Science Academic
Content Standards Revision
K-8 and High School
Draft 2
Request for Review

The Oregon Department of Education (ODE) is conducting a review and revision of the science academic content standards. ODE anticipates that the State Board of Education will adopt revised science standards in February 2009. This document contains draft 2 of the revised standards for kindergarten through eighth grade and high school.

To help guide readers of this draft, we begin by providing the purpose, organization, and content of draft 2, clarification about issues that were raised by reviewers of draft 1, and a list of the input we are seeking from reviewers. This document also contains the information that was provided with draft 1 including a brief history of science content standards and the guidelines that were used in the development of the standards. We also added to this draft an appendix that provides these content standards organized by science discipline to show the progression of the standards from kindergarten through high school in life, physical, earth and space science, and for scientific inquiry and engineering design.

Purpose
The K-HS Science Content Standards define what all students are expected to know and be able to do. The standards are intended to guide instruction and serve as a basis for statewide and local assessments. It is also important to point out what the standards are not intended to provide.

The standards are not the curriculum. The standards do not specify courses, teaching methods, or instructional materials. The purpose of the standards is solely to specify what students are to know and be able to do as a result of science instruction. The statewide assessment will align to the standards.

The standards are not test specifications. The standards describe what students should know and be able to do, but they do not provide the specificity of test items or how knowledge or abilities are to be assessed on state assessments. The Office of Assessment will provide test specification documents to accompany the revised science standards when they are adopted. Standards not assessed on OAKS need to be assessed at the local level within the science program.

After the Oregon State Board of Education has adopted these Science Content Standards, instructional materials to support the standards will be reviewed using specific criteria and formally adopted by the State Board of Education. ODE also will revise the state science assessments; so that our statewide standards and assessment system is fully aligned. Additional documents will be made available to support teachers and provide guidance on the transition and implementation of the adopted revised Science Content Standards.

Organization and Content of Draft 2 of the Revised Science Standards
These science standards address scientific knowledge and processes. Science is a way of knowing about the natural world based on tested explanations supported by accumulated empirical evidence.

Explanations of natural phenomena that rely on non-scientific views are not included in these standards. This is the expressed intent of the 2009 National Assessment of Educational Progress (NAEP) Science Framework as well as the National Science Education Standards and the American Association for the Advancement of Science Benchmarks for Science Literacy. A document listing the standards and frameworks, reviews and criteria, and research used to develop this draft revision of the Oregon science

standards is available on the science standards revision web page at http://www.ode.state.or.us/teachlearn/subjects/science/curriculum/primarysourcesresearchandresources.pdf We acknowledge the excellent work done by these organizations. Oregon's revised science standards are based on the documents listed.

The revised science standards in draft 2 are organized into four core standards at each grade level and for high school. Core Standard one provides the science content of the "big ideas" in Structure and Function in the three science disciplines of physical (PS), life (LS) and earth and space science (ES). Core Standard two provides the science content of the "big ideas" in Interaction and Change in the three science disciplines. Core Standard three provides the content necessary for students to know about, be able to do, and understand the nature of Scientific Inquiry. Core Standard four provides the standards for students to know about, be able to do, and understand the nature of Engineering Design. The content standards for Core Standards three and four are not specific to any one of the three science disciplines; rather they should be taught in the context of the three science disciplines as appropriate.

Response to Issues Raised by Reviewers of Draft 1
The ODE received hundreds of comments on draft 1 via email and at meetings held across the state. All comments were reviewed by the Science Content Panel and used to produce draft 2.

Two of the major issues raised by many reviewers of draft 1 relate to the development of grade level standards in grades 6-8. The first issue relates to the assessment of the revised science standards. Reviewers asked if the state science assessments will be at grade level when the new standards are adopted. The Oregon Assessment of Knowledge and Skills (OAKS) in science will remain at grades 5, 8 and high school. The tested content at the benchmark grades will include content from that grade band (i.e., Grade 5 test will include the content in the standards at grades 3, 4 and 5; and Grade 8 test will include content in the standards at grades 6, 7 and 8.) Please note that if the federal assessment requirements change to include grade level testing in science, then Oregon will make that change.

The second issue raised by many reviewers at the middle school level is related to the grade level standards in the three disciplines of science in grades 6-8. Many reviewers asked if they will be required to teach these specific standards at each specific grade level. We are currently providing the 6-8 grade level standards as guidance. Sequencing of instruction and choice of curriculum are local decisions. However, the ODE and the Science Panel reviewed the latest science education research and used many high-quality resources in the development of these grade level standards. Our goal was to develop clear learning progressions that emphasize an integrated understanding of science. We will continue to review research and develop guidance documents and best practices to assist Oregon educators to move toward implementation of these grade level standards. For more information about providing science education that helps students develop an understanding of important connections among science ideas and the ability to use those ideas to make sense of the world, visit the American Association for the Advancement of Science (AAAS) web site http://www.project2061.org/ to learn more about their new publication, *Designing Coherent Science Education*. See also *Curriculum Coherence*[1] (2005, Schmidt, Wang and McKnight.) Visit the science standards revision web page http://www.ode.state.or.us/search/page/?=1642 for a complete list of the research and resources used to develop these grade level science standards.

Input Sought From Reviewers
Draft 2 includes revisions to draft 1 developed by the content panel to incorporate public comments received on draft 1. We are sending draft 2 to individuals and organizations for review and are posting it on the ODE website.[2, 3] ***ODE welcomes input from all interested parties***. The input received on draft 2 will be considered as ODE and the content panel prepares the final draft of the standards in December 2008.

1 Available on-line at: http://www.ode.state.or.us/teachlearn/subjects/science/curriculum/coherencearticlejcs375.pdf.
2 These include the Oregon Science Teachers Association, Oregon Science Education Council, District and ESD curriculum directors, the OSTA, the *Oregon Science Teacher Update*, and national education organizations.
3 You can find the on-line version at http://www.ode.state.or.us/search/page/?=1606

We anticipate the adoption of revised standards by the State Board of Education in February 2009. While all feedback is welcome, there are several key questions we ask reviewers to consider as they review the draft standards. Please send your comments to cheryl.kleckner@state.or.us by December 8, 2008.

1. Are there gaps in the draft standards under each core standard? That is, are there additional standards that you feel are necessary to completely cover the core standard? Please explain.
2. Is there science content missing from these draft core standards you feel is essential for all students to know and be able to do? Are there additional content standards that need to be identified? Please explain and indicate the appropriate grade level for the additional content, and how this content meets the three criteria for inclusion as a core standard (see the section on core standards below.)
3. Is there science content in these draft standards you feel is not essential for all students to know and be able to do? Please explain why this science content is not essential.
4. Do the draft standards contain an appropriate range of cognitive demand (i.e. depth of knowledge)? If not, please provide suggestions for improvement.
5. Are the draft standards sufficient (in number and detail) to guide development of curriculum and instruction at the local level and of a valid and reliable statewide multiple-choice test?

Recent History of Science Standards in Oregon

Oregon's current science standards were adopted in April 2001, and contain standards for benchmark grades 3, 5, 8, and for high school. The standards are intended to guide instruction and serve as a basis for statewide assessments.

Two of the main referents in development of the current science standards were:
National Science Education Standards (NSES), 1995 National Research Council
http://www.nap.edu/catalog.php?record_id=4962#toc; and
American Association for the Advancement of Science (AAAS), 1993 Benchmarks for Science Literacy
http://www.project2061.org/publications/bsl/online/bolintro.htm.

The NSES lists science standards in grade bands of K-4, 5-8, and 9-12, while the AAAS Benchmarks lists science standards in grade bands of K-2, 3-5, 6-8, and 9-12. Since both the NSES and AAAS are not grade-specific, many decisions had to be made regarding the precise grade placement of science topics in Oregon and in other states. The result is that grade placement of science content is generally not consistent from state to state[4] or from district to district within Oregon. There is also a widespread concern that most state science standards, including Oregon's, are too broad in scope and hence do not allow time for sufficient depth of instruction.[5] In addition, high levels of student mobility and increased emphasis on statewide accountability testing have led to the need for a more focused curriculum, with areas of emphasis clearly delineated, so that core science content provided at each grade is less variable from district to district. A number of districts in Oregon have already done work to identify standards around which to focus their instruction[6] and the State Board of Education has expressed concern with the breadth of Oregon's current standards.

Oregon's New Core Standards Structure

As part of the new Oregon Diploma requirements, the State Board of Education asked the Department of Education to identify core standards in all academic subjects. The Board's decision was based on current research showing greater student achievement when teachers and students focus on a few key ideas at each grade level.

As the academic content standards for each content area are reviewed and revised (following Oregon's standards review and revision cycle) they will reflect the core standards structure. The new 2007 K-8 mathematics standards were the first to be written in the new Core Standards Structure.

4 See *Curriculum Coherence* (2005, Schmidt, Wang and McKnight). Available on-line at: http://www.ode.state.or.us/teachlearn/subjects/science/curriculum/coherencearticlejcs375.pdf.
5 See *The Quest for a Coherent School Science Curriculum: The Need for an Organizing Principle* (2002, Schmidt) for an international comparison of the breadth and sequencing of science content topics. Available on-line at: ustimss.msu.edu/coherentscience.pdf.
6 There are several programs to guide this work. In Oregon, one of the most widely used programs is *Power Standards* by the Center for Performance Assessment, available at http://www.leadandlearn.com/resource-services.

This new structure is organized around a small, focused, coherent set of core standards and supporting content standards at each grade level. Core standards provide the major concepts that will be the primary focus of teaching and learning at each grade. This will allow teachers and students to concentrate on fewer key learning objectives each year supporting greater depth of teaching and learning.

Supporting each of these core standards are content standards, which provide the details necessary for the development of curriculum and assessments. In-depth understanding of each core standard will require, and be supported by, understanding of the underlying content standards. These standards will delineate clear learning progressions for each subject area that facilitate statewide teaching to standards and ensure that students who master the core standards at one grade-level will be ready to learn the core standards at the next.

Criteria used to identify the core standards are research-based and were identified by WestEd. These criteria include:

- Endurance: Will the standard provide students with knowledge and skills that will be of value beyond a single test date?
- Leverage: Will the standard provide knowledge and skills that will be of value in multiple disciplines?
- Success: Will the standard provide students with essential knowledge and skills that are necessary for success in the next level of instruction? Beyond school?

The new core standards structure emphasizes key ideas that are of value for students over the long-term, across the curriculum, and for success in school, work and life.

Connections

To support the content standards, ODE and the Content and Assessment Panels will develop guidance documents including connections. Connections serve three basic functions. They: 1) help provide context and bridge core standards between grades and across disciplines, 2) support learning in relation to essential skills and 3) enrich and extend the content. Standards in different grade levels and disciplines often share common content and/or have interdependent concepts. Connections help bridge these standards and show how the standards "connect." Connections also can help promote deeper conceptual understanding of core standards. Effective connections can enhance the coherence of a specific content area and of an entire curriculum.

2007-08 Science Standards Review

As required by law, the Oregon Department of Education (ODE) periodically reviews and revises the state academic content standards.[7] The review process involves the dissemination of draft standards for public review. Feedback is solicited on each draft, and is utilized to produce revised drafts. The final document is then presented to the State Board of Education for adoption. Visit the science standards revision web page (www.ode.state.or.us/search/page/?=1606) to review the timeline, materials, research, and source documents used in this revision.

To assist in these reviews, ODE uses its content and assessment panels. These content panels assist ODE in producing draft standards and incorporating feedback into the drafts. ODE maintains content panels for each of the subjects including science. Content panels include K-12 teachers, ESD and district content specialists, higher education faculty, parents, and industry professionals. Applicants can be self-nominated or be nominated by a school district, educational service district, or other group. Membership (totaling about 35) is chosen so that the panel is representative of the state both in terms of grade-level expertise and geographic location. These panels also assist in the review and development of assessment items and assessment guidelines.

7 For more information, see www.ode.state.or.us/pubs/eii/academiccontentstandardsprimer.pdf.

Based on support from science educators and State Board of Education leanings, the science content standards review began with the following goals:

1. Oregon's standards will be organized using the new Core Standards Structure and will reflect the "big Ideas" in science.
2. The core and supporting content standards will form the basis of statewide assessments. Hence, they form a common set of standards that should be covered in every classroom in the state.
3. Standards organized using the core standards structure will allow districts and ODE to more clearly communicate to teachers, parents, and students the science learning expectations at each grade.
4. Standards will be developed at grade level for grades K-8.

Several issues are contributing to the move towards developing grade level K-8 science standards. These issues include:

- The disadvantage to mobile students when instruction in life, physical, and earth and space science is provided exclusively at one grade level and the grade in which each of these science disciplines is taught varies among Oregon schools;
- Current research recommending that state standards be developed to reflect learning progressions of the "big ideas" in science across grades K-8[8,9]; and
- The potential that future national legislation will require states to develop grade level standards if science is included in Adequate Yearly Progress (AYP) under the No Child Left Behind Act.

To provide input on the issue of grade level standards at grades K-8, visit http://www.ode.state.or.us/surveys/template.aspx?sid=295 to respond to a short six question survey.

With these goals in mind, the science content panel met in February 2007 to begin the standards revision process with a review of the current science education research. In August 2007 the panel worked for two days with national and international experts Dr. Rodger Bybee and Dr. William Schmidt. In November 2007 the panel met to determine the organizing strands and format of the revised science standards and to begin to develop the core standards. In January 2008 the panel met to develop the initial draft of the standards.

At the April 2008 meeting the panel produced the initial draft of the revised science standards. In May a focus group of Oregon Teacher Scholars provided a vertical alignment led by Dr. Edith Gummer of the Northwest Regional Education Laboratory (NWREL). The comments from the vertical alignment process were used to revise the initial draft and this revision was reviewed in June by Dr. Rodger Bybee. In July the NWREL began an alignment study of the draft standards and the 2009 National Assessment of Educational Progress (NAEP) Science Framework.[10] Draft 1 was posted for public comment on August 18, 2008 and presented at meetings statewide in September and October to gather feedback from Oregon educators. The Science Content Panel reviewed the feedback and revised the first draft to produce draft 2 which was posted for public comment on November 10. The Science Panel will meet in mid-December to review the public input on draft 2 and produce the final draft. The final draft will be provided to the State Board of Education for first review in January and adoption in February 2009. Visit the science standards revision web page http://www.ode.state.or.us/search/page/?=1606 to review the drafts and access information about the process, timeline, materials, and research that have informed this work.

8 See *Taking Science to School* (2007, National Research Council) Available on-line at: www.nap.edu/catalog.php?record_id=11625.
9 See *Learning Progressions: Supporting Instruction and Formative Assessment* (CCSSO) Available on-line at: www.ode.state.or.us/teachlearn/subjects/science/curriculum/learningprogressions.pdf.
10 The 2009 National Assessment of Educational Progress Science Framework is available on-line at: www.nagb.org/frameworks/naep_science_framework_2009_re.doc.

Kindergarten

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

K.1 Structure and Function: **The natural world includes living and non-living things.**

K.1.PS.1 Compare and contrast living and non-living things.
K.1.LS.1 Compare and contrast plants and animals.
K.1.ES.1 Gather evidence that the sun warms Earth which is composed of land, air, and water.

K.2 Interaction and Change: **Living and non-living things move.**

K.2.PS.1 Examine how things move in many different ways.
K.2.ES.1 Identify that the sun can be seen only during the daytime.

K.3 Scientific Inquiry: **Science explores the natural world through observation.**

K.3.1 Explore testable questions about living and non-living things and events in the natural world.
K.3.2 Make and describe careful observations about the natural world.

K.4 Engineering Design: **Engineering Design is used to design and build things.**

K.4.1 Create structures using natural or designed materials and simple tools.
K.4.2 Show how component parts of designed structures can be disassembled and reassembled into different structures.

Grade 1

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

1.1 Structure and Function: **Living and non-living things can be described in terms of their characteristics and properties.**

1.1.PS.1 Examine objects in terms of their physical properties and materials.
1.1.LS.1 Compare and contrast characteristics among individuals within one plant or animal group.
1.1.ES.1 Examine Earth materials in terms of their characteristics and physical properties.

1.2 Interaction and Change: **Living and non-living things exchange energy and matter.**

1.2.PS.1 Measure the movement of objects when a force (push or pull) is applied.
1.2.LS.1 Cite evidence that plants and animals both need water and air, animals need to take in food, and plants make food using nutrients and light.
1.2.ES.1 Investigate the change in Earth materials when a force is applied.

1.3 Scientific Inquiry: **Science explores the natural world using evidence from observations.**

1.3.1 Name tools and use them to make careful observations about the natural world in order to answer questions about living and non-living things and events.
1.3.2 Record data with pictures, numbers, or written statements.
1.3.3 Make and describe observations. Explain that describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.

1.4 Engineering Design: **Engineering design is used to design and build things to meet a need.**

1.4.1 Use tools to make a simple machine out of common objects and materials.
1.4.2 Demonstrate that some machines have parts that work together to perform a function.
1.4.3 Explain how tools are used to complete specific tasks every day.

Grade 2

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

2.1 Structure and Function: **Living and non-living things are found in a variety of places.**

2.1.LS.1 Compare and contrast features and behavior of plants and animals that help them to live in different environments.

2.2 Interaction and Change: **Living and non-living things change.**

2.2.PS.1 Compare how different types of materials respond to magnetic forces.
2.2.LS.1 Describe the predictable life cycles of plants and animals.
2.2.ES.1 Examine patterns of movement of the sun and the moon.
2.2.ES.2 Investigate temperature changes day to day and over the seasons.

2.3 Scientific Inquiry: **Scientific inquiry is a process used to explore the natural world using evidence from observations and investigations.**

2.3.1 Observe, measure and record properties of objects and substances using simple equipment and tools (e.g., rulers, meter sticks, thermometers, hand lenses, and balances) to gather data and extend the senses.
2.3.2 Make predictions about living and non-living things and events in the environment based on observed patterns.
2.3.3 Make, describe, and compare observations.

2.4 Engineering Design: **Engineering design is a process used to design and build things to solve problems or address needs.**

2.4.1 Identify basic tools used in engineering design.
2.4.2 Work with a team to complete an engineering design that can be shared with others.

Grade 3

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

3.1 Structure and Function: **Living and non-living things can be classified by their characteristics and properties.**

3.1.PS.1 Explain how objects vary in the extent to which they absorb and reflect light and heat.
3.1.LS.1 Explain that reproduction is necessary for the survival of a species and list similar characteristics of offspring to their parents.
3.1.ES.1 Compare and contrast fossils to one another and to living organisms and make inferences about changes in Earth over time.
3.1.ES.2 Classify rocks according to appearance and how they were formed.

3.2 Interaction and Change: **Living and non-living things interact.**

3.2.LS.1 Compare and contrast how organisms and resources interact in an ecosystem.
3.2.ES.1 Identify Earth as a major planetary body, with a moon, that has seasonal weather patterns that can be described in terms of precipitation and temperature.

3.3 Scientific Inquiry: **Scientific inquiry is a process used to explore the natural world using evidence from recorded observations and investigations.**

3.3.1 Plan a simple investigation based on a testable question, match measuring tools to their uses, and collect data from a scientific investigation.
3.3.2 Use the data collected from a scientific investigation to explain the results and draw conclusions.
3.3.3 Explain that when a scientific investigation is repeated, similar results are expected.

3.4 Engineering Design: **Engineering design is a process that uses science to solve problems or address needs or aspirations.**

3.4.1 Identify a problem that can be addressed through engineering design, propose a potential solution, and design a prototype.
3.4.2 Infer how recent inventions have significantly changed the way people live.
3.4.3 Give examples of technologies that enable scientists to observe things that are too small or too far away.

Grade 4

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

4.1 Structure and Function: **Living and non-living things are identified by their distinct properties.**

4.1.PS.1 Compare and contrast the distinct properties of states of matter.
4.1.PS.2 Compare and contrast forms of energy (heat, electricity, light, and sound) and describe their distinct properties.
4.1.LS.1 Analyze plant and animal structures that serve different functions in growth, survival, and reproduction.
4.1.ES.1 Identify properties and uses of Earth materials and summarize the limitations of their sustainability.
4.1.ES.2 Compare and contrast the composition and textures of the layers of different soils and explain that they vary in their ability to support plant growth.

4.2 Interaction and Change: **Living and non-living things undergo changes that involve force and energy.**

4.2.PS.1 Describe physical and chemical changes in matter and how they occur.
4.2.LS.1 Evaluate how energy and materials circulate in a food web in order for organisms to stay alive and grow.
4.2.ES.1 Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.

4.3 Scientific Inquiry: **Scientific inquiry is a process of investigation through questioning, collecting, describing, and examining recorded evidence to explain natural phenomena and artifacts.**

4.3.1 Based on observations identify testable questions, design a scientific investigation, and collect and record data consistent with a planned scientific investigation.
4.3.2 Summarize the results from a scientific investigation and use the results to respond to the question being tested.
4.3.3 Explain that scientific claims about the natural world must be based on evidence that can be confirmed and support a logical argument.

4.4 Engineering Design: **Engineering design is a process of using scientific knowledge to solve practical problems generated by needs and aspirations.**

4.4.1 Identify a practical problem that can be addressed through engineering design using scientific principles. Design, construct, and test a prototype of a possible solution to a problem using appropriate tools, materials, and resources.
4.4.2 Use discarded materials to design and construct a new product.
4.4.3 Explain how the solution to one problem may create other problems.

Grade 5

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

5.1 Structure and Function: **Living and non-living things are composed of component parts.**

5.1.PS.1 Describe that non-living things may be made of parts, some of which cannot be seen with the human eye.
5.1.LS.1 Compare and contrast the parts of living things including cells, tissues, organs and body systems.
5.1.LS.2 Classify and group common organisms based on their characteristics and/or common ancestors.

5.2 Interaction and Change: **Force, energy, matter, and organisms interact within living and non-living systems.**

5.2.PS.1 Apply an understanding of motion and gravitation by analyzing how the forces of friction, gravity, and magnetism affect objects on or near Earth.
5.2.PS.2 Compare and contrast the characteristics of kinetic and potential energy in relationship to an object's position and motion.
5.2.LS.1 Analyze the interdependence of organisms and their environment and how it affects the survival of individuals and populations.
5.2.ES.1 Explain that the sun is Earth's primary source of energy for atmospheric and surface heat which creates and drives weather and ocean currents and how that energy varies over time (day/year).
5.2.ES.2 Compare and contrast weather and climate.
5.2.ES.3 Explain the patterns of stars and their relative movements over time (nightly – rotation, yearly – revolution)

5.3 Scientific Inquiry: **Scientific inquiry is a process of investigation based on scientific knowledge and questioning, collecting, describing, and examining recorded evidence to explain natural phenomena and artifacts.**

5.3.1 Based on observations and scientific knowledge, identify questions that can be tested, design an experiment or investigation and identify appropriate tools. Collect and record multiple observations while conducting investigations or experiments to test a scientific question or hypothesis.
5.3.2 Identify patterns in data that support a reasonable explanation for the results of an investigation or experiment and communicate findings using graphs, charts, maps, models, and oral and written reports.
5.3.3 Explain that sometimes similar investigations have different results because of differences in the things being investigated, the methods used, or the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations.

5.4 Engineering Design: **Engineering design is a process of using scientific knowledge and principles to make modifications in the world to meet human needs and aspirations.**

5.4.1 Using scientific principles, describe a solution to a need or problem given criteria and constraints.
5.4.2 Design and build a prototype of a proposed engineering solution and identify factors such as cost, safety, appearance, environmental impact, and what will happen if the solution fails.
5.4.3 Explain that inventions are likely to lead to other inventions and once an invention exists, people are likely to think of novel ways of using it.

Grade 6

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

6.1 Structure and Function: **Living and non-living systems are organized groups of related parts that function together and have characteristic properties.**

6.1.PS.1 Explain that all matter is made of atoms and different kinds of matter are made of different atoms.
6.1.PS.2 Describe physical and chemical properties of matter and how they can be measured.
6.1.PS.3 Distinguish among the various forms and characteristics of energy.
6.1.LS.1 Describe the function and relative complexity of cells, tissues, organs, and organ systems in organisms and explain that different body tissues and organs are made up of different kinds of cells. Explain that the way in which cells function is similar in all living organisms and compare and contrast the types and components of cells.
6.1 ES.1 Distinguish among the layers of Earth and describe the properties and composition of each layer.
6.1.ES.2 Describe objects in the solar system, including their characteristics, relative sizes and relative distances from the sun. Describe the position of the sun and its relationship to our solar system, our galaxy and other stars and galaxies.

6.2 Interaction and Change: **The related parts within a system interact and change.**

6.2.PS.1 Describe types and properties of waves and explain how they interact with matter.
6.2.LS.1 Describe the interactions between and among cells, tissues, organs and organ systems.
6.2 LS.2 Analyze how organisms within ecosystems compete for resources, including food, space, water, air, and shelter.
6.2.ES.1 Explain the water cycle.

6.3 Scientific Inquiry: **Scientific inquiry is the investigation of the natural world based on observation and prior science knowledge. The investigation includes proposing hypotheses, developing the procedures for questioning, collecting, analyzing, and interpreting accurate and relevant data to produce justifiable evidence-based explanations.**

6.3.1 Based on observation, and scientific concepts and knowledge, propose hypotheses that can be examined through scientific investigation. Design and conduct an investigation that uses appropriate tools and techniques to collect relevant data.
6.3.2 Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.
6.3.3 Explain why if more than one variable changes at the same time in an investigation, the outcome of the investigation may not be clearly attributable to any one variable.

6.4 Engineering Design: **Engineering design is a process of identifying needs, defining problems, and evaluating proposed solutions.**

6.4.1 Define a problem that addresses a particular need and identify scientific principles that may be related to possible solutions.
6.4.2 Design, construct, and test a possible solution to a defined problem using appropriate tools and materials. Evaluate the proposed engineering design solutions to that problem.
6.4.3 Describe examples of how engineers have created inventions that address human needs and aspirations.

Grade 7

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

7.1 Structure and Function: **Living and non-living systems are composed of component parts which are responsible for the defining characteristics and traits of the system.**

7.1.PS.1 Explain that elements are composed of a single kind of atom, compounds are composed of two or more elements, and each element and compound have physical and chemical properties that are unique.
7.1.LS.1 Compare and contrast sexual and asexual reproduction and describe life cycles of organisms.
7.1.LS.2 Distinguish between inherited and learned traits, explain how inherited traits are passed from generation to generation, and describe the relationships among phenotype, genotype, chromosomes, and genes.

7.2 Interaction and Change: **The component parts and processes within a system interact.**

7.2.PS.1 Describe the relationship between electricity and magnetism, static and current electricity, and series and parallel electrical circuits.
7.2.PS.2 Explain that different types of motion result from balanced and unbalanced forces.
7.2 PS.3 Identify and describe common forces and their properties. Relate forces to Newton's laws of motion and to gravitation.
7.2.LS.1 Explain that food provides energy for the growth and metabolism of organisms. Explain how photosynthesis and respiration are the processes by which plants and animals convert energy from their environment.
7.2.ES.1 Describe the effects of renewable and nonrenewable resources on society; and evaluate the environmental and societal affects of obtaining and using renewable and non-renewable resources.
7.2.ES.2 Evaluate factors that affect global environmental change and suggest and evaluate possible solutions to problems.
7.2 ES.3 Explain how landforms change over time at various rates in terms of constructive and destructive forces.
7.2.ES.4 Describe the composition of the Earth's atmosphere and how it has changed over time and implications for the future.

7.3 Scientific Inquiry: **Scientific inquiry is the investigation of the natural world based on observation and prior science knowledge. The investigation includes proposing hypotheses, designing the procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations.**

7.3.1 Based on observations, and scientific concepts and knowledge, propose hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools and techniques to collect relevant data.
7.3.2 Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions including possible sources of error.
7.3.3 Evaluate the validity of claims, based on the amount and quality of the evidence cited.

Grade 7

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

7.4 Engineering Design: **Engineering design is a process of identifying needs, defining problems, identifying constraints, and evaluating proposed solutions.**

7.4.1 Define a problem that addresses a particular need and identify constraints that may be related to possible solutions.

7.4.2 Design, construct, and test a possible solution using appropriate tools and materials. Evaluate the proposed engineering design solutions to identify how design and constraints are addressed.

7.4.3 Explain how new scientific knowledge can be used to develop new technologies and how new technologies can be used to generate new scientific knowledge.

Grade 8

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

8.1 Structure and Function: **Systems function through interactions of component parts via mechanisms with various levels of complexity.**

8.1.PS.1 Describe the atomic model and explain how the types and arrangements of atoms determine the physical and chemical properties of a substance.
8.1.PS.2 Explain why the motion and spacing of particles determines states of matter.
8.1.PS.3 Explain how the Periodic Table is an organization of elements based on their physical and chemical properties.
8.1.LS.1 Explain how organisms from both the past and the present are classified based on their genetics and their internal and external structures. Describe how scientists use classification systems to show relationships among organisms.
8.1.ES.1 Analyze evidence of the sequence of geologic, climate, environment, and life form events recorded over time in the natural world.

8.2 Interaction and Change: **Systems interact with other systems.**

8.2.PS.1 Distinguish between physical and chemical changes and define the Law of Conservation of Mass as it applies to these changes.
8.2.PS.2 Describe and explain how energy moves from one place to another and how it is transformed from one form to another, emphasizing the Law of Conservation of Energy.
8.2.LS.1 Explain how populations in an ecosystem interact and how changes in populations are related to available resources.
8.2.LS.2 Explain how natural selection is a mechanism for biological evolution and describe evidence for evolution in living things.
8.2.LS.3 Explain how organelles within a cell perform cellular processes and how cells obtain the raw materials for those processes.
8.2.ES.1 Explain that gravity is the force that keeps objects in the solar system in regular and predictable motion. Describe how regular and predictable motions explain such phenomena as seasons, phases of the moon, tides, and eclipses.
8.2.ES.2 Describe the processes of Earth's geosphere including the rock cycle and plate tectonics. Describe the major geological events that cause and are a result of these processes.
8.2.ES.3 Evaluate how human activities have changed Earth's land, oceans and atmosphere.
8.2.ES.4 Explain what causes patterns of atmospheric and oceanic movement and how these movements affect weather and climate.

8.3 Scientific Inquiry: **Scientific inquiry is the investigation of the natural world through observations and prior science knowledge. The investigation includes proposing hypotheses, designing procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new explorations.**

8.3.1 Based on observations, and scientific concepts and knowledge, propose hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools, techniques, independent and dependent variables and controls to collect relevant data.
8.3.2 Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of a scientific investigation, and communicate the conclusions including possible sources of error. Suggest new investigations based on analysis of results.
8.3.3 Explain how scientific explanations and theories evolve as new information becomes available.

Grade 8

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

8.4 Engineering Design: **Engineering design is a process of identifying a need, defining problems, identifying design criteria and constraints, and evaluating proposed solutions.**

8.4.1 Define a problem that addresses a particular need and using prior knowledge and scientifically relevant principles investigate possible solutions given a set of specified criteria, constraints, priorities, and trade-offs.

8.4.2 Design, construct, and test a proposed engineering design solution and collect relevant data. Evaluate a proposed design solution in terms of design and performance criteria, constraints, priorities, and trade-offs. Identify possible design improvements.

8.4.3 Explain how creating a new technology requires considering societal goals, costs, priorities, and trade-offs.

High School

It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication**.**

HS.1 Structure and Function: **A system's characteristics, form and function are attributed to the quantity, type and nature of its components.**

HS.1.PS.1 Explain how electron configuration is related to the properties of elements and their position in the Periodic Table. Explain how the composition of the nucleus is related to isotopes and radioactivity.
HS.1.PS.2 Describe how different types and strengths of bonds affect the physical and chemical properties of compounds.
HS.1.PS.3 Compare the mass, linear, and time scales of nature from subatomic to cosmological using appropriate units of measure.
HS.1.LS.1 Distinguish among the four types of organic macromolecules (proteins, carbohydrates, lipids and nucleic acids). Explain how they compose the cellular structures of organisms and are involved in critical cellular processes.
HS.1.LS.2 Describe the chemical structure of DNA and its relationship to chromosomes. Explain the role of DNA in protein synthesis.
HS.1.LS.3 Explain and apply laws of heredity and their relationship to the structure and function of DNA.
HS.1.LS.4 Explain how cellular processes and cellular differentiation are regulated both internally and externally in response to the environments in which they exist.
HS.1.ES.1 Classify the bodies in our solar system based on properties and composition. Describe attributes of our galaxy and evidence for multiple galaxies in the universe.
HS.1.ES.2 Describe the structure and composition of the atmosphere, geosphere and hydrosphere of the Earth.

HS.2 Interaction and Change: **The component parts in a system can interact in dynamic ways that may result in change. In systems, changes occur with a flow of energy and/or transfer of matter.**

HS.2.PS.1 Explain that chemical reactions result from the making and breaking of bonds in a process that requires or releases energy. Explain how the rate of a chemical reaction is affected by temperature, pressure, and concentration,
HS.2.PS.2 Apply the Law of Conservation of Mass to physical and chemical changes.
HS.2.PS.3 Describe the interactions of energy and matter in terms of the Law of Conservation of Energy.
HS.2.PS.4 Apply Newton's laws of motion and gravitation to describe the interaction of forces on an object and the resultant motion.
HS.2.LS.1 Explain how energy and chemical elements pass through systems. Describe how chemical elements are combined and recombined in different ways as they cycle through the various levels of organization in biological systems.
HS.2.LS.2 Explain how ecosystems change in response to disturbances and interactions. Analyze the relationships among biotic and abiotic factors in ecosystems.
HS.2.LS.3 Analyze the impacts of asexual and sexual reproduction on genetic diversity.
HS.2.LS.4 Explain that biological evolution is the consequence of natural selection.
HS.2.LS.5 Explain how multiple lines of scientific evidence support biological evolution.
HS.2.ES.1 Identify and predict the effect of energy sources, physical forces and transfer processes that occur in the Earth system. Describe how matter and energy are cycled between system components over time.
HS.2.ES.2 Explain how Earth's surface changes over time and at varying rates.
HS.2.ES.3 Describe the evidence of how the universe, galaxies, stars, and planets evolve over time. Explain techniques used to elucidate the age of events on Earth, including correlation of rock units, fossil associations, and measurement of stable isotopes and radionuclides.
HS.2.ES.4 Evaluate the impact of human activities on the sustainability of life and societies on Earth.

HS.3 Scientific Inquiry: **Scientific inquiry is the investigation of the natural world by a systematic process that includes proposing a testable question or hypothesis and developing procedures for collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new explorations.**

HS.3.1 Based on observations, and scientific concepts and knowledge, formulate a question that can be investigated through the collection and analysis of relevant information.
HS.3.2 Design a process for making systematic observations about the natural world. The design must support the collection of sufficient and appropriate data to test a scientific idea.
HS.3.3 Design a scientific experiment and conduct a scientific investigation. The design must support the collection of sufficient and appropriate data to test a scientific idea.
HS.3.4 Analyze data from a scientific investigation and identify uncertainties in such a way as to aid its interpretation and the development of a scientific explanation. Draw a valid conclusion, explain how it is supported by the evidence, and communicate the findings of a scientific investigation.
HS.3.5 Identify examples from the history of science to illustrate that scientific knowledge is subject to modification as new information challenges prevailing explanations and as old observations are viewed in a new or more comprehensive way.
HS.3.6 Relate how technological problems and advances create a demand for new scientific knowledge. Describe how new technologies make it possible for scientists to extend their research in creative ways or to undertake entirely new lines of research.

HS.4 Engineering Design: **Engineering design is a process of formulating problem statements, identifying criteria and constraints, proposing and testing possible solutions, incorporating modifications based on test data, and communicating the recommendations.**

HS.4.1 Define a problem and specify criteria for a solution within specific constraints or limits based on scientific principles. Generate several possible solutions to a problem and use the concept of tradeoffs to compare them in terms of criteria and constraints.
HS.4.2 Create and test the most promising solution. Collect and process relevant data. Incorporate modifications based on data from testing.
HS.4.3. Analyze data, identify uncertainties, and display data so that the implications for the solution being tested are clear.
HS.4.4 Recommend a proposed solution, identify its strengths and weaknesses, and describe how it is better than alternative designs. Identify further engineering that might be done to refine the recommendations.
HS.4.5 Describe how the introduction of new technologies is largely responsible for changes in how people live and work.
HS.4.6 Evaluate ways that ethics, public opinion, and government policy influence the work of engineers and scientists, and how the results of their work impact human society and the environment.

Appendix
Core Standards for Physical, Life, and Earth and Space Science Grades K-HS

This appendix provides the core and content standards organized by science discipline to show the progression of the standards from kindergarten through high school in life, physical, earth and space science, and for scientific inquiry and engineering design.

K.1 Structure and Function: **The natural world includes living and non-living things.**
K.2 Interaction and Change: **Living and non-living things move.**
1.1 Structure and Function: **Living and non-living things can be described in terms of their characteristics and properties.**
1.2 Interaction and Change: **Living and non-living things exchange energy and matter.**
2.1 Structure and Function: **Living and non-living things are found in a variety of places.**
2.2 Interaction and Change: **Living and non-living things change.**
3.1 Structure and Function: **Living and non-living things can be classified by their characteristics and properties.**
3.2 Interaction and Change: **Living and non-living things interact.**
4.1 Structure and Function: **Living and non-living things are identified by their distinct properties.**
4.2 Interaction and Change: **Living and non-living things undergo changes that involve force and energy.**
5.1 Structure and Function: **Living and non-living things are composed of component parts.**
5.2 Interaction and Change: **Force, energy, matter, and organisms interact within living and non-living systems.**
6.1 Structure and Function: **Living and non-living systems are organized groups of related parts that function together and have characteristic properties.**
6.2 Interaction and Change: **The related parts within a system interact and change.**
7.1 Structure and Function: **Living and non-living systems are composed of component parts which are responsible for the defining characteristics and traits of the system.**
7.2 Interaction and Change: **The component parts and processes within a system interact.**
8.1 Structure and Function: **Systems function through interactions of component parts via mechanisms with various levels of complexity.**
8.2 Interaction and Change: **Systems interact with other systems.**
HS.1 Structure and Function: **A system's characteristics, form and function are attributed to the quantity, type and nature of its components.**
HS.2 Interaction and Change: **The component parts in a system can interact in dynamic ways that may result in change. In systems, changes occur with a flow of energy and/or transfer of matter.**

Physical Science Content Standards Grades K-HS

K.1.PS.1 Compare and contrast living and non-living things.
K.2.PS.1 Examine how things move in many different ways
1.1.PS.1 Examine objects in terms of their physical properties and materials.
1.2.PS.1 Measure the movement of objects when a force (push or pull) is applied.
2.2.PS.1 Compare how different types of materials respond to magnetic forces.
3.1.PS.1 Explain how objects vary in the extent to which they absorb and reflect light and heat.
4.1.PS.1 Compare and contrast the distinct properties of states of matter.
4.1.PS.2 Compare and contrast forms of energy (heat, electricity, light, and sound) and describe their distinct properties.
4.2.PS.1 Describe physical and chemical changes in matter and how they occur.
5.1.PS.1 Describe that non-living things may be made of parts, some of which cannot be seen with the human eye.
5.2.PS.1 Apply an understanding of motion and gravitation by analyzing how the forces of friction, gravity, and magnetism affect objects on or near Earth.
5.2.PS.2 Compare and contrast the characteristics of kinetic and potential energy in relationship to an object's position and motion.
6.1.PS.1 Explain that all matter is made of atoms and different kinds of matter are made of different atoms.
6.1.PS.2 Describe physical and chemical properties of matter and how they can be measured.
6.1.PS.3 Distinguish among the various forms and characteristics of energy.
6.2.PS.1 Describe types and properties of waves and explain how they interact with matter.
7.1.PS.1 Explain that elements are composed of a single kind of atom, compounds are composed of two or more elements, and each element and compound have physical and chemical properties that are unique.
7.2.PS.1 Describe the relationship between electricity and magnetism, static and current electricity, and series and parallel electrical circuits.
7.2.PS.2 Explain that different types of motion result from balanced and unbalanced forces.
7.2 PS 3 Identify and describe common forces and their properties. Relate forces to Newton's laws of motion and to gravitation.
8.1.PS.1 Describe the atomic model and explain how the types and arrangements of atoms determine the physical and chemical properties of a substance.
8.1.PS.2 Explain why the motion and spacing of particles determines states of matter.
8.1.PS.3 Explain how the Periodic Table is an organization of elements based on their physical and chemical properties.
8.2.PS.1 Distinguish between physical and chemical changes and define the Law of Conservation of Mass as it applies to these changes.
8.2.PS.2 Describe and explain how energy moves from one place to another and how it is transformed from one form to another, emphasizing the Law of Conservation of Energy.
HS.1.PS.1 Explain how electron configuration is related to the properties of elements and their position in the Periodic Table. Explain how the composition of the nucleus is related to isotopes and radioactivity.
HS.1.PS.2 Describe how different types and strengths of bonds affect the physical and chemical properties of compounds.
HS.1.PS.3 Compare the mass, linear, and time scales of nature from subatomic to cosmological using appropriate units of measure.
HS.2.PS.1 Explain that chemical reactions result from the making and breaking of bonds in a process that requires or releases energy. Explain how the rate of a chemical reaction is affected by temperature, pressure, and concentration,
HS.2.PS.2 Apply the Law of Conservation of Mass to physical and chemical changes.
HS.2.PS.3 Describe the interactions of energy and matter in terms of the Law of Conservation of Energy.
HS.2.PS.4 Apply Newton's laws of motion and gravitation to describe the interaction of forces on an object and the resultant motion.

Life Science Content Standards Grades K-HS

K.1.LS.1 Compare and contrast plants and animals.

1.1.LS.1 Compare and contrast characteristics among individuals within one plant or animal group.

1.2.LS.1 Cite evidence that plants and animals both need water and air, animals need to take in food, and plants make food using nutrients and light.

2.1.LS.1 Compare and contrast features and behavior of plants and animals that help them to live in different environments.

2.2.LS.1 Describe the predictable life cycles of plants and animals.

3.1.LS.1 Explain that reproduction is necessary for the survival of a species and list similar characteristics of offspring to their parents.

3.2.LS.1 Compare and contrast how organisms and resources interact in an ecosystem.

4.1.LS.1 Analyze plant and animal structures that serve different functions in growth, survival, and reproduction.

4.2.LS.1 Evaluate how energy and materials circulate in a food web in order for organisms to stay alive and grow.

5.1.LS.1 Compare and contrast the parts of living things including cells, tissues, organs and body systems.

5.1.LS.2 Classify and group common organisms based on their characteristics and/or common ancestors.

5.2.LS.1 Analyze the interdependence of organisms and their environment and how it affects the survival of individuals and populations.

6.1.LS.1 Describe the function and relative complexity of cells, tissues, organs, and organ systems in organisms and explain that different body tissues and organs are made up of different kinds of cells. Explain that the way in which cells function is similar in all living organisms and compare and contrast the types and components of cells.

6.2.LS.1 Describe the interactions between and among cells, tissues, organs and organ systems.

6.2 LS.2 Analyze how organisms within ecosystems compete for resources, including food, space, water, air, and shelter.

7.1.LS.1 Compare and contrast sexual and asexual reproduction and describe life cycles of organisms.

7.1.LS.2 Distinguish between inherited and learned traits, explain how inherited traits are passed from generation to generation, and describe the relationships among phenotype, genotype, chromosomes, and genes.

7.2.LS.1 Explain that food provides energy for the growth and metabolism of organisms. Explain how photosynthesis and respiration are the processes by which plants and animals convert energy from their environment.

8.1.LS.1 Explain how organisms from both the past and the present are classified based on their genetics and their internal and external structures. Describe how scientists use classification systems to show relationships among organisms.

8.2.LS.1 Explain how populations in an ecosystem interact and how changes in populations are related to available resources.

8.2.LS.2 Explain how natural selection is a mechanism for biological evolution and describe evidence for evolution in living things.

8.2.LS.3 Explain how organelles within a cell perform cellular processes and how cells obtain the raw materials for those processes.

HS.1.LS.1 Distinguish among the four types of organic macromolecules (proteins, carbohydrates, lipids and nucleic acids). Explain how they compose the cellular structures of organisms and are involved in critical cellular processes.

HS.1.LS.2 Describe the chemical structure of DNA and its relationship to chromosomes. Explain the role of DNA in protein synthesis.

HS.1.LS.3 Explain and apply laws of heredity and their relationship to the structure and function of DNA.

HS.1.LS.4 Explain how cellular processes and cellular differentiation are regulated both internally and externally in response to the environments in which they exist.

HS.2.LS.1 Explain how energy and chemical elements pass through systems. Describe how chemical elements are combined and recombined in different ways as they cycle through the various levels of organization in biological systems.
HS.2.LS.2 Explain how ecosystems change in response to disturbances and interactions. Analyze the relationships among biotic and abiotic factors in ecosystems.
HS.2.LS.3 Analyze the impacts of asexual and sexual reproduction on genetic diversity.
HS.2.LS.4 Explain that biological evolution is the consequence of natural selection.
HS.2.LS.5 Explain how multiple lines of scientific evidence support biological evolution.

Earth and Space Science Content Standards Grades K-HS

K.1.ES.1 Gather evidence that the sun warms Earth which is composed of land, air, and water.
K.2.ES.1 Identify that the sun can be seen only during the daytime.
1.1.ES.1 Examine Earth materials in terms of their characteristics and physical properties.
1.2.ES.1 Investigate the change in Earth materials when a force is applied.
2.2.ES.1 Examine patterns of movement of the sun and the moon.
2.2.ES.2 Investigate temperature changes day to day and over the seasons.
3.1.ES.1 Compare and contrast fossils to one another and to living organisms and make inferences about changes in Earth over time.
3.1.ES.2 Classify rocks according to appearance and how they were formed.
3.2.ES.1 Identify Earth as a major planetary body, with a moon, that has seasonal weather patterns that can be described in terms of precipitation and temperature.
4.1.ES.1 Identify properties and uses of Earth materials and summarize the limitations of their sustainability.
4.1.ES.2 Compare and contrast the composition and textures of the layers of different soils and explain that they vary in their ability to support plant growth.
4.2.ES.1 Compare and contrast the changes in the surface of the Earth that are due to slow and rapid processes.
5.2.ES.1 Explain that the sun is Earth's primary source of energy for atmospheric and surface heat which creates and drives weather and ocean currents and how that energy varies over time (day/year).
5.2.ES.2 Compare and contrast weather and climate.
5.2.ES.3 Explain the patterns of stars and their relative movements over time (nightly – rotation, yearly – revolution)
6.1 ES.1 Distinguish among the layers of Earth and describe the properties and composition of each layer.
6.1.ES.2 Describe objects in the solar system, including their characteristics, relative sizes and relative distances from the sun. Describe the position of the sun and its relationship to our solar system, our galaxy and other stars and galaxies.
6.2.ES.1 Explain the water cycle.
7.2.ES.1 Describe the effects of renewable and nonrenewable resources on society; and evaluate the environmental and societal affects of obtaining and using renewable and non-renewable resources.
7.2.ES.2 Evaluate factors that affect global environmental change and suggest and evaluate possible solutions to problems.
7.2 ES.3 Explain how landforms change over time at various rates in terms of constructive and destructive forces.
7.2.ES.4 Describe the composition of the Earth's atmosphere and how it has changed over time and implications for the future.
8.1.ES.1 Analyze evidence of the sequence of geologic, climate, environment, and life form events recorded over time in the natural world.

8.2.ES.1 Explain that gravity is the force that keeps objects in the solar system in regular and predictable motion. Describe how regular and predictable motions explain such phenomena as seasons, phases of the moon, tides, and eclipses.

8.2.ES.2 Describe the processes of Earth's geosphere including the rock cycle and plate tectonics. Describe the major geological events that cause and are a result of these processes.

8.2.ES.3 Evaluate how human activities have changed Earth's land, oceans and atmosphere.

8.2.ES.4 Explain what causes patterns of atmospheric and oceanic movement and how these movements affect weather and climate.

HS.1.ES.1 Classify the bodies in our solar system based on properties and composition. Describe attributes of our galaxy and evidence for multiple galaxies in the universe.

HS.1.ES.2 Describe the structure and composition of the atmosphere, geosphere and hydrosphere of the Earth.

HS.2.ES.1 Identify and predict the effect of energy sources, physical forces and transfer processes that occur in the Earth system. Describe how matter and energy are cycled between system components over time.

HS.2.ES.2 Explain how Earth's surface changes over time and at varying rates.

HS.2.ES.3 Describe the evidence of how the universe, galaxies, stars, and planets evolve over time. Explain techniques used to elucidate the age of events on Earth, including correlation of rock units, fossil associations, and measurement of stable isotopes and radionuclides.

HS.2.ES.4 Evaluate the impact of human activities on the sustainability of life and societies on Earth.

Core Standards for Scientific Inquiry
Grades K-HS

K.3 **Science explores the natural world through observation.**
1.3 **Science explores the natural world using evidence from observations.**
2.3 **Scientific inquiry is a process used to explore the natural world using evidence from observations and investigations.**
3.3 **Scientific inquiry is a process used to explore the natural world using evidence from recorded observations and investigations.**
4.3 **Scientific inquiry is a process of investigation through questioning, collecting, describing, and examining recorded evidence to explain natural phenomena and artifacts.**
5.3 **Scientific inquiry is a process of investigation based on scientific knowledge and questioning, collecting, describing, and examining recorded evidence to explain natural phenomena and artifacts.**
6.3 **Scientific inquiry is the investigation of the natural world based on observation and prior science knowledge. The investigation includes proposing hypotheses, developing the procedures for questioning, collecting, analyzing, and interpreting accurate and relevant data to produce justifiable evidence-based explanations.**
7.3 **Scientific inquiry is the investigation of the natural world based on observation and prior science knowledge. The investigation includes proposing hypotheses, designing the procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations.**
8.3 **Scientific inquiry is the investigation of the natural world through observations and prior science knowledge. The investigation includes proposing hypotheses, designing procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new explorations.**
HS.3 **Scientific inquiry is the investigation of the natural world by a systematic process that includes proposing a testable question or hypothesis and developing procedures for collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new explorations.**

Scientific Inquiry Content Standards Grades K-HS

K.3.1 Explore testable questions about living and non-living things and events in the natural world.
K.3.2 Make and describe careful observations about the natural world.
1.3.1 Name tools and use them to make careful observations about the natural world in order to answer questions about living and non-living things and events.
1.3.2 Record data with pictures, numbers, or written statements.
1.3.3 Make and describe observations. Explain that describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.
2.3.1 Observe, measure, and record properties of objects and substances using simple equipment and tools (e.g., rulers, meter sticks, thermometers, hand lenses, and balances) to gather data and extend the senses.
2.3.2 Make predictions about living and non-living things and events in the environment based on observed patterns.
2.3.3 Make, describe, and compare observations.
3.3.1 Plan a simple investigation based on a testable question, match measuring tools to their uses, and collect data from a scientific investigation.

3.3.2 Use the data collected from a scientific investigation to explain the results and draw conclusions.
3.3.3 Explain that when a scientific investigation is repeated, similar results are expected.
4.3.1 Based on observations identify testable questions, design a scientific investigation, and collect and record data consistent with a planned scientific investigation.
4.3.2 Summarize the results from a scientific investigation and use the results to respond to the question being tested.
4.3.3 Explain that scientific claims about the natural world must be based on evidence that can be confirmed and support a logical argument.
5.3.1 Based on observations and scientific knowledge, identify questions that can be tested, design an experiment or investigation and identify appropriate tools. Collect and record multiple observations while conducting investigations or experiments to test a scientific question or hypothesis.
5.3.2 Identify patterns in data that support a reasonable explanation for the results of an investigation or experiment and communicate findings using graphs, charts, maps, models, and oral and written reports.
5.3.3 Explain that sometimes similar investigations have different results because of differences in the things being investigated, the methods used, or the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations.
6.3.1 Based on observation, and scientific concepts and knowledge, propose hypotheses that can be examined through scientific investigation. Design and conduct an investigation that uses appropriate tools and techniques to collect relevant data.
6.3.2 Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.
6.3.3 Explain why if more than one variable changes at the same time in an investigation, the outcome of the investigation may not be clearly attributable to any one variable.
7.3.1 Based on observations, and scientific concepts and knowledge, propose hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools and techniques to collect relevant data.
7.3.2 Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions including possible sources of error.
7.3.3 Evaluate the validity of claims, based on the amount and quality of the evidence cited.
8.3.1 Based on observations, and scientific concepts and knowledge, propose hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools, techniques, independent and dependent variables and controls to collect relevant data.
8.3.2 Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of a scientific investigation, and communicate the conclusions including possible sources of error. Suggest new investigations based on analysis of results.
8.3.3 Explain how scientific explanations and theories evolve as new information becomes available.
HS.3.1 Based on observations, and scientific concepts and knowledge, formulate a question that can be investigated through the collection and analysis of relevant information.
HS.3.2 Design a process for making systematic observations about the natural world. The design must support the collection of sufficient and appropriate data to test a scientific idea.
HS.3.3 Design a scientific experiment and conduct a scientific investigation. The design must support the collection of sufficient and appropriate data to test a scientific idea.
HS.3.4 Analyze data from a scientific investigation and identify uncertainties in such a way as to aid its interpretation and the development of a scientific explanation. Draw a valid conclusion, explain how it is supported by the evidence, and communicate the findings of a scientific investigation.
HS.3.5 Identify examples from the history of science to illustrate that scientific knowledge is subject to modification as new information challenges prevailing explanations and as old observations are viewed in a new or more comprehensive way.
HS.3.6 Relate how technological problems and advances create a demand for new scientific knowledge. Describe how new technologies make it possible for scientists to extend their research in creative ways or to undertake entirely new lines of research.

Core Standards for Engineering Design
Grades K-HS

K.4 **Engineering Design is used to design and build things.**
1.4 **Engineering Design is used to design and build things to meet a need.**
2.4 **Engineering Design is a process used to design and build things to solve problems or address needs.**
3.4 **Engineering Design is a process that uses science to solve problems or address needs or aspirations.**
4.4 **Engineering Design is a process of using scientific knowledge to solve practical problems generated by needs and aspirations.**
5.4 **Engineering Design is a process of using scientific knowledge and principles to make modifications in the world to meet human needs and aspirations.**
6.4 **Engineering Design is a process of identifying needs, defining problems, and evaluating proposed solutions.**
7.4 **Engineering Design is a process of identifying needs, defining problems, identifying constraints, and evaluating proposed solutions.**
8.4 **Engineering Design is a process of identifying needs, defining problems, identifying design criteria and constraints, and evaluating proposed solutions.**
HS.4 **Engineering Design is a process of formulating problem statements, identifying criteria and constraints, proposing and testing possible solutions, incorporating modifications based on test data, and communicating the recommendations.**

Engineering Design Content Standards Grades K-HS

K.4.1 Create structures using natural or designed materials and simple tools.
K.4.2 Show how component parts of designed structures can be disassembled and reassembled into different structures.
1.4.1 Use tools to make a simple machine out of common objects and materials.
1.4.2 Demonstrate that some machines have parts that work together to perform a function.
1.4.3 Explain how tools are used to complete specific tasks every day.
2.4.1 Identify basic tools used in engineering design.
2.4.2 Work with a team to complete an engineering design that can be shared with others.
3.4.1 Identify a problem that can be addressed through engineering design, propose a potential solution, and design a prototype.
3.4.2 Infer how recent inventions have significantly changed the way people live.
3.4.3 Give examples of technologies that enable scientists to observe things that are too small or too far away.
4.4.1 Identify a practical problem that can be addressed through engineering design using scientific principles. Design, construct, and test a prototype of a possible solution to a problem using appropriate tools, materials, and resources.
4.4.2 Use discarded materials to design and construct a new product.
4.4.3 Explain how the solution to one problem may create other problems.
5.4.1 Using scientific principles, describe a solution to a need or problem given criteria and constraints.
5.4.2 Design and build a prototype of a proposed engineering solution and identify factors such as cost, safety, appearance, environmental impact, and what will happen if the solution fails.
5.4.3 Explain that inventions are likely to lead to other inventions and once an invention exists, people are likely to think of novel ways of using it.
6.4.1 Define a problem that addresses a particular need and identify scientific principles that may be related to possible solutions.
6.4.2 Design, construct, and test a possible solution to a defined problem using appropriate tools and materials. Evaluate the proposed engineering design solutions to that problem.

6.4.3 Describe examples of how engineers have created inventions that address human needs and aspirations.
7.4.1 Define a problem that addresses a particular need and identify constraints that may be related to possible solutions.
7.4.2 Design, construct, and test a possible solution using appropriate tools and materials. Evaluate the proposed engineering design solutions to identify how design and constraints are addressed.
7.4.3 Explain how new scientific knowledge can be used to develop new technologies and how new technologies can be used to generate new scientific knowledge.
8.4.1 Define a problem that addresses a particular need and using prior knowledge and scientifically relevant principles investigate possible solutions given a set of specified criteria, constraints, priorities, and trade-offs.
8.4.2 Design, construct, and test a proposed engineering design solution and collect relevant data. Evaluate a proposed design solution in terms of design and performance criteria, constraints, priorities, and trade-offs. Identify possible design improvements.
8.4.3 Explain how creating a new technology requires considering societal goals, costs, priorities, and trade-offs.
HS.4.1 Define a problem and specify criteria for a solution within specific constraints or limits based on scientific principles. Generate several possible solutions to a problem and use the concept of tradeoffs to compare them in terms of criteria and constraints.
HS.4.2 Create and test the most promising solution. Collect and process relevant data. Incorporate modifications based on data from testing.
HS.4.3 Analyze data, identify uncertainties, and display data so that the implications for the solution being tested are clear.
HS.4.4 Recommend a proposed solution, identify its strengths and weaknesses, and describe how it is better than alternative designs. Identify further engineering that might be done to refine the recommendations.
HS.4.5 Describe how the introduction of new technologies is largely responsible for changes in how people live and work.
HS.4.6 Evaluate ways that ethics, public opinion, and government policy influence the work of engineers and scientists, and how the results of their work impact human society and the environment.