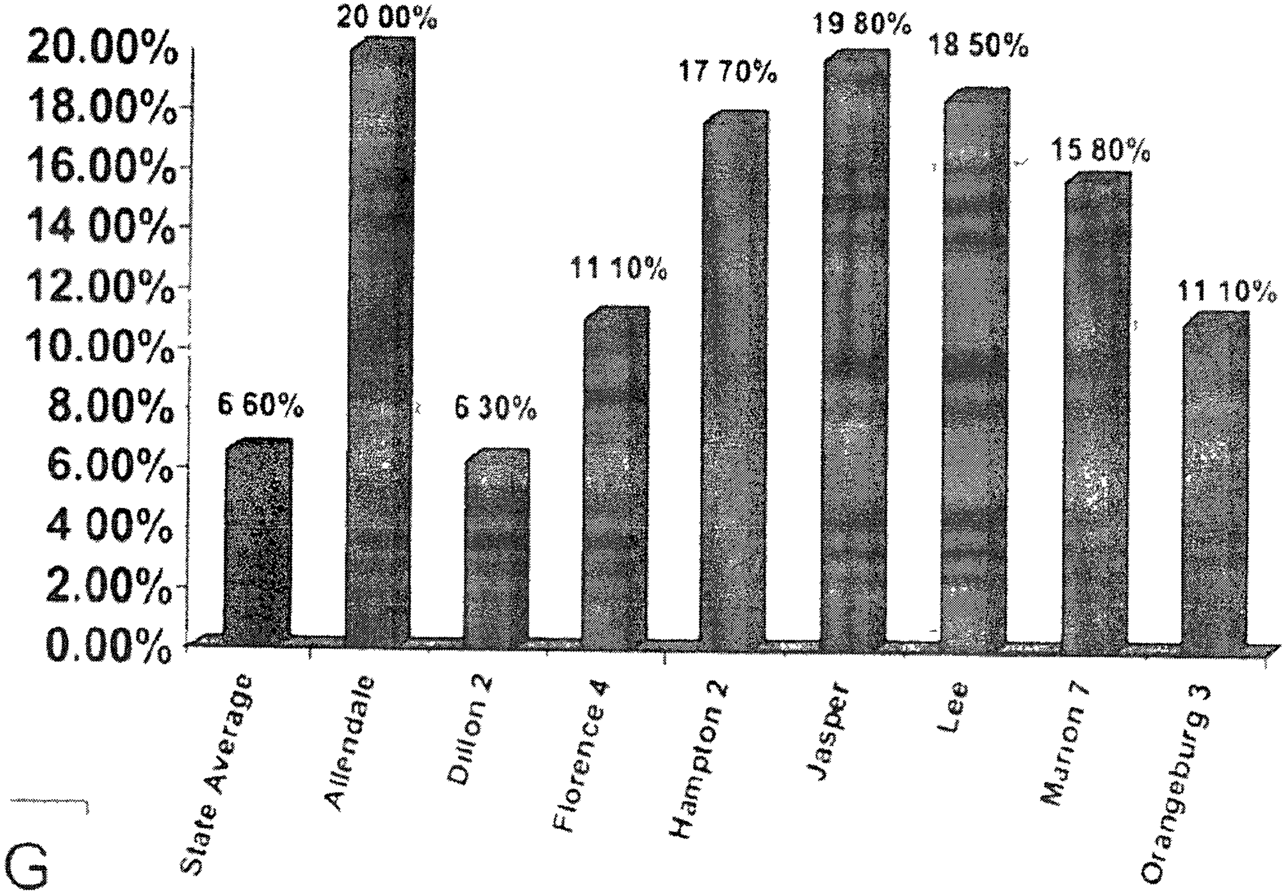
Percentages of Teachers with Substandard Certificates and Out-of-Field Permits



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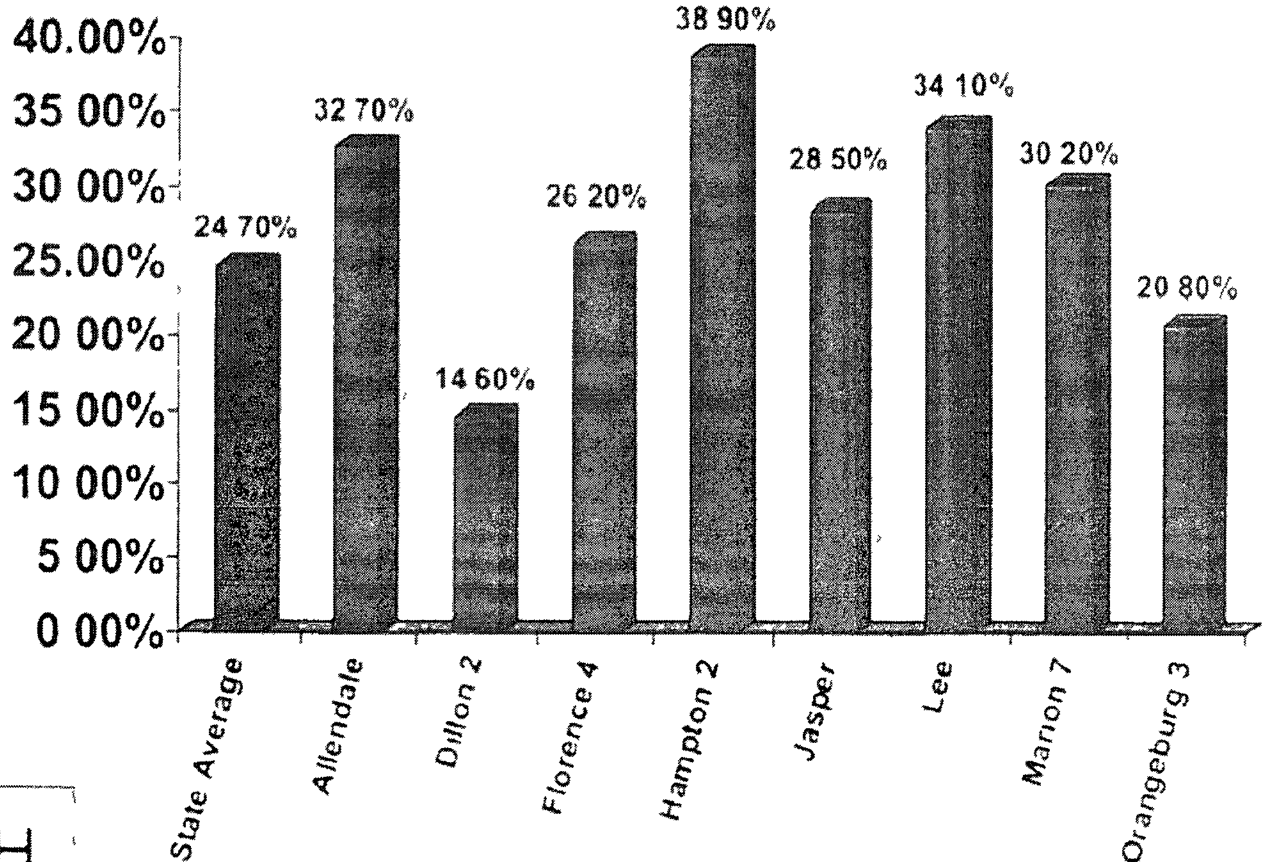
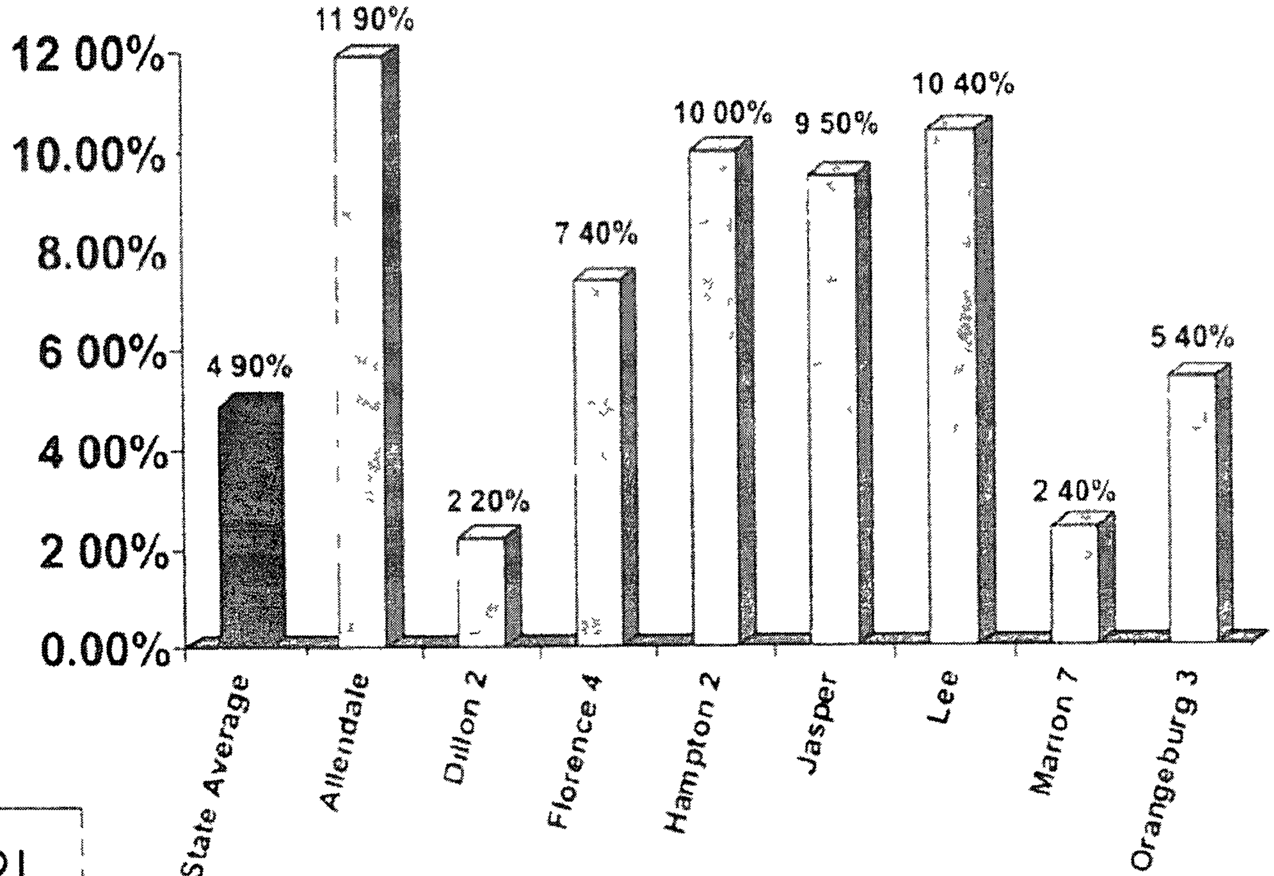
Percentage of Teachers with 0-5 Years Experience



Percentage of Induction Contract Teachers



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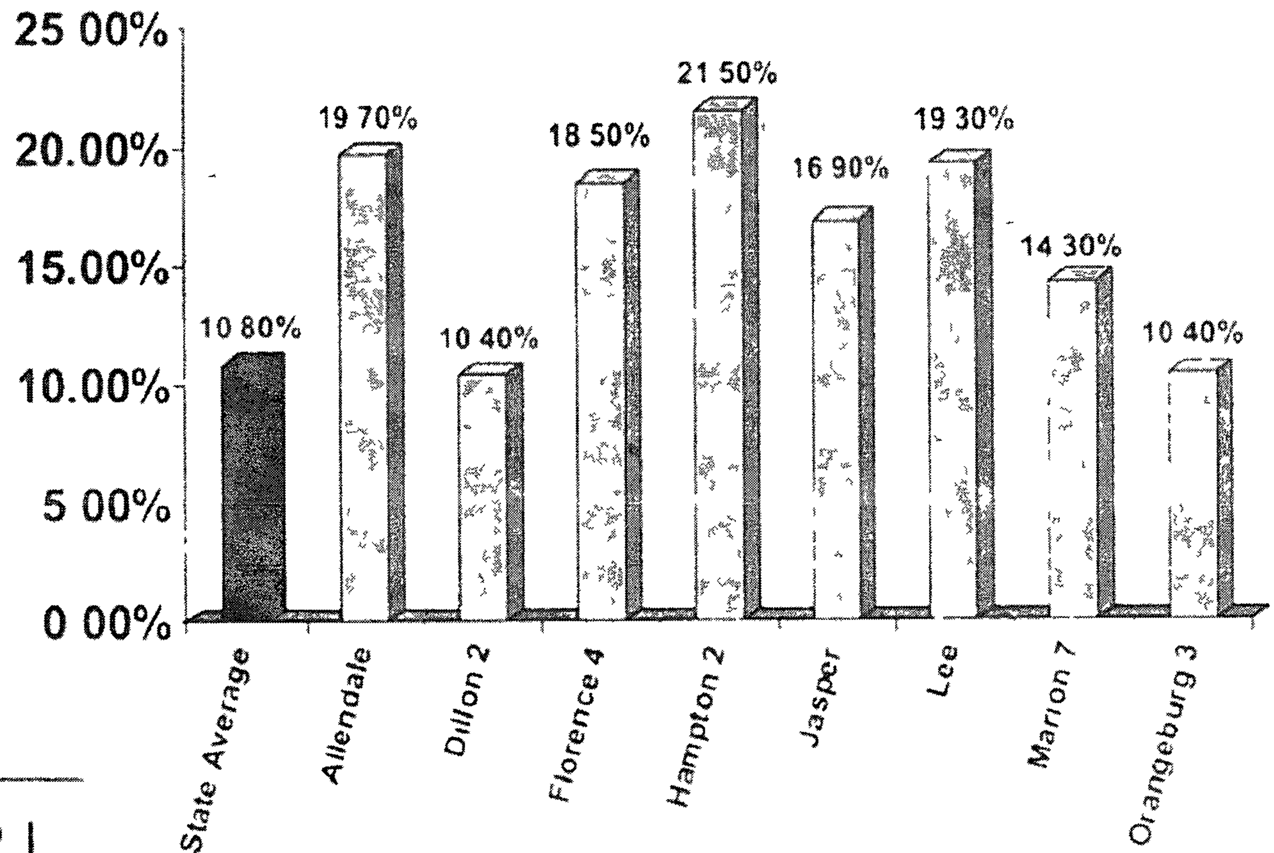
Percentage of New Teachers Hired



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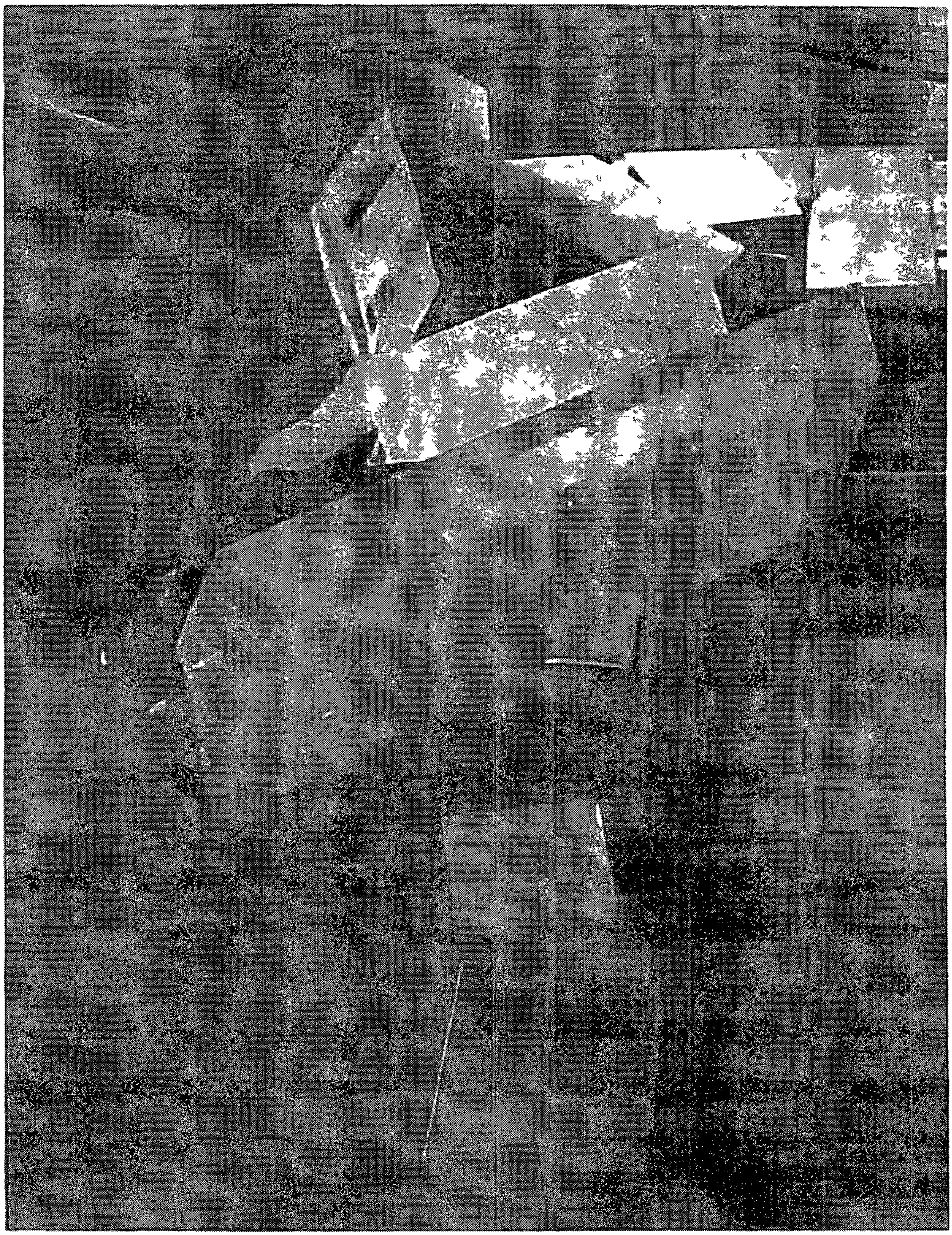

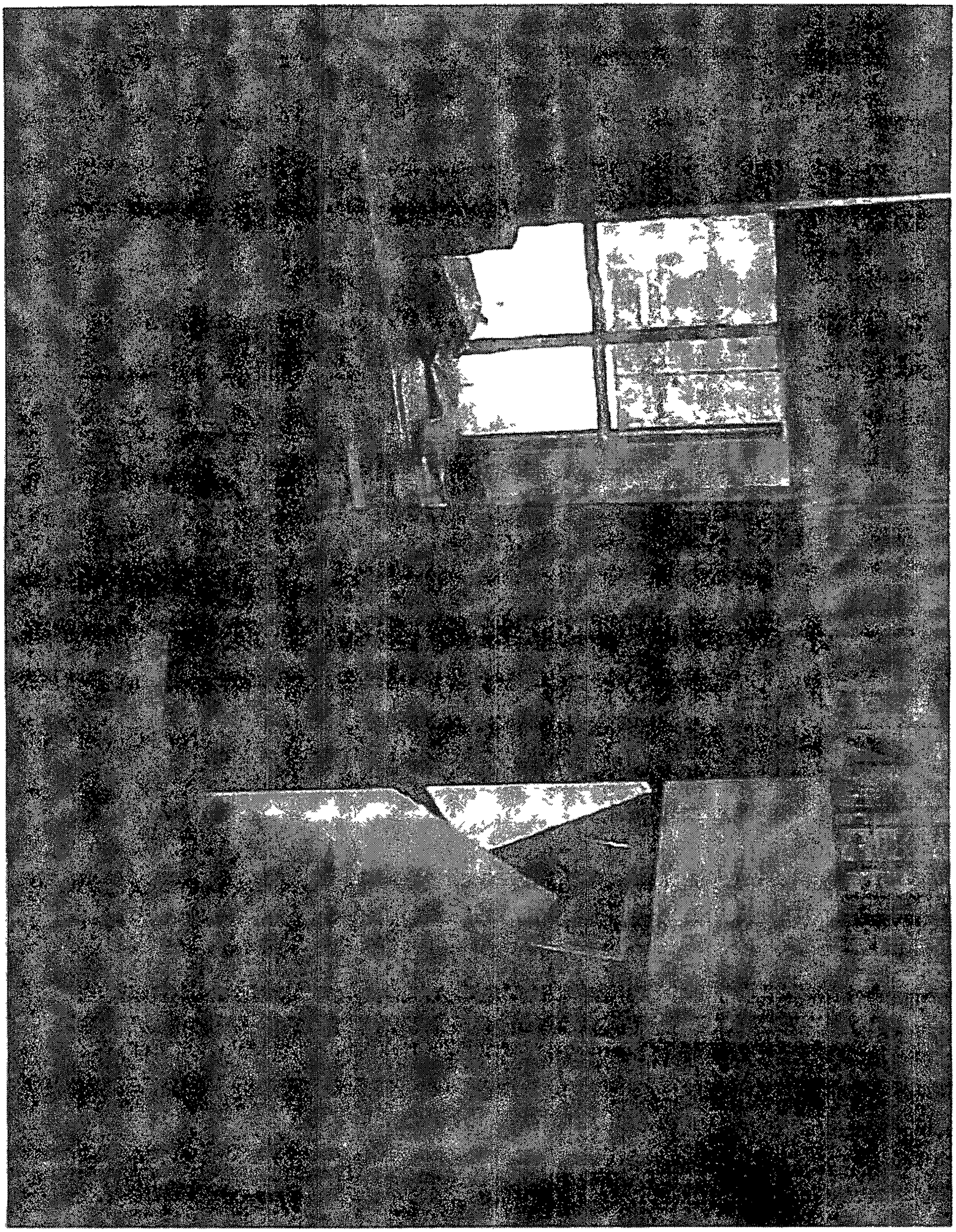

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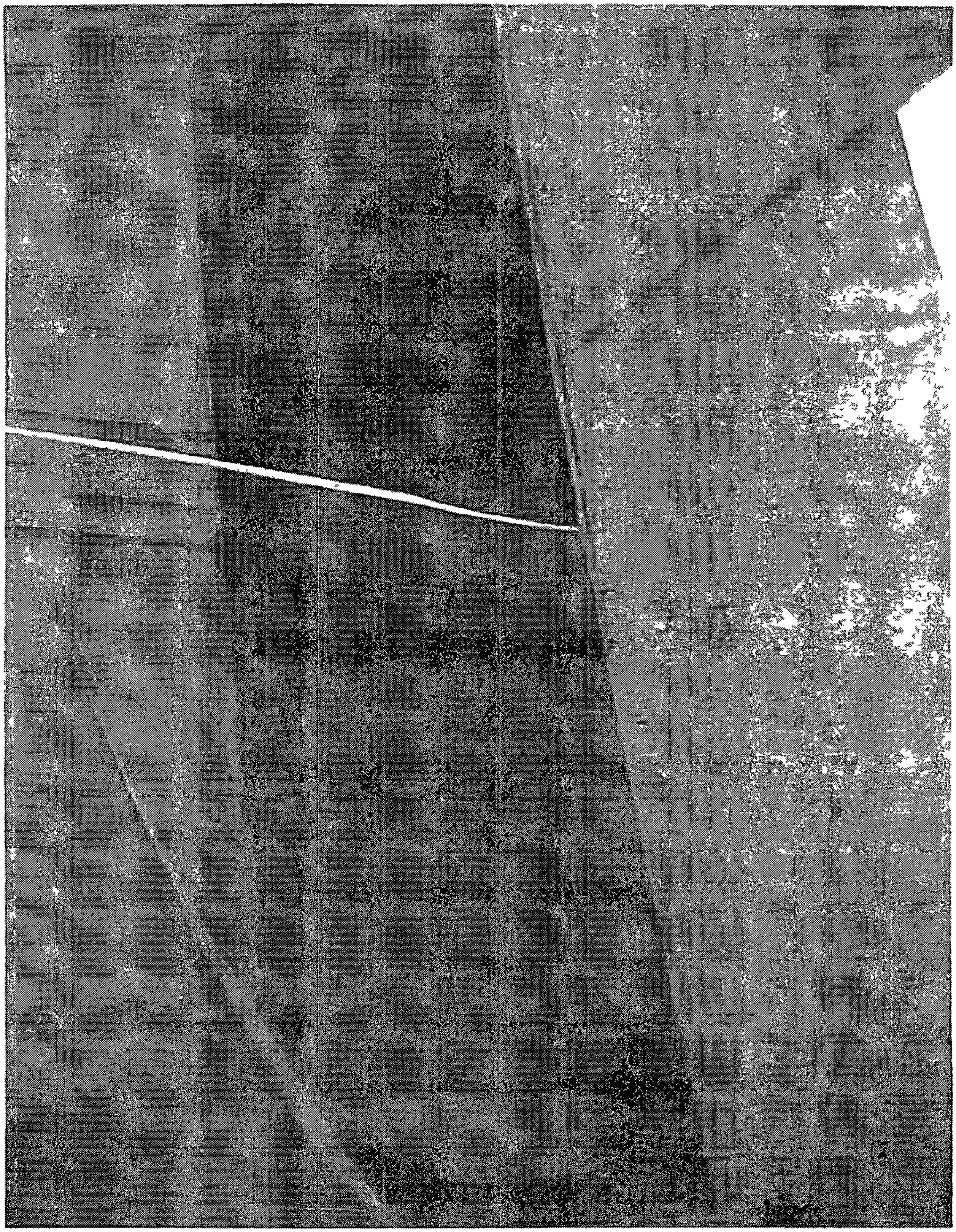

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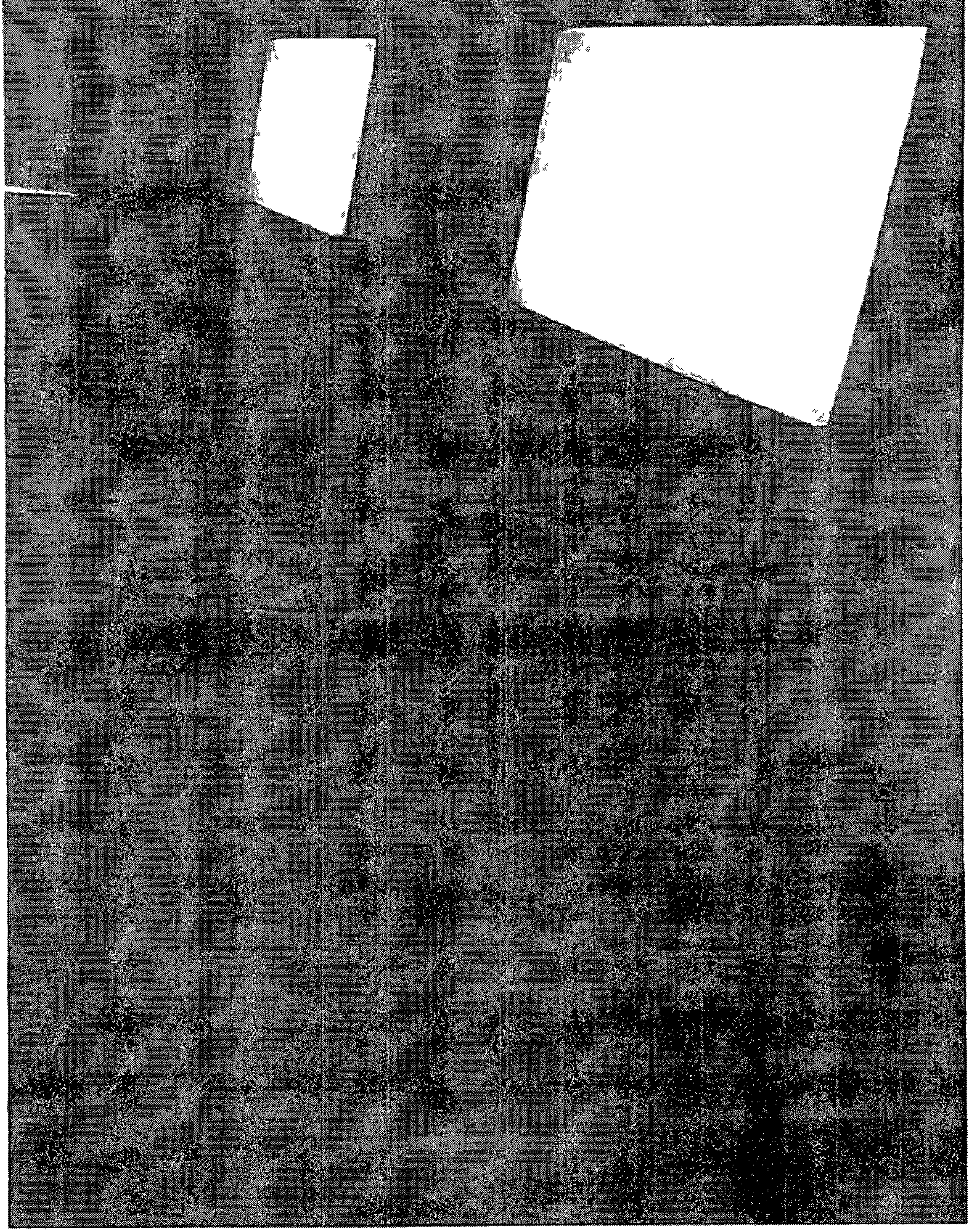

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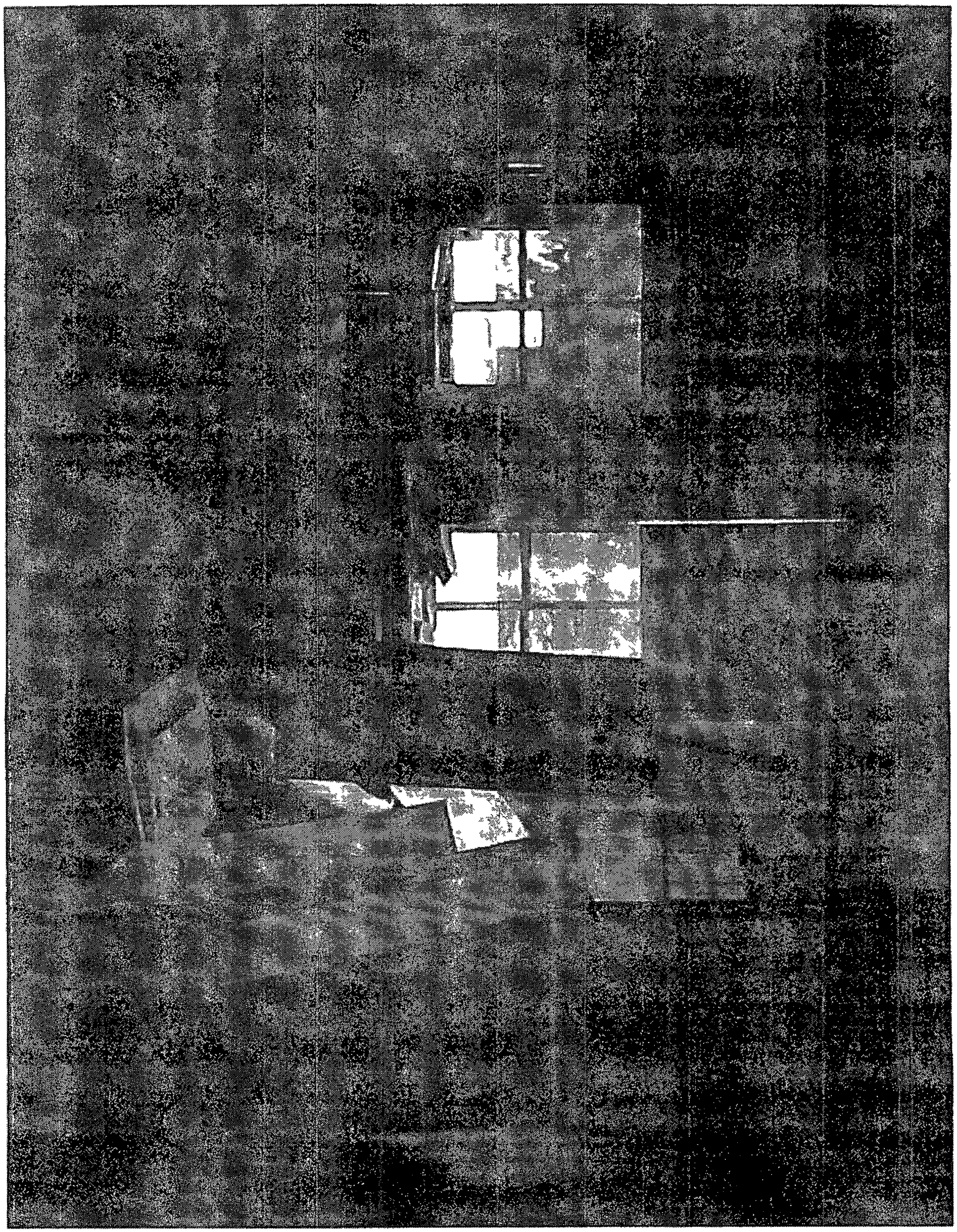

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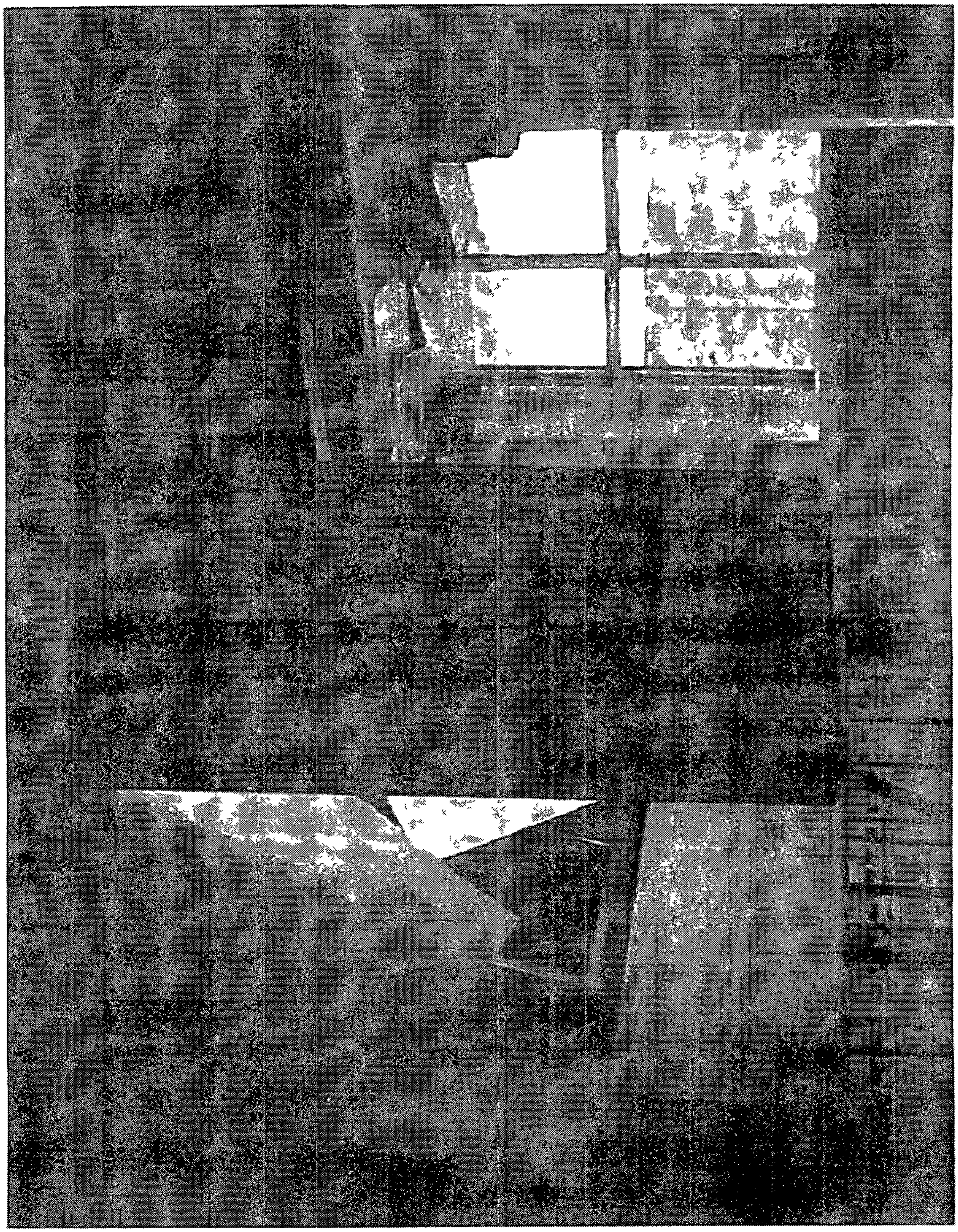

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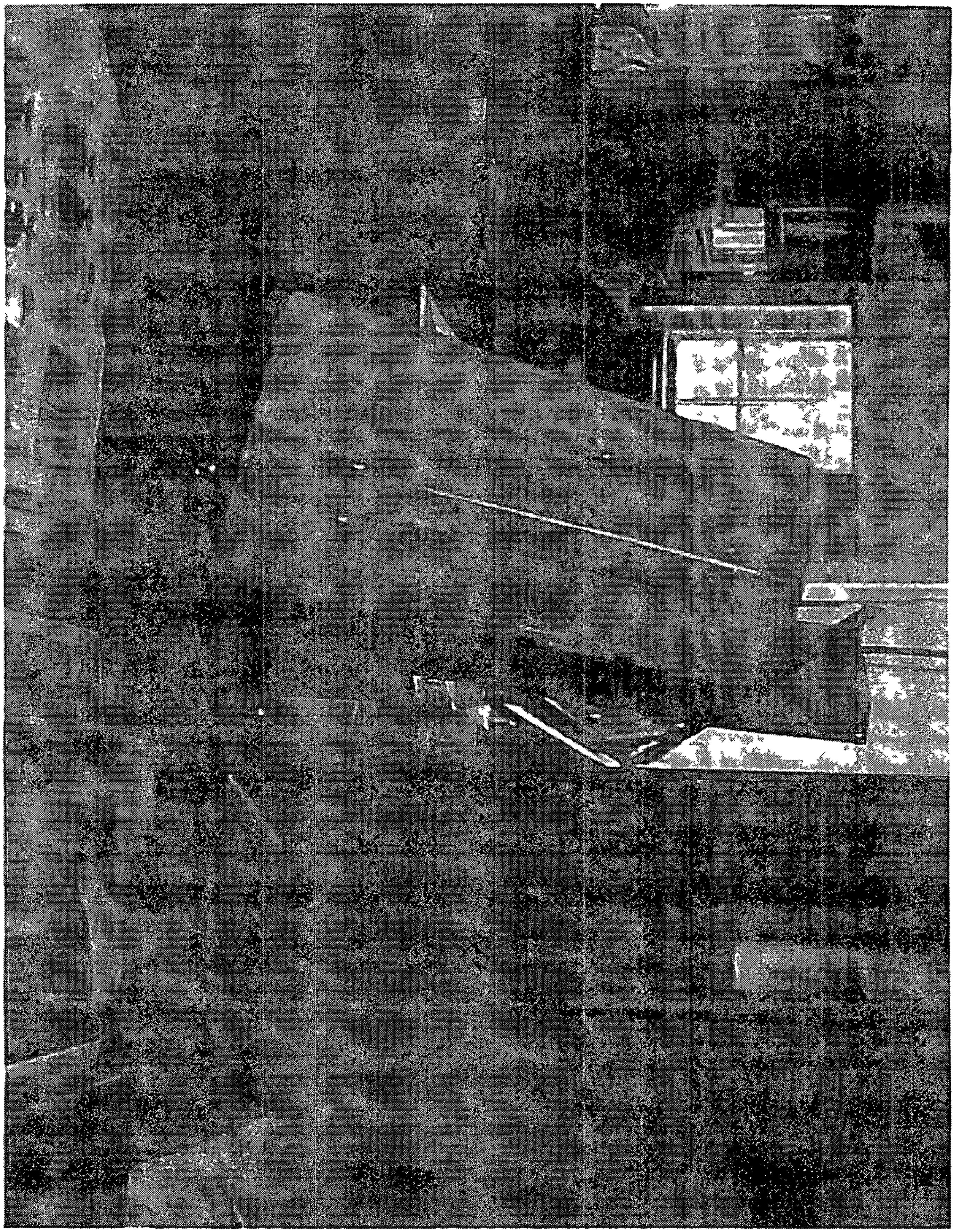

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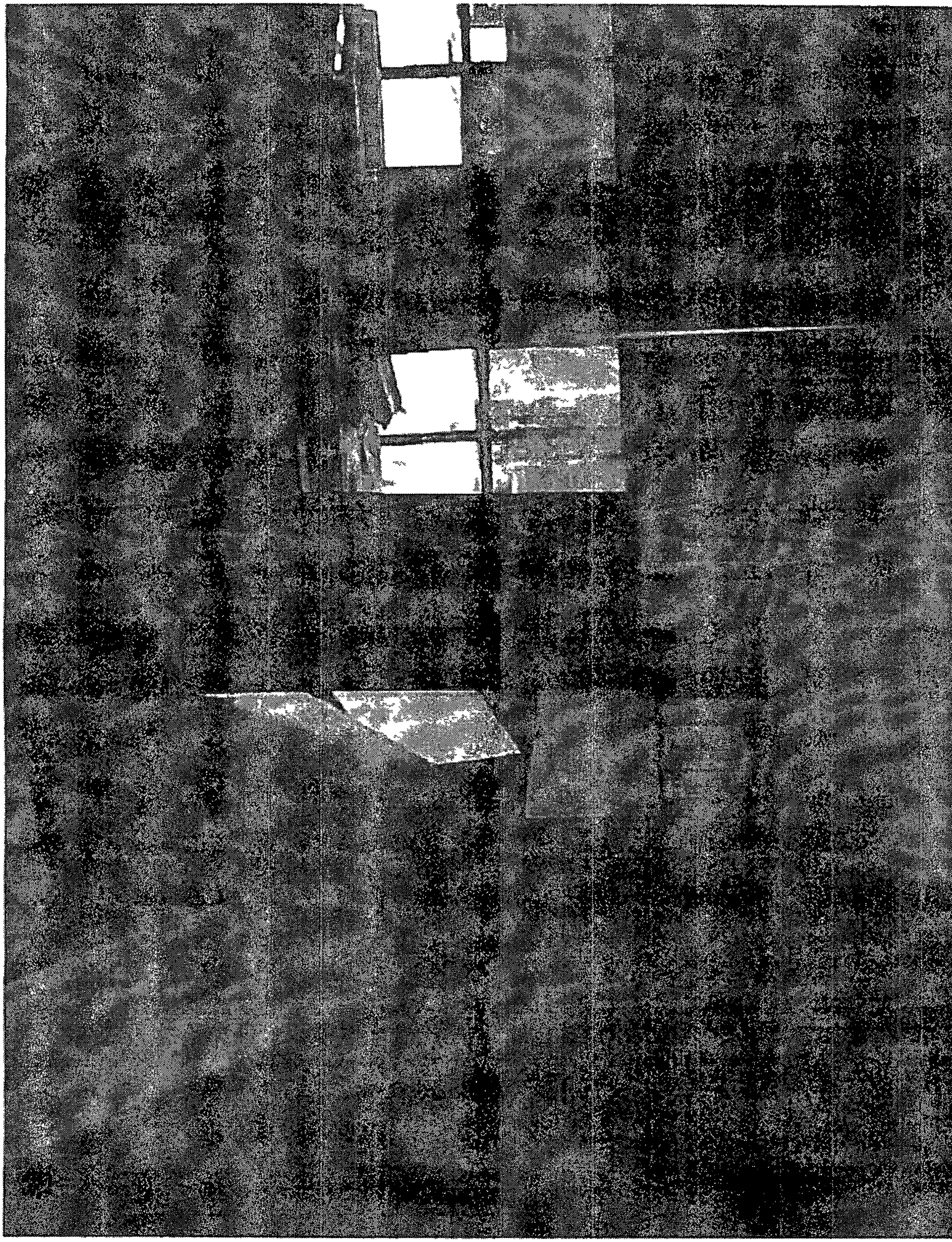

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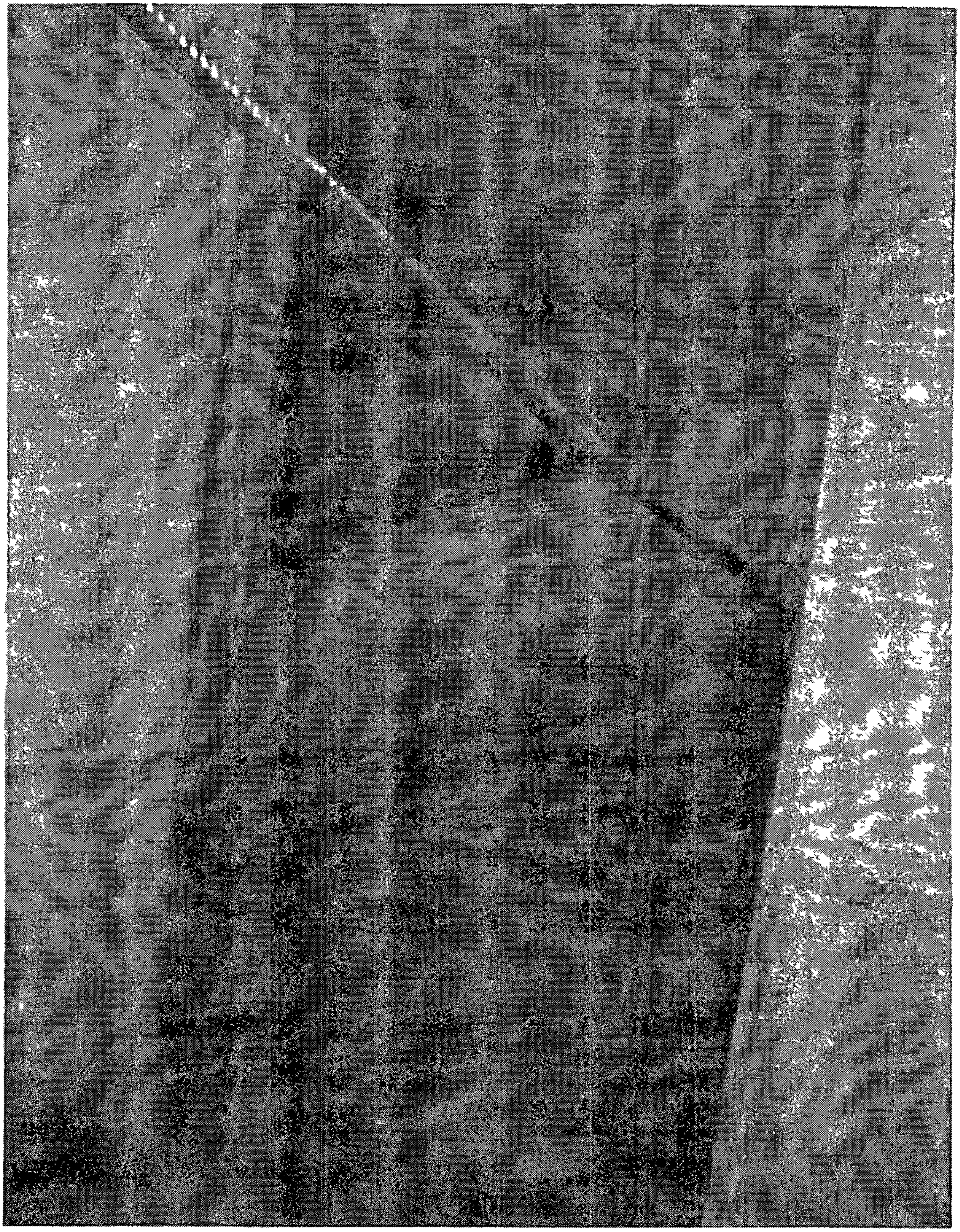

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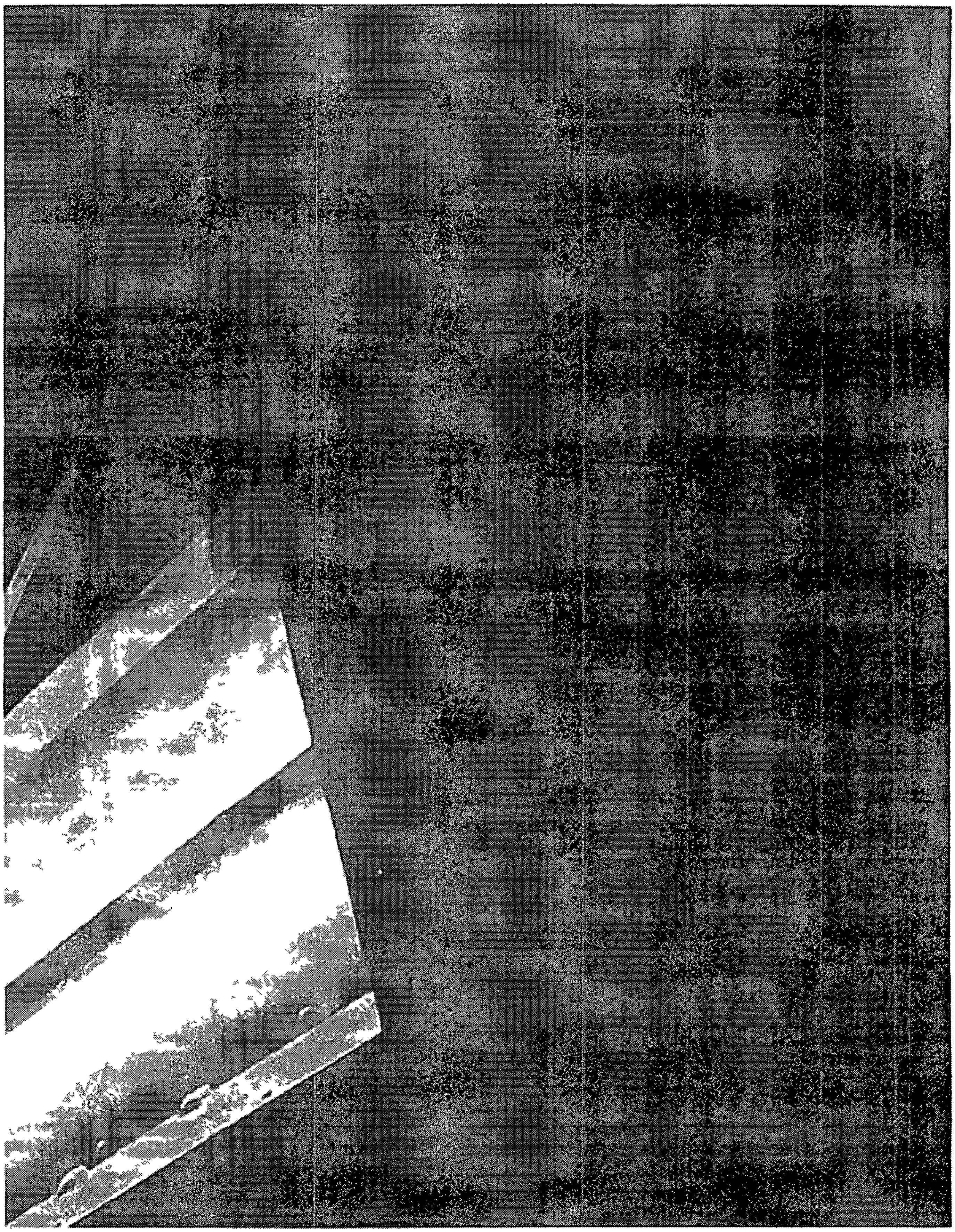

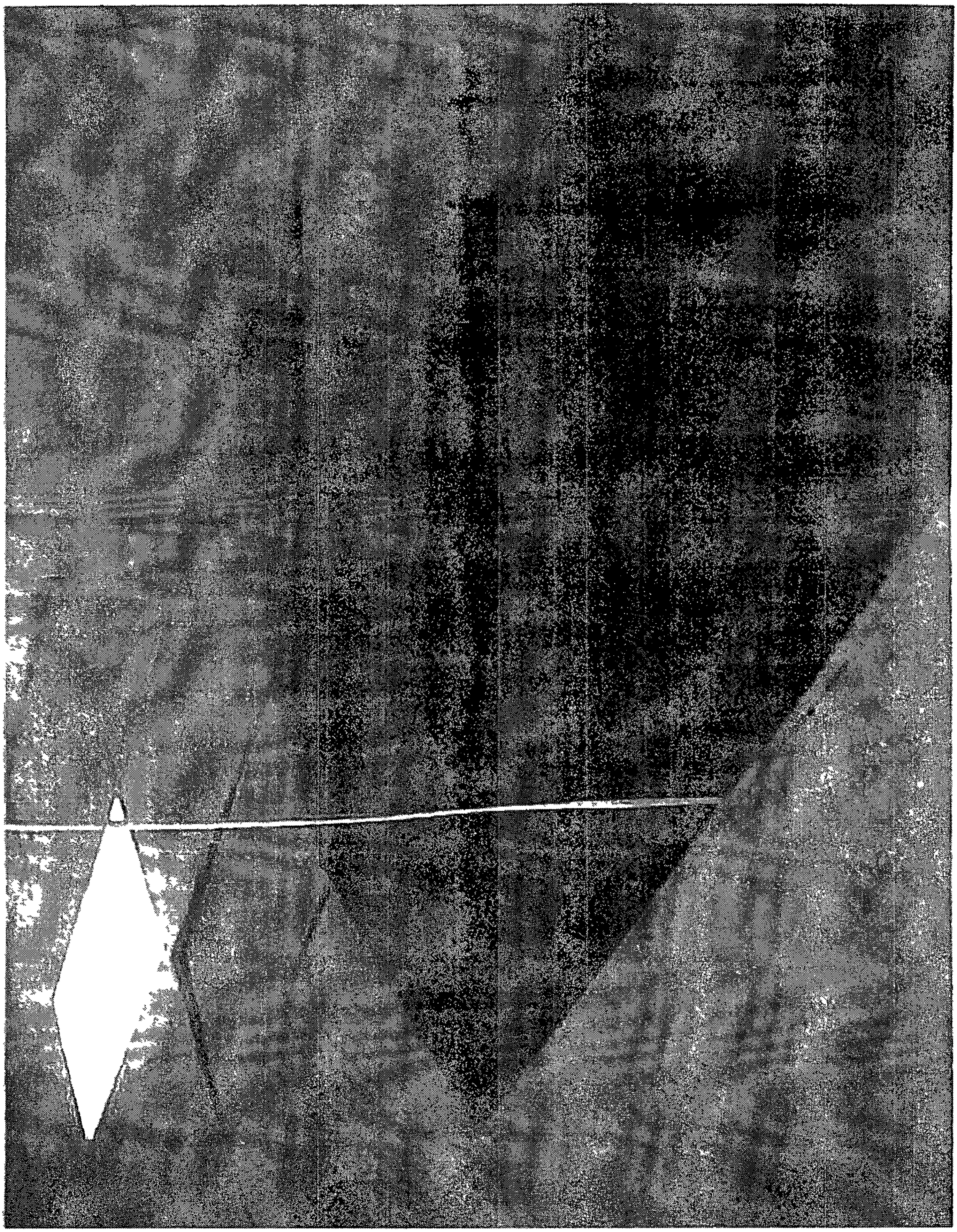

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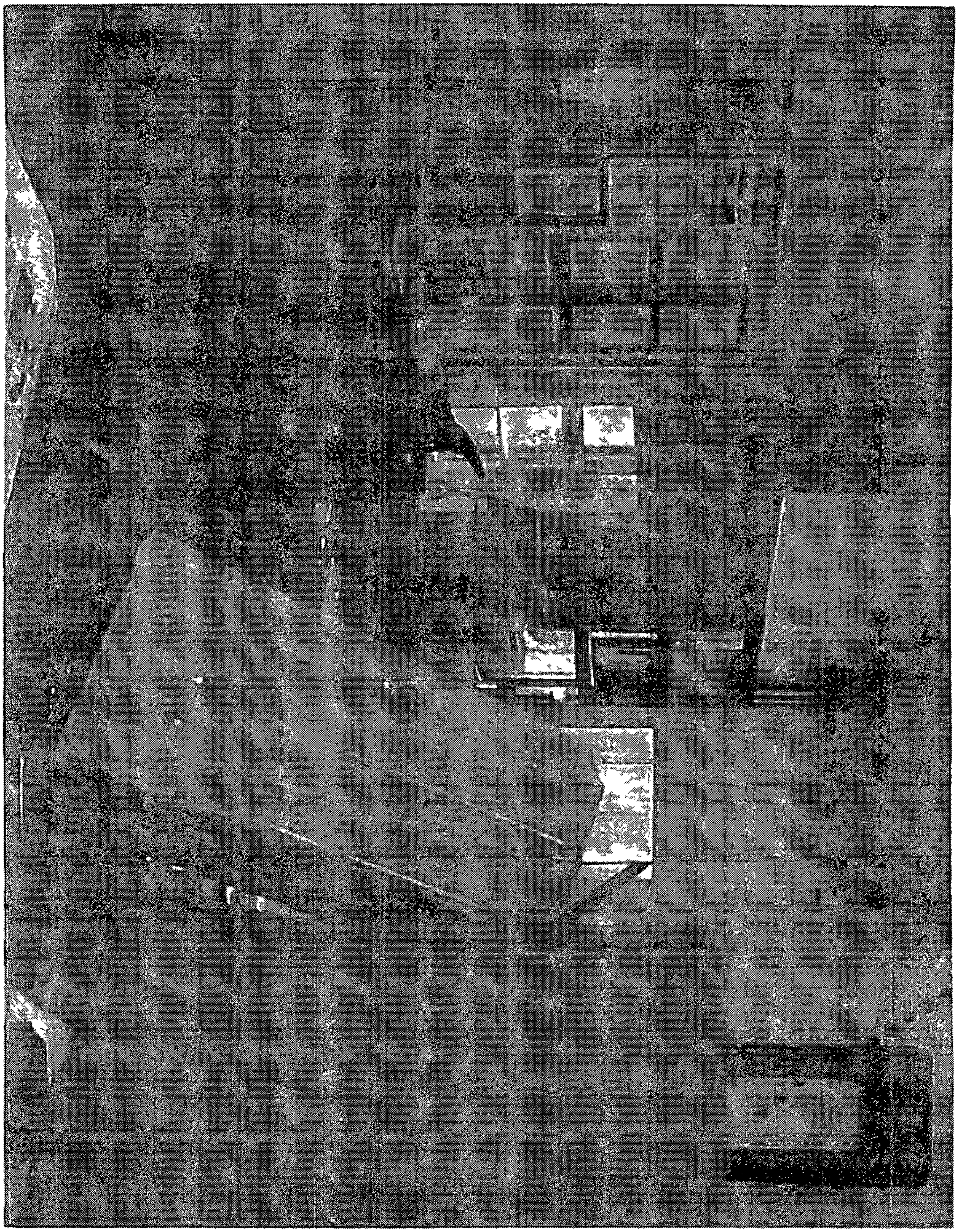

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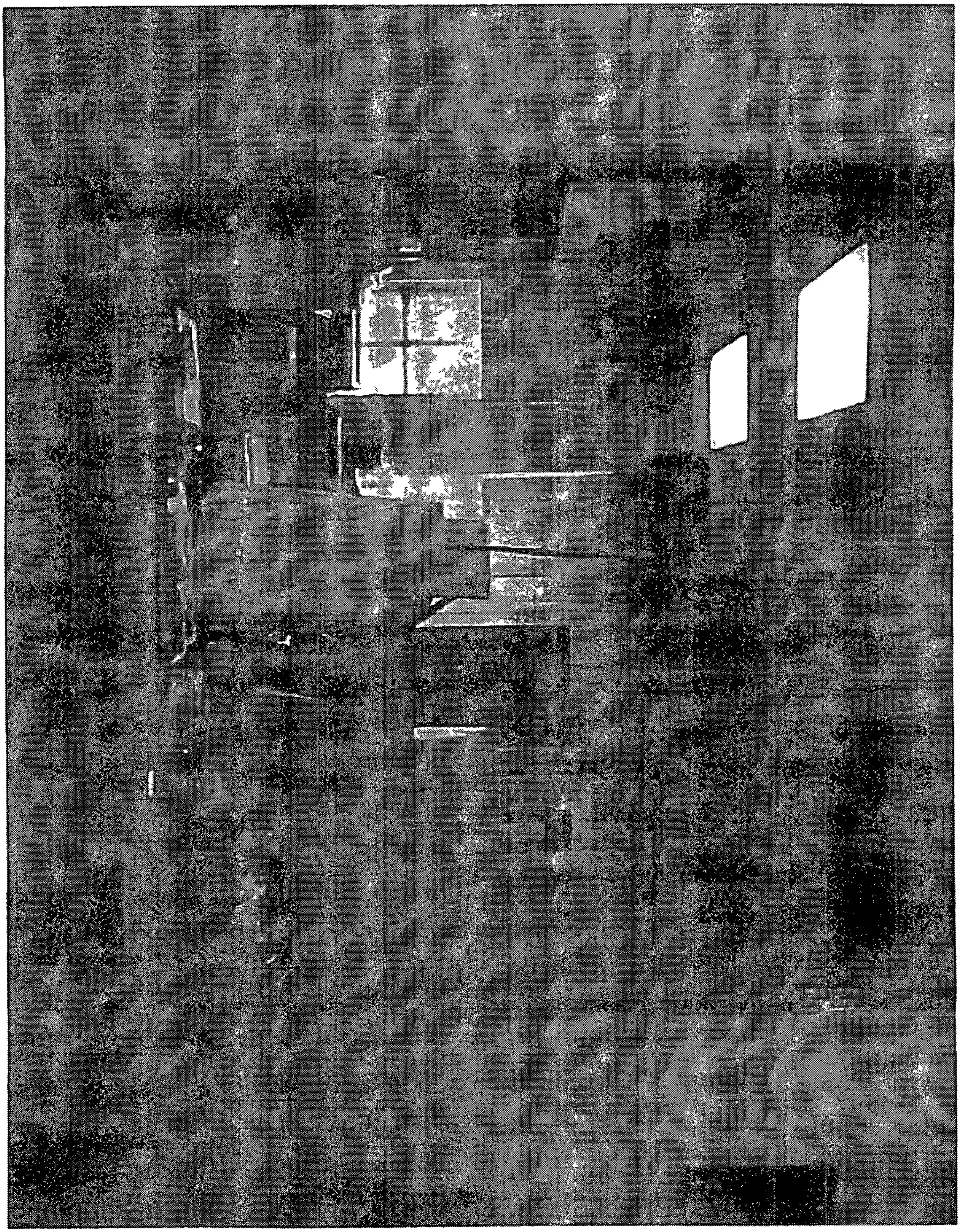

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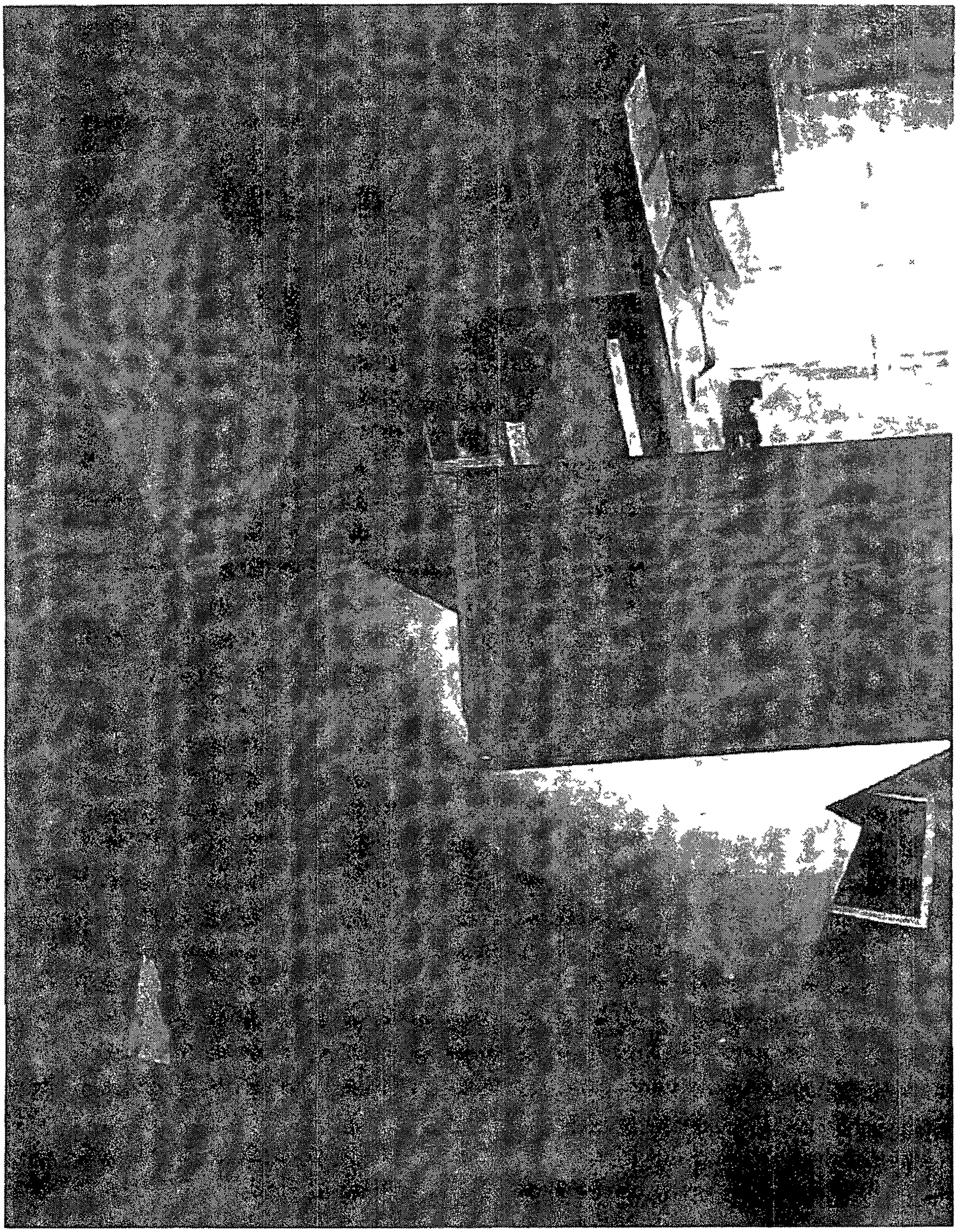

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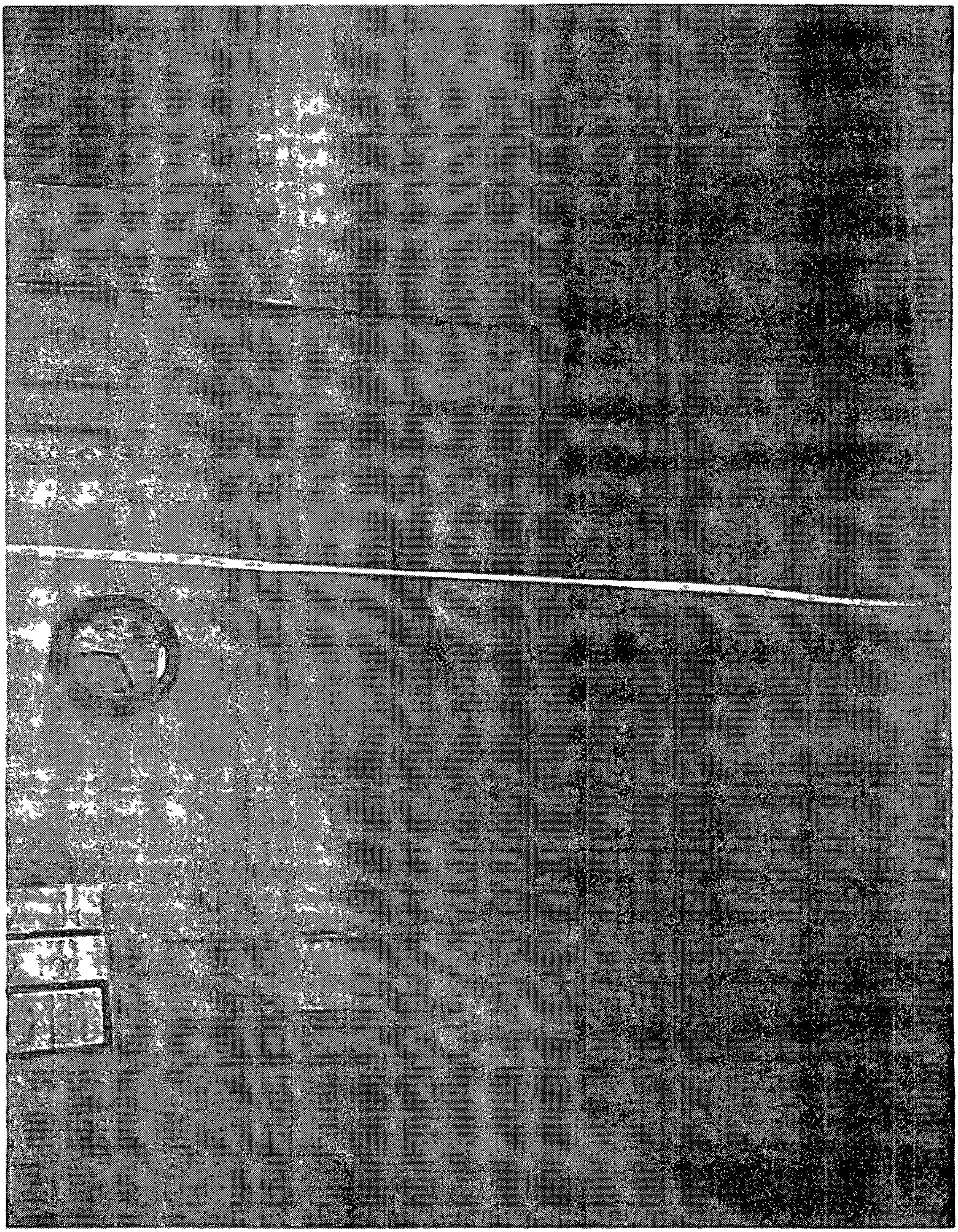

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2003-04 Inexperienced Teachers

Induction Teachers (including 5 PACE)

Long-Term Substitute Teachers

Teachers on ADEPT (did not meet goals)

Other Teachers on Full Evaluation

- –13 were induction in 2002-03
- –6 are new to district in 2003-04
- –4 are 2nd Annual
- –1 is 1st Annual

PACE Teachers (that are not also induction)

of 140 Total Teachers are Inexperienced

Per Pupil Expenditures
FY 2002

Fiscal Year 2002			
Total Expenditures	$	19 884 726 00	
Less TSOS & PSOS Capital Projects/Debt Service	$	(918 030 00)	
Total Net Expenditures	$	18 966 696 00	Includes ALL expenditures for the District
Divided by 135 ADM		1 822 35	Does not include 3 & 4 year olds (114 students)
2002 Per Pupil Expenditure	$	**10,404 00**	
PER PUPIL EXPENDITURES JUST GENERAL FUND	$	11 282 492 00	
Divided by 135 ADM		1 822 35	
2002 PER PUPIL EXP JUST GENERAL FUND	$	**6 191 18**	
AVERAGE TEACHER SALARY	$	**32 645 00**	
2002-03			

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Acknowledgements

South Carolina is able to continue the forward movement in mathematics as a result of the effort and dedication of those educators who served on the original writing team for the *South Carolina Mathematics Frameworks* and the *South Carolina Mathematics Curriculum Standards* For their hard work and dedication in making the first revisions to the *Mathematics Curriculum Standards*, a debt of gratitude is owed to the outstanding educators listed here

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Preface

A national mathematics panel, a panel of parents and business persons, and a state team reviewed the 1998 *South Carolina Mathematics Curriculum Standards* and made the recommendations that resulted in the *South Carolina Mathematics Curriculum Standards 2000* The standards in this document are aligned with those of the National Council of Teachers of Mathematics (NCTM) as they are enunciated in *Principles and Standards for School Mathematics*, a volume released in April 2000 The NCTM's Web site at <http //www NCTM org> provides a wealth of information and resources to support implementation of the South Carolina standards

The Content Standards, which describe the mathematical knowledge, skills, and conceptual understandings expected of students, are meant to serve two purposes they specify what should be taught and learned by all students in a grade, and they designate what should be assessed by South Carolina s teachers and by the State at each grade level The standards should direct the selection of instructional materials, professional development, and preservice education

The standards have been constructed to provide students with a comprehensive understanding of mathematics. Therefore, teachers are expected to teach all of the standards The Content Standards reflect "what" should be taught, learned, and assessed, the process standards explain how' teaching of the Content Standards should be accomplished The K–8 focus standards are indicated with an asterisk (*) and reflect critical areas of teaching, learning, and assessing within the K–8 Content Standards

The following explanation of the organization and format of the revised document is designed to assist the implementation of the standards

- There are five content strands adopted from NCTM s *Principles and Standards for School Mathematics* Those strands are number and operations, algebra, geometry, measurement, and data analysis and probability
- The standards organized by roman numerals are preK–12 unifying concepts taken directly from NCTM s *Principles and Standards for School Mathematics*
- The 'expectations' indicated by capital letters are grade band unifying concepts taken directly from NCTM s *Principles and Standards for School Mathematics* The four grade bands are preK–2, 3–5, 6–8, and 9–12

- South Carolina's Content Standards indicate what should be taught, learned, and assessed at the indicated grade level These Content Standards are listed by grade band in a table format to make it easy for educators to trace the progression of a standard from one grade to the next within the grade band (vertical articulation)

- Also included in the document are the Process Standards, which should be considered the "how" of teaching, learning, and assessing A graphic that depicts how the Process Standards should be woven throughout the Content Standards appears at the beginning of each grade band An explanation of each of the Process Standards is included on the back of the graphic

- The standards for grades 9–12 and end of-course standards are listed separately in the document. The end of-course standards include Algebra 1, Algebra 2, Geometry, Precalculus, and Probability and Statistics. The end of course standards contain all of the 9–12 standards as well as those standards that pertain to each individual course

- The standards for grades K–8 that are marked with an asterisk (*) should be considered as focus standards While all standards must be taught, focus standards provide guidance for teachers in determining content emphasis Due to the critical nature of the content, the focus standards should be emphasized in the planning and delivery of instruction

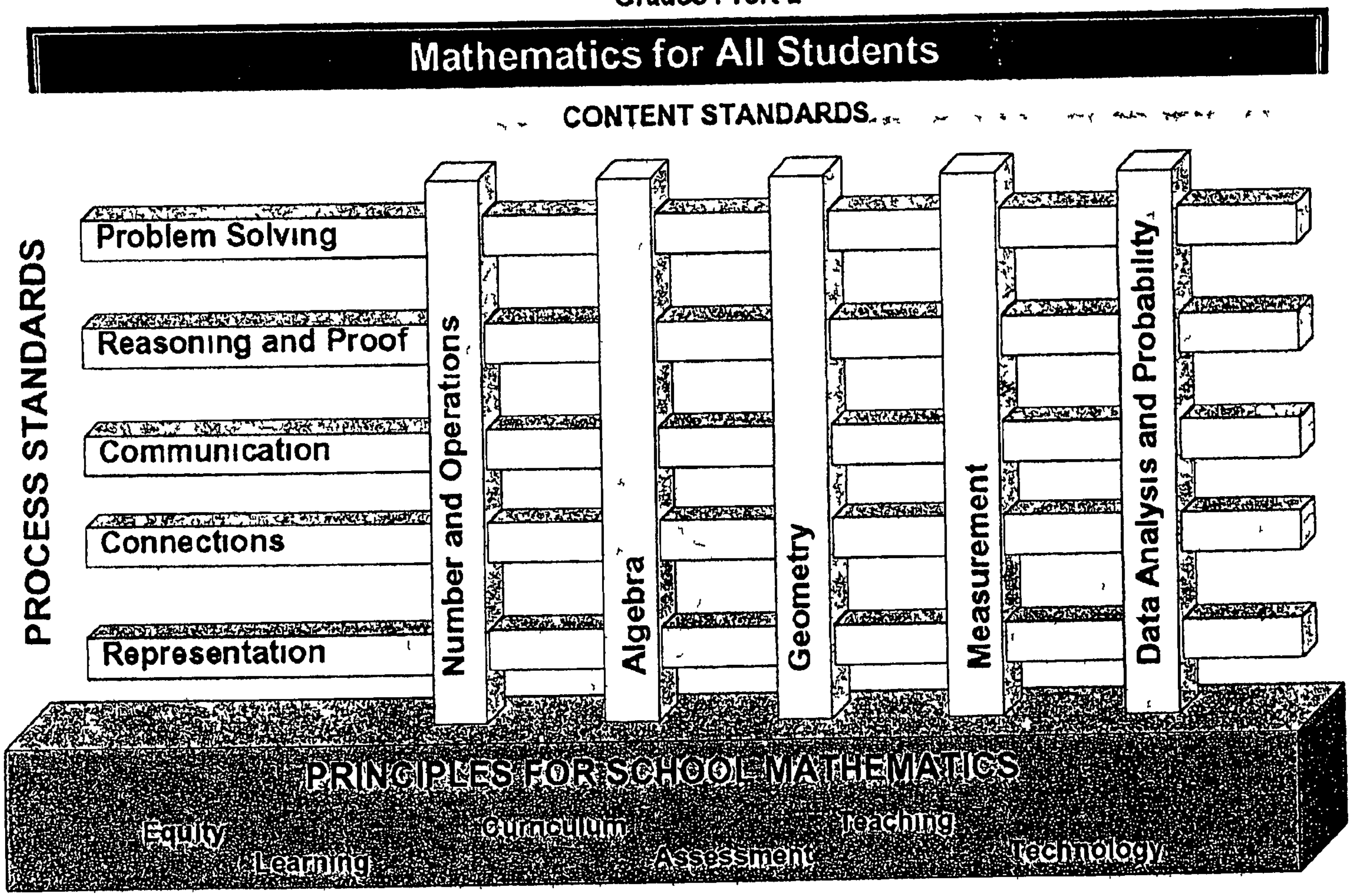
- The content of those standards for grades 9–12 that are marked with an asterisk (*) may be eligible for the Exit Examination For information concerning specific eligibility and opportunity to-learn relative to the Exit Examination, consult the latest edition of the mathematics blueprint developed by the Office of Assessment

- The course standards will serve as the basis for the end-of-course tests.

- Although these standards address the needs of all students, a section on adaptations of the mathematics standards has been included in this document The adaptations section reflects examples of essential real-world performance skills that were developed for students with unique needs and abilities The main goal of the adaptations is to move students toward independence (Independence may range from a level of self-care with assistance to total self sufficiency)

- A brief glossary of mathematical terms is included in the last section of the document to provide support on frequently questioned terminology

Grades PreK-2



As the above model reflects Principles describe particular features of a high-quality mathematics program and serve as the foundation for Content Standards and Process Standards Process Standards outline the methods through which students attain the mathematical knowledge, skills, and conceptual understandings set forth in the Content Standards

PROCESS STANDARDS EXPLANATIONS

The process standards provide the framework for teaching learning and assessing the content standards

Problem Solving Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• build new mathematical knowledge through problem solving • solve problems that arise in mathematics and in other contexts • apply and adapt a variety of appropriate strategies to solve problems and • monitor and reflect on the process of mathematical problem solving

Reasoning and Proof Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• recognize reasoning and proof as fundamental aspects of mathematics • make and investigate mathematical conjectures • develop and evaluate mathematical arguments and proofs and • select and use various types of reasoning and methods of proof

Communication Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• organize and consolidate their mathematical thinking through communication, • communicate their mathematical thinking coherently and clearly to peers, teachers and others • analyze and evaluate the mathematical thinking and strategies of others and • use the language of mathematics to express mathematical ideas precisely

Connections Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• recognize and use connections among mathematical ideas • understand how mathematical ideas interconnect and build on one another to produce a coherent whole and • recognize and apply mathematics in contexts outside of mathematics

Representation Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• create and use representations to organize record and communicate mathematical ideas • select apply and translate among mathematical representations to solve problems, and • use representations to model and interpret physical, social and mathematical phenomena

Grades PreK–2 Number and Operations

STANDARD I Understand numbers, ways of representing numbers, relationships among numbers, and number systems

EXPECTATION A Count with understanding and recognize "how many" in sets of objects

PreK	K	1	2
	*1 Given a set containing 10 or fewer concrete items, tell how many are in a set by counting the number of items orally using 1 1 correspondence	1 Given a set of 10 to 100 objects, tell how many items there are by using 1 1 correspondence	
	*2 Given a set of 10 or fewer concrete items, identify and describe one set as having more, fewer, or the same number of members as the other set		
	*3 Count forward to 20 and backward from 10		

EXPECTATION B Use multiple models to develop initial understandings of place value and the base-ten number system

PreK	K	1	2
		*1 Represent up to three-digit numerals using various concrete and pictorial models	1 Using a calculator, explain the patterns in the numeration system relating to place value in numerals up to four digits
		2 Identify the place value of each digit in a three-digit numeral	*2 Identify the place value of each digit in a four-digit numeral

EXPECTATION C Develop understanding of the relative position and magnitude of whole numbers and of ordinal and cardinal numbers and their connections

PreK	K	1	2
		1 Compare the magnitudes of three given quantities (a one digit numeral, a two-digit numeral, and a three-digit numeral)	
	1 Identify the positions first through tenth using an ordered set of objects	*2 Identify the positions first through twentieth, using an ordered set of objects	1 Name the positions first through thirtieth, using an ordered set of objects
1 Determine more than, less than, and equals based on counts using manipulatives (more, less, same number)		3 Describe pairs of numerals each less than 100 using the words *is greater than*, *is less than*, and *equals*	*2 Compare and write two whole numerals between 0 and 999, using symbols and words (>, <, =, *is greater than*, *is less than*, and *equals*)
		*4 Read whole numbers from a number line labeled from 0 to 180 (180 school days)	

EXPECTATION D Develop a sense of whole numbers and represent and use them in flexible ways, including relating, composing, and decomposing numbers

PreK	K	[illegible]	[illegible]
	1 Discuss and explain how numerals are used in the environment (e g , house numbers, phone numbers dates)	1 Construct representations of number combinations up to 10 (e g , number stories equations, pictures)	

EXPECTATION E Connect number words and numerals to the quantities they represent, using various physical models and representations

PreK	K	1	2
1 Distinguish one" from 'many	*1 Identify the numeral that matches a quantity (1–10)	*1 Write the numeral that corresponds to a given set up to 100	
		2 Write in words whole numbers through 10	1 Write in words whole numbers through 20
		*3 Identify odd and even numerals up to 100	

EXPECTATION F Understand and represent commonly used fractions, such as 1/4, 1/3, and 1/2

PreK	K	1	2
	1 Divide a set of objects into equal groups	*1, Identify and represent 1/4, 1/3, and 1/2 of a whole using concrete and pictorial models	1 Write the fractions that represent 1/4, 1/3, and 1/2 of a set or region.
			*2 Using models order 1/4, 1/3 and 1/2

STANDARD II Understand meanings of operations and how they relate to one another

EXPECTATION A Understand various meanings of addition and subtraction of whole numbers and the relationship between the two operations

PreK	K	1	2
	*1 Add and subtract whole numbers using up to ten concrete items	*1 Demonstrate concretely and symbolically the meaning of one-digit and two-digit addition and subtraction	1 Demonstrate the inverse relationship between addition and subtraction

EXPECTATION B Understand the effects of adding and subtracting whole numbers

PreK	K	1	2
	1 Relate the operation of addition to increase in quantity and subtraction to decrease in quantity		

EXPECTATION C Understand situations that entail multiplication and division, such as equal groupings of objects and sharing equally

PreK	K	1	2
			*1 Describe models of equal groupings (multiplication) as repeated addition and arrays
			*2 Describe models of sharing equally (division) as repeated subtraction and arrays

STANDARD III Compute fluently and make reasonable estimates

EXPECTATION A Develop and use strategies for whole-number computations, with a focus on addition and subtraction

PreK	K	1	2
		1 Explain and describe strategies for addition and subtraction	*1 Demonstrate the connection between the base-ten concepts and computational strategies
		*2 Solve story and picture problems using one-step solutions and basic addition facts with sums up to 18 and corresponding subtraction facts	*2 Solve addition and subtraction problems (two-step solutions) using data from simple charts and picture graphs

EXPECTATION B Develop fluency with basic number combinations for addition and subtraction

PreK	K	1	2
		*1 Recall basic addition facts with sums up to 18 and the corresponding subtraction facts	*1 Write addition and subtraction facts in numerical sentences
		*2 Add and subtract pairs of two-digit whole numbers without regrouping	*2 Add and subtract pairs of two-digit whole numbers with and without regrouping
			*3 Find missing addends and subtrahends in number combinations up to 20

EXPECTATION C Use a variety of methods and tools to compute, including objects, mental computation, estimation, paper and pencil, and calculators

		1 Estimate the number of objects in a set of from 5 to 20 objects	1 Given choices, select a reasonable estimate for a set of at most 1 000 objects
		2 Determine the most reasonable answer for an addition or subtraction problem	2 Justify the most reasonable answer for an addition and subtraction problem using paper and pencil and using a calculator
			3 Select the most efficient method to solve an addition or subtraction problem
			*4 Round numbers up to 90 to the nearest 10

Grades PreK–2 Algebra

STANDARD I Understand patterns, relations, and functions

EXPECTATION A Sort, classify, and order objects by size, number, and other properties

PreK	K	1	2
1 Recognize patterns in their environment by color, shape and size	1 Sort and classify objects by one attribute (size shape and color)	1 Sort and classify concrete objects according to one or more attributes including color size, shape, and thickness	
	2 Sort and classify objects by more than one attribute (size, shape, and color)		
2 Order three objects by size	3 Order objects by size quantity, and other properties	*2 Sequence random numerals between 1 and 100	1 Sequence random numerals between 1 and 1,000

EXPECTATION B Recognize, describe, and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate from one representation to another

PreK	K	1	2
1 Recognize a two-part pattern and extend.	*1 Identify, describe, and extend a repeating relationship (pattern) found in common objects, sounds, and movements	*1a Using symbols and objects, identify and create and extend a wide variety of patterns 1b Use letters to represent a created pattern (e g, ABC ABC)	1 Create, extend, and label a wide variety of patterns, orally and in writing, by using symbols and objects
	2 Construct two-part and three-part patterns	*2 Use numerical patterns to skip count by 2s 5s and 10s	*2 Skip count by any numeral (1–10) using mental mathematics, paper and pencil, hundreds charts, calculators, and concrete objects (starting at any numeral)

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EXPECTATION C Analyze how both repeating and growing patterns are generated

PreK	K	1	2
	1 Determine a rule for repeating and growing patterns	1 Create a repeating or growing pattern	1 Create and describe a general rule for a growing pattern and a repeating pattern, both orally and in writing
		2 Identify missing numerals and elements in a pattern or sequence	

STANDARD II Represent and analyze mathematical situations and structures using algebraic symbols

EXPECTATION A Illustrate general principles and properties of operations, such as commutativity, using specific numbers

PreK	K	1	2
	1 Using concrete materials, construct addition and subtraction models	*1 Identify inverse relationships between addition and subtraction facts (fact families)	

EXPECTATION B Use concrete, pictorial, and verbal representations to develop an understanding of invented and conventional symbolic notations

PreK	K	1	2
	*1 Use language such as *less than*, *more than*, or *the same number as* to describe the relative sizes of sets of concrete objects	*1 Recognize that the equals sign (=) indicates that the quantities on each side are equivalents	*1 Use symbolic notation to represent a statement of equality (__ + 2 = 5, 3 + 6 = __)

STANDARD III Use mathematical models to represent and understand quantitative relationships

EXPECTATION A Model situations that involve the addition and subtraction of whole numbers, using objects, pictures, and symbols

PreK	K	1	2
	*1 Combine two sets of objects and count the result.	1 Use concrete and pictorial models to develop an understanding of the concepts of addition and subtraction of whole numbers	*1 Use concrete and pictorial models to develop an understanding of the concepts of addition, subtraction, multiplication, and division with whole numbers
	2 Given a set of objects remove some and then count the result.		

STANDARD IV Analyze change in various contexts

EXPECTATION A Describe qualitative change, such as a student's growing taller

PreK	K	1	2
		1 Describe the change in one attribute over time	1 Compare and contrast the attribute changes over time in two or more qualities

EXPECTATION B Describe quantitative change, such as a student's growing two inches in one year

PreK	K	1	2
		1 Compare a wide variety of measurements over time (e.g. students heights, plant growth)	1 Compare and contrast the quantitative changes over time in two or more quantities

Grades PreK–2 Geometry

STANDARD I Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

EXPECTATION A Recognize, name, build, draw, compare, and sort two- and three-dimensional shapes

PreK	K	1	2
1 Identify name model and draw two-dimensional geometric shapes (circle, square, triangle, rectangle)	*1 Identify model and draw two-dimensional geometric shapes (circle, square, triangle, rectangle)	1 Describe and draw two-dimensional geometric shapes and match plane figures to the appropriate name (circle, square, triangle, rectangle)	1 Describe, model, and draw two-dimensional geometric shapes with up to eight sides
2 Investigate three-dimensional shapes in informal settings	2 Identify, sort, and classify two dimensional geometric shapes according to their attributes (size shape color)	*2 Recognize three-dimensional shapes (cube, cone, cylinder, sphere, rectangular prism)	2 Identify, name, model and draw two-dimensional geometric shapes with up to eight sides
3 Sort two-dimensional shapes according to attributes	3 Identify examples of three dimensional shapes seen in the environment (cube, sphere, cone, cylinder)	3 Sort two and three dimensional models given prescribed criteria	

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EXPECTATION B Describe attributes and parts of two- and three-dimensional shapes

PreK	K	1	2
	*1 Compare the size (larger/smaller) and shape of plane geometric figures (circles triangles, squares, rectangles)	*1 Classify concrete two- and three-dimensional objects according to one or more attributes including color, size shape, and thickness	*1- Compare and describe three-dimensional shapes according to the number and shape of faces, edges, bases, and corners (cube, rectangular solid, square pyramid)
	2 Locate two-dimensional shapes on parts of three-dimensional objects	2 Draw, describe, and order triangles squares, rectangles, and circles according to the number of sides, corners and square corners	*2 Compare and contrast plane and solid geometric shapes (circle/sphere, square/cube, triangle/pyramid, rectangle/rectangular solid)

EXPECTATION C Investigate and predict the results of putting together and taking apart two- and three-dimensional shapes

PreK	K	1	2
1 Investigate the results of combining and partitioning geometric shapes (square, rectangle, triangle, circle)	1 Combine and subdivide geometric shapes and discuss the results (square, rectangle triangle, circle)	1 Using manipulatives, combine and subdivide geometric shapes to create a new shape or design	1 Predict the results of combining and partitioning two- and three-dimensional geometric shapes

STANDARD II **Specify locations and describe spatial relationships using coordinate geometry and other representational systems**

EXPECTATION A **Describe, name, and interpret relative positions in space and apply ideas about relative position**

PreK	K	1	2
1 Use positional words to describe the location of objects (*up down, on off over under*)	*1 Use positional words to describe the location of objects (*near far up down below above, beside next to between, over, under*)	1 Apply a knowledge of relative position to objects in space through conversations, demonstrations, and stories	

EXPECTATION B **Describe, name, and interpret direction and distance in navigating space and apply ideas about direction and distance**

PreK	K	1	2
		1 Describe the direction from one object to another on a pictorial map using words such as *up, down, left,* and *right*	1 Compare distances between objects on a pictorial map using words such as *closer to* and *farther than*

EXPECTATION C **Find and name locations with simple relationships such as "near to" and in coordinate systems such as maps**

PreK	K	1	2
		*1 Identify locations on a pictorial map using the positional words *next to beside between* and *across*	*1 Identify locations on a pictorial map using the positional words *left, right, north, south, east,* and *west*

STANDARD III Apply transformations and use symmetry to analyze mathematical situations

EXPECTATION A Recognize and apply slides, flips, and turns

PreK	K	1	2
		1 Choose the figure that is the result of a transformation of a geometric shape (slide, flip, or turn)	1 Predict the results of and demonstrate transformations of geometric shapes, including slides, flips, and turns

EXPECTATION B Recognize and create shapes that have symmetry

PreK	K	1	2
	*1 Identify and describe shapes in the world that show symmetry across a line (nature art, the human body)	*1 Draw lines of symmetry through shapes to divide them into congruent shapes	*1 Using various concrete materials, create figures that are symmetrical across a line

STANDARD IV. Use visualization, spatial reasoning, and geometric modeling to solve problems

EXPECTATION A Create mental images of geometric shapes using spatial memory and spatial visualization

PreK	K	1	2
		1 Draw geometric objects based on a mental image	1 Create geometric objects based on mental images

EXPECTATION B Recognize and represent shapes from different perspectives

PreK	K	1	2
		1 Recognize geometric shapes in different positions	1 Describe congruent and similar shapes
		2 Find and identify geometric patterns in real-world settings (tile floors sidewalks art)	

EXPECTATION C Relate ideas in geometry to ideas in number and measurement

PreK	K	1	2
	1 Recall the configuration of dots on dominoes or name objects seen briefly	1 Reproduce collections of shapes and dot configurations after viewing them briefly	1 Analyze and predict the effect on the number of pieces used to form a geometric shape when various arrangements are formed using the same number of pieces
	2 Identify, describe and extend a repeating pattern found in common objects, numerals, sounds, and movements	2 Compare/contrast two different units of length used to measure the same object	2 Using square tiles, grid paper and unifix cubes, connect geometry to related concepts in measurement and number
	3 Compare the relative size of objects as bigger, smaller, or the same		

Grades PreK-2 Data Analysis and Probability

STANDARD I **Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them**

EXPECTATION A **Pose questions and gather data about themselves and their surroundings**

PreK	K	1	2
1 Collect data related to familiar experiences by counting	*1 Collect data related to familiar experiences	1 Pose and answer questions about charts and graphs relating to familiar experiences (e g , recording daily temperature, the lunch count, class attendance, and favorite flavors of ice cream)	1 Collect data using surveys

EXPECTATION B **Sort and classify objects according to their attributes and organize data about the objects**

PreK	K	1	2
1 Sort and classify by a single attribute (color, shape, size)	1 Compare, sort, and group objects by a given attribute	1 Compare sort, and group objects by observable attributes	*1 Collect, sort, and organize data

EXPECTATION C **Represent data using concrete objects, pictures, and graphs**

PreK	K	1	2
1 Draw a picture to represent data	*1 Display information by using object graphs, pictorial graphs, and tables	*1 Use organized data to construct picture, object, and bar graphs	*1 Use organized data to create charts, graphs, and tables

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1 Draw a picture to represent data	*1 Display information by using object graphs, pictorial graphs, and tables	*1 Use organized data to construct picture, object, and bar graphs	*1 Use organized data to create charts, graphs, and tables

STANDARD II Select and use appropriate statistical methods to analyze data.

EXPECTATION A Describe parts of the data and the set of data as a whole to determine what the data show

PreK	K	1	2
	*1 Interpret information on a graph	*1 Interpret information displayed in a picture graph, object graph, and bar graph using the vocabulary *more, less fewer greater than* and *less than*	1 Explain the trends of a data set (e g increasing, decreasing, random)

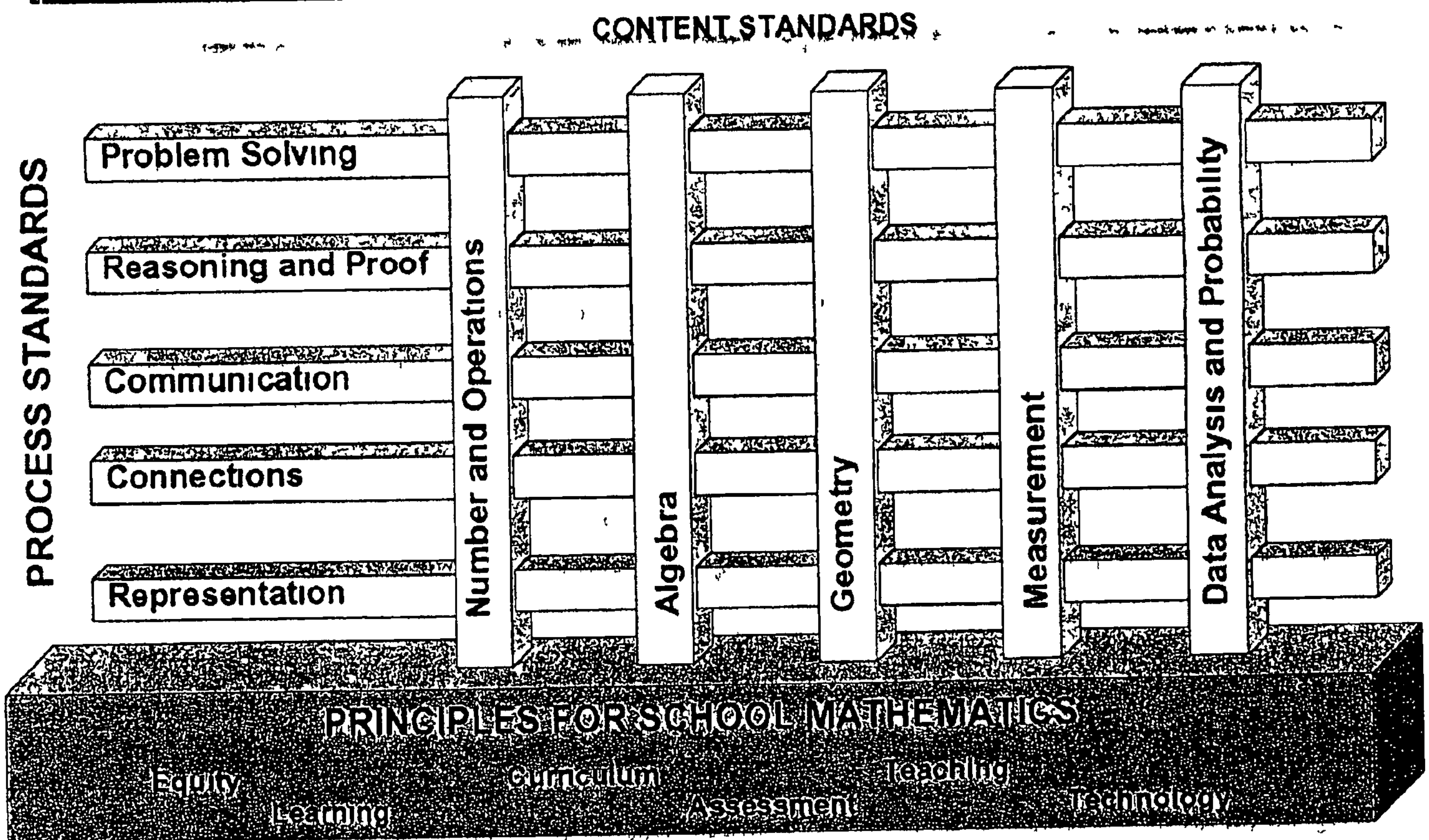
STANDARD III Develop and evaluate inferences and predictions that are based on data.

EXPECTATION A Discuss events related to students' experiences as likely or unlikely

PreK	K	1	2
		1 Identify an event as likely or unlikely to occur	*1 Describe events as more likely or less likely to occur

Grades 3-5

Mathematics for All Students



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Grades 3–5 Number and Operations

STANDARD I **Understand numbers, ways of representing numbers, relationships among numbers, and number systems**

EXPECTATION A **Understand the place-value structure of the base-ten number system and be able to represent and compare whole numbers and decimals**

3	4	5
*1 Explain the place value structure of whole numbers through hundred thousands	1 Explain the place value structure of whole numbers including periods (thousands, millions billions, etc.)	
2 Read and write whole numbers		
3 Compare whole numbers using symbols (>, <, =) and words (*is greater than is less than*, and *equals*)		
4 Identify the place value of decimals through hundredths using concrete and pictorial models		1 Describe the place value structure of decimals
5 Read and write decimals through hundredths based on concrete and pictorial models		2 Read and write decimals
6 Compare decimals (through hundredths) using symbols (>, < and =) and words (*is greater than, is less than*, and *equals*) with concrete and pictorial models	*2 Compare decimals (through hundredths) using symbols (>, <, and =) and words (*is greater than is less than*, and *equals*)	*3 Order lists of three or more numbers that contain whole numbers, decimals or both
7 Read and write amounts of money using the dollar sign ($) and decimal notation ( )		

EXPECTATION B Recognize equivalent representations for the same number and generate them by decomposing and composing numbers

*1 Recognize equivalent representations for the same whole number by decomposing and composing whole numbers up through three digits		
2 Write three-digit whole numbers in standard form, in expanded form, and in words	1 Write whole numbers in standard form, in expanded form, and in words	1 Write decimals (ten thousandths) in standard form, in expanded form, and in words

EXPECTATION C Develop understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers

3	4	5
*1 Describe fractional parts of a unit or a group of objects (1/100, 1/10, 1/8, 1/6, 1/5, 1/4, 1/3, and 1/2)	1 Describe fractional parts of collections of objects	1 Name and write mixed numbers and improper fractions shown in concrete and pictorial models
	2 Locate points on a number line corresponding to a unit fraction and its multiples between 0 and 1	2 Locate points on a number line corresponding to mixed numbers and improper fractions
		3 Explain the relationship between fractions and division

EXPECTATION D Use models, benchmarks, and equivalent forms to judge the size of fractions

	1 Relate the size of fractions to the benchmark fractions of 0, 1/2, and 1	1 Relate the size of fractions to the benchmark fractions 0, 1/4, 1/2, 3/4, and 1
	2 Compare concrete or pictorial models of fractions using the symbols >, <, and =	*2 Compare fractions using symbols (>, <, and =) and words (*is greater than*, *is less than*, and *equals*)

EXPECTATION E Recognize and generate equivalent forms of commonly used fractions, decimals, and percents

3	4	5
*1 Represent equivalent forms of commonly used fractions using concrete and pictorial models	1 Write equivalent forms of commonly used fractions	1 Represent fractions as decimals and percents using concrete and pictorial models
	2 Write equivalent forms of decimals.	*2 Identify equivalent relationships among fractions, decimals and percents such as 1/4 = .25 = 25% 1/3 = [redacted] = 33 1/3%, 2/5 = .40 = 40%, 1/2 = .50 = 50%, and 3/4 = .75 = 75%
	*3 Identify and represent common fraction-decimal equivalents	

EXPECTATION F Explore numbers less than 0 by extending the number line and through familiar applications

3	4	5
	1 Identify situations in which numbers less than 0 are used	1 Describe numbers less than 0 using real world models.

EXPECTATION G Describe classes of numbers according to characteristics such as the nature of their factors.

3	4	5
1 Describe and identify the characteristics of even and odd numbers by examining their divisibility by 2	*1 Determine the factors of a given number up to 50	1 Identify a number as prime, composite, or neither
		*2 Explain the characteristics of prime numbers and composite numbers
	*2 Determine common multiples of pairs of whole numbers each of which is less than or equal to 12	*3 Determine the least common multiple of two whole numbers

STANDARD II Understand meanings of operations and how they relate to one another

EXPECTATION A Understand various meanings of multiplication and division

3	4	5
*1 Describe the meaning of multiplication using concrete and pictorial models		*1 Solve problems using multiplication and division
*2 Describe the meaning of division using concrete and pictorial models	1 Explain the meaning of a remainder	

EXPECTATION B Understand the effects of multiplying and dividing whole numbers

3	4	5
	1 Explain the effect on the product when one of the factors is changed.	1 Describe and explain the effect on the product when both factors are changed
	2 Compare the size of the quotient to the dividend when dividing two whole numbers	2 Describe and explain the effect on the quotient when the divisor is changed.

EXPECTATION C Identify and use relationships between operations, such as division as the inverse of multiplication, to solve problems.

3	4	5
*1 Use the inverse relationships between addition and subtraction to solve problems	*1 Use the inverse relationships between multiplication and division to solve problems	*1 Describe the relationships among the four operations
		2 Solve multiplication problems such as rates and applications of the Fundamental Counting Principle

EXPECTATION D Understand and use properties of operations, such as the distributivity of multiplication over addition

[illegible]	[illegible]	[illegible]
1 Recognize commutativity in the addition facts	1 Recognize commutativity in the multiplication facts	
2 Use the associative property to add efficiently	*2 Use the associative and distributive properties to multiply efficiently	
	3 Apply divisibility rules for 2, 5, and 10	1 Apply the divisibility rules for 3, 6, and 9

STANDARD III Compute fluently and make reasonable estimates

EXPECTATION A Develop fluency with basic number combinations for multiplication and division and use these combinations to mentally compute related problems, such as 30 x 50

3	[illegible]	5
1 Recall multiplication and division facts through 9		
*2 Use basic number combinations to compute related problems in multiplication and division using multiples of 10 (e g using 3 x 5 to compute 30 x 5)	1 Use basic number combinations to compute related problems in multiplication and division using multiples of 100 and 1,000	

EXPECTATION B Develop fluency in adding, subtracting, multiplying, and dividing whole numbers

3	4	5
1 Compare and contrast different addition and subtraction algorithms to select the most efficient one for solving a given problem	*1 Construct and analyze algorithms for all operations on whole numbers	
2 Construct and analyze concrete models (rectangular arrays) for multiplication of one and two-digit numbers		1 Find the quotient and a remainder given a dividend of four digits or less and a divisor of two digits or less
*3 Demonstrate fluency in the use of both addition and subtraction algorithms and explain the steps involved	*2 Demonstrate fluency in the use of a multiplication algorithm and explain the steps involved.	*2 Demonstrate fluency in the use of a division algorithm and explain the steps involved.
		3 Explain computational strategies used to solve mathematical problem situations

EXPECTATION C Develop and use strategies to estimate the results of whole-number computations and to judge the reasonableness of such results

3	4	5
1 Round whole numbers to the nearest 10 100, and 1 000	1 Round whole numbers to the nearest 10,000, 100,000, and 1,000,000	
2 Estimate whole number sums and differences describe the method used, and determine the reasonableness of the results	*2 Estimate and determine the reasonableness of the product of whole numbers (one factor with two digits or less and the other factor with three digits or less)	1 Use estimation as a tool for judging the reasonableness of calculator, mental, and paper-and-pencil computations,
	3 Estimate the quotient of whole numbers with a one-digit divisor a two-digit divisor, and multiples of 10 and determine the reasonableness of results	*2 Apply a variety of computational estimation strategies to solve problems involving whole numbers
	4 Refine estimates using terms such as *closer to*, *between*, and *a little more than*	

EXPECTATION D Develop and use strategies to estimate computations involving fractions and decimals in situations relevant to students' experience

3	4	5
	1 Round decimals to the nearest tenth and hundredth	1 Round decimals to the nearest tenth, hundredth, and thousandth
	2 Develop and use strategies to estimate sum and difference of decimals	*2 Estimate the sum and difference of decimals through thousandths and determine the reasonableness of the results

EXPECTATION E Use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals

3	4	5
		*1 Add and subtract commonly used fractions using concrete models, pictorial models, and equivalent forms
		2 Multiply commonly used fractions (including decimals) using area models
		3 Relate connections between products of fractions and products of decimals using area models
	1 Add and subtract decimals through hundredths using concrete and pictorial models	*4 Add and subtract decimals through thousandths

EXPECTATION F Select appropriate methods and tools for computing with whole numbers from among mental computation, estimation, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tool.

3	4	5
*1 Select appropriate methods and tools and use the selected method or tool to solve addition and subtraction problems	*1 Explain why a particular method or tool may be the most appropriate one to use in solving a given problem	*1 Create and solve problems involving addition subtraction, multiplication and division of whole numbers using appropriate methods and tools.

Grades 3–5 Algebra

STANDARD I Understand patterns, relations, and functions

EXPECTATION A Describe, extend, and make generalizations about geometric and numeric patterns

3	4	5
1 Describe, create and extend numeric patterns with and without models and calculators	1 Using models and calculators, create, extend, and analyze numeric patterns (including decimal patterns through thousandths)	1 Using models and calculators, analyze and extend numeric and geometric patterns such as triangular numbers, perfect squares, and arithmetic sequences
		2 Find the missing elements in numeric and nonnumeric patterns

EXPECTATION B Represent and analyze patterns and functions, using words, tables, and graphs.

3	4	5
1 Determine the pattern to identify missing numbers in a sequence and in a table of number pairs	1 Describe and represent number relationships with tables	*1 Represent and analyze patterns and functions using words, tables and graphs
*2 Use pattern identification to solve problems	*2 Determine the rule to identify missing numbers in a sequence or a table	2 Analyze, describe, and use function rules to make generalizations

STANDARD II Represent and analyze mathematical situations and structures using algebraic symbols

EXPECTATION A Identify such properties as commutativity, associativity, and distributivity and use them to compute with whole numbers

For all three grade levels refer to these concepts in the "Number and Operations" strand.

EXPECTATION B Represent the idea of a variable as an unknown quantity using a letter or a symbol

3	4	5
1 Use concrete or pictorial models and symbols to represent missing addends or factors	1 Use variables to represent an unknown quantity using a letter or a symbol	1 Use variables to write a mathematical expression in symbolic form.

EXPECTATION C Express mathematical relationships using equations

3	4	5
*1 Use concrete or pictorial models and symbols to identify missing addends or factors in equations that express relationships between two quantities	*1 Use equations to represent relationships	*1 Use a variable to write an open sentence representing a given mathematical relationship

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STANDARD III Use mathematical models to represent and understand quantitative relationships

EXPECTATION A Model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions

3	4	5
*1 Use patterns and relationships in a variety of real world contexts		1 Use a single variable to create a problem situation based on a given open sentence

STANDARD IV Analyze change in various contexts

EXPECTATION A Investigate how a change in one variable relates to a change in a second variable

3	4	5
	1 Describe how a rate of growth varies over time	1 Describe the relationship among distance, speed, and time

EXPECTATION B Identify and describe situations with constant or varying rates of change and compare them

3	4	5
1 Identify real situations and events that show change	*1 Using charts and graphs, describe changes over time as increasing, decreasing, and varying.	1 Create charts and graphs to show change over time.
		2 Represent situations with number tables, graphs, and verbal descriptions
		*3 Associate tables, graphs, and stories of the same event.

STANDARD I **Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships**

EXPECTATION A **Identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes**

*1 Using appropriate vocabulary identify and describe attributes of polygons including triangles, quadrilaterals (rectangles, squares, other parallelograms, trapezoids), pentagons hexagons, and octagons	*1 Choose appropriate models of two- and three-dimensional shapes from descriptions of attributes	1 Using models and appropriate vocabulary compare and analyze attributes of polygons, attributes of polyhedra, and attributes of cones and cylinders
*2 Using appropriate vocabulary, describe properties of circles (center radius and diameter)		
*3 Using appropriate vocabulary identify and describe attributes of three-dimensional shapes including prisms, pyramids, spheres, cones, and cylinders		

EXPECTATION B **Classify two- and three-dimensional shapes according to their properties and develop definitions of classes of shapes such as triangles and pyramids**

	*1 Classify triangles by lengths of sides (scalene, isosceles and equilateral) and sizes of angles (acute, obtuse, and right)	*1 Using models and appropriate vocabulary classify quadrilaterals polyhedra, cones, and cylinders according to their attributes
1 Classify three-dimensional shapes according to their attributes		2 Develop definitions for classes of two and three-dimensional shapes

EXPECTATION C Investigate, describe, and reason about the results of subdividing, combining, and transforming shapes

1 Combine two-dimensional shapes to form new shapes and draw conclusions about area and fractional relationships	1 Subdivide two-dimensional shapes to form new shapes and draw conclusions about area and fractional relationships	

EXPECTATION D Explore congruence and similarity

3	4	5
*1 Compare two-dimensional shapes to determine if they exactly match (congruency)		*1 Compare two-dimensional shapes to determine if they are similar by transformations of magnifying or shrinking

EXPECTATION E Make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions

3	4	5
1 Using models, make and test conjectures about geometric properties and relationships and explain the conclusions	1 Using models and mathematical vocabulary, make and test conjectures about geometric properties and relationships and explain the conclusions	*1 Make and test conjectures about geometric properties and relationships and then develop logical arguments to justify the conclusions

STANDARD II Specify locations and describe spatial relationships using coordinate geometry and other representational systems

EXPECTATION A Describe location and movement using common language and geometric vocabulary

3	4	5
1 Give instructions (direction, distance, turns) for moving from one location to another	1 Describe location and movement using common language and geometric vocabulary and illustrate both with and without technology	

EXPECTATION B Make and use coordinate systems to specify locations and to describe paths

3	4	5
1 Specify locations on maps and grids using direction and distance	*1 Investigate possible paths from one point to another along vertical and horizontal grid lines	*1 Using ordered pairs of numbers, locate and name points in the first quadrant of a coordinate system
*2 Locate points corresponding to given whole numbers on a number line	2 Identify and name points on a coordinate grid using an ordered pair of whole numbers	

EXPECTATION C Find the distance between points along horizontal and vertical lines of a coordinate system

3	4	5
		*1 Find the distance between points in the first quadrant of a coordinate system along horizontal and vertical lines

STANDARD III Apply transformations and use symmetry to analyze mathematical situations

EXPECTATION A Predict and describe the results of sliding, flipping, and turning two-dimensional shapes

3	4	5
	1 Using models, describe the results of translations (slides), reflections (flips) and rotations (turns)	*1 Predict the results of geometric motion of shapes including combinations of translations (slides), reflections (flips) and rotations (turns)
	2 Using models and technology, create simple tessellations	

EXPECTATION B Describe a motion or a series of motions that will show that two shapes are congruent

3	4	5
1 Use slides flips and turns informally with models to determine whether or not two shapes are congruent	*1 Draw two-dimensional shapes that are related by translation (slide) or reflection (flip)	1 Describe series of motions that may be used to show that two shapes are congruent.
	2 Given a shape and its translation (slide) or reflection (flip) describe the motion that has been applied.	

EXPECTATION C Identify and describe line and rotational symmetry in two- and three-dimensional shapes and designs

3	4	5
*1 Identify and describe the line symmetry of two-dimensional shapes		*1 Determine whether given two-dimensional shapes and designs have rotational symmetry
		2 Investigate and describe symmetry and congruence of shapes drawn on a grid.

STANDARD IV Use visualization, spatial reasoning, and geometric modeling to solve problems

EXPECTATION A Build and draw geometric objects

3	4	5
*1 Create representations of points lines (intersecting, perpendicular, and parallel) line segments (including intersecting and parallel) rays, and angles in a plane	*1 Draw and label representations of points, lines, line segments rays, and angles, using mathematical notation	
*2 Build and draw two-dimensional geometric objects		*1 Build and draw three-dimensional objects

EXPECTATION B Create and describe mental images of objects, patterns, and paths

3	4	5
1 Identify two-dimensional shapes given a verbal description	*1 Write a description of a given three-dimensional object.	*1 Sketch the front, top, and side views of a model of a three-dimensional shape built with cubes.
2 Describe the path that results from following specific directions in moving from one location to another	2 Describe a path along grid lines from one point to another	
	3 Given a verbal description, draw two or three-dimensional objects	

EXPECTATION C Identify and build a three-dimensional object from two-dimensional representations of that object

3	4	5
1 Identify and build a cube from its two-dimensional representation (net)	*1 Identify and build rectangular prisms and cylinders from a given two-dimensional representation (net)	

EXPECTATION D Identify and build a two-dimensional representation of a three-dimensional object

3	4	5
1 Identify and build a two-dimensional representation (net) of a cube	1 Identify and build a two-dimensional representation (net) of a given rectangular prism	

EXPECTATION E Use geometric models to solve problems in other areas of mathematics, such as number and measurement.

For all three grade levels refer to these concepts in the "Number and Operations" and the "Measurement" strands

EXPECTATION F Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life

3	4	5
	1 Connect geometry to other areas of mathematics, to other disciplines, and to the world outside the classroom	

Grades 3–5 Measurement

STANDARD I **Understand measurable attributes of objects and the units, systems, and processes of measurement**

EXPECTATION A **Understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute**

3	[illegible]	5
1 Use a variety of objects to measure length (e g width height, perimeter), volume, weight/mass, and area (e g , cubes grid, paper, string, squares)	1 Apply counting procedures to estimate measurements of length, area, volume, and weight/mass	*1 Using models, investigate and describe the measure of circumference of a circle as length
*2 Compare the size of a given angle with a right angle (*greater than, less than* or *equal to*) and classify as obtuse acute or right	*2 Investigate and compare angle measures using models and manipulatives with angles of measure 45 degrees 90 degrees and 180 degrees	2 Identify, describe, and draw right, acute and obtuse angles
	*3 Using models, find the area of geometric shapes	3 Using models, create examples of polygons with a given area and explain
		*4 Using models, create examples of right prisms with a given volume and explain
*3 Develop strategies and determine perimeters of polygons		
4 Select appropriate units of measurement—length, weight/mass, and time—and explain the basis for the selection	4 Select units appropriate for the attributes being measured (length and area) and explain the basis for the selection	5 Select units appropriate for the attributes being measured (length, area, and volume) and explain the basis for the selection

EXPECTATION B Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems

1 Explain the need for measuring with standard units		
*2 Use metric and U.S customary units to measure length (inches feet, yards, centimeters, and meters), liquid volume (cups pints quarts, gallons and liters) temperature (degrees Fahrenheit, degrees Celsius) and weight/mass (ounces, pounds, grams, and kilograms)		

EXPECTATION C Carry out simple unit conversions, such as from centimeters to meters, within a system of measurement.

	*1 Convert units of measure within the metric system length (centimeters, meters, kilometers) mass (grams kilograms), and capacity (milliliters liters) and within the customary system length (inches, feet, yards) weight (ounces pounds) and liquid volume (cups, pints, quarts, gallons)	
	2 Convert units of time including days, hours, minutes, and seconds	

EXPECTATION D Understand that measurements are approximations and understand how differences in units affect precision

		1 Describe factors that affect precision such as the limitations of the measuring tool the scale on the measuring instrument, and the need for accuracy

EXPECTATION E Explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way

		1 Compare changes in area and changes in total perimeter when shapes are combined or subdivided.
		2 Construct models to demonstrate the effect of holding one variable constant while changing the value of another variable such as building rectangles with varying perimeters and constant areas

STANDARD II Apply appropriate techniques, tools, and formulas to determine measurements

EXPECTATION A Develop strategies for estimating the perimeters, areas, and volumes of irregular shapes

3	[illegible]	5
	1 Develop and describe strategies for estimating the area and perimeter of irregular shapes using manipulatives (e g , geoboards, square tiles, graphic representations)	1 Compare and evaluate different strategies for estimating area and perimeter of irregular shapes
		2 Develop and describe strategies for estimating volumes of irregular shapes

EXPECTATION B Select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles

1 Determine an appropriate measurement unit to measure time, length, weight, and volume (e g student chooses centimeters instead of meters to measure a pencil)	1 Estimate the distance to objects or places and determine the amounts of various units of time (minutes, hours, days weeks, etc) it will take to reach these objects or places	
*2 Select and use an appropriate tool to measure time (minutes or larger) length (centimeters, meters, inches, feet, yards), mass/weight (grams, kilograms ounces, pounds) and liquid volume (cups and fractional parts liters and fractional parts)	*2 Select and use an appropriate tool to measure liquid volume including pints and quarts	*1 Select and use appropriate tools and units to measure given items to an indicated precision (time in seconds through years, length in millimeters through kilometers, one-eighth of an inch through miles, liquid volume in milliliters through liters, ounces through gallons, mass/weight in milligrams through kilograms, ounces through pounds)
	3 Determine the amount of elapsed time in hours and minutes within a twelve hour period	*2 Determine an amount of elapsed time in hours, minutes, and seconds within a 24 hour period
	*4 Using analog and digital clocks, tell time to the nearest minute and to the nearest five minute interval, including use of A.M and P M	
		*3 Using a protractor, measure angles between 0 and 180 degrees inclusive
3 Read temperature to the nearest degree from a Celsius thermometer and from a Fahrenheit thermometer	5 Determine temperature changes during time intervals from a Celsius thermometer and a Fahrenheit thermometer	
4 Estimate the conversion of Celsius and Fahrenheit units relative to familiar situations (water freezes at 0° C and 32° F water boils at 100° C and 212° F, and normal body temperature is about 37° C and 98 6° F)		

EXPECTATION C Select and use benchmarks to estimate measurements

1 Develop a sense for measurement by using appropriate benchmarks (e g., the distance from the elbow to the index finger is about a foot, a paper clip is about a gram)		

EXPECTATION D Develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms

1 Use concrete and graphic models to find areas of common two-dimensional shapes	*1 Use concrete and graphic models to discover formulas for finding the area of common two-dimensional shapes	1 Investigate and solve problems involving area, using concrete, graphic or pictorial models to identify patterns and develop formulas for determining area
		*2 Describe and determine the area of rectangles and related triangles and parallelograms

EXPECTATION E Develop strategies to determine the surface areas and volumes of rectangular solids

		*1 Using models, develop and describe strategies for determining the volume and surface area of rectangular solids

Grades 3–5 Data Analysis and Probability

STANDARD I **Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them**

EXPECTATION A **Design investigations to address a question and consider how data-collection methods affect the nature of the data set**

3	4	5
1 Write questions about objects and events that can be investigated by collecting data	1 Develop strategies for administering a simple survey to obtain unbiased results	1 Compare data sets collected in different ways to address a given question and then determine how the methods of collection affected the data sets

EXPECTATION B **Collect data using observations, surveys, and experiments**

3	4	5
1 Collect data using observations	1 Systematically collect data using surveys	1 Collect data using observations, surveys, and experiments

EXPECTATION C **Represent data using tables and graphs such as line plots, bar graphs, and line graphs**

3	4	5
*1 Construct line (dot) plots for data sets	*1 Construct bar graphs for collected data sets with scale increments of one or greater	1 Determine appropriate horizontal and vertical scales for data sets and then how to represent zero on a graph
		*2 Construct and interpret tables and line graphs for data sets from applied situations
*2 Read and interpret information from tables, pictographs, bar graphs, and line (dot) plots	*2 Read and interpret information from tables, line graphs, and bar graphs	3 Explain what type of graph may be appropriate for a given data set

EXPECTATION D Recognize the differences in representing categorical and numerical data.

3	4	5
1 Define and give examples of categorical data	1 Describe types of graphs that may be used to represent categorical data	*1 Compare the types of graphs that may be used for categorical data with the types that may be used for numerical data
	2 Describe types of graphs that may be used to represent numerical data	

STANDARD II Select and use appropriate statistical methods to analyze data.

EXPECTATION A Describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed

3	4	5
1 Describe the shape of a line (dot) plot or bar graph of a numerical data set (i e where the data are concentrated, values for which there are no data, the range, and data points with unusual values)	1 Compare the shapes of graphs of two different numerical data sets that address the same question for different populations	*1 Describe the features of a data set, including measures of center range, and outliers

EXPECTATION B Use measures of center, focusing on the median, and understand what each does and does not indicate about the data set.

3	4	5
*1 Find the median and mode of a data set and explain what each indicates about the data set	1 Use the mode to describe a set of categorical data	*1 Find the mean, median, and mode of a numerical data set and explain what each indicates about the data set

EXPECTATION C Compare different representations of the same data and evaluate how well each representation shows important aspects of the data

1 Compare the tabular, line (dot) plot, and bar graph representations of a given data set and explain the benefits of each	1 Compare the line graph and bar graph representations of a given data set and explain the benefits of each	*1 Compare the different types of graphs (bar graph, line [dot] plot, line graph and pictograph) to represent a given data set and explain the benefits of each.

STANDARD III Develop and evaluate inferences and predictions that are based on data.

EXPECTATION A Propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions

1 Use line (dot) plots and bar graphs to make conjectures about populations based on data sets	*1 Use line graphs to make conjectures about populations based on data sets	1 Make and justify predictions based on data from a variety of applied situations
		2 Consider alternative explanations to the conjectures formed on the basis of presentations of data and then design further studies to test the conjectures

STANDARD IV Understand and apply basic concepts of probability

EXPECTATION A **Describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain, equally likely,* and *impossible***

*1 Identify common events as likely unlikely, certain, or impossible	1 Record the outcomes of a multiple stage event (e g tossing two coins) explain the method used, and determine whether the outcomes are equally likely	

EXPECTATION B **Predict the probability of outcomes of simple experiments and test the predictions**

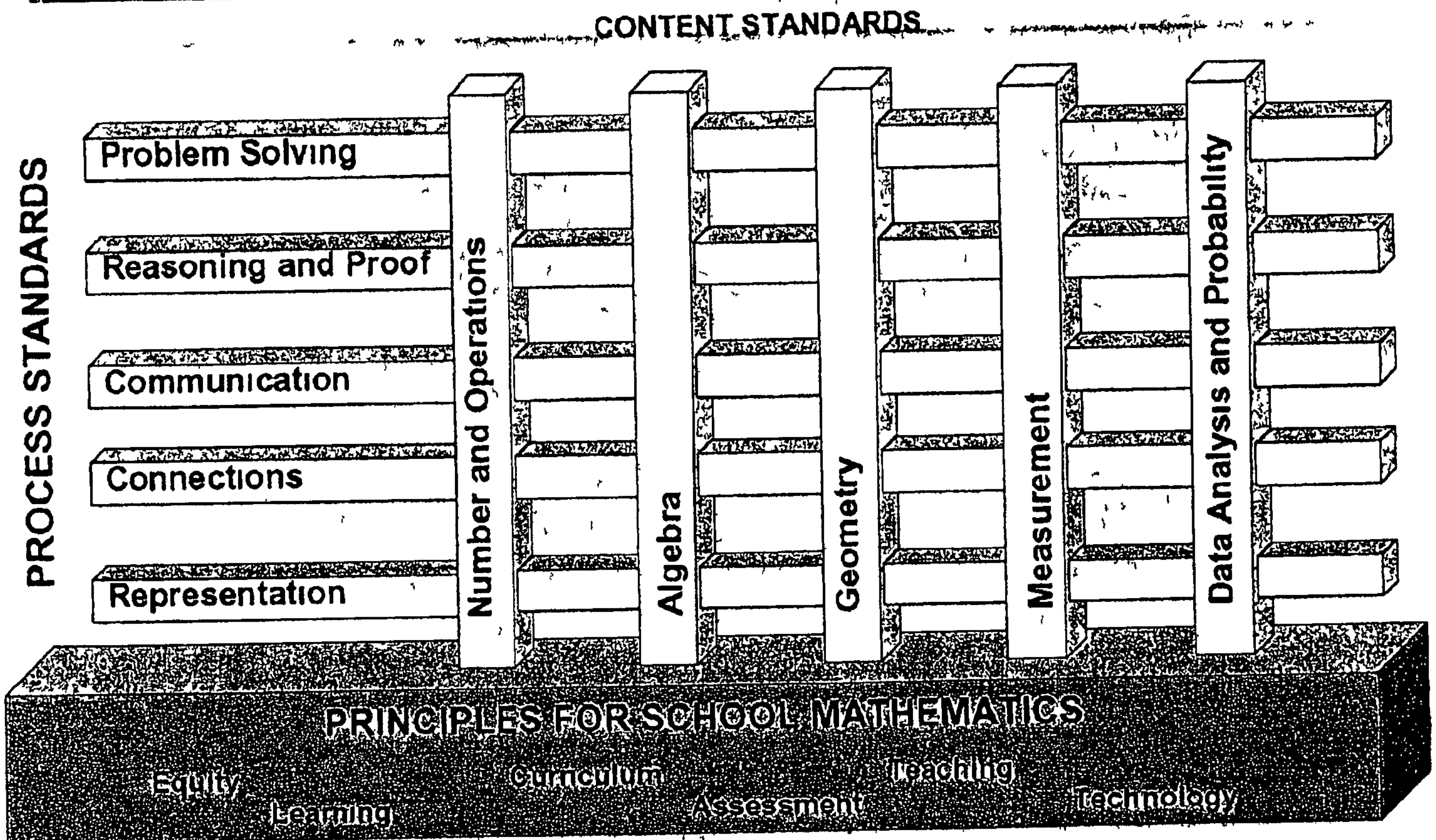
*1 Record the possible outcomes for a simple event (e g., tossing a coin) and systematically keep track of the outcomes when the event is repeated many times	1 Using models, determine the probability of a given simple event	*1 Determine the probability of a simple single-stage and a two-stage event
	2 Construct tree diagrams to list the possible outcomes for multiple-stage events (e g., tossing two coins)	2 Create a problem statement involving probability based on information from a given problem situation. (Students will not be required to solve the problem created.)

EXPECTATION C Understand that the measure of the likelihood of an event can be represented by a number from 0 to 1

	*1 Give examples of events for which the probability is a fraction between 0 and 1 inclusive and explain	1 Understand when the probability of an event is 0 or 1 and give examples in each case
		2 Explain why the sum of the probabilities of the outcomes of an experiment must equal 1

Grades 6-8

Mathematics for All Students



As the above model reflects, Principles describe particular features of a high-quality mathematics program and serve as the foundation for Content Standards and Process Standards Process Standards outline the methods through which students attain the mathematical knowledge, skills, and conceptual understandings set forth in the Content Standards

PROCESS STANDARDS EXPLANATIONS

The process standards provide the framework for teaching, learning and assessing the content standards

Problem Solving Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• build new mathematical knowledge through problem solving • solve problems that arise in mathematics and in other contexts • apply and adapt a variety of appropriate strategies to solve problems and • monitor and reflect on the process of mathematical problem solving

Reasoning and Proof Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• recognize reasoning and proof as fundamental aspects of mathematics • make and investigate mathematical conjectures, • develop and evaluate mathematical arguments and proofs and • select and use various types of reasoning and methods of proof

Communication Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• organize and consolidate their mathematical thinking through communication • communicate their mathematical thinking coherently and clearly to peers, teachers and others • analyze and evaluate the mathematical thinking and strategies of others, and • use the language of mathematics to express mathematical ideas precisely

Connections Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• recognize and use connections among mathematical ideas • understand how mathematical ideas interconnect and build on one another to produce a coherent whole, and • recognize and apply mathematics in contexts outside of mathematics

Representation Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• create and use representations to organize record and communicate mathematical ideas, • select apply and translate among mathematical representations to solve problems, and • use representations to model and interpret physical social and mathematical phenomena

Grades 6–8 Number and Operations

STANDARD I **Understand numbers, ways of representing numbers, relationships among numbers, and number systems.**

EXPECTATION A Work flexibly with fractions, decimals, and percents to solve problems

6	7	8
*1 Show the relationship among fractions, decimals, and percents	1 Write and use the appropriate equivalent forms of whole numbers, fractions, decimals, and percents	1 Solve real world problems involving fractions decimals, and percents

EXPECTATION B Compare and order fractions, decimals, and percents efficiently and find their approximate locations on a number line

6	7	8
1 Use order symbols to compare two fractions, two decimals, or two percents	1 Identify, represent, and find the approximate location of fractions, decimals, percents, and square roots of perfect squares on a number line and then justify the reasoning used.	1 Compare and order rational and irrational numbers and find their approximate locations on a number line
	2 Use order symbols to compare fractions, decimals, percents and square roots of perfect squares and then justify the reasoning used.	

EXPECTATION C Develop meaning for percents greater than 100 and less than 1

6	7	8
1 Use models to represent percents greater than 100 percent and solve problems involving them	1 Use models to represent percents less than 1 percent and solve problems involving them	1 Solve real world problems involving the use of percents greater than 100 percent or less than 1 percent.

EXPECTATION D Understand and use ratios and proportions to represent quantitative relationships

6	7	8
1 Connect the concept of ratio and fractions by determining the equivalence of two ratios	*1 Create and write ratios and proportions from applied situations and explain the reasoning used	

EXPECTATION E Develop an understanding of large numbers and recognize and appropriately use exponential, scientific, and calculator notation

6	7	8
1 Evaluate powers of ten up to 10^6	1 Translate to standard form a number written in exponential form, in scientific notation, and in calculator notation	1 Use scientific notation to write very large numbers and numbers less than one

EXPECTATION F Use factors, multiples, prime factorization, and relatively prime numbers to solve problems

6	7	8
1 Solve problems using prime factorization, common multiples, and common factors and then explain the reasoning used	1 Apply primes, composites, factors, multiples, and relatively prime numbers in a variety of applied and mathematical situations and explain the reasoning used	

EXPECTATION G Develop meaning for integers and represent and compare quantities with them

6	7	8
1 Use integers to describe real world phenomena in order to develop meanings for integers	1 Compare and order integers	

STANDARD II Understand meanings of operations and how they relate to one another

EXPECTATION A **Understand the meaning and effects of arithmetic operations with fractions, decimals, and integers**

6	7	8
1 Explain the meaning and effects of adding, subtracting, multiplying, and dividing	1 Explain the meaning and effects of arithmetic operations with integers	

EXPECTATION B **Use the associative and commutative properties of addition and multiplication and the distributive property of multiplication over addition to simplify computations with integers, fractions, and decimals**

6	7	8
1 Apply the commutative associative, and distributive properties to simplify computations with whole numbers, fractions, and decimals	1 Apply the associative, commutative, and distributive properties for operations on integers, fractions, and decimals	1 Apply the associative, commutative, and distributive properties to simplify expressions

EXPECTATION C **Understand and use the inverse relationships of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and solve problems.**

6	7	8
	1 Using models and numbers, explain the inverse relationships between squaring and finding square roots of perfect squares	
		1 Approximate to the nearest tenth the square root of a number that falls between two perfect squares

STANDARD III Compute fluently and make reasonable estimates

EXPECTATION A Select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods

6	7	8
1 Select appropriate methods and tools to solve problems requiring the addition and subtraction of fractions and decimals	1 Applying all operations to fractions, decimals, and integers, select appropriate methods and tools to solve problems	1 Select appropriate methods and tools to solve problems requiring the use of rational numbers

EXPECTATION B Develop and analyze algorithms for computing with fractions, decimals, and integers and develop fluency in their use

6	7	8
1 Using models divide commonly used fractions (including decimals)		
*2 Use models and numbers to develop and analyze algorithms with fractions and decimals	*1 Use models and numbers to develop and analyze the algorithms for computing with integers	
*3 Add, subtract, multiply and divide fractions (including decimals) to solve a variety of applied and mathematical problems	*2 Add, subtract, multiply and divide integers to solve a variety of applied and mathematical problems	*1 Compute with rational numbers to solve a variety of applied and mathematical problems

EXPECTATION **C** **Develop and use strategies to estimate the results of rational-number computations and judge the reasonableness of the results**

[illegible]	[illegible]	[illegible]
1 Estimate the sums and differences of fractions, describe the method used, and determine the reasonableness of results	1 Estimate the products and quotients of fractions and decimals describe the method used, and determine the reasonableness of results	
	2 Estimate the sums and differences of integers describe the method used, and determine the reasonableness of results	1 Justify the reasonableness of an estimate of rational number computations

EXPECTATION **D** **Develop, analyze, and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios**

[illegible]	[illegible]	[illegible]
	1 Explain the equivalent ratio method of solving problems involving proportions	*1 Analyze and explain each method for solving a proportion (equivalent ratios, unit rates, and cross multiplying)
		*2 Use proportional reasoning to solve applied problems and then justify the solution

Grades 6–8, Algebra

STANDARD I Understand patterns, relations, and functions.

EXPECTATION A Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules

6	7	8
*1 Describe, extend, and write rules for a wide variety of patterns	1 Describe, extend, analyze, and create a wide variety of patterns to investigate relationships and to solve problems	

EXPECTATION B Relate and compare different forms of representations for a relationship

6	7	8
	1 Use different forms of representing information (e g graphical, symbolic, tabular)	1 Describe the merits and limitations of graphical, symbolic, and tabular representations

EXPECTATION C Identify functions as linear or nonlinear and contrast their properties from tables, graphs, or equations

6	7	8
	1, Examine tables and graphs to determine if there is a constant rate of change between the quantities,	1 Examine tables, graphs, or simple equations to classify relationships as linear or nonlinear

STANDARD II Represent and analyze mathematical situations and structures using algebraic symbols

EXPECTATION A Develop an initial conceptual understanding of different uses of variables.

6	7	8
*1 Use order of operations to evaluate numerical expressions		*1 Evaluate simple algebraic expressions for given values of variables by using the substitution principle and the rules for order of operations
	1 Explain the use of a variable as a quantity that can change its value as a quantity on which other values depend, and as generalization of patterns	

EXPECTATION B Explore relationships between symbolic expressions and graphs of lines, paying particular attention to the meaning of intercept and slope

6	7	8
1 Write simple equations and inequalities accurately to represent relationships	1 Analyze quantitative changes by comparing and contrasting numerical patterns in tables with their respective graphs in the coordinate plane	
	2 State the coordinates of the x and y intercepts from a graph	
		1 Explain the impact of coefficients and constants on linear equations as they reflect simple applications

EXPECTATION C Use symbolic algebra to represent situations and to solve problems, especially those that involve linear relationships

	1 Use variables to describe numerical expressions and relationships	1 Write or model a linear equation to solve a simple applied problem

EXPECTATION D Recognize and generate equivalent forms for simple algebraic expressions and solve linear equations

		*1 Simplify a variety of algebraic expressions using properties of real numbers and rules for order of operations
1 Use commutative, associative and distributive properties to examine equivalence of a variety of simple algebraic expressions	1 Recognize and apply the additive and multiplicative inverses	
	2 Use models and numbers to solve one-step linear equations and inequalities in one variable.	*2 Using strategies that involve inverse operations, solve one- and two-step linear equations and inequalities in one variable.

STANDARD III. Use mathematical models to represent and understand quantitative relationships

EXPECTATION A. Model and solve contextualized problems using various representations, such as graphs, tables, and equations.

6	7	8
1 Use graphs and tables to solve applied problems	*1 Use graphs, tables, and equations to solve applied problems involving tips, discounts, sales tax, and simple interest.	*1 Use one or more representations to model and to analyze the relationship in applied problems to determine if it is linear or nonlinear

STANDARD IV. Analyze change in various contexts.

EXPECTATION A Use graphs to analyze the nature of changes in quantities in linear relationships

6	7	8
		1 Use tables and graphs to model and analyze linear relationships between variables
	1 From a graph, describe a linear relationship as positive or negative.	

Grades 6–8 Geometry

STANDARD I - **Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.**

EXPECTATION A **Precisely describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties**

6	[illegible]	8
	1 Classify polygons as regular or nonregular and investigate relationships between the number of diagonals and the number of sides of a regular polygon	
1 Compare and contrast prisms, cylinders, and pyramids with the polygons or circles that constitute their faces		1 Identify the necessary and sufficient properties that characterize quadrilaterals

EXPECTATION B **Understand relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects.**

6	[illegible]	8
1 Describe relationships among angles, side lengths, perimeters and areas of similar polygons	*1 Describe relationships between the edge lengths and the volume of similar prisms	*1 Describe how a change in the edge length affects the angle measures, perimeters, and areas of similar regular polygons

EXPECTATION C Create and critique inductive and deductive arguments concerning geometric ideas and relationships, such as congruence, similarity, and the Pythagorean relationship

1 Identify and describe point and line symmetry in two-dimensional shapes	*1 Compare and contrast attributes of similar figures and the attributes of congruent figures	1 Given the length of three segments determine and explain whether or not they can form a triangle.
2 Distinguish between similarity and congruence		2 Apply the Pythagorean relationship to determine if a triangle is a right triangle
		*3 Apply the Pythagorean theorem to find the missing length of a side of a right triangle

STANDARD II **Specify locations and describe spatial relationships using coordinate geometry and other representational systems**

EXPECTATION A Use coordinate geometry to represent and examine the properties of geometric shapes

1 Given the coordinates of three vertices of a rectangle or square oriented horizontally or vertically, use the first quadrant of the rectangular coordinate system to locate the other vertex	1 Identify and graph ordered pairs in the four quadrants of a coordinate plane	*1 Given the coordinates of a vertex and the length of adjacent sides of a polygon, use the rectangular coordinate system to locate other vertices of a square, rectangle, or right triangle

EXPECTATION B Use coordinate geometry to examine special geometric shapes, such as regular polygons or those with pairs of parallel or perpendicular sides

1 Plot the vertices of squares and rectangles and determine the relationship among the coordinates	*1 State relationships among the coordinates of the vertices of rectangles, squares, parallelograms, trapezoids, and rhombuses oriented horizontally	

STANDARD III. Apply transformations and use symmetry to analyze mathematical situations.

EXPECTATION A Describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling

1 Describe the transformation used to move a polygon from one location to another in the first quadrant	1 Describe the transformation used to move a polygon in one quadrant to another quadrant in the coordinate plane	1 Apply dilations and describe their results

EXPECTATION B Examine the congruence, similarity, and line or rotational symmetry of objects using transformations

*1 Apply a transformation to a polygon and describe how it has changed	1 Determine the type of symmetry (point or line) found in a reflection or a rotation	1 Determine the equivalence, if any, between multiple applications of one transformation and the application of a different transformation

STANDARD IV Use visualization, spatial reasoning, and geometry modeling to solve problems

EXPECTATION A Draw geometric objects with specified properties, such as side lengths or angle measures

6	7	8
1 Use symbols for parallel lines and perpendicular lines to describe polygons and figures where appropriate	*1 Draw two-dimensional objects from a geometric description and write a description of geometric properties for a given object.	1 Identify the congruent and supplementary relationships of the angles formed by parallel lines and a transversal

EXPECTATION B Use two-dimensional representations of three-dimensional objects to visualize and solve problems such as those involving surface area and volume

6	7	8
*1 Given the top, side, and front views, construct a three-dimensional model using cubes	1 Construct nets for three-dimensional figures	1 Use isometric drawings of three-dimensional figures to build the model with cubes
	2 Compare and contrast the number of faces, vertices, and edges of three-dimensional figures	*2 Determine the changes in volume and surface area of three-dimensional figures that can be built with cubes when one or more measurements are changed.

EXPECTATION C Use visual tools such as networks to represent and solve problems

6	7	8
	1 Given a network with up to six vertices, determine the number of paths.	1 Construct a network to solve a problem situation

EXPECTATION D Use geometric models to represent and explain numerical and algebraic relationships.

6	7	8
		1 Use an area model to analyze probability

EXPECTATION E Recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life

1 Identify and apply geometric concepts in a variety of practical contexts	1 Identify transformations in tessellations, use transformations to draw tessellations, and describe relationships among figures that tessellate	1 Identify applications of transformations such as tiling, fabric design, art, and scaling

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Grades 6–8 Measurement

STANDARD I **Understand measurable attributes of objects and the units, systems, and processes of measurement**

EXPECTATION A **Understand both metric and customary systems of measurement**

6	7	8
	1 Explain the relationship between the metric system and the base ten number system	

EXPECTATION B **Understand relationships among units and convert from one unit to another within the same system**

6	7	8
	1 Compare and convert units of measure for length, weight/mass, and volume within the U S customary system and the metric system	1 Use dimensional analysis to convert from one unit to another
	2 Add and subtract mixed units of measure and express answers in appropriate form	

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EXPECTATION C Understand, select, and use units of appropriate size and type to measure angles, perimeter, area, surface area, and volume

1 Estimate angle measure using 45 degrees, 90 degrees, 180 degrees 270 degrees and 360 degrees as referents and use the appropriate tools to measure any angle		
2 Use appropriate units of measure to label angles, perimeter, and area	1 Use appropriate units of measure to label surface area and volume.	

STANDARD II Apply appropriate techniques, tools, and formulas to determine measurements.

EXPECTATION A Use common benchmarks to select appropriate methods for estimating measurements

*1 Using standard and nonstandard units of measure, estimate and then determine length, weight/mass, area, and volume/capacity	1 Use appropriate methods to approximate the surface area and volume of irregular figures.	
2 Estimate and justify estimates of perimeter and area of irregular shapes		

EXPECTATION B Select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision

1 Select and use appropriate tools and units to measure to the degree of accuracy required in a particular situation	1 Analyze a variety of measurement situations to determine the necessary degree of accuracy and precision	

EXPECTATION C Develop and use formulas to determine the circumference of circles and the area of triangles, parallelograms, trapezoids, and circles and develop strategies to find the area of more-complex shapes

6	7	8
1 Investigate and describe the relationship between areas of rectangles and triangles or other quadrilaterals	1 Use measurements and formulas to solve real-world and mathematical problems	*1 Find the area of irregular shapes
*2 Develop and apply the formulas for the area of triangles and parallelograms	2 Using concrete materials or computer models derive approximations for pi from measurements for circumference and diameter	2 Find the area of a trapezoid using the formula
	*3 Create and solve problems by finding the circumference and/or area of a circle when given the diameter or radius	

EXPECTATION D Develop strategies to determine the surface area and volume of selected prisms, pyramids, and cylinders

6	7	8
	*1 Investigate and describe the relationship between the area of the base and the volume of a prism, pyramid, and cylinder	1 Investigate and describe the relationship between the area of the faces and the surface area of prisms, pyramids, and cylinders

EXPECTATION E Solve problems involving scale factors, using ratio and proportion

6	7	8
1 Use a scale to find distance		
		*1 Use the properties of similar figures to determine the length of a missing side
	*1 Determine the unit rate	

EXPECTATION F Solve simple problems involving rates and derived measurements for such attributes as velocity and density

	1 Apply rates to solve problems in real world situations	1 Use measurements and formulas to solve real-world and mathematical problems

Grades 6–8 Data Analysis and Probability

STANDARD **I** **Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them**

EXPECTATION **A** **Formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population**

6	7	8
1 Given a problem situation involving one population, collect, analyze and interpret data	1 Given a problem situation involving two populations, collect, analyze, and interpret data	

EXPECTATION **B** **Select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots**

6	7	8
1 Organize and display data in a variety of ways including frequency tables, histograms, and stem-and leaf plots	1 Organize, display, and interpret data in a variety of ways including box-and-whisker plots	1 Use a matrix to organize and describe data.
	2 Construct circle graphs and interpret the meaning	2 Create and use a scatterplot and estimate its line of fit
		3 Explain what type of graph would be appropriate for a given data set.

STANDARD II Select and use appropriate statistical methods to analyze data

EXPECTATION A Find, use, and interpret measures of center and spread, including mean and interquartile range

6	7	8
1 Create and solve problems involving the mean, median, mode and range of a set of data	1 Compute, describe, and interpret the interquartile range	1 Determine which measure of center is the most appropriate for a given situation and explain the reasoning used.

EXPECTATION B Discuss and understand the correspondence between data sets and their graphical representations, especially histograms, stem-and-leaf plots, box plots, and scatterplots

6	7	8
1 Interpret histograms and stem-and-leaf plots	*1 Describe the relationship between a data set and its corresponding box plot or circle graph	
*2 Describe the relationship between a data set and its corresponding histogram or stem and-leaf plot.		1 Explain how different graphical representations of data can bias the interpretation of these data

STANDARD III Develop and evaluate inferences and predictions that are based on data.

EXPECTATION A Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken

6	7	8
1 Analyze and list the differences between two data sets	1 Make inferences and predictions based on the analysis of sample data	

EXPECTATION B Make conjectures about possible relationships between two characteristics of a sample on the basis of scatterplots of the data and approximate lines of fit

		*1 Use a scatterplot and its line of fit to determine if a positive relationship a negative relationship or no relationship exists between two sets of data and then use them to make predictions

EXPECTATION C Use conjectures to formulate new questions and plan new studies to answer them

		1 Formulate a hypothesis and then design and carry out an experiment to test it.
		2 Formulate new areas of investigation based on the results of prior experiments

STANDARD IV Understand and apply basic concepts of probability

EXPECTATION A Understand and use appropriate terminology to describe complementary and mutually exclusive events

1 Identify and describe complementary events	1 Identify and describe mutually exclusive events	

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EXPECTATION B Use proportionality and a basic understanding of probability to make and test conjectures about the results of experiments and simulations

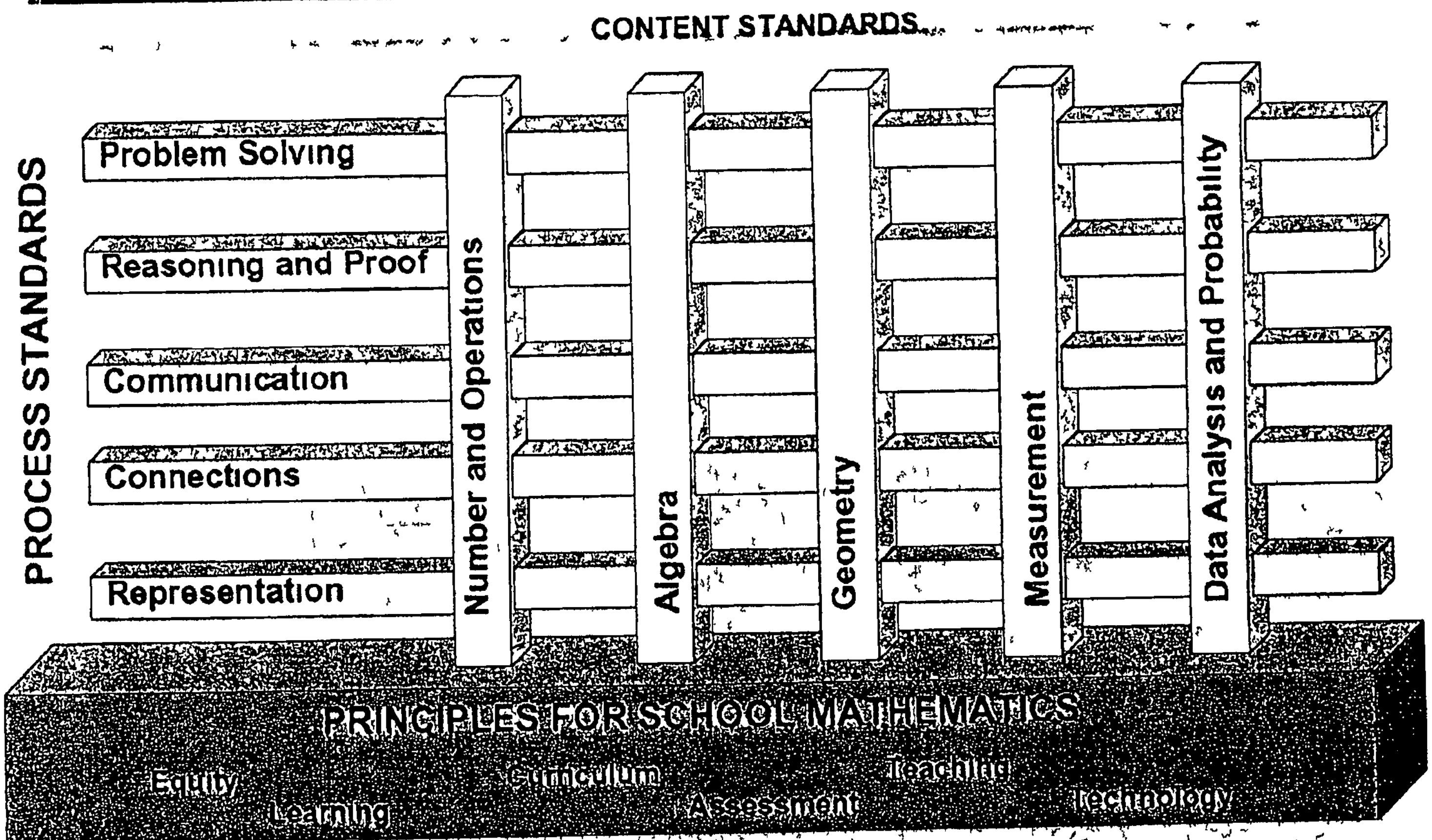
[illegible]	[illegible]	[illegible]
1 Create a sample space for one or two-stage events and represent it in the form of a list, chart, picture, or tree diagram	1 Investigate and describe the difference between the probability of an event found through simulation and the theoretical probability of that same event.	1 Make inferences and convincing arguments based on analysis of theoretical or experimental probability
*2 From a given sample space determine, and interpret the probability of an event.		

EXPECTATION C Compute probabilities for simple compound events, using such methods as organized lists, tree diagrams, and area models

6	7	8
1 Making a tree diagram or using models, determine the number of possible outcomes in two-stage events	1 Using the fundamental counting principle or other techniques determine the number of possible outcomes in a multistage event.	
	*2 Compute the probability of two independent events	*1 Compute the probability of two dependent events
		2 Determine the odds of a given event.

Grades 9-12

Mathematics for All Students



As the above model reflects, Principles describe particular features of a high quality mathematics program and serve as the foundation for Content Standards and Process Standards. Process Standards outline the methods through which students attain the mathematical knowledge, skills, and conceptual understandings set forth in the Content Standards

PROCESS STANDARDS EXPLANATIONS

The process standards provide the framework for teaching, learning, and assessing the content standards

Problem Solving Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• build new mathematical knowledge through problem solving • solve problems that arise in mathematics and in other contexts, • apply and adapt a variety of appropriate strategies to solve problems and • monitor and reflect on the process of mathematical problem solving

Reasoning and Proof Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• recognize reasoning and proof as fundamental aspects of mathematics • make and investigate mathematical conjectures • develop and evaluate mathematical arguments and proofs and • select and use various types of reasoning and methods of proof

Communication Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• organize and consolidate their mathematical thinking through communication • communicate their mathematical thinking coherently and clearly to peers, teachers and others • analyze and evaluate the mathematical thinking and strategies of others and • use the language of mathematics to express mathematical ideas precisely

Connections Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• recognize and use connections among mathematical ideas • understand how mathematical ideas interconnect and build on one another to produce a coherent whole' and • recognize and apply mathematics in contexts outside of mathematics

Representation Standard

Instructional programs from prekindergarten through grade 12 should enable all students to accomplish the following	• create and use representations to organize record and communicate mathematical ideas • select, apply and translate among mathematical representations to solve problems and • use representations to model and interpret physical social and mathematical phenomena

Grades 9–12 Number and Operations

STANDARD I Understand numbers, ways of representing numbers, relationships among numbers, and number systems

EXPECTATION A Develop a deeper understanding of very large and very small numbers and of various representations of them

1 Read, write, and represent very large and very small numbers in a variety of forms including exponential and radical

EXPECTATION B Compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions

1 Identify the kinds of equations that can and cannot be solved in each subset of the complex number system

EXPECTATION C Understand vectors and matrices as systems that have some of the properties of the real number system

1 Use vectors to represent situations that involve both magnitude and direction, such as force, displacement, velocity, and acceleration.
2 Identify and use properties related to operations with matrices to justify the steps in solving problems that arise from applications

EXPECTATION D. Use number-theory arguments to justify relationships involving whole numbers

*1 Use the commutative, associative distributive, equality and identity properties to justify the steps in solving equations and inequalities
*2 Use symbolic representation reasoning, and proof to verify statements about numbers

STANDARD II Understand meanings of operations and how they relate to one another

EXPECTATION A Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities

*1 Recognize and justify the relationship between the magnitude of a number and the application of specific arithmetic operations

EXPECTATION B Develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices

*1 Organize data and perform operations of addition, subtraction and scalar multiplication to solve problems using matrices

EXPECTATION C Develop an understanding of permutations and combinations as counting techniques

1 Determine the relationship between counting when order matters and when order does not matter

STANDARD III Compute fluently and make reasonable estimates.

EXPECTATION A Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more complicated cases

1 Given a problem situation, determine whether to use a rough estimate, an approximation, or an exact answer Select a suitable method of computing from techniques such as the use of mental mathematics, paper and pencil computations, calculators, and computers

EXPECTATION B Judge the reasonableness of numerical computations and their results

*1 Explain why a solution is mathematically reasonable using supporting data.

Grades 9–12 Algebra

Hand-held graphing calculators are required as part of instruction and assessment. Students should use a variety of representations (concrete, numerical, algorithmic, graphical), tools (matrices, data), and technology to model mathematical situations in solving meaningful problems Technology includes, but is not limited to, powerful and accessible hand-held calculators as well as computers with graphing capabilities

STANDARD I Understand patterns, relations, and functions

EXPECTATION A. Generalize patterns using explicitly defined and recursively defined functions.

*1 Interpret and make inferences from explicit and recursive functional relationships
*2 Describe independent and dependent quantities in functional relationships
*3 Use patterns to generate the laws of exponents and apply them in problem-solving situations

EXPECTATION B Understand relations and functions and select, convert flexibly among, and use various representations for them

*1 Gather and record data, or use data sets, to determine functional (systematic) relationships between quantities
*2 Represent relationships among quantities using concrete models tables graphs diagrams, verbal descriptions equations, and inequalities including representations involving computer algebra systems, spreadsheets, and graphing calculators
*3 Interpret situations in terms of given graphs and create situations that fit given graphs

EXPECTATION C Analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior

*1 Relate the solution(s) of quadratic equations to the root(s) of the quadratic functions
*2 Determine domain and range restrictions for linear and quadratic functions, given the constraints of the problem
*3 Analyze graphs of quadratic functions and write conclusions for problem situations

EXPECTATION D Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more complicated symbolic expressions

EXPECTATION E Understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions

*1 Identify and sketch the general forms of linear ($y = x$) and quadratic ($y = x^2$) parent functions
*2 Determine reasonable domain and range values for a variety of situations.
*3 Relate direct variation to linear functions and solve problems involving proportional change
*4 With and without using a graphing calculator, investigate, describe, and predict the effects of changing the slope and the y-intercept in applied situations
*5 With and without using a graphing calculator investigate, describe, and predict the effects of vertical and horizontal translations, reflections, and dilations on linear and quadratic functions
6 With and without using a graphing calculator investigate, describe, and predict the effects of vertical and horizontal translations, reflections, and dilations on exponential, polynomial, rational logarithmic, and periodic functions

EXPECTATION F Interpret representations of functions of two variables

1 Recognize that real world phenomena can be modeled by specific functions (e g., population growth can be modeled by exponential functions, periodicity can be modeled by trigonometric functions)

STANDARD II Represent and analyze mathematical situations and structures using algebraic symbols

EXPECTATION A Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

*1 Find specific function values and evaluate expressions
*2 Simplify polynomial expressions and perform polynomial arithmetic
3 Represent functions in algebraic, tabular graphical, and verbal forms using paper and pencil, graphing calculators, computer algebra, and spreadsheet technologies

EXPECTATION B Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases

*1 Transform and solve equations and inequalities, factoring as necessary in problem situations
*2 Solve systems of linear equations using concrete models graphs tables and algebraic methods
*3 Select a method for solving linear equations and inequalities and then solve the equations and inequalities
*4 Solve quadratic equations using concrete models tables graphs, and algebraic methods that include factoring, the quadratic formula, and computer algebra systems, spreadsheets, and graphing calculators

EXPECTATION C Use symbolic algebra to represent and explain mathematical relationships

*1	Look for patterns and represent generalizations algebraically in given situations
*2	Use symbols to represent unknowns and variables

EXPECTATION D Use a variety of symbolic representations, including recursive and parametric equations, for functions and relations

*1	Translate among and use algebraic, tabular, graphical, or verbal descriptions of linear functions using computer algebra systems, spreadsheets and graphing calculators
2	Translate among and use algebraic, tabular, graphical, or verbal descriptions of quadratic rational, exponential and other functions using computer algebra systems, spreadsheets and graphing calculators
3	Translate among and use algebraic tabular graphical or verbal descriptions of recursive and parametric equations or functions, using computer algebra systems, spreadsheets, and graphing calculators

EXPECTATION E Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

*1	Interpret solutions and determine the reasonableness of solutions to linear equations and inequalities
*2	Interpret solutions and determine the reasonableness of solutions to systems of linear equations

STANDARD III Use mathematical models to represent and understand quantitative relationships

EXPECTATION A Identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships.

*1	Determine whether or not given situations can be represented by linear functions
*2	Analyze situations involving linear functions and formulate linear equations or inequalities to solve problems
3	Determine whether or not given situations can be represented by nonlinear functions
4	Analyze situations involving nonlinear functions and formulate nonlinear equations or inequalities to solve problems

EXPECTATION B Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts

*1	Describe functional relationships for given problem situations and write equations, inequalities, and recursive relations to answer questions arising from the situations
*2	Graph and write equations of lines given characteristics such as two points, a point and a slope, or a slope and y-intercept.
3	Analyze data and represent situations involving inverse variation using concrete models, tables, graphs, or algebraic methods as well as computer algebra systems, spreadsheets, and graphing calculators
4	Analyze data and represent situations involving exponential growth and decay using concrete models, tables graphs, or algebraic methods as well as computer algebra systems, spreadsheets, and graphing calculators

EXPECTATION C Draw reasonable conclusions about a situation being modeled

1	Verify and explain the conclusion based on the data and the processes used.
2	Demonstrate that no solution or multiple solutions may exist.

STANDARD IV Analyze change in various contexts

EXPECTATION A Approximate and interpret rates of change from graphical and numerical data.

1 Interpret rates of change as they apply to phenomena such as inflation, spread of disease, population growth, tax brackets, and pollution
2 Analyze graphical data gathered by technical equipment including combinations of graphs periodic phenomena, and rates of change
3 Determine changes in slope relative to the changes in the independent variable

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Grades 9–12 Geometry

The use of geometry software that supports a dynamic, interactive approach is essential to the instruction and assessment of geometry, especially in the exploration of multiple geometric relationships and the resulting analyses and proofs

STANDARD I — Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

EXPECTATION A — Analyze properties and determine attributes of two- and three-dimensional objects

1 Use numeric and geometric patterns to make generalizations about a geometric properties including properties of polygons b ratios in similar figures and solids, and c angle relationships in polygons and circles
2 Analyze ratios of similar figures and analyze the properties of circles, polygons, and their angle relationships
3 Examine and classify the cross sections of three-dimensional objects

EXPECTATION B — Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them

1 Identify, describe, and defend congruence and similarity between shapes
2 Solve problems involving similar figures using proportion
3 Justify conjectures about geometric figures using similarity and transformations
4 Determine the resulting change in the area and volume of a figure when one or more dimensions are changed
5 Make generalizations about geometric properties of solids

EXPECTATION C Establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others

1	Verify conjectures about angles, lines polygons circles and three-dimensional figures, choosing from a variety of approaches such as coordinate, transformational, or axiomatic
2	Construct and judge validity of a logical argument consisting of a set of premises and a conclusion
3	Use logical reasoning to draw conclusions about geometric figures from given assumptions

EXPECTATION D Use trigonometric relationships to determine lengths and angle measures

	Calculators will be used to solve problems and find decimal approximations for the solutions for both of the following
1	Explore concepts and applications of trigonometry by solving applied problems using right triangle trigonometry
2	Solve applied problems using the law of sines and law of cosines

STANDARD II Specify locations and describe spatial relationships using coordinate geometry and other representational systems

EXPECTATION A Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations

1	Draw a pair of perpendicular vectors to find a distance graphically
2	Solve applied problems using scale modeling
3	Develop and use formulas including distance and midpoint

EXPECTATION B Investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates

1	Given two ordered pairs, find the distance between them, locate the midpoint of the segment, and determine the slope of the line that contains them
2	Describe geometric relationships using slopes and equations of lines including parallel lines, perpendicular lines, and special segments of triangles and other polygons
3	Given geometric figures utilize a coordinate system to identify and justify conjectures

STANDARD III Apply transformations and use symmetry to analyze mathematical situations

EXPECTATION A Understand and represent translations, reflections, rotations and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices

1	Solve applied problems using a system of vectors or using matrix addition
2	Plot coordinates for translations and describe the vertical and horizontal transformational vector(s)

EXPECTATION B Use various representations to help understand the effects of simple transformations and their compositions

1	Translate reflect, rotate, and dilate figures on the plane
2	Analyze the symmetry of objects using the language of transformations

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STANDARD IV Use visualization, spatial reasoning, and geometric modeling to solve problems

EXPECTATION A Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools

1 Represent a three-dimensional object in two dimensions using graph or dot paper
2 Construct a three-dimensional object using a two-dimensional diagram such as a blueprint or pattern
3 Use constructions with straight-edge and compass paper folding, and dynamic, interactive geometry software to explore attributes of geometric figures and make conjectures about geometric relationships

EXPECTATION B Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections.

1 Use top, front, side, and corner views of three-dimensional objects to create accurate and complete representations and solve problems

EXPECTATION C Use vertex-edge graphs to model and solve problems

1 Using digraphs or vertex-edge graphs, find optimal solutions to problems involving paths, networks, or relationships among a finite number of objects

EXPECTATION D Use geometric models to gain insights into and answer questions about related areas of mathematics and other disciplines

1 Select an appropriate representation (concrete pictorial, graphical verbal or symbolic) to solve a problem
2 Represent geometric relationships and solve problems using dynamic interactive geometry software

EXPECTATION E Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture

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Grades 9–12 Measurement

Measurement tools must include electronic devices as well as traditional measurement tools. Examples of basic technologies that might be used are calculator-based laboratories (CBLs), calculator based rangers (CBRs), the Global Positioning System (GPS), digital micrometers, and infrared distance measurers

STANDARD I Understand measurable attributes of objects and the units, systems, and processes of measurement

EXPECTATION A Make decisions about units, scales, and viewing windows that are appropriate for problem situations involving measurement.

1 Make judgments about the appropriateness of units of measure and scales within a system and between systems

STANDARD II Apply appropriate techniques, tools, and formulas to determine measurements

EXPECTATION A Analyze precision, accuracy, and approximate error in measurement situations

EXPECTATION B Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinder

1 Use formulas for surface area and volume of three-dimensional objects to solve practical problems

EXPECTATION C Apply informal concepts of successive approximation, upper and lower bounds, and limit in measurement situations

1 Use linear measurements to estimate lengths of curves
2 Use polygons to estimate areas of curved regions
3 Use boxes or spheres to estimate the volume of curved solids

EXPECTATION D Use unit analysis to check measurement computations

*1 Use unit analysis to check measurement computations

Grades 9–12 Data Analysis and Probability

Data resources from the Internet, statistical software, and graphing calculators with statistical features are essential to the instruction and assessment of data analysis and probability

STANDARD I — Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

EXPECTATION A — Understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each

1	Distinguish among surveys, observational studies, and controlled experiments and evaluate the quality of each
2	Evaluate the legitimacy of conclusions about the population based on the sample(s) studied

EXPECTATION B — Know the characteristics of well-designed studies, including the role of randomization in surveys and experiments

1	Identify two or more experimental treatments (or conditions) to be compared and the sources of variation to be controlled
2	Compare the responses of a group that gets treatment with those of a control group that does not
3	Given a problem situation, describe the basic principles of experimental design (control, randomization, and replication)
4	Given a problem situation, evaluate whether conclusions drawn are based on randomization and control

EXPECTATION C — Understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable

1	Given a problem situation, identify variables as categorical or measurement
2	Given a problem situation, distinguish between independent/explanatory and dependent/response variables

EXPECTATION D Understand histograms, parallel box plots, and scatterplots and use them to display data

1 Represent, display, and interpret data using scatterplots bar graphs stem-and leaf plots and box-and whiskers diagrams including representations on graphing calculators and computers
2 Display univariate data in problem situations with parallel box plots, histograms, or stem-and leaf plots

EXPECTATION E Compute basic statistics and understand the distinction between a statistic and a parameter

1 Given a problem situation, identify each variable as a statistic or a parameter
2 Calculate measures of center and spread for univariate statistics
3 Determine positive, negative, or no correlation between bivariate statistics

STANDARD II Select and use appropriate statistical methods to analyze data.

EXPECTATION A For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics

1 Given a problem situation, select the appropriate display and describe the distribution's overall shape and characteristics
2 Based on the shape of the distribution, determine how the measures of center and spread are related to each other

EXPECTATION B For bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools

1 Interpret the value of the correlation coefficient as it pertains to the relationship between the two variables
*2 Write a linear equation that fits a data set, check the model for goodness of fit, and make predictions using the model

EXPECTATION C Display and discuss bivariate data where at least one variable is categorical

1 Given a problem situation with one variable as categorical and the other as measurement, compare the categorical variables using the appropriate display for the measurement variables and draw conclusions from those comparisons

EXPECTATION D Recognize how linear transformations of univariate data affect shape, center, and spread

1 Describe the effect of transformations of data on measures of central tendency and variability
2 Describe the effect of transformations of data on the shape of the data s distribution

EXPECTATION E Identify trends in bivariate data and find functions that model the data or transform the data so that they can be modeled

1 Draw a line-of-best-fit or a curve-of best-fit for a scatterplot
2 Determine the function that models the data best

STANDARD III Develop and evaluate inferences and predictions that are based on data

EXPECTATION A Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions

1 Conduct simulations to collect random sample statistics and examine the variability of them from a known population
2 Conduct simulations to construct sampling distributions

EXPECTATION B Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference

1 Use the properties of the normal curve to describe how sample data estimates the population mean and standard deviation
2 Examine sampling distributions to make inferences and predictions about population parameters

EXPECTATION C Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions

1 Given a published report based on data, determine the design of the study, the appropriateness of the data analysis, and the validity of the conclusions
2 Given a published report based on data, interpret the results

EXPECTATION D Understand how basic statistical techniques are used to monitor process characteristics in the workplace

1 Apply confidence intervals and margins of error to workplace processes
2 Interpret the results of hypothesis testing for a single proportion or mean

STANDARD IV Understand and apply basic concepts of probability

EXPECTATION A Understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases

1 Describe all possible outcomes of an event containing a finite number of outcomes
2 Determine a sample space for selected experiments and represent it in the form of a list, chart, picture or tree diagram.

EXPECTATION B Use simulations to construct empirical probability distributions and interpret the results in the context of an applied problem

1 Use simulations to construct empirical probability distributions
2 Interpret the results in the context of an applied problem

EXPECTATION C Compute and interpret the expected value of random variables in simple cases

1 Given a problem situation, delineate the sample space and conduct simulations to calculate the expected value of the random variables
2 Given a problem situation, interpret the expected value of the random variables

EXPECTATION D Understand the concepts of conditional probability and independent events

1 Identify mutually exclusive, joint, and independent events
2 Recognize and compute conditional probability

EXPECTATION E, Understand how to compute the probability of a compound event

1 Empirically and theoretically calculate the probabilities of a compound event.

Glossary of Mathematical Terms

algorithm A specific set of instructions for carrying out a procedure or solving a problem

array An arrangement (usually rectangular) of objects or numbers

benchmarks Important units used as a referent for estimation Benchmark numbers for fractions could be 0, 1/2, 1, 1 1/2, and so forth Benchmarks for measurements could be multiples of standard units Benchmarks for whole numbers could be multiples of 10, 100, 1000, and so forth

box plot (*or* **box-and-whisker plot**) Displays a set of data with a rectangular box extending from the lower quartile to the upper quartile of the data and two lines extending from the ends of the box to the extreme values of the data.

composing/decomposing a number A strategy used to reinforce number sense Involves conceptualizing a number as being made up of two or more parts putting the parts together to make a number is *composing* a number; breaking a number into two or more parts is *decomposing* the number

compute fluently Use efficient and accurate methods for computing

edge A line segment where two faces of a polyhedron meet

faces The flat polygonal regions of a polyhedron

histogram A special type of bar graph that displays the frequency of data as rectangles with areas proportionate to the corresponding frequencies Each bar has the same width The width of the bar represents a range of values along the horizontal axis

inverse relationship between operations. The inverse of a mathematical operation undoes the operation For example, subtraction undoes addition

line graph In a line graph, points representing two related pieces of data are plotted and then connected by a line.

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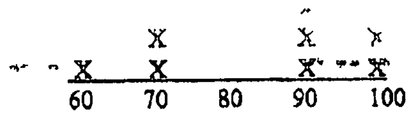

student Y s test scores second quarter

models Concrete, pictorial, symbolic, verbal, and algorithmic representations

nets A two-dimensional fold up model of a polyhedron

networks A graph or directed graph together with a function that assigns a positive real number to each edge

perfect square The product of an integer multiplied by itself For example, 4 is a perfect square because 2 x 2 = 4, 9 is a perfect square because 3 x 3 = 9

polygon A closed plane figure with *n* sides The sides of a polygon are line segments

polygonal regions Flat surfaces enclosed by polygons.

polyhedron A closed three-dimensional object whose surfaces are formed by polygonal regions (e g , prism, pyramid, octahedron)

Algebra 1

In Algebra 1, students build upon the mathematical understandings that are addressed in prekindergarten through the eighth grade Students will

- use symbolic reasoning to represent mathematical situations, to express generalizations, and to study relationships among quantities,
- use functions to represent and model problem situations as well as to analyze and interpret relationships,
- set up equations in a wide range of situations and use a variety of methods to solve them, and
- use problem solving, representation, reasoning and proof, language and communication, and connections both within and outside mathematics

In Algebra 1, hand held graphing calculators are required as part of instruction and assessment. Students should use a variety of representations (concrete, numerical, algorithmic, graphical), tools (matrices, data), and technologies to model mathematical situations to solve meaningful problems The technologies include, but are not limited to, powerful and accessible hand held calculators as well as computers with graphing capabilities

I Understanding Functions

A Relationships

1 Describe independent and dependent quantities in functional relationships
2 Gather and record data or use data sets to determine functional (systematic) relationships between quantities
3 Describe functional relationships for given problem situations and write equations, inequalities, and recursive relations to answer questions arising from the situations
4 Represent relationships among quantities using concrete models, tables, graphs, diagrams, verbal descriptions, equations, and inequalities including representations involving computer algebra systems, spreadsheets, and graphing calculators
5 Make judgments about units of measure and scales within a system and between systems
6 Interpret and make inferences from explicit and recursive functional relationships.

B Linear and Quadratic Functions and Data Representations

1 Identify and sketch the general forms of linear ($y = x$) and quadratic ($y = x^2$) parent functions
2 For a variety of situations, identify and determine reasonable domain and range values for given situations
3 Interpret situations in terms of given graphs or create situations that fit given graphs
4 Represent, display, and interpret data using scatterplots, bar graphs, stem and leaf plots, and box-and-whiskers diagrams, including representations on graphing calculators and computers
5 Write a linear equation that fits a data set, check the model for "goodness of fit, and make predictions using the model

Algebra 1

C Generalizations, Algebraic Symbols, and Matrices

1 Read, write, and represent very large and very small numbers in a variety of forms including exponential

2 Use unit analysis to check measurement computations

3 Given situations, determine patterns and represent generalizations algebraically

4 Use symbolic representation, reasoning, and proof to verify statements about numbers

5 Recognize and justify the relationship between the magnitude of a number and the application of specific operations

6 Identify and use properties related to operations with matrices (addition, subtraction, and scalar multiplication) to solve applied problems

D Algebraic Expressions in Problem Solving Situations

1 Find specific function values and evaluate expressions

2 Simplify polynomial expressions and perform polynomial arithmetic

3 Transform and solve equations and inequalities, factoring as necessary in problem situations

4 Given a problem situation, determine whether to use a rough estimate, an approximation, or an exact answer Select a suitable method of computing from techniques such as the use of mental mathematics, paper-and-pencil combinations, calculators, and computers

5 Use supporting data to explain why a solution is mathematically reasonable

6 Use the commutative, associative, and distributive properties to simplify algebraic expressions

II Linear Functions

A Representations

1 Determine whether or not given situations can be represented by linear functions.

2 Based on the constraints of the problem, determine the domain and range values for linear functions.

3 Translate among and use algebraic, tabular, graphical, or verbal descriptions of linear functions using computer algebra systems, spreadsheets, and graphing calculators.

B Interpretations

1 Develop the concept of slope as rate of change and determine slope from graphs, tables, and algebraic representations

2 Interpret the meaning of slope and intercepts in situations using data, symbolic representations, or graphs.

3 With and without using a graphing calculator, investigate, describe, and predict the effects of changes in m and b on the graph of $y = mx + b$

4 Graph and write equations of lines given characteristics such as two points, a point and a slope, or a slope and y intercept.

5 Determine the intercepts of linear functions from graphs, tables, and algebraic representations

6 With and without using a graphing calculator, interpret and predict the effects of changing slope and y intercept in applied situations

7 Relate direct variation to linear functions and solve problems involving proportional change.

C Equations and Inequalities

1 Analyze situations involving linear functions and formulate linear equations or inequalities to solve problems

2 Investigate methods for solving linear equations and inequalities using concrete models, graphs, and the properties of equality, select a method and solve the equations and inequalities.

3 Use the commutative, associative, distributive, equality, and identity properties to justify the steps in solving equations and inequalities

4 Using concrete models for given contexts, interpret and determine the reasonableness of solutions to linear equations and inequalities

D Systems of Linear Equations

1 Analyze situations and formulate systems of linear equations to solve problems

2 Solve systems of linear equations using concrete models, graphs, tables, and algebraic methods including computer algebra systems, spreadsheets, and graphing calculators

3 For given contexts, interpret and determine the reasonableness of solutions to systems of linear equations

III Quadratic and Other Functions

A Quadratic Functions

1 Given the constraints of the problem, determine the domain and range values for quadratic functions

2 With and without using a graphing calculator, investigate, describe, and predict the effects of changes in the coefficient a on the graph of $y = ax^2$

3 With and without using a graphing calculator, investigate, describe, and predict the effects of changes in the constant c on the graph of $y = x^2 + c$

4 For problem situations, analyze graphs of quadratic functions and draw conclusions

5 Solve quadratic equations using concrete models, tables, graphs, and algebraic methods that include factoring and using the quadratic formula as well as computer algebra systems, spreadsheets, and graphing calculators

6 Relate the solutions of quadratic equations to the roots of their functions

Algebra 1

B Other Functions

1. Use patterns to generate the laws of exponents and apply the laws of exponents in problem solving situations
2. Analyze data and represent situations involving inverse variation using concrete models, tables, graphs, or algebraic methods as well as computer algebra systems, spreadsheets, and graphing calculators
3. Analyze data and represent situations involving exponential growth and decay using concrete models, tables, graphs, or algebraic methods as well as computer algebra systems, spreadsheets, and graphing calculators.

Algebra 2

I Understanding Functions

Each of the standards in this section applies to all types of functions studied in this course (quadratic, exponential, absolute value, radical, and rational)

A. Properties of Functions

1. Identify the mathematical domains and ranges of functions for a variety of situations both from graphical, tabular, and algebraic representations.
2. Determine reasonable domain and range values for given problem situations
3. Collect data and record results, organize the data, make scatterplots, fit the curves to the appropriate parent function using graphing calculator technology and computer software
4. Recognize that real world phenomenon can be modeled by specific functions, make predictions, decisions and critical judgments using the model Graphing calculator technology and computer software are to be used for data organization and curve fitting
5. Determine changes in slope relative to the change in the independent variable

B Solving Equations and Inequalities

1. Analyze situations and formulate systems of equations or inequalities in two or more unknowns to solve problems
2. Use algebraic methods, graphs, tables, and matrices to solve systems of equations or inequalities, verify solutions using computer algebra systems, spreadsheets, and graphing calculators
3. Identify the kinds of equations that can and cannot be solved in each subset of the complex number system.
4. Demonstrate that no solution or multiple solutions may exist
5. Use computer algebra systems, spreadsheets, and graphing calculators to solve linear programming problems
6. Identify and use properties related to operations with matrices to justify the steps in solving applied problems.

II Algebra and Geometry

A Algebraic and Geometric Representations of Functions

1. Identify and sketch graphs of parent functions, including square root ($y = \sqrt{x}$), inverse ($y = 1/x$), exponential ($y = a^x$), and absolute value ($y = |x|$) functions.
2. With and without using a graphing calculator, investigate, describe, and predict the effects of vertical and horizontal translations, reflections, and dilations on parent functions
3. Perform the composition of functions
4. Recognize inverse relationships between various functions.

Algebra 2

B Conic Sections
1 Explain each conic section as the intersection of a plane and cone(s)
2 Identify symmetries from graphs of conic sections.
3 Complete the square to determine the type, shape, and location of a conic section

III Quadratic, Square Root, and Absolute Value Functions

A Quadratic Functions
1 Represent quadratic functions in algebraic, tabular, graphical, and verbal forms using paper and pencil, graphing calculators, computer algebra, and spreadsheet technologies
2 Generate a quadratic function from its roots or its graph.
3 Use the parent function to sketch graphs and to investigate, describe, and predict the effects of changes in a, h, and k on the graphs of $y = a(x - h)^2 + k$ form of a function.
4 Use complex numbers to describe the solutions of quadratic equations
B Quadratic Equations and Inequalities
1 Formulate quadratic equations and inequalities to solve problems
2 Solve quadratic equations and inequalities including solutions from the complex number system.
3 Analyze the solutions of quadratic equations using discriminants and solve quadratic equations using the quadratic formula
4 Using graphing calculators and computer algebra systems, compare and translate between algebraic and graphical solutions of quadratic equations.
C Radical Functions and Absolute Value Functions
1 Represent radical and absolute value functions in algebraic, tabular, graphical, and verbal forms using paper and pencil, graphing calculators, computer algebra, and spreadsheet technologies
2 Solve square root and absolute value equations and inequalities using graphs, tables, and algebraic methods Verify solutions using graphing calculators, computer algebra systems, and spreadsheets
3 Analyze situations modeled by square root and absolute value functions, formulate equations or inequalities, and solve problems

Algebra 2

IV Rational and Exponential Functions

A. Rational Functions
1. Represent rational functions in algebraic, tabular, graphical, and verbal forms using paper and pencil, graphing calculators, computer algebra, and spreadsheet technologies
2. Solve problem situations using direct and inverse variation

B. Exponential Functions
1. Represent exponential functions in algebraic, tabular, graphical, and verbal forms using paper and pencil, graphing calculators, computer algebra, and spreadsheet technologies.
2. Analyze a situation modeled by an exponential function, formulate an equation or inequality, and solve the problem.

South Carolina

Science

Curriculum Standards

Developed by the
South Carolina Science Curriculum Standards Revision Team

Adopted by the
South Carolina State Board of Education
January 12, 2000

Inez Moore Tenenbaum
State Superintendent of Education
South Carolina Department of Education
Columbia South Carolina

TABLE OF CONTENTS

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The Science and Mathematics Hubs and Focus Group Reviewers,* and
The School District Focus Group Reviewers.*

** See Appendixes A B and C for the individual members of these groups*

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The South Carolina Science Curriculum Standards may be downloaded from the South Carolina Department of Education web site
Web page http //www state sc us/sde/educators/standards

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Introduction

To science, pilot of industry, conqueror of disease, multiplier of the harvest, explorer of the universe, revealer of nature s laws, eternal guide to truth

—George Ellery Hale

Inscription in the dome of the Great Hall, U S. National Academy of Sciences Washington DC

Over the past seven years South Carolinians have worked together to set shared educational goals and academic "world class" standards This work involved thousands of science educators school board members and legislators. From this process emerged the South Carolina Science Curriculum Framework and the Science Academic Achievement Standards which describe what all students should know and be able to do in science The present document *South Carolina Science Curriculum Standards* is a further refinement in order to bring into sharper focus the kind of education we want in our state It was approved for first reading by the State Board of Education on November 10 1999 Second-reading approval by the State Board of Education was accomplished on January 12 2000 During the summer of 2000 implementation guides will be developed to assist teachers in the interpretation of standards. District and school curriculum and assessment should reflect these standards. Classroom instruction units of study and learning experiences should reflect these standards State-level assessment (using the Palmetto Achievement Challenge Test known as PACT) instructional materials adoption and professional development will be based on these standards.

A document will also be developed for parents to explain to them what students should know and be able to do at every grade level Science content academies during the summer of 2000 and workshops during the fall and winter of 2000-01 will provide technical assistance to teachers in the implementation of the science standards. Additionally exit exam standards will be identified from these science curriculum standards along with standards for high school end of-course tests in science. New instructional materials for science in kindergarten through grade eight will be up for adoption in 2000-01 During the next two years high school science instructional materials will be adopted. "Building A Presence for the Science Standards" a cooperative effort of the South Carolina Department of Education the National Science Teachers Association and the Exxon Corporation will establish Key Leaders and Points of Contact in each and every school in the State The thirteen science and mathematics hubs will be available to provide professional development for teachers in the implementation of the standards.

The science curriculum standards are not a scope and sequence or a district curriculum guide They provide goals and expectations for schools to develop a schoolwide science curriculum and for teachers to develop their own classroom lessons. A science curriculum is the way that science content is organized and presented in the classroom. Teachers' creativity and skills will enable them to find ways to integrate the areas of inquiry, life science earth science and physical science into meaningful learning opportunities for all students

The science curriculum standards in this document were developed from those set forth in the *National Science Education Standards*. The national standards were the result of years of research discussion reflection, and review by well over eighteen thousand science educators and scientists. The many individuals who developed the content standards sections of the *National Science Education Standards* used their own interpretations to make independent use of the statements published in *Science for All Americans* and *Benchmarks for Science Literacy* regarding what all students should know and be able to do The United States has established a goal that all students achieve scientific literacy The National Science Education Standards are designed to enable us as a nation to achieve that goal. These standards spell out a vision of science education that will make scientific literacy for all a reality in the twenty-first century They point toward a destination and provide a roadmap for how we are to get there

All of us have a stake as individuals and as a society in scientific literacy An understanding of science makes it possible for everyone to share in the richness and excitement of comprehending the natural world. Scientific literacy enables people to use scientific principles and processes in making personal decisions and to participate in discussions of scientific issues that affect society A sound grounding in science strengthens many of the skills that people use every day such as solving problems creatively thinking critically working cooperatively in teams using technology effectively and valuing lifelong learning. The economic productivity of our society is tightly linked to the scientific and technological skills of our workforce. The South Carolina Science Curriculum Standards make acquiring scientific knowledge understanding and abilities a central aspect of education just as science has become a central aspect of our society

The standards apply to all students regardless of age gender cultural or ethnic background disabilities aspirations or interest and motivation in science. Different students will achieve understanding in different ways and different students will achieve different degrees of depth and breadth of understanding depending on their interest and ability and the context of the material. All students can develop the knowledge and skills described in the standards even as some students go well beyond these levels Students cannot achieve high levels of performance without access to skilled professional teachers adequate classroom time a rich variety of learning materials technology accommodating work spaces and the resources of the communities surrounding their schools Responsibility for providing this support falls on all those involved with the science education system.

The South Carolina Science Curriculum Standards are organized by grade level beginning with kindergarten The grade-specific standards are arranged in four major areas:
Area I Inquiry Area II Life Science Area III Earth Science and Area IV Physical Science

Bold-faced type indicates text directly from the *National Science Education Standards*. The statements below each national standard represent what students in South Carolina should know and be able to do in order to demonstrate competency in achieving the standard Major areas of the national science standards that were integrated into each of the areas of Life Science Earth Science and Physical Science include History of Science

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Nature of Science Science in Social and Personal Perspectives and Technology The standards for kindergarten through grade eight are organized into units of study

In the *South Carolina Science Curriculum Standards* the Revision Team hopes to dispel the myth that science is a specialized activity reserved exclusively for professional scientists and to show that it is instead a part of human intelligence from which everyone can benefit Thus science plays a vital role in the way each of us thinks and behaves x

The world looks so different after learning science For example, trees are made of air, primarily When they are burned, they go back to air, and in the flaming heat is released the flaming heat of the sun which was bound in to convert the air into tree And in the ash is the small remnant of the part which did not come from air, that came from the solid earth, instead

These are beautiful things, and the content of science is wonderfully full of them They are very inspiring, and they can be used to inspire others

—Richard P Feynman Ph D
1965 Nobel Laureate, Physics

The term investigate is defined as an opportunity for students to explore questions and develop content knowledge by making observations and inferences collecting and interpreting data and drawing tentative conclusions through the use of active learning strategies

I Inquiry

Process skills and inquiries are not an isolated unit of instruction and should be embedded throughout the content areas Safety issues should be addressed as developmentally appropriate

A Process Skills

1 Observe

a. Use the senses to gather information about objects or events such as size shape color texture sound position and change (qualitative observations)

2 Classify

a. Compare sort and group concrete objects according to observable properties
b. Arrange objects in sequential order

3 Measure

a. Use standard (U S. customary and metric) and nonstandard whole units to estimate and measure mass length volume and temperature (quantitative observations)

4 Communicate

a. Use drawings tables graphs written and oral language to describe objects and explain ideas and actions.

B Inquiry

1 **Plan and conduct a simple investigation**

a. Ask a question about objects organisms, and events in the environment that could start an investigation.
b. Use simple equipment to gather data and extend the senses

II Life Science

Units of Study: Animals and Plants
My Body

A Characteristics of Organisms

1 **Organisms have basic needs**

a. Observe and describe how living things change as they grow

Key H=History of Science N=Nature of Science P=Science in Social and Personal Perspectives T=Technology — major categories of the National Science Education Standards that have been integrated in content areas.

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b Investigate and identify the natural resources (food water and air) that living things need to survive (P)

2. **Humans have distinct body structures for walking holding seeing and talking**
   a. Name major body parts.
   b Identify the uses of body parts.

3 **Humans have senses including sight smell hearing touch and taste**
   a. Describe the five senses.
   b Investigate using sensory organs associated with each of the senses.
   c. Communicate using sensory descriptors (e.g. sweet, sour, bitter salty rough smooth hard soft cold warm hot, loud high, low bright dull)

B Life Cycles of Organisms

1 **Plants and animals closely resemble their parents**
   a. Observe that plants and animals go through a life cycle
   b Observe and identify structures that are common between plants and animals and their offspring
   c. Compare offspring of plants and animals as similar but not identical to their parents and one another.

III Earth Science

Units of Study: Rocks, Soil and Water
Seasonal Changes

A Properties of Earth Materials

1 **Solid rocks soils and water are earth materials.**
   a. Describe earth materials using the senses.
   b Explore the natural flow of water downhill.
   c. Describe a way to conserve water at home or at school (P)

2 **Soils have properties of color and texture**
   a. Compare a variety of soil samples.
   b Sort soil samples by a single attribute

B Changes in Earth and Sky

1 **Weather changes from day to day and over the seasons**
   a. Record weather observations pictorially

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b Name and describe the seasons.

c. Describe how seasonal changes may affect plants and animals.

IV Physical Science

Unit of Study· Exploring Matter

A. Properties of Objects and Materials

1 **Objects have many observable properties**

a. Examine describe and compare common physical properties of a variety of materials.

b Observe and describe water as a solid or a liquid.

c Observe classify and describe objects made of different materials such as paper wood fabric and metal.

d Observe that objects can move

2 **Objects can be described by the properties of the materials from which they are made and those properties can be used to separate or sort a group of objects or materials**

a Classify materials that float/sink in water

b Investigate how magnets affect some materials and have useful applications as a tool.

c Classify and describe everyday materials that can be recycled (P)

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The term investigate is defined as an opportunity for students to explore questions and develop content knowledge by making observations and inferences collecting and interpreting data and drawing tentative conclusions through the use of active learning strategies

I Inquiry

Process skills and inquiries are not an isolated unit of instruction and should be embedded throughout the content areas Safety issues should be addressed as developmentally appropriate

A Process Skills

1 Observe

a Use the senses to gather information about objects or events such as size shape color, texture sound position and change (qualitative observations)

2 Classify

a Compare sort and group concrete objects according to observable properties.

b Arrange objects in sequential order

3 Measure

a Use standard (U S customary and metric) and nonstandard whole units to estimate and measure mass length volume and temperature (quantitative observations)

4 Communicate

a Use drawings tables graphs written and oral language to describe objects and explain ideas and actions

B Inquiry

1 Plan and conduct a simple investigation

a Ask a question about objects organisms and events in the environment

b Employ simple equipment such as hand lenses thermometers balances etc to gather data and extend the senses.

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II Life Science

Unit of Study Plants

A Characteristics of Organisms

1 **Organisms have basic needs**
   a. Investigate and explain that plants require air water, nutrients, space and light to survive and reproduce

2 **Plants have basic structures**
   a. Identify the parts of a plant (seeds roots stems leaves, flower, and fruit)
   b Classify edible plant parts as seeds roots etc
   c Explore and compare methods of seed dispersal.

B Life Cycles of Organisms

1 **Plants have life cycles The details of the life cycle are different for different organisms**
   a. Observe and communicate the growth and development of a variety of plants from seed
   b Recognize that fruits and nuts come from flowers.

C Organisms and Their Environments

1 **Organisms can survive only in environments in which their needs can be met**
   a. Classify plants according to their habitats.
   b Describe characteristics of plants that help them to survive in specific environments

2 **All organisms cause changes in the environment where they live**
   a. Explore and describe that living things can change the environment
   b Investigate how natural resources can be reused and recycled to reduce consumption. (P)

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III Earth Science

Unit of Study Things in the Sky

A Objects in the Sky

1. **The sun moon and stars have properties locations and movements that can be observed and described.**
   a. Observe and describe the basic relationships between the sun moon and Earth.
   b. Identify that the sun is a star and is the source of heat and light for Earth.

B Changes in the Earth and Sky

1. **The sun and moon appear to move across the sky on a daily basis**
   a. Observe and compare the day and the night sky
   b. Observe and describe changes in shadows over time.
   c. Observe and describe the phases of the moon over time looking for patterns.

IV Physical Science

Units of Study Properties of Objects and Materials
Exploring Motion

A. Properties of Objects and Materials

1. **Objects have many observable properties including size mass shape color and temperature**
   a. Observe describe compare and classify common physical properties of matter

2. **Properties of matter can be measured using tools such as rulers balances and thermometers**
   a. Measure length mass, and temperature of various materials in nonstandard and standard units. (U S. Customary and Metric Systems)
   b. Sort objects and materials based on a single attribute.

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3 **Objects can be described by the properties of the materials from which they are made and those properties can be used to separate or sort a group of objects or materials**
   a. Investigate that some materials mix with water and others will not
   b. Make and separate simple mixtures.

4. **Materials can exist in different states**
   a. Explore and describe characteristics of solids
   b. Explore and describe characteristics of liquids.
   c. Identify materials as either solid or liquid

B Position and Motion of Objects

1 **The position and motion of objects can be changed by pushing and pulling**
   a. Investigate the effect of a push or a pull on the position and motion of common objects.
   b. Explore and describe patterns of motion

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Note Bold face type indicates text directly from the National Science Education Standards.

The term investigate is defined as an opportunity for students to explore questions and develop content knowledge by making observations and inferences, collecting and interpreting data, and drawing tentative conclusions through the use of active learning strategies

I Inquiry

Process skills and inquiries are not an isolated unit of instruction and should be embedded throughout the content areas Safety issues should be addressed as developmentally appropriate

A **Process Skills**

1 **Observe**

a. Use the senses to gather information about objects or events such as size shape color texture, sound position and change (qualitative observations)

2 **Classify**

a. Compare sort, and group concrete objects according to observable properties.

b Arrange objects in sequential order

3 **Measure**

a. Use standard (U S. customary and metric) and nonstandard whole units to estimate and measure mass length volume and temperature (quantitative observations)

4 **Communicate**

a. Use drawings tables graphs written and oral language to describe objects and explain ideas and actions.

B **Inquiry**

1 **Plan and conduct a simple investigation**

a. Ask a question about objects organisms and events in the environment

b. Plan and conduct a simple investigation

c Use simple equipment such as hands lenses thermometers balances, rulers etc. to gather data and extend the senses.

d Communicate investigations and explanations

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II Life Science

Unit of Study Animals

A **Characteristics of Organisms**

1 **Organisms have basic needs Animals need air water, and food**

a Identify the basic needs of animals including shelter and living space,

2 **Organisms can survive only in environments in which their needs can be met**

a Describe the relationship between animals and their habitats.

b Group animals based on their habitats.

B **Life Cycles of Organisms**

1 **Animals have life cycles that include being born developing into adults reproducing and eventually dying**

a Observe and describe the growth and development of animals throughout their life cycles

b Investigate and understand that animals go through a series of orderly changes in their life cycles.

c. Observe growth in animals over time

2 **Animals closely resemble their parents**

a Investigate that some animals go through distinct stages (metamorphosis) during their lives while others generally resemble their parents throughout their life cycle.

b Classify animals based on their similarities.

C **Organisms and Their Environments**

1 **All animals depend on plants Some animals eat plants for food Other animals eat animals that eat the plants**

a Investigate and describe ways in which animals interact with each other and with the environment

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III Earth Science

Unit of Study Weather

A Changes in the Earth and Sky

1. **Weather changes from day to day and over the seasons**
   a. Define components of weather, including temperature wind and precipitation (rain sleet snow and hail)
   b. Observe and identify weather conditions and patterns.
   c. Create and use symbols to represent weather conditions.
   d. Describe and sequence the seasons
   e. Identify safety precautions to use during severe weather conditions. (P)

2. **Weather can be described by measurable quantities such as temperature wind direction and precipitation**
   a. Measure and record temperature in both degrees Fahrenheit and Celsius.
   b. Measure and record precipitation
   c. Investigate and describe changes in wind direction and the motion of objects due to the wind
   d. Make simple charts and graphs of observed weather data.
   e. Identify the importance of measuring and recording weather data. (T)
   f. Compare drought and flood conditions.
   g. Investigate and describe how weather affects water supply and water conservation. (P)

IV Physical Science

Units of Study Changes in Matter
Magnets

A Property of Objects and Materials

1. **Objects have many observable properties**
   a. Examine and classify common physical properties of solids liquids and gases

2. **Materials can exist in different states — solid liquid and gas Some common materials such as water can be changed from one state to another**
   a. Identify materials as solid liquid and gas.

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b Demonstrate and describe how water and other materials change from one state to another

3 **Properties of matter can be measured using tools such as rulers balances and thermometers**

a Measure length mass volume and temperature of various materials in standard (U S Customary and Metric Systems) units.

B **Magnetism**

1 **Magnets attract and repel each other and certain kinds of other materials**

a Investigate and classify the results of magnetic forces on common objects (metals/nonmetals)

b Demonstrate and describe how the poles of magnets attract and repel each other

c Give examples of useful applications of magnets (e g., refrigerator magnet can opener magnetized screwdriver magnetic compass) (T)

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I Inquiry

Process skills and inquiries are not an isolated unit of instruction and should be embedded throughout the content areas Safety issues should be addressed as developmentally appropriate

A Process Skills

1 **Observe**
- a. Use the senses to gather information about objects or events such as size shape color texture sound position and change (qualitative observations).

2 **Classify**
- a. Compare sort and group concrete objects according to two attributes.
- b. Arrange objects in sequential order

3 **Measure**
- a. Use standard (U S customary and metric) to estimate and measure mass length, area, perimeter volume and temperature to the nearest whole unit (quantitative observations)

4 **Communicate**
- a. Use drawings tables graphs written and oral language to describe objects and explain ideas and actions.

5 **Infer**
- a. Explain or interpret an observation based on data and prior knowledge.

6 **Predict**
- a. Use prior knowledge and observations to identify and explain in advance what will happen.

B Inquiry

1 **Plan and conduct a simple investigation**
- a. Ask a question about objects, organisms and events in the environment
- b. Plan and conduct a simple investigation that represents a fair test.
- c. Use simple equipment and tools to gather data and extend the senses
- d. Use data to construct a reasonable explanation
- e. Communicate investigations and explanations.

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II Life Science

Unit of Study Habitats and Adaptations

A Characteristics of Organisms

1 **Organisms can survive only in habitats in which their needs can be met**
   - a Compare and contrast the basic needs of plants and animals.
   - b Select and describe an appropriate habitat for a plant or animal

2 **Each plant or animal has different structures that serve different functions in growth survival and reproduction**
   - a Investigate and predict how structural adaptations such as methods of movement defense rearing young camouflage and mimicry function to allow animals to respond to life needs.
   - b Recognize bones joints and muscles in the arms and legs of the human body as structural adaptations responsible for movement
   - c Investigate and predict how physical adaptations such as seed dispersal scent color of flower and tropism (light and gravity) function to allow plants to respond to life needs.

B Life Cycles of Organisms

1 **Many characteristics of an organism are inherited from the parents of the organism but other characteristics result from an individual s interactions with the environment**
   - a Compare and describe growth of living things based on observations and measurements over time including stages of development and life.
   - b Record and describe the growth and development of a specific plant or animal over time.

C Organisms and Their Environments

1 **All animals depend on plants**
   - a Investigate and predict ways living things will interact with each other and the environment
   - b Interpret the interdependency of plants and animals within a food chain by defining the following producer, consumer decomposer herbivore carnivore omnivore predator and prey

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2 **When the environment changes some plants and animals survive and reproduce and others die or move to new locations**

a. Describe how habitats and organisms change over time due to many influences (effects of natural forces wind rain water air sunlight, and temperature)

b Research and describe how habitats are managed and species are monitored in South Carolina. (P)

c Investigate and describe behavioral adaptations, such as hibernation migration, and dormancy that allow living things to respond to seasonal conditions.

d Investigate and describe that aquatic and terrestrial habitats support a diversity of plants and animals that share limited resources.

e Investigate communicate and debate that natural events natural resources and human influences can affect the survival/extinction of a species. (P)

f Determine how humans impact natural resources (renewable and nonrenewable) (P)

III Earth Science

Unit of Study Earth Materials

A. Properties of Earth Materials

1 **The varied earth materials have different physical properties and uses**

a Describe earth materials (rocks minerals water soil and fossils) by their physical properties.

b State similarities and differences among earth materials.

c. Classify similar earth materials (e g. types of rocks/soils) according to their physical properties.

d Recognize that rock clay silt sand and humus are components of soils

e. Describe and show that soils are layered (topsoil subsoil and bedrock).

f Identify that soil provides support and nutrients for plant growth.

g. Observe and describe the unique physical characteristics of a variety of rock types.

h Give examples of how humans obtain and use earth materials as resources (P T)

i. Explain how fossils provide evidence about prehistoric life and environments.

j Explore careers in earth science. (N)

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2 **The sun provides the heat necessary to maintain the temperature of the Earth**
   a. Compare the effects of heat from the sun on various earth materials (rocks soils and water).

B **Changes in the Earth**

1 **The surface of the Earth changes**
   a. Describe surface features of the Earth (mountains hills valleys plateaus plains oceans lakes and rivers).
   b. Construct and interpret models that illustrate features of the Earth.
   c. Compare some changes in the Earth's surface that are due to slow processes such as erosion and weathering with some changes that are due to rapid processes such as landslides volcanic eruptions and earthquakes
   d. Infer how human behavior such as farming mining, and construction changes the Earth s surface (P N)
   e. Predict and explain the consequences of natural events such as fire flood drought erosion earthquake and volcanic eruption. (P)
   f. Explore how technologies are used to help predict some natural events. (T)

IV Physical Science

Units of Study: Heat and Changes of Matter
Machines and Motion

A. **Property of Objects and Materials**

1 **Some common materials such as water can be changed from one state to another by heating or cooling**
   a. Recognize and explore how matter can be changed in form (solid liquid and gas) through processes such as condensation evaporation melting boiling freezing and sublimation (solid to gas such as dry ice) and apply these processes to real world examples
   b. Measure record and graph the temperature (Celsius and Fahrenheit) of matter as it is heated and cooled
   c. Investigate the unique properties of water (expansion and contraction) as it is heated and cooled
   d. Compare the unique properties of water with other substances as they are heated and cooled.

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2 **Heat can be produced in many ways such as burning and rubbing or mixing one substance with another Heat can move from one object to another by conduction**

a Explore and identify things that produce heat

b Explore and describe how heat moves from one object to another

c Investigate and describe how heat travels by direct contact (conduction) so that a warmer object can warm a cooler object

d Investigate and describe what materials can be used to prevent heat from moving from one object to another such as insulators and apply to real world examples

e Describe ways to stop a fire from burning (P)

B **Position and Motion of Objects**

1 **The position and motion of objects can be changed by pushing or pulling The size of the change is related to the strength of the push or pull**

a Investigate and describe push and pull involved in simple machines

b Identify and describe simple machines such as lever pulley wheel and axle and inclined plane and apply their uses to real world situations (T)

c Demonstrate how bones joints and muscles are responsible for human movement and work as levers

d Observe and identify examples of simple machines found in the school playground home and work environment (P)

e Observe the motion of simple machines in toys and in playground activities

f Infer how simple machines developed as a result of human needs and exploration (T)

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I Inquiry

Process skills and inquiries are not an isolated unit of instruction and should be embedded throughout the content areas Safety issues should be addressed as developmentally appropriate

A Process Skills

1 Observe
   a Use the senses and simple tools to gather information about objects or events such as size shape color texture sound, position and change (qualitative observations)

2 Classify
   a Compare sort and group concrete objects according to two attributes.
   b Arrange objects in sequential order

3 Measure
   a Use standard (U S. customary and metric) to estimate and measure mass, length area perimeter volume and temperature to the nearest whole unit (quantitative observations).

4 Communicate
   a Use drawings tables graphs written and oral language to describe objects and explain ideas and actions

5 Infer
   a Explain or interpret an observation based on data and prior knowledge
   b Discriminate between observations and inferences

6 Predict
   a Use prior knowledge and observations to identify and explain in advance what will happen.
   b. Discriminate between inferences and predictions.

B Inquiry

1 **Plan and conduct a simple investigation**
   a Ask a question about objects organisms and events in the environment
   b Plan and conduct a simple investigation that represents a fair test
   c Select and use appropriate equipment and tools to gather data and extend the senses

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d Use data to construct a reasonable explanation
e Communicate investigations and explanations

II Life Science

Unit of Study Organisms and Their Environment

A Characteristics of Organisms

1 **Organisms have basic needs and can survive only in environments in which their needs can be met The world has many different environments and distinct environments support the life of different types of organisms**

a Identify the characteristics of different environments, such as forests wetlands grasslands deserts and in polar temperate and tropical regions.

b Describe the diversity of life forms (vertebrate and invertebrate animals and plants) supported by each environment

c Investigate the relationships between the basic needs of different organisms and whether or not a particular environment meets those needs

2 **Organisms have senses that help them detect internal and external cues**

a Analyze specific behaviors influenced by internal cues (e g hunger and thirst)

b Analyze specific behaviors influenced by external cues in the environment (e g temperature light and precipitation).

c. Describe how animal sensory organs (including human eye and ear) detect external cues (P)

3 **Many characteristics of an organism are inherited from the parents of the organism but other characteristics result from an individual's interactions with the environment**

a Identify and describe characteristics and behaviors that are inherited (e.g. color of flowers and animal instincts).

b Identify and describe characteristics and learned behaviors that enable organisms to survive in their environment (e g bear learning to fish)

c Distinguish major groups of organisms based on significant characteristics (e g body covering number of legs body parts type of skeleton)

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B Organisms and Their Environments

1 **An organism s patterns of behavior are related to the nature of that organism s environment including the kinds and the numbers of other organisms present the availability of food and resources, and the physical characteristics of the environment**

a. Describe how animals behave and interact within groups (e.g. schools flocks packs hives and herds)

b Describe how animals behave and interact within their environment (living and nonliving)

2 **All organisms cause changes in the environment where they live**

a. Describe how organisms may benefit their environment (e g earthworms improve the quality of soil birds disperse seeds)

b Describe how organisms may harm their environment (e g locusts destroy crops red tides reduce oxygen levels in the ocean)

3 **Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms**

a. Describe changes in the environment caused by humans (H)

b Infer the impact of agricultural technology (e g air/land/ water pollution and improved crop yield) on society and the environment (T)

c. Infer the impact of industrial technologies (e g air/land/water pollution and improved standard of living) on society and the environment (T)

d Relate how human population growth changes the environment (P)

III Earth Science

Units of Study Sky Patterns
Weather and Climate

A. **Objects in the Sky**

1 **The sun moon and stars and planets asteroids and comets all have properties locations and movements that can be observed and described**

a. State that the sun produces its own light while the moon reflects light from the sun

b Describe the positional relationship between the Earth and the moon and their positional relationship to the sun

c. Observe and record phase changes of the moon over time.

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d Observe and recognize the location and apparent movement of constellations throughout the seasons

e Compare the properties locations, and movements of the Earth with other planets

f Research and describe the historical/cultural significance of astronomy such as navigation and exploration. (P H T N)

g Explore and identify careers in space science. (P)

2 **Objects in the sky have patterns of movement The sun for example appears to move across the sky in the same way every day but its path changes slowly over the seasons**

a. Model and describe how the Earth s rotation on its axis produces day and night

b Model and describe how the tilt of the Earth on its axis and its revolution around the sun produce seasonal changes.

c. Describe how sunrise/sunset patterns change over time.

d Investigate describe and predict the sun's apparent movement related to the shadows of objects throughout the day

e Identify safe ways to observe the sun.

f Research and compare the technology humans have used to measure time throughout history (T H)

B *Changes in the Earth and Sky*

1 **Weather changes from day to day and over the seasons**

a. Observe daily and seasonal weather patterns.

b Describe how clouds form.

c Record and identify various cloud formations (such as, cirrus stratus and cumulus)

d Predict weather based on observations

e Research and describe severe weather phenomena technological advances and related safety concerns. (T P)

2. **Weather can be described by measurable quantities such as temperature wind direction speed and precipitation**

a. Measure and collect daily weather data using meteorological tools (such as Fahrenheit/Celsius thermometer barometer weather vane anemometer, and rain gauge)

b Interpret weather data from a variety of sources.

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IV Physical Science

Units of Study Electricity and Magnetism
Light and Sound

A Light and Sound

1 **Sound is produced by vibrating objects**
- a Observe and describe sounds (a form of energy) produced by vibrating objects.
- b Investigate and examine how various media (solids liquids and gases) transmit sound
- c Research and describe the development and use of communication tools (e g. the Morse code, telephone sonar musical instruments) (T)
- d Plan design and create a communication tool. (T)

2 **The pitch of the sound can be varied by changing the rate of vibration**
- a Investigate and compare the different pitches of sound produced by changing the size tension or amount of the vibrating material.
- b Compare different types of sounds based on characteristics such as pitch and volume
- c. Describe how the human ear receives and transmits sound from the environment

3 **Light travels in a straight line until it strikes an object**
- a Observe and demonstrate that light waves travel in a straight line
- b Investigate and examine how light waves travel through various media (solids liquids and gases).
- c. Investigate and describe ways that light can be reflected refracted or absorbed by an object
- d Describe how the human eye receives and transmits light from the environment
- e Research investigate and describe the development and use of optical tools such as eyeglasses magnifying lens prisms and mirrors. (T H N P)

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B Electricity and Magnetism

1 **Electricity in circuits can produce light heat, sound and magnetic effect**

a. Recognize that electricity is a form of energy and can produce light and heat
b Demonstrate and distinguish between static and current electricity
c. Describe and illustrate with symbols the parts of an electrical circuit
d Predict and test various materials to identify conductors and insulators
e Distinguish between open and closed circuits.
f Distinguish between parallel/series circuits and their everyday uses.
g. Describe how humans use electricity (P)
h Discuss the safe use of electricity (P)

2 **Magnets attract and repel each other and certain kinds of other materials**

a. Distinguish and describe objects that are magnetic and nonmagnetic
b Investigate and describe the properties of different magnets.
c Observe and describe the magnetic fields of various types of magnets
d Distinguish the lines of force between like and unlike poles
e Define electromagnetism
f Analyze the factors that influence the strength of an electromagnet
g Apply electromagnetism to real world situations. (T P)

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I Inquiry

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A Process Skills

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   a. Use drawings tables graphs written and oral language to describe objects and explain ideas and actions.

5 **Infer**
   a. Explain or interpret an observation based on data and prior knowledge.
   b. Discriminate between observations and inferences.

6 **Predict**
   a. Use prior knowledge and observations to identify and explain in advance what will happen.
   b. Discriminate between inferences and predictions.

7 **Hypothesize**
   a. Devise a statement of assumption based on observations experiences and research that can be supported or refuted through experimentation

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8 **Define variables**

a Identify independent (manipulated) dependent (responding) and controlled variables in an experiment

B **Inquiry**

1 **Plan and conduct a simple investigation**

a Identify questions that can be answered through scientific investigations.

b Design and conduct a scientific investigation

c Use appropriate tools and techniques to gather analyze and interpret data.

d Develop descriptions explanations predictions and models using evidence

e Use mathematical thinking in all aspects of scientific inquiry

f Communicate outcomes and explanations.

C. **Abilities Necessary to Do Technological Design**

1 **Identify appropriate problems for technological design**

a Identify a specific need for a product

b Determine whether the product will meet that identified need

2 **Design a solution or product**

a Compare and contrast different proposals using selected criteria (e.g cost time trade-off and materials needed)

b Communicate ideas with drawings and simple models.

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II Life Science

Units of Study Cells and Systems
Ecosystems (Aquatic/Terrestrial)

A **Structure and Function in Living Systems**

1 **All organisms are composed of cells the fundamental unit of life Most organisms are single cells Other organisms including humans are multicellular**

a Recognize that animals and plants are made of cells.

b Observe identify and distinguish among plant and animal cell parts nucleus cytoplasm vacuole cell membrane cell wall and chloroplasts.

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2 **The human organism has systems for respiration and circulation These systems interact with each other**

a. Label the parts and distinguish among the functions of the major organs of the respiratory system including nose/mouth larynx trachea bronchi alveoli lungs diaphragm.

b Label the parts and distinguish among the function of the major organs of the circulatory system including heart arteries veins capillaries and blood cells.

c Describe how the respiratory and circulatory systems work together to carry gases to and from the body

3 **Disease is a breakdown in structures or functions of an organism Some diseases are the result of intrinsic failures of the system (respiratory and circulatory)**

a. Identify common diseases associated with the respiratory system caused by viruses (such as colds influenza) diseases caused by bacteria (such as pneumonia and tuberculosis), and diseases caused by substances such as tobacco (P)

b Identify common intrinsic diseases and disorders associated with the respiratory system such as asthma and with the circulatory system such as leukemia sickle cell and heart disease

B Populations and Ecosystems

1 **A population consists of all individuals of a species that occur together at a given place and time All populations live together and the physical factors with which they interact compose an ecosystem**

a. Define a population

b Investigate and understand how plants and animals in aquatic/terrestrial ecosystems interact with one another and with the nonliving environment

2 **Populations of organisms can be categorized by the function they serve in an ecosystem Plants and some microorganisms are producers--they make their own food All animals including humans are consumers which obtain food by eating other organisms Decomposers primarily bacteria and fungi are consumers that use waste materials and dead organisms for food.**

a. Distinguish among the roles organisms serve in a food web (producers decomposers consumers prey and predators).

b Describe an organism by its niche in an ecosystem.

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3 **For ecosystems the major source of energy is sunlight Energy entering ecosystems as sunlight is used by producers through photosynthesis**

a. Recognize that energy passes from organism to organism in food webs.
b Diagram how energy flows through food webs

4 **The number of organisms an ecosystem can support depends on the resources available**

a. Identify and investigate the abiotic factors in an ecosystem such as quantity of light air and water range of temperature salinity, water pressure and soil composition.
b Identify and investigate the biotic factors in an ecosystem
c. Describe the effect of limiting factors such as food water space and shelter on a population
d Evaluate the impact of the environment on populations of organisms
e Draw conclusions about the influence of human activity on ecosystems (P)
f Discuss ways to minimize the negative impact of technology/industrialization on ecosystems and to maximize the positive impact (T)
g Explore and identify career opportunities in natural resource/ environmental/marine science (P)

III Earth Science

Unit of Study Changes in the Earth s Surface Landforms and Oceans

A Structure of the Earth System

1 **Land forms are the result of a combination of constructive and destructive forces**

a. Define constructive forces which include crustal deformation (folding and faulting) volcanic eruptions and deposition of sediment
b Describe how landforms are created as a result of constructive forces.
c Locate and describe the characteristics of South Carolina landform regions such as Blue Ridge Piedmont Sandhills Coastal Plains and Coastal Zone
d Model how constructive forces change the surface of the Earth.
e Define destructive forces which include weathering and erosion.
f Describe how landforms change as a result of destructive forces.
g Model how destructive forces change the surface of the Earth.
h Investigate and describe how the Earths surface is constantly changing by weathering erosion deposition and human impact (P)

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i. Identify technological advances developed as a result of major geological events such as earthquakes (T)
j. Infer how waves currents tides and storms affect the geological features of the ocean shore zone (e.g. beaches barrier islands inlets estuaries and harbors etc.)
k. Discuss safety concerns associated with major geological events. (P)

2. **The ocean floor is a part of the Earth's lithosphere Lithospheric plates on the ocean floor move**
   a. Identify that the lithosphere includes the crust and parts of the upper mantle and is broken into large sections known as plates.
   b. Recognize how plate movement produces volcanoes earthquakes and mountains on the ocean floor
   c. Identify and create a model of the geological features of the ocean floor (continental shelf/rise/slope mid-Atlantic ridges rifts and trenches)

3. **Water which covers the majority of the Earth s surface circulates through the crust oceans and atmosphere in what is known as the "water cycle "**
   a. Diagram label and describe evaporation condensation and precipitation as components of the water cycle
   b. Explain how the water cycle affects the salinity of the ocean s water

4. **Gravity is the force that explains the phenomena of the tides**
   a. Describe the relationship of the positions of the sun and the moon on the ocean s tides.

IV Physical Science

Units of Study: Mixtures and Solutions
Forces Motion and Design

A Properties of Matter

1. **A mixture of substances often can be separated into the original substances using one or more of the characteristic properties**
   a. Distinguish between a mixture and a solution recognizing that a solution is one type of a mixture.
   b. Create and classify mixtures made of two or more substances (solid-solid solid-liquid and liquid-liquid).
   c. Identify the potential dangers associated with using some mixtures and solutions such as bleach ammonia abrasive powders etc (P)

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d Design an investigation to separate (filtration sifting magnetism evaporation and flotation) mixtures based on their different properties

e Investigate the effect of temperature changes on the solubility of a substance.

2 **Solubility is one characteristic property of a substance**

a Distinguish various solids (e g cornstarch sugar salt baking powder and flour) based on observed solubility in water

b Distinguish between solvent and solute

c Investigate the effect of stirring shaking, and crushing on the rate of dissolving of solutes

d Explain the difference between diluted and concentrated solutions.

e Identify safety concerns on the labels of common household solutions (P)

f Research and identify common pollutants and their sources and infer their impact as they relate to water quality since water is the universal solvent (P N)

B **Motions and Forces**

1 **The motion of an object can be described by its position direction of motion and speed**

a Investigate and describe the relative positions and movements of objects using points of reference

b Record and graph in metric units the distance vs time of moving objects

c Investigate the variables that affect speed (e g ramp height/length/surface and mass of object)

2 **If more than one force acts on an object along a straight line then the forces will reinforce or cancel one another**

a Distinguish among gravity friction magnetism drag lift and thrust

b Investigate and describe how forces affect the motion of objects

c Analyze a device with parts that move and determine the purpose of each moving part and the overall purpose of the device

d Design and construct a device that moves (T)

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I Inquiry

A. Abilities Necessary to do Scientific Inquiry

1 **Identify process skills that can be used in scientific investigations**

a **Observe**
1. Observe patterns of objects and events
2. Distinguish between qualitative and quantitative observations.

b **Classify**
1. Arrange data in sequential order
2. Use scientific (e.g. field guides charts periodic tables etc) and dichotomous keys for classification

c **Measure**
1. Select and use appropriate tools (e.g metric ruler graduated cylinder thermometer balances spring scales stopwatches) and units (e.g. meter liter Celsius gram Newton second) to measure to the unit required in a particular situation
2. Select and use appropriate metric prefixes to include milli- centi- and kilo-

d **Infer**
1. Make inferences based on observations.

e **Predict**
1. Predict the results of actions based on patterns in data and experiences.

2 **Design and conduct a scientific investigation**

a. Recognize potential hazards within a scientific investigation and practice appropriate safety procedures.
b Pose questions and problems to be investigated
c Obtain scientific information from a variety of sources (such as Internet electronic encyclopedias journals community resources etc.)
d Distinguish and operationally define independent (manipulated) and dependent (responding) variables.
e. Manipulate one variable over time with repeated trials and controlled conditions.

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- f Collect and record data using appropriate metric measurements.
- g Organize data in tables and graphs.
- h Analyze data to construct explanations and draw conclusions.

3 **Use appropriate tools and techniques to gather analyze and interpret data**

- a Select and use appropriate tools and technology (such as calculators computers probes thermometers balances spring scales microscopes binoculars and hand lenses) to perform tests collect data, and display data
- b Analyze and interpret data using computer hardware and software designed for these purposes.

4 **Develop descriptions explanations predictions and models using evidence**

- a Discriminate among observations inferences and predictions
- b Construct and/or use models to carry out/support scientific investigations

5 **Think critically and logically to make relationships between evidence and explanations**

- a Review and summarize data to show cause-effect relationships in experiments.
- b State explanations in terms of independent (manipulated) and dependent (responding) variables.
- c State hypotheses in ways that include the independent (manipulated) and dependent (responding) variables

6 **Recognize and analyze alternative explanations and predictions**

- a Analyze different ideas and explanations to consider alternative ideas.
- b Accept the skepticism of others as part of the scientific process (N)

7 **Communicate scientific procedures and explanations**

- a Use drawings and written and oral expression to communicate information.
- b Create drawings diagrams charts tables and graphs to communicate data.

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c. Interpret and describe patterns of data on drawings diagrams charts tables graphs and maps.
d Create and/or use scientific models to communicate information

5 **Use mathematics in all aspects of scientific inquiry**

a. Use mathematics to gather organize and present data.
b Use mathematics to structure convincing explanations.

B **Abilities Necessary to Do Technological Design**

1. **Identify appropriate problems for technological design**

a. Identify a specific need for a product
b Determine whether the product will meet the identified need.

2 **Design a solution or product**

a. Compare and contrast different proposals using selected criteria (e.g. cost time trade-off and materials needed).
b Communicate ideas with drawings and simple models.

3 **Implement a proposed design**

a. Select suitable tools and techniques to ensure adequate accuracy
b Organize materials devise a plan and work collaboratively where appropriate

4 **Evaluate completed technological designs or products**

a. Measure the quality of the product based on the original purpose or need and the degree to which it meets the needs of the users.
b Suggest improvements and try proposed modifications to the design

5 **Communicate the process of technological design**

a. Identify the four stages of problem solving- problem identification solution design implementation and evaluation.

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C **Understandings about Science and Technology**

1 **Scientific inquiry and technological design have similarities and differences**

a Compare and contrast scientific inquiry and technological design

2 **Many different people in different cultures have made and continue to make contributions to science and technology**

a Describe examples of contributions people have made to science and technology (H N)

3 **Science and technology are reciprocal**

a Explain how science and technology are essential to each other (T)

4 **Perfectly designed solutions do not exist**

a Discuss factors that affect product design and alter the original design (T)
b Discuss risk versus benefit factors in product design (P)

5 **Technological designs have constraints.**

a Describe examples of constraints on technological designs (T)
b Explain why constraints on technological design are unavoidable (T N)

6 **Technological solutions have intended benefits and unintended consequences**

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II Life Science

Unit of Study Fungi and Plants

A Structure and Function in Fungi and Plant Systems

1 **Important levels of organization for structure and function include cells and whole organisms All organisms are composed of cells — the fundamental unit of life**

a. Identify and explain the function of plant cell parts (e g vacuoles nucleus cytoplasm cell membrane cell wall and chloroplasts)
b Distinguish between and illustrate plant and animal cells (e.g. cell wall chloroplasts, and nucleus)
c Describe the basic characteristics of two of the kingdoms of organisms--fungi and plants.
d Compare and contrast three forms of fungi (mushrooms yeasts and molds)
e. Compare and contrast vascular and nonvascular plants flowering and non-flowering plants and deciduous and coniferous trees.

2 **Some diseases are the result of damage by infection by other organisms**

a. Describe the helpful and harmful effects of some fungi on other organisms (e.g athlete s foot and ringworm in humans rust in plants penicillin) (P)

B Plant Reproduction and Heredity

1 **Reproduction is a characteristic of all living systems because no individual organism lives forever reproduction is essential to the continuation of every species Some organisms reproduce asexually Other organisms reproduce sexually**

a. Describe asexual reproduction processes in plants and fungi (e.g vegetative propagation in stems roots and leaves of plants budding in yeasts fruiting bodies in fungi)
b Identify the process of cell division as asexual reproduction.
c Identify where sexual spores are produced on mushrooms and explain how the spores are dispersed.

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2 **Plants also reproduce sexually — the egg and sperm are produced in the flowers of flowering plants**

a. Observe draw and label the parts of a flower and examine their functions in sexual reproduction.
b. Describe the importance of wind water or insects to the pollination process and the adaptations of flowering plants to ensure pollination.
c. Discuss the negative impacts of pesticides on the pollination process. (P)

3 **An egg and sperm unite to begin the development of a new individual**

a. Trace the path of the sperm cells to the egg cell in the ovary of a flower to produce a seed
b. Analyze the structures and functions of parts of a seed in the formation of a plant
c. Investigate and describe the conditions necessary for the germination of seeds.
d. Analyze the structures and functions of fruits in the reproduction of seed plants

C **Regulation and Behavior**

1 **All organisms must be able to obtain and use resources, grow reproduce and maintain stable internal conditions while living in a constantly changing external environment**

a. Describe the most effective conditions for the growth of fungi and their adaptations to those conditions.
b. Describe how green plants absorb energy from the sun and transform it into stored chemical energy using the terms photosynthesis chlorophyll water carbon dioxide oxygen and sugar
c. Describe how plants break down sugar to release stored chemical energy through respiration
d. Explain the importance of green plants to the survival of other organisms in the environment
e. Relate the structures of roots stems and leaves to their functions in plants.
f. Observe draw and analyze the structure and function of xylem and phloem tissues in roots and stems of vascular plants.
g. Identify guard cells and explain their function in the operation of stomata (transpiration)

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h Examine why stomata in most plants are closed at night and open during the day

2 **Behavior is one kind of response an organism can make to an internal or environmental stimulus**

a Define tropisms in plants
b Apply tropisms in plants in response to specific stimuli (e.g , light gravity touch and water) to real world situations.

3 **An organism s behavior evolves through adaptation to its environment**

a Explain the importance of fungi as decomposers and their adaptations to that role
b Compare and contrast the major characteristics of land biomes (e g Tropical rainforests Temperate rainforests deserts tundra coniferous forests/taiga and deciduous forests).
c. Distinguish adaptations of various plants to survive and reproduce in different biomes.

Unit of Study Muscular and Skeletal Systems

D **Structure and Function in Muscular and Skeletal Systems**

1 **The human organism has muscular and skeletal systems for movement**

a Illustrate the parts and describe the functions of the skeletal and muscular systems including bones muscles ligaments joints and tendons

2 **Disease is a breakdown in structures or functions of an organism Some diseases are the result of intrinsic failures of the system**

a Identify the diseases of the muscular and skeletal systems that are the result of intrinsic factors (e g muscular dystrophy and arthritis).

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III Earth Science

Unit of Study Energy Transfer in the Atmosphere

A **Structure of the Earth System**

1 **Water which covers the majority of the Earths surface circulates through the crust oceans and atmosphere in what is known as the "water cycle" Water evaporates from the Earths surface rises and cools as it moves to higher elevations condenses as rain or snow and falls to the surface where it collects in lakes oceans soil and rocks underground**

a. Identify, investigate and explain the processes of condensation evaporation precipitation and runoff using a model or diagram.
b Relate the occurrence of water in the Earths crust oceans and atmosphere to the water cycle processes
c. Analyze why precipitation occurs in the form of rain sleet hail or snow

2 **Water is a solvent As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans**

a. Classify different substances based on their solubility in water
b Infer the effects of water on the weathering of the Earths surface in terms of solubility
c. Describe how minerals (and salts) accumulate in lakes and oceans. [Concept has been taught at a previous grade level]
d Explain how acid rain forms from gases (carbon dioxide sulfur and nitrogen oxides from burning fossil fuels) dissolved in the water in the atmosphere.

3 **The atmosphere is a mixture of nitrogen oxygen, and trace gases that include water vapor**

a. Identify the gas composition of the atmosphere
b Operationally define humidity and relative humidity and relate these to weather conditions.

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4 The atmosphere has different properties at different elevations

a. Compare and contrast the physical characteristics of the different layers of the atmosphere (e g. troposphere stratosphere mesosphere thermosphere exosphere)
b. Relate the characteristics of the layers of the atmosphere (e g. temperature pressure composition of gases) to different altitudes.
c. Explain the effect of air pressure at different elevations (e g. effects on cooking, on our ears popping)

5 Clouds formed by the condensation of water vapor, affect weather and climate

a. Demonstrate and explain the formation of clouds.
b. Classify shapes and types of clouds according to elevation
c. Relate cloud types to weather events and patterns.
d. Use weather maps Internet sites with satellite images and other weather data to identify and predict weather conditions.

6 Global patterns of atmospheric movement influence local weather

a. Relate heat transfer to the movement of air masses high and low pressure areas and fronts in the atmosphere.
b. Compare characteristics and locations of global wind patterns (e g. trade winds and the jet stream), and give examples of how these global patterns can affect local weather
c. Describe how satellites and computers provide information on local and worldwide weather patterns (T)

7 Oceans have a major effect on climate because water in the oceans holds a large amount of heat

a. Relate heat transfer to the circulation of ocean currents.
b. Compare the characteristics of the Gulf Stream with other large ocean currents and their effects on climate in Eastern North America and Western Europe
c. Infer why air temperatures are more moderate in areas near large bodies of water
d. Describe where hurricanes form and their movement across the oceans.
e. Describe what happens when hurricanes move over land

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IV Physical Science

Unit of Study Physical Properties and Changes of Matter

A Properties and Changes of Properties in Matter

1 **A substance has characteristic properties such as density boiling point and solubility, all of which are independent of the amount of the sample**

a. Investigate the direct relationship between the amount of water an object displaces and the object s volume
b Relate the properties of sinking and floating to different densities of substances (hydrometer)
c Determine mass and volume of various substances and calculate their densities as mass/volume
d Define and give examples of the three states of matter Introduce plasma (e g lightning and material in neon lights) as a fourth state of matter
e Apply properties of different densities to oil spill pollution problems and life in frozen lakes and to other real world situations.
f Classify substances based on melting points boiling points and solubility data.
g Investigate and describe how solubility differences can be used to identify components of a mixture (e g chromatography)

2 **Substances often are placed in categories or groups if they react in similar ways metals are an example of such a group**

a. Distinguish among elements compounds, and mixtures.
b Use the periodic table to identify common elements in their groups.
c Distinguish metals from non-metals based on observed characteristics.
d Create models of atoms representing common elements by identifying the location and charges of the protons neutrons and electrons in the models.
e Distinguish between acids and bases using indicators
f Relate the pH scale to the colors of indicators and relative strengths of acids and bases

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3 **There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter**

a. List the most common elements and compounds found in living organisms.

b Interpret labels on foods household chemicals and over-the-counter medicines to identify common elements and compounds present

Unit of Study Machines and Work

B Motion and Forces

1 **Motion can be measured and represented on a graph**

a. Measure force required to move an object using appropriate devices (e g spring scale rubber band ruler)

b Manipulate and graph force vs distance required to move an object using a lever pulley or inclined plane without changing the total work involved

2 **If more than one force acts on an object along a straight line then the forces will reinforce or cancel one another depending on their direction and magnitude Unbalanced forces will cause changes in the speed or direction of an object s motion**

a. Construct and analyze simple machines (e.g. levers pulleys and inclined planes) to analyze forces and distances (i e. work)

b Investigate how using simple machines can reduce the force (effort) required to do the same amount of work done without a machine by increasing the distance required to move the object

c Demonstrate the change in direction of an object s motion using a machine or by interpreting diagrams or descriptions

d Describe the effect of friction on an object by using different surfaces on an inclined plane or by interpreting diagrams or descriptions.

e Investigate how machines can reduce the effect of the forces of friction and gravity

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Unit of Study Forms and Transfer of Energy

C **Energy is transferred in many ways**

1 **Energy is a property of many substances and is associated with heat light, electricity, mechanical motion, sound and the nature of a chemical**

a Identify sources of heat light sound electrical and chemical energy and mechanical motion

b Recognize and identify heat light sound, electrical and chemical energy and mechanical motion as forms of energy

2 **Energy is transferred in many ways**

a Demonstrate how mechanical energy is transformed to another form of energy (e g vibrations heat through friction)

b Demonstrate how chemical energy is transformed to another form of energy (e.g , light wands, lightning bugs batteries, and bulbs)

3 **Heat moves in predictable ways flowing from warmer to cooler objects until both reach the same temperature**

a Predict and demonstrate the effect of the flow of heat in solids liquids and gases

b Investigate the effects of temperature differences on the movement of water

c. Design an experiment that reduces the rate at which a substance melts

d Observe and compare the melting time of a substance in an insulated container vs an open container

e. Analyze how insulating factors affect the flow of heat

f Relate insulating factors to real life applications (e g building construction clothing animal covering).

g. Analyze and use examples to show how conduction convection or radiation factors enhance the flow of heat

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4 **Electrical circuits provide a means of transferring electrical energy when heat light sound and chemical changes are produced Heat light mechanical motion, or electricity might be involved in such transfers**

a Design and diagram using common pictures and symbols an electrical circuit to demonstrate energy transfer
b Relate electricity to magnetism (e.g., electromagnets and simple electric motors) using descriptions and diagrams.
c Analyze how an electric motor demonstrates energy transfers (e g chemical to electrical to mechanical motion)
d Explain how generators produce electricity from mechanical motion

5 **The sun is a major source of energy for changes on the Earth s surface**

a Measure temperature differences as the sun or a model of the sun warms different surfaces
b Graph time vs temperature of different surfaces exposed to the sun and analyze the graphs to infer factors that affect heat absorption.
c Investigate and describe practical uses of solar energy (e.g solar ovens, water heaters calculators etc)

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Grade 7

I Inquiry

A Abilities Necessary to do Scientific Inquiry

1. **Identify process skills that can be used in scientific investigations**

   a **Observe**
      1. Observe patterns of objects and events
      2. Distinguish between qualitative and quantitative observations.

   b **Classify**
      1. Arrange data in sequential order
      2. Use scientific (e.g. field guides charts periodic tables etc) and dichotomous keys for classification

   c **Measure**
      1. Select and use appropriate tools (e.g. metric ruler graduated cylinder thermometer balances spring scales stopwatches) and units (e.g. meter liter Celsius gram Newton second) to measure to the unit required in a particular situation
      2. Select and use appropriate metric prefixes to include milli- centi- and kilo-

   d **Infer**
      1. Make inferences based on observations.

   e **Predict**
      1. Predict the results of actions based on patterns in data and experiences.

2. **Design and conduct a scientific investigation**

   a. Recognize potential hazards within a scientific investigation and practice appropriate safety procedures.
   b. Pose questions and problems to be investigated
   c. Obtain scientific information from a variety of sources (such as Internet electronic encyclopedias journals community resources etc).
   d. Distinguish and operationally define independent (manipulated) and dependent (responding) variables.
   e. Manipulate one variable over time with repeated trials and controlled conditions.
   f. Collect and record data using appropriate metric measurements.

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g. Organize data in tables and graphs.
h Analyze data to construct explanations and draw conclusions.

3. **Use appropriate tools and techniques to gather, analyze and interpret data**

a. Select and use appropriate tools and technology (such as calculators computers probes thermometers, balances spring scales microscopes, binoculars, and hand lenses) to perform tests collect data and display data.
b Analyze and interpret data using computer hardware and software designed for these purposes.

4. **Develop descriptions explanations predictions and models using evidence**

a. Discriminate among observations inferences and predictions.
b Construct and/or use models to carry out/support scientific investigations

5 **Think critically and logically to make relationships between evidence and explanations**

a. Review and summarize data to show cause-effect relationships in experiments.
b State explanations in terms of independent (manipulated) and dependent (responding) variables.
c. State hypotheses in ways that include the independent (manipulated) and dependent (responding) variables.

6 **Recognize and analyze alternative explanations and predictions**

a. Analyze different ideas and explanations to consider alternative ideas.
b Accept the skepticism of others as part of the scientific process

7 **Communicate scientific procedures and explanations**

a. Use drawings written and oral expression to communicate information
b Create drawings diagrams charts tables and graphs to communicate data.
c. Interpret and describe patterns of data on drawings diagrams charts tables, graphs and maps
d Create and/or use scientific models to communicate information.

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8 **Use mathematics in all aspects of scientific inquiry**

a Use mathematics to gather organize and present data

b Use mathematics to structure convincing explanations

B **Abilities Necessary to Do Technological Design**

1 **Identify appropriate problems for technological design**

a Identify a specific need for a product

b Determine whether the product will meet the specified need

2 **Design a solution or product**

a Compare and contrast different proposals using selected criteria (e g cost time trade-off materials needed)

b Communicate ideas with drawings and simple models

3 **Implement a proposed design**

a Select suitable tools and techniques to ensure adequate accuracy

b Organize materials devise a plan and work collaboratively where appropriate

4 **Evaluate completed technological designs or products**

a Measure the quality of the product based on the original purpose or need and the degree to which it meets the needs of the users

b Suggest improvements and try proposed modifications to the design

5 **Communicate the process of technological design**

a Identify the four stages of problem solving: problem identification solution design implementation and evaluation

C **Understandings about Science and Technology**

1 **Scientific inquiry and technological design have similarities and differences**

a Compare and contrast scientific inquiry and technological design

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2 **Many different people in different cultures have made and continue to make contributions to science and technology**

a Describe examples of contributions people have made to science and technology (H N)

3 **Science and technology are reciprocal**

a Explain how science and technology are essential to each other (T)

4 **Perfectly designed solutions do not exist**

a Discuss factors that affect product design and alter the original design (T)
b Discuss risk versus benefit factors in product design (P)

5 **Technological designs have constraints**

a Describe examples of constraints on technological designs (T)
b Explain why constraints on technological design are unavoidable (T N)

6 **Technological solutions have intended benefits and unintended consequences**

II Life Science

Unit of Study Organization and Classification of Living Things

A Structure and Function in Living Systems

1 **All organisms are composed of cells — the fundamental unit of life Most organisms are single cells other organisms including humans are multicellular**

a Explain why the cell is the most basic unit of living things
b Classify organisms as single-celled (e.g bacteria algae protozoa and certain fungi) or multicellular (e.g animals [vertebrate/invertebrate])
c Give evidence to support the statement that single-celled organisms comprise the greatest biomass of life on Earth

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d Analyze the use of single-celled organisms in industry and in the production of food and problems single celled organisms can cause for humans. (T P)

2. **Cells carry on the many functions needed to sustain life They grow and divide thereby producing more cells This requires that they take in nutrients which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs**

a. Compare the major components of the cell (nucleus* cytoplasm* cell membrane* cell wall*, vacuole* mitochondrion nuclear membrane and chromosome) and their general functions (e.g. mitochondrion is the site of energy production) [The asterisk indicates that the concept has been taught at a previous grade level]
b Describe the processes of respiration (aerobic and anaerobic) growth and reproduction (asexual and sexual) removal of wastes and cellular transport (osmosis and diffusion) in cells.
c. Demonstrate diffusion and osmosis

3 **Living systems at all levels of organization demonstrate the complementary nature of structure and function Important levels of organization for structure and function include cells organs tissues organ systems whole organisms and ecosystems Specialized cells perform specialized functions in multicellular organisms Groups of specialized cells cooperate to form a tissue such as a muscle. Different tissues are in turn grouped together to form larger functional units called organs Each type of cell tissue and organ has a distinct structure and set of functions that serve the organism as a whole**

a. Compare and contrast the major structures and functions of typical plant and animal cells.*
b Observe compare and contrast different types of cells and tissues (e g. epithelial nerve, bone, blood and muscle). (T)
c. Differentiate among cells tissues organs and organ systems.
d Compare and contrast the structure and functions of cells tissues and organs in single celled and multicellular organisms
e Classify living organisms according to similarities in structure using a dichotomous key (kingdom phylum class order family genus and species)

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4 **The human organism has systems for digestion respiration* circulation* excretion movement*, control and coordination* and protection from disease These systems interact with one another [The asterisk indicates that the concept has been taught at a previous grade level]**

a. Identify the general functions of the major body systems and give examples of how these systems work together (e g respiratory and circulatory)
b Explain how the nervous and endocrine systems are regulators of activities in humans.
c. Define regulation as the process of monitoring and coordinating activities in an organism
d Illustrate the parts and describe the functions of the organs of the nervous system (e.g parts of the brain the spinal cord and nerves)
e Illustrate the parts and describe the functions of the glands of the endocrine system (e g pituitary thyroid adrenal glands and pancreas)
f Illustrate the parts and describe the functions of the digestive system including mouth, esophagus stomach, small intestine large intestine rectum liver pancreas and gall bladder
g. Design an appropriate diet and describe the effects and benefits on body functions. (P)
h Illustrate the parts and describe the functions of the organs of the excretory system including kidneys liver and urinary bladder
i Compare and contrast the human body organs and systems to other animals (e.g. earthworm frog and chicken)

5 **Disease is a breakdown in structures or functions of an organism. Some diseases are the result of intrinsic failures of the system Others are the result of damage by infection by other organisms**

a. Describe the work of scientists (e g Pasteur Fleming Salk) in the discovery and prevention of disease (H)
b Differentiate among a virus a bacterium and a protist
c. List common diseases caused by viruses (e.g. polio measles smallpox) bacteria (e.g. tetanus strep throat) and protists (e.g. malaria).
d Identify the intrinsic diseases associated with the digestive system (e.g. Crohn s disease) and the nervous and endocrine systems (e g diabetes and Parkinson s disease)

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e. Examine how health care technology has improved the quality of human life (e.g. computerized tomography [CT] artificial organs bionics magnetic resonance imaging [MRI], ultrasound) (T)

B. Regulation and Behavior

1 **All organisms must be able to obtain and use resources grow reproduce and maintain stable internal conditions while living in a constantly changing external environment**

a. Analyze the basic characteristics and needs of living things.
b. Compare and contrast how organisms use resources grow reproduce and maintain stable internal conditions (homeostasis)

2 **Regulation of an organisms internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive**

a. Contrast warm-blooded and cold-blooded animals' mechanisms to control their internal environment
b. Infer how environmental stimuli cause changes in hormone production that allow organisms to survive (e g. adrenaline is produced in response to fear or excitement)

3 **Behavior is one kind of response an organism can make to an internal or environmental stimulus A behavioral response requires coordination and communication at many levels including cells organ systems and whole organisms Behavioral response is a set of actions determined in part by heredity and in part from experience**

a. Evaluate behaviors to determine if they are inherited or learned
b. Predict an organism's response to an environmental stimulus based on its level of organization (e g. endospore formation and hibernation).

Unit of Study Genetics

C Reproduction and Heredity

1 **Reproduction is a characteristic of all living systems and essential to the continuation of every species Some organisms reproduce asexually Other organisms reproduce sexually**

a. Compare and contrast sexual and asexual reproduction

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b Account for the adaptability of species that reproduce sexually versus asexually

2 **In many species females produce eggs and males produce sperm An egg and a sperm unite to begin the development of a new individual That new individual receives genetic information from its mother (via the egg) and its father (via the sperm) Sexually produced offspring never are identical to either of their parents**

a Explain the formation of sex cells (meiosis) and the way this results in each cell having only half the genetic material needed to produce a new individual.

b Analyze how the combination of sex cells results in a new combination of genetic information different from either parent

3 **Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another Hereditary information is contained in genes located in the chromosomes of each cell Each gene carries a single unit of information An inherited trait of an individual can be determined by one or by many genes and a single gene can influence more than one trait A human cell contains many thousands of different genes**

a Identify the historical contributions and significance of discoveries of Gregor Mendel as related to genetics. (H)

b Describe the relationship between genes and chromosomes and their relationship to inherited characteristics.

c. Analyze how traits are passed from parents to offspring through pairs of genes.

d Explain how inherited traits are determined by one or many genes.

4 **The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment**

a Differentiate between dominant and recessive traits (genotypes and phenotypes)

b Categorize traits as inherited or acquired

c. Construct and use Punnett squares to explain how single genetic traits are combined and passed to offspring.

d Calculate the probability of simple phenotypes and genotypes

e. Discuss advantages and disadvantages of selective breeding genetic engineering and biomedical research (P)

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Grade 7

Unit of Study Ecology – The Biotic Environment

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D **Populations and Ecosystems**

1 **A population consists of all individuals of a species that occur together at a given place and time All populations living together and the physical factors with which they interact compose an ecosystem**

a. Describe the characteristics of populations. [The asterisk indicates that this concept has been taught at a previous grade level]
b Distinguish between populations and communities.
c Distinguish between habitats and niches.
d Differentiate between an ecosystem and a biome

2 **Populations of organisms can be categorized by the function they serve in an ecosystem All animals including humans are consumers which obtain food by eating other organisms. Decomposers primarily bacteria and fungi are consumers that use waste materials and dead organisms for food Food webs identify the relationships among producers consumers and decomposers in an ecosystem**

a. Analyze the role of producers consumers and decomposers in an ecosystem
b Identify kinds of relationships organisms have with each other (predator/prey competition)
c Analyze energy flow in a food chain and its relationship to a food web

3 **The number of organisms an ecosystem can support depends on the biotic resources available Given adequate biotic resources and no disease or predators populations (including humans) increase at rapid rates Lack of resources and other factors such as predation and climate, limit the growth of populations in specific niches in the ecosystem**

a Compare and contrast how cooperation competition and predation affect population growth.
b Analyze the effects of overpopulation within an ecosystem on the amount of resources available. (P)
c. Analyze how natural hazards (earthquakes, landslides wildfires volcanic eruptions floods and storms) affect populations. (P)

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III Earth Science

Unit of Study Ecology — The Abiotic Environment

A Structure of the Earth System

1 **Landforms are the result of a combination of constructive forces (e g deposition of sediments) and destructive forces (e g weathering and erosion)**

- a Distinguish among weathering erosion and deposition
- b Examine how physical weathering and chemical weathering break rocks into fragments.
- c Investigate and examine how the earth's surface is constantly changed by weathering erosion deposition and human impact (P)
- d Examine the effects of weathering erosion and deposition on the formation of major landform regions in South Carolina.
- e Relate the fertility of floodplains to deposition of sediments.
- f Discuss the benefits and hazards of living on a floodplain. (P)

2 **Soil consists of weathered rocks and decomposed organic material from dead plants animals and bacteria. Soils are often found in layers with each having a different chemical composition Living organisms have played many roles in the Earth system including affecting the composition of the atmosphere producing some types of rocks and contributing to the weathering of rocks**

- a Discuss how climatic conditions affect the development of soils.
- b Analyze soil properties that can be observed (soil profile composition texture particle size) and measured (permeability temperature, pH moisture) to predict soil quality
- c Explain why soil (sediments) can be a major pollutant of streams. (P)
- d Evaluate ways in which human activities have affected soil and the measures taken to control the impact (silt fences ground cover farming land use nutrient balance). (P)

3 **Water which covers the majority of the Earth s surface circulates through the crust oceans and atmosphere in what is known as the "water cycle " Water evaporates from the Earth s surface, rises and cools as it moves to higher elevations condenses as rain or snow and falls to the surface where it collects in lakes oceans soil and in rocks underground**

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a. Define groundwater runoff drainage divide and drainage basin (watershed)
b. Infer what happens to water that does not soak into the ground or evaporate
c. Analyze the factors that affect runoff
d. Differentiate between drainage divides and drainage basins using maps or aerial photography and illustrate the relationships between groundwater and surface water in a watershed (T)
e. Identify and illustrate groundwater zones including water table, zone of saturation and zone of aeration
f. Identify technologies designed to reduce sources of point and non-point water pollution. (T P)

4 **The atmosphere is a mixture of nitrogen oxygen and trace gases that include water vapor**

a. Infer how air pollution affects people and the environment
b. Infer how air pollution affects the human body
c. Analyze ways air pollution can be reduced.
d. Analyze how chemical hazards (pollutants in air water, soil, and food) affect populations and ecological succession (P)

5 **The sun is a major source of energy for changes on the Earths surface Energy is transferred in many ways**

a. Analyze the greenhouse effect and its consequences. (P)
b. Describe ways that humans may be influencing or contributing to global warming. (P)

6 **For ecosystems the major source of energy is sunlight Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis That energy then passes from organism to organism in food webs**

a. Describe how sunlight through photosynthesis is transferred by producers into chemical energy
b. Trace the path of solar energy through a simple food chain and through food webs that include humans
c. Examine how energy is transferred through an ecosystem.
d. Examine how energy is distributed in an energy pyramid.

7 **The number of organisms an ecosystem can support depends upon the abiotic factors Given adequate abiotic resources and no disease or**

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predators populations (including humans) increase at a rapid rate Lack of resources and other factors such as predation and climate limit the growth of populations in specific niches in the ecosystem

a. Compare and contrast the abiotic factors that affect population growth and size (quantity of light water range of temperatures soil compositions)
b Diagram the cycles of water carbon oxygen and nitrogen in the environment
c. Analyze the vital role of single-celled organisms (e.g. phytoplankton) in the carbon oxygen cycles.
d Examine how materials are reused in a continuous cycle in ecosystems.
e. Distinguish between renewable and nonrenewable resources and examine the importance of their conservation (P)
f Evaluate the effects of human population on air water and land (P)
g. Analyze the benefits of solid waste management (reduce reuse recycle) (T, P)

IV Physical Science

Unit of Study Chemical Nature of Matter

A. Properties and Changes of Properties in Matter

1 **Chemical elements do not break down during normal laboratory reactions involving such treatments as heating exposure to electric current or reaction with acids Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties**

a. Distinguish between physical and chemical properties.
b Distinguish between physical and chemical changes.
c. Cite examples of chemical changes in matter (e g. rusting [slow oxidation], combustion [fast oxidation] and food spoilage)

2 **In chemical reactions the total mass is conserved**

a Recognize chemical symbols and chemical formulas of common substances such as NaCl (table salt) H_2O (water) $C_6H_{12}O_6$ (sugar) O_2 (oxygen gas) CO_2 (carbon dioxide) and N_2 (nitrogen gas).
b Identify evidences of chemical reactions (e g. gas evolved color and/or temperature change precipitate formed).

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c. Determine the reactants and products in simple chemical reactions such as photosynthesis (plants) and respiration (plants and animals)
d. Explain the role of the enzymes as catalysts.
e. Use balanced chemical equations such as photosynthesis and respiration to support the law of conservation of matter
f. Explain how the total mass of matter involved in the chemical reaction does not change even when a gas is released

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I Inquiry

A Abilities Necessary to do Scientific Inquiry

1 Identify process skills that can be used in scientific investigations

a **Observe**
1. Observe patterns of objects and events.
2. Distinguish between qualitative and quantitative observations.

b **Classify**
1. Arrange data in sequential order
2. Use scientific (e.g. field guides charts periodic tables etc) and dichotomous keys for classification.

c **Measure**
1. Select and use appropriate tools (e.g. metric ruler graduated cylinder thermometer balances spring scales and stopwatches) and units (e.g. meter liter Celsius gram Newton and second) to measure to the unit required in a particular situation.
2. Select and use appropriate metric prefixes to include milli- centi- and kilo-

d **Infer**
1. Make inferences based on observations.

e **Predict**
1. Predict the results of actions based on patterns in data and experiences.

2 Design and conduct a scientific investigation

a. Recognize potential hazards within a scientific investigation and practice appropriate safety procedures.
b. Pose questions and problems to be investigated.
c. Obtain scientific information from a variety of sources (such as Internet electronic encyclopedias journals, community resources etc.)
d. Distinguish and operationally define independent (manipulated) and dependent (responding) variables.
e. Manipulate one variable over time with repeated trials and controlled conditions.
f. Collect and record data using appropriate metric measurements.

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g. Organize data in tables and graphs.
h Analyze data to construct explanations and draw conclusions.

3 **Use appropriate tools and techniques to gather analyze, and interpret data**

a. Select and use appropriate tools and technology (such as calculators computers probes thermometers balances spring scales microscopes binoculars and hand lenses) to perform tests collect data and display data.
b Analyze and interpret data using computer hardware and software designed for these purposes

4 **Develop descriptions explanations predictions and models using evidence**

a. Discriminate among observations inferences and predictions.
b Construct and/or use models to carry out/support scientific investigations

5. **Think critically and logically to make relationships between evidence and explanations**

a. Review and summarize data to show cause-effect relationships in experiments.
b State explanations in terms of independent (manipulated) and dependent (responding) variables.
c State hypotheses in ways that include the independent (manipulated) and dependent (responding) variables.

6. **Recognize and analyze alternative explanations and predictions**

7 **Communicate scientific procedures and explanations**

a. Use drawings written and oral expression to communicate information.
b Create drawings, diagrams charts tables and graphs to communicate data.
c. Interpret and describe patterns of data on drawings, diagrams charts tables graphs and maps.
d Create and/or use scientific models to communicate information

8 **Use mathematics in all aspects of scientific inquiry**

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a. Use mathematics to gather organize and present data.
b. Use mathematics to structure convincing explanations.

B. Understandings about Scientific Inquiry

1 **Different kinds of questions suggest different kinds of scientific investigations**

a. Relate how the kind of question being asked directs the type of investigation conducted (e g. observing and describing collecting experimenting surveying inventing and making models)

2 **Current scientific knowledge and understanding guide scientific investigations**

3 **Mathematics is important in all aspects of scientific inquiry**

4 **Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results**

a. Compare and contrast the quality of data collected with and without technological devices.

5 **Scientific explanations emphasize evidence have logically consistent arguments and use scientific principles models and theories**

a. Discuss how scientific knowledge advances when new scientific explanations displace previously accepted knowledge

6 **Science advances through legitimate skepticism**

7 **Scientific investigations sometimes result in new ideas and phenomena for study**

C Abilities Necessary to Do Technological Design

1 **Identify appropriate problems for technological design**

a. Identify a specific need for a product
b. Determine whether the product will meet the needs and be used

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2 **Design a solution or product**

a. Compare and contrast different proposals using selected criteria (e.g. cost time trade-off and materials needed).
b. Communicate ideas with drawings and simple models

3 **Implement a proposed design.**

a. Select suitable tools and techniques to ensure adequate accuracy
b. Organize materials devise a plan and work collaboratively where appropriate.

4 **Evaluate completed technological designs or products**

a. Measure the quality of the product based on the original purpose or need and the degree to which it meets the needs of the users.
b. Suggest improvements and try proposed modifications to the design

5 **Communicate the process of technological design**

a. Identify the four stages of problemsolving. problem identification solution design implementation and evaluation.

D Understandings about Science and Technology

1 **Scientific inquiry and technological design have similarities and differences**

a. Compare and contrast scientific inquiry and technological design.

2 **Many different people in different cultures have made and continue to make contributions to science and technology**

a. Describe examples of contributions people have made to science and technology (H N)

3 **Science and technology are reciprocal**

a. Explain how science and technology are essential to each other (T)

4 **Perfectly designed solutions do not exist**

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a. Discuss factors that affect product design and alter the original design (T)
b. Discuss risk versus benefit factors in product design (P)

5 **Technological designs have constraints**

a. Describe examples of constraints on technological designs. (T)
b. Explain why constraints on technological design are unavoidable. (T N)

6 **Technological solutions have intended benefits and unintended consequences**

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II Life Science

Unit of Study Classification, Diversity, and Adaptations of Organisms Over Time

A. Diversity and Adaptations of Organisms

1 **Millions of species of animals plants and microorganisms are alive today Although different species might look dissimilar the unity among organisms becomes apparent from an analysis of internal structures the similarity of their chemical processes and the evidence of common ancestry**

a. Observe describe and examine the diversity of organisms over time including differences and similarities based on kingdoms phyla classes (e g structure body temperature size and shape) *[This concept has been taught at a previous grade level]

2 **Biological change accounts for the diversity of species developed through gradual processes over many generations Biological adaptations which involve the selection of naturally occurring variations in populations enhance survival and reproductive success in a particular environment How a species moves obtains food reproduces and responds to danger is based in the species evolutionary history**

a. Suggest evidence of how species have adapted to changes in their habitats.

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b Analyze how an adaptation can increase an organism's chances to survive and reproduce in a particular habitat (e g, cacti needles/ leaves fur/scales) *[This concept has been taught at a previous grade level]

c. Examine how natural selection increases the variations within populations.

3 **Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival**

a. Determine the factors that contribute to an organism becoming extinct

b Explain some of the natural and human-made pressures that can cause extinction.

c. Examine ways to prevent the extinction of an organism

4 **Fossils provide important evidence of how life and environmental conditions have changed** (Earths History Earth Science) **Fossils indicate that many organisms that lived long ago are extinct Extinction of species is common Most of the species that have lived on the Earth no longer exist**

a. Examine how scientists use fossils as clues to study the Earth's past

b Observe interpret, and analyze fossilized tracks.

c List different types of fossils and infer how each formed (petrifaction mold and cast imprint)

d Demonstrate how to determine the relative age of rocks and fossils (index fossil oldest rock layer and youngest rock layer)

e Explain how scientists use technology to date rocks and fossils (e g radioactive dating). (T)

5 **The Earths processes we see today including erosion movement of lithospheric plates and changes in atmospheric composition are similar to those that occurred in the past Earths history is also influenced by occasional catastrophes such as the impact of an asteroid or comet**

a. Illustrate the principle of uniformitarianism (the concept that Earth processes over time are consistent)

b Explain how the geologic time scale is divided into units (e g. era period and epoch)

c Group different life forms according to the geologic time scale.

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III Earth Science

Unit of Study: Earth and Space Systems

A Earth in the Solar System

1 **The Earth is the third planet from the sun in the system that includes the moon the sun eight other planets and their moons and smaller objects such as asteroids and comets (solar system)**

- a. Describe the features of the planets in terms of size composition relative distance from the sun, and ability to support life
- b. Compare and contrast the Earth to other planets in terms of size composition and relative distance from the sun and ability to support life
- c. Describe the features and explain the origins of asteroids comets and meteors.

2 **The sun an average star, is central and largest body in the solar system**

- a. Describe and classify the main layers of the sun's atmosphere (corona, chromosphere, photosphere) and core.
- b. Evaluate how phenomena on the sun's surface (e.g. sunspots prominences and solar flares) affect earth.
- c. Describe how the solar wind affects Earth (e.g. auroras interference in radio television communication)

3 **Energy is a property of many substances and is associated with nuclei**

- a. Explain the process by which the sun produces energy (fusion).
- b. Compare and contrast nuclear fusion and nuclear fission.

4 **Most objects in the solar system are in regular and predictable motion which explains such phenomena as the day the year phases of the moon and eclipses**

- a. Compare and contrast the Earth's rotation and revolution as they relate to daily and annual changes.
- b. Sequence and predict the phases of the moon (e.g. waxing waning crescent new and full)
- c. Demonstrate the arrangement of the sun, the moon and the Earth during solar and lunar eclipses (include partial eclipses)

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5 **Gravity alone holds us to the Earth s surface and explains the phenomena of the tides**

a. Compare and contrast the contributions of Copernicus and Galileo. (H)
b Diagram the relative position of the sun the moon and the Earth during tides.
c Examine the effect of the sun and moon on tides.

6 **Seasons result from variations in the amount of the sun s energy hitting the surface, due to the tilt of the Earth s rotation on its axis and the length of the day**

a. Analyze how the parallel rays of the sun effect the temperature of Earth and produce different amounts of heating on Earth s surface.
b Diagram how the tilt of Earth's axis affects the seasons and the length of day
c Relate the seasons to the tilt of the Earth and the angle of the sun s rays.

7 **Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system**

a. Examine the role of gravity in keeping the components of the solar system in orbit
b Describe the relationship among gravity distance and mass on orbiting bodies.

Unit of Study Earth Processes

B **Structure of the Earth System**

1 **The solid Earth is layered with a lithosphere hot, convecting asthenosphere within the mantle and dense metallic core.**

a. Describe how seismic wave velocities support the existence of a layered Earth
b Explain the relative position density and composition of Earth s crust mantle and core
c. Differentiate among composition density and location of continental crust and oceanic crust
d Identify the lithosphere as comprised of crust and upper mantle.
e Identify the asthenosphere as the hot convecting mantle below the lithosphere

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f Compare the physical nature of the lithosphere (brittle and rigid) with the asthenosphere (plastic and flowing).
g. Examine how the lithosphere responds to tectonic forces (faulting and folding)

2 **Some changes in the solid Earth can be described as the "rock cycle" Old rocks at the Earth s surface weather forming sediments that are buried then compacted heated and often recrystallized into new rock Eventually those new rocks may be brought to the surface by the forces that drive plate motions and the rock cycle continues**

a. Identify and classify minerals that form rocks and explain how recrystallization of these minerals can take place.
b Distinguish minerals by their physical properties with a dichotomous key
c. Identify and classify common rock types based on physical characteristics (such as minerals present grain size banding or layering presence of organic material)
d Compare and contrast intrusive and extrusive igneous rocks, clastic and chemical sedimentary rocks and foliated and nonfoliated metamorphic rocks.
e Explain how igneous metamorphic and sedimentary rocks are related in a rock cycle

3 **Major geologic events such as earthquakes volcanic eruptions and mountain building result from lithospheric plate motions Landforms and sea-floor features are the result of a combination of constructive (crustal deformation volcanic eruptions deposition of sediment) and destructive (weathering erosion) processes**

a. Illustrate and summarize what causes a volcano to erupt
b Compare and contrast how volcanoes are formed at mid ocean ridges, within intra-plate regions at island arcs, and along some continental edges
c Examine how earthquakes result from forces inside Earth (tension shearing, and compression)
d Compare and contrast the three major types of seismic waves (primary secondary and surface waves).
e. Identify and investigate longitudinal and transverse waves.
f Describe how the seismograph measures seismic activity (size and type of wave).(T)

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g Demonstrate how an earthquake's epicenter is located by using seismic wave information.
h Explain the hazards that earthquakes pose to structures. (P)
i Identify ways architectural engineers design and construct buildings in earthquake prone areas (e.g. buildings use shock absorbers and are designed to bend) (T)
j Relate the occurrence of earthquakes and volcanoes to lithospheric plate boundaries using seismic data.
k. Compare and contrast constructive and destructive forces in volcanic and folded mountain building.
l Identify and interpret geological features using imagery (aerial photography and satellite) and topographic maps. (T)
m. Describe the geologic history of South Carolina including the formation of the major landform regions (Blue Ridge Piedmont, Sandhills Coastal Plains and Coastal Zone) according to the geologic time scale.
n Explain the modern distribution of continents to the movement of lithospheric plates since the formation of Pangaea.

4 **Lithospheric plates on the scales of continents and oceans move at rates of centimeters per year in response to movement in the asthenosphere**

a Explain how plate tectonics accounts for the motion of lithospheric plates and the break-up of Pangaea.
b Compare and contrast the characteristics and interactions of the three types of plate boundaries (divergent convergent and transform plate boundaries)
c Explain how the age of rocks and magnetic data on opposite sides of a divergent boundary are used to estimate the rates at which plates move.
d Explain how paleoclimate evidence of fossil records supports the theory of plate tectonics.
e Infer how subduction supports the theory of plate tectonics
f Examine how the movement of a lithospheric plate over a hot spot formed the Hawaiian Islands

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IV Physical Science

Unit of Study Forces and Motion

A Motions and Forces

1 **The motion of an object can be described by its position, direction of motion and speed and can be measured and represented on a graph**

a. Operationally define speed velocity acceleration and momentum and apply these in real world situations.
b Distinguish between speed and velocity in terms of direction.
c Create and plot a time distance line graph and make predictions based on the graph.

2 **An object that is not being subjected to a force will continue to move at a constant speed in a straight line If more than one force acts on an object along a straight line then the forces will reinforce or cancel one another depending on their direction and magnitude Unbalanced forces will cause changes in the speed or direction of an object s motion**

a. Analyze the direction and effects of forces in a variety of situations (e.g gravity and friction)
b Compare and contrast forces that are balanced and unbalanced
c Use arrows to illustrate the magnitude and direction of a force applied to an object
d Analyze the effect of an unbalanced force on an object's motion in terms of speed and direction.
e Analyze the effect of balanced forces on an object's motion in terms of speed and direction
f Predict what happens to an object at rest or an object in motion when unbalanced forces act upon it
g. Apply Newton s Laws of Motion to the way that a rocket works.
h Explain how satellites are placed in orbit around Earth
i. Describe the motion of an object in free fall
j Summarize some of the programs that have allowed people to explore space. (H)
k. Analyze the benefits generated by space explorations (e.g. food preservations fabric insulation materials) (T)
l Predict future space missions and the contributions of those missions. (H)

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Grade 8

Unit of Study Light

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B Transfer of Light Energy

1 **The sun's energy arrives as light with a range of wavelength's, consisting of visible light infrared and ultraviolet radiation**

a Identify and distinguish the components of the electromagnetic spectrum (e g infrared visible light ultraviolet)
b Compare and contrast the characteristics of waves in various parts of the electromagnetic spectrum
c. Explain how prisms and diffraction gratings refract light and produce the colors in the visible spectrum.
d Explain in terms of absorption and reflection why a certain color is seen
e Explain rainbow phenomena in terms of refraction of sunlight by water droplets in the sky
f Relate the importance of using sunscreen to the harmful effects of ultraviolet radiation on the skin. (P)

2 **Light interacts with matter by transmission (including refraction) absorption or scattering (including reflection) To see an object light from that object--emitted by or scattered from it--must enter the eye**

a Distinguish between objects producing light and objects reflecting light
b Investigate and describe the properties of reflection refraction transmission and absorption of light
c Classify objects as opaque transparent or translucent
d Distinguish between images formed in convex and concave lenses.
e Analyze how the parts of an eye interact with light to enable a person to see an object
f Explain and diagram how images are formed on plane mirrors.
g. Compare and contrast reflecting and refracting telescopes. (T)
h Compare and contrast radio telescopes and light telescopes
i Explain how space probes satellites radio and light telescopes and spectroscopes have increased our knowledge of the earth the solar system and the universe (T)

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I Inquiry

Inquiry is not an isolated unit of instruction and should be embedded throughout the content areas.

The nature of science and technology is incorporated within this area.

A **Identify Questions and Concepts that Guide Scientific Investigations**

Experimental design should demonstrate logical connections between a knowledge base and conceptual understanding.

1 Formulate a testable hypothesis based on literary research and previous knowledge.
2 Identify and select experimental variables (independent and dependent) and controlled conditions.

B **Design and Conduct Investigations**

Prior knowledge about major concepts laboratory apparatus laboratory techniques and safety should be used in designing and conducting a scientific investigation.

1. Design a scientific investigation based on the major concepts in the area being studied.
2 Select and use appropriate instruments to make the observations necessary for the investigation taking into consideration the limitations of the equipment
3 Identify technologies that could enhance the collection of data
4 Select the appropriate safety equipment needed to conduct an investigation (e g goggles aprons etc)
5 Suggest safety precautions that need to be implemented for the handling of materials and equipment used in an investigation.
6 Describe the proper response to emergency situations in the laboratory
7 Conduct a laboratory investigation with repeated trials and systematic manipulation of variables.
8 Identify possible sources of error inherent in an experimental design.
9 Organize and display data in useable and efficient formats such as tables graphs maps and cross sections.
10 Draw conclusions based on qualitative and quantitative data.
11. Discuss the impact of sources of error on experimental results
12 Communicate and defend the scientific thinking that resulted in conclusions

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C **Use Technology and Mathematics to Improve Investigations and Communications**
Scientific investigations can be improved through the use of technology and mathematics. While it is acknowledged that the SI system is the accepted measurement system in science opportunities to use the English System are encouraged

1. Select and use appropriate technologies (e g. computers, calculators CBLs) to enhance the precision and accuracy of data collection, analysis, and display
2. Discriminate between data that may be valid or anomalous.
3. Select and use mathematical formulas and calculations to extend the usefulness of laboratory measurements.
4. Draw a "best fit" curve through data points
5. Calculate the slope of the curve and use correct units for the value of the slope for linear relationships
6. Calculate interpolated and predict extrapolated data points,
7. Perform dimensional analysis calculations.

D **Formulate and Revise Scientific Explanations and Models Using Logic and Evidence**
Scientific explanations and models are developed and revised through discussion and debate

1. Construct experimental explanations or models through discussion debate logic and experimental evidence.
2. Develop explanations and models that eliminate bias and demonstrate the use of ethical principles. (P)
3. Revise explanations or models after review

E **Recognize and Analyze Alternative Explanations and Models**
Scientific criteria are used to discriminate among plausible explanations.

1. Compare current scientific models with experimental results.
2. Select and defend based on scientific criteria the most plausible explanation or model

F **Communicate and Defend a Scientific Argument**
Experimental processes data and conclusions should be communicated in a clear and logical manner

1. Develop a set of laboratory instructions that someone else can follow
2. Develop a presentation to communicate the process and conclusion of a scientific investigation

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6 **Understandings about Scientific and Technological Inquiry**
Historical scientific knowledge current research technology mathematics and logic should be the basis for conducting investigations and drawing conclusions.

1. Analyze how science and technology explain and predict relationships

   a. Defend the idea that conceptual principles and knowledge guide scientific and technological inquiry

   b. Explain how historical and current scientific knowledge influences the design interpretation and evaluations of investigations

      1. Discuss the reasons scientists and engineers conduct investigations.
      2. Defend the use of technology as a method for enhancing data collection, data manipulation and advancing the fields of science and technology
      3. Explain how mathematics is important to scientific and technological inquiry
      4. Explain why scientific models and explanations need to be based on historical and current scientific knowledge.
      5. Understand that scientific explanations must be logical supported by the evidence and open to revision

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II Life Science

A The Cell

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1 **Cells have particular structures that underlie their function Inside the cell is a concentrated mixture of thousands of different molecules which form a variety of specialized structures that carry out such cell functions as energy production transport of molecules waste disposal synthesis of new molecules and the storage of genetic material**

a Compare prokaryotic and eukaryotic cells.
b Identify the cellular structures that are responsible for energy production waste disposal molecular synthesis storage of genetic material and cell movement
c. Trace the development of the Cell theory (H)
d Discuss uses of technologies that enable in-depth studies of the cell such as microscopes ultracentrifuge techniques and radioscopy studies. (T)

2 **Most cell functions involve chemical reactions Food molecules taken into the cell react to provide the chemical constituents needed to synthesize other molecules Both breakdown and synthesis are made possible by a large set of protein catalysts called enzymes The breakdown of some of the food molecules enables the cell to store energy in specific chemicals that are used to carry out the many functions of the cell**

a Explain the role of enzymes in chemical reactions within the cell.
b Differentiate the functions of carbohydrates proteins lipids and nucleic acids in the cell.

3 **Cells store and use information to guide their functions The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins each cell requires.**

a Compare DNA and RNA
b Explain the role of the triplet codon in protein synthesis.
c. Illustrate the steps of protein synthesis

4 **Cell functions are regulated Regulation occurs through changes in the activity of the functions performed by proteins and by the selective expression of certain genes This regulation allows cells to respond to their environment and to control and coordinate cell growth and division**

a Examine the importance of DNA and proteins in cell regulation.
b Discuss mishaps in cell regulation (e g tumors). (P)

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5 **Cells can differentiate and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells In the development of these multicellular organisms the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism This differentiation is regulated through the expression of different genes**

a. Illustrate the development of both an animal and a plant multicellular organism (cells specialized cells tissues organs organ systems and organisms)

b Describe how organs and systems in both plants and animals function. *[This concept has been taught at a previous grade level]

c. Recognize that a degenerative disease involves the deterioration of the organs or tissues.

B The Molecular Basis of Heredity

1 **In all organisms the instructions for specifying the characteristics of the organism are carried in DNA a large polymer formed from subunits of four kinds (A T G and C) The chemical and structural properties of DNA explain how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "letters") and replicated (by a templating mechanism) Each DNA molecule in a cell forms a single chromosome**

a. Explain how DNA genes and chromosomes are related.

b Analyze the chemical structure of DNA.

c Explain how DNA replication occurs

d Evaluate the impact of DNA technology on society (e g., bioengineering forensics, genome project DNA fingerprinting) (T P)

2 **Most of the cells in a human contain two copies of each of 22 different chromosomes In addition there is a pair of chromosomes that determines sex a female contains two X-chromosomes and a male contains one X and one Y chromosome Transmission of genetic information to offspring occurs through egg and sperm cells that contain only one representative from each chromosome pair An egg**

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and sperm unite to form a new individual The fact that the human body is formed from cells that contain two copies of each chromosome--and therefore two copies of each gene--explains many features of human heredity such as how variations that are hidden in one generation can be expressed in the next

a. Explain the process of meiosis.
b. Make predictions concerning inheritance based on the laws of heredity
c. Discuss advancements in the study of heredity since Mendel including the chromosome theory (H)

3. **Changes in DNA (mutations) occur spontaneously at low rates Some of these changes make no difference to the organism whereas others can change cells and organisms Only mutations in germ cells can create the variation that changes an organism s offspring**

a. Discuss how both chromosomal and gene mutations might occur
b. Infer how mutations contribute to genetic diversity
c. Discuss the characteristics and molecular basis of various genetic disorders such as sickle cell anemia Tay-Sachs cystic fibrosis, and hemophilia (P)

C. Biological Evolution

1. **Species evolve over time Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers (2) the genetic variability of offspring due to mutation and recombination of genes (3) a finite supply of the resources required for life and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring**

a. Discuss evolution as a consequence of various interactions such as the number of offspring genetic variability finite supply of resources, and environmental factors.
b. Discuss the scientific evidence that illustrates change over time.

2. **Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms as well as for the striking molecular similarities observed among the diverse species of living organisms**

a. Evaluate the process of natural selection and its consequences.

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b Infer how the fossil record can reveal evolutionary changes over time.

c. Describe how carbon dating is utilized in the study of evolution. (H T)

d Discuss Charles Darwin s contribution to the study of evolution (H)

3 **Biological classifications are based on how organisms are related**

a. Investigate the modern kingdom classification system based on fossil record interpretation and similarities in structural and chemical make-up.

b Analyze the complexity of classifying organisms based on structural adaptations physiology nutritional strategies biochemical similarities genetic similarities embryological similarities and methods of reproduction.

c Justify why many scientists group viruses in a category separate from living things

D **Interdependence of Organisms**

1 **The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere**

a. Analyze how organisms interact with the biosphere as part of the geochemical cycles (carbon nitrogen phosphorous and water cycles).

b Evaluate the importance of nutrient cycles in an ecosystem.

2 **Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers**

a. Trace the flow of energy through various trophic levels.

b Assess the value of the carbon cycle to the flow of energy through the ecosystems

3 **Organisms both cooperate and compete in ecosystems The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years**

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a Relate the terms of cooperation and competition to organisms within an ecosystem.

b Evaluate how interrelationships and interdependencies of living things contribute to the homeostasis of ecosystems.

4 **Living organisms have the capacity to produce populations of infinite size but environments and resources are finite This fundamental tension has profound effects on the interactions between organisms**

a Describe and give examples of demographic characteristics of populations (e.g birth and death rates age structure and sex ratio)

b Give examples and explain how limiting factors such as water food oxygen and living space play a role in the stability of ecosystems

c Predict how interactions among organisms such as predation competition and parasitism affect population growth

d Discuss the effects of succession on terrestrial ecosystems.

e Evaluate dynamic equilibrium as a result of checks and balances within populations communities and ecosystems

5 **Human beings live within the world's ecosystems Increasingly humans modify ecosystems as a result of population growth, technology and consumption Human destruction of habitats through direct harvesting pollution atmospheric changes and other factors is threatening current global stability and if not addressed ecosystems will be irreversibly affected**

a Identify events that lead to awareness of environmental concerns such as fish kills destruction of the ozone layer global warming and decline of the bald eagle. (H)

b Discuss the conflicts that could occur between land developers and conservationists. (P)

c Debate the consequences of extinction and introduction of species within ecosystems.

d Assess the consequences of acid rain on ecosystems (P)

e Give examples of how technology has advanced the study of environmental science (T P)

E **Matter Energy and Organization in Living Systems**

1 **The energy for life primarily derives from the sun Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules These molecules can be used to assemble larger molecules**

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with biological activity (including proteins, DNA sugars, and fats) In addition the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes

a Summarize the basic process by which photosynthesis converts solar energy into chemical energy (food molecules)

b Summarize the basic aerobic and anaerobic processes by which cellular respiration breaks down food molecules into energy that can be used by cells.

2 **The chemical bonds of food molecules contain energy Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed Cells usually store this energy temporarily in phosphate bonds of a small high-energy compound called ATP**

a Analyze bond energy as it relates to food molecules

b Discuss the importance of ATP and how it is cycled.

3 **The complexity and organization of organisms accommodates the need for obtaining transforming transporting releasing and eliminating the matter and energy used to sustain the organism**

a Explain why energy is necessary for the development growth and maintenance of organisms.

b Explain homeostasis and predict the consequences of a lack of energy on homeostasis.

4 **As matter and energy flow through different levels of organization of living systems (cells organs organisms communities) and between living systems and the physical environment chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat Matter and energy are conserved in each change**

a Discuss the dynamics of energy and entropy as they apply to biological systems.

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b Analyze energy in biological systems in terms of transformation conservation and efficiency

F Behavior and Regulation

1 **Multicellular animals have nervous systems that generate behavior Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules In sense organs specialized cells detect light sound and specific chemicals and enable animals to monitor what is going on in the world around them**

a Describe how cells of multicellular animals communicate by signals conducted through a nervous system.

b Discuss the adaptive value of the reflexes such as blinking of the eye opening/closing of the iris responses to hot and cold etc

c Give examples of specialized cells such as taste buds touch receptors and rods and cones in sense organs that detect stimuli.

2 **Organisms have behavioral responses to internal change and external stimuli Responses to external stimuli can result from interactions with the organism s own species and others as well as environmental changes these responses can be either innate or learned The broad patterns of behavior exhibited by animals have evolved to ensure reproductive success Animals often live in unpredictable environments and so their behavior must be flexible enough to deal with uncertainty and change Plants also respond to stimuli**

a Investigate how different organisms maintain homeostasis.

b Give examples of feedback mechanisms.

c Explain how organisms react to pathogens.

d Assess both the positive and negative effects of introducing chemical substances into the body (P)

e Give examples that illustrate innate behavior

f Give examples of learned behavior

g Discuss tropisms in plants as responses to external stimuli

3 **Like other aspects of an organism s biology behaviors have evolved through natural selection Behaviors often have an adaptive logic when viewed in terms of evolutionary principles**

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a Give examples of common behavioral responses in organisms such as waggle dancing courtship and nesting behaviors that maximize their fitness and success.

b Evaluate how computer technology has been instrumental in collecting and analyzing data in the study of animal behavior (T)

4 **Behavioral biology has implications for humans as it provides links to psychology sociology and anthropology**

a Describe classical studies of learned behavior such as B F Skinner Jane Goodall and Dian Fossey (H)

b Give examples of how these classical studies relate to human behavior

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III Earth Science

A Energy in the Earth System

1 **Earth systems have internal and external sources of energy both of which create heat The sun is the major external source of energy Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the Earth original formation**

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a Describe how the decay of radioactive isotopes produces internal heat in the Earth
b Describe how gravitational forces led to the production of heat in the early history of the Earth and to the differentiation of the Earth into a core, mantle and crust
c Give evidence that some of that heat is still escaping from the Earths interior

2 **The outward transfer of Earths internal heat drives convection circulation in the mantle that propels the plates comprising Earths surface across the face of the globe**

a Examine how internal heat produces convection currents that are the driving force for plate tectonics
b Analyze the pros and cons of living in areas affected by natural hazards such as earthquakes, and volcanic eruptions. (P)

3 **Heating of Earths surface and atmosphere by the sun drives convection within the atmosphere Global climate is determined by energy transfer from the sun at and near the Earths surface This energy transfer is influenced by dynamic processes such as cloud cover and the Earths rotation and static conditions such as the position of mountain ranges and oceans**

a Analyze the effects of atmospheric convection, atmospheric dust and cloud cover rotation of the Earth revolution of the Earth and tilt of the Earth's rotational axis on global climates and seasons.
b Explain the factors that affect geographic variations in climate including distribution of land and water, physiographic (geologic) features and latitude effects.
c. Relate the transfer of heat energy to the patterns of wind belts.
d Compare and contrast the formation of high- and low pressure systems the formation of fronts and the movement of weather systems across the surface of the Earth.
e Analyze the pros and cons of living in areas affected by natural hazards such as hurricanes tornadoes and other severe weather (P)

4 The hydrosphere is affected by both internal and external sources of energy Solar energy drives the hydrologic cycle and produces convection in the hydrosphere The outward transfer of Earths internal heat drives hydrothermal processes (Not an NSES Standard)

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a. Describe how solar energy is transferred to ocean currents and waves.
b Investigate and describe the formation of waves and the effects of the transfer of energy as waves interact with the shore.
c. Evaluate the effectiveness of human interventions designed to reduce the effects of rising sea level and waves on coastal erosion.
d Examine the influence of heat from the Earth s interior on chemosynthesis in the marine hydrosphere.

B Geochemical Cycles

1 **The Earth is a system containing essentially a fixed amount of each stable chemical atom or element Each element can exist in several different chemical reservoirs Each element on Earth moves among reservoirs in the solid earth oceans atmosphere and organisms as part of geochemical cycles**

a. Illustrate and explain how elements such as carbon oxygen and nitrogen cycle through the atmosphere oceans rocks and living organisms.
b Analyze how the use and recovery of fossil fuels impacts the environment (T P)
c. Evaluate the importance of limiting consumption of nonrenewable resources (T P)

2 **Movement of matter between reservoirs is driven by the Earth s internal and external sources of energy These movements are often accompanied by a change in the physical and chemical properties of the matter Carbon for example occurs in carbonate rocks such as limestone in the atmosphere as carbon dioxide gas in water as dissolved carbon dioxide and in all organisms as complex molecules that control the chemistry of life**

a. Describe how the Earth s internal and external energy drives the physical and chemical changes carbon undergoes as it moves through its geochemical cycle
b Discuss how these changes affect the reservoirs.

C The Origin and Evolution of the Earth System

1 **Scientists theorize that the sun the Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4 6**

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billion years ago. The early Earth was very different from the planet we live on today

a. Describe how scientists theorize that the Solar system formed from a nebular cloud of dust and gas

b Describe changes in atmospheric conditions over time and infer possible causes including the greenhouse effect and ice age cycles

2 **Geologic time can be estimated by observing rock sequences and using fossils to correlate the sequences at various locations Current methods include using the known decay rates of radioactive isotopes present in the rock to measure the time since the rock was formed**

a. Trace the historical development of relative dating using rock sequences and fossils including the contributions of Hutton (uniformitarianism) and Lyell (crosscutting relationships and inclusions) (H N)

b Describe techniques of relative dating using rock sequences and fossils to establish a sequence of geologic events, including the age of fossils

c Describe radioactive decay as a means of dating events in the Earth s history

3 **Interactions among the solid Earth the oceans and organisms have resulted in the ongoing evolution of the Earth system We can observe some changes such as earthquakes and volcanic eruptions on a human time scale, but many processes such as mountain building and plate movements take place over hundreds of millions of years**

a. Explain how scientists conclude that processes take place and change occurs even when the change is too slow to observe directly

b Infer from surface features shown on aerial satellite and topographic maps the underlying subsurface conditions resulting from past geologic events (T)

c Infer how interactions between the atmosphere hydrosphere and solid Earth result in the formation of sedimentary rocks

d. Predict changes in the Earth s surface based on past and current geologic events (e g earthquakes volcanic activity mountain building weathering erosion and impact craters) (N)

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e Trace the historical development of the theory of plate tectonics including the contributions of Wegener (H N)

4 **Evidence for one-celled forms of life--the bacteria--extends back more than 3 5 billion years The evolution of life caused dramatic changes in the composition of the Earth s atmosphere which did not originally contain oxygen**

a Relate the dramatic changes in the composition of the Earth s atmosphere (introduction of oxygen) to the evolution of single-celled life forms.

D The Origin and Evolution of the Universe

1 **The origin of the universe remains one of the greatest questions in science The big bang theory places the origin between 10 and 20 billion years ago when the universe began in a hot dense state according to this theory the universe has been expanding ever since**

a Trace the historical development of scientific theories for the formation of and changes in the universe including the contributions of Copernicus Kepler and Galileo (H N)
b Discuss the evidence for an expanding universe.
c. Give examples of the technology used to provide evidence about the history and origin of the universe. (H N T)

2 **Early in the history of the universe matter primarily the light atoms hydrogen and helium clumped together by gravitational attraction to form countless trillions of stars Billions of galaxies each of which is a gravitationally bound cluster of billions of stars now form most of the visible mass in the universe**

a Infer how gravity and motion affect the formation of different types of galaxies.
b Identify the location of our Sun in the Milky Way galaxy

3 **Stars produce energy from nuclear reactions primarily the fusion of hydrogen to form helium These and other processes in stars have led to the formation of all the other elements**

a Describe the life cycles of stars.
b Explain the formation of elements by fusion in stars and supernova explosions

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IV Physical Science (CHEMISTRY)

A. Structure of Atoms

1 **Matter is made of minute particles called atoms and atoms are composed of even smaller components These components have measurable properties such as mass and electrical charge Each atom has a positively charged nucleus surrounded by negatively charged electrons The electric force between the nucleus and electrons holds the atom together**

- a Trace the historical development of the model of the atom including the contributions of John Dalton J J Thomson Ernest Rutherford and Neils Bohr (H N)
- b Cite the physical and chemical evidences for the existence and structure of atoms

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c Compare and contrast the component particles of the atom

2 **The atom s nucleus is composed of protons and neutrons which are much more massive than electrons When an element has atoms that differ in the number of neutrons these atoms are called different isotopes of the element**

a Trace the development of nuclear models including the contributions of the Marie and Pierre Curie, Lise Meitner and Enrico Fermi. (H N)

b Identify the charge component particles and relative mass of the nucleus.

c Explain that elements exist as isotopes which may be stable or unstable (radioactive)

3 **The nuclear forces that hold the nucleus of an atom together at nuclear distances, are usually stronger than the electric forces that would make it fly apart Nuclear reactions convert a fraction of the mass of interacting particles into energy and they can release much greater amounts of energy than atomic interactions Fission is the splitting of a large nucleus into smaller pieces Fusion is the joining of two nuclei at extremely high temperature and pressure and is the process responsible for the energy of the sun and other stars**

a Explain why like charges are able to remain in close proximity in the nucleus.

b Contrast the energy released by nuclear reactions to that released by chemical reactions.

c. Compare and contrast fission and fusion reactions showing how they are processes that convert matter to energy

d Describe fusion as the process that fuels the sun and other stars

e Debate the consequences of the development of nuclear applications such as the atomic bomb nuclear power plants and medical technologies (P)

4 **Radioactive isotopes are unstable and undergo spontaneous nuclear reactions emitting particles and/or wavelike radiation The decay of any one nucleus cannot be predicted but a large group of identical nuclei decay at a predictable rate This predictability can be used to estimate the age of materials that contain radioactive isotopes**

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a Explain that unstable isotopes undergo spontaneous nuclear decay emitting energy or particles and energy
b Apply the predictable rate of nuclear decay to estimate the age of materials.

B Structure and Properties of Matter

1 **Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus These outer electrons govern the chemical properties of the element**

a Predict the charge a representative element will acquire based on its outer electron arrangement

2 **An element is composed of a single type of atom When elements are listed in order according to the number of protons (called the atomic number) repeating patterns of physical and chemical properties identify families of elements with similar properties This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies**

a Trace the historical development of the periodic table including the contributions of Mendeleev (H N)
b Explain the arrangement of elements within a group on the periodic table based on similar physical and chemical properties
c Explain that property trends on the periodic table are a function of the elements' atomic structures.
d Determine atomic number mass number # protons # neutrons # electrons for given isotopes of elements.

3 **Bonds between atoms are created when electrons are paired up by being transferred or shared A substance composed of a single kind of atom is called an element The atoms may be bonded together into molecules or crystalline solids A compound is formed when two or more kinds of atoms bind together chemically**

a Trace the historical development of the systematic approach to the study of matter by including the contributions of Lavoisier (Law of Conservation of Matter) and Dalton (atomic theory). (H N)
b. Compare and contrast elements and compounds.

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c. Classify compounds as being crystalline solids (ionic) or molecules (covalent) based on the transfer or sharing of outer electrons.

d Predict the ratio by which the representative elements combine to form ionic compounds expressing that ratio in a chemical formula.

4 **The physical properties of compounds reflect the nature of the interactions among its molecules These interactions are determined by the structure of the molecule including the constituent atoms and the distances and angles between them**

a Relate the physical properties of compounds to their type of bonding

b Analyze the physical properties of water as they relate to water s bonding and molecular shape.

c Investigate how solubility varies among different solutes and for the same solute at different temperatures.

d Analyze the behavior of polar and nonpolar substances in forming solutions.

e Identify factors that affect the rates at which substances dissolve.

f Compare the amount of solute and solvent in concentrated and dilute mixtures.

5 **Solids liquids and gases differ in the distances and angles between molecules or atoms and therefore the energy that binds them together In solids the structure is nearly rigid in liquids molecules or atoms move around each other but do not move apart and in gases molecules or atoms move almost independently of each other and are mostly far apart**

a. Compare and contrast solids liquids and gases in terms of particle arrangement and the energy that binds them together

6 **Carbon atoms can bond to one another in chains rings and branching networks to form a variety of structures including synthetic polymers, oils and the large molecules essential to life**

a. Analyze how carbon atoms bond to one another in a variety of structures.

b Describe polymers as molecules bonded together

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c. Determine uses of aromatic compounds and polymers in everyday life (P)

d Explore investigate and list some common uses of petroleum products including manufacturing and medical applications

C **Chemical Reactions**

1 **Chemical reactions occur all around us for example in health care cooking cosmetics and automobiles Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies**

a. Explain the process of rusting in terms of electron transfer and debate the economic impact of rusting.

b Describe how metabolism is an inter-related collection of chemical reactions.

1 Explain that food is composed partially of large complex molecules that are broken down into simpler molecules. (P)

2 Analyze how these simpler molecules are rearranged into new molecules within living things. (N)

c. Explain the sources and environmental effects of some inorganic and organic toxic substances such as heavy metals and PCB's. (P)

2 **Chemical reactions may release or consume energy Some reactions such as the burning of fossil fuels release large amounts of energy by losing heat and by emitting light Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog**

a. Investigate and provide evidences of a chemical change by recording systematic observations such as change in color odor and temperature for various chemical reactions. (N)

b Recognize balanced chemical equations

c Classify reactions as energy-absorbing (endothermic) or energy-releasing (exothermic) based on temperature measurements.

d Conclude from experimental evidence that mass is neither created nor destroyed based on mass measurements. (N)

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3 **A large number of important reactions involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base reactions) between reaction ions molecules or atoms In other reactions chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels the formation of polymers and explosions**

a Differentiate between acids and bases

1 Identify the physical characteristics of acids and bases
2 Identify acids and bases in terms of their pH
3 Describe neutralization reactions
4 Explain how acid rain is formed and discuss its effects on the environment (P)
5 Evaluate the role pH plays in the development of consumer products (N P)
6 Analyze the color changes of some common indicators to distinguish among the ranges of acidic, basic and neutral solutions

b Examine the role of free radicals in atmospheric changes cellular changes, and processes such as organic synthesis and burning (N P)

4 **Chemical reactions can take place in time periods ranging from the few femtoseconds (10^{15} seconds) required for an atom to move a fraction of a chemical bond distance to geologic time scales of billions of years Reaction rates depend on how often the reacting atoms and molecules encounter one another on the temperature, and on the properties - including shape - of the reacting species Catalysts such as metal surfaces accelerate chemical reactions Chemical reactions in living systems are catalyzed by protein molecules called enzymes**

a Describe how reaction rates are a function of the collisions among particles

b Analyze the effects of temperature, particle size stirring concentration and catalysts on reaction rates

c Apply reaction rate concepts to real life applications such as food spoilage storage of film and batteries digestive aids and catalytic converters (P T)

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IV Physical Science (PHYSICS)

A Motions and Forces

1 **Objects change their motion only when a net force is applied Laws of motion are used to calculate precisely the effects of forces on the motion of objects The magnitude of the change in motion can be calculated using the relationship F=ma which is independent of the nature of the force Whenever one object exerts force on another a force equal in magnitude and opposite in direction is exerted on the first object**

a Trace the historical development of the understanding of forces including the contributions of Galileo Isaac Newton Benjamin Franklin and Charles-Augustin de Coulomb (H N)

b Predict the motion of an object in terms of Newtons three laws of motion

c. Solve uniformly accelerated linear motion problems quantitatively and graphically

d. Generate and interpret graphs of linear motion

e Cite evidence to justify the use of auto safety devices including seat belts air bags bumpers and head rests in terms of Newtons laws. (P T)

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2 **Gravitation is a universal force that each mass exerts on any other mass The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them**

a. Describe quantitative changes in gravitational attraction in terms of changes in distances between masses.

b Describe quantitative changes in gravitational attraction in terms of changes in the masses.

3 **The electric force is a universal force that exists between any two charged objects Opposite charges attract while like charges repel The strength of the force is proportional to the charges and as with gravitation inversely proportional to the square of the distance between them Between any two charged particles electric force is vastly greater than the gravitational force Most observable forces such as those exerted by a coiled spring or friction may be traced to electric forces acting between atoms and molecules**

a. Demonstrate the interactions of like and unlike charges

b Examine changes in electrostatic attraction in terms of changes in distances between two point charges.

c. Examine changes in electrostatic attraction in terms of changes in the quantities of the charges.

d Compare the magnitudes of electrical and gravitational forces.

e. Discuss the role of static electricity in disruptions and damage to electrical devices. (N P T)

4 **Electricity and magnetism are two aspects of a single electromagnetic force Moving electric charges produce magnetic forces and moving magnets produce electric forces These effects help students to understand electric motors and generators**

a. Describe how moving electrical charges produce magnetic fields.

b Describe how moving magnets produce electrical fields.

c. Compare and contrast electrical motors and electrical generators in terms of energy transfers. (N T)

d Examine the effects of the advent of electricity on individuals and society (H N P T)

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5 Analyze electrical circuits that obey Ohms Law (Not an NSES standard)

a. Construct and schematically diagram simple series circuits and parallel circuits
b Use an electric meter to measure the voltage and resistance. (T)
c. Compare and contrast series and parallel circuits.
d Perform calculations using Ohm's Law
e Explain how fuses surge protectors and breakers function (T)

B **Conservation of Energy and the Increase in Disorder**

1 **The total energy of the universe is constant Energy can be transferred by collisions in chemical and nuclear reactions by light waves and other radiations and in many other ways However it can never be destroyed As these transfers occur the matter involved becomes steadily less ordered**

a. Evaluate transformations between potential and kinetic energies and other forms of energy
b State and apply quantitative relationships between energy work power and efficiency
c. Cite or identify examples of how the disorder of matter changes with energy changes. (N)

2 **All energy can be considered to be either kinetic energy which is the energy of motion potential energy which depends on relative position or energy contained by a field, such as electromagnetic waves**

a. Classify energy types as potential kinetic or electromagnetic

3 **Heat consists of random motion and the vibrations of atoms molecules and ions The higher the temperature the greater the atomic or molecular motion**

a. Predict and measure the effects of varying the temperature pressure and volume of gases. (N)
b Assess particle motion and distance as they relate to temperature and phase changes
c Assess the hazards of handling and storing pressurized gases (P T)

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4 **Everything tends to become less organized and less orderly over time Thus in all energy transfers the overall effect is that the energy is spread out uniformly Examples are the transfer of energy from hotter to cooler objects by conduction radiation or convection and the warming of our surroundings when we burn fuels**

a. Compare and contrast the environmental impact of power plants that use fossil fuels water or nuclear energy to produce electricity (P T)

C **Interactions of Energy and Matter**

1 **Waves including sound and seismic waves waves on water and light waves have energy and can transfer energy when they interact with matter**

a. Identify and show relationships among wave characteristics such as velocity period frequency amplitude phase and wavelength.

b. Compare and contrast models of longitudinal and transverse waves.

c. Give examples of the wave behaviors of reflection refraction diffraction interference polarization, and Doppler effect

d. Compare light and sound in terms of wave models.

e. Distinguish between the electromagnetic spectrum seismic waves water waves and sound waves based on their properties and behaviors.

f. Describe the energy of a wave in terms of amplitude and frequency

g. Relate wave behavior to health issues such as skin cancer cataracts medical diagnostics and treatment (P T)

h. Relate wave behavior to communication issues such as cellular phones satellites and animal communication (P T)

i. Relate wave behavior to optical and sonic devices such as optic fibers and motion detectors. (P T)

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2 **Electromagnetic waves result when a charged object is accelerated or decelerated Electromagnetic waves include radio waves (the longest wavelength) microwaves infrared radiation (radiant heat) visible light ultraviolet radiation x-rays and gamma rays The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength**

a Compare and contrast the parts of the electromagnetic spectrum in terms of energy

3 **Each kind of atom or molecule can gain or lose energy only in particular discrete amounts and thus can absorb and emit light only at wavelengths corresponding to these amounts These wavelengths can be used to identify the substance**

a Describe how the absorbing and releasing of energy by electrons produces light
b Explain that each element has its own configuration of electrons and has a unique line spectrum that can be used to identify that element
c Discuss the application of emitted colors by certain substances in such areas as fireworks and light sources. (P T)

4 **In some materials such as metals electrons flow easily whereas in insulating materials such as glass they can hardly flow at all Semiconducting materials have intermediate behavior At low temperatures some materials become superconductors and offer no resistance to the flow of electrons.**

a Compare insulators conductors and semiconductors
b Describe the conditions under which superconductivity exists
c. Evaluate the impact of miniaturization of electric circuits upon individuals and society (H P T)

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APPENDIX A

Expert External Review Panel

Mary Anne Brearton Benchmarks for Science Literacy Project 2061

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Lawrence Lerner College of Natural Sciences and Mathematics California State University

Harold Pratt, National Research Council

Senta Raizen, National Center for Improvement of Science Education

APPENDIX B

Expert Internal Review Panel

Ann Floyd
Royall Elementary School

Tonya Collins
Brockington Elementary

Linda Foster
Clarke Middle School

Erlinda Broughton
South Middle School

Leslie Sanford
Northside Middle School

Rodney Moore
Middleton High School

Don Franklin
Battery Creek High School

Andress Carter Simms
Virginia Pack Elementary

Linda Swint
Merriwether Elementary

Debra Rood
Aiken Elementary School

Starr Bright
Branchville High School

Don Kirkpatrick
Johnakin Middle School

Laura Lutz
Emerald High School

Paula Weinspach
Chapin High School

Richard Locke
Spartanburg High School

Dr Carolyn Randolph
Lexington Two District Office

Lorraine Moore
Clifdale Elementary School

Martha Brackin
Crosswell Elementary School

Keith Nix
Sims Junior High School

Pam Walsh
JET Middle School

Connie McMorris
Newberry Middle School

Leslie Hill
Johnsonville High School

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Darlington High School

Rene Potts
Pendleton High School

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APPENDIX C

Focus Group Reviewers of the Revised Science Standards

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APPENDIX D

Glossary

Abiotic. Referring to non-living substances.

Biotic Relating to life or living things

Classify To sort or order objects and events according to their properties or attributes based on their similarities

Communicate To transfer information by use of various methods, such as oral or written language pictures maps graphs diagrams or mathematical equations.

Concept. A broad fundamental understanding that must be developed and continuously refined as the individual gains further experience

Constructivism The process of building new knowledge based on what is already known

Content What students should know and be able to do in the natural sciences over the course of K-12 education.

Controlling variables Managing the factors in an experiment necessary for the results of the experiment to be reliable

Curriculum The organization and presentation of content in the classroom

Defining operationally Stating definitions in working terms

Evolution A series of changes over time some gradual and some sporadic that accounts for the present form and function of objects organisms and natural and designed systems Evolution may refer to biological changes, geological changes and/or technological changes

Experiment To test a hypothesis through the manipulation and control of independent variables and noting the effects on a dependent variable necessary to the total scientific process uses all process skills

Extrinsic disease A disease or illness originating from a causative agent outside the body

Hypothesize Forming a generalization based on observations inferences and predictions that may be tested by one or more experiments.

Infer the use of logic to make conclusions from observations facts or recognized patterns

Inquiry a set of processes by which students and scientists pose questions plan and conduct investigations think critically about relationships, and construct and analyze explanations allows students to learn science in a way that reflects how science actually works

Interpreting data Making predictions inferences and hypotheses from a set of data

Intrinsic disease A disease originating or situated within the body or part acted on, and not caused by an external pathogen

Investigation: Conducting research and experimentation using the proper method of inquiry and tools of science, to arrive at reasonable hypotheses based on the results

Mass The amount of matter in an object

Measure To express the amount of an object or substance in quantitative terms such as area length volume or mass, proper instruments and tools must be utilized and the results in science are most often expressed in metric terminology such as meters liters and grams

Model A representation of an object idea concept or "real" thing Models may be physical, conceptual mathematical or verbal

Natural Resource. Material supplied by nature, and not made or caused by human beings, such as water, coal, forests, natural gas, etc

Nature of Science An understanding of historical perspectives, the development of science as a human endeavor, and methods of inquiry, problem solving and interpreting information

Niche The habitat supplying the factors necessary for the existence of an organism or species

Observe To use one or more of the five senses, as well as simple or complex instruments or tools to investigate the properties of objects and events

Predict to forecast a future occurrence based on past experiences prior knowledge or current observations

Process Skills The ways in which scientists gather, sort, organize, analyze and make sense of information about the world Basic skills are observing communicating, classifying and measuring Advanced skills are predicting inferring, controlling variables defining operationally and experimenting.

Qualitative Relating to characteristics or attributes

Quantitative Relating to measurement or amount

Technology The application of science to solve practical problems and design solutions or products

Theory A comprehensive logical explanation of phenomena based on currently available evidence, and capable of generating hypotheses and testable predictions about the natural world A theory may be challenged, tested and modified over time

APPENDIX E

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PLT_6208-0113

REC030904

Physical Science Course Standards

Course Description

Physical Science is designed to serve as a foundation for other high school science courses. It is a laboratory course (minimum of 30 percent hands-on investigation) that integrates principles of chemistry and physics. It emphasizes inquiry-based learning, process skills, and higher-order thinking skills Chemistry units include composition and classification of matter, atomic structure and the periodic table, and chemical bonds and reactions, together with basic nuclear chemistry Physics units include forces and motion, conservation of energy, electricity and magnetism and wave phenomena, characteristics, and behavior, including electromagnetic and sound waves. Because experimentation is the basis of science, laboratory investigations are an integral part of this course Investigative, hands-on lab activities that address the high school inquiry standards are central to effective instruction in this course

Standards in italics describe classroom learning that is essential for students to perform at a high level but that cannot be tested directly on a state assessment because of formatting, bias, technology, and sensitivity issues. However, these standards are appropriate for classroom assessment

I Inquiry

Inquiry is not an isolated unit of instruction and should be embedded throughout the content area of physical science The nature of science and technology is incorporated within this area

A Identify Questions and Concepts That Guide Scientific Investigations

Experimental design should demonstrate logical connections between a knowledge base and conceptual understanding

1 Demonstrate an understanding of the process of developing scientific hypotheses (e.g., formulate a testable hypothesis based on literature research and prior knowledge, select the correct form for a hypothesis statement based on a given scenario)
2 Identify and select experimental variables (independent and dependent) and devise methods for controlling relevant conditions.

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The term *investigate* is defined as an opportunity for students to explore questions and develop content knowledge by making observations and inferences collecting and interpreting data, and drawing tentative conclusions through the use of active learning strategies.

PLT_6208-0114

REC030905

B Design and Conduct Investigations

Science builds on prior knowledge, thus prior knowledge about major concepts, laboratory apparatus, laboratory techniques, and safety should be used in designing and conducting a scientific investigation.

1 **Demonstrate an understanding of the process of testing scientific hypotheses (e g., design and conduct a scientific investigation based on the major concepts in the area being studied)**
2 **Select and use appropriate instruments to make the observations necessary for the investigation, taking into consideration the limitations of the equipment.**
3 **Select the appropriate safety equipment needed to conduct an investigation (e g., goggles, aprons) and identify safety precautions for the handling of materials and equipment used in an investigation.**
4 **Describe the proper response to emergency situations in the laboratory**
5 **Identify possible sources of procedural error (e.g, incorrect measurement) and identify appropriate methods of control (e g , repeated trials, systematic manipulation of variables) in an experimental design**
6 **Organize and display data in useable and efficient formats, such as tables, graphs, maps, cross sections, and mathematical expressions.**
7 **Draw conclusions based on qualitative and/or quantitative data.**
8 **Discuss the impact of sources of error on experiments.**
9 **Communicate and defend the scientific thinking that has resulted in conclusions.**

C Use Technology and Mathematics to Improve Investigations and Communications

Scientific investigations can be improved through the use of technology and mathematics While it is acknowledged that the System International of Units (called the SI system) is the accepted measurement system in science, opportunities to use the U S Customary System are encouraged where appropriate.

1 **Select and use appropriate technologies (e g , computers, calculators, calculator-based laboratories [CBLs], electronic balances, calipers) to achieve appropriate precision and accuracy of data collection, analysis, and display**
2 **Discriminate between valid and questionable data.**
3 **Select and use mathematical formulas and calculations to express and interpret laboratory measurements.**
4 **Demonstrate an understanding of trends and patterns in data (e.g., calculate interpolated data points, predict extrapolated data points) and demonstrate the ability to interpret these phenomena.**
5 *Draw a "best fit curve through data points by using computer software and/or graphing calculators*

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6 Calculate the slope of the curve and use correct units for the value of the slope for linear relationships.
7 Perform dimensional analysis calculations.
8 Perform calculations using numbers expressed in scientific notation

D Formulate and Revise Scientific Explanations and Models Using Logic and Evidence

Scientific explanations and models are developed and revised through discussion and debate

1 Construct scientific explanations or models (physical, conceptual, and mathematical) by using discussion, debate, logic, and experimental evidence
2 Develop explanations and models that demonstrate scientific integrity (P)
3 Revise explanations or models.

E Recognize and Analyze Alternative Explanations and Models

Scientific criteria are used to discriminate among plausible explanations.

1 Compare current scientific models with experimental results.
2 Select and defend, on the basis of scientific criteria, the most plausible explanation or model

F Communicate and Defend a Scientific Argument

Experimental processes, data, and conclusions are communicated in a clear and logical manner

1 Develop a set of laboratory instructions that someone else can follow
2 Develop a presentation to communicate the process and the conclusion of a scientific investigation.

G Understandings about Scientific Inquiry

Historical and current scientific knowledge, current research, technology, mathematics, and logic form the basis for conducting investigations and drawing conclusions.

1 Analyze how science and technology explain and predict relationships

a Defend the idea that conceptual principles and knowledge guide scientific inquiry

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b *Discuss how the available body of scientific knowledge, historical and current, influences the design, interpretation, and evaluations of investigations*

2 Discuss the reasons why scientists and engineers conduct investigations and the methods they use to conduct these investigations.
3 Demonstrate and discuss the use of technology as a method of enhancing data collection and data manipulation and of advancing the fields of science and technology
4 Discuss how mathematics is important to scientific inquiry
5 Discuss why scientific models and explanations need to be based on the available body of scientific knowledge
6 Demonstrate the understanding that scientific explanations must be logical, supported by the evidence, and open to revision

II Physical Science (Chemistry)

A Structure of Atoms

1 **Matter is made of minute particles called atoms, and atoms are composed of even smaller components These components have measurable properties, such as mass and electrical charge Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and the electrons holds the atom together**

a. Trace the historical development of the model of the atom, including the contributions of John Dalton, J J Thomson, Ernest Rutherford, and Neils Bohr (H, N)
b Compare and contrast the component particles of the atom.

2 **The atom's nucleus is composed of protons and neutrons, which are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element**

a Trace the development of nuclear models including the contributions of Marie and Pierre Curie, Lise Meitner, and Enrico Fermi (H, N)
b Identify the charge, component particles, and mass of the nucleus
c Recognize that elements exist as isotopes, which may be stable or unstable (radioactive)
d Demonstrate the understanding that the number of protons identifies an element and is the same for all atoms of that element

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3 **The nuclear forces that hold the nucleus of an atom together, at nuclear distances, are usually stronger than the electric forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions Fission is the splitting of a large nucleus into smaller pieces Fusion is the joining of two nuclei at extremely high temperature and pressure, and is the process responsible for the energy of the sun and other stars**

a. Compare and contrast fission and fusion reactions, showing how they are processes that convert matter to energy
b Describe fusion as the process that fuels the sun and other stars.
c *Demonstrate an understanding of the consequences of the development of nuclear applications such as the atomic bomb nuclear power plants, and medical technologies* (P)

B **Structure and Properties of Matter**

1 **Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus. These outer electrons govern the chemical properties of the element**

a Determine the charge a representative element will acquire based on its outer electron arrangement.

2 **An element is composed of a single type of atom When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies**

a Trace the historical development of the periodic table including the contribution of Dmitri Mendeleev (H, N)
b Explain the arrangement of elements within a group on the periodic table based on similar physical and chemical properties.
c Explain that property trends on the periodic table are a function of the elements atomic structures.
d. Determine atomic number, mass number, the number of protons, the number of neutrons, and the number of electrons for given isotopes of elements using the periodic table

3 **Bonds between atoms are created when electrons are paired up by being transferred or shared A substance composed of a single kind of atom is called**

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an element The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically

a. Compare and contrast elements and compounds.
b Classify compounds as being ionic or covalent on the basis of the transferring or sharing of outer electrons
c Determine the ratio by which elements combine to form ionic compounds and express that ratio in a chemical formula

4 **The physical properties of a compound reflect the nature of the interactions among its molecules These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them**

a Relate the physical properties (e.g., boiling point, melting point, conductivity) of compounds to their ionic or covalent bonding
b Identify factors that affect the rates at which substances dissolve
c Compare the ratios of solute to solvent in concentrated and dilute solutions in relation to the physical properties of the solution (e g , conductivity, melting point depression)
d Analyze the behavior of polar and nonpolar substances in forming solutions.

5 **Solids, liquids, and gases differ in the distances and angles between molecules or atoms and therefore the energy that binds them together In solids the structure is nearly rigid, in liquids molecules or atoms move around each other but do not move apart, and in gases molecules or atoms move almost independently of each other and are mostly far apart.**

a. Compare and contrast solids, liquids, and gases in terms of particle arrangement and the energy that binds them together

6 **Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life**

a. Demonstrate an understanding of how carbon atoms bond to one another as simple hydrocarbons.
b Describe the formation of polymers.
c Discuss the importance of polymers as biological compounds such as proteins, carbohydrates, and lipids.
d. Determine the uses of polymers in everyday life

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C Chemical Reactions

1 **Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies**

a Demonstrate an understanding of the process of rusting in terms of electron transfer (e g , determine the number of electrons lost or gained, write and balance chemical equation for rusting, discuss the economic impact of rusting)

b Demonstrate an understanding of how metabolism is an inter-related collection of chemical reactions.

1 Demonstrate the understanding that food is composed partially of large complex molecules that are broken down into simpler molecules (P)

2 Analyze how these simpler molecules are rearranged into new molecules within living things (N)

c *Explain the sources and environmental effects of some inorganic and organic toxic substances such as heavy metals and PCBs (P)*

2 **Chemical reactions may release or consume energy Some reactions such as the burning of fossil fuels release large amounts of energy by losing heat and by emitting light. Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog**

a Investigate and provide evidence of a chemical change by recording systematic observations, such as change in color, odor, and temperature for various chemical reactions (N)

b Recognize balanced chemical equations.

c Classify reactions as energy-absorbing (endothermic) or energy releasing (exothermic) on the basis of temperature measurements.

d. Conclude from experimental evidence, based on mass measurements, that mass is neither created nor destroyed during ordinary chemical reactions (e g , balance simple synthesis and decomposition equations, conduct mass measurements before and after reactions). (N)

3 **A large number of important reactions involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base reactions) between reaction ions, molecules, or atoms In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and**

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greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions

a Differentiate between acids and bases.

1 Identify the physical and chemical characteristics of acids and bases, including their formulas, reactions with metals, and pH
2 Determine the pH ranges and strengths of acidic, basic, and neutral solutions using appropriate instruments and indicators (e g , pH meters, CBL probes, universal indicators)
3 Explain how acid rain is formed and discuss its effects on the environment (P)
4 Demonstrate an understanding of the significance of pH as related to consumer products.

4 **Chemical reactions can take place in time periods ranging from the few femtoseconds (10–15 seconds) required for an atom to move a fraction of a chemical bond distance to geologic time scales of billions of years. Reaction rates depend on how often the reacting atoms and molecules encounter one another, on the temperature, and on the properties—including shape—of the reacting species Catalysts, such as metal surfaces, accelerate chemical reactions. Chemical reactions in living systems are catalyzed by protein molecules called enzymes**

a. Demonstrate an understanding of how reaction rates are a function of the collisions among particles (i e., effects of temperature, particle size, stirring, concentration on reaction rates, and the effects of catalysts on reaction rates)
b *Apply reaction rate concepts to real-life applications such as food spoilage storage of film and batteries digestive aids and catalytic converters* (P, T)

III Physical Science (Physics)

A Motions and Forces

1 **Objects change their motion only when a net force is applied Laws of motion are used to calculate precisely the effects of forces on the motion of objects The magnitude of the change in motion can be calculated using the relationship F = ma, which is independent of the nature of the force Whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted on the first object.**

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a Trace the historical development of the understanding of forces, including the contributions of Galileo, Isaac Newton, Benjamin Franklin, and Charles-Augustin de Coulomb (H, N)
b Predict the motion of an object in terms of Newton's first law (inertia)
c Identify and investigate the factors that affect acceleration in terms of Newton's second law (F = ma)
d. Evaluate the effects of action/reaction in terms of Newton's third law
e Generate and interpret graphs of linear motion.
f Cite examples of Newton's laws that are common in everyday life (e g , using seat belts, diving from a boat, pushing a swing) (P, T)

2 **Gravitation is a universal force that each mass exerts on any other mass The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them**

a. Describe changes in gravitational attraction in terms of changes in distances between masses and in terms of changes in the masses

3 **The electric force is a universal force that exists between any two charged objects Opposite charges attract while like charges repel The strength of the force is proportional to the charges, and, as with gravitation, inversely proportional to the square of the distance between them Between any two charged particles, electric force is vastly greater than the gravitational force Most observable forces such as those exerted by a coiled spring or friction may be traced to electric forces acting between atoms and molecules**

a Demonstrate the interactions of like and unlike charges by examining changes in electrostatic attraction in terms of changes in distance between two point charges
b Demonstrate an understanding of the production and effects of static electricity (e g , its role in disruptions and damage to electrical devices destruction of property and life, everyday annoyances such as static cling) (N, P, T)

4 **Electricity and magnetism are two aspects of a single electromagnetic force Moving electric charges produce magnetic forces, and moving magnets produce electric forces These effects help students to understand electric motors and generators**

a. Demonstrate an understanding of the relationship between electricity and magnetism (e g , describe how moving electrical charges produce magnetic fields, describe how moving magnets produce electrical fields)

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b *Examine the effects of the advent of electricity on individuals and society* (H, N, P, T)

5 Analyze electrical circuits that obey Ohm s Law

a. Demonstrate an understanding of simple series and parallel circuits (e g, construct, compare, contrast, and schematically diagram simple series and parallel circuits)
b Describe the meaning of voltage and amperage.
c Perform calculations using Ohm s Law
d. Explain how fuses, surge protectors, and breakers function. (T)

B Conservation of Energy and the Increase in Disorder

1 **The total energy of the universe is constant. Energy can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in many other ways However, it can never be destroyed As these transfers occur, the matter involved becomes steadily less ordered**

a. Analyze transformations between potential and kinetic energies.
b Analyze transformations among other forms of energy such as heat, light, and sound, and mechanical, electrical, and chemical energy
c State and apply quantitative relationships among energy, work, power, and efficiency
d. Understand and apply the principles of mechanical advantage (e.g, contrast the two forces and two distances that produce mechanical advantage when a machine is used to produce work)

2 **All energy can be considered to be either kinetic energy, which is the energy of motion, potential energy, which depends on relative position, or energy contained by a field, such as electromagnetic waves**

a Classify energy types as potential, kinetic, or electromagnetic

3 **Heat consists of random motion and the vibrations of atoms, molecules, and ions The higher the temperature, the greater the atomic or molecular motion**

a. Predict and measure the effects of varying the temperature, pressure, and volume of gases (e g, balloon studies, the bends in divers, and the hazards of handling and storing pressurized gases (N, P, T)
b Describe particle motion and distance as the phase changes from liquid to solid to gas

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4 **Everything tends to become less organized and less orderly over time Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection and the warming of our surroundings when we burn fuels.**

a Demonstrate an understanding of the transfer of energy from hotter to cooler objects by conduction, radiation, and convection.

b Compare and contrast the environmental impact of power plants that use fossil fuels water or nuclear energy to produce electricity (P, T)

C **Interactions of Energy and Matter**

1 **Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter**

a. Identify and show relationships among wave characteristics such as velocity, period, frequency, amplitude, and wavelength using the formula $v = f\lambda$

b Compare and contrast models of longitudinal waves (e.g., sound waves, seismic waves) and transverse waves (e g , electromagnetic waves, water waves)

c Distinguish among the electromagnetic spectrum, seismic waves, water waves, and sound waves on the basis of their properties and behaviors.

d. Demonstrate an understanding of factors affecting wave energy (wavelength, amplitude, and frequency) and its effects on everyday life (e g , health issues, medical diagnostics and treatments)

2 **Electromagnetic waves result when a charged object is accelerated or decelerated Electromagnetic waves include radio waves (the longest wavelength), microwaves, infrared radiation (radiant heat), visible light, ultraviolet radiation, x-rays, and gamma rays The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength**

a Compare and contrast the parts of the electromagnetic spectrum in terms of velocity, wavelength, frequency, and energy using the formula $v = f\lambda$

3 **Each kind of atom or molecule can gain or lose energy only in particular discrete amounts and thus can absorb and emit light only at wavelengths corresponding to these amounts These wavelengths can be used to identify the substance**

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a. Demonstrate an understanding of how the releasing of energy by electrons produces light (e g , fireworks, neon lights, florescent lights, halogen lights)

4 **In some materials, such as metals, electrons flow easily, whereas in insulating materials such as glass they can hardly flow at all Semiconducting materials have intermediate behavior At low temperatures some materials become superconductors and offer no resistance to the flow of electrons**

a Understand and compare the functions of insulators, conductors, and semiconductors.

b Evaluate the impact of the miniaturization of electric circuits upon individuals and society (H, P, T)

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Biology 1 Course Standards

Course Description

Biology 1 is an introductory laboratory-based course (minimum of 30 percent hands-on investigation) designed to familiarize the student with the major concepts of biological science: the cell, molecular basis of heredity; biological evolution, interdependence of organisms, matter, energy, and organization in living systems, and behavior and regulation. This course provides numerous opportunities for students to develop science process skills, critical thinking, and an appreciation for the nature of science through inquiry-based learning experiences Investigative, hands-on lab activities that address the high school inquiry standards are an integral part of this course

Standards in italics describe classroom learning that is essential for students to perform at a high level but that cannot be tested directly on a state assessment because of formatting, bias, technology, and sensitivity issues However, these standards are appropriate for classroom assessment.

I Inquiry

Inquiry is not an isolated unit of instruction and should be embedded throughout the content area of physical science The nature of science and technology is incorporated within this area.

A Identify Questions and Concepts That Guide Scientific Investigations

Experimental design should demonstrate logical connections between a knowledge base and conceptual understanding

1 Demonstrate an understanding of the process of developing scientific hypotheses (e.g , formulate a testable hypothesis based on literature research and prior knowledge, select the correct form for a hypothesis statement based on a given scenario)
2 Identify and select experimental variables (independent and dependent) and devise methods for controlling relevant conditions.

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B Design and Conduct Investigations

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2 Select and use appropriate instruments to make the observations necessary for the investigation, taking into consideration the limitations of the equipment
3 Select the appropriate safety equipment needed to conduct an investigation (e g , goggles, aprons) and identify safety precautions for the handling of materials and equipment used in an investigation.
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Historical and current scientific knowledge, current research, technology, mathematics, and logic form the basis for conducting investigations and drawing conclusions

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a. Defend the idea that conceptual principles and knowledge guide scientific inquiry

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b *Discuss how the available body of scientific knowledge, historical and current, influences the design, interpretation, and evaluations of investigations*

2 Discuss the reasons why scientists and engineers conduct investigations and the methods they use to conduct these investigations
3 Demonstrate and discuss the use of technology as a method of enhancing data collection and data manipulation and of advancing the fields of science and technology
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6 Demonstrate the understanding that scientific explanations must be logical, supported by the evidence, and open to revision

II Biology

A The Cell

1 **Cells have particular structures that underlie their function Inside the cell is a concentrated mixture of thousands of different molecules which form a variety of specialized structures that carry out such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and the storage of genetic material**

a. Compare and contrast prokaryotic and eukaryotic cells
b Identify and explain the functions of the cellular structures that are responsible for energy production, waste disposal, molecular synthesis, storage of genetic material, cell movement, and active and passive transport
c Trace the development of cell theory (H)
d Discuss uses of technologies that enable in-depth studies of the cell, such as microscopes, ultracentrifuge techniques, and radioscopy studies. (T)

2 **Most cell functions involve chemical reactions Food molecules taken into the cell react to provide the chemical constituents needed to synthesize other molecules. Both breakdown and synthesis are made possible by a large set of protein catalysts, called enzymes The breakdown of some of the food molecules enables the cell to store energy in specific chemicals that are used to carry out the many functions of the cell.**

a Demonstrate an understanding of the roles of enzymes in chemical reactions within the cell

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b Differentiate among the functions of carbohydrates, proteins, lipids, and nucleic acids in the cell

3 **Cells store and use information to guide their functions The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins each cell requires**

a. Compare DNA and RNA.
b Illustrate the steps of protein synthesis and explain the role of the triplet codon in protein synthesis

4 **Cell functions are regulated Regulation occurs through changes in the activity of the functions performed by proteins and by the selective expression of certain genes This regulation allows cells to respond to their environment and to control and coordinate cell growth and division**

a Demonstrate an understanding of the importance of DNA and proteins in cell regulation.
b Discuss mishaps in cell regulation (e g tumors) (P)

5 **Cells can differentiate and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells In the development of these multicellular organisms, the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism This differentiation is regulated through the expression of different genes.**

a. Demonstrate the understanding that cells can differentiate and form complex multicellular organisms that are a highly organized arrangement of differentiated cells (e.g , illustrate the development of both an animal and a plant multicellular organism. cells specialized cells tissues, organs organ systems, and organisms)
b Determine how organs and systems in both plants and animals function as a physiological unit [Note this concept has been taught at a previous grade level]
c Evaluate how a degenerative disease involves the deterioration of organs or tissues.

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The Molecular Basis of Heredity

1. **In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A, T, G, and C) The chemical and structural properties of DNA explain how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "letters") and replicated (by a templating mechanism) Each DNA molecule in a cell forms a single chromosome.**

   a Demonstrate an understanding of the key features of DNA, genes, and chromosomes and the relationships that exist among them.
   b Analyze the chemical structure of DNA and explain how DNA replication occurs
   c *Evaluate the impact of DNA technology on society (e g bioengineering, forensics genome project, DNA fingerprinting)* (T, P)

2. **Most of the cells in a human contain two copies of each of 22 different chromosomes. In addition, there is a pair of chromosomes that determines sex a female contains two X-chromosomes and a male contains one X and one Y chromosome Transmission of genetic information to offspring occurs through egg and sperm cells that contain only one representative from each chromosome pair An egg and sperm unite to form a new individual. The fact that the human body is formed from cells that contain two copies of each chromosome—and therefore two copies of each gene—explains many features of human heredity, such as how variations that are hidden in one generation can be expressed in the next.**

   a Compare the key features and differences between mitosis and meiosis
   b Make predictions concerning inheritance based on Gregor Mendel s laws of heredity
   c Discuss significant advancements in the study of heredity since Mendel, including the chromosome theory (H)

3. **Changes in DNA (mutations) occur spontaneously at low rates Some of these changes make no difference to the organism, whereas others can change cells and organisms Only mutations in germ cells can create the variation that changes an organism's offspring**

   a Demonstrate an understanding of the characteristics and implications of both chromosomal and genetic mutations (e.g , the occurrence of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, and hemophilia) (P)
   b Demonstrate an understanding of how mutations contribute to genetic diversity

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The term *investigate* is defined as an opportunity for students to explore questions and develop content knowledge by making observations and inferences collecting and interpreting data, and drawing tentative conclusions through the use of active learning strategies.

C Biological Evolution

1 **Species evolve over time Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring**

a Demonstrate an understanding of the factors that affect evolution, such as the number of offspring, genetic variability, finite supply of resources, and environmental factors
b Demonstrate an understanding of the scientific evidence that establishes that change occurs over time

2 **Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms**

a. Demonstrate an understanding of the process of natural selection and its consequences
b Infer how a fossil record can reveal evolutionary changes over time
c Discuss the various lines of scientific evidence that underlie our understanding of the evolution and diversification of life over time
d Describe how carbon dating is utilized in the study of evolution. (H, T)
e Discuss Charles Darwin s contribution to the study of evolution (H)

3 **Biological classifications are based on how organisms are related Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships Species is the most fundamental unit of classification**

a Investigate the modern kingdom classification system, which is based on fossil record interpretation and similarities in structural and chemical makeup
b Demonstrate an understanding of how to classify organisms on the basis of structural adaptations, physiology, nutritional strategies, biochemical similarities, genetic similarities, embryological similarities, and methods of reproduction
c *Develop a working definition of living things and justify why many scientists group viruses in a category separate from living things*

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D Interdependence of Organisms

1 **The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere**

a. Demonstrate an understanding of how organisms interact with the biosphere as part of the geochemical cycles (e g , carbon, nitrogen, phosphorous, water cycles)
b Identify important nutrient cycles and evaluate how they affect ecosystems

2 **Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers**

a. Demonstrate an understanding of the flow of energy, beginning with the sun, through various trophic levels.
b Assess the value of the carbon cycle to the flow of energy through the ecosystems

3 **Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years**

a. Relate the concepts of cooperation and competition to organisms within an ecosystem.
b Evaluate how interrelationships and interdependencies of living things contribute to the homeostasis of ecosystems
c Demonstrate an understanding of how living things maintain their high level of order at the expense of increasing the disorder of their physical surroundings

4 **Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite This fundamental tension has profound effects on the interactions between organisms.**

a. *Describe and give examples of demographic characteristics of populations (e g., birth and death rates age structure sex ratio)*
b Give examples and explain how limiting factors such as water, food, oxygen, and living space play a role in the stability of ecosystems.
c Predict how interactions among organisms such as predation, competition, and parasitism affect population growth
d Demonstrate an understanding of the characteristics, stages, and implications of succession on terrestrial ecosystems
e Evaluate dynamic equilibrium as a result of checks and balances within populations, communities, and ecosystems

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5 **Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected**

a *Identify events that lead to awareness of environmental concerns such as fish kills destruction of the ozone layer global warming, and the decline of the bald eagle (H)*
b *Discuss the conflicts that could occur between land developers and conservationists* (P)
c Describe the effects of human overpopulation and activities on the survival of other species.
d *Debate the consequences of extinction and the introduction of species within ecosystems*
e Assess the consequences of acid rain on ecosystems. (P)
f *Give examples of how technology has advanced the study of environmental science* (T, P)

E **Matter, Energy and Organization in Living Systems**

1 **The energy for life primarily derives from the sun Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. These molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars, and fats) In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes**

a. Summarize the basic process by which photosynthesis converts solar energy into chemical energy (food molecules)
b Summarize the basic aerobic and anaerobic processes by which cellular respiration breaks down food molecules into energy that can be used by cells.

2 **The chemical bonds of food molecules contain energy Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed Cells usually store this energy temporarily in phosphate bonds of a small high-energy compound called ATP**

a. Analyze bond energy as it relates to food molecules.
b Discuss the importance of ATP and how it is cycled.

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3 **The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism**

a. Demonstrate an understanding of the factors involved in obtaining and processing matter and energy for the development, growth, and maintenance of organisms.

b Demonstrate an understanding of homeostasis and the effect of an energy deficit on that state

4 **As matter and energy flow through different levels of organization of living systems (cells, organs, organisms, communities) and between living systems and the physical environment, chemical elements are recombined in different ways Each recombination results in storage and dissipation of energy into the environment as heat Matter and energy are conserved in each change**

a Demonstrate an understanding of the dynamics of energy and entropy as they apply to biological systems.

b. Analyze energy in biological systems in terms of transformation, conservation, and efficiency

F **Behavior and Regulation**

1 **Multicellular animals have nervous systems that generate behavior Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules In sense organs, specialized cells detect light, sound, and specific chemicals and enable animals to monitor what is going on in the world around them**

a. Demonstrate an understanding of how cells of multicellular animals communicate through signals conducted by a nervous system.

b. Demonstrate an understanding of the adaptive value of the reflexes (e g , blinking of the eye, opening/closing of the iris, responses to hot and cold)

c Give examples of specialized cells in sense organs that detect stimuli (e g , taste buds, touch receptors, rods and cones)

2 **Organisms have behavioral responses to internal change and external stimuli Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes, these responses can be either innate or learned The broad patterns of behavior exhibited by animals have evolved to ensure reproductive success Animals often live in unpredictable**

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environments, and so their behavior must be flexible enough to deal with uncertainty and change Plants also respond to stimuli

a Investigate how different organisms maintain homeostasis.
b Give examples of feedback mechanisms.
c Identify pathogens and understand how organisms react to them.
d *Assess both the positive and the negative effects of introducing chemical substances into the body* (P)
e Give examples of innate behavior and learned behavior
f Demonstrate an understanding of tropisms in plants as responses to external stimuli

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DRAFT Earth Science

Course Competencies/Objectives with Activities and Labs

Course Code 3265

Course Description

Earth Science consists of selected topics from the fields of geology, oceanography, meteorology, and astronomy Topics are selected from these areas of study to convey to the student both an appreciation for the basic processes of science and an acquaintance with the current problems and ideas in the earth sciences. By the end of this course, students should gain a better understanding of the planet on which they live

Special Note **The standards notation in this document is based on the notation in the Science Curriculum Standards 2000 document for grades 9-12 Earth Science**

III Earth Science

A Energy in the Earth System

1 Earth systems have internal and external sources of energy, both of which create heat The Sun is the major external source of energy Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the Earth's original formation.

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Describe how the decay of radioactive isotopes produces internal heat in the Earth	• Define and give examples of isotopes and explain their role in radioactive decay	• Review physical science concepts of unstable isotopes • Diagram and label the products of radioactive decay
b Describe how gravitational forces led to the production of heat in the early history of the Earth and the differentiation of the Earth into a core, mantle, and crust	• Explain the physical concepts of gravitational force and heat production and relate them to the proximity of objects. • Relate this gravitational property to the formation of the nebula cloud theory • Define density	• Demonstrate that heat is produced when hands are rubbed together • Demonstrate difference in density of various solids and liquids

c Give evidence that some of that heat is still escaping from the Earth's interior	• Determine the factors that are contributors to heat loss • Cite specific examples of locations where heat is being released such as volcanoes and geysers	• Use some form of multimedia clips to show and examine actual volcano, earthquake, and geyser activity • Plot current earthquake and volcanic activity on a world map

III Earth Science

A Energy in the Earth System

2 The outward transfer of Earth's internal heat drives convection circulation in the mantle that propels the plates comprising Earth s surface across the face of the globe

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Examine how internal heat produces convection currents that are the driving force for plate tectonics	• Define and demonstrate convection currents • Describe sea floor spreading • Investigate plate tectonics and the evidence that lead to current thought	• Lab activity on convection currents
b Analyze the pros and cons of living in areas affected by natural hazards such as earthquakes and volcanic eruptions.	• Determine and defend your position on living in naturally hazardous areas	• Using the Internet, research sites on subjects such as Mt. St Helens and Mt Vesuvius. • Research the Charleston earthquake of 1886 and relate the information you find to earthquake activity and fault location throughout South Carolina. • Excessive amounts of uranium were recently found in well water supplies in southern Greenville County, South Carolina (winter 2000)

		Research to find the relationship between the uranium and other water pollutants and the natural faults in this area as well as other areas

III Earth Science

A Energy in the Earth System

3 Heating of Earth s surface and atmosphere by the Sun drives convection within the atmosphere Global climate is determined by energy transfer from the Sun at and near the Earth s surface This energy transfer is influenced by dynamic processes, such as cloud cover and the Earth s rotation and static conditions, such as the position of mountain ranges and oceans

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Analyze the effects of atmospheric convection, atmospheric dust and cloud cover, rotation of the Earth, revolution of the Earth, and tilt of the Earth's rotational axis on global climates and seasons	• Define convection • Discuss the effects of atmospheric pollution on climate • Determine the factors that affect seasons	• Lab activity on convection currents in air • Use a light source to demonstrate temperature differences due to angle of incidence
b Explain the factors that affect geographic variations in climate, including distribution of land and water, physiographic (geologic) features, and latitude effects	• Review major geographic areas such as mountain ranges and bodies of water and their effect on climate • Analyze the positions of land and water and determine their influence on climate	• Lab activity on heating rates of land versus water

c Relate transfer of heat energy to the patterns of wind belts	• Define Coriolis Effect • Contrast the Coriolis Effect in the northern and southern hemispheres. • Describe the relationship between the rotation of the Earth and the pattern of wind belts	• Lab activity on Coriolis Effect • Map the major wind belts
d Compare and contrast the formation of high and low-pressure systems, the formation of fronts, and the movement of weather systems across the surface of the Earth	• Classify high and low pressure systems • Define and characterize types of fronts.	• Use weather maps to explain how weather forecasts are made.
e Analyze the pros and cons of living in areas affected by natural hazards such as hurricanes, tornadoes, and other severe weather	• Give characteristics of hurricanes, tornadoes, and other severe weather • Differentiate hurricanes, tornadoes, and other severe weather systems	• Research and analyze yearly patterns of severe weather both locally and globally • Produce an emergency plan in response to severe weather conditions

III Earth Science

A Energy in the Earth System

4 The hydrosphere is affected by both internal and external sources of energy Solar energy drives the hydrologic cycle and produces convection in the hydrosphere The outward transfer of Earth's internal heat drives hydrothermal processes *(Not one of the National Science Education Standards)*

S C Standard	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Describe how solar energy is transferred to ocean currents and waves *(Not wave production)*	• Define and illustrate convection currents	• Lab activity on convection currents as they occur in a liquid.
b Investigate and describe the formation of waves and the effects of the transfer of energy as the waves interact with the shore	• Describe the formation of waves and the factors that affect wave size • Discuss the interaction of the shore and waves	• Lab activity on wave creation • Lab activities demonstrating various shoreline effects
c. Evaluate the effectiveness of human interventions designed to reduce the effects of rising sea level and waves on coastal	• Contrast the various devices used by humans in an attempt to control the sea.	• Research to find out what methods and laws are in place to reduce and/or prevent coastal erosion on South Carolina shorelines

erosion		
d Examine the influence of heat from the Earth's interior on chemosynthesis in the marine hydrosphere	• Define chemosynthesis • Analyze the effects of chemosynthesis on marine organisms	• Research to find out the relationship between marine life and ocean floor vents in volcanically active areas.

III Earth Science

B Geochemical Cycles

1 The Earth is a system containing essentially a fixed amount of each stable chemical atom or element Each element can exist in several different chemical reservoirs Each element on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of geochemical cycles

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Illustrate and explain how elements such as carbon, oxygen, and nitrogen cycle through the atmosphere, oceans, rocks, and living things.	• Review the carbon, oxygen, and nitrogen cycles	
b Analyze how the use and recovery of fossil fuels impacts the environment.	• Define fossil fuels • Discuss different mining techniques • Contrast alternative sources of energy	• Perform copper extraction from a source such as copper sulfate (activity usually found in text) • Research current reclamation methods • Debate the use of fossil fuels vs. alternative energy sources
c Evaluate the importance of	• Distinguish between nonrenewable and	• Research and debate current mining

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limiting consumption of nonrenewable resources	renewable resources	of nonrenewable resources.

III Earth Science

B Geochemical Cycles

2 Movement of matter between reservoirs is driven by the Earth's internal and external sources of energy These movements are often accompanied by a change in the physical and chemical properties of the matter Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in organisms as complex molecules that control the chemistry of life.

S C Standards	**Performance Objectives (Competencies)**	**Supporting Strategies and Activities**
a. Describe how the Earth s internal and external energy drives the physical and chemical changes carbon undergoes as it moves through its geochemical cycle	• Review the carbon cycle.	• Trace the development of fossil fuels from their origin to their economic impact.
b Discuss how these changes affect the reservoirs	• Review physical and chemical properties	

III Earth Science

C The Origin and Evolution of the Earth System

1 Scientists theorize that the Sun, the Earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4 6 billion years ago The early Earth was very different from the planet we live on today

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Describe how scientists theorize that the solar system formed from a nebular cloud of gas and dust	• Explain the nebular theory of the origin of the solar system • Describe how the planets developed • Discuss the formation of the Earth's land, atmosphere, and oceans	• Have pairs of students pictorially depict one stage of the nebular theory Ask class to identify the stages depicted and chronologically arrange them.
b Describe changes in atmospheric conditions over time and infer possible causes, including the greenhouse effect and ice age cycles	• Define greenhouse effect • Explain the role volcanic eruptions, sunlight, and plants played in the formation of the Earth s atmosphere • Predict the influence of human activities on the atmosphere	• Research and debate the existence of the greenhouse effect

III Earth Science

C The Origin and Evolution of the Earth System

2 Geologic time can be estimated by observing rock sequences and using fossils to correlate the sequences at various locations Current methods include using the known decay rates of radioactive isotopes present in the rock to measure the time since the rock was formed

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Trace the historical development of relative dating using rock sequences and fossils, including the contributions of Hutton (uniformitarianism) and Lyell (cross-cutting relationships and intrusions)	• Operationally define uniformitarianism, cross-cutting relationships, intrusion, unconformaties and superposition • Define relative dating • Differentiate between relative dating and absolute dating • Define law of superposition and describe and contrast the three types of unconformities • Discuss how geologists use rates of erosion and deposition to determine absolute age of rocks	• Lab activities using Grand Canyon rock strata data diagrams. • Research the Grand Canyon and its geologic history
b Describe techniques of relative dating using rock sequences	• Define index fossil	• Use rock sequence diagrams to illustrate occurrence of geologic

and fossils to establish a sequence of geologic events, including the age of fossils	• Describe how index fossils can be used to determine relative ages of rocks. • Describe the process of carbon dating • Cite examples of the use of carbon dating	events
c Describe radioactive decay as a means of dating events in the Earth's history	• Review radioactive decay	• Conduct a half-life activity to illustrate radioactive decay

III Earth Science

C The Origin and Evolution of the Earth System

3 Interactions among the solid Earth, the oceans, and organisms have resulted in the ongoing evolution of the Earth system. We can observe some changes such as earthquakes and volcanic eruptions on a human time scale, but many processes such as mountain building and plate movements take place over hundreds of millions of years

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Explain how scientists conclude that processes take place and change occurs, even when the change is too slow to observe directly	• Describe deformation and the forces that cause it to occur • Review uniformitarianism	• Lab activities on folding, faulting and other mountain building processes • Lab activities on plate tectonics
b Infer from surface features shown on aerial, satellite, and topographic maps the underlying subsurface conditions resulting from past geologic events	• Demonstrate the use of topographic maps	• Use South Carolina topographic maps to infer subsurface features and explain past geologic events
c. Infer how interactions between the atmosphere, hydrosphere, and solid Earth result in the formation of sedimentary rocks	• Describe the formation of sedimentary rocks • Classify sedimentry rocks	• Lab activities on deposition of sediments

d Predict changes in the Earth's surface based on past and current geologic events (e.g., earthquakes, volcanic activity, mountain building, weathering, erosion, and impact craters)	• Explain how geologists determine the history of the Appalachian Mountains • Investigate the five geologic[1] regions of South Carolina and explain their origins.	• Lab activities on weathering and erosion • Lab activities to demonstrate impact craters
e Trace the historical development of the theory of plate tectonics, including the contributions of Wegener	• Differentiate among continental drift, paleomagnetism, and sea floor spreading in relation to plate tectonics	• Lab activities to illustrate continental drift, paleomagnetism, and sea floor spreading

[1] The solidus (slash) indicates "or." Is that the meaning you intend here? The slash has been removed

III Earth Science

C The Origin and Evolution of the Earth System

4 Evidence for one celled forms of life—bacteria—extends back more than 3 5 billion years The evolution of life caused dramatic changes in the composition of the Earth s atmosphere, which did not originally contain oxygen.

S C Standards	**Performance Objectives (Competencies)**	**Supporting Strategies and Activities**
a. Relate the dramatic changes in the composition of the Earth s atmosphere (introduction of oxygen) to the evolution of single-celled life forms.[2]	• List the stages in the formation of the Earth s atmosphere and the life forms that were supported at each stage	• Use materials from the PBS production Evolution. Lesson plans and video are available from SC ITV

[2] No objectives or strategies? They have been added

III Earth Science

D The Origin and Evolution of the Universe

1 The origin of the universe remains one of the greatest questions in science The "Big Bang theory places the origin between ten and twenty billion years ago, when the universe began in a hot, dense state, according to this theory, the universe has been expanding ever since

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Trace the historical development of scientific theories for the formation of and changes in the universe, including the contributions of Copernicus, Kepler, and Galileo[1]	• Compare and contrast the contributions of early theories about the formation of the universe	• Design a children's book to illustrate the development of the universe • Use a spectroscope to explain the existence of red shift.
b Discuss the evidence for an expanding universe	• Define Doppler Effect. • Analyze the electromagnetic spectrum. • Relate the Doppler effect to red shift.	• Use Doppler Effect and electromagnetic spectrum activities to validate universe expansion. • Illustrate expanding universe with "dots on balloon" activity (Add dots to balloon and blow up balloon As balloon expands, spaces between dots

1 No objectives or strategies/We have added them

		increase)

c Give examples of the technology used to provide evidence of the history and the origin of the universe	• Differentiate the tools used by scientists to explore the univeerse	• Activities using telescopes and spectroscopes

III Earth Science

D The Origin and Evolution of the Universe

2 Early in the history of the universe, matter—primarily the light atoms hydrogen and helium—clumped together by gravitational attraction to form countless trillions of stars. Billions of galaxies, each of which is a gravitationally bound cluster of billions of stars, now form most of the visible mass in the universe

SC Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Infer how gravity and motion affect the formation of different types of galaxies [4]	• Relate the theories of gravity and motion to the formation of galaxies.	• Utilize video programs available through SC ITV and NASA
b Identify the location of our Sun in the Milky Way galaxy	• Diagram the Milky Way galaxy	• Utilize video programs available through SC ITV and NASA

[4] No objectives or strategies. We have added these.

III. Earth Science

D The Origin and Evolution of the Universe

3 Stars produce energy from nuclear reactions primarily, the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all the other elements.

S C Standards	Performance Objectives (Competencies)	Supporting Strategies and Activities
a. Describe the life cycles of stars	• Define and discuss fusion and relate it to energy production in stars.	• Trace the effects of fusion on the life cycle of a star
b Explain the formation of elements by fusion in stars and supernova explosions [5]	• Diagram the formation of elements due to fusion.	• Utilize video programs available through SC ITV or NASA

[5] No objectives or strategies? We have added them

Note to editor: Please disregard this version of physical science. The physical science has gone through several reviews for purposes of end of course testing since this version was sent to Dianne Parham. Therefore, I have attached a brand new version of physical science.

Physical Science

Course Competencies/Objectives with Activities and Labs

Course code 3211

Course Description

Physical Science is designed to serve as a foundation course for other high school sciences as well as preparation for the exit exam. It is a laboratory course that incorporates principles of chemistry and physics by emphasizing inquiry-based learning, process skills, and higher-order thinking skills. Chemistry concepts include composition and classification of matter, atomic structure and periodic table, and chemical bonds and reactions, with some nuclear chemistry. Physics concepts include forces and motion, energy and electricity, and wave characteristics and behavior including electromagnetic and sound waves. Laboratory investigations are an integral part of this course, reinforcing the experimental nature of science. Investigative, hands-on lab activities that address the high school inquiry standards are an integral part of this course.

Preface

A major objective of science instruction is to promote scientific thinking. One way to accomplish this in the laboratory is to avoid giving too much direction in experimentation. The ultimate goal would be for students to design their own experiments, including purposes, hypotheses, procedures, data collection and analysis, and conclusions. A good way to lead students to this level of thinking is to begin with experiments that have clearly-defined goals but no clearly defined procedures or equipment lists. Laboratory time must then be focused on solving problems and analyzing the components of a well-designed investigation. Much of what is performed is called "guided inquiry." Students are given a final goal to achieve and little else. Students are responsible for forming hypotheses, designing procedures, choosing equipment, recording and organizing data, performing calculations, error analyses, and conclusions. Students must learn to think for themselves in order to pose scientific questions and solve scientific problems. Activities

Pre-Chemistry Unit Composition and Classification of Matter (Solids, Liquids, Gases, Elements and Compounds, Mixtures and Solutions, Acids and Bases)

S C Standard	Performance Objectives (Competencies)	Suggested Activities and Labs
IV B 3 b Compare and contrast elements and compounds	• Given examples of substances, classify as elements or compounds based on chemical and physical properties	• Rotation lab lab stations with examples to classify • Lab—Physical and chemical properties and changes
IV B 4 e Identify factors that affect the rates at which substances dissolve	• Relate the factors of temperature, surface area, and stirring to the rate at which various substances dissolve	• Design and conduct an experiment to determine which factors increase the rate at which a substance dissolves (heating, stirring, crushing, cooling)
IV B 4 f Compare the amount of solute and solvent in concentrated and dilute mixtures	• Given a solute and a solvent, describe the differences in the preparation of a concentrated and dilute solution	• Prepare some simple concentrated and dilute solutions of tea, juice, or Kool Aid
IV B 5 a Compare and contrast solids, liquids, and gases in terms of particle arrangement and the energy that binds them together	• Given examples of solids, liquids, and gases, describe their characteristics, including the spacing of the particles relative to their energy	• Illustrate, label, and explain particle arrangements and movement in solids, liquids, and gases

IV C 3 a 1 Identify the physical characteristics of acids and bases	• Describe the physical properties of common acids and bases	• Construct a table comparing and contrasting acids and bases
IV C.3 a 2 Identify acids and bases in terms of their pH	• Use the pH scale to determine if a substance is an acid or a base (or neutral)	• Review the pH scale with regard to range for acids and bases, then draw a pH scale with common examples with regard to strong and weak acids and bases • Create solutions of various pHs using water and a selected acid and base
IV C 3 a 6 Analyze the color changes of some common indicators to distinguish among the ranges of acidic, basic, and neutral solutions	• Determine the pH of a variety of substances of unknown pH using indicators of varying pH ranges	• Determine the pH of common household substances using a variety of indicators (phenolphthalein, litmus paper, pH paper, cabbage juice, universal indicator, or appropriate tools such as a CBL probe and pH meter)

Pre-Chemistry Unit Atomic Structure and Periodic Table

S C Standard	Performance Objectives (Competencies)	Suggested Activities and Labs
IV.A 1 a Trace the historical development of the model of the atom, including the contributions of Dalton, Thomson, Rutherford, and Bohr	• Sequence atomic models in their development and determine how each scientist used information from preceding models to further the atomic theory	• Design pictures to portray models on a timeline showing ideas of each scientist and discuss factors influencing the growth of models Research each scientist (Internet), design a poster, and share his contribution to form the illustrated timeline • Power point presentation available on Frontier High School Web site (http //pc65 frontier osrhe edu) • Using marbles and a sponge hidden under a large cardboard square, design a way to determine the shape of the hidden object Relate this experience of indirect evidence to Rutherford s alpha particle bombardment of gold foil in which he discovered a nucleus
IV.A 1 c Compare and contrast the component particles of the atom.	• Compare and contrast the mass, location, and charge of each major subatomic particle	• Construct a table and interpret data from the table comparing and contrasting protons, electrons, and

		neutrons. (Example Which particles make up most of the mass of an atom?) • Make models of atoms
IV.A 2 b Identify the charge, component particles, and relative mass of the nucleus	• Identify the charge and relative mass of protons and neutrons.	• Research the charge and mass of the nucleus Discuss what is the charge of the nucleus as a whole (positive) and relate it to the charge of the atom as a whole (neutral)
IV.A 2 c Explain that elements exist as isotopes, which may be stable or unstable (radioactive)	Identify stable and radioactive/unstable[9] isotopes of elements	• Make models of isotopes of different atoms (suggested model materials plastic Easter eggs with BBs, beads, or pennies) Compare masses of isotopes of the same element and construct a table of comparison. • Identify where most radioactive isotopes of elements are found on the periodic table

[9] The solidus (slash) means "or " Is that the intended meaning here? Yes

IV.A.3 a Explain why like charges are able to remain in close proximity in the nucleus	• State an explanation for the possible role of the neutron in the nucleus	• Compare the number of protons and neutrons in hydrogen, helium, chlorine, and uranium. Identify and discuss a pattern that is observed as atoms increase in size • Discuss the role of the neutron and why particles of like charge such as protons can exist in close proximity within the nucleus
IV.A 3 c Compare and contrast fission and fusion reactions showing how they are processes that convert matter to energy	• Describe the conversion of matter into energy during fission and fusion reactions	• Using visuals as models, explain the basic differences between fission and fusion Construct a table or Venn diagram to compare and contrast fission and fusion
IV.A.3 d Describe fusion as the process that fuels the Sun and other stars	• Identify and explain fusion as the process that fuels the Sun and other stars	• Make and label a student-designed diagram of the steps of the fusion process that converts hydrogen to helium.
IV.A 3 e Debate the consequences of the development of nuclear applications such as the atomic bomb, nuclear power plants, and medical technologies.	• Describe the environmental impact and medical uses of nuclear applications	• Research and debate the various nuclear applications as related to their positive and negative consequences

IV B 2 a Trace the historical development of the periodic table, including the contributions of Gregor Mendeleev	o Identify the contributions that led to the present-day periodic table	• Research Gregor Mendeleev's development of the periodic table and further contributions of later scientists to the construction and arrangements of the table
IV B 2 b Explain the arrangement of elements within a group on the periodic table based on similar physical and chemical properties	• Classify elements into various groups/families on the periodic table according to their physical and chemical properties	• Lab Investigate the chemical behavior in the reaction of elements of similar groups. (For example, react group one and group two elements with ammonium phosphate and ammonium carbonate and observe whether precipitation occurs)
IV B 2 c Explain that property trends on the periodic table are a function of the elements atomic structure	• Examine similarities and differences between elements within a given period or group on the periodic table	• Observe and investigate visuals/diagrams for periodic trends, make predictions. ▪ Groups valence electrons, size of atoms, reactivity levels ▪ Periods metallic and nonmetallic properties, number of energy levels, ascending atomic number
IV B 2 d Determine atomic number, mass number, number of protons, number of neutrons, and number of electrons for given isotopes of elements	• Use the atomic number and mass number of an isotope of an element to determine the number of protons, neutrons, and electrons	• Given a periodic table, determine the number of subatomic particles in the isotopes of given elements

Pre-Chemistry Unit Chemical Bonding and Reactions

S C Standard	Performance Objectives (Competencies)	Suggested Activities and Labs
IV B 1 a Predict the charge a representative element will acquire based on its outer electron arrangement	• Determine the ionic charge an atom will acquire if it gains or loses electrons	• Use models or electron dot diagrams to show how electrons are gained or lost when ions are formed
IV B 3 c Classify compounds as being crystalline solids (ionic) or molecules (covalent) based on the transfer or sharing of outer electrons	• Describe the processes that form ionic and covalent bonds • Give examples of ionic compounds and covalent molecules	• Use models with representative bond connections to make examples of ionic and covalent substances. • Given a list of compounds, determine ionic and covalent compounds based on their type of bonding (transfer or sharing)
IV B 3 d Predict the ratio by which the representative elements combine to form ionic compounds, expressing that ratio in a chemical formula	• Write chemical formulas for ionic compounds	• Use the compound name and oxidation numbers to write a chemical formula for ionic compounds

IV B 4 a Relate the physical properties of compounds to their type of bonding	• Differentiate between ionic and covalent substances based on their physical properties.	• Lab—Properties of ionic and covalent compounds (e g , melting point, conductivity)
IV C 2 a Investigate and provide evidences of a chemical change by recording systematic observations, such as change in color, odor, and temperature for various chemical reactions. (N)	• Identify characteristics that indicate that a chemical reaction has taken place	• Lab—Checking out chemical changes Design several activities where substances are combined. Look for a change in the product(s) and give evidence during the reaction that a chemical change has taken place • Find examples of chemical changes in everyday life and give evidence that the change was chemical
IV C 2 b Recognize balanced chemical equations.	• Show the parts of a chemical reaction. • Describe the characteristics of a balanced equation.	• Determine the reactants and products in a chemical equation from a list of sample equations • Prove that an equation is balanced by determining the number of atoms of each element in the reactants and the products.

[1] Note references such as this one have been included inconsistently in the standards for this subject. If you wish to include notes, notes for all standards that include them must be added, and a key should be included in the preface to the charts. If notes are not desired for the standards for this course, they may be deleted where they do appear. The N does not stand for notes. It is a symbol in the standards document that is footnoted at the bottom of the page. I have deleted it since we do not use them elsewhere in this doc

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IV C 2 c. Classify reactions as energy absorbing (endothermic) or energy releasing (exothermic) based on temperature measurements.	• Distinguish between endothermic and exothermic reactions.	• Lab—"Hot pack/cold pack" Combine various designated substances and measure the temperature or feel the container for evidence of an increase or decrease in temperature
IV C 2 d Conclude from experimental evidence that mass is neither created nor destroyed based on mass measurements	• State and apply the Law of Conservation of Mass to chemical reactions.	• Lab—Showing conservation of mass in a chemical reaction Find the mass of all reactants on a balance, combine reactants in a closed system; find the mass of the products, compare (Example Alka-seltzer in a sealed container) • Determine whether a chemical equation is balanced using total mass of reactants and products.

[11] See footnote on preceding page.

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Pre-Physics Unit Forces and Motion

SC Standard	Performance Objectives (Competencies)	Suggested Activities and Labs
IV.A 1 a Trace the historical development of the understanding of forces including the contributions of Galileo, Newton, Franklin, and Coulomb (H,N)[1]	• Identify different kinds of forces. • State how Galileo and Isaac Newton have developed greater understanding of gravitational force.	• Design a concept map of different forces including (by description and/or pictures) common examples of these forces. • Research the contributions of Galileo and Isaac Newton, and prepare a time-line or presentation of this information as related to gravitation force
IV.A 1 b Predict the motion of an object in terms of Newton s three laws of motion.	• State and demonstrate the meaning of each of Newton's three laws of motion and give examples	• Lab Use equipment (dynamic carts, marbles, etc) to show the principles of the three laws. inertia, acceleration, action reaction. • Using derived units and formulas, solve problems related to Newton's laws (F = ma)
IV.A 1.d Generate and interpret graphs of linear motion	• Using data construct, label, and interpret distance-time and speed time graph	• Measure the distance and time that it takes an object (marble, tennis ball

[1] See footnote on preceding page.

	• Solve problems involving speed, velocity, and acceleration	cart) to roll down a sloped surface or move a designated distance (like a person on a track), calculate the average speed of the object. • Based on data collected from investigations or provided in a table, construct and label a line graph with appropriate variables (opportunity to use CBLs)
IV.A 1 e Cite evidence to justify the use of auto safety devices, including seat belts, air bags, bumpers, and head rests, in terms of Newton s laws	• Describe the role of inertia, acceleration, and momentum in various motions of a car and its passengers • Evaluate the role of safety devices in relation to various motions of a car and its passengers	• Role play the motions of a passenger in a car as it accelerates (slower, faster, or different directions) • Make a list of safety features you will find in a typical new car, and describe their uses as applied to Newton's laws.

Pre-Physics Unit Energy and Electricity

S C Standard	Performance Objectives (Competencies)	Suggested Activities and Labs
IV B 1 a Evaluate transformations between potential and kinetic energies and other forms of energy	• Given the highest and lowest vertical positions of a moving object, identify point at which kinetic and potential energy vary • Identify specific types of energy transformations.	• Lab Label the position of an object as it changes height (pendulum, roller coaster) to show energy transformation. • Make a list of various energy transformations common to the home and school environment.
IV B 1 b State and apply quantitative relationships among energy, work, power, and efficiency	• Describe the relationship between energy and work done, work and power, and work and efficiency • Solve mathematical problems related to work, power, and efficiency	• Given common examples, pictorial or verbal, determine how work is related to energy, power, and efficiency • Use appropriate formulas and units to calculate work, power, and efficiency from given or generated data (simple machines, motors, stair-climbing activities)
IV B 2.a Classify energy types as potential, kinetic, or electromagnetic	• Classify the types of energy as either potential or kinetic	• Generate practical examples of energy and classify them as potential or kinetic

	• Describe the energy as contained by a field such as electromagnetic waves	• Investigate how electricity can produce magnetism and magnetism can produce electricity (generators and motors)
IV B 3 b Assess particle motion and distance as they relate to temperature and phase changes	• Relate the effect of temperature on particle movement in terms of energy and distance	• Interpret a graph of phase changes generated from data collected from a phase-change lab (ice to steam) • Make a visual representation of the phase changes describing the particle motion and distance in each phase
IV B.3 c Assess the hazards of handling and storing pressurized gases	• List and evaluate the hazards of handling and storing pressurized gases.	• Safety lab/demonstration/video Refer to MSDS sheets to determine precautions and safety procedures for handling and storing pressurized gases
IV B 4.a Compare and contrast the environmental impact of power plants that use fossil fuels, water, and nuclear energy to produce electricity [redacted]	• Evaluate the advantages and disadvantages of the use of alternative sources of energy and analyze their effect on the environment.	• Research and debate the environmental impact of various sources of energy • Visit a power plant or invite guest speakers to discuss the advantages and disadvantages of alternative fuel

[11] See earlier footnotes relating to the presence of these notes on the standards.

		sources
IV.A 3.a Demonstrate the interaction of like and unlike charges.	• Examine how like and unlike charges interact.	• Investigate how like and unlike charges interact (examples include static friction[14] rod activities, pith balls, balloons, glass and amber rods with fabric, effects on an electroscope).
IV.A 3 e Discuss the role of static electricity in disruptions and damage to electronic devices.	• Explain how static electricity affects electronic devices.	• Discuss the effects of static electricity produced from lightning on appliances and the effect of power lines on disruption of cell phones and radios.
IV.A 4.d Examine the effects of the advent of electricity on individuals and society [redacted]	• Compare and contrast life before and after the introduction of electricity in a home and in the community	[redacted]

[14] The solidus (slash) means "or " Is that the meaning you wish to indicate here? [redacted]
[15] See earlier footnotes on the inclusion of notes to the standards.

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		on individuals and society.
IV.A.5.a Construct and schematically diagram simple series circuits and parallel circuits.	• Assemble, investigate, and draw diagrams of series and parallel circuits	• Construct series and parallel circuits that will turn on light bulbs. Sketch a diagram indicating which bulbs will light under different conditions.
IV.A.5.c. Compare and contrast series and parallel circuits	• Compare and contrast series and parallel circuits.	• Justify applications of each type of circuit.
IV.A.5.d Perform calculations using Ohm's Law	• Given two of the following three variables—current, resistance, and potential difference (voltage)—calculate the third variable by applying Ohm's Law	• Determine through student-designed investigations whether increasing the voltage in a circuit will increase the current in that circuit. • Solve mathematical problems related to the factors in Ohm's Law
IV.A.5.e Explain how fuses, surge protectors, and breakers function	• Describe how the safety devices in circuits work and explain the role of each	• Provide examples of fuses, surge protectors, and breakers, and discuss how they work • Use a bimetallic strip to demonstrate how a circuit breaker works • Relate the number of amps to the thickness of the wire in fuses. • Discuss the dangers of using pennies

[14] See earlier footnotes regarding the inclusion of notes on standards.

		to replace fuses • Invite an electrician to discuss this topic • Discuss how the role of a surge protector is different from a fuse and a circuit breaker

IV C 4.a Compare insulators, conductors, and semiconductors.	• Differentiate between electrical conductors, insulators, and semiconductors based on their ability to allow the movement of electrons	• Design an experiment that will investigate the conductivity property of materials • Relate the ability to move electrons to an element's position on the periodic table.
IV C 4 c Evaluate the impact of miniaturization of electric circuits upon individuals and society (H, P, D)	• Examine the effects of the advent of computers, cell phones, personal digital assistants (e g , Palm Pilots), and other technologies on the individual and society	• Debate or evaluate the significance of miniaturized circuits in your personal life and your community

[17] See earlier footnotes on the inclusion of notes to the standards.

Pre-Physics Unit Wave Characteristics and Behavior

S C Standard	Performance Objectives (Competencies)	Suggested Activities and Labs
IV C 1 b Compare and contrast models of longitudinal and transverse waves	• Categorize waves as either transverse or longitudinal (compressional)	• Create longitudinal (compressional) and transverse waves in springs or Slinkys Determine the effect the waves have on the medium. *(Student investigation)*
IV C 1 d Compare light and sound in terms of wave models	• Relate sound and light waves to the two types of waves	• Draw a diagram of a transverse light wave and longitudinal sound wave labeling the properties crest/trough or compression/rarefaction, amplitude, and wavelength of the wave • Use a long, coiled spring to demonstrate the wave characteristics.
IV C 1 e Distinguish between the electromagnetic spectrum, seismic waves, water waves, and sound waves based on their properties and behaviors	• Differentiate between various types of waves as to the wave category, properties, and behaviors (such as movement through a medium, speed, reflection/refraction/polarization)	• Make a chart/concept map of the classification, properties, and behaviors of each type of wave, including examples.

IV C 1 f Describe the energy of a wave in terms of amplitude and frequency	• Illustrate amplitude and frequency or high and low energy waves	• Use a coiled spring to investigate amplitude and frequency , Change the force on the spring to change the amplitude and frequency Note the effects • Use different pitched tuning folks and a pan of water to investigate how wave energy is related to wave frequency
IV C 1 g Relate wave behavior to health issues such as skin cancer, cataracts, medical diagnostics, and treatment.	• Investigate the negative effects of wave behavior on the human body and the contributions of waves to medical and dental examination, diagnosis, and treatment	• Research recent developments in the cause and treatment of wave-related diseases. • Invite guest speakers from the medical profession.
IV C 2 a Compare and contrast the parts of the electromagnetic spectrum in terms of energy	• Order the waves in the electromagnetic spectrum according to wavelength, frequency, and energy	• Make a sketch of the electromagnetic spectrum. Label and analyze the forms of energy according to wavelength, frequency, and energy Give common applications for different areas of the spectrum.
IV C 3 a Describe how the absorbing and releasing of energy by electrons produces light.	• Explain the energy transformations as the electrons change energy levels	• Lab—Flame test. Relate the results of these tests to fireworks • Demonstration Fluorescence of chlorophyll

Physics 1

Course Competencies/Objectives with Activities and Labs

Course Code 3241

Course Description

Physics, the most fundamental of the natural sciences, is quantitative in nature and uses the language of mathematics to describe natural phenomena This course is designed to prepare students for the demands of a two or four-year college degree program. The following topics are considered essential in a basic physics curriculum.

- Mechanics
- Electricity and magnetism
- Waves

Topics from modern physics (quantum physics, nuclear physics, etc) should be included as time permits or could be included in an advanced physics course.

Percentages following the topic headings in the charts below indicate the amount of instructional time that should be devoted to that topic

Minimum Course Requirements Successful completion of Algebra 1 or equivalent, with a B or better, and geometry; or, successful completion of Algebra 1 or equivalent, geometry, and Algebra 2

Teacher Resources

Books.

McDermott, Lillian C and the Physics Education Group at the University of Washington *Physics By Inquiry* Vols 1, 2, and 3 John Wiley and Sons, New York, 1996 [18]

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[18] City and date of publication are needed here. [redacted]

Internet

The Frontier High School Web site at Red Rock, Oklahoma, is an excellent source with templates and rubrics for graphing, reports, projects, and essays <http //pc65 frontier osrhe edu/hs/science/hsci.htm>

Frank Potter s Science Gems Great Links to Great Science Resources. For students, parents, teachers, scientists, engineers and mathematicians More than fourteen thousand science resources sorted by category, subcategory, and grade level <http.//www.sciencegems.com>

Special note to teachers **The standards notation in this document is based on the notation in the Science Curriculum Standaards 2000 document for grades 9-12, physical science section The Science Curriculum Standards 2000 document represents scientific literacy for all students Therefore standards have been expanded to include more advanced topics that should be included in a Physics course**

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Topic Motion and Forces (25%)

S C Standards	Performance Objectives (Competencies)	Suggested Activities
	• Distinguish between vector quantities (displacement, velocity, acceleration, and force) and scalar quantities (distance, speed, and mass)	
	• Illustrate how to represent vectors graphically and be able to add them both graphically and analytically	• Force table lab Graphical analysis of forces, finding the equilibrant force
IV A 1 c. Solve uniformly accelerated, linear motion problems quantitatively and graphically	• Distinguish between and solve problems involving velocity, speed, and constant [redacted]	
	• Create and interpret graphs of one-dimensional and two-dimensional motion (position vs. time, speed vs time, velocity vs. time, constant acceleration vs time)	• Motion lab (students generate and interpret position-time and velocity-time graphs) ▪ Constant velocity vehicle ▪ Analysis of constant velocity or accelerated motion, including falling bodies, using appropriate equipment (tape timer, photogate timer, CBL, etc) ▪ Motion in two-dimension lab ▪ Projectile motion

IV.A 1 b Predict the motion of an object in terms of Newton's three laws of motion.	• Explain the relationship between mass and inertia	
	• Interpret and apply Newton's first law of motion	
	• Assess, measure, and calculate the relationship among the force acting on a body, the mass of the body, and the nature of the acceleration produced (Newton's second law of motion)	• Newton's second law of motion lab Using dynamics cart with air track, smart pulleys, tape-timers, photogate timers, CBL, or other technology
	[redacted] a free body diagram to show forces acting on an object and [redacted]	
	• Qualitatively and quantitatively distinguish between static and kinetic friction, what they depend on, and their effects on the motion of objects	• Friction lab ▪ Investigation of variables affecting frictional forces. ▪ Determination of the coefficient of friction on horizontal and inclined surfaces.

	• Interpret and apply Newton's third law of motion	• Newton's third law of motion lab Action/reaction labs.
IV.A 2 a Describe quantitative changes in gravitational attraction in terms of distances between masses IV.A 2 b Describe quantitative changes in gravitational attraction in terms of changes in the masses	• Assess and calculate the nature and magnitude of gravitational forces (Newton's Law of Universal Gravitation) Apply concepts to analyze the motion of satellites.	• Kepler's Laws lab
	• Analyze and evaluate the nature of uniform circular motion	• Circular motion lab
	• Analyze, evaluate, and apply the principle of torque	

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Topic Conservation of Energy and Momentum (25%)

S C Standard	Performance Objectives (Competencies)	Suggested Activities
IV B 1 b State and apply quantitative relationships among energy, work, power, and efficiency	• Describe and apply the relationships between energy, work, power, and efficiency both conceptually and quantitatively	• Use simple machines to calculate work, power, and efficiency.
IV B 1 a Evaluate transformations between potential and kinetic energies and other forms of energy	• Analyze energy of position and energy of motion.	• Pendulum lab Strobe photography to analyze the motion of a pendulum.
	• Analyze, evaluate, and apply the principle of conservation of mechanical energy	• Conservation of energy lab ▪ Expanded pendulum lab ▪ Inclined plane. ▪ Playground or amusement park physics ▪ Interface lab (CBL Smart Pulley)
	• Analyze and measure the transfer of mechanical energy through work.	• Hooke's Law lab

	◦ Assess the vector nature of momentum and its dependency on mass and velocity of an object.	
	• Compare and contrast impulse and the change in momentum.	
	• Analyze the factors required to produce a change in momentum.	
	• Apply the conservative laws to inelastic and elastic collisions	• Conservation of momentum lab (using ballistic pendulum, air track, dynamics carts, etc)

Topic Heat and Heat Transfer (5%)

S C Standard	Performance Objectives (Competencies)	Suggested Activities
IV B 3 c Assess particle motion and distance as they relate to temperature and phase changes.	• Relate thermal energy to molecular motion	
	• Differentiate between specific heat and heat capacity temperature and heat	
	• Explain the relationship between temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance	• Specific heat lab Calorimetry experiment.
	• Calculate the heat associated with phase changes	• Latent heat lab Calorimetry experiment.

Topic Electromagnetism (25%)

S C Standard	Performance Objectives (Competencies)	Suggested Activities
IV.A 1 a. Trace the historical development of the understanding of forces, including the contributions of Galileo, [redacted] Coulomb	• Explain the contributions [redacted] to the understanding of electrical phenomena.	
IV.A 3 a. Demonstrate the interactions of like and unlike charges	• Recognize the characteristics of static charge, and explain how a static charge is generated	
IV.A 3.a Examine changes in electrostatic attraction in terms of changes in distances between two point charges. IV.A.3 b Examine changes in electrostatic attraction in terms of changes in the quantities of the charges	• Interpret and apply Coulomb s Law	• [redacted]

	• Explain the difference in concept between electric forces and electric fields [redacted]	• [redacted]
IV A 5 d Perform calculations using Ohm s Law	• Develop a qualitative and quantitative understanding of current, voltage, and resistance and the [redacted] between them. [redacted]	• Ohm s Law lab
	• Identify appropriate units of measurement for current, voltage, and resistance and explain how they are measured	

IV.A.5 a Construct and schematically diagram simple series circuits and parallel circuits **IV.A.5 b** Use an electric meter to measure the voltage and resistance in a circuit. **IV A 5 c** Compare and contrast series and parallel circuits	• Analyze and measure the relationship among current, voltage, and resistance in electrical circuits.	• Resistors in series and parallel lab
	• Calculate the electric power and electric energy for DC circuits • Predict the cost of operating a given electrical device	• Joule heat lab
IV.A 5 e Explain how fuses, surge protectors, and breakers function.	• Explain how fuses, surge protectors, and breakers function	
IV A 4 a. Describe how moving electrical charges produce magnetic fields **IV.A 4 b** Describe how moving magnets produce electrical fields.	• Analyze magnetic forces on current carrying wires and moving charges and the production of electrical fields by moving magnets.	

IV.A 4 c Compare and contrast electrical motors and electrical generators in terms of energy transfers	• Compare and contrast electric motors and generators	• [redacted]
	• Explain the production of electricity using Faraday's Law	• Genco lab