SCIENCE

K – 12

COURSE OF STUDY

Olmsted Falls City Schools

June 2007

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STATEMENT OF APPROVAL

The Olmsted Falls Science graded course of study K – 12 was developed by a District Science Committee. It was designed to implement the new Ohio Science Academic Content Standards for the development of a graded Science Course of Study and will be articulated and implemented through in-service meetings to administrators and teachers.

This course of study will serve to stimulate further improvements of the science program. All Olmsted Falls staff members are charged with the responsibility of using this course of study regularly and consistently in the development and presentation of the best instructional program possible for the Olmsted Falls students.

The K – 12 course of study will be approved by the Olmsted Falls Board of Education and disseminated to all appropriate teachers and administrators for implementation.

The Olmsted Falls Science Course of Study provides all students in the kindergarten through 12^{th} grade program with a set of clear and rigorous expectations. The science standards focus on what all Ohio students need to know and be able to do for scientific literate citizenship, regardless of age, gender, cultural or ethic background, disabilities or aspirations in science.

SCIENCE PHILOSOPHY
K - 12

A general knowledge of science is important to all members of society to ensure a good understanding of the unity and diversity of the world and the issues and problems of the ever-changing technological age in which we live. Today's learner needs to be prepared to identify problems, sort out issues, recognize and synthesize scientific knowledge and processes, develop scientific skills necessary to solving problems and resolving issues, and make informed, evidence-based decisions in a wide variety of contexts.

Basic skills in organizing and interpreting information, measuring, reasoning logically, and problem solving are not unique to science but apply to one's everyday life. Individuals must be able to use their education not only to survive and exist, but also to meet the demands and problems of change, assure the welfare of humankind, sustain human progress, and protect and preserve our environment.

The Science Content Standards serve as a base for what students should know and be able to do by the time they graduate from high school. These standards, benchmarks, and grade level indicators provide a set of common experiences for all students on which our Course of Study is based. The intent of these standards and the Olmsted Falls K – 12 Science Course of Study is to:

- Foster an understanding of the nature of science, the development of science processes, the principles of science, and the connections between the physical, life, and earth and space sciences.
- Prepare students to use appropriate scientific processes and principles in making personal decisions.
- Increase their future economic productivity through the use of scientific knowledge, understanding and skills in their careers.

In the classroom, these activities should involve inquiry learning, hands-on interaction, and evidence based decisions in a cooperative environment to promote natural and life-long learning.

RECOMMENDATION FOR PROGRAM ADOPTION

This course of study is recommended for approval by the following study committee members:

Patty Michaels
Marty Simon
Karen Kolozvary
Cheryl Keith
Karen Gommel
Michelle LaGruth
Gina Pilko
Mike Moore
Cindy Bennett
Susan Chaplin
Bobbie Thompson
Pat Donahue
Lynette Bock
Lisa Whitney
Carol Rami

The course of study was approved by the Olmsted Falls Board of Education at its meeting on

June, 2007

Olmsted Falls Board of Education

PHILOSOPHY and GOALS

The Board of Education of the Olmsted Falls School District believes that each student participate in a school program that provides learning experiences which are intended to result in intellectual and personal growth.

A. Physical and mental health.

B. Moral and ethical values.

C. An appreciation of one's relation to the family, community, state, nation, and world.

D. Individual abilities and the use of them to reach the individual's fullest potential.

E. Skills for participation in our democratic way of life.

F. Skills of communication.

G. Skills which will help in vocational endeavors.

H. Scientific and aesthetic skills and appreciation.

I. Constructive utilization of leisure time.

J. A desire for continued self-advancement.

K. A desire to excel.

L. Curiosity.

M. An excitement for learning.

INTRODUCTION

The Olmsted Falls Science Course of Study has been developed using the best available resources detailing best practice in the field of science instruction. The principal of these resources include the Ohio Department of Education's Academic Content Standards for K – 12 Science, and The Science and Mathematics Achievement Required for Tomorrow Consortium's (SMART) Course of Study.

The Olmsted Falls Course of Study is based on these standards that provide all students in the K- 12 program with a set of clear and rigorous expectations and serve as the fundamental core for this course of study. The Science Standards focus on what all students need to know and be able to do for scientific literate citizenship, regardless of age, gender, cultural or ethnic background, disabilities, or aspirations in science.

The Science Standards include science concepts, processes, and ways of thinking. All students can apply these skills and understanding to make informed personal decisions, to accurately communicate with a variety of audiences, to become life-long learners, and to make successful transitions to post-secondary education and the work force. The standards also include expectations for all students to safely and effectively use technological tools for learning and doing science. The Science Academic Content Standards are listed below:

Content Standards:
- Earth and Space Sciences
- Physical Sciences
- Life Sciences
- Science and Technology
- Scientific Inquiry
- Scientific Ways of Knowing

The Science Standards identify essential expectations for students: concepts, principles, theories, and understanding how science is done. The science standards describe broad areas of content such as the interdependence of organisms, the interactions of matter and energy, objects in the sky, and the nature of scientific knowledge. The six standards address essential knowledge and skills in science that people may use in solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning.

The Science Standards provide for teaching and learning opportunities that include accurate and technically precise science information, scientific inquiry, technological design, communication and understanding of science concepts, analysis of data, and application of concepts.

Students' success in meeting the expectations of the standards depends on teaching and learning as an active inquiry process. This means that all teachers need the opportunity to teach science as something in which students are actively engaged. When participating in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. This includes engaging all students' thinking with relevant, real-world activities that extend students' thinking and communication skills, and develop students' science process skills.

The Science standards enhance development of students' understanding of science concepts by combining science inquiry and technology studies with mathematical reasoning / analysis and language skills. Scientific literacy enables students to use scientific principles and processes in making personal decisions and to participate in discussions of scientific issues that affect society. Science instruction can also integrate knowledge and skills from other disciplines such as mathematics, English language arts, social studies, and other disciplines to develop conceptual frameworks that lead to broader understandings.

The following terms and definitions are used in this document:

Standard: An overarching goal or theme in science. The standard statement describes, in broadest terms, what all students should know and be able to do as a result of the K- 12 program.

The standards will be enclosed with a border.

Benchmark: A specific statement of what all students should know and be able to do at a specified time in their schooling. Benchmarks are used to measure a student's progress toward meeting the standard. Science benchmarks are defined for grade bands K-2, 3-5, 6-8, 9-10, and 11-12.

Grade-level Indicator: A specific statement of the knowledge and / or skills that a student is expected to demonstrate at each grade level. These indicators serve as checkpoints that monitor progress toward the benchmarks.

Key to Coding:

Standard Overarching Goal
K - 12

5PSBA 5th gr. - Physical Sciences - Benchmark A

5PSI 1 5th gr. - Physical Sciences - Indicator 1

Benchmark 5PSBF matches Indicator 5PSI 6

- Added indicators are in *italics.*
- Those indicators moved from one grade to another are in **bold.**

Science Content Standards Program Philosophy

The science program, based on Ohio's science content standards, serve as a basis for what all students should know and be able to do by the time they graduate from high school. The vision for the broad learning goals of Ohio's Science Academic Content Standards provides for a scientifically literate citizen. These standards, benchmarks and grade-level indicators are intended to provide Ohio's educators with a set of common expectations upon which to base science curriculum.

The goals of the science program are to:

- help students develop an understanding of the unity and diversity of the natural (empirical) world;
- foster an understanding of the nature of science, the development of science processes, the principles of science, and the connections between the physical, life, and Earth and space sciences;
- prepare students to use appropriate scientific processes and principles in making personal decisions;
- enable students to engage intelligently in public discourse about matters of scientific and technological concern; and
- increase students future economic productivity through the use of scientific knowledge, understanding, and skill in their careers.

Assumptions for Science Course of Study

- set high expectations and provide strong support for science achievement by ALL students
- represent scientific knowledge and skills needed to make a successful transition to post-secondary education, the workplace and daily life
- reflect sound application of research on how students learn science concepts and processes
- align with the nation's science education standards documents
- provide balance among conceptual understanding, procedural knowledge and skills, and application and problem-solving
- address scientific content knowledge and processes including technological design, scientific ways of knowing, inquiry, communication, representation, and connections across the domains of science
- apply scientific knowledge and processes to individual and societal issues
- focus on important scientific concepts that are well-articulated through benchmarks and grade-level indicators
- represent rigorous progression across grades and in-depth study within each grade
- incorporate use of technology by ALL students in learning science and develop an understanding about the nature of science and technology including technological design
- serve as the basis for classroom and state-wide assessments
- emphasize the nature, connections, and historical development of scientific knowledge in the physical, life and Earth and space sciences

Ohio's K -12 Science Standards

Earth and Space Sciences

Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and space sciences.

Life Sciences

Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure, and function of cells, organisms, and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Physical Sciences

Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with the physical sciences.

Science and Technology

Students recognize that science and technology are interconnected and that using technology in assessment of the benefits, risks and costs. Students should build scientific and technological knowledge as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Scientific Inquiry

Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Scientific Ways of Knowing

Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support modify existing theories, as well as to encourage the development of new theories. Students are able reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Scope and Sequence

Kindergarten

Kindergarten provides students with the opportunity to develop the scientific skills of wondering, questioning, investigating, and communicating to enable them to begin to develop a sense of the world. Kindergarteners learn through discovery about changes on Earth, in the sky, plants, animals, their habitats and non-living things in their local community. Through hands-on exploration, students learn the characteristics of objects, tools, materials, how they move, and whether or not they are natural or man-made. Students explore the different ways people learn about science and interact with living things and the environment to promote respect for nature. To complete this year, students show knowledge of scientific concepts through demonstration of verbal and non-verbal skills and activities.

Grade One

Science instruction in the first grade builds upon the science skills developed in kindergarten and from the child's life experiences. Students have increasing opportunities to explore how living things change, how they interact with their environment, and how they acquire food. Students discover that many objects are made of different parts and characteristics. Students learn ways objects are made of different parts and characteristics. Students learn ways objects change, move, the materials of which they are composed and their physical properties. Students recognize and realize that natural resources are limited and can be extended by recycling or decreasing use. First-graders explore ways people learn about science through questioning, comparing, investigating and observing to conclude year one.

Grade Two

Second-graders continue to relate science concepts and skills to their life experiences. They compare similarities and differences between people, animals, and plants. Living system functions and the interactions they have with their physical environment are explained. Focus is placed upon habits and the interdependence and survival of plants and animals in Ohio. Weather changes both short-term and long term are observed, described, and measured. Second-graders discover how cycles are present in their everyday lives through investigations of Earth and sky, sound and light, and plants and animals. Students recognize the purpose, process and effects of technology, simple equipment and instruments used in learning about science. Students develop an awareness of repeated scientific investigations and understand that under the same conditions the results are similar or the same, which will build skills for grade two.

Grade Three

The scientific skills of observation, measuring and classification serve as focal points for the third grade. Students learn to read and interpret simple tables and graphs, conduct safe investigations in which they collect and analyze data, and communicate the results. Third-graders explore the properties and composition of rocks, arid soils and the interaction of forces and motion. They also compare the life cycles of animals, classifications of animals according to their characteristics, descriptions of their habitat and adaptations to their environment. Students examine results of technology and explore careers in science, as scientific contributions from a diversity of cultures.

Grade Four

Fourth-graders continue to safely conduct investigations, choose appropriate tools, measure, collect, formulate conclusions and communicate findings. They draw inferences from simple experiments and study the physical and chemical changes of matter. Properties of materials and the discovery of new materials formed by combining two or more materials are explored. Students expand the study of life cycles of plants by examining characteristics, growth, and functions. Students gather information on the weather and its patterns and how weather impacts the Earth's surface, land, air and water. They explore how utilizing technology affects human lives and how technology and inventions change to meet people's needs.

Grade Five

Earth and space sciences are investigated in more detail in grade five. Earth's characteristics, resources, and location in the solar system are identified and their implications explored. Students also learn about the interrelationship of organisms and ecosystems and simple food chains and food webs. Energy and energy transfer through an electrical current are addressed. Fifth graders describe and illustrate the design process and describe the positive and negative impacts of human activity and technology on the environment. Students observe, measure and collect data when conducting a scientific investigation; students use this information to formulate inferences and conclusions; and students develop skills to communicate the results.

Grade Six

Students in grade six continue to conduct investigations and begin to apply mathematical skills in evaluating and analyzing variables of data. They identify basic skills of the scientific inquiry process, such as how thinking scientifically is helpful in daily life and how technological advances affect the quality of life. Students research how men and women of other countries and cultures contribute to science. Sixth- grade students identify rocks, their distinct properties, and formation and characteristic properties of the minerals that form them. Students acquire knowledge of the uses, properties and chemical processes of the small particles that compose matter. They access knowledge to explain how energy entering the ecosystems, such as sunlight, supports the life of organisms through photosynthesis and the transfer of energy through the interactions of organisms and the environment. Students learn to describe interactions of matter and energy throughout the lithosphere, hydrosphere, and atmosphere.

Grade Seven

Seventh grade students will continue to develop skills of scientific inquiry. Students apply math skills to evaluate and analyze variables and data from investigations as they draw conclusions from scientific evidence. Students are able to recognize that technology can create environmental and economic conflicts, affect the quality of life, and that science and technology cannot answer all questions and cannot solve all human problems. Students continue to explain how energy entering the ecosystems, such as sunlight, supports the life of organisms through photosynthesis and the transfer of energy through the interactions of organisms and the environment. They learn about renewable and nonrenewable sources of energy as part of the grade six indicators. Students learn to recognize that a cell continually divides to create new cells, reproduction of cells occur, similar cells have special functions, and characteristics of an organism are a result of inherited traits. Students will be able to explain how extinction of a species occurs when the environment changes and its adaptive characteristics are insufficient to allow survival.

Grade Eight

Students in the eighth grade explore space and plate tectonics as they continue to draw conclusions from scientific evidence that support theories related to the change of Earth's surface. They acquire knowledge to describe how positions and motions of objects in the universe cause predictable and cyclic events. Students explain that the universe is composed of vast amounts of matter and that it is held together by gravitational force. They explore equipment to study the universe - telescopes, probes, satellites, and spacecraft. Motion of objects, effects of forces on objects, and how waves (sound, water and earthquake) transfer energy are explored. They continue to develop skills of scientific inquiry, explain how matter can change forms and describe how energy is potential or kinetic and takes many forms. Students design a solution to a problem or design and build a product, given certain constraints. Technological influences on the quality of life are also explored in this grade level.

Grade Nine

The ninth-grade year addresses physical science and related principles in Earth and space sciences. Physical science concepts include the nature of matter and energy; identifiable physical properties of substances; and properties of forces that act on objects. Ninth-graders learn about forces and motions, structures and properties of atoms, how atoms react with each other to form other substances, and how molecules react with each other or other atoms. Earth and space science topics include processes that move and shape Earth, Earth's interaction with the solar system, and gravitational forces and weather. Students continue to develop a deeper understanding of the processes of scientific inquiry and how these processes use evidence to support conclusions based on logical reasoning. Students investigate ways in which science and technologies combine to meet human needs and solve human problems. Ninth-graders trace the historical development of scientific theories and ideas, explore scientific theories, and develop their scientific literacy to become knowledgeable citizens.

Grade 10

The l0th grade year emphasizes the concepts, principles, and theories that enable people to understand the living environment. Students study life science concepts such as cells and their structure and function, the genetic and molecular bases of inheritance, biological evolution, and the diversity and interdependence of life. Students explain the Earth's history using geologic evidence, identifying the Earth's resources, and exploring processes that shape the Earth. The flow of energy and the cycling of matter through biological and ecological systems are addressed in the 10^{th} grade. Embedded throughout this study are the basic science processes of inquiry, modeling investigations and the nature of science. Students learn to trace the historical development of scientific theories, ideas, ethical guidelines in science, the interdependence of science and technology, and the study of emerging issues to become scientifically literate citizens.

Grade 11

In grade 11 students draw on their previous experience and connect Earth, space, life and physical sciences into a coherent study of the environment. Emphasis is placed on the interactions between humans and earth, ecosystems, biological evolution, populations and diversity. Students also explore matter and energy relationships. The human interactions with science and technology are discussed, as well as how man has modified current ecosystems and natural systems. Students have the opportunity to use basic science processes of inquiry, scientific investigations, and the nature of science to examine past events, current situations, and to develop and revise scientific predictions, ideas or theories.

Grade 12

Grade 12 focuses on advanced topics in biologica1 and physical sciences. Biological topic clusters include cell specialization, biotechnology, and DNA evolutionary theory. In the physical sciences, students study equilibrium of systems, electromagnetic radiation, isotopes, radioactive decay, concepts of forces and motion as applied to large and small objects and energy levels. Integrated with these topics are historical perspectives, the process of inquiry, and nature of science, ethical practices and use of appropriate technology. Twelfth graders learn to apply principles of forces and motion to mathematically analyze, describe and predict the net effects of forces and motion of objects or systems. Students explore science research, scientific literature and the relationship of science and society.

SCIENCE STANDARDS K – 2

Grade Level	Earth and Space Sciences	Life Sciences	Physical Sciences	Science and Technology	Scientific Inquiry	Scientific Ways of Knowing
K	Changes on the Earth and in the Sky	-Characteristics and Diversity of Plants and Animals; -Habitats	-Characteristics of Objects and How They Move	-Natural or Manmade Objects; -Tools and Materials	-Wondering, Questioning, Investigating, Communicating	-Different Ways People Learn about Science
1	-Living and Nonliving Environmental Resources	-Interactions between Living Things and their Environment	-Physical Interactions and Changes; -Sources of Energy	-Building/Using Technology and the Effects	-Wondering, Questioning, Investigating, Communicating	-How People Learn; -Science in all Societies
2	-Sky and Earth Cycles -Earth Layers -9 Planets -Erosion (erosion kit)	-Interdependence and Survival of Plants and Animals in Ohio; (need materials, books, video, models, pictures) -Heredity	-Light and Sound -Inventions (light unit)	-Purpose, Process and Effect of Science and technology	-Wondering, Questioning, Investigating, Communicating	-The Nature of Science Investigation: Ethical Practices

SCIENCE STANDARDS 3 – 5

Grade Level	Earth and Space Sciences	Life Sciences	Physical Sciences	Science and Technology	Scientific Inquiry	Scientific Ways of Knowing
3	-Rocks and Soil	-Diversity of Animal Classifications, Adaptations, Habitats, and Life Cycles.	-Forces and Motion Changes in Matter; Intro.	-Helpful and Harmful Results -Simple Design Process; Simple Machine Application	-Safely Conducting Investigations, Measuring and Collecting, Formulating Conclusions, Communicating Findings	-Documentation of Science Investigations; -Careers in Science; Science Biography
4	-Weather -Erosion (Land and Water Unit)	-Plant Classifications and Adaptations	-Physical/Chemical Changes in Matter	-Technology and Human Lives	-Safely conducting Investigations, Measuring and Collecting, Formulating Conclusions, Communicating Findings	-Using Results and Data; -Explanation of Observations and Investigations
5	-Earth and It's Place in the Solar System	-Ecosystems	-Thermal and Electric Energy; -Energy Transfer	-Design Processes; -Technology and the Environment -Motion and Design	-Safety Conducting Investigations, Measuring and Collecting, Formulating Conclusions, Communicating Findings	-Methods of Investigation; -Facts and theories

STANDARDS 6 – 8

Grade Level	Earth and Space Sciences	Life Sciences	Physical Sciences	Science and Technology	Scientific Inquiry	Scientific Ways of Knowing
6	- Earth Systems Rocks and Minerals Weather and Climate	- Diversity & Interdependence of Life: Ecology/ Biomes Plant Unit?	- Nature of Matter: Chemical and Physical Changes	-Technological Design; Technology Influences on the Quality of Life	-Conducting Investigations, Applying Mathematics Skills, Evaluating and Analyzing Variables of Data, Drawing Valid Conclusions Based on Evidence	-Skills of Scientific Inquiry; Science practices in everyday life
7	- Earth Systems Earth's capacity to recycle Pollution & availability of fresh water	- Characteristics & Structure of Life: Cells Variety of body plans Heredity: Genetics Diversity & Interdependence of Life: Interaction of Organisms Evolutionary Theory: Diversity among organisms Survival of Species	- Nature of Energy: Renewable and Nonrenewable Resources	-Technology Influences on the Quality of Life; Abilities to do Technological Design; Ethical Issues of Technology	-Conducting Investigations, applying Mathematics, Skills, Evaluating and Analyzing Variables of Data, Drawing Valid Conclusions based on Evidence	- Validity of Scientific Experiments; Ethical Practices
8	-Space Plate Tectonics Theories Related to the change of Earth's Surface		- Nature of Energy: Conservation of Matter and Energy Forces and Motion; Waves	-Design Solutions; History and Relationships between Culture, Society and Technology Evaluate Solutions	-Conducting Investigations, Applying Mathematics Skills, Evaluating and Analyzing Variables of Data, Drawing Valid Conclusions based on Evidence	-Describing and Explaining in Science

SCIENCE STANDARDS 9 - 12

Grade Level	Earth and Space Sciences	Life Sciences	Physical Sciences	Science and Technology	Scientific Inquiry	Scientific Ways of Knowing
9	- Processes within and on the Earth Earth's history through geologic evidence Resources	Not a focus at Grade 9	- Atoms Chemical Reactions Physical Properties, Mixtures and Solutions Laws of Motion Forces Energy Waves Historical Perspectives and Emerging Issues	- Relationship between Technology and Science	- Modeling Investigations	- Diversity of Scientific Investigations Scientific theories Scientific Literacy Scientific conclusions
10	- Processes within and on Earth Earth' history through geologic evidence Resources	- Cells Genetics and DNA Diversity of Life Ecology, Biological Evolution Historical Perspectives and Emerging Issues	Not a focus at Grade 10	- Scientific Advances and Emerging Technologies	- Modeling Investigations	- Nature of Science Inquiry Ethics in Science Science and Careers
11	- Interactions between Humans and the Earth	- Ecosystems, Environmental Factors Biological Evolution Populations Diversity	- Matter and Energy Relationships	- Human Interactions with Science and technology Understanding Technology	- Application of science processes, techniques and research	- Research, Science and Society
12	- Properties of the Universe Thermal Energy Earth's Resources	- Cell Specialization Biotechnology DNA Biological Evolutionary Change	- Electromagnetic Radiation, Force and Motion, Equilibrium Isotopes and Radioactive Decay Energy Levels Historical Perspectives	- Differences and Implications between Science and Technology	- Application of science processes, techniques and research	- Scientific Research Reviewing Scientific Literature Science and Society

GRADE: KINDERGARTEN **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks K - 2:

KESSB	A.	Observe constant and changing patterns of objects in the day and night sky.
KESSB	B.	Explain that living things cause changes on Earth.
KESSB	C.	Observe, describe and measure changes in the weather, both long term and short term.
KESSB	D.	Describe what resources are and recognize some are limited but can be extended through recycling or decreased use.

Grade Level Indicators Grade K:

The Universe

KESSI	1.	Observe that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day. [KESSBA]

Processes That Shape Earth

KESSI	2.	Explore that animals and plants cause changes to their surroundings. [KESSBB]
KESSI	3.	Explore that sometimes change is too fast to see and sometimes change is too slow to see (e.g., water, light, fall leaves, weathering of rocks). [KESSBC]
KESSI	4.	Observe and describe day-to-day weather changes (e.g., today is hot, yesterday we had rain). [KESSBC]
KESSI	5.	Observe and describe seasonal changes in weather. [KESSBC]

GRADE: KINDERGARTEN **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades K - 2:

KLSB	A.	Discover that there are living things, non-living things and pretend things, and describe the basic needs of living things (organisms).
KLSB	B.	Explain how organisms function and interact with their physical environment.
KLSB	C.	Describe similarities and differences that exist among individuals of the same kind of plants and animals.

Grade Level Indicators Grade K:

Characteristics and Structure of Life

KLSI	1.	Explore differences between living and non –living things (e.g., plant-rock). [KLSBA]
KLSI	2.	Discover that stories (e.g., cartoons, movies, comics) sometimes give plants and animals characteristics they really do not have (e.g., talking flowers). [KLSBA]

Heredity

KLSI	3.	Describe how plants and animals usually resemble their parents. [KLSBC]
KLSI	4.	Investigate variations that exist among individuals of the same kind of plant or animal. [KLSBC]

Diversity and Interdependence of Life

KLSI	5.	Investigate observable features of plants and animals that help them live in different kinds of places. [KLSBB]
KLSI	6.	Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community. [KLSBB]

GRADE: KINDERGARTEN **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades K - 2:

KPSB	A.	Discover that many objects are made of parts that have different characteristics. Describe these characteristics and recognize ways an object may change.
KPSB	B.	Recognize that light, sound and objects move in different ways.
KPSB	C.	Recognize sources of energy and their uses.

Grade Level Indicator Grade K:

Nature of Matter

KPSI	1.	Demonstrate that objects are made of parts (e.g., toys, chairs). [KPSBA]
KPSI	2.	Examine and describe objects according to the materials that make up the object (e.g., wood, meal, plastic and cloth). [KPSBA]
KPSI	3.	Describe and sort objects by one or more properties (e.g., size, color and shape); (e.g., rocks). [KPSBA]
KPSI	*4.*	*Explore solids and liquids. Introduce terms and examples.*

Forces in Motion

KPSI	4.	Explore that things can be made to move in many different ways such as straight, zigzag, up and down, round and round, back and forth, or fast and slow. [KPSSBB]
KPSI	5.	Investigate ways to change who something is moving (e.g., push, pull). [KPSBB]

GRADE: KINDERGARTEN **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades K - 2:

KSTB	A.	Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.
KSTB	B.	Explain that to construct something requires planning, communication, problem solving and tools.

Grade Level Indicator Grade K:

Understanding Technology

KSTI	1.	Explore that objects can be sorted as “natural” or “man-made”. [KSTBA]
KSTI	2.	Explore that some materials can be used over and over again (e.g., plastic or glass containers, cardboard boxes and tubes). [KSTBA]

Abilities to do Technological Design

KSTI	3.	Explore that each kind of tool has an intended use, which can be helpful or harmful (e.g., scissors can be used to cut paper but they can also hurt you). [KSTBB]

GRADE: KINDERGARTEN **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and together and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades K - 2:

KSIB	A.	Ask a testable question.
KSIB	B.	Design and conduct a simple investigation to explore question.
KSIB	C.	Gather and communicate information from careful observations and simple investigation through a variety of methods

Grade Level Indicators Grade K:

Doing Scientific Inquiry

KSII	1.	Ask "what if" questions. Introduce "hypothesis" as a term and a concept. [KSIBA]
KSII	2.	Explore and pursue student-generated "what if" questions. [KSIBA]
KSII	3.	Use appropriate safety procedures when completing scientific investigations. [KSIBB]
KSII	4.	Use the five senses to make observations about the natural world. [KSIBB]
KSII	5.	Draw pictures that correctly portray features of the item being described. [KSIBC]
KSII	6.	Recognize that numbers can be used to count a collection of things. [KSIBC]
KSII	7.	Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers and other appropriate tools). [KSIBB]
KSII	8.	Measure the lengths of objects using non-standard methods of measurement (e.g., teddy bear counters and pennies). [KSIBC]
KSII	9.	Make pictographs and use them to describe observations and draw conclusions. [KSIBC]
KSII	10.	Make new observations when people give different descriptions for the same thing. [KSIBB]

GRADE: KINDERGARTEN **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades K - 2:

KSWKB	A.	Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.
KSWKB	B.	Recognize the importance of respect for all living things.
KSWKB	C.	Recognize that diverse groups of people contribute to our understanding of the natural world.

Grade Level Indicators Grade K:

Nature of Science

KSWKI	1.	Recognize that scientific investigations involve asking open-ended questions. (How? What if?) [KSWKBA]
KSWKI	2.	Recognize that people are more likely to accept your ideas if you can give good reasons for them. [KSWKBA]

Ethical Practices

KSWKI	3.	Interact with living things and the environment in ways that promote respect. [KSWKBB]

Science and Society

KSWKI	4.	Demonstrate ways science is practiced by people everyday (children and adults). [KSWKBC]

GRADE: ONE **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades K - 2:

1ESSB	A.	Observe constant and changing patterns of objects in the day and night sky.
1ESSB	B.	Explain that living things cause changes on Earth.
1ESSB	C.	Observe, describe and measure changes in the weather, both long term and short term.
1ESSB	D.	Describe what resources are and recognize some are limited but can be extended through recycling or decreased use.

Grade Level Indicators Grade 1:

Earth Systems

1ESSI	1.	Identify that resources are things that we get from the living (e.g., forests) and nonliving (e.g., minerals, water) environment and that resources are necessary to meet the needs and want of a population. [1ESSBD]
1ESSI	2.	Explain that the supply of many resources is limited but the supply can be extended through careful use, decreased use, reusing and/or recycling (e.g., trees, oil). [1ESSBD]

Processes that Shape Earth

1ESSI	3.	Explain that all organisms cause changes in the environment where they live; the changes can be very noticeable or slightly noticeable, fast or slow (e.g., spread of grass cover slowing soil erosion, tree roots slowly breaking sidewalks). [1ESSBB]

GRADE: ONE **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades K - 2:

1LSB	A.	Discover that there are living things, non-living things and pretend things, and describe the basic needs of living things (organisms).
1LSB	B.	Explain how organisms function and interact with their physical environment.
1LSB	C.	Describe similarities and differences that exist among individuals of the same kind of plants and animals.

Grade Level Indicators Grade 1:

Characteristics and Structure of Life

1LSI	1.	Explore that organisms, including people, have basic needs which include air, water, food, living space, and shelter. [1LSBA]
1LSI	2.	Explain that food comes from sources other than grocery stores (e.g., farm crops, farm animals, oceans, lakes and forests). [1LSBB]
1LSI	3.	Explore that humans and other animals have body parts that help to seek, find and take in food when they are hungry (e.g., sharp teeth, flat teeth, good nose and sharp vision). [1LSBB]

Diversity and Interdependence of Life

1LSI	4.	Investigate that animals eat plants and/or other animals for food and may also use plants or other animals for shelter and nesting. [1LSBA]
1LSI	5.	Recognize that seasonal changes can influence the health, survival, or activities of organisms. [1LSBB]

GRADE: ONE **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of mater, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades K - 2:

1PSB	A.	Discover that many objects are made of parts that have different characteristics. Describe these characteristics and recognize ways an object may change.
1PSB	B.	Recognize that light, sound and objects move in different ways.
1PSB	C.	Recognize sources of energy and their uses.

Grade Level Indicator Grade 1:

Nature of Matter

1PSI	1.	Classify objects according to the materials they are made of and their physical properties. [1PSBA]
1PSI	2.	Investigate that water can change from liquid to solid or solid to liquid. [1PSBA]
1PSI	3.	Explore and observe that things can be done to materials to change their properties (e.g., heating, freezing, mixing, cutting, wetting, dissolving, bending and exposing to light). [1PSBA]
1PSI	4.	Explore changes that greatly change the properties of an object (e.g., burning paper) and changes that leave the properties largely unchanged (e.g., tearing paper). [1PSBA]

Forces and Motion

1PSI	5.	Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets). [1PSBB]
1PSI	6.	Investigate a variety of ways to make things move and what causes them to change speed, direction and/or stop. [1PSBB]

Nature of Energy

1PSI	7.	Explore how energy makes things work (e.g., batteries in a toy and electricity turning fan blades). [1PSBC]
1PSI	8.	Recognize that the sun is an energy source that warms the land, air and water. [1PSBC]
1PSI	9.	Describe that energy can be obtained from many sources in many ways (e.g., food, gasoline, electricity or batteries). [1PSBC]

GRADE: ONE **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades K - 2:

1STB	A.	Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.
1STB	B.	Explain that to construct something requires planning, communication, problem solving and tools.

Grade Level Indicator Grade 1:

Understanding Technology

1STI	1.	Explore that some kinds of materials are better suited than others for making something new (e.g., the building materials used in the *Three Little* Pigs). [1STBA]
1STI	2.	Explain that when trying to build something or get something to work better, it helps to follow directions and ask someone who has done it before. [1STBB]
1STI	3.	Identify some materials that can be saved for community recycling projects (e.g., newspapers, glass and aluminum). [1STBA]
1STI	4.	Explore ways people use energy to cook their food and warm their homes (e.g., wood, coal, natural gas and electricity). [1STBA]
1STI	5.	Identify how people can save energy by turning things off when they are not using them (e.g., lights and motors). [1STBA]

Abilities To Do Technological Design

1STI	6.	Investigate that tools are used to help make things and some things cannot be made without tools. [1STBB]
1STI	7.	Explore that several steps are usually needed to make things (e.g., building with blocks). [1STBB]
1STI	8.	Investigate that when parts are put together they can do things that they could not do by themselves (e.g., blocks, gears and wheels). [1STBB]

GRADE: ONE **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and together and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades K - 2:

1SIB	A.	Ask a testable question.
1SIB	B.	Design and conduct a simple investigation to explore question.
1SIB	C.	Gather and communicate information from careful observations and simple investigation through a variety of methods

Grade Level Indicators Grade 1:

Doing Scientific Inquiry

1SII	1.	Ask "what happens when" questions. *Introduce a hypothesis as a term and a concept.* [1SIBA]
1SII	2.	Explore and pursue student-generated "what happens when" questions. [1SIBA]
1SII	3.	Use appropriate safety procedures when completing scientific investigations. [1SIBB]
1SII	4.	Work in a small group to complete an investigation and then share findings with others. [1SIBC]
1SII	5.	Create individual conclusions about group findings. [1SIBC]
1SII	6.	Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, timers and simple balances and other appropriate tools). [1SIBB]
1SII	7.	Make estimates to compare familiar lengths, weights and time intervals. [1SIBC]
1SII	8.	Use oral, written and pictorial representation to communicate work. [1SIBC]
1SII	9.	Describe things as accurately as possible and compare with the observations of others. [1SIBC]

GRADE: ONE **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades K - 2:

1SWKB	A.	Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.
1SWKB	B.	Recognize the importance of respect for all living things.
1SWKB	C.	Recognize that diverse groups of people contribute to our understanding of the natural world.

Grade Level Indicators Grade 1:

Nature of Science

1SWKI	1.	Discover that when a science investigation is done the same way multiple times, one can expect to get very similar results each time it is performed. [1SWKBA]
1SWKI	2.	Demonstrate good explanations based on evidence from investigations and observations. [1SWKBA]

Science and Society

1SWKI	3.	Explain that everybody can do science, invent things, and have scientific ideas no matter where they live. [1SWKBC]

GRADE: TWO **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades K - 2:

2ESSB	A.	Observe constant and changing patterns of objects in the day and night sky.
2ESSB	B.	Explain that living things cause changes on Earth.
2ESSB	C.	Observe, describe and measure changes in the weather, both long term and short term.
2ESSB	D.	Describe what resources are and recognize some are limited but can be extended through recycling or decreased use.

Grade Level Indicators Grade 2:

The Universe

2ESSI	1.	Recognize that there are more stars in the sky than anyone can easily count. [2ESSBA]
2ESSI	2.	Observe and describe how the sun, moon, and stars all appear to move slowly across the sky. [2ESSBA}
2ESSI	3.	Observe and describe how the moon appears a little different every day but looks nearly the same again about every four weeks. [2ESSBA]

Earth Systems

2ESSI	4.	Observe and describe that some weather changes occur throughout the day and some changes occur in a repeating Seasonal pattern. [2ESSBC]
2ESSI	5.	Describe weather by measurable quantities such as temperature and precipitation. [2ESSBC]
2ESSI	*6.*	*Order of the nine plants.*

GRADE: TWO **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades K - 2:

2LSB	A.	Discover that there are living things, non-living things and pretend things, and describe the basic needs of living things (organisms).
2LSB	B.	Explain how organisms function and interact with their physical environment.
2LSB	C.	Describe similarities and differences that exist among individuals of the same kind of plants and animals.

Grade Level Indicators Grade 2:

Characteristics and Structure of Life

2LSI	1.	Explain that animals, including people, need air, water, food, living space and shelter; plants need air, water nutrients (e.g., minerals), living space and light to survive. [2LSBA].
2LSI	2.	Identify that there are many distinct environments that support different kinds of organisms. [2LSBB]
2LSI	3.	Explain why organisms can survive only in environments that meet their needs (e.g., organisms that once lived on Earth have disappeared for different reasons such as natural forces or human-caused effects). [2LSBB]

Heredity

2LSI	4.	Compare similarities and differences among individuals of the same kind of plants and animals, including people. [2LSBC]

Diversity and Interdependence of Life

2LSI	5.	Explain that food is a basic need of plants and animals (e.g., plants need sunlight to make food and to grow, animals eat plants and/or other animals for food, food chain) and is important because it is a source of energy (e.g., energy used to play, ride bicycles, read, etc.). [2LSBA]
2LSI	6.	Investigate the different structures of plants and animals that help them live in different environments (e.g., lungs, gills, leaves and roots). [2LSBB]
2LSI	7.	Compare the habitats of many different kinds of Ohio plants and animals and some of the ways animals depend on

plants and each other. *Nature Tracks from Metroparks – assembly. [2LSBB]*

2LSI 8. Compare the activities of Ohio's common animals (e.g., squirrels, chipmunks, deer, butterflies, bees, ants, bats and frogs) during the different seasons by describing changes in their behaviors and body covering. [2LSBB]

2LSI 9. Compare Ohio plants during the different seasons by describing changes in their appearance. [2LSBB]

GRADE: TWO **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades K - 2:

2PSB	A.	Discover that many objects are made of parts that have different characteristics. Describe these characteristics and recognize ways an object may change.
2PSB	B.	Recognize that light, sound and objects move in different ways.
2PSB	C.	Recognize sources of energy and their uses.

Grade Level Indicator Grade 2:

Forces and Motion

2PSI	1.	Explore how things make sound (e.g., rubber bands, tuning fork and strings). [2PSBB]
2PSI	2.	Explore and describe sounds (e.g., high, low, soft and loud) produced by vibrating objects. [2PSBC]
2PSI	3.	Explore with flashlights and shadows that light travels in a straight line until it strikes an object. [2PSBC]

GRADE: TWO **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades K - 2:

2STB	A.	Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.
2STB	B.	Explain that to construct something requires planning, communication, problem solving and tools.

Grade Level Indicator Grade 2:

Understanding Technology

2STI	1.	Explain that developing and using technology involves benefits and risks. [2STBA]
2STI	2.	Investigate why people make new products or invent new ways to meet their individual wants and needs. [2STBA]
2STI	3.	Predict how building or trying something new might affect other people and the environment. [2STBA]
2STI	4.	Communicate orally, pictorially, or in written form the design process used to make something. [2STBB]

GRADE: TWO **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades K - 2:

2SIB	A.	Ask a testable question.
2SIB	B.	Design and conduct a simple investigation to explore a question.
2SIB	C.	Gather and communicate information from careful observations and simple investigation through a variety of methods

Grade Level Indicators Grade 2:

Doing Scientific Inquiry

2SII	1.	Ask "how can I/we" questions. [2SIBA]
2SII	2.	Ask "how do you know" questions (not "why" questions) in appropriate situations and attempt to give reasonable answers when others ask questions. [2SIBA]
2SII	3.	Explore and pursue student-generated "how" questions. [2SIBA]
2SII	4.	Use appropriate safety procedures when completing scientific investigations. [2SIBB]
2SII	5.	Use evidence to develop explanations of scientific investigations. (What do you think? How do you know?) [2SIBC]
2SII	6.	Recognize that explanations are generated in response to observations, events and phenomena. [2SIBC]
2SII	7.	Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, non-breakable thermometers, timers, rulers, balances and calculators and other appropriate tools). [2SIBB]
2SII	8.	Measure properties of objects using tools such as rulers, balances, and thermometers. [2SIBB]
2SII	9.	Use whole numbers to order, count, identify, measure and describe things and experiences. [2SIBC]
2SII	10.	Share explanations with others to provide opportunities to ask questions, examine evidence and suggest alternative explanations. [2SIBC]

GRADE: TWO **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades K - 2:

2SWKB	A.	Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.
2SWKB	B.	Recognize the importance of respect for all living things.
2SWKB	C.	Recognize that diverse groups of people contribute to our understanding of the natural world.

Grade Level Indicators Grade 2:

Nature of Science

2SWKI	1.	Describe that scientific investigations generally work the same way under the same conditions. [2SWKBA]
2SWKI	2.	Explain why scientists review and ask questions about the results of other scientists' work. [2SWKBC]

Ethical Practices.

2SWKI	3.	Describe ways in which using the solution to a problem might affect other people and the environment. [2SWKBB]

Science and Society

2SWKI	4.	Demonstrate that in science it is helpful to work with a team and share findings with others. [2SWKBC]

GRADE: THREE **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 3 - 5:

3ESSB	A.	Explain the characteristics, cycles and patterns involving Earth and its place in the solar system.
3ESSB	B.	Summarize the processes that shape Earth's surface and describe evidence of those processes.
3ESSB	C.	Describe Earth's resources including rocks, soil, water, air, animals and plants and the ways in which they can be conserved.
3ESSB	D.	Analyze weather and changes that occur over a period of time.

Grade Level Indicators Grade 3:

Earth Systems

3ESSI	1.	Compare distinct properties of rocks (e.g., color, layering and texture). [3ESSBC]
3ESSI	2.	Observe and investigate that rocks are often found in layers. [3ESSBC]
3ESSI	3.	Describe tht smaller rocks come from the breakdown of larger rocks through the actions of plants and weather. [3ESSBC]
3ESSI	4.	Observe and describe the composition of soil (e.g., small pieces of rock and decomposed pieces of plants and animals, and products of plants and animals). [3ESSBC]
3ESSI	5.	Investigate the properties of soil (e.g., color, texture, capacity to retain water, ability to support plant growth). [3ESSBC]
3ESSI	6.	Investigate that soils are often found in layers and can be different from place to place. [3ESSBC}
3ESSI	*7.*	*Identify how water exists in the air in different forms, creating a water cycle.*
3ESSI	*8.*	*Trace how weather patterns generally move from west to east in the United States.*
3ESSI	*9.*	*Describe the weather, which accompanies cumulus cirrus and stratus clouds.*

3ESSI	*10.*	*Identify the sun, moon, and Earth as having different physical characteristics and regular movements that result in daily, monthly, and yearly patterns.*

GRADE: THREE **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 3 - 5:

3LSB	A.	Differentiate between the life cycles of different plants and animals.
3LSB	B.	Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system all organisms use to survive.
3LSB	C.	Compare changes in an organism's ecosystem/habitat that affect its survival.

Grade Level Indicators Grade 3:

Heredity

3LSI	1.	Compare the life cycles of different *plants* and animals including birth or *germination* to adulthood, or *maturity*, reproduction and death (e.g., e-tadpole-frog, egg-caterpillar-chrysalis-butterfly). [3LSBA]

Diversity and Interdependence of Life

3LSI	2.	Relate animal and *plant* structures to their specific survival functions (e.g., obtaining food, escaping or hiding from enemies). (*Relate plant structures to their specific functions (e.g., growth, survival, reproduction, basic needs). [3LSBB])*
3LSI	3.	Classify *plants* and animals according to their characteristics (e.g., body coverings and body structure or *leaves, flowers, seeds, roots and stems). [3LSBB]*
3LSI	4.	Use examples to explain that extinct organisms may resemble organisms that are alive today. [3LSBC]
3LSI	5.	Observe and explore how fossils provide evidence about animals that lived long ago and the nature of the environment at that time. [3LSBC]
3LSI	6.	Describe how changes in an organism's habitat are sometimes beneficial and sometimes harmful. [3LSBC]

GRADE: THREE **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 3 - 5:

3PSB	A.	Compare the characteristics of simply physical and chemical changes.
3PSB	B.	Identify and describe the physical properties of matter in its various states.
3PSB	C.	Describe the forces that directly affect objects and their motion.
3PSB	D.	Summarize the way changes in temperature can be produced and thermal energy transferred.
3PSB	E.	Trace how electrical energy flows through a simple electrical circuit and describe how the electrical energy can produce thermal energy, light, sound and magnetic forces.
3PSB	F.	Describe the properties of light and sound energy.

Grade Level Indicator Grade 3:

Forces and Motion

3PSI	1.	Describe an objects position by locating it relative to another object or the background. [3PSBC]
3PSI	2.	Describe an objects motion by tracing and measuring its position over time. [3PSBC]
3PSI	3.	Identify contact/noncontact forces that affect motion of an object (e.g., gravity, magnetism, *air pressure*, and collision). [3PSBC]
3PSI	4.	Predict the changes when an object experiences a force (e.g., a push or pull, weight and fiction, *gravity and mass*). [3PSBC]
3PSI	*5.*	*Explain that matter has different states (e.g., solids, liquids and gas) and that each state has distinct physical properties. Heating or cooling can change matter form one state to another and the change is reversible.*

GRADE: THREE **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades 3 - 5:

3STB	A.	Describe how technology affects human life.
3STB	B.	Describe and illustrate the design process.

Grade Level Indicator Grade 3:

Understanding Technology

3STI	1.	Describe how technology can extend human abilities (e.g., to move things and to extend senses). [3STBA]
3STI	2.	Describe ways that using technology can have helpful and/or harmful results. [3STBA]
3STI	3.	Investigate ways that the results of technology may affect the individual, family and community. [3STBA]

Abilities to do Technological Design

3STI	4.	Use a simple design process to solve a problem (e.g., identify a problem, identify possible solutions and design a solution). [3STBB]
3STI	5.	Describe possible solutions to a design problem (e.g., how to hold down paper in the wind). [3STBB]

GRADE: THREE **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and together and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades 3 - 5:

3SIB	A.	Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.
3SIB	B.	Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.
3SIB	C.	Develop, design and safely conduct scientific investigations and communicate the results.

Grade Level Indicators Grade 3:

Doing Scientific Inquiry

3SII	1.	Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units. [3SIBA]
3SII	2.	Discuss observations and measurements made by other people. [3SIBB]
3SII	3.	Read and interpret simple tables and graphs produced by self/others. [3SIBB]
3SII	4.	Identify and apply science safety procedures. [3SIBC]
3SII	5.	Record and organize observations (e.g., journals, charts and tables). [3SIBB]
3SII	6.	Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and recorded observations). [3SIBC]

GRADE: THREE **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades 3 - 5:

3SWKB	A.	Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained**.**
3SWKB	B.	Describe different types of investigations and use results and data from investigations to provided evidence to support explanations and conclusions.
3SWKB	C.	Explain the importance of keeping records of observations and investigations that are accurate and understandable.
3SWKB	D.	Explain that men and women of diverse countries and cultures participate in careers in all fields of science.

Grade Level Indicators Grade 3:

Nature of Science

3SWKI	1.	Describe different kinds of investigations that scientists use depending on the question they are trying to answer. [3SWKBB]

Ethical Practices

3SWKI	2.	Keep records of investigations and observations and do not change the records that are different from someone else's work.

Science and Society

3SWKI	3.	Explore through stories how men and women have contributed to the development of science.
3SWKI	4.	Identify various careers in science.
3SWKI	5.	Discuss how both men and women find science rewarding as a career in their everyday lives.

GRADE: FOUR **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 3 - 5:

4ESSB	A.	Explain the characteristics, cycles and patterns involving Earth and its place in the solar system.
4ESSB	B.	Summarize the processes that shape Earth's surface and describe evidence of those processes.
4ESSB	C.	Describe Earth's resources including rocks, soil, water, air, animals and plants and the ways in which they can be conserved.
4ESSB	D.	Analyze weather and changes that occur over a period of time.

Grade Level Indicators Grade 4:

Earth Systems

4ESSI	1.	Explain that air surrounds us, takes up space, moves around us as wind, and may be measured using barometric pressure. [4ESSBD]
4ESSI	2.	Identify how water exists in the air in different forms (e.g., in clouds, fog, rain, snow and hail). [4ESSBD]
4ESSI	3.	Investigate how water changes from one state to another (e.g., freezing, melting, condensation and evaporation). [4ESSBD]
4ESSI	4.	Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure. [4ESSBD]
4ESSI	5.	Record local weather information on a calendar or map and describe changes over a period of time (e.g., barometric pressure, temperature, precipitation symbols and cloud conditions). [4ESSB]
4ESSI	6.	Trace how weather patterns generally move from west to east in the United States. *Understand the relationship between latitude and general temperature and weather patterns.*
4ESSI	7.	Describe the weather, which accompanies cumulus, cumulonimbus, cirrus and stratus clouds. [4ESSBD]

4ESSI	*8.*	*Associate storms, precipitation, or cloudy skies with colliding warm and cold fronts.*
4ESSI	*9.*	*Associate high-pressure systems with clear skies.*
Processes That Shape Earth		
4ESSI	10.	Describe how wind, water and ice shape and reshape Earth's land surface by eroding rock and soil in some areas and depositing them in other areas producing characteristic landforms (e.g., dunes, deltas and glacial moraines). [4ESSBB]
4ESSI	11.	Identify and describe how freezing, thawing and plant growth reshape the land surface by causing the weathering of rock. [4ESSBB]
4ESSI	12.	Describe evidence of changes on Earth's surface in terms of slow processes (e.g., erosion, weathering, mountain building and deposition) and rapid processes (e.g., volcanic eruptions, earthquakes and landslides). [4ESSBB]

GRADE: FOUR **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 3 - 5:

4LSB	A.	Differentiate between the life cycles of different plants and animals.
4LSB	B.	Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system all organisms use to survive.
4LSB	C.	Compare changes in an organism's ecosystem/habitat that affect its survival.

Grade Level Indicators Grade 4:

Heredity

4LSI	1.	Compare the life cycles of different plants *and animals* including germinating, maturity, reproduction and death. *Identify characteristics that identify a thing as living: the ability to grow and change, the ability to react to its environment need for food or another source of energy taking in gas for respiration, the ability to reproduce, and being made of cells. [4LSBB]*

Diversity and Interdependence of Life

4LSI	2.	Relate plant *and animal* structures to their specific functions (e.g., growth, survival and reproduction). *Ex. – basic needs of plants and animals.* [4LSBB]
4LSI	3.	Classify common plants *and animals*, according to their characteristics (e.g., tree leaves, flowers, seeds roots and stems). [4LSBB]
4LSI	4.	Observe and explore that fossils provide evidence about plants that lived long ago and the nature of the environment at that time. [4LSBC]
4LSI	5.	Describe how organisms interact with one another in various ways (e.g., many plants depend on animals for carrying pollen or dispersing seeds). [4LSBA]

GRADE: FOUR **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 3 - 5:

4PSB	A.	Compare the characteristics of simply physical and chemical changes.
4PSB	B.	Identify and describe the physical properties of matter in its various states.
4PSB	C.	Describe the forces that directly affect objects and their motion.
4PSB	D.	Summarize the way changes in temperature can be produced and thermal energy transferred.
4PSB	E.	Trace how electrical energy flows through a simple electrical circuit and describe how the electrical energy can produce thermal energy, light, sound and magnetic forces.
4PSB	F.	Describe the properties of light and sound energy.

Grade Level Indicator Grade 4:

Nature of Matter

4PSI	1.	Identify characteristics of a simple physical change (size, shape, change in state of matter) (e.g., heating or cooling can change water from one state to another and the change is reversible. (*Employ real-world examples of physical changes: evaporation, condensation, melting, and change in volume due to temperature*). [4PSBA]
4PSI	2.	Identify characteristics of a simple chemical change. When a new material is made by combining two or more materials, it has chemical properties that are different form the original materials (e.g., burning paper, vinegar and baking soda). [4PSBA]
4PSI	3.	Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic and metal). [4PSBB]
4PSI	4.	Explain that matter has different states (e.g., solid, liquid and gas) and that each state has distinct physical properties. [4PSBB]

Nature of Energy

4PSI	5.	Compare ways the temperature of an object can be changed (e.g., rubbing, heating and bending of metal). [4PSBD]

GRADE: FOUR **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades 3 - 5:

4STB	A.	Describe how technology affects human life.
4STB	B.	Describe and illustrate the design process.

Grade Level Indicator Grade 4:

Understanding Technology

4STI	1.	Explain how technology from different areas (e.g., transportation, communication, nutrition, healthcare, agriculture, entertainment and manufacturing has improved human lives. [4STBA]
4STI	2.	Investigate how technology and inventions change to meet peoples' needs and wants. [4STBA]

Abilities To Do Technological Design

4STI	3.	Describe, illustrate, and evaluate the design process used to solve a problem. [4STBB]

GRADE: FOUR **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and together and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades 3 - 5:

4SIB	A.	Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.
4SIB	B.	Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.
4SIB	C.	Develop, design and safely conduct scientific investigations and communicate the results.

Grade Level Indicators Grade 4:

Doing Scientific Inquiry

4SII	1.	Select the appropriate tools, *recognize which metric units are appropriate for*, and use relevant safety procedures to measure and record length, weight, volume, temperature and area in metric and English units. [4SIBA]
4SII	2.	Analyze a series of events and/or simple daily or seasonal cycles, describe the patterns, and infer the likely occurrence. [4SIBB]
4SII	3.	Develop, design and conduct safe, simple investigations or experiments to answer questions. [4SIBC]
4SII	4.	Explain the importance of keeping conditions the same in an experiment. [4SIBC]
4SII	5.	Describe how comparisons may not be fair when some conditions are not kept the same between experiments.
4SII	6.	Formulate instructions and communicate data in a manner that allows others to understand and repeat an investigation or experiment. [4SIBC]

GRADE: FOUR **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades 3 - 5:

4SWKB	A.	Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained**.**
4SWKB	B.	Describe different types of investigations and use results and data from investigations to provided evidence to support explanations and conclusions.
4SWKB	C.	Explain the importance of keeping records of observations and investigations that are accurate and understandable.
4SWKB	D.	Explain that men and women of diverse countries and cultures participate in careers in all fields of science.

Grade Level Indicators Grade 4:

Nature of Science

4SWKI	1.	Differentiate fact from opinion and explain that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed. [4SWKBA]
4SWKI	2.	Record the results and data from an investigation and make a reasonable explanation. [4SWKBC]
4SWKI	3.	Explain discrepancies in an investigation using evidence to support findings. [4SWKBB]

Ethical Practices

4SWKI	4.	Explain why keeping records of observations and investigations is important. [4SWKBB]
4SWKI	*5.*	*Be able to use graphic organizers: ex. Dichotomous keys, flow charts.*
4SWKI	*6.*	*Distinguish observations from inferences.*

GRADE: FIVE **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 3 - 5:

5ESSB	A.	Explain the characteristics, cycles and patterns involving Earth and its place in the solar system.
5ESSB	B.	Summarize the processes that shape Earth's surface and describe evidence of those processes.
5ESSB	C.	Describe Earth's resources including rocks, soil, water, air, animals and plants and the ways in which they can be conserved.
5ESSB	D.	Analyze weather and changes that occur over a period of time.

Grade Level Indicators Grade 5:

The Universe

5ESSI	1.	Describe how night and day are caused by Earth's rotation. [5ESSBA]
5ESSI	2.	Explain that Earth is one of several planets to orbit the sun, and that the moon orbits Earth. [5ESSBA]
5ESSI	3.	Describe the characteristics of Earth and its orbit about the sun (e.g., three-fourths of Earth's surface is covered by a layer of water [some of it frozen], the entire planet surrounded by a thin blanket of air, elliptical orbit, tilted axis and spherical planet). [5ESSBA]
5ESSI	4.	Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light. [5ESSBA]

Earth Systems

5ESSI	5.	Explain how the supply of many non-renewable resources is limited and can be extended through reducing, reusing, and recycling but cannot be extended indefinitely. [5ESSBC]
5ESSI	6.	Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife, and trees can be maintained. [5ESSBC]

GRADE: FIVE **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 3 - 5:

5LSB	A.	Differentiate between the life cycles of different plants and animals.
5LSB	B.	Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system all organisms use to survive.
5LSB	C.	Compare changes in an organism's ecosystem/habitat that affect its survival.

Grade Level Indicators Grade 5:

Diversity and Interdependence of Life

5LSI	1.	Describe the role of producers in the transfer of energy entering ecosystems as sunlight to chemical energy through photosynthesis. [5LSBB]
5LSI	2.	Explain how almost all kinds of animals' food can be traced back to plants. [5LSBB]
5LSI	3.	Trace the organization of simple food chains and food webs (e.g., producers, herbivores, carnivores, omnivores and decomposers). [5LSBB]
5LSI	4.	Summarize that organisms can survive only in ecosystems in which their needs can be met (e.g., food, water, shelter, air, carrying capacity and waste disposal). The world has different ecosystems and distinct ecosystems support the lives of different types of organisms. [5LSBC]
5LSI	5.	Support how an organism's patterns of behavior are related to the nature of that organism's ecosystem, including the kinds and numbers of other organisms present, the availability of food and resources, and the changing physical characteristics of the ecosystem. [5LSBC]
5LSI	6.	Analyze how all organisms, including humans, cause changes in their ecosystems and how these changes can be beneficial, neutral or detrimental (e.g., beaver ponds, earthworm burrows, grasshoppers eating plants, people planting and cutting trees and people introducing anew species). [5LSBC]
5LSI	*7.*	*Use a dichotomous key to identify unknown object or organism.*

GRADE: FIVE **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 3 - 5:

5PSB	A.	Compare the characteristics of simply physical and chemical changes.
5PSB	B.	Identify and describe the physical properties of matter in its various states.
5PSB	C.	Describe the forces that directly affect objects and their motion.
5PSB	D.	Summarize the way changes in temperature can be produced and thermal energy transferred.
5PSB	E.	Trace how electrical energy flows through a simple electrical circuit and describe how the electrical energy can produce thermal energy, light, sound and magnetic forces.
5PSB	F.	Describe the properties of light and sound energy.

Grade Level Indicator Grade 5:

Nature of Energy

5PSI	1.	Define temperature as the measure of thermal energy and describe the way it is measured. [5PSBD]
5PSI	2.	Trace how thermal energy can transfer from one object to another by conduction. [5PSBD]
5PSI	3.	Describe that electrical current in a circuit can produce thermal energy, light, sound and/or magnetic forces. [5PSBE]
5PSI	4.	Trace how electrical current travels by creating a simple electric circuit that will light a bulb. [5PSBE]
5PSI	5.	Explore and summarize observations of the transmission, bending (refraction) and reflection of light. [5PSBE]
5PSI	6.	Describe and summarize observations of the transmission, reflection, and absorption of sound. [5PSBF]
5PSI	7.	Describe that changing the rate of vibration can vary the pitch of a sound. [5PSBF]

GRADE: FIVE **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades 3 - 5:

5STB	A.	Describe how technology affects human life.
5STB	B.	Describe and illustrate the design process.

Grade Level Indicator Grade 5:

Understanding Technology

5STI	1.	Investigate positive and negative impacts of human activity and technology on the environment. [5STBA]

Abilities To Do Technological Design

5STI	2.	Revise an existing design used to solve a problem based on peer review. [5STBB]
5STI	3.	Explain how the solution to one problem may create other problems. [5STBB]

GRADE: FIVE **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and together and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades 3 – 5:

5SIB	A.	Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.
5SIB	B.	Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.
5SIB	C.	Develop, design and safely conduct scientific investigations and communicate the results.

Grade Level Indicators Grade 5:

Doing Scientific Inquiry

5SII	1.	Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g., thermometers, timers, balances, spring scales, magnifiers, microscopes and other appropriate tools). [5SIBA]
5SII	2.	Evaluate observations and measurements made by other people and identify reasons for any discrepancies. [5SIBB]
5SII	3.	Use evidence and observations to explain and communicate the results of investigations. [5SIBB]
5SII	4.	Identify one or two variables in a simple experiment. [5SIBC]
5SII	5.	Identify potential hazards and/or precautions involved in an investigation. [5SIBC]
5SII	6.	Explain why results of an experiment are sometimes different (e.g., because of unexpected differences in what is being investigated, unrealized differences in the methods used or in the circumstances in which the investigation was carried out, and because of errors in observations). [5SIBC]

GRADE: FIVE **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades 3 - 5:

5SWKB	A.	Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained**.**
5SWKB	B.	Describe different types of investigations and use results and data from investigations to provided evidence to support explanations and conclusions.
5SWKB	C.	Explain the importance of keeping records of observations and investigations that are accurate and understandable.
5SWKB	D.	Explain that men and women of diverse countries and cultures participate in careers in all fields of science.

Grade Level Indicators Grade 5:

Nature of Science

5SWKI	1.	Summarize how conclusions and ideas change as new knowledge is gained. [5SWKBA]
5SWKI	2.	Develop descriptions, explanations and models using evidence to defend/support findings. [5SWKBB]
5SWKI	3.	Explain why an experiment must be repeated by different people or at different times or places and yield consistent results before the results are accepted. [5SWKBB]
5SWKI	4.	Identify how scientists use different kinds of ongoing investigations depending on the questions they are trying to answer (e.g., observations of things or events in nature, data collection and controlled experiments). [5SWKBB]

Ethical Practices

5SWKI	5.	Keep records of investigations and observations that are understandable weeks or months later. [5SWKBC]

Science and Society

5SWKI	6.	Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform. [5SWKBD]

GRADE: SIX **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 6 - 8:

6ESSB	A.	Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.
6ESSB	B.	Explain that the universe is composed of vast amounts of matter, most of which is at incomprehensible distances and held together by gravitational force. Describe how the universe is studied by the use of equipment such as telescopes, probes, satellites and spacecraft.
6ESSB	C.	Describe interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g., water cycle, weather and pollution).
6ESSB	D.	Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are formed and/or classified.
6ESSB	E.	Describe the processes that contribute to the continuous changing of Earth's surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).

Grade Level Indicators Grade 6:

Earth Systems

6ESSI	1.	Describe the rock cycle and explain that there are sedimentary, igneous and metamorphic rocks that have distinct properties (e.g., color, texture) and are formed in different ways. [6ESSBD}
6ESSI	2.	Explain that rocks are made of one or more minerals. [6ESSBD]
6ESSI	3.	Identify minerals by their characteristics properties. [6ESSBD]

Grade Level Indicators Grade 7:

Earth Systems

7ESSI	**1.**	**Explain the biogeochemical cycles which move arterials between the lithosphere (land), hydrosphere (water) and atmosphere (air). [7ESSBB]**
7ESSI	**3.**	**Describe the water cycle and explain the transfer of energy between the atmosphere and hydrosphere. [7ESSBB]**
7ESSI	**5.**	**Make simple weather predictions based on the changing cloud types associated with frontal systems. [7ESSBB]**
7ESSI	**6.**	**Determine how weather observations and measurements are combined to produce weather maps and that data for specific location at one point in time can be displayed in a station model. [7ESSBB]**
7ESSI	**7.**	**Read a weather map top interpret local, regional and national weather. [7ESSBB]**
7ESSI	**8.**	**Describe how temperature and precipitation determine climatic zones (biomes) (e.g., desert, grasslands, forests, tundra and alpine). [7ESSBB]**
7ESSI	**9.**	**Describe the connection between the water cycle and weather-related phenomenon (e.g., tornadoes, floods, droughts and hurricanes). [7ESSBB]**

GRADE: SIX **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 6 - 8:

6LSB	A.	Explain that the basic functions of organisms are carried out in cells and groups of specialized cells form tissues and organs; the combination of these cells make up multicellular organisms that have a variety of body plans and internal structures.
6LSB	B.	Describe the characteristics of an organism in terms of a combination of inherited traits and recognize reproduction as a characteristic of living organisms essential to the continuation of the species.
6LSB	C.	Explain how energy entering the ecosystems as sunlight supports the life of organisms through photosynthesis and the transfer of energy through the interactions of organisms and the environment.
6LSB	D.	Explain how extinction of a species occur when the environment changes and its adaptive characteristics are insufficient to allow survival (as seen in evidence of the fossil record).

Grade Level Indicators Grade 7:

Diversity and Interdependence of Life

7LSI	**3.**	**Explain how the number of organisms an ecosystem can support depends on adequate biotic (living) resources (e.g., plants, animals) and abiotic non-living) resources (e.g., light, water and soil). [7LSBC]**
7LSI	**5.**	**Explain that some environmental changes occur slowly while others occur rapidly (e.g., forest and pond succession fires and decomposition). [7LSBD]**
7LSI	**6.**	**Summarize the ways that natural occurrences and human activity affect the transfer of energy in Earth's ecosystems (e.g., fire, hurricanes, roads and oil spills). [7LSBC]**

GRADE: SIX **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 6 - 8:

6PSB	A.	Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.
6PSB	B.	In simple cases, describe the motion of objects and conceptually describe the effects of forces on an object.
6PSB	C.	Describe renewable and nonrenewable sources of energy (e.g., solar, wind, fossil fuels, biomass, hydroelectricity, geothermal and nuclear energy) and the management of these sources.
6PSB	D.	Describe that energy takes many forms, some forms represent kinetic energy and some forms represent potential energy; and during energy transformations the total amount of energy remains constant.

Grade Level Indicator Grade 6:
Nature of Matter

6PSI	1.	Explain that equal volumes of different substances usually have different masses. [6PSBA]
6PSI	2.	Describe that in a chemical change new substances are formed with different properties that the original substance (e.g., rusting, burning). [6PSBA]
6PSI	3.	Describe that in a physical change (e.g., state, shape and size) the chemical properties of a substance remain unchanged. [6PSBA]
6PSI	4.	Describe that chemical and physical changes occur all around us (e.g., in the human body, cooking and industry). [6PSBBA]

Grade Level Indicator Grade 7:
Nature of Matter

7PSI	**1.**	**Investigate how matter can change forms but the total amount of matter remains constant. [7PSBA]**

Nature of Energy

7PSI	**2.**	**Describe how an object can have potential energy due to its position or chemical composition and can have kinetic energy due to its motion. [7PSBD]**
7PSI	**3.**	**Identify different forms of energy (e.g., electrical, mechanical, chemical, thermal, nuclear, radiant and acoustic). [7PSBD]**
7PSI	**4.**	**Explain how energy can change forms but the total amount of energy remains constant. [7PSBD]**
7PSI	**5.**	**Trace energy transformation in a simple closed system (e.g., a flashlight). [7PSBD]**

GRADE: SIX **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades 6 - 8:

6STB	A.	Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.
6STB	B.	Design a solution or product taking into account needs and constraints (e.g., cost, time, trade-offs, properties of materials, safety and aesthetics).

Grade Level Indicator Grade 6:

Understanding Technology

6STI	1.	Explain how technology influences the quality of life. [6STBA]
6STI	2.	Explain how decisions about he use of products and systems can result in desirable or undesirable consequences (e.g., social and environmental). [6STBA]
6STI	3.	Describe how automation (e.g., robots) has changed manufacturing including manual labor being replaced by highly-skilled jobs. [6STBA]
6STI	4.	Explain how the usefulness of manufactured parts of an object depend on how well their properties allow them to fit and interact with other materials. [6STBA]

Abilities To Do Technological Design

6STI	5.	Design and build a product or create a solution to a problem given one constraint (e.g., limits of cost and time for design and production, supply of materials and environmental effects). [6STBB]

GRADE: SIX **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades 6 - 8:

6SIB	A.	Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.
6SIB	B.	Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.

Grade Level Indicators Grade 6:

Doing Scientific Inquiry

6SII	1.	Explain that there are not fixed procedures for guiding scientific investigations; however, the nature of an investigation determines the procedures needed. [6SIBA]
6SII	2.	Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations. [6SIBA]
6SII	3.	Distinguish between observation and inference. [6SIBB]
6SII	4.	Explain that a single example can never prove that something is always correct, but sometimes a single example can disprove something. [6SIBB]

GRADE: SIX **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades 6 - 8:

6SWKB	A.	Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).
6SWKB	B.	Explain the importance of reproducibility and reduction of bias in scientific methods.
6SWKB	C.	Give examples of how thinking scientifically is helpful in daily life.

Grade Level Indicators Grade 6:

Nature of Science

6SWKI	1.	Identify that hypotheses are valuable even when they are not supported. [6SWKBA]

Ethical Practices

6SWKI	2.	Describe why it is important to keep clear, thorough and accurate records. [6SWKBA]

Science and Society

6SWKI	3.	Identify ways scientific thinking is helpful in a variety of everyday settings. [6SWKBC]
6SWKI	4.	Describe how the pursuit of scientific knowledge is beneficial for any career and for daily life. [6SWKBC]
6SWKI	5.	Research how men and women of all countries and cultures have contributed to the development of science. [6SWKBC]

GRADE: SEVEN **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 6 - 8:

7ESSB	A.	Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.
7ESSB	B.	Explain that the universe is composed of vast amounts of matter, most of which is at incomprehensible distances and held together by gravitational force. Describe how the universe is studied by the use of equipment such as telescopes, probes, satellites and spacecraft.
7ESSB	C.	Describe interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g., water cycle, weather and pollution).
7ESSB	D.	Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are formed and/or classified.
7ESSB	E.	Describe the processes that contribute to the continuous changing of Earth's surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).

Grade Level Indicators Grade 7:
Earth Systems

7ESSI	2.	Explain that Earth's capacity to absorb and recycle materials naturally (e.g., smoke, smog and sewage) can change the environmental quality depending on the length of time involved (e.g., global warming). [7ESSBB]
7ESSI	4.	Analyze date on the availability of fresh water that is essential for life and for most industrial agricultural processes. Describe how rivers, lakes and groundwater can be depleted or polluted becoming less hospitable to life and even becoming unavailable or unsuitable for life. [7ESSBB]

GRADE: SEVEN **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 6 - 8:

7LSB	A.	Explain that the basic functions of organisms are carried out in cells and groups of specialized cells form tissues and organs; the combination of these cells make up multicellular organisms that have a variety of body plans and internal structures.
7LSB	B.	Describe the characteristics of an organism in terms of a combination of inherited traits and recognize reproduction as a characteristic of living organisms essential to the continuation of the species.
7LSB	C.	Explain how energy entering the ecosystems as sunlight supports the life of organisms through photosynthesis and the transfer of energy through the interactions of organisms and the environment.
7LSB	D.	Explain how extinction of a species occur when the environment changes and its adaptive characteristics are insufficient to allow survival (as seen in evidence of the fossil record).

Grade Level Indicators Grade 6:

Characteristics and Structure of Life

6LSI	**1.**	**Explain that many of the basic functions of organisms are carried out by or within cells and are similar in all organisms. [6LSBA]**
6LSI	**2.**	**Explain that multicellular organisms have a variety of specialized cells, tissues, organs and organ systems that perform specialized functions. [6LSBA]**
6LSI	**3.**	**Identify how plant cells differ from animal cells (e.g., cell wall and chloroplasts). [6LSBA]**

Heredity

6LSI	**4.**	**Recognize that an individual organism does not live forever; therefore reproduction is necessary for the continuation of every species and traits are passed on to the next generation through reproduction. [6LSBB]**
6LSI	**5.**	**Describe that in asexual reproduction all the inherited traits come from a single parent. [6LSBB]**

6LSI 6. Describe that in sexual reproduction an egg and sperm unite and some traits come from each parent, so the offspring is never identical to either of its parents. [6LSBB]

6LSI 7. Recognize that likenesses between parents and offspring (e.g., eye color, flower color) are inherited. Other likenesses, such as table manners are learned. [6LSBB]

Diversity and Interdependence of Life

6LSI 8. Describe how organisms may interact with one another. [6LSBB]

Grade Level Indicators Grade 7:

Characteristics and Structure of Life

7LSI 1. Investigate the great variety of body plans and internal structures found in multicellular organisms. [7LSBA]

Diversity and Interdependence of Life

7LSI 2. Investigate how organisms or populations may interact with one another through symbiotic relationships and how some species have become so adapted to each other that neither could survive without the other (e.g., predator-prey, parasitism, mutualism and commensalisms). [7LSBC]

7LSI 4. Investigate how overpopulation impacts on ecosystem. [7LSBD]

7LSI 7. Explain that photosynthetic cells convert solar energy into chemical energy that is used to carry on life functions or is transferred to consumers and used to carry on their life functions. [7LSBC]

Evolutionary Theory

7LSI 8. Investigate the great diversity among organisms. [7LSBB]

Grade Level Indicators Grade 8:

Heredity

8LSI 1. Describe that asexual reproduction limits the spread of detrimental characteristics through a species and allows for genetic continuity. [8LSIB]

8LSI 2. Recognize that in sexual reproduction new combinations of traits are produced which may increase or decrease an organism's chances for survival. [8LSBB]

Evolutionary Theory

8LSI 3. Explain how variations in structure, behavior or physiology allow some organisms to enhance their reproductive success and survival in a particular environment. [8LSBB]

8LSI 4. Explain that diversity of species is developed through gradual processes over many generations (e.g., fossil record). [8LSBD]

8LSI **5.** **Investigate how an organism adapted to a particular environment may become extinct if the environment, as shown by the fossil record, changes. [8LSBD]**

GRADE: SEVEN **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 6 - 8:

7PSB	A.	Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.
7PSB	B.	In simple cases, describe the motion of objects and conceptually describe the effects of forces on an object.
7PSB	C.	Describe renewable and nonrenewable sources of energy (e.g., solar, wind, fossil fuels, biomass, hydroelectricity, geothermal and nuclear energy) and the management of these sources.
7PSB	D.	Describe the energy takes many forms, some forms represent kinetic energy and some forms represent potential energy; and during energy transformations the total amount of energy remains constant.

Grade Level Indicator Grade 6:
Nature of Energy

6PSI	**5.**	**Explain that the energy found in nonrenewable resources such as fossil fuel (e.g., oil, coal, and natural gas) originally came from the sun and may renew slowly over millions of years. [6PSBC]**
6PSI	**6.**	**Explain that energy derived from renewable resources such as wind and water is assumed to be available indefinitely. [6PSBC]**
6PSI	**7.**	**Describe how electric energy can be produced from a variety of sources (e.g., sun, wind and coal). [6PSBC]**
6PSI	**8.**	**Describe how renewable and nonrenewable energy resources can be managed (e.g., fossil fuels, trees and water). [6PSBC]**

GRADE: SEVEN **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades 6 - 8:

7STB	A.	Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.
7STB	B.	Design a solution or product taking into account needs and constraints (e.g., cost, time, trade-offs, properties of materials, safety and aesthetics).

Grade Level Indicator Grade 7:

Understanding Technology

7STI	1.	Explain how needs, attitudes and values influenced the directing of technological development in various cultures. [7STBA]
7STI	2.	Describe how decisions to develop and use technologies often put environmental and economic concerns in direct competition with each other. [7STBA]
7STI	3.	Recognize that science can only answer some questions and technology can only solve some human problems. [7STBA]
7STI	4.	Design and build a product or create a solution to a problem given two constraints (e.g., limits of cost and time for design and production or supply of materials and environmental effects).[7STBB]

GRADE: SEVEN **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades 6 - 8:

7SIB	A.	Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.
7SIB	B.	Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.

Grade Level Indicators Grade 7:

Doing Scientific Inquiry

7SII	1.	Explain that variables and controls can affect the results of an investigation and that ideally one variable should be tested at a time; however it is not always possible to control all variables. [7SIBA]
7SII	2.	Identify simple independent and dependent variables. [7SIBA]
7SII	3.	Formulate and identify questions to guide scientific investigations that connect to science concepts and can be answered through scientific investigations. [7SIBA]
7SII	4.	Choose the appropriate tools and instruments and use relevant safety procedures to complete scientific investigations. [7SIBA]
7SII	5.	Analyze alternative scientific explanations and predictions and recognize that there may be more than one good way to interpret a given set of data. [7SIBB]
7SII	6.	Identify faulty reasoning and statements that go beyond the evidence or misinterpret the evidence. [7SIBB]
7SII	7.	Use graphs, tables and charts to study physical phenomena and infer mathematical relationships between variables (e.g., speed and density). [7SIBB]

GRADE: SEVEN **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades 6 - 8:

7SWKB	A.	Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).
7SWKB	B.	Explain the importance of reproducibility and reduction of bias in scientific methods.
7SWKB	C.	Give examples of how thinking scientifically is helpful in daily life.

Grade Level Indicators Grade 7:

Ethical Practices

7SWKI	1.	Show that the reproducibility of results is essential to reduce bias in scientific investigations. [7SWKBB]
7SWKI	2.	Describe how repetition of an experiment may reduce bias. [7SWKBB]

Science and Society

7SWKI	3.	Describe how the work of science requires a variety of human abilities and qualities that are helpful in daily life (e.g., reasoning, creativity, skepticism and openness). [7SWKBC]

GRADE: Grade 8 **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 6 - 8:

8ESSB	A.	Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.
8ESSB	B.	Explain that the universe is composed of vast amounts of matter, most of which is at incomprehensible distances and held together by gravitational force. Describe how the universe is studied by the use of equipment such as telescopes, probes, satellites and spacecraft.
8ESSB	C.	Describe interactions of matter and energy throughout the lithosphere, hydrosphere, and atmosphere (e.g., water cycle, weather and pollution).
8ESSB	D.	Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are formed and/or classified.
8ESSB	E.	Describe the processes that contribute to the continuous changing of Earth's surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).

Grade Level Indicators Grade 8:

The Universe

8ESSI	1.	Describe how objects in the solar system are in regular and predictable motions that explain such phenomena as days, years, seasons, eclipses, tides and moon cycles. [8ESSBA]
8ESSI	2.	Explain that gravitational force is the dominant force determining motions in the solar system and in particular keeps the planets in orbit around the sun. [8ESSBA]

Earth Systems

8ESSI	9.	Describe the interior structure of Earth and Earth's crust as divided into tectonic plates riding on top of the slow moving currents of magma in the mantle. [8ESSBE]

8ESSI	10.	Explain that most major geological events (e.g., earthquakes, volcanic eruptions, hot spots and mountain building) result from plate motion. [8ESSBE]
8ESSI	11.	Use models to analyze the size and shape of Earth, its surface and its interior (e.g., globes, topographic maps, satellite images). [8ESSBE]
8ESSI	12.	Explain that some processes involved in the rock cycle are directly related to thermal energy and forces in the mantle that drive plate motions. [8ESSBE]
8ESSI	13.	Describe how landforms are created through a combination of destructive (e.g., weathering and erosion) and constructive processes (e.g., crustal deformation, volcanic eruptions and deposition of sediment). [8ESSBE]
8ESSI	14.	Explain that folding, faulting, and uplifting can rearrange the rock layers so the youngest is not always found on top. [8ESSBE]
8ESSI	15.	Illustrate how the three primary types of plate boundaries (transform, divergent and convergent) cause different landforms (e.g., mountains, volcanoes, and ocean trenches). [ESSBE]

Processes that shape the Earth

9ESSI	**5.**	**Explain how the slow movement of material within Earth results from: [9ESSBE]** a. **thermal energy transfer (conduction and convection) from the deep interior;** b. **the action of gravitational forces on regions of different density.**
9ESSI	**6.**	**Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding). [9ESSBE]**
9ESSI	**7.**	**Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating). [9ESSBE]**

GRADE: Grade 8 **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grades 6 - 8:

8PSB	A.	Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.
8PSB	B.	In simple cases, describe the motion of objects and conceptually describe the effects of forces on an object.
8PSB	C.	Describe renewable and nonrenewable source of energy (e.g., solar, wind, fossil fuels, biomass, hydroelectricity, geothermal and nuclear energy) and the management of these sources.
8PSB	D.	Describe that energy takes many forms, some forms represent kinetic energy and some forms represent potential energy; and during energy transformations the total amount of energy remains constant.

Grade Level Indicators Grade 8:

Forces in Motion

8PSI	1.	Describe how the change in the position (motion) of an object is always judged and described in comparison to a reference point. [8PSBB]
8PSI	2.	Explain that motion describes the change in the position of an object (characterized by a speed and direction) as time changes. [8PSBB]
8PSI	3.	Explain that an unbalanced force acting on an object changes that object's speed and/or direction. [8PSBB]
8PSI	5.	Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves). [8PSBD]
9PSI	**21.**	**Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time. [9PSBD]**
9PSI	**22.**	**Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it. [9PSBD**]

Nature of Energy

8PSI	4.	Demonstrate that waves transfer energy. [8PSBD]
8PSI	5.	Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves). [8PSBD]
9PSI	**12.**	**Explain how an object's kinetic energy depends on its mass and its speed (KE=*1/2mve*^{2}). [9PSBE]**
9PSI	**13.**	**Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight (*mg* where *m* is the object's mass and *g* is the acceleration due to gravity) and height (*h*) above a reference surface (*PD=mgh*). [9PSBE]**
9PSI	**12.**	**Explain how an object's kinetic energy depends on its mass and its speed (KE=*1/2mve*^{2}). [9PSBE]**
9PSI	**13.**	**Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight (*mg* where *m* is the object's mass and *g* is the acceleration due to gravity) and height (*h*) above a reference surface (*PD=mgh*). [9PSBE]**
9PSI	**15.**	**Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy. [9PSBF]**
9PSI	**17.**	**Demonstrate that thermal energy can be transferred by conduction, convection, or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). [9PSBF]**
9PSI	**18.**	**Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible light is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). [9PSBG]**

GRADE: Grade 8 **SCIENCE AND TECHNOLOGY**

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grades 6 - 8:

8STB	A.	Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.
8STB	B.	Design a solution or product taking into account needs constraints (e.g., cost, time, trade-offs, and properties of materials, safety and aesthetics).

Grade Level Indicator Grade 8:

Understanding Technology

8STI	1.	Examine how science and technology have advanced through the contributions of many different people, cultures and times in history. [8STBA]
8STI	2.	Examine how choices regarding the use of technology are influenced by constraints caused by various unavoidable factors (e.g., geographic location, limited resources, social political and economic considerations). [8SIBA]

Abilities To Do Technological Design

8STI	3.	Design and build a product or create a solution to a problem given more than two constraints (e.g., limits of cost and time for design and production, supply of materials and environmental effects). [8STBB]
8STI	4.	Evaluate the overall effectiveness of a product design or solution. [8STBB]

GRADE: Grade 8 **SCIENTIFIC INQUIRY**

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grades 6 - 8:

8SIB	A.	Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.
8SIB	B.	Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.

Grade Level Indicators Grade 8:

Doing Scientific Inquiry

8SII	1.	Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations. [8SIBA]
8SII	2.	Describe the concepts of sample size and control and explain how these affect scientific investigations. [8SIBA]
8SII	3.	Read, construct and interpret data in various forms produced by self and others in both written and oral form (e.g., tables, charts, maps, graphs, diagrams and symbols). [8SIBB]
8SII	4.	Apply appropriate math skills to interpret quantitative data (e.g., mean, median and mode). [8SIBB]

GRADE: Grade 8 **SCIENTIFIC WAYS OF KNOWING**

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grades 6 - 8:

8SWKB	A.	Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).
8SWKB	B.	Explain the importance of reproducibility and reduction of bias in scientific methods.
8SWKB	C.	Give examples of how thinking scientifically is helpful in daily life.

Grade Level Indicators Grade 8:

Nature of Science

8SWKI	1.	Identify the difference between description (e.g., observation and summary) and explanation (e.g., inference, prediction, significance and importance). [8SWKBA]
8SWKI	2.	Explain why it is important to examine data objectively and not let bias affect observations. [8SWKBB]

DISCRETE COURSES

GRADES 9 - 12

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grade 9:

9ESSB	A.	Explain how evidence from stars and other celestial objects provide information about the processes that cause changes in the composition and scale of the physical universe.
9ESSB	B.	Explain that many processes occur in patterns within the Earth's systems.
9ESSB	C.	Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.
9ESSB	D.	Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.
9ESSB	E.	Explain the processes that move and shape Earth's surface.
9ESSB	F.	Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.

Grade Level Indicators Grade 8-9:

The Universe

9ESSI	1.	Describe that stars produce energy from nuclear reactions and that processes in stars have led to the formation of all elements beyond hydrogen and helium. [9ESSBA]
9ESSI	2.	Describe the current scientific evidence that supports the theory of the explosive expansion of the universe, the Big Bang, over 10 billion years ago. [9ESSBA]
9ESSI	3.	Explain that gravitational forces govern the characteristics and movement patterns of the planets, comets, and asteroids in the solar system. [9ESSBC]
8ESSI	**3.**	**Compare the orbits and composition of comets and asteroids with that of Earth. [8ESSBA]**

8ESSI	**4.**	**Describe the effect that asteroids or meteoroids have when moving through space and sometimes entering planetary atmospheres (e.g., meteor-"shooting star" and meteorite).**
8ESSI	**5.**	**Explain that the universe consists of billions of galaxies that are classified by shape. [8ESSBB]**
8ESSI	**6.**	**Explain interstellar distances are measured in light years (e.g., the nearest star beyond the sun is 4.3 light years away). [8ESSBB]**
8ESSI	**7.**	**Examine the life cycle of a star and predict the next likely stage of a star. [8ESSBB]**
8ESSI	**8.**	**Name and describe tools used to study the universe (e.g., telescopes, probes, satellites and spacecraft). [8ESSBB]**
Earth Systems		
9ESSI	4.	Explain the relationships of the oceans to the lithosphere and atmosphere (e.g., transfer of energy, ocean currents and landforms). [9ESSBB]
10ESSI	3.	Explain how geologic time can be estimated by multiple methods (e.g., rock sequences, fossil correlation and radiometric dating). [10ESSBC]
10ESSI	4.	Describe how organisms on Earth contributed to the dramatic change in oxygen content of Earth's early atmosphere. [10ESSBC]
Processes that Shape Earth		
9ESSI	5.	Explain how the slow movement of material within Earth results from: [9ESSBE] a. thermal energy transfer (conduction and convection) from the deep interior; b. the action of gravitational forces on regions of different density.
9ESSI	6.	Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding). [9ESSBE]
9ESSI	7.	Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating). [9ESSBE]
Historical Personal and Scientific Revolutions		
9ESSI	8.	Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., Heliocentric Theory and Plate Tectonics Theory). [9ESSBF]
10ESSI	7.	Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geologic time scales, global warming, depletion of resources and exponential population growth). [10ESSBF]

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks Grade 9:

9PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.
9PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.

Grade Level Indicators Grade 9:

Nature of Matter

9PSI	1.	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. [9PSBA]

9PSI	2.	Illustrate atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. [9PSBA]
9PSI	3.	Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation. [9PSBF]
9PSI	4.	Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize that the periodic table was formed as a result of the repeating pattern of electron configurations. [9PSBA]
9PSI	5.	Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.
9PSI	6.	Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water). [9PSBB]
9PSI	7.	Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations). [9PSBB]
9PSI	8.	Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral. [9PSBB]
9PSI	9.	Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors). [9PSBC]
9PSI	10.	Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity. [9PSBC]
Nature of Energy		
9PSI	11.	Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant. [9PSBBF]
9PSI	14.	Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at extremely high energies). [9PSBF]
9PSI	16.	Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). [9PSBF]
9PSI	17.	Demonstrate that thermal energy can be transferred by conduction, convection, or radiation (e.g., through materials by

the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). [9PSBF]

9PSI 18. Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible light is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). [9PSBG]

9PSI 19. Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium. [9PSBG]

9PSI 20. Describe how waves can superimpose on one another when propagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed by materials they enter, and change direction and speed when entering a different material. [9PSBG]

Forces and Motion

9PSI 23. Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object ($F_{net} = ma$. Note that weight is the gravitational force on a mass.)

9PSI 24. Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object. [9PSBD]

9PSI 25. Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight). [9PSBD]

Historical Perspectives and Scientific Revolutions

9PSI 26. Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., atomic theory, quantum theory and Newtonian mechanics). [9PSBH]

9PSI 27. Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics, ceramics and communication technology). [9PSBH]

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks Grade 9:

9STB	A.	Explain the ways in which the processes of technological design respond to the needs of society.
9STB	B.	Explain that science and technology are interdependent, each drives the other.

Grade Level Indicator Grade 9:

Understanding Technology

9STI	1.	Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI	2.	Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]
9STI	3.	Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks Grade 9:

9SIB	A.	Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.

Grade Level Indicators Grade 9:

Doing Scientific Inquiry

9SII	1.	Distinguish between observations and inferences given a scientific situation. [9SIBA]
9SII	2.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). [9SIBA]
9SII	3.	Construct, interpret, and apply physical and conceptual models that represent or explain systems, objects, events, or concepts. [9SIBA]
9SII	4.	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. [9SIBA]
9SII	5.	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. [9SIBA]
9SII	6.	Draw logical conclusions based on scientific knowledge and evidence from investigations. [9SIBA]

Scientific Ways of Knowing:

Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks Grade 9:

9SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9SWKB	C.	Describe the ethical practices and guidelines in which science operates.

9SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.

Grade Level Indicators Grade 9:

Nature of Science

9SWKI	1.	Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. [9SWKBA]
9SWKI	2.	Illustrate the method and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. [9SWKBC]
9SWKI	3.	Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. [9SWKBA]

Ethical Practices

9SWKI	4.	Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. [9SWKBC]

Scientific Theories

9SWKI	5.	Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. [9SWKBB]
9SWKI	6.	Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. [9SWKBB]
9SWKI	7.	Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. [9SWKBB]

Science and Society

9SWKI	8.	Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study. [9SWKBD]
9SWKI	9.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [9SWKBD]

BIOLOGY **LIFE SCIENCES**

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 - 10:

9-10LSB	A.	Explain that cells are the basic unit of structure and function of living organisms, that once life originated all cells come from pre-existing cells and that there are a variety of cell types.
9-10LSB	B.	Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development.
9-10LSB	C.	Explain the genetic mechanisms and molecular basis of inheritance.
9-10LSB	D.	Explain the flow of energy and the cycling of matter through biological and ecological systems (cellular, organisms, and ecological).
9-10LSB	E.	Explain how evolutionary relationships contribute to an understanding of the unity and diversity of life.
9-10LSB	F.	Explain the structure and function of ecosystems and relate how ecosystems change over time.
9-10LSB	G.	Describe how human activities can impact the status of natural systems.
9-10LSB	H.	Describe a foundation of biological evolution as the change in gene frequency of a population over time. Explain the historical and current scientific developments, mechanisms, and processes of biological evolution. Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this benchmark does not mandate the teaching or testing of intelligent design.)
9-10LSB	I.	Explain how natural selection and other evolutionary mechanisms account for the unity and diversity of past and present life forms.
9-10LSB	J.	Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences.

Grade Level Indicators 9 - 10:

Characteristics and Structure of Life

10LSI 1. Explain that living cells: [10LSBA]
   a. are composed of a small number of key chemical elements (carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur)
   b. are the basic unit of structure and function of all living things
   c. come from pre-existing cells after life originated, and
   d. are different from viruses.

10LSI 2. Compare the structure, function and interrelatedness of cell organelles in eukaryotic cells (e.g., nucleus, chromosome, mitochondria, cell membrane, cell wall, chloroplast, cilia, flagella) and prokaryotic cells. [10LSBA]

10LSI 3. Explain the characteristics of life as indicated by cellular processes including: [10LSBB]
   a. homeostasis
   b. energy transfers and transformation
   c. transportation of molecules
   d. disposal of wastes
   e. synthesis of new molecules.

10LSI 4. Summarize the general processes of cell division and differentiation, and explain why specialized cells are useful to organisms and explain that complex multicellular organisms are formed as highly organized arrangements of differentiated cells. [10LSBB]

Heredity

10LSI 5. Illustrate the relationship of the structure and function of DNA to protein synthesis and the characteristics of an organism. [10LSBC]

10LSI 6. Explain that a unit of hereditary information is called a gene, and genes may occur in different forms called alleles (e.g., gene for pea plant height has two alleles, tall and short). [10LSBC]

10LSI 7. Describe that spontaneous changes in DNA are mutations, which area source of genetic variation. When mutations occur in sex cells, they may be passed on to future generations; mutations that occur in body cells may affect the functioning of that cell or the organism in which that cell is found. [10LSBC]

10LSI 8. Use the concepts of Mendelian and non-Mendelian genetics (e.g., segregation, independent assortment, dominant and recessive traits, sex-linked traits and jumping genes) to explain inheritance. [10LSBC]

Diversity and Interdependence of Life

10LSI	9.	Describe how matter cycles and energy flows through different levels of organization in living systems and between living systems and the physical environment. Explain how some energy is stored and much is dissipated into the environment as thermal energy (e.g., food webs and energy pyramids). [10LSBD]
10LSI	10.	Describe how cells and organisms acquire and release energy (photosynthesis, chemosynthesis, cellular respiration and fermentation). [10LSBD]
10LSI	11.	Explain that living organisms use matter and energy to synthesize a variety of organic molecules (e.g., proteins, carbohydrates, lipids and nucleic acids) and to drive life processes (e.g., growth, reacting to the environment, reproduction and movement). [10LSBD]
10LSI	12.	Describe that biological classification represents how organisms are related with species being the most fundamental unit of the classification system. Relate how biologists arrange organisms into a hierarchy of groups and subgroups based on similarities and differences that reflect their evolutionary relationships. [10LSBD]
10LSI	13.	Explain that the variation of organisms within a species increases the likelihood that at least some members of a species will survive under gradually changing environmental conditions. [10LSBE]
10LSI	14.	Relate diversity and adaptation to structures and their functions in living organisms (e.g., adaptive radiation). [10LSBE]
10LSI	15.	Explain how living things interact with biotic and abiotic components of the environment (e.g., predation, competition, natural disasters and weather). [10LSBF]
10LSI	16.	Relate how distribution and abundance of organisms and populations in ecosystems are limited by the ability of the ecosystem to recycle materials and the availability of matter, space, and energy. [10LSBF]
10LSI	17.	Conclude that ecosystems tend to have cyclic fluctuations around a state of approximate equilibrium that can change when climate changes, when one or more new species appear as a result of immigration or when one or more species disappear. [10LSBF]
10LSI	18.	Describe ways that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. Explain how changes in technology/biotechnology can cause significant changes, either positive or negative, in environmental quality and carrying capacity. [10LSBG]
10LSI	19.	Illustrate how uses of resources at local, state, regional, national, and global levels have affected the quality of life (e.g., energy production and sustainable vs. non sustainable agriculture). [10LSBG]

Evolutionary Theory

10LSI	20.	Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution. [10LSBH]

10LSI	21.	Explain that natural selection provides the following mechanism for evolution; undirected variation in inherited characteristics exist within every species. These characteristics may give individuals an advantage or disadvantage compared to others in surviving and reproducing. The advantaged offspring are more likely to survive and reproduce. Therefore, the proportion of individuals that have advantageous characteristics will increase. When an environment changes, the survival value of some inherited characteristics may change. [10LSBH]
10LSI	22.	Describe historical scientific developments that occurred in evolutionary thought (e.g., Lamarck and Darwin, Mendelian Genetics and modern synthesis). [10LSBH]
10LSI	23.	Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this indicator does not mandate the teaching or testing of intelligent design.) [10LSBH]
10LSI	24.	Analyze how natural selection and other evolutionary mechanisms (e.g., genetic drift, immigration, emigration, mutation) and their consequences provide a scientific explanation for the diversity and unity of past life forms, as depicted in the fossil record, and present life forms. [10LSBI]
10LSI	25.	Explain that life on Earth is thought to have begun as simple, one celled organisms approximately 4 billion years ago. During most of the history of Earth only single celled microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved. [10LSBI]

Historical Perspectives and Scientific Revolutions

10LSI	26.	Use historical examples to explain how new ideas are limited by the context in which they are conceived. These ideas are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., biological evolution, germ theory, biotechnology and discovering germs.) [10LSBJ]
10LSI	27.	Describe advances in life sciences that have important long-lasting effects on science and society (e.g., biological evolution, germ theory, biotechnology and discovering germs). [10LSBJ]
10LSI	28.	Analyze and investigate emerging scientific issues (e.g., genetically modified food, stem cell research, genetic research and cloning). [10LSBJ]

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 - 10:

9-10PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9-10PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.

Physical Sciences

9-10PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9-10PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9-10PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9-10PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9-10PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9-10PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.

Grade Level Indicators 9:

Nature of Matter

9PSI	1.	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. [9PSBA]
9PSI	2.	Illustrate atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. [9PSBA]

9PSI	5.	Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.
9PSI	6.	Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water). [9PSBB]
9PSI	7.	Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations). [9PSBB]
9PSI	8.	Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral. [9PSBB]

Nature of Energy

9PSI	11.	Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant. [9PSBBF]
9PSI	12.	Explain how an object's kinetic energy depends on its mass and its speed (KE=$1/2mve^2$). [9PSBE]
9PSI	16.	Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). [9PSBF]
9PSI	18.	Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible lights is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). [9PSBG]

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 - 12:

9-10STB	A.	Explain the ways in which the processes of technological design respond to the needs of society.
9-10STB	B.	Explain that science and technology are interdependent, each drives the other.
11-12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicators 9 - 10:

Understanding Technology

9STI 1. Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI 2. Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]

9STI 3. Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Understanding Technology

10STI 1. Cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the needs to meet human needs and solve human problems. [10STBB]

10STI 2. Describe examples of scientific advances and emerging technologies and how they may impact society. [10STBB]

Abilities to Do Technological Design

10STI 3. Explain that when evaluating a design for a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced and disposed of in addition to who will sell, operate and take care of it. Explain how the costs associated with these considerations may introduce additional constraints on the design. [10STBA]

Grade Level Indicator 11:

Understanding Technology

11STI 1. Identify that science and technology are essential social enterprises but alone they can only indicate what can happen, not what should happen. Realize the latter involves human decisions about the use of knowledge. [11STBA]

11STI 2. Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA]

11STI 3. Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 9 - 10:

9-10SIB	A.	Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.

Grade Level Indicators 9 - 10:

Doing Scientific Inquiry

9SII	1.	Distinguish between observations and inferences given a scientific situation. [9SIBA]
9SII	2.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). [9SIBA]
9SII	3.	Construct, interpret, and apply physical and conceptual models that represent or explain systems, objects, events, or concepts. [9SIBA]
9SII	4.	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. [9SIBA]
9SII	5.	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. [9SIBA]
9SII	6.	Draw logical conclusions based on scientific knowledge and evidence from investigations. [9SIBA]

Doing Scientific Inquiry

10SII	1.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII	2.	Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII	3.	Use mathematical models to predict and analyze natural phenomena. [10SIBA]
10SII	4.	Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII	5.	Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 - 10:

9-10SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9-10SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9-10SWKB	C.	Describe the ethical practices and guidelines in which science operates.
9-10SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.

Grade Level Indicators 9 – 10:

Nature of Science

9SWKI	1.	Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. [9SWKBA]
9SWKI	2.	Illustrate the method and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. [9SWKBC]
9SWKI	3.	Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. [9SWKBA]

Ethical Practices

9SWKI	4.	Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. [9SWKBC]

Scientific Theories

9SWKI	5.	Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. [9SWKBB]
9SWKI	6.	Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. [9SWKBB]

9SWKI	7.	Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. [9SWKBB]
Science and Society		
9SWKI	8.	Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study. [9SWKBD]
9SWKI	9.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [9SWKBD]
Nature of Science		
10SWKI	1.	Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. [10SWKBA]
10SWKI	2.	Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science. [10SWKBA]
10SWKI	3.	Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to move adequate explanations of natural phenomena. [10SWKBA]
Ethical Practices		
10SWKI	4.	Recognize that ethical considerations limit what scientists can do. [10SWKBC]
10SWKI	5.	Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. [10SWKBC]
10SWKI	6.	Recognize that animal-based research much be conducted according to currently accepted professional standards and laws. [10SWKBC]
Science and Society		
10SWKI	7.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [10SWKBD]

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks Grades 9 - 12:

9-10ESSB	A.	Explain how evidence from stars and other celestial objects provide information about the processes that cause changes in the composition and scale of the physical universe.
9-10ESSB	B.	Explain that many processes occur in patterns within the Earth's systems.
9-10ESSB	C.	Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.
9-10ESSB	D.	Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.
9-10ESSB	E.	Explain the processes that move and shape Earth's surface.
9-10ESSB	F.	Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.
11-12ESSB	A.	Explain how technology can be used to gather evidence and increase our understanding of the universe.
11-12ESSB	B.	Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.
11-12ESSB	C.	Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.
11-12ESSB	D.	Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences.

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Grade Level Indicators 9 - 10:

11ESSI	11.	Analyze how materials from human societies (e.g., radioactive waste and air pollution) affect both physical and chemical cycles of Earth. [11ESSBC] *Geology & Space, Chemistry)*

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 - 12:

9-10PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9-10PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.
9-10PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9-10PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9-10PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9-10PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9-10PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9-10PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.
11-12PSB	A.	Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.
11-12PSB	B.	Recognize that some atomic nuclei are unstable and will spontaneously break down.
11-12PSB	C.	Describe how atoms and molecules can gain or lose energy only in discrete amounts.
11-12PSB	D.	Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.
11-12PSB	E.	Summarize the historical development of scientific theories and ideas within the study of physical sciences.

Grade Level Indicators 9 - 10:

Nature of Matter

9PSI	1.	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. [9PSBA]
9PSI	2.	Illustrate atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. [9PSBA]
9PSI	3.	Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation. [9PSBF]
9PSI	4.	Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize that the periodic table was formed as a result of the repeating pattern of electron configurations. [9PSBA]
9PSI	5.	Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.
9PSI	6.	Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water). [9PSBB]
9PSI	7.	Show how atoms may be bonded together by losing gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations). [9PSBB]
9PSI	8.	Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral. [9PSBB]
9PSI	9.	Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors). [9PSBC]
9PSI	10.	Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity. [9PSBC]

Nature of Energy

9PSI	11.	Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant. [9PSBBF]
9PSI	12.	Explain how an object's kinetic energy depends on its mass and its speed (KE=$1/2mve^2$). [9PSBE]
9PSI	14.	Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves

the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at extremely high energies). [9PSBF]

9PSI 15. Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy. [9PSBF]

9PSI 16. Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). [9PSBF]

9PSI 17. Demonstrate that thermal energy can be transferred by conduction, convection, or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). [9PSBF]

9PSI 18. Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible lights is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). [9PSBG]

9PSI 19. Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium. [9PSBG]

Grade Level Indicators 11-12:

Nature of Matter

11PSI 1. Explain that elements with the same number of protons may or may not have the same mass and those with different masses (different number of neutrons) are called isotopes. Some of these are radioactive. [11PSBA] *(All)*

11PSI 2. Explain that humans have used unique bonding of carbon atoms to make a variety of molecules (e.g., plastics). [11PSBE] *(Biology, Chemistry)*

Forces and Motion

11PSI 3. Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use). [11PSBC] *(All)*

Nature of Matter

12PSI 1. Explain how atoms join with one another in various combinations in distinct molecules or in repeating crystal patterns. [12PSB] *(Geology and Space, Chemistry)*

12PSI 2. Describe how a physical, chemical, or ecological system in equilibrium may return to the same state of equilibrium if the disturbances it experiences are small. Large disturbances may cause it to escape that equilibrium and eventually settle into some other state of equilibrium. [12PSBA] *(Chemistry, Biology, Advanced Biology)*

12PSI 3. Explain how all matter tends toward more disorganized states and describe real world examples (e.g., erosion of rocks and expansion of the universe). [12PSBD] (Biology, Chemistry, Physics, Geology and Space).

12PSI 4. Recognize that at low temperatures some materials become superconducting and offer little or no resistance to the flow

of electrons. [12PSBA] *(Physics, Chemistry)*

Forces and Motion

12PSI 5. Use and apply the laws of motion to analyze, describe, and predict the effects of forces on the motions of objects mathematically. [12PSBD] *(Physics)*

12PSI 6. Recognize that the nuclear forces that hold the nucleus of an atom together, at nuclear distances, are stronger than the electric forces that would make it fly apart. [12PSBD] *(Biology, Physics, Chemistry)*

12PSI 7. Recognize that nuclear forces are much stronger than electromagnetic forces, and electromagnetic forces are vastly stronger than gravitational forces. The strength of the nuclear forces explains why greater amounts of energy are released from nuclear reactions (e.g., from atomic and hydrogen bombs and in the sun and other stars). [12PSBD] *(Physics)*

12PSI 8. Describe how the observed wavelength of a wave depends upon the relative motion of the source and the observer (Doppler effect). If either is moving towards the other, the observed wavelength is shorter; if either is moving away, the observed wavelength is longer (e.g., weather radar, bat echoes and police radar). [12PSBD] (*Physics)*

12PSI 9. Describe how gravitational forces act between all masses and always create a force of attraction. Recognize that the strength of the force is proportional to the masses and weakens rapidly with increasing distance between them. [12PSBD] *(Physics)*

Nature of Energy

12PSI 10. Explain the characteristics of isotopes. The nuclei of radioactive isotopes are unstable and spontaneously decay emitting particles and/or wavelike radiation. It cannot be predicted exactly when, if ever, an unstable nucleus will decay, but a large group of identical nuclei decay at a predictable rate. [12PSBB] *(Chemistry, Geology and Space, Physics, Biology)*

12PSI 11. Use the predictability of decay rates and the concept of half-life to explain how radioactive substances can be used in estimating the age of materials. [12PSBB] *(Biology, Chemistry, Physics)*

12PSI 12. Describe how different atomic energy levels are associated with the electron configurations of atoms and electron configurations (and/or conformations) of molecules. [12PSBC] *(Biology, Chemistry)*

12PSI 13. Explain how atoms and molecules can gain or lose energy in particular discrete amounts (quanta or packets); therefore they can only absorb or emit light at the wavelengths corresponding to these amounts. [12PSBC] *(Biology, Chemistry)*

Historical Perspectives and Scientific Revolutions

12PSI 14. Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly

through contributions from many different investigators (e.g., nuclear energy, quantum theory and theory of relativity). [12PSBE] *Physics, Chemistry)*

12PSI 15. Describe concepts/ideas in physical sciences that have important, long-lasting effects on science and society (e.g., quantum theory, theory of relativity, age of the universe). [12PSBE] *(Physics, Chemistry, Geology and Space)*

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 - 12:

9-10STB A. Explain the ways in which the processes of technological design respond to the needs of society.
9-10STB B. Explain that science and technology are interdependent, each drives the other.
11-12STB A. Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicator 9 – 10:

Understanding Technology

9STI 1. Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI 2. Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]
9STI 3. Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Grade Level Indicator 11 - 12:

Understanding Technology

11STI 2. Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA] *(All)*
11STI 3. Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]*(All)*

11STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [11STBA] *(All)*
11STI	5.	Investigate that all fuels (e.g., fossil, solar and nuclear) have advantages and disadvantages, therefore society must consider the trade-offs among them (e.g., economic costs and environmental impact). [11STBA] *(All)*
11STI	6.	Research sources of energy beyond traditional fuels and the advantages, disadvantages and trade-offs society must consider when using alternative sources (e.g., biomass, solar, hybrid engines, wind and fuel cells. [11STBA]*(All)*

Understanding Technology

12STI	1.	Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA] *(All)*
12STI	2.	Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. [12STBA] *(All)*
12STI	3.	Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA] *(All)*
12STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA] *(All)*

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 9 – 12:

9-10SIB	A.	Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.
11-12SIB	A.	Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 9 – 10:

Doing Scientific Inquiry

9SII	1.	Distinguish between observations and inferences given a scientific situation. [9SIBA]
9SII	2.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). [9SIBA]
9SII	3.	Construct, interpret, and apply physical and conceptual models that represent or explain systems, objects, events, or concepts. [9SIBA]
9SII	4.	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. [9SIBA]
9SII	5.	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. [9SIBA]
9SII	6.	Draw logical conclusions based on scientific knowledge and evidence from investigations. [9SIBA]

Doing Scientific Inquiry

10SII	1.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII	2.	Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII	3.	Use mathematical models to predict and analyze natural phenomena. [10SIBA]
10SII	4.	Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII	5.	Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Grade Level Indicators 11 - 12:

Doing Scientific Inquiry

11SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [11SIBA] *(All)*
11SII	2.	Evaluate assumptions that have been used in reaching scientific conclusions. [11SIBA] *(All)*
11SII	3.	Design and carry out scientific inquiry (investigation), communicate and critique results through peer review. [11SIBA] *(All)*
11SII	4.	Explain why the methods of an investigation are based on the questions being asked. [11SIBA] *(All)*

11SII	5.	Summarize data and construct a reasonable argument based on those data and other known information. [11SIBA] *(All)*

Doing Scientific Inquiry

12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA] *(All)*
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA] *(All)*
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA] *(All)*
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. [12SIBA] *(All)*
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA] *(All)*

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 - 12:

9-10SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9-10SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9-10SWKB	C.	Describe the ethical practices and guidelines in which science operates.
9-10SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.
11-12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.
11-12SWKB	B.	Explain how ethical considerations shape scientific endeavors.
11-12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Grade Level Indicators 9 – 10:

Nature of Science

9SWKI	1.	Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. [9SWKBA]
9SWKI	2.	Illustrate the method and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. [9SWKBC]
9SWKI	3.	Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. [9SWKBA]

Ethical Practices

9SWKI	4.	Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. [9SWKBC]

Scientific Theories

9SWKI	5.	Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. [9SWKBB]
9SWKI	6.	Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. [9SWKBB]
9SWKI	7.	Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. [9SWKBB]

Science and Society

9SWKI	8.	Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study. [9SWKBD]
9SWKI	9.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [9SWKBD]

Nature of Science

10SWKI	1.	Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. [10SWKBA]
10SWKI	2.	Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the

process of science. [10SWKBA]

10SWKI 3. Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to move adequate explanations of natural phenomena. [10SWKBA]

Ethical Practices

10SWKI 4. Recognize that ethical considerations limit what scientists can do. [10SWKBC]

10SWKI 5. Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. [10SWKBC]

10SWKI 6. Recognize that animal-based research much be conducted according to currently accepted professional standards and laws. [10SWKBC]

Science and Society

10SWKI 7. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [10SWKBD]

Grade Level Indicators 11 – 12:

Nature of Science

11SWLI 1. Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). [11SWKA] (*All)*

11SWKI 2. Apply scientific inquiry to elevate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. [11SWLBA] (*All)*

11SWKI 3. Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. [11SWLBA] (*All)*

11SWKI 4. Explain why scientists can assume that the universe is a vast single system in which the basic rules are the same everywhere. [11SWKBA]

Ethical Practices

11SWKI 5. Recognize that bias affects outcomes. People tend to ignore evidence that challenges their beliefs but accept evidence that supports their beliefs. Scientists attempt to avoid bias in their work. [11SWKBA] (*Biology*, *Chemistry*, Physics)

11SWKI 6. Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. [11SWKBA] (*All)*

Scientific Theories

11SWKI	7.	Explain how theories are judged by how well they fit with other theories, the range of included observations, how well they explain observations and how effective they are in predicting new findings. [11AWKBA] (All)

Science and Society

11SWKI	8.	Explain that the decision to develop a new technology is influenced by societal opinions and demands and by cost benefit considerations. [11SWKBA] (All)
11SWKI	9.	Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society as well as cause risks. [11SWKBA] (All)
11SWKI	10.	Describe costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. [11SWKBA] (All)
11SWKI	11.	Research the role of science and technology in careers that students plan to pursue. [11SWKBA] (All)

Nature of Science

12SWKI	1.	Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA] *(All)*
12SWKI	2.	Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. [12SWKBA] *(All)*
12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. [12SWLBA] *(All)*
12SWKI	4.	Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA] *(All)*
12SWKI	5.	Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA] *(All)*

Ethical Practices

12SWKI	6.	Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC] *(All)*

Science and Society

12SWKI	7.	Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC] *(All)*
12SWKI	8.	Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC] (All)
12SWKI	9.	Recognize the appropriateness and value of basic questions "What can happen?", "What are the odds?" and "How do scientists and engineers know what will happen?" [12SWKBC] *(All)*
12SWKI	10.	Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC] *(All)*
12SWKI	11.	Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC] (All)

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and Space Sciences.

Science Benchmarks 9 - 12:

9-10ESSB	A.	Explain how evidence from stars and other celestial objects provide information about the processes that cause changes in the composition and scale of the physical universe.
9-10ESSB	B.	Explain that many processes occur in patterns within the Earth's systems.
9-10ESSB	C.	Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.
9-10ESSB	D.	Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.
9-10ESSB	E.	Explain the processes that move and shape Earth's surface.
9-10ESSB	F.	Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.
11-12ESSB	A.	Explain how technology can be used to gather evidence and increase our understanding of the universe.
11-12ESSB	B.	Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.
11-12ESSB	C.	Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.
11-12ESSB	D.	Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences.

Grade Level Indicators 11 – 12:

The Universe

11ESSI	1.	Describe how the early Earth was different from planet we live on today, and explain the formation of the sun, Earth and the rest of the solar system from a nebular cloud of dust and gas approximately 4.5 billion years ago. [11ESSBA]

Earth Systems

11ESSI	7.	Describe the effects of particulates and gases in the atmosphere including those originating from volcanic activity. [11ESSBB]

Historical Perspectives and Scientific Revolutions

11ESSI	15.	Use historical examples to show how new ideas are limited by the context in which they are conceived; are often rejected by the social establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., global warming, Heliocentric Theory and Theory of Continental Drift). [11ESSBD]
11ESSI	16.	Describe advances in Earth and space science that have important long-lasting effects on science and society (e.g., global warming, Heliocentric Theory and Plate Tectonics Theory). [11ESSBD]

The Universe

12ESSI	1.	Explain how scientists obtain information about the universe by using technology to detect electromagnetic radiation that is emitted, reflected or absorbed by stars and other objects. [12ESSBA]
12ESSI	2.	Explain how the large-sale motion of objects in the universe is governed by gravitational forces and detected by observing electromagnetic radiation. [12ESSBA]
12ESSI	3.	Explain how information about the universe is inferred by understanding that stars and other objects in space emit, reflect or absorb electromagnetic radiation, which we then detect. [12ESSBA]
12ESSI	4.	Explain how astronomers infer that the whole universe is expanding by understanding how light seen from distant galaxies has longer apparent wavelengths than comparable light sources close to Earth. [12ESSBA]

Earth Systems

12ESSI	5.	Investigate how thermal energy transfers in the world's oceans impact physical features (e.g., ice caps, oceanic and atmospheric currents) and weather patterns. [12ESSBB]

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 - 12:

9-10PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9-10PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.
9-10PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9-10PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9-10PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9-10PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9-10PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9-10PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.
11-12PSB	A.	Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.
11-12PSB	B.	Recognize that some atomic nuclei are unstable and will spontaneously break down.
11-12PSB	C.	Describe how atoms and molecules can gain or lose energy only in discrete amounts.
11-12PSB	D.	Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.
11-12PSB	E.	Summarize the historical development of scientific theories and ideas within the study of physical sciences.

Grade Level Indicators 9 - 10:

Nature of Energy

9PSI	16.	Illustrate that chemical reactions are eight endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). [9PSBF]
9PSI	18.	Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible lights is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). [9PSBG]
9PSI	19.	Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium. [9PSBG]
9PSI	20.	Describe how waves can superimpose on one another when propagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed by materials they enter, and change direction and speed when entering a different material. [9PSBG]

Forces and Motion

9PSI	21.	Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time. [9PSBD]
9PSI	22.	Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it. [9PSBD]
9PSI	23.	Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object (F_{net} = ma. Note that weight is the gravitational force on a mass.)
9PSI	24.	Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object. [9PSBD]
9PSI	25.	Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight). [9PSBD]

Historical Perspectives and Scientific Revolutions

9PSI	27.	Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics, ceramics and communication technology). [9PSBH]

Grade Level Indicators 11 – 12:

Nature of Matter

11PSI	1.	Explain that elements with the same number of protons may or may not have the same mass and those with different masses (different number of neutrons) are called isotopes. Some of these are radioactive. [11PSBA]

Forces and Motion

11PSI	3.	Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use). [11PSBC]

Nature of Matter

12PSI	3.	Explain how all matter tends toward more disorganized states and describe real world examples (e.g., erosion of rocks and expansion of the universe). [12PSBD] (Biology, Chemistry, Physics, Geology and Space).
12PSI	4.	Recognize that at low temperatures some materials become superconducting and offer little or no resistance to the flow of electrons. [12PSBA]

Forces and Motion

12PSI	5.	Use and apply the laws of motion to analyze, describe, and predict the effects of forces on the motions of objects mathematically. [12PSBD]
12PSI	6.	Recognize that the nuclear forces that hold the nucleus of an atom together, at nuclear distances, are stronger than the electric forces that would make it fly apart. [12PSBD]
12PSI	7.	Recognize that nuclear forces are much stronger than electromagnetic forces, and electromagnetic forces are vastly stronger than gravitational forces. The strength of the nuclear forces explains why greater amounts of energy are released from nuclear reactions (e.g., from atomic and hydrogen bombs and in the sun and other star. [12PSBD]
12PSI	8.	Describe how the observed wavelength of a wave depends upon the relative motion of the source and the observer (Doppler effect). If either is moving towards the other, the observed wavelength is shorter; if either is moving away, the observed wavelength is longer (e.g., weather radar, bat echoes and police radar). [12PSBD]
12PSI	9.	Describe how gravitational forces act between all masses and always create a force of attraction. Recognize that the strength of the force is proportional to the masses and weakens rapidly with increasing distance between them. [12PSBD]

Nature of Energy

12PSI	10.	Explain the characteristics of isotopes. The nuclei of radioactive isotopes are unstable and spontaneously decay emitting particles and/or wavelike radiation. It cannot be predicted exactly when, if ever, an unstable nucleus will decay, but a large group of identical nuclei decay at a predictable rate. [12PSBB]
12PSI	11.	Use the predictability of decay rates and the concept of half-life to explain how radioactive substances can be used in estimating the age of materials. [12PSBB]

Historical Perspectives and Scientific Revolutions

12PSI	14.	Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., nuclear energy, quantum theory and theory of relativity). [12PSBE]
12PSI	15.	Describe concepts/ideas in physical sciences that have important, long-lasting effects on science and society (e.g., quantum theory, theory of relativity, age of the universe). [12PSBE]

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 – 12:

9-10STB	A.	Explain the ways in which the processes of technological design respond to the needs of society.
9-10STB	B.	Explain that science and technology are interdependent, each drives the other.
11-12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicator 9 - 10:
Understanding Technology

9STI	1.	Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI	2.	Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]
9STI	3.	Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Grade Level Indicator 11 - 12:
Understanding Technology

11STI	1.	Identify that science and technology are essential social enterprises but alone they can only indicate what can happen, not what should happen. Realize the latter involves human decisions about the use of knowledge. [11STBA]
11STI	2.	Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA]
11STI	3.	Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]

Understanding Technology

12STI	1.	Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA]
12STI	2.	Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. [12STBA]
12STI	3.	Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA]
12STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA]

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 9 - 12:

9-10SIB	A.	Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.
11-12SIB	A.	Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 10:

Doing Scientific Inquiry

10SII	1.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII	2.	Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII	3.	Use mathematical models to predict and analyze natural phenomena. [10SIBA]
10SII	4.	Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII	5.	Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Grade Level Indicators 11 - 12:

Doing Scientific Inquiry

11SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variable (dependent and independent) in scientific experimentation. [11SIBA]
11SII	2.	Evaluate assumptions that have been used in reaching scientific conclusions. [11SIBA]
11SII	3.	Design and carry out scientific inquiry (investigation), communicate and critique results through peer review. [11SIBA]
11SII	4.	Explain why the methods of an investigation are based on the questions being asked. [11SIBA]

11SII	5.	Summarize data and construct a reasonable argument based on those data and other known information. [11SIBA]

Doing Scientific Inquiry

12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA]
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA]
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA]
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. [12SIBA]
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA]

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 - 12:

9-10SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9-10SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9-10SWKB	C.	Describe the ethical practices and guidelines in which science operates.
9-10SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.
11-12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.
11-12SWKB	B.	Explain how ethical considerations shape scientific endeavors.

11-12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Grade Level Indicators 10:

Nature of Science

10SWKI	1.	Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. [10SWKBA]
10SWKI	2.	Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science. [10SWKBA]
10SWKI	3.	Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to move adequate explanations of natural phenomena. [10SWKBA]

Ethical Practices

10SWKI	4.	Recognize that ethical considerations limit what scientists can do. [10SWKBC]
10SWKI	5.	Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. [10SWKBC]
10SWKI	6.	Recognize that animal-based research much be conducted according to currently accepted professional standards and laws. [10SWKBC]

Science and Society

10SWKI	7.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [10SWKBD]

Grade Level Indicators 11 – 12:

Nature of Science

11SWKI	1.	Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). [11SWKA]
11SWKI	2.	Apply scientific inquiry to elevate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. [11SWLBA]

11SWKI	3.	Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. [11SWLBA]
Ethical Practices		
11SWKI	5.	Recognize that bias affects outcomes. People tend to ignore evidence that challenges their beliefs but accept evidence that supports their beliefs. Scientists attempt to avoid bias in their work. [11SWKBA]
11SWKI	6.	Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. [11SWKBA]
Scientific Theories		
11SWKI	7.	Explain how theories are judged by how well they fit with other theories, the range of included observations, how well they explain observations and how effective they are in predicting new findings. [11AWKBA]
Science and Society		
11SWKI	8.	Explain that the decision to develop a new technology is influenced by societal opinions and demands and by cost benefit considerations. [11SWKBA]
11SWKI	9.	Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society as well as cause risks. [11SWKBA]
11SWKI	10.	Describe costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. [11SWKBA]
11SWKI	11.	Research the role of science and technology in careers that students plan to pursue. [11SWKBA] (All)
Nature of Science		
12SWKI	1.	Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA]
12SWKI	2.	Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. [12SWKBA]
12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. [12SWLBA]
12SWKI	4.	Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA]

12SWKI	5.	Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA]
Ethical Practices		
12SWKI	6.	Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC]
Science and Society		
12SWKI	7.	Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC]
12SWKI	8.	Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC]
12SWKI	9.	Recognize the appropriateness and value of basic questions “What can happen?”, “What are the odds?” and “How do scientists and engineers know what will happen?” [12SWKBC]
12SWKI	10.	Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC]
12SWKI	11.	Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC]

ANATOMY & PHYSIOLOGY — LIFE SCIENCES

Life Sciences:
Students demonstrate an understanding of how the human body functions and how it interacts with the physical environment. This includes an understanding of the cycling of matter and flow of energy, (Physiology) and an understanding of the characteristics, structure and function of organ systems of the human body (Anatomy) will be developed. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 11 – 12:

11-12LSB	A.	Explain how processes at the cellular level affect the functions and characteristics of an organism.
11-12LSB	B.	Explain how humans are connected to and impact natural systems.
11-12LSB	C.	Explain how the molecular basis of life and the principles of genetics determine inheritance.
11-12LSB	E.	Explain the interconnectedness of the components of a natural system.
11-12LSB	F.	Explain how human choices today will affect the quality and quantity of life on earth.
11-12LSB	G.	Summarize the historical development of scientific theories and ideas within the study of life sciences.

Grade Level Indicators 10 - 12:

Diversity and Interdependence of Life

10LSI	14.	Relate diversity and adaptation to structures and their functions in living organisms. [10LSBE]

Evolutionary Theory

10LSI	21.	Explain that natural selection provides the following mechanism for evolution; undirected variation in inherited characteristics exist within every species. These characteristics may give individuals an advantage or disadvantage compared to others in surviving and reproducing. The advantaged offspring are more likely to survive and reproduce. Therefore, the proportion of individuals that have advantageous characteristics will increase. When an environment changes, the survival value of some inherited characteristics may change. [10LSBH]

Characteristics and Structure of Life

12LSI 2. Explain why specialized cells/structures are useful to animals (e.g., blood, nerve, muscle, egg and sperm). [12LSBA]

Heredity

12LSI 6. Explain how developmental differentiation is regulated through the expression of different genes. [12LSBC

Diversity and Interdependence of Life

12LSI 7. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. [12LSBE]

12LSI 9. Explain why and how living systems require a continuous input of energy to maintain their chemical and physical organization. Explain that with death and the cessation of energy input, living systems rapidly disintegrate toward more disorganized states. [12LSBE]

Historical Perspectives and Scientific Revolutions

12LSI 12. Describe advances in life sciences that have important, long-lasting effects on science and society (e.g., biotechnology). [12LSBG]

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 11 - 12:

11-12PSB A. Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.

11-12PSB D. Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.

Grade Level Indicators 12:

Nature of Matter

12PSI	2.	Describe how a physical, chemical, or ecological system in equilibrium may return to the same state of equilibrium if the disturbances it experiences are small. Large disturbances may cause it to escape that equilibrium and eventually settle into some other state of equilibrium. [12PSBA]

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 11:

11-12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicator 11 - 12:

Understanding Technology

11STI	2.	Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA]
11STI	3.	Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]

Understanding Technology

12STI	1.	Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA]
12STI	2.	Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. [12STBA]
12STI	3.	Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA]

12STI 4. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA]

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 11 - 12:

11-12SIB A. Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 11 - 12:
Doing Scientific Inquiry

10SII 1. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII 2. Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII 3. Use mathematical models to predict and analyze natural phenomena. [10SIBA]
10SII 4. Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII 5. Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Grade Level Indicators 11 - 12:

Doing Scientific Inquiry

11SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variable (dependent and independent) in scientific experimentation. [11SIBA]
11SII	2.	Evaluate assumptions that have been used in reaching scientific conclusions. [11SIBA]
11SII	3.	Design and carry out scientific inquiry (investigation), communicate and critique results through peer review. [11SIBA]
11SII	4.	Explain why the methods of an investigation are based on the questions being asked. [11SIBA]
11SII	5.	Summarize data and construct a reasonable argument based on those data and other known information. [11SIBA]

Doing Scientific Inquiry

12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA]
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA]
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA]
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. [12SIBA]
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA]

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 11 - 12:

11-12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.

11-12SWKB	B.	Explain how ethical considerations shape scientific endeavors.
11-12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Grade Level Indicators 11 – 12:

Nature of Science

11SWKI	1.	Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). [11SWKA]
11SWKI	2.	Apply scientific inquiry to elevate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. [11SWLBA]
11SWKI	3.	Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. [11SWKBA]

Ethical Practices

11SWKI	6.	Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. [11SWKBA]

Scientific Theories

11SWKI	7.	Explain how theories are judged by how well they fit with other theories, the range of included observations, how well they explain observations and how effective they are in predicting new findings. [11SWKBA]

Science and Society

11SWKI	8.	Explain that the decision to develop a new technology is influenced by societal opinions and demands and by cost benefit considerations. [11SWKBA]
11SWKI	9.	Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society as well as cause risks. [11SWKBA]
11SWKI	10.	Describe costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. [11SWKBA]
11SWKI	11.	Research the role of science and technology in careers that students plan to pursue. [11SWKBA]

Nature of Science

12SWKI	1.	Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA]
12SWKI	2.	Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. [12SWKBA]
12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. [12SWLBA]
12SWKI	4.	Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA]
12SWKI	5.	Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA]

Ethical Practices

12SWKI	6.	Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC]

Science and Society

12SWKI	7.	Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC]
12SWKI	8.	Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC]
12SWKI	9.	Recognize the appropriateness and value of basic questions “What can happen?” “What are the odds?” and “How do scientists and engineers know what will happen?” [12SWKBC]
12SWKI	10.	Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC]
12SWKI	11.	Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC]

GEOLOGY **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth Sciences.

Science Benchmarks 9 - 12:

9-10ESSB	B.	Explain that many processes occur in patterns within the Earth's systems.
9-10ESSB	C.	Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.
9-10ESSB	D.	Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.
9-10ESSB	E.	Explain the processes that move and shape Earth's surface.
9-10ESSB	F.	Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.
11-12ESSB	A.	Explain how technology can be used to gather evidence and increase our understanding of the universe.
11-12ESSB	B.	Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.
11-12ESSB	C.	Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.
11-12ESSB	D.	Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences.

Grade Level Indicators 9 – 10:
Earth Systems

9ESSI	4.	Explain the relationships of the oceans to the lithosphere and atmosphere (E.g., transfer of energy, ocean currents and landforms). [9ESSBB]

Processes that Shape Earth

9ESSI	5.	Explain how the slow movement of material within Earth results from: [9ESSBE] a. thermal energy transfer (conduction and convection) from the deep interior; b. the action of gravitational forces on regions of different density.
9ESSI	6.	Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding). [9ESSBE]
9ESSI	7.	Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating). [9ESSBE]

Historical Perspectives and Scientific Revolutions

9ESSI	8.	Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., Heliocentric Theory and Plate Tectonics Theory). [9ESSBF]

Earth Systems

10ESSI	1.	Summarize the relationship between the climatic zone and the resultant biomes. (This includes explaining the nature of the rainfall and temperature of the mid-latitude climatic zone that supports the deciduous forest). [10ESSBB]
10ESSI	2.	Explain climate and weather patterns associated with certain geographic locations and features (e.g., tornado alley, tropical hurricanes and lake effect snow). [10ESSBB]
10ESSI	3.	Explain how geologic time can be estimated by multiple methods (e.g., rock sequences, fossil correlation and radiometric dating). [10ESSBC]
10ESSI	4.	Describe how organisms on Earth contributed to the dramatic change in oxygen content of Earth's early atmosphere. [10ESSBC]
10ESSI	5.	Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life. [10ESSBD]
10ESSI	6.	Describe ways that human activity can alter biogeochemical cycles (e.g., carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers). [10ESSBD]

Historical Perspectives and Scientific Revolutions

10ESSI	7.	Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geologic time scales, global warming, depletion of resources and exponential population growth). [10ESSBF]

Grade Level Indicators 11 - 12:

The Universe

11ESSI	1.	Describe how the early Earth was different from planet we live on today, and explain the formation of the sun, Earth and the rest of the solar system from a nebular cloud of dust and gas approximately 4.5 billion years ago. [11ESSBA] *(Physics, Geology & Space)*

Earth Systems

11ESSI	2.	Analyze how the regular and predictable motions of Earth, sun and moon explain phenomena on Earth (e.g., seasons, tides, eclipses and phases of the moon). [11ESSBB] (*Geology & Space)*
11ESSI	3.	Explain heat and energy transfers in and out of the atmosphere and its involvement in weather and climate (radiation, conduction, convection and advection). [11ESSBB] *(Geology & Space)*
11ESSI	4.	Explain the impact of oceanic an atmospheric currents on weather and climate. [11ESSBB] (*Geology & Space)*
11ESSI	5.	Use appropriate data to analyze and predict upcoming trends in global weather patterns (e.g., El Nino and La Nina, melting glaciers and icecaps and changes in ocean surface temperatures). [11ESSBB] *(Geology & Space)*
11ESSI	6.	Explain how interactions among Earth's lithosphere, hydrosphere, atmosphere and biosphere have resulted in the ongoing changes of Earth's system. [11ESSBB] *(Geology & Space)*
11ESSI	7.	Describe the effects of particulates and gases in the atmosphere including those originating from volcanic activity. [11ESSBB] *(Physics, Geology & Space)*
11ESSI	8.	Describe the normal adjustments of Earth, which may be hazardous for humans. Recognize that humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in Earth's solid crust. Realize that as societies have grown, become stable and come to value aspects of the environment, vulnerability to natural processes of change has increased. [11ESSBB] *(Geology & Space)*
11ESSI	9.	Explain the effects of biomass and human activity on climate (e.g., climatic change and global warming). [11ESSBC] *(Geology & Space)*
11ESSI	10.	Interpret weather maps and their symbols to predict changing weather conditions worldwide (e.g., monsoons, hurricanes and cyclones). [11ESSBB] *(Geology & Space)*
11ESSI	11.	Analyze how materials from human societies (e.g., radioactive waste and air pollution) affect both physical and chemical cycles of Earth. [11ESSBC] *Geology & Space, Chemistry)*
11ESSI	12.	Explain ways in which humans have had a major effect on other species (e.g., the influence of humans on other organisms occurs through land use, which changes the chemical composition of air, soil and water). [11ESSBC] *(Biology, Geology & Space)*

11ESSI	13.	Explain how human behavior affects the basic processes of natural ecosystems and the quality of the atmosphere, hydrosphere and lithosphere. [11ESSBC] *(Biology, Geology & Space)*
11ESSI	14.	Conclude that Earth has finite resources and explain that humans deplete some resources faster than they can be renewed. [ESSBC] *(Biology)*

Historical Perspectives and Scientific Revolutions

11ESSI	15.	Use historical examples to show how new ideas are limited by the context in which they are conceived; are often rejected by the social establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., global warming, Heliocentric Theory and Theory of Continental Drift). [11ESSBD] *(Geology, & Space, Physics)*
11ESSI	16.	Describe advances in Earth and space science that have important long-lasting effects on science and society (e.g., global warming, Heliocentric Theory and Plate Tectonics Theory). [11ESSBD] *(Geology & Space, Physics)*

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 - 12:

9-10PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9-10PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.
9-10PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9-10PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9-10PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9-10PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9-10PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9-10PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.
11-12PSB	A.	Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.
11-12PSB	B.	Recognize that some atomic nuclei are unstable and will spontaneously break down.
11-12PSB	C.	Describe how atoms and molecules can gain or lose energy only in discrete amounts.
11-12PSB	D.	Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.
11-12PSB	E.	Summarize the historical development of scientific theories and ideas within the study of physical sciences.

Grade Level Indicators 9 – 10:

Nature of Matter

9PSI	1.	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. [9PSBA]
9PSI	2.	Illustrate atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. [9PSBA]

Grade Level Indicators 11 – 12:

Nature of Matter

11PSI	1.	Explain that elements with the same number of protons may or may not have the same mass and those with different masses (different number of neutrons) are called isotopes. Some of these are radioactive. [11PSBA] *(All)*

Forces and Motion

11PSI	3.	Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use). [11PSBC] *(All)*

Nature of Matter

12PSI	1.	Explain how atoms join with one another in various combinations in distinct molecules or in repeating crystal patterns. [12PSB] *(Geology and Space, Chemistry)*

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 - 12:

9-10STB	A.	Explain the ways in which the processes of technological design respond to the needs of society.
9-10STB	B.	Explain that science and technology are interdependent, each drives the other.
11-12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicator 9 - 10:

Understanding Technology

9STI 1. Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI 2. Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]

9STI 3. Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Grade Level Indicator 11 - 12:

Understanding Technology

11STI 2. Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA] *(All)*

11STI 3. Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]*(All)*

11STI 4. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [11STBA] *(All)*

11STI 5. Investigate that all fuels (e.g., fossil, solar and nuclear) have advantages and disadvantages, therefore society must consider the trade-offs among them (e.g., economic costs and environmental impact). [11STBA] *(All)*

11STI 6. Research sources of energy beyond traditional fuels and the advantages, disadvantages and trade-offs society must consider when using alternative sources (e.g., biomass, solar, hybrid engines, wind and fuel cells. [11STBA] *(All)*

Understanding Technology

12STI 1. Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA] *(All)*

12STI 2. Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. [12STBA] *(All)*

12STI 3. Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA] *(All)*

12STI 4. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA] *(All)*

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 9 - 12:

9-10SIB	A.	Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.
11-12SIB	A.	Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 9 - 10:

Doing Scientific Inquiry

9SII	1.	Distinguish between observations and inferences given a scientific situation. [9SIBA]
9SII	2.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). [9SIBA]
9SII	3.	Construct, interpret, and apply physical and conceptual models that represent or explain systems, objects, events, or concepts. [9SIBA]
9SII	4.	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. [9SIBA]
9SII	5.	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. [9SIBA]
9SII	6.	Draw logical conclusions based on scientific knowledge and evidence from investigations. [9SIBA]

Doing Scientific Inquiry

10SII	1.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII	2.	Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII	3.	Use mathematical models to predict and analyze natural phenomena. [10SIBA]

10SII	4.	Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII	5.	Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Grade Level Indicators 11 - 12:

Doing Scientific Inquiry

11SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variable (dependent and independent) in scientific experimentation. [11SIBA] *(All)*
11SII	2.	Evaluate assumptions that have been used in reaching scientific conclusions. [11SIBA] *(All)*
11SII	3.	Design and carry out scientific inquiry (investigation), communicate and critique results through peer review. [11SIBA] *(All)*
11SII	4.	Explain why the methods of an investigation are based on the questions being asked. [11SIBA] *(All)*
11SII	5.	Summarize data and construct a reasonable argument based on those data and other known information. [11SIBA] *(All)*
12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA] *(All)*
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA] *(All)*
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA] *(All)*
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. [12SIBA] *(All)*
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA] *(All)*

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 - 12:

9-10SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9-10SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9-10SWKB	C.	Describe the ethical practices and guidelines in which science operates.
9-10SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.
11-12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.
11-12SWKB	B.	Explain how ethical considerations shape scientific endeavors.
11-12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Grade Level Indicators 9 – 10:

Nature of Science

9SWKI	1.	Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. [9SWKBA]
9SWKI	2.	Illustrate the method and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. [9SWKBC]
9SWKI	3.	Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. [9SWKBA]

Ethical Practices

9SWKI	4.	Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. [9SWKBC]

Scientific Theories		
9SWKI	5.	Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. [9SWKBB]
9SWKI	6.	Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. [9SWKBB]
9SWKI	7.	Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. [9SWKBB]
Science and Society		
9SWKI	8.	Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study. [9SWKBD]
9SWKI	9.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [9SWKBD]
Nature of Science		
10SWKI	1.	Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. [10SWKBA]
10SWKI	2.	Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science. [10SWKBA]
10SWKI	3.	Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to move adequate explanations of natural phenomena. [10SWKBA]
Ethical Practices		
10SWKI	4.	Recognize that ethical considerations limit what scientists can do. [10SWKBC]
10SWKI	5.	Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. [10SWKBC]
10SWKI	6.	Recognize that animal-based research much be conducted according to currently accepted professional standards and laws. [10SWKBC]
Science and Society		
10SWKI	7.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [10SWKBD]

Grade Level Indicators 11 – 12:

Nature of Science

11SWKI 1. Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). [11SWKBA] (*All)*

11SWKI 2. Apply scientific inquiry to elevate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. [11SWKBA] (*All)*

11SWKI 3. Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. [11SWKBA] (*All)*

11SWKI 6. Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. [11SWKBA] (*All)*

Scientific Theories

11SWKI 7. Explain how theories are judged by how well they fit with other theories, the range of included observations, how well they explain observations and how effective they are in predicting new findings. [11SWKBA] (All)

Science and Society

11SWKI 8. Explain that the decision to develop a new technology is influenced by societal opinions and demands and by cost benefit considerations. [11SWKBA] (All)

11SWKI 9. Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society as well as cause risks. [11SWKBA] (All)

11SWKI 10. Describe costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. [11SWKBA] (All)

11SWKI 11. Research the role of science and technology in careers that students plan to pursue. [11SWKBA] (All)

Nature of Science

12SWKI 1. Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA] *(All)*

12SWKI 2. Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and

suggesting alternative explanations for the same observations. [12SWKBA] *(All)*

12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. [12SWKBA] *(All)*
12SWKI	4.	Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA] *(All)*
12SWKI	5.	Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA] *(All)*

Ethical Practices

12SWKI	6.	Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC] *(All)*

Science and Society

12SWKI	7.	Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC] *(All)*
12SWKI	8.	Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC] (All)
12SWKI	9.	Recognize the appropriateness and value of basic questions “What can happen?” “What are the odds?” and “How do scientists and engineers know what will happen?” [12SWKBC] *(All)*
12SWKI	10.	Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC] *(All)*
12SWKI	11.	Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC] *(All)*

ASTRONOMY **EARTH AND SPACE SCIENCES**

Earth and Space Sciences:
Students demonstrate an understanding of the composition of the universe and the solar system. In addition, students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Space Science.

Science Benchmarks 9 - 12:

9-10ESSB	A.	Explain how evidence from stars and other celestial objects provide information about the processes that cause changes in the composition and scale of the physical universe.
9-10ESSB	B.	Explain that many processes occur in patterns within the Earth's systems.
9-10ESSB	E.	Explain the processes that move and shape Earth's surface.
9-10ESSB	F.	Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.
11-12ESSB	A.	Explain how technology can be used to gather evidence and increase our understanding of the universe.
11-12ESSB	D.	Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences.

Grade Level Indicators 9 – 10:
The Universe

9ESSI	1.	Describe that stars produce energy from nuclear reactions and that processes in stars have led to the formation of all elements beyond hydrogen and helium. [9ESSBA] (Geology and Space continued)…
9ESSI	2.	Describe the current scientific evidence that supports the theory of the explosive expansion of the universe, the big Bang, over 10 billion years ago. [9ESSBA]
9ESSI	3.	Explain that gravitational forces govern the characteristics and movement patterns of the planets, comets, and asteroids in the solar system. [9ESSBC]

Historical Perspectives and Scientific Revolutions

9ESSI 8. Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., Heliocentric Theory and Plate Tectonics Theory). [9ESSBF]

Earth Systems

10ESSI 3. Explain how geologic time can be estimated by multiple methods (e.g., rock sequences, fossil correlation and radiometric dating). [10ESSBC]

Historical Perspectives and Scientific Revolutions

10ESSI 7. Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geologic time scales, global warming, depletion of resources and exponential population growth). [10ESSBF]

Grade Level Indicators 11 - 12:

The Universe

11ESSI 1. Describe how the early Earth was different from planet we live on today, and explain the formation of the sun, Earth and the rest of the solar system from a nebular cloud of dust and gas approximately 4.5 billion years ago. [11ESSBA] *(Physics, Geology & Space)*

Earth Systems

11ESSI 2. Analyze how the regular and predictable motions of Earth, sun and moon explain phenomena on Earth (e.g., seasons, tides, eclipses and phases of the moon). [11ESSBB] (*Geology & Space)*

Historical Perspectives and Scientific Revolutions

11ESSI 15. Use historical examples to show how new ideas are limited by the context in which they are conceived; are often rejected by the social establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., global warming, Heliocentric Theory and Theory of Continental Drift). [11ESSBD] *(Geology, & Space, Physics)*

11ESSI 16. Describe advances in Earth and space science that have important long-lasting effects on science and society (e.g., global warming, Heliocentric Theory and Plate Tectonics Theory). [11ESSBD] *(Geology & Space, Physics)*

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 - 12:

9-10PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9-10PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.
9-10PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9-10PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9-10PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9-10PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9-10PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9-10PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.
11-12PSB	A.	Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.
11-12PSB	B.	Recognize that some atomic nuclei are unstable and will spontaneously break down.
11-12PSB	C.	Describe how atoms and molecules can gain or lose energy only in discrete amounts.
11-12PSB	D.	Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.
11-12PSB	E.	Summarize the historical development of scientific theories and ideas within the study of physical sciences.

Grade Level Indicators 9 – 10:

Nature of Matter

9PSI	1.	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. [9PSBA]
9PSI	2.	Illustrate atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. [9PSBA]

Grade Level Indicators 11 – 12:

Nature of Matter

11PSI	1.	Explain that elements with the same number of protons may or may not have the same mass and those with different masses (different number of neutrons) are called isotopes. Some of these are radioactive. [11PSBA] *(All)*

Forces and Motion

11PSI	3.	Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use). [11PSBC] *(All)*

Nature of Matter

12PSI	1.	Explain how atoms join with one another in various combinations in distinct molecules or in repeating crystal patterns. [12PSB] *(Geology and Space, Chemistry)*

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 - 12:

9-10STB	A.	Explain the ways in which the processes of technological design respond to the needs of society.
9-10STB	B.	Explain that science and technology are interdependent, each drives the other.
11-12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicator 9 - 10:

Understanding Technology

9STI	1.	Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI	2.	Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]
9STI	3.	Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Grade Level Indicator 11 - 12:

Understanding Technology

11STI	2.	Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA] *(All)*
11STI	3.	Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]*(All)*
11STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [11STBA] *(All)*
11STI	5.	Investigate that all fuels (e.g., fossil, solar and nuclear) have advantages and disadvantages, therefore society must consider the trade-offs among them (e.g., economic costs and environmental impact). [11STBA] *(All)*
11STI	6.	Research sources of energy beyond traditional fuels and the advantages, disadvantages and trade-offs society must consider when using alternative sources (e.g., biomass, solar, hybrid engines, wind and fuel cells. [11STBA] *(All)*

Understanding Technology

12STI	1.	Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA] *(All)*
12STI	2.	Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. [12STBA] *(All)*
12STI	3.	Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA] *(All)*
12STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA] *(All)*

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 9 - 12:

9-10SIB	A.	Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.
11-12SIB	A.	Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 9 - 10:

Doing Scientific Inquiry

9SII	1.	Distinguish between observations and inferences given a scientific situation. [9SIBA]
9SII	2.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). [9SIBA]
9SII	3.	Construct, interpret, and apply physical and conceptual models that represent or explain systems, objects, events, or concepts. [9SIBA]
9SII	4.	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. [9SIBA]
9SII	5.	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. [9SIBA]
9SII	6.	Draw logical conclusions based on scientific knowledge and evidence from investigations. [9SIBA]

Doing Scientific Inquiry

10SII	1.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII	2.	Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII	3.	Use mathematical models to predict and analyze natural phenomena. [10SIBA]

10SII	4.	Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII	5.	Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Grade Level Indicators 11 - 12:

Doing Scientific Inquiry

11SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variable (dependent and independent) in scientific experimentation. [11SIBA] *(All)*
11SII	2.	Evaluate assumptions that have been used in reaching scientific conclusions. [11SIBA] *(All)*
11SII	3.	Design and carry out scientific inquiry (investigation), communicate and critique results through peer review. [11SIBA] *(All)*
11SII	4.	Explain why the methods of an investigation are based on the questions being asked. [11SIBA] *(All)*
11SII	5.	Summarize data and construct a reasonable argument based on those data and other known information. [11SIBA] *(All)*
12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA] *(All)*
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA] *(All)*
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA] *(All)*
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. [12SIBA] *(All)*
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA] *(All)*

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 - 12:

9-10SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9-10SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9-10SWKB	C.	Describe the ethical practices and guidelines in which science operates.
9-10SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.
11-12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.
11-12SWKB	B.	Explain how ethical considerations shape scientific endeavors.
11-12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Grade Level Indicators 9 – 10:

Nature of Science

9SWKI	1.	Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. [9SWKBA]
9SWKI	2.	Illustrate the method and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. [9SWKBC]
9SWKI	3.	Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. [9SWKBA]

Ethical Practices

9SWKI	4.	Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. [9SWKBC]

Scientific Theories

9SWKI	5.	Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. [9SWKBB]
9SWKI	6.	Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. [9SWKBB]
9SWKI	7.	Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. [9SWKBB]

Science and Society

9SWKI	8.	Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study. [9SWKBD]
9SWKI	9.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [9SWKBD]

Nature of Science

10SWKI	1.	Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. [10SWKBA]
10SWKI	2.	Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science. [10SWKBA]
10SWKI	3.	Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to move adequate explanations of natural phenomena. [10SWKBA]

Ethical Practices

10SWKI	4.	Recognize that ethical considerations limit what scientists can do. [10SWKBC]
10SWKI	5.	Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. [10SWKBC]
10SWKI	6.	Recognize that animal-based research much be conducted according to currently accepted professional standards and laws. [10SWKBC]

Science and Society

10SWKI	7.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [10SWKBD]

Grade Level Indicators 11 – 12:

Nature of Science

11SWKI	1.	Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). [11SWKA] (*All)*
11SWKI	2.	Apply scientific inquiry to elevate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. [11SWLBA] (*All)*
11SWKI	3.	Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. [11SWLBA] (*All)*
11SWKI	6.	Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. [11SWKBA] (*All)*

Scientific Theories

11SWKI	7.	Explain how theories are judged by how well they fit with other theories, the range of included observations, how well they explain observations and how effective they are in predicting new findings. [11AWKBA] (All)

Science and Society

11SWKI	8.	Explain that the decision to develop a new technology is influenced by societal opinions and demands and by cost benefit considerations. [11SWKBA] (All)
11SWKI	9.	Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society as well as cause risks. [11SWKBA] (All)
11SWKI	10.	Describe costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. [11SWKBA] (All)
11SWKI	11.	Research the role of science and technology in careers that students plan to pursue. [11SWKBA] (All)

Nature of Science

12SWKI	1.	Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA] *(All)*
12SWKI	2.	Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. [12SWKBA] *(All)*

Scientific Ways of Knowing

12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. [12SWLBA] *(All)*
12SWKI	4.	Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA] *(All)*
12SWKI	5.	Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA] *(All)*
Ethical Practices		
12SWKI	6.	Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC] *(All)*
Science and Society		
12SWKI	7.	Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC] *(All)*
12SWKI	8.	Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC] (All)
12SWKI	9.	Recognize the appropriateness and value of basic questions "What can happen?", "What are the odds?" and "How do scientists and engineers know what will happen?" [12SWKBC] *(All)*
12SWKI	10.	Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC] *(All)*
12SWKI	11.	Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC] *(All)*

AP BIOLOGY

Life Sciences:
Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living system. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences

Science Benchmarks 9 - 12:

12LSB	A.	Explain how processes at the cellular level affect the functions and characteristics of an organism.
12LSB	B.	Explain how humans are connected to, and impact natural systems.
12LSB	C.	Explain how the molecular basis of life and the principles of genetics determine inheritance.
12LSB	D.	Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future.
12LSB	E.	Explain the interconnectedness of the components of a natural system.
12LSB	F.	Explain how human choices today will affect the quality and quantity of life on earth.
12LSB	G.	Summarize the historical development of scientific theories and ideas within the study of life sciences.

Grade Level Indicators 12:
Characteristics and Structure of Life:

12LSI	1.	Recognize that information stored in DNA provides the instructions for assembling protein molecules used by the cells that determine the characteristics of the organism. [12LSBA]
12LSI	2.	Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood nerve, muscle, egg and sperm). [12LSBA]
12LSI	3.	Explain that the Sun is essentially the primary source of energy for life. Plants capture energy buy absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. [12LSBA]
12LSI	4.	Explain the carbon-containing 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. [12LSBA]

Heredity

12LSI	5.	Examine the inheritance of traits through one or more genes and how a single gene can influence more than one trait. [12LSBC]
12LSI	6.	Explain how developmental differentiation is regulated through the expression of different genes. [12LSBC]

Diversity and Interdependence of Life

12LSI	7.	Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. [12LSIBE]
12LSI	8.	Based on structure and stability of ecosystems and their non-living components, predict the biotic and abiotic changes in such systems when disturbed (e.g., introduction of non-native species, climatic changes, etc.). [12LSIBE]
12LSI	9.	Explain why and how living systems require a continuous input of energy to maintain their chemical and physical organization. Explain that with death and the cessation of energy input, living systems rapidly disintegrate toward more disorganized states. [12LSIBE]

Evolutionary Theory

12LSI	10.	Explain additional components of the evolution theory, including genetic drift, immigration, emigration, and mutation. [12LSIBD]

Historical Perspectives and Scientific Revolutions

12LSI	11.	Trace the historical development of a biological theory or idea (e.g., genetics, cytology and germ theory). [12LSIBG]
12LSI	12.	Describe advances in life sciences that have important, long-lasing effects on science and society (e.g., biotechnology). [12LSIBG]

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 12:

12PSB	A.	Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.
12PSB	B.	Recognize that some atomic nuclei are unstable and will spontaneously break down.

Grade Level Indicators 12:

Nature and Energy

12PSI	1.	Explain how atoms join with one another in various combinations and distinct molecules or in repeating crystal patterns. [12PSBA]
12PSI	2.	Describe how a physical, chemical or ecological system in equilibrium may return to the same state of equilibrium if the disturbances it experiences are small. Large disturbances may cause it to escape that equilibrium and eventually settle into some other state of equilibrium. [12PSBA]

Forces and Motion

12PSI	6.	Recognize that the nuclear forces that hold the nucleus of an atom together, at nuclear distances, are stronger than the electric forces that would make it fly apart. [12PSBB]

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 - 12:

12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicators 12:
Understanding Technology

12STI	1.	Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA]
12STI	2.	Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. [STBA]
12STI	3.	Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA}
12STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA]

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 12:

12SIB	A.	Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 12:

Doing Scientific Inquiry

12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA]
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA]
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA]
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. 12SIBA]
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA]

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 - 12:

12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.
12SWKB	B.	Explain how ethical considerations shape scientific endeavors.
12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Nature of Science

12SWKI	1.	Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA]

12SWKI	2.	Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. [12SWKBA]
12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. [12SWLBA]
12SWKI	4.	Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA]
12SWKI	5.	Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA]
12SWKI	6.	Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC]
Science and Society		
12SWKI	7.	Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC]
12SWKI	8.	Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC]
12SWKI	9.	Recognize the appropriateness and value of basic questions “What can happen?” “What are the odds?” and “How do scientists and engineers know what will happen?” [12SWKBC]
12SWKI	10.	Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC]
12SWKI	11.	Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC]

AP CHEMISTRY **PHYSICAL SCIENCES**

Physical Sciences:
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Science Benchmarks 9 – 12:

9-10PSB	A.	Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.
9-10PSB	B.	Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.
9-10PSB	C.	Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.
9-10PSB	D.	Explain the movement of objects by applying Newton's three laws of motion.
9-10PSB	E.	Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).
9-10PSB	F.	Explain how energy may change form or be redistributed but the total quantity of energy is conserved.
9-10PSB	G.	Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.
9-10PSB	H.	Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.
11-12PSB	A.	Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.
11-12PSB	B.	Recognize that some atomic nuclei are unstable and will spontaneously break down.
11-12PSB	C.	Describe how atoms and molecules can gain or lose energy only in discrete amounts.
11-12PSB	D.	Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.

11-12PSB E. Summarize the historical development of scientific theories and ideas within the study of physical sciences.

Grade Level Indicators 9 - 10:

Nature of Matter

9PSI 1. Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. [9PSBA]

9PSI 2. Illustrate atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. [9PSBA]

9PSI 3. Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation. [9PSBF]

9PSI 4. Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize that the periodic table was formed as a result of the repeating pattern of electron configurations. [9PSBA]

9PSI 5. Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.

9PSI 6. Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water). [9PSBB]

9PSI 7. Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations). [9PSBB]

9PSI 8. Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral. [9PSBB]

9PSI 9. Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors). [9PSBC]

9PSI 10. Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity. [9PSBC]

Nature of Energy

9PSI 11. Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the

higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant. [9PSBBF]

9PSI 12. Explain how an object's kinetic energy depends on its mass and its speed (KE=$1/2mve^2$). [9PSBE]

9PSI 15. Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy. [9PSBF]

9PSI 16. Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). [9PSBF]

9PSI 17. Demonstrate that thermal energy can be transferred by conduction, convection, or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). [9PSBF]

9PSI 17. Demonstrate that thermal energy can be transferred by conduction, convection, or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). [9PSBF]

9PSI 18. Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible lights is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). [9PSBG]

9PSI 19. Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium. [9PSBG]

Grade Level Indicators 11 - 12:

Nature of Matter

11PSI 1. Explain that elements with the same number of protons may or may not have the same mass and those with different masses (different number of neutrons) are called isotopes. Some of these are radioactive. [11PSBA] *(All)*

Forces and Motion

11PSI 3. Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use). [11PSBC] *(All)*

Science and Technology:
Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks, and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Science Benchmarks 9 - 12:

9-10STB A. Explain the ways in which the processes of technological design respond to the needs of society.

9-10STB	B.	Explain that science and technology are interdependent, each drives the other.
11-12STB	A.	Predict how human choices today will determine the quality and quantity of life on Earth.

Grade Level Indicator 9 - 10:

Understanding Technology

9STI	1.	Describe means of comparing the benefits with the risks of technology and how science can inform public policy. [9STBB]

Abilities to Do Technological Design

9STI	2.	Identify a problem or need, propose designs and choose among alternative solutions for the problem. [9STBA]
9STI	3.	Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. [9STBA]

Grade Level Indicator 11 - 12:

Understanding Technology

11STI	1.	Identify that science and technology are essential social enterprises but alone they can only indicate what can happen, not what should happen. Realize the latter involves human decisions about the use of knowledge. [11STBA] (B*iology)*
11STI	2.	Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans. [11STBA] *(All)*
11STI	3.	Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics). [11STBA]*(All)*
11STI	4.	Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [11STBA] *(All)*
11STI	5.	Investigate that all fuels (e.g., fossil, solar and nuclear) have advantages and disadvantages, therefore society must consider the trade-offs among them (e.g., economic costs and environmental impact). [11STBA] *(All)*
11STI	6.	Research sources of energy beyond traditional fuels and the advantages, disadvantages and trade-offs society must consider when using alternative sources (e.g., biomass, solar, hybrid engines, wind and fuel cells. [11STBA] *(All)*

Understanding Technology

12STI	1.	Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. [12STBA] *(All)*
12STI	2.	Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of

research. [12STBA] *(All)*

12STI 3. Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. [12STBA] *(All)*

12STI 4. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. [12STBA] *(All)*

Scientific Inquiry:
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and together and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Science Benchmarks 9 - 12:

9-10SIB A. Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.

11-12SIB A. Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.

Grade Level Indicators 9 - 10:

Doing Scientific Inquiry

9SII 1. Distinguish between observations and inferences given a scientific situation. [9SIBA]

9SII 2. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). [9SIBA]

9SII 3. Construct, interpret, and apply physical and conceptual models that represent or explain systems, objects, events, or concepts. [9SIBA]

9SII 4. Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. [9SIBA]

9SII 5. Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. [9SIBA]

9SII 6. Draw logical conclusions based on scientific knowledge and evidence from investigations. [9SIBA]

Doing Scientific Inquiry

10SII	1.	Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [10SIBA]
10SII	2.	Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. [10SIBA]
10SII	3.	Use mathematical models to predict and analyze natural phenomena. [10SIBA]
10SII	4.	Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. [10SIBA]
10SII	5.	Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. [10SIBA]

Grade Level Indicators 11 - 12:

Doing Scientific Inquiry

11SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [11SIBA] *(All)*
11SII	2.	Evaluate assumptions that have been used in reaching scientific conclusions. [11SIBA] *(All)*
11SII	3.	Design and carry out scientific inquiry (investigation), communicate and critique results through peer review. [11SIBA] *(All)*
11SII	4.	Explain why the methods of an investigation are based on the questions being asked. [11SIBA] *(All)*
11SII	5.	Summarize data and construct a reasonable argument based on those data and other known information. [11SIBA] *(All)*

Doing Scientific Inquiry

12SII	1.	Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. [12SIBA] *(All)*
12SII	2.	Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). [12SIBA] *(All)*
12SII	3.	Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles, and ventilation). [12SIBA] *(All)*
12SII	4.	Create and clarify the method, procedures, controls, and variables in complex scientific investigations. [12SIBA] *(All)*
12SII	5.	Use appropriate summary statistics to analyze and describe data. [12SIBA] *(All)*

Scientific Ways of Knowing:
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Science Benchmarks 9 – 12:

9-10SWKB	A.	Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.
9-10SWKB	B.	Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
9-10SWKB	C.	Describe the ethical practices and guidelines in which science operates.
9-10SWKB	D.	Recognize that scientific literacy is part of being a knowledgeable citizen.
11-12SWKB	A.	Explain how scientific evidence is used to develop and revise scientific predictions, ideas or theories.
11-12SWKB	B.	Explain how ethical considerations shape scientific endeavors.
11-12SWKB	C.	Explain how societal issues and considerations affect the progress of science and technology.

Grade Level Indicators 9 – 10:

Nature of Science

9SWKI	1.	Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. [9SWKBA]
9SWKI	2.	Illustrate the method and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. [9SWKBC]
9SWKI	3.	Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. [9SWKBA]

Ethical Practices

9SWKI	4.	Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. [9SWKBC]

Scientific Theories

9SWKI	5.	Justify that scientific theories are explanations of large bodies of information and/or observations that withstand

repeated testing. [9SWKBB]

9SWKI	6.	Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. [9SWKBB]
9SWKI	7.	Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. [9SWKBB]

Science and Society

9SWKI	8.	Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study. [9SWKBD]
9SWKI	9.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [9SWKBD]

Nature of Science

10SWKI	1.	Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. [10SWKBA]
10SWKI	2.	Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science. [10SWKBA]
10SWKI	3.	Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to move adequate explanations of natural phenomena. [10SWKBA]

Ethical Practices

10SWKI	4.	Recognize that ethical considerations limit what scientists can do. [10SWKBC]
10SWKI	5.	Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. [10SWKBC]
10SWKI	6.	Recognize that animal-based research much be conducted according to currently accepted professional standards and laws. [10SWKBC]

Science and Society

10SWKI	7.	Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. [10SWKBD]

Grade Level Indicators 11 – 12:

Nature of Science

11SWKI	1.	Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g., biome data). [11SWKA] (*All)*
11SWKI	2.	Apply scientific inquiry to elevate results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists. [11SWLBA] (*All)*
11SWKI	3.	Demonstrate that scientific explanations adhere to established criteria, for example a propose explanation must be logically consistent, it must abide by the rules of evidence and it must be open to questions and modifications. [11SWLBA] (*All)*
11SWKI	6.	Describe the strongly held traditions of science that serve to keep scientists within the bounds of ethical professional behavior. [11SWKBA] (*All)*

Scientific Theories

11SWKI	7.	Explain how theories are judged by how well they fit with other theories, the range of included observations, how well they explain observations and how effective they are in predicting new findings. [11AWKBA] (All)

Science and Society

11SWKI	8.	Explain tht the decision to develop a new technology is influenced by societal opinions and demands and by cost benefit considerations. [11SWKBA] (All)
11SWKI	9.	Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society as well as cause risks. [11SWKBA] (All)
11SWKI	10.	Describe costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. [11SWKBA] (All)
11SWKI	11.	Research the role of science and technology in careers that students plan to pursue. [11SWKBA] (All)

Nature of Science

12SWKI	1.	Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. [12SWKBA] *(All)*
12SWKI	2.	Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. [12SWKBA] *(All)*
12SWKI	3.	Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge,

perceptions or technology. [12SWLBA] *(All)*

12SWKI 4. Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). [12SWKBA] *(All)*

12SWKI 5. Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem). [12SWKBA] *(All)*

Ethical Practices

12SWKI 6. Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. [12SWKBC] *(All)*

Science and Society

12SWKI 7. Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. [12SWKBC] *(All)*

12SWKI 8. Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. [12SWKBC] (All)

12SWKI 9. Recognize the appropriateness and value of basic questions "What can happen?", "What are the odds?" and "How do scientists and engineers know what will happen?" [12SWKBC] *(All)*

12SWKI 10. Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.) [12SWKBC] *(All)*

12SWKI 11. Research how advances in scientific knowledge have impacted society on a local, national or global level. [12SWKBC] (All)