K-12 Science Literacy
New Hampshire
Curriculum Framework

June 2006

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New Hampshire Curriculum Framework Science

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Philosophy of the Frameworks

How do the new frameworks differ from the old ones?

Science should not be approached as a collection of isolated abilities and bits of information, but as a rich fabric of mutually supported ideas and skills that must develop overtime. From primary school to high school what students learn should build on what they learned before, makes sense in terms of what else they are learning, and prepare them for what they will learn next[1].This framework looks at how kids perceive and interact with the world.

One of the major changes from the earlier framework can be seen the structure of the new frameworks reflecting the developmental stages of children. To help districts develop curricula for all grade levels, the new Frameworks for Science Literacy includes Grade Span Expectations (GSEs) that break down the content into specific grade spans (K-2, 3-4, 5-6, 7-8, 9-12). Each span lists proficiencies which indicate what all students should know and be able to do by the end of that grade span.

The old framework had six strands: 1) Inquiry; 2) Science, Technology and Society; 3) Life Science; 4) Earth Space Science; 5) Physical Science; and 6) Unifying Themes. Many district curricula had little to no emphasis on strands 1, 2, and 6. In the new edition, Science is divided into three content domains (Earth Space Science, Life Science, and Physical Science) and one Science Process Skills domain. Ideas and objectives which correspond to the 1995 Science Framework strands 1, 2, and 6 have been rolled into each of the new strands.

Science Process Skills (SPS) is a new addition to the Frameworks. It reflects the need to make sure that in the early years students develop specific skill sets that will help them be successful in future science experiences. The last section of the skills strand, SPS4, looks at goals for Information and Computer Technology standards in Science. This was included to help districts meet the needs of all students and to meet the new ICT requirements for K-8 and 9-12 digital portfolios.

Everything in the old framework could be the subject of the state assessment in science. In the new framework, only specific proficiencies will be part of the upcoming NECAP Science Assessment. These “NECAP Science Targets” are clearly marked in bold boxes throughout the GSEs for each grade span. They are also referenced in the Science Process Skills documents as they connect to Inquiry and the Unifying themes of science. The other proficiencies should become part of each districts local science assessment system.

[1] *Atlas of Science Literacy,* American Association for the Advancement of Science, 2001, page 3

Why include Design Technology in Science?

Science comprises our knowledge about the natural world and the processes by which that knowledge is acquired, synthesized, evaluated, and applied. Therefore, science education must emphasize hands-on exploration and direct experience with the natural world. Students should be engaged in the observation of these phenomena whenever possible. Science is, above all, an inquiry activity that seeks answers to questions by collecting and analyzing data in an attempt to offer a rational explanation of naturally-occurring events. The knowledge that results from scientific problem solving is most useful when it is organized into concepts, generalizations, and unifying principles, which lead to further investigation of objects and events in the environment.

Science and technology are practiced in the context of human culture, and therefore, dynamic interactions occur among science, technology, and society. Each component-- inquiry and problem solving, and how these relate to each other and to society-- is critically important to instruction at every grade level.

Technology concerns the human-made world. Technology is much older than science, and has its roots in the very early use of tools by our human-like ancestors. Enabling our children to understand how humans modify the natural world to solve problems and to meet human needs and desires is equally as important as teaching them how to inquire about the natural world. And of course, these two endeavors are related. The reason for including technology along with science in the curriculum is stated in the National Science Education Standards: "Although these are science education standards, the relationship between science and technology is so close that any presentation of science without developing an understanding of technology would portray an inaccurate picture of science." [2] The National Standards goes on to define technology and its relationship to science as follows:

> "As used in the Standards, the central distinguishing characteristic between science and technology is a difference in goal: The goal of science is to understand the natural world, and the goal of technology is to make modifications in the world to meet human needs. Technology as design is included in the Standards as parallel to science as inquiry." [3]

In order to broaden our students' career opportunities and awareness it is also important that they learn distinction between the occupations of scientist and engineer: Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs, and aspirations. Scientists and engineers frequently work together in teams, along with people from other fields, to tackle the essential issues facing our society.

[2] *National Science Education Standards*, National Research Council, Washington, D.C.: National Academy Press, 1996, page 190.
[3] *Ibid*. page 24.

K-12 Broad Goals of Science Education

1. Students will use inquiry strategies to investigate and understand the natural world.

2. Students will demonstrate an understanding of key concepts and principles central to the biological, physical, and earth sciences, and engineering, while recognizing the interrelationship of all the sciences.

3. Students will demonstrate an understanding of the basic laws which govern and explain phenomena observed in the natural world

4. Students will demonstrate an understanding of, and be able to practice, the basic processes which scientists use to obtain and continually revise knowledge about the natural world.

5. Students will perceive that scientific and technological knowledge is the result of the cumulative efforts of people, past and present, who have attempted to explain the world through an objective, peer-tested, rational approach to understanding natural phenomena and occurrences.

6. Students will display a sense of curiosity and wonder about the natural world, and demonstrate an increasing awareness of the interdependence between all living things and the environment.

7. Students will demonstrate their abilities to identify human needs and concerns and to engage in problem-solving processes to define the problem, research and generate solutions, and develop simulations and prototypes to test their ideas before implementation.

8. Students will be able to apply rational, creative-thinking, and investigative skills and use scientific and technical knowledge in their roles as citizens, workers, family members, and consumers in an increasingly technological society.

9. Students will use oral and written communication, mathematical representation, and physical and conceptual models to describe and explain scientific concepts and ideas, and will be able to apply scientific and technical knowledge.

10. Students will know and employ safe practices and techniques in the laboratory, in field work or any other scientific investigation, and when using scientific or technological materials at home or work.

The History of the New Hampshire Science Frameworks

The state of New Hampshire adopted the NH Science Frameworks in February 1995. These frameworks, based on the draft *National Science Education Standards*[4] and *Benchmarks for Science Literacy*[5], provided guidance for what we would assess in our state science assessment. We tested all students in NH in science at the ends of grades 6 and 10 to determine how well districts were developing science curricula which would improve what all students should know and be able to do in science. Due to budgetary constraints, NH suspended the Science Assessment in school year 2003-2004.

Realizing that NCLB required a science assessment by 2008, in March 2004 we began a thorough review of the NH Science Frameworks and relative research and literature. The goal of this process was to revise our science frameworks to reflect changes in our understanding of how children learn science in the classroom and to guide the development of a rigorous science assessment that will drive change in instructional practice.

As we began our internal review, we joined with Rhode Island and Vermont to develop guidance for a common assessment that would look at specific content covered in all three states frameworks (standards). We spent a great deal of time analyzing the research about how students learn and looked at how to focus our assessment on those things that would improve classroom practice and expose more students, across all three states, to challenging science curricula. The NECAP Science Assessment will be given at the end of Grades 4, 8, and 11 and will consist of three test sessions (one session will be performance).

More than one hundred and fifty NH educators and community members were involved with the revision process. The revised frameworks, now referred to as the *New Hampshire Frameworks for Science Literacy K-12,* were approved by the New Hampshire State Board of Education in June 2006.

The New Hampshire Frameworks for Science Literacy K-12 includes Grade Span Expectations (GSEs) which clearly delineate expected content for 2 or 3 year grade spans. NECAP Science Assessment Targets are highlighted but they are not the only things included in the framework. In order to provide guidance but allow for some local flexibility, grade spans include: K to 4 (K-2, 3-4); 5 to 8 (5-6, 7-8); and 9 to 12 (9-11 basic, 11 -12 advanced level).

[4] *National Science Education Standards*, © 1995, National Academy of Science
[5] *Benchmarks for Science Literacy*, © 1993, American Association for the Advancement of Science

Science in the Grade Spans

ELEMENTARY – GRADES K to 4
USING SCIENCE TO EXPLORE THE WORLD

Children in grades K-4 observe, describe, and interact with the world around them. At this level effective learning environments provide opportunities for developing awareness of and involvement with the world around them through:

- Playing with, exploring, collecting, handling, sorting, and classifying objects.
- Using graphic organizers and other strategies to motivate, organize, and identify the questions children ask about the world. [*Test Guess*]
- Using tools (for example: non standard measures, rulers, and magnifiers) to enhance observations, collect, represent and interpret data.
- Organizing and manipulating data in multiple ways, which may include tools of technology, e.g., calculators, and computers.
- Communicating (through reading, writing, speaking, listening, movement and viewing) to describe their observations of the world.

In summary, the K-4 classroom should provide students opportunities to engage with concrete manipulative activities that will lead children to construct the desired concepts through investigation and analysis of experience. At this level in particular, science should be integrated with other curricular areas (e.g., reading, writing, math, social studies, technology, art, music, or physical education).

MIDDLE LEVEL SCIENCE – GRADES 5 to 8
STUDENTS IDENTIFY AND SHAPE THEIR UNDERSTANDING OF THE WORLD

Children in grades 5-8 will build on their K-4 measurement and observation skills to construct new understandings and validate scientific theories and explanations. At this level, effective learning environments provide opportunities for collaborative inquiry in the field, classroom, and laboratory. These students need content knowledge as well as frequent and varied practice in experimentation and inquiry. Since students in the middle years tend to center on evidence which supports their current beliefs, they need to be able to examine their beliefs and concepts in a safe environment and be provided with scientific theories as alternatives. At this level effective learning environments provide opportunities for students to construct new understandings and validate scientific theories and explanations through:

- Providing frequent opportunities for students to engage in full and partial Inquiries
- Providing students with background content and theories to guide their design of observations and investigations.
- Helping students shape and modify their background knowledge through experiments and observations. Students should develop their abilities in systematic observation, making accurate measurements, and identifying and controlling variables.
- Since students in the middle years tend to center on evidence which supports their current beliefs, teachers need to challenge current beliefs and concepts that students hold and provide scientific theories as alternatives.

- Giving ample opportunity for students to establish and refine methods of experimentation, data collection and reporting.
- Encouraging students to develop skills to present their understandings using the language of science to communicate scientific explanations and ideas. Students should receive constructive criticism and questions and should be able to provide the same for fellow student groups and individuals.
- The use of writing, labeling drawings, completing concept maps, developing spreadsheets, and designing computer images and representations should be part of the middle school science experience.
- Use literature and technology, and graphic organizers to support different explanations and predictions

Science is a way of knowing and understanding the world around us. Because science plays a key role in developing an informed citizen, it is important that all middle school children have experience in the enterprise and content of science.

HIGH SCHOOL – GRADES 9 to 12
REFINING, ENRICHING, AND APPLYING KEY SCIENCE CONCEPTS

It is important that students develop a solid understanding of how specific domains of science operate. Students in high school should learn science in courses with clear content goals and expectations. Understanding the connections of one science domain to another is important but research indicates students need concentrated knowledge and skills in specific science domains.

Courses become more content-intensive without losing the field, experiential, and laboratory components. Although content may take on a more prominent role, instruction should proceed as much as possible on an inquiry basis. Alternative paths may exist to serve increasingly divergent student needs.

- Use formal controlled experimentation to gather data about the natural world. Limit scope, isolate variables, prove or disprove a limited hypothesis.
- Generate their own questions, develop hypotheses, and design or modify experiments to test those hypotheses.
- Manipulate scientific apparatus and use advanced technology to gather data (e.g., air tracks, electrophoresis, lasers, titration glassware.)
- Analyze collected data to validate or refute a hypothesis.
- Articulate clearly and defend a scientific viewpoint.

The importance of linking science content to student lives can not be overemphasized. The ability of students to link new content to their personal science knowledge is critical for students to understand and remember concepts. Collaboration in science as a critical process will be fostered in the classroom. In addition, an increased use of quantitative reasoning should occur throughout high school.

What is Science?

The following information should be of help to teachers, parents, and students. One of the greatest problems in science education centers on this lack of understanding by the general public.

Science teachers teach about science concepts in their classrooms, but rarely do they take time to help students understand what science is and what it is not. The New Hampshire Framework for Science Literacy contains information about what science is and it is intended that teachers will take time to repeatedly help students understand the nature of science. The business of science is to develop theories based on natural explanations about how the natural world works.

Students need to realize how the scientific processes are used to acquire new knowledge. The best way for them to do this is to spend time using scientific inquiry, experimentation, discussing data, drawing inferences based on data, and writing conclusions based on evidence. These processes should be practiced in every science course at every science level. It is also desirable that students be aware of past scientific works that formed the basis for the development of present theories, and the fact that scientific theories are built on the sequential work of many scientists over time.

The Nature of Science

(Adapted from Arkansas Science Framework 1999)

People have many ways of knowing about their world including scientific knowledge, societal knowledge, religious knowledge and cultural knowledge. Science differs from these other ways of knowing in important ways (see: Comparison of Ways of Knowing).

Science is a system of exploring the natural universe through data collected by observation, experimentation and peer verification. This data must be reviewed by many scientists before it is accepted as valid evidence. Based on evidence from collected data, theories are advanced to explain and account for observations. Science must limit itself to explanation about the natural world.

The success and credibility of science are anchored in the willingness of scientists to:

1. Expose their ideas and results to independent testing and replication by other scientists. This requires the complete and open exchange of data, procedures and materials.
2. Abandon or modify accepted conclusions when confronted with more complete or reliable experimental evidence.

Science definitions for the following terms are specific:

Fact: In science, an observation that has been repeatedly confirmed
Hypothesis: A testable statement or prediction about the natural world which can be supported by experiment or observation
Law: A descriptive generalization or pattern about how some aspect of the natural world behaves under stated circumstances; often stated in a form of a mathematical equation
Theory: In science, a well-substantiated explanation of how the natural world works that explains facts, laws, inferences, and tested hypotheses

Before a theory can be included in the system of science, it must meet all of the following criteria:

1. Be able to explain what has been observed;
2. Be able to predict what has not yet been observed; and
3. Be able to be tested by further experimentation and to be modified as required by the acquisition of new data.

People often use the word *theory* to mean a hunch or a guess; but as these criteria show, that is not correct. A scientific theory is held with a high degree of confidence and is supported by

enough evidence to make its abandonment unlikely. As new evidence is found, a theory may be modified but only with compelling evidence, verification and peer review. The business of science is to build theories that explain how the natural world works and predict how it might work in the future.

Science is not a matter of belief; rather, it is a matter of conclusive evidence that can be subjected to the test of observation, reasoning and peer review. The open competition of ideas in published papers is a major part of scientific work.

The goal of science is an understanding of the general principles underlying the functioning of the universe. Such understanding is achieved by means of four components:

1. Observation of specific facts or phenomena
2. Formulation of generalizations about such phenomena
3. Production of causal hypotheses relating the phenomena
4. Test of the causal hypotheses by means of further observation and experimentation

The science is based on two fundamental assumptions:

1. A naturalistic explanation is sufficient to account for the functioning of the universe.
2. The universe can be understood using logic and rational thinking.

Two types of evidence are accepted by practicing scientists:

1. Confirmation of hypothesis by data strengthens their validity.
2. Repeated inconsistency of data with a hypothesis eventually leads to the rejection of the hypothesis.

Science can only deal with events or things that can be measured, observed or detected. It cannot be used to investigate all questions. There are beliefs that cannot be proved or disproved by their very nature (e.g., the meaning of life or the existence of supernatural powers and beings). In other cases, a scientific approach that may be valid is likely to be rejected as irrelevant by people who hold certain beliefs (e.g., astrology, fortune-telling, and superstition). Scientists do not have the means to settle issues concerning good and evil. Answers to these questions must be found in religion, philosophy, cultural ideals and other systems of beliefs.

Scientific Theories

Science theories are not hunches or guesses, but all have been subjected repeated testing and verification. All scientific theories are subject to change as new evidence comes to be accepted by all scientists. Students should develop an understanding of the basic theories that are foundational in science and which guide scientific understanding. A few current scientific theories are listed below:

Atomic Theory: This theory states that the atom is the smallest unit of matter. The atom is composted of the nucleus in the middle of the atom that is composed of neutrons and protons (both of these may break down into smaller particles). The neutrons have no charge. The protons have a positive charge. Surround the nucleus are electrons that swirl around the nucleus in a large region, rather than orbiting in a fixed pattern (electron cloud). The electrons have a negative charge. Many modern scientists have contributed to our current view of the atom in which the electrons swirl around the nucleus in a large region (electron cloud), rather than orbiting in a fixed pattern. Plus modern quantum theory shows how atomic particles such as electrons may also be seen as having wavelike properties (see below).

Big Bang Theory: Big bang theory assumes that the universe began from a singular state of infinite density and expanding from an explosive moment of creation. The theory was further developed in the 1940s by George Gamow and R. A. Alpher. Fred Hoyle coined the term Big Bang. The Big Bang Theory is the dominant scientific theory about the origin of the universe. According to the big bang, the universe was created sometime between 10 billion and 20 billion years ago from a cosmic explosion that hurled matter and in all directions.

Gravity Theory: Gravitation, or gravity, is a force that attracts all objects in the universe. The most familiar of the four fundamental interactions of matter, gravitation has several characteristics that distinguish it from the other interactions: (1) It is universal; (2) It is always attractive; (3) It is a long-range interaction; and (4) It is a long-range attractive force affecting all matter.

Evolution Theory: Evolution theory says that all living things are related to one another through common ancestry from earlier forms that differed from the present forms. Exactly how evolution occurs is still a matter of debate, but that it occurs is a scientific fact. Biologists agree that all living things arose through a long history of changes shaped by physical and chemical processes that are still taking place. According to the theory, variability among individuals in a population of sexually reproducing organisms is produced by mutation and genetic recombination. The resulting genetic variability is subject to natural selection in the environment.

Cell Theory: The cell theory of life states: (1) All living material is made up of cells; (2) All cells are derived from previously existing cells; most cells arise by cell division, but in sexual organisms they may be formed by the fusion of sperm and egg; (3) A cell is the most elementary unit of life; (4) Every cell is bounded by a plasma membrane, an extremely thin skin separating it from the environment and from other cells; (5) All cells have strong biochemical similarities; and (6) Most cells are small, about 0.001 cm (0.0004 in) in length; for example, the smallest cells of

the microorganism mycoplasma are 0.3 micrometers in size, whereas some giant algae cells may be several centimeters long.

The Germ Theory of Disease: French bacteriologist Louis Pasteur is considered the founder of microbiology. Pasteur argued that infectious diseases were caused by germs. The germ theory has affected our views on infectious disease, surgery, hospital management, agriculture, and industry.

Relativity Theories: Albert Einstein's theory of special relativity, published in 1905, revealed that energy and matter are different manifestations of the same phenomenon and can be transformed into each other in terms of the relationship $E = mc^2$. Einstein's theory of general relativity, published in 1917, provided a powerful new way to view gravity as a warping of the four-dimensional space-time continuum by the presence of matter. If space-time is imagined as a rubber sheet, then massive objects such as stars and galaxies create deformations in space-time, just as a bowling ball sitting on a mattress creates a dent into which nearby smaller objects fall. Thus the shape of space-time determines the behavior of matter/energy. At the same time, the presence of matter/energy determines the shape of space-time.

Plate Tectonics Theory: Plate tectonics is an all-embracing theory that the Earth is divided into a number of rigid plates floating on a viscous underlayer in the mantle. Alfred L. Wegener was the first to propose in 1912 that the continents were at one time connected and had drifted apart. In 1960 when H. H. Hess suggested that new ocean floor was created at the mid-oceanic ridges and that the ocean evolved by seafloor spreading.

Quantum Theory: This theory that says that energy exists in tiny discrete units called quanta. Just as earlier theory showed how light, generally seen as a wave motion, could also in some ways be seen as composed of discrete particles (photons), quantum theory shows how atomic particles such as electrons may also be seen as having wavelike properties. Quantum theory is the basis of particle physics, modern theoretical chemistry, and the solid-state physics that describes the behavior of the silicon chips used in computers. Quantum theory and the theory of relativity together form the theoretical basis of modern physics. Later work by scientists elaborated the theory into what is called quantum mechanics (or wave mechanics).

Unified Field Theory: This theory proposes to unify the four known interactions, or forces– the strong, electromagnetic, weak, and gravitational forces– by a simple set of general laws. These four distinct forces control all the observed interactions in matter: gravitation, electromagnetism, the strong force (force that holds atomic nuclei together), and the weak force (force present in some nuclear processes).

Comparison of Ways of Knowing

People have several ways that they know about their world. The chart below lists some of the ways of knowing. One way of knowing is no more valid that another. However, as you read the chart please note that science is a way of knowing that requires the use of certain rules and methods that differs from the other means of knowing. Scientific knowledge is limited to the natural world. The other ways of knowing do not have these limitations. (Adapted from the Arkansas Science Teachers Association website, http://users.aristotle.net/~asta/science.htm)

Religious Knowledge	Philosophic Knowledge	Cultural Knowledge	Scientific Knowledge
Seeks answers to any question that can be posed including answers to the ultimate questions (e.g., What is my purpose? What is the meaning of life? Is there a supreme being?).	Seeks answers to any question that can be posed including answers to the ultimate (e.g., What is my purpose? What is the meaning of life? Is there a supreme being?).	Seeks answers to any question that can be posed including answers to the ultimate questions (e.g., What is my purpose? What is the meaning of life?), but generally relates to how people treat one another.	Can only seek answers about the natural world but cannot answer ultimate questions (e.g., Is there a god? What is the meaning of life? What is my purpose?).
Seeks predictions on any event based on faith and belief.	Seeks predictions on any event based on point of view.	Seeks predictions on any event based on belief and cultural history.	Seeks predictions about future natural events based on observational evidence and testing.
The rules may vary among the different religions.	The rules may vary among the different philosophic views.	The rules may vary among the different cultures.	Has a set of rules that must be followed in order to be called science.
Explanations are based on beliefs and faith and seek to understand and follow an ultimate purpose.	Explanations are based on logic or viewpoint and seek to understand and follow an ultimate purpose and may undergo some type of testing.	Explanations are based on beliefs and seek to understand and follow an ultimate purpose.	Explanations are based on observation, evidence, and testing.
Explanations can include supernatural forces.	Explanations can include supernatural forces and viewpoints.	Explanations can include supernatural forces and other historical viewpoints.	Explanations cannot include supernatural forces.
Hypotheses need not be part of the religion, nor do hypotheses have to be tested nor proved or disproved.	Hypotheses may be a part of the philosophic view and hypotheses may or may not have to be tested and proved or disproved.	Hypotheses need not be part of the cultural view, nor do hypotheses have to be tested nor proven.	The hypothesis used in tests must be able to be disproved.
Is a belief system and seeks truths.	Is a point of view and seeks truths.	May be a belief system rooted in historical views and seeks truths.	Is not a belief system nor seeks truths.
Knowledge may not change greatly over time, but may be swayed by culture.	Knowledge may not change greatly over time and may be influenced by culture.	Knowledge may or may not change slowly over time.	Knowledge may change as new data (evidence) arises.
Accepted knowledge does not need peer review or verification.	Accepted knowledge may seek peer review or verification, but conclusions may differ among individuals.	Accepted knowledge may seek review or verification, but conclusions may differ among individuals.	All knowledge must have peer review and verification.

How to Read the Science GSEs

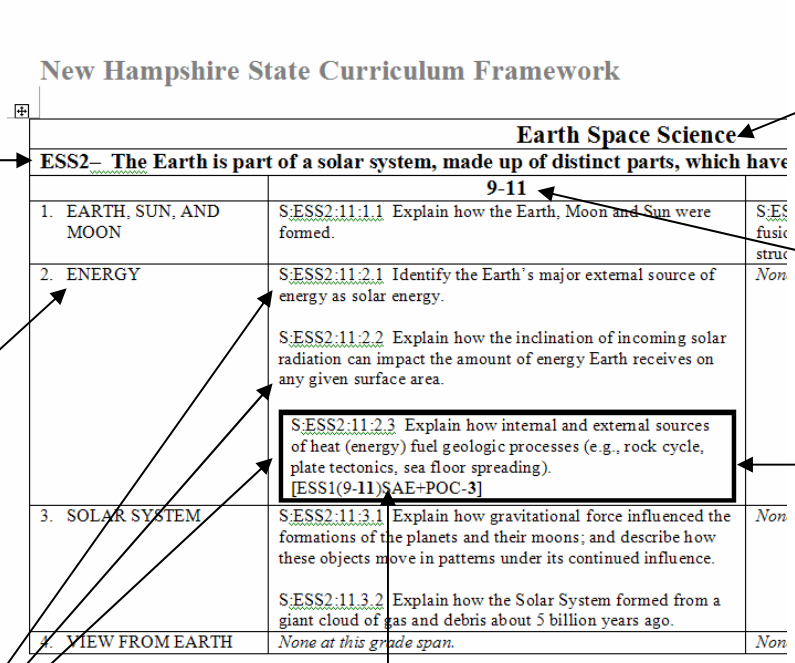
The numbering system for the NH Science GSEs is made up of the following information.
Example: **S:ESS2:11:1.1**

Content Area ➔*(Science)*
Domain ➔ (*Earth Space)*
Strand ➔ *(ESS2)*
Grade level ➔ *(by end of 11*)
Stem ➔ *(Earth, Sun, and Moon)*
Expectation➔ *(Explain how…)*

Strand– This is the Enduring Knowledge Statement for this section of the GSE. Strands will be two or three letters and one number. The same strands are used across grade levels.
Example: ESS2

Stem– This is an organizing topic for content and skills. The same stems are used across all grade levels.
Example: 2. Energy

Expectations– These are listed in the columns by grade level. All expectations should be the foundation of your local assessment system. Each expectation has a unique number. The order is not specific.
Example:
S:ESS2:11:2.1 Identify the Earth's major external source of energy as solar energy.



New Hampshire State Curriculum Framework

	Earth Space Science	
ESS2– The Earth is part of a solar system, made up of distinct parts, which have		
	9-11	
1. EARTH, SUN, AND MOON	S:ESS2:11:1.1 Explain how the Earth, Moon and Sun were formed.	S:ES fusi stru
2. ENERGY	S:ESS2:11:2.1 Identify the Earth's major external source of energy as solar energy. S:ESS2:11:2.2 Explain how the inclination of incoming solar radiation can impact the amount of energy Earth receives on any given surface area. S:ESS2:11:2.3 Explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading). [ESS1(9-**11**)SAE+POC-**3**]	*Non*
3. SOLAR SYSTEM	S:ESS2:11:3.1 Explain how gravitational force influenced the formations of the planets and their moons; and describe how these objects move in patterns under its continued influence. S:ESS2:11:3.2 Explain how the Solar System formed from a giant cloud of gas and debris about 5 billion years ago.	*Non*
4. VIEW FROM EARTH	*None at this grade span.*	*Non*

Domain (Science Skills, Earth Space, Life, or Physical)
Example: Earth Space Science

Grade Level– the highest grade in the column.
Example: 11

NECAP Science Assessment Targets– These are indicated by a bold box around the expectation. Each Assessment target will be assessed each year.
Example:
S:ESS2:11:2.3 will be assessed on the NECAP Science Assessment.

Reading the NECAP ASSESSMENT TARGET CODE– Found below the text of the Assessment Target is a unique code that identifies the enduring knowledge statement, the grade levels, and the Big Ideas (Unifying Themes) that the content will be approached from. The last number just is the number in a sequence.
Example: [ESS1(9-**11**)SAE+POC-**3**]
ESS1 – grade 11 – SAE (Systems and Energy) POC (Patterns of Change) – 3 (third item on the NECAP list)

Science Process Skills Overview

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
1. MAKING OBSERVATIONS AND ASKING QUESTIONS	S:SPS1:2:1.1 Make observations and explore materials using all of their senses (one sense at a time). S:SPS1:2:1.2 Record observations using language, concrete objects, and symbolic representations. S:SPS1:2:1.3 Ask questions about objects, organisms and events in their immediate environment. S:SPS1:2:1.4 Ask questions that lead to exploration and investigation as a result of working with materials and objects. S:SPS1:2:1.5 Sort and classify object materials and events based on one or more attributes; and explain the methods used for sorting.	S:SPS1:4:1.1 Extend the senses using simple tools. S:SPS1:4:1.2 Make and record observations for a given purpose. S:SPS1:4:1.3 Differentiate between observations and inferences. S:SPS1:4:1.4 Record observations using standard units of measurement. S:SPS1:4:1.5 Classify according to several attributes and describe or show the method for classification. S:SPS1:4:1.6 Compare methods of classifying based on the goal. S:SPS1:4:1.7 Ask questions about objects, organisms and events in their local environment. S:SPS1:4:1.8 Pose questions to investigate and practical problems to solve.
2. DESIGNING SCIENTIFIC INVESTIGATIONS	S:SPS1:2:2.1 Select tools and procedures, in a purposeful way, to explore objects and materials. S:SPS1:2:2.2 Suggest a plan and describe a sequence of events for conducting an exploration. S:SPS1:2:2.3 Predict how changing one part of an exploration will affect the outcome.	S:SPS1:4:2.1 Plan a step-by-step process to solve a practical problem or to carry out a “fair test” of a simple scientific question. S:SPS1:4:2.2 Select an activity and justify it as an effective means of collecting appropriate data.
3. CONDUCTING SCIENTIFIC INVESTIGATIONS	S:SPS1:2:3.1 Follow their own plan for conducting an investigation. S:SPS1:2:3.2 Follow a simple step-by-step procedure.	S:SPS1:4:3.1 Follow a set of procedures. S:SPS1:4:3.2 Plan and test ideas through guided experiments. S:SPS1:4:3.3 Identify and use appropriate tools.

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
4. REPRESENTING AND UNDERSTANDING RESULTS OF INVESTIGATIONS	S:SPS1:2:4.1 Represent and interpret information and observations in many ways (such as in tally, pictographs, bar graphs, tables). S:SPS1:2:4.2 Identify and describe patterns and relationships in observed objects and events.	S:SPS1:4:4.1 Compile and display data in a variety of formats. S:SPS1:4:4.2 Select an appropriate format to represent data or observations. S:SPS1:4:4.3 Identify and suggest possible explanations for patterns. S:SPS1:4:4.4 Analyze data and identify discrepancies.
5. EVALUATING SCIENTIFIC EXPLANATIONS	*None at this level.*	S:SPS1:4:5.1 Cite evidence or data to support conclusions. S:SPS1:4:5.2 Determine if an observation or measurement supports a given scientific explanation. S:SPS1:4:5.3 Draw a conclusion to answer an initial question, based on the evidence collected.
NECAP ASSESSMENT TARGETS FOR INQUIRY *MAY BE SUBJECT OF PERFORMANCE COMPONENT*		NECAP ASSESSMENT TARGETS S:ESS1:4:2.4 S:ESS1:4:5.2 S:ESS1:4:6.4 S:LS1:4:1.2 S:PS1:4:2.5 S:PS2:4:3.8 S:PS3:4:2.1 S:PS3:4:1.5 (For actual text: please see GSE's for Earth Space, Life, and Physical Science.)

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
1. NATURE OF SCIENCE (NOS)	S:SPS2:2:1.1 Recognize that information can be obtained merely by careful observation, but sometimes even more data can be collected by conducting scientific investigations. S:SPS2:2:1.2 Discover that when a scientific investigation is done the way it was done before, we expect to get a very similar result. S:SPS2:2:1.3 Explain that sometimes people aren't sure what will happen because they don't know all the factors that may have an effect on the outcome.	S:SPS2:4:1.1 Recognize that sometimes scientists have different explanations for the same set of observations which usually lead them to make more observations to resolve the differences. S:SPS2:4:1.2 Realize that results of similar scientific investigations seldom turn out exactly the same, but if the differences are large it's important to try to figure out why. S:SPS2:4:1.3 Know when comparisons might not be fair because some conditions are not kept the same. S:SPS2:4:1.4 Explain that scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments; and that investigations can focus on physical, biological, and social questions. S:SPS2:4:1.5 Realize that scientists' explanations about what happens in the world come partly from what they observe, and partly from what they think.
2. SYSTEMS AND ENERGY (SAE)	S:SPS2:2:2.1 Show how most things are made of parts. S:SPS2:2:2.2 Observe that when parts are put together, they can do things that they couldn't do by themselves. S:SPS2:2:2.3 Explain that something may not work if some of its parts are missing.	S:SPS2:4:2.1 Demonstrate that if something consists of many parts, the parts usually influence one another. S:SPS2:4:2.2 Provide examples that demonstrate that something may not work well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected.

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
3. MODELS AND SCALE (MAS)	S:SPS2:2:3.1 Describe how a model of something is different from the real thing but can be used to learn something about the real thing. S:SPS2:2:3.2 Explain how one way to describe something is to say how it is like something else. S:SPS2:2:3.3 Provide examples to explain that things in nature and things people make have very different sizes, weights, ages and speeds.	S:SPS2:4:3.1 Know that seeing how a model works after changes are made to it may suggest how the real thing would work if the same changes were done to it. S:SPS2:4:3.2 Use geometric figures, number sequences, graphs, diagrams, and pictures as scientific models. S:SPS2:4:3.3 Recognize that most everything has limits on how big or small it can be.
4. PATTERNS OF CHANGE (POC)	S:SPS2:2:4.1 Discover that things change in some ways and stay the same in some ways. S:SPS2:2:4.2 Understand that people can keep track of some things by seeing where they come from and where they go. S:SPS2:2:4.3 Observe that things can change in different ways, such as in size, weight, color and movement.	S:SPS2:4:4.1 Observe that some small changes can be detected by taking measurements. S:SPS2:4:4.2 Understand that some changes are so slow or so fast that they are hard to see. S:SPS2:4:4.3 Demonstrate that some features of things may stay the same even when other features change (e.g., some patterns look the same when they are shifted over, turned, reflected, or seen from different directions).
5. FORM AND FUNCTION (FAF)	S:SPS2:2:5.1 Identify shape and use of objects. S:SPS2:2:5.2 Draw an object and the object in use.	S:SPS2:4:5.1 Discover the relationship between shape and use. S:SPS2:4:5.2 Explore methods, designs and problems of transporting liquids.

Science Process Skills		
SPS3– Personal, Social, and Technological Perspectives		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
1. COLLABORATION IN SCIENTIFIC ENDEAVORS	S:SPS3:2:1.1 Work with a partner to accomplish a specific task. S:SPS3:2:1.2 Take turns. S:SPS3:2:1.3 Ask questions of others about their work.	S:SPS3:4:1.1 Be able to complete an assigned task when given a specific role in a group. S:SPS3:4:1.2 Communicate ideas to others. S:SPS3:4:1.3 Give specific feedback about work of others.
2. COMMON ENVIRONMENTAL ISSUES, NATURAL RESOURCES MANAGEMENT AND CONSERVATION	S:SPS3:2:2.1 Use observation skills to describe the area around their homes and school.	S:SPS3:4:2.1 Demonstrate a basic conservation action such as recycling or a schoolyard habitat project. S:SPS3:4:2.2 Develop questions based upon their observations about the natural world and design a simple investigation. S:SPS3:4:2.3 Develop questions that help them learn about the environment; and design and conduct simple investigations. S:SPS3:4:2.4 Locate and collect information about the environment and environmental and natural resources topics. S:SPS3:4:2.5 Use reliable information to answer questions. S:SPS3:4:2.6 Organize information to search for relationships and patterns concerning the environment and environmental topics. S:SPS3:4:2.7 Identify and investigate issues in their local environments and communities.

Science Process Skills		
SPS3– Personal, Social, and Technological Perspectives		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
3. SCIENCE AND TECHNOLOGY, TECHNOLOGICAL DESIGN AND APPLICATION	S:SPS3:2:3.1 Demonstrate that all tools have a special purpose (e.g., to measure, to help in observations, to make things or to make things better). S:SPS3:2:3.2 Provide examples that highlight the importance of the planning phase of any project. S:SPS3:2:3.3 Identify multiple ways to solve a design problem. S:SPS3:2:3.4 Describe how most things are made up of multiple parts and explain that things may not work if some parts are missing. S:SPS3:2:3.5 Provide examples of how people throughout history have used legends and stories to explain how the world works.	S:SPS3:4:3.1 Describe the design process as a logical progression for transforming ideas into reality. S:SPS3:4:3.2 Describe how people have designed and used tools throughout history; and provide examples of how many of these tools, while improved, are still in use today. S:SPS3:4:3.3 Provide examples illustrating that throughout history, people of all ages and from all walks of life have made significant contributions to the fields of science and technology.

Science Process Skills		
SPS4– Science Skills for Information, Communication and Media Literacy (from *ICT Literacy Map for Science*, www.21stcenturyskills.org)		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
1. INFORMATION AND MEDIA LITERACY	S:SPS4:2:1.1 Have experience with a variety of media sources. S:SPS4:2:1.2 Use tools. S:SPS4:2:1.3 Use age-appropriate sources such as newspapers, books and websites.	S:SPS4:4:1.1 Access information from a variety of media sources (e.g., Internet, CD-ROM programs, print resources). S:SPS4:4:1.2 Use appropriate tools to measure and graph data. S:SPS4:4:1.3 Analyze and compare data from a variety of age-appropriate sources such as newspapers and websites.
2. COMMUNICATION SKILLS	S:SPS4:2:2.1 Communicate ideas and observations through a variety of tools and formats (e.g., oral, journal, drawing, projects, multimedia).	S:SPS4:4:2.1 Use a variety of tools and formats (oral presentations, journals, and multimedia presentations) to summarize and communicate the results of observations.
3. CRITICAL THINKING AND SYSTEMS THINKING	S:SPS4:2:3.1 Make observations and tell ideas about real-life issues. S:SPS4:2:3.2 Use pictures or other means to organize ideas. S:SPS4:2:3.3 Make a graph to represent data.	S:SPS4:4:3.1 Apply a variety of age-appropriate strategies to address real-life issues (e.g., identify factors that affect plants in a particular habitat). S:SPS4:4:3.2 Build a concept map (or other graphic organizer) to understand a complex problem. S:SPS4:4:3.3 Organize observations and data into tables, charts and graphs.
4. PROBLEM IDENTIFICATION, FORMULATION, AND SOLUTION	S:SPS4:2:4.1 Ask questions and take part in investigations. S:SPS4:2:4.2 Compile observations (one to one relationship) by making or using simple pictographs, tally charts or simple graphs. S:SPS4:2:4.3 Look for evidence to support ideas.	S:SPS4:4:4.1 Ask questions and plan investigations to find answers. S:SPS4:4:4.2 Compile data gathered through observations to record and present results using tally charts, tables and graphs. S:SPS4:4:4.3 Use evidence to construct explanations.
5. CREATIVITY AND INTELLECTUAL CURIOSITY	S:SPS4:2:5.1 Use computer software and various technologies as appropriate to display and communicate information and ideas.	S:SPS4:4:5.1 Use a variety of equipment and software packages to enter, process, display, and/or communicate information in different forms using text, tables, pictures, and sound (e.g., brainstorming software, collaboration software, telecommunications, presentation software, digital cameras, projectors).

Science Process Skills		
SPS4– Science Skills for Information, Communication and Media Literacy (from *ICT Literacy Map for Science,* www.21stcenturyskills.org)		
	By the end of Grade 2, all students will…	**By the end of Grade 4, all students will apply skills from previous grades and…**
6. INTERPERSONAL AND COLLABORATIVE SKILLS	S:SPS4:2:6.1 Plan and carry out simple activities with a group.	S:SPS4:4:6.1 Plan and conduct a scientific investigation in group settings. S:SPS4:4:6.2 Engage in group decision making activities. S:SPS4:4:6.3 Role-play different points of view on an issue.
7. SELF DIRECTION	S:SPS4:2:7.1 Keep a visual or written journal.	S:SPS4:4:7.1 Keep a journal record of observations, recognizing patterns, summarizing findings, and reflecting on the observations.
8. ACCOUNTABILITY AND ADAPTABILITY	S:SPS4:2:8.1 Take part in sharing information with another classroom or school as a group.	S:SPS4:4:8.1 Establish ongoing communication with students from other communities or countries to share and compare data.
9. SOCIAL RESPONSIBILITY	S:SPS4:2:9.1 Collaborate, as a group, with another classroom or school.	S:SPS4:4:9.1 Collaborate with other learners by letter, phone, or online.

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
1. MAKING OBSERVATIONS AND ASKING QUESTIONS	S:SPS1:6:1.1 Make observations and record measurements using a variety of tools and instruments. S:SPS1:6:1.2 Plan observations based on a given purpose. S:SPS1:6:1.3 Identify and investigate similarities and differences among observations and sets of observations. S:SPS1:6:1.4 Use appropriate units and precision of metric measurement when recording data. S:SPS1:6:1.5 Use a classification key, such as a dichotomous key, to identify and distinguish among members of a group or set. S:SPS1:6:1.6 Construct a simple classification key. S:SPS1:6:1.7 Compare methods of classification for a specific purpose. S:SPS1:6:1.8 Ask questions about relationships between and among observations. S:SPS1:6:1.9 Determine which observations will be helpful to a given investigation. S:SPS1:6:1.10 Distinguish between those questions that can be answered by science and those that cannot.	S:SPS1:8:1.1 Use appropriate tools to accurately collect and record both qualitative and quantitative data gathered through observations (e.g., temperature probes, electronic balances, spring scales, microscopes, stop watches). S:SPS1:8:1.2 Determine the degree of accuracy that can be obtained using a given instrument. S:SPS1:8:1.3 Investigate similarities and differences noted when making observations. S:SPS1:8:1.4 Construct and use a dichotomous key to classify a given set of objects or organisms. S:SPS1:8:1.5 Evaluate methods of classification for a specific purpose. S:SPS1:8:1.6 Rephrase questions so that they can be tested or investigated using scientific methodologies. S:SPS1:8:1.7 Ask questions about relationships between and among observable variables.

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
2. DESIGNING SCIENTIFIC INVESTIGATIONS	S:SPS1:6:2.1 Design and record a simple step-by-step procedure to follow in order to carry out a fair test of a scientific question. S:SPS1:6:2.2 Identify and utilize appropriate tools/technology for collecting data in designing investigations. S:SPS1:6:2.3 Incorporate components of good experimental design, such as controls and multiple trials, into investigations.	S:SPS1:8:2.1 Identify the manipulated, responding and controlled variables in an experiment. S:SPS1:8:2.2 Design a controlled experiment, identifying and controlling the major variables. S:SPS1:8:2.3 Identify flaws or omissions in the design of simple experiments.
3. CONDUCTING SCIENTIFIC INVESTIGATIONS	S:SPS1:6:3.1 Carry out simple student or teacher-developed procedures or experiments. S:SPS1:6:3.2 Use appropriate tools to collect and record data. S:SPS1:6:3.3 Follow the teacher's instructions in performing experiments, following all appropriate safety rules and procedures.	S:SPS1:8:3.1 Use appropriate laboratory techniques to carry out student- or teacher-developed procedures or experiments. S:SPS1:8:3.2 Use appropriate tools to gather data as part of an investigation (e.g., ruler, meter stick, thermometer, spring scale, graduated cylinder, calipers, balance, probes, microscopes). S:SPS1:8:3.3 Follow the teacher's instructions in performing experiments, following all appropriate safety rules and procedures.
4. REPRESENTING AND UNDERSTANDING RESULTS OF INVESTIGATIONS	S:SPS1:6:4.1 Use appropriate tools to organize, represent, analyze and explain data. S:SPS1:6:4.2 Make and record observations using a pre-determined format. S:SPS1:6:4.3 Compare and display data in a variety of student or computer generated formats (such as diagrams, flow charts, tables, bar graphs, line graphs, scatter plots, and histograms). S:SPS1:6:4.4 Identify patterns and relationships in data and formulate basic explanations. S:SPS1:6:4.5 Draw appropriate conclusions based on data collected.	S:SPS1:8:4.1 Use appropriate tools (including computer hardware and software) to collect, organize, represent, analyze and explain data. S:SPS1:8:4.2 Identify sources of error in experiments. S:SPS1:8:4.3 Draw appropriate conclusions regarding the scientific question under investigation, based on the data collected.

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
5. EVALUATING SCIENTIFIC EXPLANATIONS	S:SPS1:6:5.1 Determine if the results of an experiment support or fail to support the scientific idea tested. S:SPS1:6:5.2 Explain how a hypothesis is a direct extension of a scientific idea and therefore makes that idea "testable."	S:SPS1:8:5.1 Determine if the results of an experiment support or refute the scientific idea tested. S:SPS1:8:5.2 Evaluate whether the information and data collected allows an evaluation of the scientific idea under investigation. S:SPS1:8:5.3 Determine what additional information would be helpful in answering the scientific question.
NECAP ASSESSMENT TARGETS FOR INQUIRY *MAY BE SUBJECT OF PERFORMANCE COMPONENT*		NECAP ASSESSMENT TARGETS S:ESS1:8:2.2 S:ESS1:8:6.4 S:LS1:8:2.5 S:LS2:8:1.3 S:LS4:8:2.4 S:LS1:8:3.7 S:LS4:8:3.4 S:PS1:8:2.4 S:PS1:8:2.5 S:PS1:8:1.6 S:PS2:8:3.6 S:PS3:8:1.3 (For actual text: please see GSE's for Earth Space, Life, and Physical Science.)

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
1. NATURE OF SCIENCE (NOS)	S:SPS2:6:1.1 Explain that scientists do not pay much attention to claims about how something works unless they are backed up with evidence that can be confirmed with a logical argument. S:SPS2:6:1.2 Describe how results of similar and repeated investigations may vary and suggest possible explanations for variations. S:SPS2:6:1.3 Explain that sometimes similar investigations get different results because of unexpected 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 of observations. S:SPS2:6:1.4 Realize that if more than one variable changes at the same time in an experiment, the outcome of the experiment may not be clearly attributable to any one of the variables.	S:SPS2:8:1.1 Describe how scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence. S:SPS2:8:1.2 Realize that when similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, and this often requires more investigations. S:SPS2:8:1.3 Realize that knowledge, based on science, is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way. S:SPS2:8:1.4 Provide examples that show how some scientific knowledge is very old and yet is still applicable today. S:SPS2:8:1.5 Recognize that some matters cannot be examined usefully in a scientific way, such as those matters that by their nature cannot be tested objectively and those that are essentially matters of morality. S:SPS2:8:1.6 Give examples of how science can sometimes be used to inform ethical decisions by identifying the likely consequences of particular actions but cannot be used to establish that some action is either moral or immoral.

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
2. SYSTEMS AND ENERGY (SAE)	S:SPS2:6:2.1 Recognize that thinking about things as systems means looking for how every part relates to others. S:SPS2:6:2.2 Discover that collections of pieces (e.g., powders, marbles, sugar cubes or wooden blocks) may have properties that the individual pieces do not. S:SPS2:6:2.3 Estimate or predict the effect that making a change in one part of the system will have on other parts, and on the system as a whole. S:SPS2:6:2.4 Compare a variety of forms of energy, including heat, light, sound, mechanical, electrical, and chemical energy. S:SPS2:6:2.5 Demonstrate how energy can be transformed from one form to another (e.g., from electrical energy to heat, light or mechanical energy).	S:SPS2:8:2.1 Understand that any system is usually connected to other systems, both internally and externally; thus a system may be thought of as containing subsystems and as being a subsystem of a larger system. S:SPS2:8:2.2 Analyze how the output of one part of a system, which can include materials, energy or information, can become the input to other parts. S:SPS2:8:2.3 Realize that as the complexity of any system increases, gaining an understanding of it depends increasingly on summaries (such as averages and ranges) and on descriptions of typical examples of that system. S:SPS2:8:2.4 Explain that when energy is transformed or converted from one type to another, there is no net loss of energy. S:SPS2:8:2.5 Describe how objects and substances can store energy (e.g., a battery, food, gasoline).

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
3. MODELS AND SCALE (MAS)	S:SPS2:6:3.1 Understand that models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly; or that are too vast to be changed deliberately; or that are potentially dangerous. S:SPS2:6:3.2 Analyze how finding out the biggest and smallest values of something are often as revealing as knowing what the usual value is.	S:SPS2:8:3.1 Demonstrate how mathematical models can be displayed on a computer and then modified to see what happens. S:SPS2:8:3.2 Know that different models can be used to represent the same thing; what kind of model is used and how complex it should be depends on its purpose; and the usefulness of a model is one of the instances in which intuition and creativity come into play in science, mathematics and engineering. S:SPS2:8:3.3 Discover how properties of systems that depend on volume, such as capacity and weight change, change out of proportion to properties that depend on area, such as strength or surface processes. S:SPS2:8:3.4 Recognize that as the complexity of any system increases, gaining an understanding increasingly depends on summaries (such as averages and ranges) and on descriptions of typical examples of that system.

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
4. PATTERNS OF CHANGE (POC)	S:SPS2:6:4.1 Understand that things change in steady, repetitive, or irregular ways, or sometimes in more than one way at the same time; often the best way to tell which kinds of change are happening is to make a table or graph of measurements. S:SPS2:6:4.2 Discover how a system may stay the same because nothing is happening or because things are happening that exactly balance each other out.	S:SPS2:8:4.1 Analyze how physical and biological systems tend to change until they become stable and then stay that way unless their surroundings change. S:SPS2:8:4.2 Recognize how many systems contain feedback mechanisms that serve to keep changes within specified limits. S:SPS2:8:4.3 Realize that symbolic equations can be used to summarize how the quantity of something changes over time or in response to other changes. S:SPS2:8:4.4 Explain how symmetry (or the lack of it) may determine properties of many objects, from molecules and crystals to organisms and designed structures. S:SPS2:8:4.5 Realize that cycles, such as the seasons or body temperature, can be described by their cycle length or frequency, what their highest and lowest values are, and when those values occur; different cycles range from many thousand years down to less than a billionth of a second.
5. FORM AND FUNCTION (FAF)	S:SPS2:6:5.1 Describe the structure and function of organs. S:SPS2:6:5.2 Diagram and label the structure of the primary components of representative organs in plants and animals. S:SPS2:6:5.3 Investigate the relationship between various landforms and wind currents.	S:SPS2:8:5.1 Describe the relationship between structure and function of organ systems in plants and animals. S:SPS2:8:5.2 Describe the structure and function of various organ systems (i.e., digestion, respiration, circulation, nervous, protection and support) and how these systems contribute to homeostasis of the organism. S:SPS2:8:5.3 Compare the structure and function of organ systems in one organism to the structure and function in another organism.

Science Process Skills		
SPS3– Personal, Social, and Technological Perspectives		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
1. COLLABORATION IN SCIENTIFIC ENDEAVORS	S:SPS3:6:1.1 Work effectively within a cooperative group setting, accepting and executing assigned roles and responsibilities. S:SPS3:6:1.2 Work collectively within a group toward a common goal. S:SPS3:6:1.3 Demonstrate respect of one another's abilities and contributions to the group.	S:SPS3:8:1.1 Work effectively within a cooperative group setting, accepting and executing assigned roles and responsibilities. S:SPS3:8:1.2 Work collectively within a group toward a common goal. S:SPS3:8:1.3 Demonstrate respect of one another's abilities and contributions to the group. S:SPS3:8:1.4 Demonstrate an understanding of the ethics involved in scientific inquiry.
2. COMMON ENVIRONMENTAL ISSUES, NATURAL RESOURCES MANAGEMENT AND CONSERVATION	S:SPS3:6:2.1 Develop, focus and explain questions about the environment and do environmental investigations. S:SPS3:6:2.2 Design environmental investigations to answer particular questions. S:SPS3:6:2.3 Explore evidence that human-caused changes have consequences for the immediate environment as well as for other places and future times. S:SPS3:6:2.4 Explore how humans shape and control the environment while creating knowledge and developing new technologies. S:SPS3:6:2.5 Investigate environmental and resource management issues at scales that range from local to national to global.	S:SPS3:8:2.1 Locate and collect reliable information about the environment and environmental topics using a variety of methods and sources. S:SPS3:8:2.2 Judge the weaknesses and strengths of the information they are using. S:SPS3:8:2.3 Explore the uses and limitations of models. S:SPS3:8:2.4 Synthesize observations and findings into coherent explanations about natural resources and the environment.

Science Process Skills		
SPS3– Personal, Social, and Technological Perspectives		
	By the end of Grade 6, all students will apply skills from previous grades and…	**By the end of Grade 8, all students will apply skills from previous grades and…**
3. SCIENCE AND TECHNOLOGY, TECHNOLOGICAL DESIGN AND APPLICATION	S:SPS3:6:3.1 Identify problems/issues that can be addressed by design technology. S:SPS3:6:3.2 Identify and describe the procedure for designing a product, including identifying a need, researching, brainstorming, selecting, developing a prototype, testing and evaluating. S:SPS3:6:3.3 Evaluate technological designs using established criteria.	S:SPS3:8:3.1 Design a product or solution to a problem. S:SPS3:8:3.2 Build a product that has been designed in class. S:SPS3:8:3.3 Evaluate student-designed products according to established criteria and recommend improvements or modifications.

Science Process Skills	
SPS4– Science Skills for Information, Communication and Media Literacy (from *ICT Literacy Map for Science,* www.21stcenturyskills.org)	
	By the end of Grade 8, all students will apply skills from previous grades and…
1. INFORMATION AND MEDIA LITERACY	S:SPS4:8:1.1 Use a variety of information access tools to locate, gather, and organize potential sources of scientific information to answer questions. S:SPS4:8:1.2 Collect real-time observations and data, synthesizing and building upon existing information (e.g., online databases, NOAA, EPA, USGS) to solve problems. S:SPS4:8:1.3 Use appropriate tools to analyze and synthesize information (e.g., diagrams, flow charts, frequency tables, bar graphs, line graphs, stem-and-leaf plots) to draw conclusions and implications based on investigations of an issue or question.
2. COMMUNICATION SKILLS	S:SPS4:8:2.1 Use a wide range of tools and a variety of oral, written, and graphic formats to share information and results from observations and investigations.
3. CRITICAL THINKING AND SYSTEMS THINKING	S:SPS4:8:3.1 Execute steps of scientific inquiry to engage in the problem-solving and decision making processes. S:SPS4:8:3.2 Apply new and unusual applications of existing knowledge to new and different situations. S:SPS4:8:3.3 Make sketches, graphs, and diagrams to explain ideas and to demonstrate the interconnections between systems.
4. PROBLEM IDENTIFICATION, FORMULATION, AND SOLUTION	S:SPS4:8:4.1 Formulate a scientific question about phenomena, a problem, or an issue and using a broad range of tools and techniques; and plan and conduct an inquiry to address the question. S:SPS4:8:4.2 Use evidence collected from observations or other sources and use them to create models and explanations.
5. CREATIVITY AND INTELLECTUAL CURIOSITY	S:SPS4:8:5.1 Use a variety of media tools to make oral and written presentations, which include written notes and descriptions, drawings, photos, and charts to communicate the procedures and results of an investigation.
6. INTERPERSONAL AND COLLABORATIVE SKILLS	S:SPS4:8:6.1 Work in diverse pairs/teams to answer questions, solve problems and make decisions. S:SPS4:8:6.2 Plan and develop team science projects. S:SPS4:8:6.3 Articulate understanding of content through personal interaction and sharing with peers.
7. SELF DIRECTION	S:SPS4:8:7.1 Keep a journal of observations and investigations, and periodically evaluate entries to assess progress toward achieving the understanding of key ideas.
8. ACCOUNTABILITY AND ADAPTABILITY	S:SPS4:8:8.1 Develop and execute a plan to collect and record accurate and complete data from various sources to solve a problem or answer a question; and gather and critically analyze data from a variety of sources. S:SPS4:8:8.2 Participate in science competitions, where students are responsible for creating a product or participating in an event.
9. SOCIAL RESPONSIBILITY	S:SPS4:8:9.1 Collaborate with a network of learners by phone, video, virtual classroom platform. S:SPS4:8:9.2 Participate in simulation or role-playing activities in which students grapple with the ethics of complex issues.

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
1. MAKING OBSERVATIONS AND ASKING QUESTIONS	S:SPS1:11:1.1 Ask questions about relationships among variables that can be observed directly as well as those that cannot. S:SPS1:11:1.2 Use complex classification criteria and keys to identify items/organisms. S:SPS1:11:1.3 Evaluate complex methods of classification for a specific purpose. S:SPS1:11:1.4 Identify limitations of a given classification system and identify alternative ways of classifying to accommodate anomalies.	S:SPS1:12:1.1 Define and delimit problems to facilitate investigation. S:SPS1:12:1.2 Make and record measurements to the correct number of significant figures based on the precision of the instrument used. S:SPS1:12:1.3 Make measurements and observations about a variety of events and phenomena, including those that occur during very small and very large time frames. S:SPS1:12:1.4 Ask questions about relationships between and among observable variables as well as theoretical entities. S:SPS1:12:1.5 Use, evaluate and apply complex classification schemes based on an understanding of scientific concepts, laws and principles. S:SPS1:12:1.6 Describe and apply classification systems and nomenclatures used in the sciences.
2. DESIGNING SCIENTIFIC INVESTIGATIONS	S:SPS1:11:2.1 Apply scientific theories and laws to new situations to generate hypotheses. S:SPS1:11:2.2 State a hypothesis and prediction based on available evidence and background information.	S:SPS1:12:2.1 Identify the theoretical basis of an investigation and develop a prediction and a hypothesis that are consistent with the theoretical basis. S:SPS1:12:2.2 Evaluate and select appropriate instruments for collecting data and evidence in an investigation. S:SPS1:12:2.3 Develop appropriate sampling procedures for a given investigation.

Science Process Skills		
SPS1– Scientific Inquiry and Critical Thinking Skills (INQ)		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
3. CONDUCTING SCIENTIFIC INVESTIGATIONS	S:SPS1:11:3.1 Select and use apparatus and material safely. S:SPS1:11:3.2 Use instruments effectively and accurately for collecting data. S:SPS1:11:3.3 Compile and organize data, using appropriate units.	S:SPS1:12:3.1 Carry out procedures controlling major variables and adapting or extending procedures where required. S:SPS1:12:3.2 Implement appropriate sampling procedures. S:SPS1:12:3.3 Identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty.
4. REPRESENTING AND UNDERSTANDING RESULTS OF INVESTIGATIONS	S:SPS1:11:4.1 Compile and display data, evidence and information by hand and computer, in a variety of formats, including diagrams, flow charts, tables, graphs and scatter plots.	S:SPS1:12:4.1 Interpret patterns and trends in data, and infer or calculate linear and non-linear relationships among variables. S:SPS1:12:4.2 Compare theoretical and empirical values and account for discrepancies. S:SPS1:12:4.3 Evaluate the relevance, reliability and adequacy of data and data collection methods.
5. EVALUATING SCIENTIFIC EXPLANATIONS	S:SPS1:11:5.1 Explain how data support or refute the hypothesis or prediction. S:SPS1:11:5.2 Provide a statement that addresses and answers the question investigated in light of the evidence generated in the investigation.	S:SPS1:12:5.1 Explain how two different scientific explanations for the same phenomenon can be evaluated using the predictive value of the explanations. S:SPS1:12:5.2 Apply and assess alternative theoretical models.
NECAP ASSESSMENT TARGETS FOR INQUIRY *MAY BE SUBJECT OF PERFORMANCE COMPONENT*	NECAP ASSESSMENT TARGETS S:ESS1:11:4.1 S:ESS1:11:3.2 S:LS1:11:2.8 S:LS2:11:1.5 S:LS3:11:3.9 S:LS3:11:2.6 S:LS4:11:2.6 S:PS1:11:2.6 S:PS2:11:3.10 S:PS3:11:1.8 (For actual text: please see GSE's for Earth Space, Life, and Physical Science.)	

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
1. NATURE OF SCIENCE (NOS)	S:SPS2:11:1.1 Explore new phenomena through investigations conducted for different reasons, or to check on previous results. S:SPS2:11:1.2 Test how well a theory predicts a phenomena. S:SPS2:11:1.3 Recognize that sometimes scientists can control conditions in order to focus on the effect of a single variable; when that is not possible for practical or ethical reasons, they try to observe as wide a range of natural occurrences as possible to be able to discern patterns. S:SPS2:11:1.4 Show how hypotheses are widely used in science for choosing what data to pay attention to and what additional data to seek, and for guiding the interpretation of the data (both new and previously available). S:SPS2:11:1.5 Understand that in the long run, theories are judged by how they fit with other theories, the range of observations they explain, how well they explain observations, and how effective they are in predicting new findings. S:SPS2:11:1.6 Show how the usefulness of a model can be tested by comparing its predictions to actual observations in the real world; but a close match does not mean that the model is the only "true" model or the one that would work. S:SPS2:11:1.7 Realize that in science, the testing, revising, and occasional discarding of theories, new and old, never ends; this ongoing process leads to an increasingly better understanding of how things work in the world but not to absolute truth.	S:SPS2:12:1.1 Recognize that there are different traditions in science about what is investigated and how; but they all have in common certain beliefs about the value of evidence, logic and good arguments. S:SPS2:12:1.2 Understand that no matter how well one theory fits observations, a new theory might fit them better, or might fit a wider range of observations. S:SPS2:12:1.3 Explain how in the short run, new ideas that do not mesh well with mainstream ideas in science often encounter vigorous criticism. S:SPS2:12:1.4 Know that from time to time, major shifts occur in the scientific view of how the world works; more often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge (change and continuity are persistent features of science). S:SPS2:12:1.5 Recognize that evidence for the value of testing, revising and discarding theories is given by the improving ability of scientists to offer reliable explanations and make accurate predictions.

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
2. SYSTEMS AND ENERGY (SAE)	S:SPS2:11:2.1 Realize that systems may be so closely related that there is no way to draw boundaries that separate all parts of one from all parts of the others. S:SPS2:11:2.2 Give examples to show that a system usually has some properties that are different from those of its parts, but appear because of the interaction of those parts. S:SPS2:11:2.3 Demonstrate that even in some very simple systems, it may not always be possible to predict accurately the result of changing some part or connection.	S:SPS2:12:2.1 Use evidence and logic to explain that as the number of parts in a system grows in size, the number of possible interactions increases much more rapidly, roughly with the square of the number of parts. S:SPS2:12:2.2 Know that understanding how things work and designing solutions to problems of almost any kind can be facilitated by systems analysis; in defining a system, it is important to specify its boundaries and subsystems, indicate its relation to other systems, and identify what its input and output are expected to be.
3. MODELS AND SCALE (MAS)	S:SPS2:11:3.1 Understand that the basic idea of mathematical modeling is to find a mathematical relationship that behaves in the same way as the objects or processes under investigation; a mathematical model may give insight about how something really works or may fit observations very well without any intuitive meaning.	S:SPS2:12:3.1 Recognize that computers have greatly improved the power and use of mathematical models by performing computations that are very long, very complicated, or repetitive; therefore, computers can show the consequences of applying complex rules or of changing the rules. The graphic capabilities of computers make them useful in the design and testing of devices and structures and in the simulation of complicated processes.

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
4. PATTERNS OF CHANGE (POC)	S:SPS2:11:4.1 Recognize that things can change in detail, but remain the same in general (e.g., the players change but the team remains, the cells are replaced but the organism remains); sometimes counterbalancing changes are necessary for a thing to retain its essential constancy in the presence of changing conditions. S:SPS2:11:4.2 Describe how graphs and equations are useful (and often equivalent) ways for depicting and analyzing patterns of change. S:SPS2:11:4.3 Give examples of how a system in equilibrium may return to the same state of equilibrium if the disturbances it experiences are small; but large disturbances may cause it to escape that equilibrium and eventually settle into some other state of equilibrium. S:SPS2:11:4.4 Describe how in evolutionary change, the present arises from the materials and forms of the past, more or less gradually, and in ways that can be explained.	S:SPS2:12:4.1 Give examples of how in many physical, biological and social systems, changes in one direction tend to produce opposing (but somewhat delayed) influences, leading to repetitive cycles of behavior. S:SPS2:12:4.2 Realize that most systems above the molecular level involve so many parts and forces and are so sensitive to tiny differences in conditions that their precise behavior is unpredictable, even if all the rules for change are known. Predictable or not, the precise future of a system is not completely determined by its present state and circumstances but also on the fundamentally uncertain outcomes of events on the atomic scale.

Science Process Skills		
SPS2– Unifying Concepts of Science		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
5. FORM AND FUNCTION (FAF)	S:SPS2:11:5.1 Explore how the movement of ocean floor plates under continental plates or two continental plates moving against each other can deform the earth's surface. S:SPS2:11:5.2 Provide data and evidence on how folding in crustal plates can cause mountain ranges. S:SPS2:11:5.3 Understand that an atom's electron configuration determines how the atom can interact with other atoms. S:SPS2:11:5.4 Provide examples of how configuration of atoms in a molecule determines a molecule's properties. S:SPS2:11:5.5 Discover how the shape of large molecules affects the interaction with other molecules. S:SPS2:11:5.6 Demonstrate that a variety of biological, chemical and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.	*Same as Grade 11*

Science Process Skills		
SPS3– Personal, Social, and Technological Perspectives		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
1. COLLABORATION IN SCIENTIFIC ENDEAVORS	S:SPS3:11:1.1 Collaborate with existing research efforts. S:SPS3:11:1.2 Identify global researchers in a field of interest.	*Same as grade 11*
2. COMMON ENVIRONMENTAL ISSUES, NATURAL RESOURCES MANAGEMENT AND CONSERVATION	S:SPS3:11:2.1 Develop, modify, clarify and explain questions that guide environmental investigations of various types. S:SPS3:11:2.2 Design investigations to answer particular questions about the environment. S:SPS3:11:2.3 Locate and collect reliable information for environmental investigations of many types. S:SPS3:11:2.4 Apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. S:SPS3:11:2.5 Organize and display information in ways appropriate to different types of environmental investigations and purposes. S:SPS3:11:2.6 Create, use and evaluate models to understand environmental phenomena. S:SPS3:11:2.7 Use to evidence and logic in developing proposed explanations that address their initial questions and hypotheses. S:SPS3:11:2.8 Analyze global, social, cultural, political, economic and environmental linkages. S:SPS3:11:2.9 Evaluate presentations of environmental issues for accuracy.	*Same as grade 11*

Science Process Skills		
SPS3– Personal, Social, and Technological Perspectives		
	By the end of Grade 11, all students will apply skills from previous grades and…	**By the end of Grade 12, advanced students will apply skills from previous grades and…**
3. SCIENCE AND TECHNOLOGY, TECHNOLOGICAL DESIGN AND APPLICATION	S:SPS3:11:3.1 Analyze environmental issues such as water quality, air quality, hazardous waste, and depletion of natural resources. S:SPS3:11:3.2 Evaluate status of a local community system (transportation, water, communication, food resources or electrical) in partnership with local officials. S:SPS3:11:3.3 Analyze technical writing, graphs, charts, and diagrams.	*Same as grade 11*

Science Process Skills	
SPS4– Science Skills for Information, Communication and Media Literacy (from *ICT Literacy Map for Science,* www.21stcenturyskills.org)	
	By the end of Grade 11, all students will apply skills from previous grades and…
1. INFORMATION AND MEDIA LITERACY	S:SPS4:12:1.1 Select and analyze information from various sources (including electronic resources, print resources, community resources) and personally collected data to answer questions being investigated. S:SPS4:12:1.2 Collect and use qualitative and quantitative data and information, seek evidence and sources of information to identify flaws such as errors and bias, and explain how the evidence supports or refutes an initial hypothesis. S:SPS4:12:1.3 Analyze data and information gathered to clarify problems or issues identifying costs and benefits from a social, cultural, and/or environmental perspective; predict the consequences of action or inaction; and propose possible solutions.
2. COMMUNICATION SKILLS	S:SPS4:12:2.1 Select and use appropriate scientific vocabulary to orally share and communicate scientific ideas, plans, results, and conclusions resulting from investigations. S:SPS4:12:2.2 Create written reports and journals to share and communicate scientific ideas, plans, results, and conclusions resulting from observations and investigations. S:SPS4:12:2.3 Create a multimedia presentation incorporating numeric symbolic and/or graphic modes of representation to share scientific ideas, plans, results, and conclusions.
3. CRITICAL THINKING AND SYSTEMS THINKING	S:SPS4:12:3.1 Pursue scientific inquiry such as observation, measurement, hypothesis formation and analysis, and value "habits of mind" such as persistence, accuracy, and collaboration. S:SPS4:12:3.2 Generate solutions to scientific questions and challenges through developing, modeling and revising investigations. S:SPS4:12:3.3 Apply scientific knowledge and skills to make reasoned decisions about the use of science and scientific innovations.
4. PROBLEM IDENTIFICATION, FORMULATION, AND SOLUTION	S:SPS4:12:4.1 Formulate scientific questions about an issue and define experimental procedures for finding answers. S:SPS4:12:4.2 Plan and conduct practical tests to solve problems or answer a question, collect and analyze data using appropriate instruments and techniques safely and accurately. S:SPS4:12:4.3 Develop models and explanations to fit evidence obtained through investigations.

Science Process Skills	
SPS4– Science Skills for Information, Communication and Media Literacy (from *ICT Literacy Map for Science,* www.21stcenturyskills.org)	
	By the end of Grade 11, all students will apply skills from previous grades and…
5. CREATIVITY AND INTELLECTUAL CURIOSITY	S:SPS4:12:5.1 Prepare multimedia presentations to share results of investigations, demonstrating a clear sense of audience and purpose. S:SPS4:12:5.2 Use electronic networks to share information. S:SPS4:12:5.3 Model solutions to a range of problems in science and technology using computer simulation software.
6. INTERPERSONAL AND COLLABORATIVE SKILLS	S:SPS4:12:6.1 Create a culminating team project that demonstrates content knowledge and conceptual understanding and shows connections between science content and real-world settings. S:SPS4:12:6.2 Collect, synthesize, and report information from a variety of points of view.
7. SELF DIRECTION	S:SPS4:12:7.1 Use key ideas of science to document and explain through an investigation the relationship between science and concepts. S:SPS4:12:7.2 Self-assess progress toward a predetermined outcome and decide what needs to be done to meet the goal.
8. ACCOUNTABILITY AND ADAPTABILITY	S:SPS4:12:8.1 Identify the reputable and appropriate communities of learners to whom research findings should be reported, compare data, and adapt as needed. S:SPS4:12:8.2 Use science learned to create a personal action plan on a community issue.
9. SOCIAL RESPONSIBILITY	S:SPS4:12:9.1 Collaborate with interested learners using appropriate web resources and publication media such as journals (print and electronic).

Earth Space Science Overview

Strand (Enduring Knowledge Statements)	Stem (rows) in GSEs	Page K-4	Page 5-8	Page 9-12
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.	1. Atmosphere, Climate, and Weather	**47**	**52**	**59**
	2. Composition and Features	**47**	**52**	**59**
	3. Fossils	**48**	**52**	**60**
	4. Observation Of The Earth From Space	**48**	**53**	**60**
	5. Processes and Rates Of Change	**48**	**53**	**61**
	6. Rock Cycle	**48**	**53**	**61**
	7. Water	**48**	**54**	**61**
ESS2– The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.	1. Earth, Sun And Moon	**49**	**55**	**62**
	2. Energy	**49**	**55**	**62**
	3. Solar System	**49**	**56**	**62**
	4. View From Earth	**49**	**56**	**62**
ESS3– The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.	1. Size And Scale	**50**	**57**	**63**
	2. Stars And Galaxies	**50**	**57**	**63**
	3. Universe	**50**	**57**	**64**
ESS4– The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.	1. Design Technology	**51**	**58**	**65**
	2. Tools	**51**	**58**	**65**
	3. Local And Global Environmental Issues	**51**	**58**	**65**
	4. Career and Technical Education	**51**	**58**	**65**

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	K-2	**3-4**
1. ATMOSPHERE, CLIMATE, AND WEATHER	S:ESS1:2:1.1 Recognize that weather conditions change frequently, and that weather patterns change over the seasons. S:ESS1:2:1.2 Describe and compare weather using observations and measurements of local weather conditions.	S:ESS1:4:1.1 Explain how water exists in the atmosphere in different forms and describe how it changes from one form to another through various processes such as freezing, condensation, precipitation and evaporation. S:ESS1:4:1.2 Explain that air surrounds the Earth, it takes up space, and it moves around as wind. S:ESS1:4:1.3 Based on data collected from daily weather observations, describe weather changes or weather patterns. [ESS1(K-**4**)POC-**5**] S:ESS1:4:1.4 Explain how the use of scientific tools helps to extend senses and gather data about weather (i.e., weather/wind vane– direction; wind sock– wind intensity; anemometer– speed; thermometer– temperature; meter sticks/rulers– snow depth; rain gauges– rain amount in inches). [ESS1(K-**4**)NOS-**3**]
2. COMPOSITION AND FEATURES	S:ESS1:2:2.1 Recognize that solid rocks, soils, and water in its liquid and solid states can be found on the Earth's surface. S:ESS1:2:2.2 Use observable properties, such as color and texture, to classify and organize rocks and minerals. S:ESS1:2:2.3 Recognize that Earth materials have a variety of properties, including size, shape, color and texture.	S:ESS1:4:2.1 Describe Earth materials such as gases found in the atmosphere, rocks, soils, and water in its liquid and solid states. S:ESS1:4:2.2 Describe rock as being composed of different combinations of minerals. S:ESS1:4:2.3 Given information about Earth materials, explain how their characteristics lend themselves to specific uses. [ESS1(K-**4**)FAF-**6**] S:ESS1:4:2.4 Given certain Earth materials (soils, rocks, or minerals) use physical properties to sort, classify, and/or describe them. [ESS1(K-**4**)INQ-**1**]

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	K-2	**3-4**
3. FOSSILS	*None at this grade span.*	S:ESS1:4:3.1 Recognize and explain that fossils offer evidence of plants, animals and the nature of environments that existed long ago.
4. OBSERVATION OF THE EARTH FROM SPACE	*None at this grade span.*	S:ESS1:4:4.1 Recognize features of the Earth as viewed by astronauts in orbit and as transmitted by scientific instruments on satellites and spacecraft.
5. PROCESSES AND RATES OF CHANGE	S:ESS1:2:5.1 Recognize that some changes are too slow or too fast to be easily observed.	S:ESS1:4:5.1 Identify and describe processes that affect the features of the Earth's surface, including weathering, erosion, deposition of sediment. S:ESS1:4:5.2 Explain how wind, water, or ice shape and reshape the Earth's surface. [ESS1(K-**4**)INQ+SAE-**4**]
6. ROCK CYCLE	S:ESS1:2:6.1 Explain that large rocks can be broken down into smaller rocks. S:ESS1:2:6.2 Describe rocks and soils in terms of their physical properties.	S:ESS1:4:6.1 Explain that smaller rocks come from the breaking and weathering of larger rocks and bedrock. S:ESS1:4:6.2 Distinguish between the three categories of rocks (metamorphic, igneous and sedimentary) and describe the processes that create them. S:ESS1:4:6.3 Identify minerals by their physical properties, such as color, texture and cleavage, and describe simple tests used in the identification process. S:ESS1:4:6.4 Use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves). [ESS1(K-**4**)INQ-**2**]
7. WATER	S:ESS1:2:7.1 Recognize that water can be a liquid or a solid; and explain that it can be made to change from one state to the other, but the amount (mass) of water always remains the same in either state.	S:ESS1:4:7.1 Recognize and describe the Earth's surface as mostly covered by water. S:ESS1:4:7.2 Explain that most of Earth's water is salt water, which is found in the oceans, and that fresh water is found in rivers, lakes, underground sources, and glaciers.

Earth Space Science		
ESS2– The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.		
	K-2	**3-4**
1. EARTH, SUN, AND MOON	S:ESS2:2:1.1 Recognize the basic patterns of the Sun, including its appearance during the daytime, and how its position in the sky changes through the seasons. S:ESS2:2:1.2 Recognize the basic patterns of the Moon, including its appearance sometimes at night and sometimes during the day; and how it appears to change shape through the month.	S:ESS2:4:1.1 Explain that night and day are caused by the Earth's rotation on its axis; and that the Earth rotates approximately once, every 24 hours. S:ESS2:4:1.2 Describe the Sun as a star.
2. ENERGY	S:ESS2:2:2.1 Recognize that the light and heat the Sun provides to the Earth is necessary for life.	S:ESS2:4:2.1 Recognize that the Sun provides the light and heat necessary to maintain the temperature of the Earth.
3. SOLAR SYSTEM	*None at this grade span.*	S:ESS2:4:3.1 Recognize that the Moon orbits the Earth. S:ESS2:4:3.2 Recognize that the Earth is one of a number of planets that orbit the Sun.
4. VIEW FROM EARTH	S:ESS2:2:4.1 Recognize that the Sun, Moon and stars all appear to move slowly across the sky. S:ESS2:2:4.2 Recognize that as the position of the Sun changes in relation to the Earth it creates shadows of varying length and direction. S:ESS2:2:4.3 Explain that people should not look directly at the Sun because it is dangerous and may cause injury to the eyes.	S:ESS2:4:4.1 Recognize that although star patterns seen in the sky appear to move slowly each night from east to west they actually remain the same, and explain why different stars can be seen during different seasons. S:ESS2:4:4.2 Explain why the planets look like stars, and why, over a period of time, they appear to wander among the constellations.

Earth Space Science		
ESS3– The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.		
	K-2	**3-4**
1. SIZE AND SCALE	*None at this grade span.*	S:ESS3:4:1.1 Recognize that astronomical objects in space are massive in size and are separated from one another by vast distances. S:ESS3:4:1.2 Explain that telescopes magnify the size of distant objects and significantly increase the number of these objects that can be viewed from Earth.
2. STARS AND GALAXIES	S:ESS3:2:2.1 Recognize there are too many stars to count, and that they are unequal in their brightness.	S:ESS3:4:2.1 Recognize and describe the stars, like the Sun, as spherical in nature. S:ESS3:4:2.2 Recognize that stars come in different colors, and that the Sun is a yellow star.
3. UNIVERSE	*None at this grade span.*	*None at this grade span.*

Earth Space Science		
ESS4– The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	K-2	**3-4**
1. DESIGN TECHNOLOGY	*None at this grade span.*	S:ESS4:4:1.1 Recognize that man uses various mechanical devices to record changes in the weather and the Earth.
2. TOOLS	S:ESS4:2:2.1 Recognize, and with assistance, safely demonstrate the use of tools to gather data and extend the senses, such as thermometers, hand lenses and balances.	S:ESS4:4:2.1 Demonstrate the use of simple instruments to collect weather data, including thermometers, windsocks, meter sticks, and rain gauges.
3. LOCAL AND GLOBAL ENVIRONMENTAL ISSUES	S:ESS4:2:3.1 Differentiate between natural and man-made materials. S:ESS4:2:3.2 Identify environments that are natural, such as a forest, meadow, or mountains and those that have been built or modified by people, including cities, roads, farms, and houses. S:ESS4:2:3.3 Describe actions that can help the environment, such as recycling and proper disposal of waste materials.	S:ESS4:4:3.1 Distinguish between and provide examples of materials that can be recycled/reused and those that cannot. S:ESS4:4:3.2 Provide examples of technology that have changed the environment and explain whether the effect had a positive or negative impact. S:ESS4:4:3.3 Explain how to dispose of waste so that it does not harm the environment. S:ESS4:4:3.4 Recognize there are pros and cons to using different types of energy, such as solar energy and fossil fuels, and compare the differences.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:ESS4:2:4.1 Recognize that some jobs/careers require knowledge and use of Earth science content and/or skills.	S:ESS4:4:4.1 Identify some jobs/careers that require knowledge and use of Earth science content and/or skills.

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	5-6	**7-8**
1. ATMOSPHERE, CLIMATE, AND WEATHER	S:ESS1:6:1.1 Describe and make predictions about local and regional weather conditions using observation and data collection methods. S:ESS1:6:1.2 Identify weather patterns by tracking weather related events, such as hurricanes. S:ESS1:6:1.3 Explain the composition and structure of the Earth's atmosphere. S:ESS1:6:1.4 Describe weather in terms of temperature, wind speed and direction, precipitation, and cloud cover. S:ESS1:6:1.5 Describe how clouds affect weather and climate, including precipitation, reflecting light from the sun, and retaining heat energy emitted from the Earth's surface.	S:ESS1:8:1.1 Identify and describe the processes of the water cycle and explain their effects on climatic patterns. S:ESS1:8:1.2 Identify and describe the impact certain factors have on the Earth's climate, including changes in the oceans' temperature, changes in the composition of the atmosphere, and geological shifts due to events such as volcanic eruptions and glacial movements.
2. COMPOSITION AND FEATURES	S:ESS1:6:2.1 Differentiate between renewable and non-renewable resources. S:ESS1:6:2.2 Describe and define the different landforms on the Earth's surface, such as coastlines, rivers, mountains, deltas, canyons, etc. S:ESS1:6:2.3 Identify and distinguish between various landforms using a map and/or digital images.	S:ESS1:8:2.1 Describe the layers of the Earth, including the core, mantle, lithosphere, hydrosphere, and atmosphere. S:ESS1:8:2.2 Use geological evidence provided to support the idea that Earth's crust/lithosphere is composed of plates that move. [ESS1(5-**8**)INQ+POC-**1**]
3. FOSSILS	S:ESS1:6:3.1 Recognize that fossils offer important evidence relating to changes in life forms and environmental conditions over geologic time. S:ESS1:6:3.2 Identify connections between fossil evidence and geological events, such as changes in atmospheric composition, movement of tectonic plates, and asteroid/comet impact; and develop a means of sequencing this evidence.	S:ESS1:8:3.1 Explain how fossils found in sedimentary rock can be used to support the theories of Earth's evolution over geologic time; and describe how the folding, breaking, and uplifting of the layers affects the evidence.

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	5-6	**7-8**
4. OBSERVATION OF THE EARTH FROM SPACE	S:ESS1:6:4.1 Recognize that images taken of the Earth from space can show its features and any changes in those features that appear over time. S:ESS1:6:4.2 Explain that satellites can be used to view and track storms and Earth events, such as hurricanes and wild fires.	S:ESS1:8:4.1 Describe how catastrophic changes that have taken place on the Earth's surface can be revealed by satellite images.
5. PROCESSES AND RATES OF CHANGE	S:ESS1:6:5.1 Recognize that things change in steady, repetitive, or irregular ways, or sometimes in more than one way at the same time. S:ESS1:6:5.2 Explain how some changes to the Earth's surface happen abruptly, as a result of landslides, earthquakes and volcanic eruptions; while other changes happen very slowly as a result of weathering, erosions and deposition of sediment caused by waves, wind, water and ice. S:ESS1:6:5.3 Recognize that vibrations in materials set up wavelike disturbances that spread away from the source, as with earthquakes.	S:ESS1:8:5.1 Explain that the Earth's crust is divided into plates which move at extremely slow rates in response to movements in the mantle. S:ESS1:8:5.2 Explain how Earth events, abruptly and over time, can bring about changes on Earth's surface (e.g., landforms, ocean floor, rock features, climate). [ESS1(5-**8**)POC-**3**] S:ESS1:8:5.3 Explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate. [ESS1(5-**8**)SAE+POC-**4**]
6. ROCK CYCLE	S:ESS1:6:6.1 Explain how soil is formed from combinations of weathered rock and decomposed plant and animal remains, and that it contains living organisms. S:ESS1:6:6.2 Identify the components of soil and other factors, such as bacteria, fungi and worms, which influence its texture, fertility, and resistance to erosion. S:ESS1:6.6.3 Describe the properties of soil, such as color, texture, capacity to retain water, and its ability to support plant life.	S:ESS1:8:6.1 Describe the processes of the rock cycle. S:ESS1:8:6.2 Explain that sedimentary, igneous, and metamorphic rocks contain evidence of the minerals, temperatures, and forces that created them. S:ESS1:8:6.3 Explain how sediments of sand and smaller particles, which may contain the remains of organisms, are gradually buried and cemented together by dissolved minerals to form solid rock. S:ESS1:8:6.4 Using data about a rock's physical characteristics, make and support an inference about the rock's history and connection to the rock cycle. [ESS1(5-**8**)SAE+POC-**5**]

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	5-6	**7-8**
7. WATER	S:ESS1:6:7.1 Explain the properties that make water an essential component of the Earth's system, including solvency and its ability to maintain a liquid state at most temperatures. S:ESS1:6:7.2 Explain that water quality has a direct effect on Earth's life forms.	S:ESS1:8:7.1 Describe how water flows into and through a watershed, falling on the land, collecting in rivers and lakes, soil, and porous layers of rock, until much of it flows back into the ocean. S:ESS1:8:7.2 Identify the physical and chemical properties that make water an essential component of the Earth's system. S:ESS1:8:7.3 Explain the processes that cause cycling of water into and out of the atmosphere and their connections to our planet's weather patterns. [ESS1(5-**8**)SAE-**2**]

Earth Space Science		
ESS2– The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.		
	5-6	**7-8**
1. EARTH, SUN, AND MOON	S:ESS2:6:1.1 Recognize and describe how the regular and predictable motions of the Earth and Moon explain certain Earth phenomena, such as day and night, the seasons, the year, shadows and the tides. S:ESS2:6:1.2 Recognize that of all the known planets, Earth appears to be somewhat unique; and describe the conditions that exist on Earth that allow it to support life.	S:ESS2:8:1.1 Identify the characteristics of the Sun and its position in the universe. S:ESS2:8:1.2 Recognize and describe how the regular and predictable motions of the Earth and Moon account for phenomena, such as the phases of the Moon and eclipses. S:ESS2:8:1.3 Recognize the relationships between the tides and the phases of the moon; and use tide charts and NOAA information to describe them. S:ESS2:8:1.4 Explain the temporal or positional relationships between or among the Earth, Sun and Moon (e.g., night/day, seasons, year, tide). [ESS2(5-**8**)SAE+POC-**8**]
2. ENERGY	S:ESS2:6:2.1 Recognize how the tilt of the Earth's axis and the Earth's revolution around the Sun affect seasons and weather patterns. S:ESS2:6:2.2 Identify and describe seasonal, daylight and weather patterns as they relate to energy.	S:ESS2:8:2.1 Describe the Sun as the principle energy source for phenomena on the Earth's surface.

Earth Space Science		
ESS2– The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.		
	5-6	**7-8**
3. SOLAR SYSTEM	*Districts may choose to work on End of Grade 8 standards in grades 5-8.*	S:ESS2:8:3.1 Identify the characteristics and movement patterns of the planets in our Solar System and differentiate between them. S:ESS2:8:3.2 Explain the effects of gravitational force on the planets and their moons. S:ESS2:8:3.3 Explain why Earth and our Solar System appear to be somewhat unique, while acknowledging recent evidence that suggests similar systems exist in the universe. S:ESS2:8:3.4 Compare and contrast planets based on data provided about size, composition, location, orbital movement, atmosphere, or surface features (includes moons). [ESS2(5-**8**)MAS-**6**] S:ESS2:8:3.5 Explain how gravitational force affects objects in the Solar System (e.g., moons, tides, orbits, satellites). [ESS2(5-**8**)SAE+POC-**8**]
4. VIEW FROM EARTH	S:ESS2:6:4.1 Explain the historical perspective of planetary exploration and man's achievements in space, beginning with Russia's Sputnik mission in 1957. S:ESS2:6:4.2 Describe man's perception of the constellations throughout history; and explain how he has used them to his advantage, including navigational purposes and to explain historical events.	S:ESS2:8:4.1 Explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about the Solar System. [ESS2(5-**8**)NOS-**7**]

Earth Space Science		
ESS3– The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.		
	5-6	**7-8**
1. SIZE AND SCALE	*Districts may choose to work on End of Grade 8 standards in grades 5-8.*	S:ESS3:8:1.1 Define an astronomical unit as the distance from the Earth to the Sun. S:ESS3:8:1.2 Explain that special units of measure, such as light years and astronomical units, are used to calculate distances in space.
2. STARS AND GALAXIES	*Districts may choose to work on End of Grade 8 standards in grades 5-8.*	S:ESS3:8:2.1 Describe objects such as asteroids, comets and meteors in terms of their characteristics and movement patterns.
3. UNIVERSE	*Districts may choose to work on End of Grade 8 standards in grades 5-8.*	S:ESS3:8:3.1 Describe the universe as being comprised of billions of galaxies, each containing many billions of stars; and explain that there are vast distances separating these galaxies and stars from one another and from the Earth.

Earth Space Science		
ESS4–The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	5-6	**7-8**
1. DESIGN TECHNOLOGY	S:ESS4:6:1.1 Understand that technology is used to design tools that improve our ability to measure and observe the world.	S:ESS4:8:1.1 Describe ways in which technology has increased our understanding of the world in which we live. S:ESS4:8:1.2 Recognize the importance of technology as it relates to science, for purposes such as: access to space and other remote locations, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.
2. TOOLS	S:ESS4:6:2.1 Recognize that satellites and Doppler radar can be used to observe or predict the weather. S:ESS4:6:2.2 Employ knowledge of basic weather symbols to read and interpret weather and topographic maps. S:ESS4:6:2.3 Read and interpret data from barometers, sling psychrometers and anemometers.	S:ESS4:8:2.1 Calculate temperature in degrees Celsius. S:ESS4:8:2.2 Perform calculations using metric measurements. S:ESS4:8:2.3 Describe how man uses land-based light telescopes, radio telescopes, satellites, manned exploration, probes and robots to collect data.
3. LOCAL AND GLOBAL ENVIRONMENTAL ISSUES	S:ESS4:6:3.1 Provide examples of products that man has developed which allow humans to do things that they could not do otherwise; and identify the natural materials used to produce these products. S:ESS4:6:3.2 Identify the most appropriate materials for a given design task with requirements for specific properties, such as weight, strength, hardness, and flexibility. S:ESS4:6:3.3 Provide examples of how to reduce waste through conservation, recycling, and reuse.	S:ESS4:8:3.1 Provide examples of how creative thinking and economic need has shaped the way people use natural materials, such as the use of metal ores, petroleum, and fresh water. S:ESS4:8:3.2 Explain how to test natural materials to measure and compare their properties. S:ESS4:8:3.3 Explain how technologies can reduce the environmental impact of natural disasters. S:ESS4:8:3.4 Identify the potential impact of converting forested land to uses such as farms, homes, factories, or tourist attractions.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:ESS4:6:4.1 Understand that some form of science is used in most jobs/careers and that some jobs/careers specifically require knowledge of Earth science.	S:ESS4:8:4.1 Understand that some scientific jobs/careers involve the application of Earth Space science content knowledge and experience in specific ways that meet the goals of the job.

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	9-11	**11-12 (Advanced)**
1. ATMOSPHERE, CLIMATE, AND WEATHER	S:ESS1:11:1.1 Explain how winds and ocean currents are created on the Earth's surface. S:ESS1:11:1.2 Explain how heat and energy transfer in and out of the atmosphere; and provide examples of how it is related to weather and climate. S:ESS1:11:1.3 Describe how Earth's atmospheric composition has changed from the formation of the Earth through current time. S:ESS1:11:1.4 Explain how Earth's features can affect wind and weather patterns by causing air to rise and increasing precipitation.	S:ESS1:12:1.1 Identify and describe the layers of the atmosphere. S:ESS1:12:1.2 Understand the effects of solar influences, such as flares and sunspots, on atmospheric conditions.
2. COMPOSITION AND FEATURES	S:ESS1:11:2.1 Recognize that elements exist in fixed amounts and describe how they move through the solid Earth, oceans, atmosphere, and living things as part of geochemical cycles, such as the water, carbon and nitrogen cycles. S:ESS1:11:2.2 Describe the conditions that enable the Earth to support life, such as the availability of water, the gravitational force, the electromagnetic field and the intensity of radiation from the Sun. S:ESS1:11:2.3 Explain the theory of plate tectonics. S:ESS1:11:2.4 Describe the movement of crustal plates and explain how the effects have altered the Earth's features.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	9-11	**11-12 (Advanced)**
3. FOSSILS AND GEOLOGIC TIME	S:ESS1:11:3.1 Identify and describe the methods used to measure geologic time, such as fossil identification, radioactive dating, and rock sequences. S:ESS1:11:3.2 Relate how geologic time is determined using various dating methods (e.g., radioactive decay, rock sequences, fossil records). [ESS1(9-**11**)INQ+POC+MAS-**4**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*
4. OBSERVATION OF THE EARTH FROM SPACE	S:ESS1:11:4.1 Provided with geologic data (including movement of plates) on a given locale, predict the likelihood for an earth event (e.g. volcanoes mountain ranges, islands, earthquakes, tides, tsunamis). [ESS1(9-**11**)INQ+POC-**1**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*

Earth Space Science		
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
	9-11	**11-12 (Advanced)**
5. PROCESSES AND RATES OF CHANGE	S:ESS1:11:5.1 Explain that the Earth is composed of interactive layers, which have distinct compositions, physical properties and processes. S:ESS1:11:5.2 Relate plate movement to earthquakes and volcanic activity, and explain how it results in tectonic uplift and mountain building. S:ESS1:11:5.3 Identify and describe the major external and internal sources of energy on Earth. S:ESS1:11:5.4 Provide supporting geologic/geographic evidence that supports the validity of the theory of plate tectonics. [ESS1(9-**11**)NOS-**2**] S:ESS1:11:5.5 Trace the development of the theory of plate tectonics. [ESS1(9-**11**)NOS-**2**] S:ESS1:11:5.6 Explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading). [ESS1(9-**11**)SAE+POC-**3**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*
6. ROCK CYCLE	S:ESS1:11:6.1 Explain that throughout the rock cycle, the total amount of the material remains the same.	S:ESS1:12:6.1 Describe the processes that transform one type of rock into another, such as lithification, metamorphosis, and weathering on a chemical level. S:ESS1:12:6.2 Describe the various types of igneous, sedimentary, and metamorphic rocks found on Earth.
7. WATER	S:ESS1:11:7.1 Explain that water quality can be affected positively or negatively by outside sources	*Same as Grade 11*

Earth Space Science		
ESS2– The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.		
	9-11	**11-12 (Advanced)**
1. EARTH, SUN, AND MOON	S:ESS2:11:1.1 Explain how the Earth, Moon and Sun were formed.	S:ESS2:12:1.1 Understand how the Nebular Hypothesis, fusion, and the process of differentiation contributes to the structure and organization of the universe.
2. ENERGY	S:ESS2:11:2.1 Identify the Earth's major external source of energy as solar energy. S:ESS2:11:2.2 Explain how the inclination of incoming solar radiation can impact the amount of energy Earth receives on any given surface area. S:ESS2:11:2.3 Explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading). [ESS1(9-**11**)SAE+POC-**3**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*
3. SOLAR SYSTEM	S:ESS2:11:3.1 Explain how gravitational force influenced the formations of the planets and their moons; and describe how these objects move in patterns under its continued influence. S:ESS2:11.3.2 Explain how the Solar System formed from a giant cloud of gas and debris about 5 billion years ago.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*
4. VIEW FROM EARTH	*Students should have regular access and use of data gathered by space based instruments.*	*Students should have regular access and use of data gathered by space based instruments.*

Earth Space Science		
ESS3– The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.		
	9-11	**11-12 (Advanced)**
1. SIZE AND SCALE	S:ESS3:11:1.1 Recognize electromagnetic waves can be used to locate objects in the universe, and track their movement. S:ESS3:11:1.2 Define a light year.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*
2. STARS AND GALAXIES	S:ESS3:11:2.1 Identify and describe the characteristics common to most stars in the universe. S:ESS3:11:2.2 Describe the ongoing processes involved in star formation, their life cycles and their destruction. S:ESS3:11:2.3 Explain the relationships between or among the energy produced from nuclear reactions, the origin of elements, and the life cycles of stars. [ESS3(9-**11**)POC+SAE-**8**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*

Earth Space Science		
ESS3– The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.		
	9-11	**11-12 (Advanced)**
3. UNIVERSE	S:ESS3:11:3.1 Explain that current scientific evidence supports the Big Bang Theory as a probable explanation of the origin of the universe, and describe the theory. S:ESS3:11:3.2 Explain the evidence that suggests the universe is expanding. S:ESS3:11:3.3 Provide scientific evidence that supports or refutes the "Big Bang" theory of how the universe was formed. [ESS3(9-**11**)NOS-**6**] S:ESS3:11:3.4 Based on the nature of electromagnetic waves, explain the movement and location of objects in the universe or their composition (e.g., red shift, blue shift, line spectra). [ESS3(9-**11**)SAE-**7**] S:ESS3:11:3.5 Explain how scientific theories about the structure of the universe have been advanced through the use of sophisticated technology (e.g., space probes and visual, radio and x-ray telescopes). [ESS3(9-**11**)NOS-**5**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*

Earth Space Science		
ESS4– The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	9-11	**11-12 (Advanced)**
1. DESIGN TECHNOLOGY	S:ESS4:11:1.1 Describe ways in which technology has increased our understanding of the universe. S:ESS4:11:1.2 Understand that technology is designed with a particular function in mind; and principles of Earth Space science are useful in creating technology for the Earth space sciences.	S:ESS4:12:1.1 Recognize the importance of technology as it relates to science, for purposes such as: access to space and other remote locations, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.
2. TOOLS	S:ESS4:11:2.1 Describe the use and benefits of land-based light telescopes, radio telescopes, spectrophotometers, satellites, manned exploration, probes, and robots to the study of Earth Space Science. S:ESS4:11:2.2 Explain how scientists study the Earth using computer-generated models and observations from both land-based sites and satellites; and describe the value of using these tools in unison.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*
3. LOCAL AND GLOBAL ENVIRONMENTAL ISSUES	S:ESS4:11:3.1 Differentiate between and provide examples of renewable and nonrenewable sources of energy; and explain the advantages and limitations of each. S:ESS4:11:3.2 Describe the means for transforming a natural material, such as iron ore, into useful products during different historical periods, such as the Stone Age, Iron Age, Renaissance, the Industrial Period and the current Age of Information. S:ESS4:11.3.3 Explain how the use of technologies at a local level, such as burning of fossil fuels for transportation or power generation, may contribute to global environmental problems.	S:ESS4:12:3.1 Explain the environmental effects of using both renewable and nonrenewable resources; and provide examples of how man is addressing these effects on the environment. S:ESS4:12:3.2 Provide examples of how man's use of Earth materials has changed over time; and use those examples to explain how the relationship between science and technology has gradually grown closer in the past century. S:ESS4:12:3.3 Research and evaluate a current environmental issue within the State of New Hampshire, such as a dispute regarding the conversion of a natural environment to human use; and construct a defense that supports environmental protection.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:ESS4:11:4.1 Explain the kinds of applications of knowledge and skills necessary for jobs/careers specific to Earth or space sciences.	S:ESS4:12:4.1 Understand the various scientific fields that use scientific content and skills; and distinguish between professional and skilled science jobs/careers in Earth or space sciences.

Life Science Overview

Strand (Enduring Knowledge Statements)	Stem (rows) in GSEs	Page K-4	Page 5-8	Page 9-12
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, and species).	1. Classification	**67**	**74**	**83**
	2. Living Things And Organization	**67**	**74**	**84**
	3. Reproduction	**68**	**75**	**85**
LS2– Energy flows and matter recycles through an ecosystem.	1. Environment	**69**	**76**	**86**
	2. Flow Of Energy	**69**	**76**	**87**
	3. Recycling Of Materials	**69**	**77**	**87**
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).	1. Change	**70**	**78**	**88**
	2. Evolution	**70**	**78**	**89**
	3. Natural Selection	**70**	**79**	**90**
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.	1. Behavior	**71**	**80**	**91**
	2. Disease	**71**	**80**	**92**
	3. Human Identity	**72**	**81**	**93**
LS5– The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.	1. Design Technology	**73**	**82**	**94**
	2. Tools	**73**	**82**	**94**
	3. Social Issues (Local And Global) Medical Technology and Biotechnology	**73**	**82**	**94**
	4. Career Technical Education Connections	**73**	**82**	**94**

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	K-2	**3-4**
1. CLASSIFICATION	S:LS1:2:1.1 Differentiate between living and nonliving things; and categorize objects in each group using the significant observable characteristics they share, such as color, shape and size. S:LS1:2:1.2 Recognize plants and animals as living things and describe how they are alike and different.	S:LS1:4:1.1 Recognize and identify the various ways in which living things can be grouped. S:LS1:4:1.2 Sort/classify different living things using similar and different characteristics; and describe why organisms belong to each group or cite evidence about how they are alike or not alike. [LS1(K-**4**)INQ+POC-**1**]
2. LIVING THINGS AND ORGANIZATION	S:LS1:2:2.1 Recognize that plants and animals have features that help them survive in different environments.	S:LS1:4:2.1 Recognize that living organisms have certain structures and systems that perform specific functions, facilitating survival, growth and reproduction. S:LS1:4.2.2 Identify and describe the function of the plant structures responsible for food production, water transport, support, reproduction, growth and protection. S:LS1:4:2.3 Identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire). [LS1(K-**4**)FAF-**4**] S:LS1:4:2.4 Identify the basic needs of plants and animals in order to stay alive (i.e., water, air, food, space). [LS1(K-**4**)SAE-**2**]

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	K-2	**3-4**
3. REPRODUCTION	S:LS1:2:3.1 Recognize that parents and offspring of many species closely resemble one another; and describe the similarities in appearance of given plant and animal families. S:LS1:2:3.2 Recognize that living things have a life cycle, during which they are born, grow, and die.	S:LS1:4:3.1 Distinguish between plant and animal characteristics that are inherited, such as eye color in humans and the shape of leaves in plants, and those that are affected by their environment, such as grass turning brown due to lack of water. S:LS1:4:3.2 Recognize that living organisms have life cycles, which include birth, growth and development, reproduction, and death; and explain how these life cycles vary for different organisms. S:LS1:4:3.3 Describe the reproductive process of plants, explaining some plants grow from seed, while others grow from the parts of other plants. S:LS1:4-3.4 Predict, sequence, or compare the life stages of organisms (plants and animals): e.g., put images of life stages of an organism in order, predict the next stage in sequence, and compare two organisms. [LS1(K-**4**)POC–**3**]

Life Science		
LS2– Energy flows and matter recycles through an ecosystem.		
	K-2	**3-4**
1. ENVIRONMENT	S:LS2:2:1.1 Recognize that living things can be found almost anyplace in the world; and that specific types of environments are required to support the many different species of plant and animal life. S:LS2:2:1.2 Recognize that animals, including humans, interact with their surroundings using their senses; and that different senses provide different kinds of information. S:LS2:2:1.3 Recognize that some plants and animals go through changes in appearance when the seasons change.	S:LS2:4:1.1 Describe how the nature of an organism's environment, such as the availability of a food source, the quantity and variety of other species present, and the physical characteristics of the environment affect the organism's patterns of behavior. S:LS2:4:1.2 Describe the interaction of living organisms with nonliving things.
2. FLOW OF ENERGY	S:LS2:2:2.1 Identify the resources plants and animals need for growth and energy, and describe how their habitat provides these basic needs.	S:LS2:4:2.1 Recognize that the transfer of energy through food is necessary for all living organisms and describe the organization of food webs. S:LS2:4:2.2 Recognize that energy is needed for all organisms to stay alive and grow or identify where a plant or animal gets its energy. [LS2(K-**4**)SAE-**5]**
3. RECYCLING OF MATERIALS	*Districts may choose to work on End of Grade 8 expectations in the 5-8 grade span.*	S:LS2:4:3.1 Recognize that plants and animals interact with one another in various ways besides providing food, such as seed dispersal or pollination. S:LS2:4:3.2 Describe ways plants and animals depend on each other (e.g., shelter, nesting, food). [LS2(K-**4**)SAE-**6]**

Life Science		
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
	K-2	**3-4**
1. CHANGE	S:LS3:2:1.1 Recognize that some living things, which lived on Earth long ago, are now extinct, such as dinosaurs, mammoths, giant tree ferns, and horsetail trees.	S:LS3:4:1.1 Provide examples of how environmental changes can cause different effects on different organisms. S:LS3:4:1.2 Provide examples of how an organism's inherited characteristics can adapt and change over time in response to changes in the environment. S:LS3:4:1.3 Using information (data or scenario), explain how changes in the environment can cause organisms to respond (e.g., survive there and reproduce, move away, die). [LS3(K-**4**)SAE-**7**]
2. EVIDENCE OF EVOLUTION	S:LS3:2:2.1 Recognize that some plants and animals, which are alive today, are similar to living things which have become extinct, such as elephants and mammoths.	S:LS3:4:2.1 Compare information about fossils to living organisms and other fossils to determine any similarities and differences.
3. NATURAL SELECTION	S:LS3:2:3.1 Recognize and describe the similarities and differences in both behavior and appearance of plants and animals. S:LS3:2:3.2 Recognize that there are different species of living things in various places around the world.	S:LS3:4:3.1 Recognize that individuals of the same species differ in their characteristics; and explain that sometimes these differences give individuals an advantage in survival and reproduction. S:LS3:4:3.2 Recognize that for any particular environment, some kinds of animals and plants survive well, some less well, and some cannot survive at all.

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	K-2	**3-4**
1. BEHAVIOR	S:LS4:2:1.1 Recognize and describe how living things respond when exposed to helpful and harmful situations. S:LS4:2:1.2 Recognize that humans learn from each other in many different ways, such as listening and speaking, watching and imitating. S:LS4:2:1.3 Recognize that humans can gather different kinds of information about an object by adjusting their proximity to it. S:LS4:2:1.4 Recognize that some of the things humans can do, such as playing games, reading, and writing, must be learned.	S:LS4:4:1.1 Recognize that an individual organism's behavior is affected by internal cues, such as hunger and thirst; and describe how an organism uses its senses to understand and respond to these cues. S:LS4:4:1.2 Recognize that an individual organism's behavior is influenced by external cues, such as seasonal change; and describe how an organism might react, such as migrating or hibernating. S:LS4:4:1.3 Recognize behaviors that may be unsafe or unhealthy for themselves and others.
2. DISEASE	S:LS4:2:2.1 Recognize that proper nutrition, exercise and rest are all important factors in maintaining good health. S:LS4:2:2.2 Recognize that humans can spread germs that cause disease. S:LS4:2.2.3 Identify and describe the basic personal hygiene habits for maintaining good health, such as washing one's hands with soap and water and brushing one's teeth. S:LS4:2:2.4 Recognize symptoms, such as fever, rashes, coughing and congestion for common illnesses.	S:LS4:4:2.1 Explain how the amount of rest and the types of food, exercise and recreation humans choose can influence and affect their well-being. S:LS4:4:2.2 Recognize that vitamins and minerals are needed in small amounts and are essential to maintain proper health. S:LS4:4:2.3 Explain how proper food preparation and appropriate food handling practices can maintain the safety and quality of food.

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	K-2	**3-4**
3. HUMAN IDENTITY	S:LS4:2:3.1 Recognize similarities and individual differences among people, and that children closely resemble their parents. S:LS4:2:3.2 Identify the sense organs, including eyes, ears, nose mouth, and skin; and describe how each can warn an individual about danger. S:LS4:2:3.3 Recognize that two parents, both a father and mother, are required for human reproduction. S:LS4:2:3.4 Recognize and describe the human life cycle from birth to old age. S:LS4:2:3.5 Recognize that humans need food, water, air, waste removal and a particular range of temperatures in their environment, just as other animals do.	S:LS4:4:3.1 Identify what the physical structures of humans do (e.g., sense organs– eyes, ears, skin, etc.) or compare physical structures of humans to similar structures of animals. [LS4(K-**4**)FAF-**8**] S:LS4:4:3.2 Distinguish between characteristics of humans that are inherited from parents (i.e., hair color, height, skin color, eye color) and others that are learned (e.g., riding a bike, singing a song, playing a game, reading). [LS4(K-**4**)POC-**9**] S:LS4:4:3.3 Recognize the nutritional value of different foods and distinguish between healthy and unhealthy food choices using data gathered from food labels and dietary guidelines, such as the food pyramid.

Life Science		
LS5– The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	K-2	**3-4**
1. DESIGN TECHNOLOGY	S:LS5:2:1.1 Recognize that new products can be made out of natural materials, such as paper from trees and cloth from various plants and animals.	S:LS5:4:1.1 Recognize that man uses various mechanical devices to record and describe living organisms.
2. TOOLS	S:LS5:2:2.1 Recognize that some tools, such as magnifiers, balances and thermometers, have special uses and can help gather information and extend the senses.	S:LS5:4:2.1 Demonstrate the use of appropriate tools and simple equipment, such as thermometers, magnifiers and microscopes to gather data and extend the senses. S:LS5:4:2.2 Identify and describe the purpose of tools used by health care professionals, such as X-rays and stethoscopes.
3. SOCIAL ISSUES (LOCAL AND GLOBAL) MEDICAL TECHNOLOGY BIOTECHNOLOGY	S:LS5:2:3.1 Recognize that technology is used in medicine to prevent and cure diseases through vaccinations and medications. S:LS5:2:3.2 Provide examples from personal experience that illustrate how medicine helps humans recover from illness.	S:LS5:4:3.1 Recognize that medical technology provides information about a body's condition, such as determining blood pressure, and recognizing the need to repair, replace and support the affected body parts. S:LS5:4:3.2 Recognize that biotechnology refers to the different ways humans modify the living environment to meet their needs, including growing food, genetic engineering and using living organisms such as yeast to prepare foods.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:LS5:2:4.1 Recognize that some jobs/careers require knowledge and use of life science content and/or skills.	S:LS5:4:4.1 Identify some jobs/careers that require knowledge and use of life science content and/or skills.

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	5-6	**7-8**
1. CLASSIFICATION	S:LS1:6:1.1 Identify ways in which living things can be grouped and organized, such as taxonomic groups of plants, animals and fungi. S:LS1:6:1.2 Categorize organisms into kingdoms that are currently recognized, according to shared characteristics.	S:LS1:8:1.1 Recognize that similarities among organisms are found in anatomical features and patterns of development; and explain how these can be used to infer the degree of relatedness among organisms. S:LS1:8:1.2 Describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems). [LS1(5-**8**)SAE+FAF-**2]**
2. LIVING THINGS AND ORGANIZATION	S:LS1:6:2.1 Recognize that all living things are composed of cells, and explain that while many organisms are single celled, such as yeast, others, including humans, are multicellular. S:LS1:6:2.2 Explain that the way in which cells function is similar in all organisms. S:LS1:6:2.3 Recognize that cells use energy obtain from food, to conduct the functions necessary to sustain life, such as cell growth. S:LS1:6:2.4 Recognize and describe the hierarchical organization of living systems, including cells, tissues, organs, organ systems, whole organisms, and ecosystems. S:LS1:6:2.5 Explain that multicellular organisms have specialized cells, tissues, organs and organ systems that perform certain necessary functions, including digestion, respiration, reproduction, circulation, excretion, movement, control and coordination and protection from disease. S:LS1:6:2.6 Recognize that the human cells found in tissues and organs are similar to those of other animals, but somewhat different from cells found in plants.	S:LS1:8:2.1 Identify the functions of the human body's systems, including digestion, respiration, reproduction, circulation, excretion, movement, control and coordination and protection from disease; and describe how they interact with one another. S:LS1:8:2.2 Define a population and describe the factors that can affect it. S:LS1:8:2.3 Explain why it is beneficial for an organism to be able to regulate its internal environment while living in a constantly changing external environment. S:LS1:8:2.4 Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism. [LS1(5-**8**)FAF-**4]** S:LS1:8:2.5 Using data and observations about the biodiversity of an ecosystem, make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem. [LS1(5-**8**)INQ+SAE-**1**]

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	5-6	**7-8**
3. REPRODUCTION	S:LS1:6:3.1 Explain that cells repeatedly divide to make more cells for growth and repair. S:LS1:6:3.2 Explain that the same genetic information is copied in each cell of a new organism. S:LS1:6:3.3 Explain that all living things reproduce in order to continue their species.	S:LS1:8:3.1 Differentiate between asexual and sexual reproduction, and explain that in some kinds of organisms, all the genes come from one parent, while in organisms requiring two sexes to reproduce, typically half the genes come from each parent. S:LS1:8:3.2 Explain that a species of sexually reproducing organisms is comprised of all the organisms that can mate to produce fertile offspring. S:LS1:8:3.3 Explain that in sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male in a process called fertilization. S:LS1:8:3.4 Explain that the fertilized egg cell, carrying genetic information from each parent, multiplies to form the complete organism. S:LS1:8:3.5 Explain how the basic tissues of an embryo form. S:LS1:8:3.6 Compare and contrast sexual reproduction with asexual reproduction. [LS1(5-**8**)POC-**3**] S:LS1:8:3.7 Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring. [LS4(5-**8**)INQ+POC-**11**]

Life Science		
LS2– Energy flows and matter recycles through an ecosystem.		
	5-6	**7-8**
1. ENVIRONMENT	S:LS2:6:1.1 Identify and describe the factors that influence the number and kinds of organisms an ecosystem can support, including the resources that are available, the differences in temperature, the composition of the soil, any disease, the threat of predators, and competition from other organisms. S:LS2:6:1.2 Explain that most microorganisms do not cause disease and that many are beneficial to the environment.	S:LS2:8:1.1 Explain how changes in environmental conditions can affect the survival of individual organisms and an entire species. S:LS2:8:1.2 Explain that in all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter, and that in any particular environment the growth and survival of organisms depend on the physical conditions. S:LS2:8:1.3 Using data and observations, predict outcomes when abiotic/biotic factors are changed in an ecosystem. [LS2(5-**8**)INQ+SAE-**5**]
2. FLOW OF ENERGY	S:LS2:6:2.1 Describe how energy is transferred in an ecosystem through food webs; and explain the roles and relationships between producers, consumers and decomposers. S:LS2:6:2.2 Recognize that one of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. S:LS2:6:2.3 Describe the process of photosynthesis and explain that plants can use the food they make immediately or store it for later use. S:LS2:6:2.4 Recognize that energy, in the form of heat, is usually a byproduct when one form of energy is converted to another, such as when living organisms transform stored energy to motion.	S:LS2:8:2.1 Explain how food provides energy and materials for growth and repair of body parts. S:LS2:8:2.2 Given a scenario, trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment (includes photosynthesis and respiration). [LS2(5-**8**)SAE-**6**]

Life Science		
LS2– Energy flows and matter recycles through an ecosystem.		
	5-6	**7-8**
3. RECYCLING OF MATERIALS	S:LS2:6:3.1 Define a population as all individuals of a species that exist together at a given place and time; and explain that all populations living together in a community, along with the physical factors with which they interact, compose an ecosystem. S:LS2:6:3.2 Using food webs, identify and describe the ways in which organisms interact and depend on one another in an ecosystem. S:LS2:6:3.3 Explain how insects and various other organisms depend on dead plant and animal matter for food; and describe how this process contributes to the system.	S:LS2:8:3.1 Identify autotrophs as producers who may use photosynthesis, and describe this as the basis of the food web. S:LS2:8:3.2 Explain the process of respiration and differentiate between it and photosynthesis. S:LS2:8:3.3 Know that all organisms, including humans, are part of, and depend on, two main interconnected global food webs: one which includes microscopic ocean plants, and the other which includes land plants. S:LS2:8:3.4 Describe how matter is recycled within ecosystems and explain that the total amount of matter remains the same, though its form and location change. S:LS2:8:3.5 Identify carbon, hydrogen, oxygen, nitrogen and phosphorus as common elements of living matter. S:LS2:8:3.6 Given an ecosystem, trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition and recycling, but not carbon cycle nor nitrogen cycle). [LS2(5-**8**)SAE-**7**]

Life Science		
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
	5-6	**7-8**
1. CHANGE	S:LS3:6:1.1 Provide examples of how all organisms, including humans, impact their environment; and explain how some changes can be detrimental to other organisms. S:LS3:6:1.2 Explain how changes in environmental conditions can affect the survival of individual organisms and the entire species.	S:LS3:8:1.1 Describe the type of impact certain environmental changes, including deforestation, invasive species, increased erosion, and pollution containing toxic substances, could have on local environments.
2. EVIDENCE OF EVOLUTION	S:LS3:6:2.1 Describe the fundamental concepts related to biological evolution, such as biological adaptations and the diversity of species.	S:LS3:8:2.1 Describe how the fossil record provides geologic evidence verifying the existence of now extinct life forms, and explains how this evidence provides documented proof of their appearance, diversification and extinction. S:LS3:8:2.2 Explain the concept of extinction and describes its importance in biological evolution. S:LS3:8:2.3 Use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features). [LS3(5-**8**)MAS+FAF-**8**]

Life Science		
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
	5-6	**7-8**
3. NATURAL SELECTION	S:LS3:6:3.1 Recognize that there are genetic variations among individuals in groups of organisms and provide examples of how these variations affect the survival of an organism. S:LS3:6:3.2 Recognize that only organisms that are able to reproduce can pass on their genetic information to the next generation.	S:LS3:8:3.1 Recognize that hereditary information is contained in genes, which are located in the chromosomes of each cell; and explain that inherited traits can be determined by either one or many genes, and that a single gene can influence more than one trait, such as eye and hair color. S:LS3:8:3.2 Recognize that in any given environment the growth and survival of organisms depend on the physical conditions that exist; and explain that in all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. S:LS3:8:3.3 Explain how individual organisms with certain traits are more likely than others to survive and have offspring. S:LS3:8:3.4 Recognize that humans are able to control some characteristics of plants and animals through selective breeding; and explain how this results in small differences between the parents and offspring, which can accumulate in successive generations so that decedents are very different from their ancestors. S:LS3:8:3.5 Cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring. [LS3(5-**8**)POC-**9**]

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	5-6	**7-8**
1. BEHAVIOR	S:LS4:6:1.1 Recognize that learning requires more than just storage and retrieval of information and that prior knowledge needs to be tapped in order to make sense out of new experiences or information. S:LS4:6:1.2 Explain that people can learn about others from direct experience, from the media, and from listening to others talk about their life and work. S:LS4:6:1.3 Provide examples of how humans make judgments about new situations based on memories of past experiences.	S:LS4:8:1.1 Recognize that unlike human beings, behavior in insects and many other species is determined almost entirely by biological inheritance. S:LS4:8:1.2 Explain that organism's behavioral response is a reaction to internal or and environmental stimuli, and that these responses may be determined by heredity or from past experience. S:LS4:8:1.3 Explain how all behavior is affected by both inheritance and experience.
2. DISEASE	S:LS4:6:2.1 Explain that the human body has ways to defend itself against disease-causing organisms and describe how defenders, including tears, saliva, the skin, some blood cells and stomach secretions support the defense process. S:LS4:6:2.2 Recognize that there are some diseases that human beings can only get once; and explain how many diseases can be prevented by vaccination. S:LS4:6:2.3 Explain how vaccines induce the body to build immunity to a disease without actually causing the disease itself. S:LS4:6:2.4 Recognize a healthy body cannot fight all germs that invade it; and explain how some germs interfere with the body's defenses.	S:LS4:8:2.1 Recognize that disease in organisms can be caused by intrinsic failures of the system or infection from other organisms. S:LS4:8:2.2 Describe how viruses, bacteria, fungi, and parasites may affect the human body and provide examples of how they can interfere with normal body function. S:LS4:8:2.3 Describe the function of white blood cells and explain how they support the body's defense system. S:LS4:8:2.4 Use data and observations to support the concept that environmental or biological factors affect human body systems (biotic and abiotic). [LS4(5-**8**)INQ-**10**]

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	5-6	**7-8**
3. HUMAN IDENTITY	S:LS4:6:3.1 Recognize that the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, environmental conditions, and personal health behaviors.	S:LS4:8:3.1 Compare patterns of human development with those of other vertebrates. S:LS4:8:3.2 Recognize that an organism can be described in terms of a combination of traits; and differentiate between inherited traits and those that result from interactions with the environment. S:LS4:8:3.3 Describe the major changes that occur over time in human development from single cell through embryonic development to new born (i.e., group of cells during the first trimester, organs form during the second, organs mature during the third). [LS4(5-**8**)POC-**12**] S:LS4:8:3.4 Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring. [LS4(5-**8**)INQ+POC-**11**]

Life Science		
LS5– The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	5-6	**7-8**
1. DESIGN TECHNOLOGY	S:LS5:6:1.1 Recognize that an agricultural system is designed to maximize the use of all the elements in the system, including using plants for food, oxygen, for the filtration of air and water, and for making compost.	S:LS5:8:1.1 Explain how technology has influenced the course of history, and provide examples such as those that relate to agriculture, sanitation and medicine. S:LS5:8:1.2 Provide examples of ways technology is used to protect the environment, such as using bacteria to clean water.
2. TOOLS	S:LS5:6:2.1 Demonstrate the appropriate use of tools, such as thermometers, probes, microscopes and computers to gather, analyze and interpret data in the life sciences.	S:LS5:8:2.1 Recognize and provide examples of how technology has enhanced the study of life sciences, as in the development of advanced diagnosing equipment improving medicine.
3. SOCIAL ISSUES (LOCAL AND GLOBAL) MEDICAL TECHNOLOGY BIOTECHNOLOGY	S:LS5:6:3.1 Provide examples of early health care technology that helped to extend the life expectancy of humans, such as the discovery of penicillin and sterilization of surgical instruments. S:LS5:6:3.2 Differentiate between vaccines, which help prevent diseases from developing and spreading, and medicines, which relieve symptoms or cure diseases. S:LS5:6:3.3 Recognize that the quality of personal health can be influenced by society and technology. S:LS5:6:3.4 Identify and describe some of the processes and systems used to grow food in New Hampshire, including irrigation, pest control and harvesting.	S:LS5:8:3.1 Explain the necessity of and purpose for the proper disposal of medical products. S:LS5:8:3.2 Give examples of how increased understanding of biology has led to improvements in biotechnology, such as scientific methods for increasing the yield or the pest-resistance of important food crops. S:LS5:8:3.3 Describes ways biotechnology helps humans, including improved health and medicine.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:LS5:6:4.1 Understand that some form of science is used in most jobs/careers and that some jobs/careers specifically require knowledge of life science.	S:LS5:8:4.1 Understand that some scientific jobs/careers involve the application of life science content knowledge and experience in specific ways that meet the goals of the job.

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	9-11	**11-12 (Advanced)**
1. CLASSIFICATION	S:LS1:11:1.1 Describe how organisms are classified into a hierarchy of groups and subgroups, which are based on similarities that reflect their evolutionary relationships. S:LS1:11:1.2 Explain that organisms that possess similar DNA code are more closely related than those in which DNA varies greatly. S:LS1:11:1.3 Identify plants and animals according to binomial nomenclature. S:LS1:11:1.4 Differentiate between prokaryotic and eukaryotic cells according to general structure and degrees of complexity.	S:LS1:12:1.1 Differentiate between prokaryotic and eukaryotic cells at the biochemical level, using cell wall composition, DNA structure, and other biochemical pathways.

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	9-11	**11-12 (Advanced)**
2. LIVING THINGS AND ORGANIZATION	S:LS1:11:2.1 Identify the structures of different types of cell parts/organelles and explain the functions they perform. S:LS1:11:2.2 Recognize how cell functions are regulated through changes in the activity of the functions performed by proteins, and through the selective expression of individual genes; and explain how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division. S:LS1:11:2.3 Recognize how an organism's organization and complexity accommodate its need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain it. S:LS1:11:2.4 Explain how the processes of photosynthesis and cellular respiration are interrelated and contribute to biogeochemical cycles. S:LS1:11:2.5 Describe the structures of proteins and their role in cell function. S:LS1:11:2.6 Describe the chemical reactions involved in cell functions using examples from the nervous, immune and endocrine systems in multicellular animals. S:LS1:11:2.7 Recognize that because all matter tends toward more disorganized states, living systems need a continuous input of energy to maintain their chemical and physical organizations. S:LS1:11:2.8 Use data and observation to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival (e.g., protein synthesis, DNA transport, nerve cells). [LS1(9-**11**)INQ+SAE+FAF-**1**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses* S:LS1:12:2.1 Compare the processes of mitosis and meiosis, including disruptions to the cycles, such as disease or cancer. S:LS1:12:2.2 Explain the process of cell differentiation, using stem cells as an example.

Life Science		
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
	9-11	**11-12 (Advanced)**
3. REPRODUCTION	S:LS1:11:3.1 Describe the chemical and structural properties of DNA and explain its role in identifying the characteristics of an organism. S:LS1:11:3.2 Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells; and explain why other changes in an organism cannot be passed on. S:LS1:11:3.3 Describe the alternation of generations, life cycles with haploid and diploid phases in living organisms, such as bacteria, plants and animals. S:LS1:11:3.4 Explain or justify with evidence how the alteration of the DNA sequence may produce new gene combinations that make little difference, enhance capabilities, or can be harmful to the organism (e.g., selective breeding, genetic engineering, mutations). [LS1(9-**11**)FAF+POC-**2**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses* S:LS1:12:3.1 Compare and contrast the alternation of generations' life cycles; and understand the variations of the haploid and diploid phases that produce diplontic, haplontic, and isomorphic alternation of generations in living organisms.

Life Science		
LS2– Energy flows and matter recycles through an ecosystem.		
	9-11	**11-12 (Advanced)**
1. ENVIRONMENT	S:LS2:11:1.1 Explain how the amount of life an environment can sustain is restricted by the availability of matter and energy, and the ability of the ecosystem to recycle materials. S:LS2:11:1.2 Describe how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years. S:LS2:11:1.3 Identify the factors in an ecosystem that can affect its carrying capacity. S:LS2:11:1.4 Analyze and describe how environmental disturbances, such as climate changes, natural events, human activity and the introduction of invasive species, can affect the flow of energy or matter in an ecosystem. S:LS2:11:1.5 Using data from a specific ecosystem, explain relationships or make predictions about how environmental disturbance (human impact or natural events) affects the flow of energy or cycling of matter in an ecosystem. [LS2(9-**11**)INQ+SAE-**3**] S:LS2:11:1.6 Explain or evaluate potential bias in how evidence is interpreted in reports concerning a particular environmental factor that impacts the biology of humans. [LS2(9-**11**)NOS-**5]**	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*

Life Science		
LS2– Energy flows and matter recycles through an ecosystem.		
	9-11	**11-12 (Advanced)**
2. FLOW OF ENERGY AND RECYCLING OF MATERIALS	S:LS2:11:2.1 Use examples from local ecosystems to describe the relationships among organisms at the different trophic levels.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*
3. RECYCLING OF MATERIALS	S:LS2:11:3.1 Explain that as matter and energy flow through different levels of organization in living systems and between living systems and the environment, elements, such as carbon and nitrogen, are recombined in different ways. S:LS2:11:3.2 Trace the cycling of matter (e.g., carbon cycle) and the flow of energy in a living system from its source through its transformation in cellular, biochemical processes (e.g., photosynthesis, cellular respiration, fermentation). [LS2(9-**11**)POC+SAE-**4**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses*

Life Science		
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
	9-11	**11-12 (Advanced)**
1. CHANGE	S:LS3:11:1.1 Identify ways humans can impact and alter the stability of ecosystems, such as habitat destruction, pollution, and consumption of resources; and describe the potentially irreversible effects these changes can cause. S:LS3:11:1.2 Identify ways of detecting, and limiting or reversing environmental damage. S:LS3:11:1.3 Analyze the aspects of environmental protection, such as ecosystem protection, habitat management, species conservation and environmental agencies and regulations; and evaluate and justify the need for public policy in guiding the use and management of the environment.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Life Science		
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
	9-11	**11-12 (Advanced)**
2. EVIDENCE OF EVOLUTION	S:LS3:11:2.1 Explain the currently accepted theory for the development of life on Earth, including the history of its origin and the evolutionary process. S:LS3:11:2.2 Recognize that the abilities and behaviors an organism has, and likelihood of its survival strongly depend on its heritable characteristics, which can be biochemical and anatomical. S:LS3:11:2.3 Explain the contributions of Darwin, Malthus, Wallace and Russell to the advancement of life science. S:LS3:11:2.4 Explain evolution in terms of how the Earth's present-day life forms evolved from earlier, distinctly different species as a consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection. S:LS3:11:2.5 Explain how evidence from technological advances supports or refutes the genetic relationships among groups of organisms (e.g., DNA analysis, protein analysis). [LS3(9-**11**)NOS-**6**] S:LS3:11:2.6 Given information about living or extinct organisms, cite evidence to explain the frequency of inherited characteristics of organisms in a population; or explain the evolution of varied structures (with defined functions) that affected the organisms' survival in a specific environment (e.g., giraffe, wind pollination of flowers). [LS3(9-**11**)INQ+FAF+POC-**8**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Life Science		
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
	9-11	**11-12 (Advanced)**
3. NATURAL SELECTION	S:LS3:11:3.1 Explain the concept of natural selection. S:LS3:11:3.2 Explain the diversity and unity of past and present life forms on Earth using currently accepted theories. S:LS3:11:3.3 Recognize how a species' chance of survival increases with each variation of an organism within the species; and explain how, in the event of a major global change, the greater the diversity of species on Earth, the greater the chance for survival of life. S:LS3:11:3.4 Analyze present day data and research in areas, including antibiotic resistance in bacteria, changes in viral genomes, such as bird flu, and DNA sequencing; and relate it to the concepts of natural selection. S:LS3:11:3.5 Identify and describe ways genes may be changed and combined to create genetic variation within a species. S:LS3:11:3.6 Explain that gene mutations and new combinations may have a variety of effects on the organism, including positive and negative ones, or none at all. S:LS3:11:3.7 Explain the concepts of Mendelian genetics. S:LS3:11:3.8 Use pedigree charts and Punnet Squares to determine patterns of inheritance. S:LS3:11:3.9 Given a scenario, provide evidence that demonstrates how sexual reproduction results in a great variety of possible gene combinations and contributes to natural selection (e.g., Darwin's finches, isolation of a species, Tay Sach's disease). [LS3(9-**11**)INQ+POC-**7**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.* S:LS3:12:3.1 Understand the types of mutations that cause changes in DNA and cause the appearance of new alleles, such as frameshift and point mutations, and the chromosomal mutations of insertion, deletion, translocation, and duplication.

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	9-11	**11-12 (Advanced)**
1. BEHAVIOR	S:LS4:11:1.1 Recognize that the immune system, endocrine system, and nervous system can affect the homeostasis of an organism. S:LS4:11:1.2 Describe how the functions of all the human body systems are interrelated at a chemical level and how they maintain homeostasis.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	9-11	**11-12 (Advanced)**
2. DISEASE	S:LS4:11:2.1 Explain that disease in organisms can be caused by intrinsic failures of the system or infection by other organisms, and describe as well as provide examples of how some diseases are caused by: the breakdown in cellular function, congenital conditions, genetic disorders, malnutrition, and emotional health, including stress. S:LS4:11:2.2 Explain that vaccines were developed to reduce or eliminate diseases; and provide examples of how these medical advances have proven to be successful. S:LS4:11:2.3 Describe and provide examples of how new medical techniques, efficient health care delivery systems, improved sanitation, and a more complete understanding of the nature of disease provides today's humans a better chance of staying healthier than their forebears. S:LS4:11:2.4 Describe how some drugs mimic or block the molecules involved in transmitting nerve or hormone signals and explain how this disturbs the normal operations of the brain and body. S:LS4:11:2.5 Explain that gene mutation in a cell can result in uncontrolled division, which is called cancer; and describe how exposure of cells to certain chemicals and radiation increase mutation, and thus the chance for cancer. S:LS4:11:2.6 Use evidence to make and support conclusions about the ways that humans or other organisms are affected by environmental factors or heredity (e.g., pathogens, diseases, medical advances, pollution, mutations). [LS4(9-**11)**INQ+NOS-**9**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Life Science		
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
	9-11	**11-12 (Advanced)**
3. HUMAN IDENTITY	S:LS4:11:3.1 Describe how the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, and environmental conditions and personal health behaviors. S:LS4:11:3.2 Explain how the immune system functions to prevent and fight disease. S:LS4:11:3.3 Explain how the immune system, endocrine system, or nervous system works and draw conclusions about how systems interact to maintain homeostasis in the human body. [LS4(9-**11**)SAE+FAF-**10**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Life Science		
LS5– The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	9-11	**11-12 (Advanced)**
1. DESIGN TECHNOLOGY	S:LS5:11:1.1 Describe ways in which technology has increased our understanding of the life sciences. S:LS5:11:1.2 Understand that technology is designed with a particular function in mind, and principles of life science are useful in creating technology for the life sciences.	S:LS5:12:1.1 Recognize the importance of technology as it relates to science, for purposes such as: access to information about living systems, medical diagnosis, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.
2. TOOLS	S:LS5:11:2.1 Describe the use and benefits of equipment such as light microscopes, transmission electron microscopes, scanning electron microscopes, spectrophotometers, probes, and robotics to the study of the life sciences.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*
3. SOCIAL ISSUES (LOCAL AND GLOBAL) MEDICAL TECHNOLOGY BIOTECHNOLOGY	S:LS5:11:3.1 Describe ways technology can support and improve our understanding of environmental issues. S:LS5:11:3.2 Describe aspects of the medical system available to help people in New Hampshire, including: prevention programs, vaccines and pharmaceuticals, hospitals and rehabilitation facilities. S:LS5:11:3.3 Recognize that biotechnology is used in many areas, such as agriculture, pharmaceuticals, the environment, and genetic engineering; and understand that it requires extensive knowledge of the systems being changed. S:LS5:11:3.4 Explain how advances in agriculture made using biotechnology have directly affected the food production over the past 100 years; and that this change has profoundly affected societies all over the globe, making larger populations and urban centers a possibility.	S:LS5:12:3.1 Explain how genetic engineering is used to modify the DNA structure of an organism; and describe how this process is used to research and develop medically useful products, such as insulin. S:LS5:12:3.2 Summarize arguments on both sides of a medical research controversy, such as stem cell research, cloning, or zootransplanation. S:LS5:12:3.3 Analyze and evaluate a biotechnology system in New Hampshire that focuses on a specific goal, such as pharmaceutical development; and describe all elements of the system, identifying the costs and the benefits.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:LS5:11:4.1 Explain the kinds of applications of knowledge and skills necessary for jobs/careers specific to the life sciences.	S:LS5:12:4.1 Understand the various scientific fields that use scientific content and skills; and distinguish between professional and skilled science jobs/careers in the life sciences.

Physical Science Overview

Strand (Enduring Knowledge Statements)	Stem (rows) in GSEs	Page K-4	Page 5-8	Page 9-12
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).	1. Composition	**96**	**101**	**107**
	2. Properties	**96**	**102**	**108**
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.	1. Change	**97**	**103**	**109**
	2. Conservation	**97**	**103**	**110**
	3. Energy	**98**	**104**	**111-112**
PS3– The motion of an object is affected by force.	1. Forces	**99**	**105**	**113**
	2. Motion	**99**	**105**	**114**
PS4– The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.	1. Design Technology	**100**	**106**	**115**
	2. Tools	**100**	**106**	**115**
	3. Social Issues (Local and Global) Energy, Power, and Transportation Manufacturing	**100**	**106**	**115**
	4. Career Technical Education Connections	**100**	**106**	**115**

Physical Science		
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).		
	K-2	**3-4**
1. COMPOSITION	S:PS1:2:1.1 Recognize that objects can be composed of different types of materials, such as wood, metal, and paper. S:PS1:2:1.2 Recognize that objects can be made of one or more materials.	S:PS1:4:1.1 Explain that materials may be composed of parts that are too small to be seen without magnification. S:PS1:4:1.2 Use measures of weight (data) to demonstrate that the whole equals the sum of its parts. [PS1(K-**4**)SAE-**3**]
2. PROPERTIES	S:PS1:2:2.1 Identify the observable properties of different objects, such as color, size, shape, weight and texture.	S:PS1:4:2.1 Recognize that substances can be classified by observable properties. S:PS1:4:2.2 Explain that some materials can exist in different states; and describe the distinct physical properties of each state of matter. S:PS1:4:2.3 Explain how some materials, such as water, can change from one state to another by heating or cooling. S:PS1:4:2.4 Make a prediction about what might happen to the state of common materials when heated or cooled; or categorize materials as solid, liquid, or gas. [PS1(K-**4**)POC-**2**] S:PS1:4:2.5 Collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their characteristic properties (e.g., temperature, color, size, shape, weight, texture, flexibility). [PS1(K-**4**)INQ-**1**]

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	K-2	**3-4**
1. CHANGE	S:PS2:2:1.1 Describe how the properties of certain materials can change when specific actions are applied to them, such as freezing, mixing, heating, cutting, dissolving and bending. S:PS2:2:1.2 Recognize that not all materials react the same way when an action is applied to them.	S:PS2:4:1.1 Recognize that energy has the ability to create change.
2. CONSERVATION	*None at this grade span.*	*None at this grade span.*

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	K-2	**3-4**
3. ENERGY	S:PS2:2:3.1 Recognize that sound is produced by vibrating objects and that the pitch of the sound can be varied by changing the rate of vibration. S:PS2:2:3.2 Explain that the Sun provides the Earth with heat and light. S:PS2:2:3.3 Describe that heat can be produced in a variety of ways, such as burning, rubbing, and mixing substances together. S:PS2:2:3.4 Recognize that energy comes from different sources, such as electricity and water, and is utilized in many common objects.	S:PS2:4:3.1 Identify the various forms of energy, such as electrical, light, heat, sound. S:PS2:4:3.2 Recognize that electricity in circuits can produce light, heat, sound, and magnetic effects. S:PS2:4:3.3 Identify and describe the organization of a simple circuit. S:PS2:4:3.4 Differentiate between objects and materials that conduct electricity and those that are insulators of electricity. S:PS2:4:3.5 Explain that light travels in a straight line until it strikes an object; and describe how it can be reflected by a mirror, bent by a lens, or absorbed by the object. S:PS2:4:3.6 Given a specific example or illustration (e.g., simple closed circuit, rubbing hands together) predict the observable effects of energy (i.e., the bulb lights, a bell rings, hands warm up). A test item may ask, "What will happen when…?" [PS2(K-**4**)SAE-**4**] S:PS2:4:3.7 Use observations of light in relation to other objects/substances to describe the properties of light (i.e., can be reflected, refracted, or absorbed). [PS2(K-**4**)SAE-**5**] S:PS2:4:3.8 Experiment, observe, or predict how heat might move from one object to another. [PS2(K-**4**) INQ+SAE-**6**]

Physical Science		
PS3– The motion of an object is affected by force.		
	K-2	**3-4**
1. FORCES	S:PS3:2:1.1 Describe the properties of magnetism and demonstrate how magnets can be used to move some things without touching them. S:PS3:2:1.2 Describe and demonstrate that things close to the Earth drop to the ground unless something supports them.	S:PS3:4:1.1 Recognize that magnets attract certain kinds of other materials; and classify objects by those magnets will attract and those they will not. S:PS3:4:1.2 Recognize that magnets attract and repel each other. S:PS3:4:1.3 Explain that electrically charged material pulls on all other materials and can attract or repel other charged materials. S:PS3:4:1.4 Recognize that the Earth's gravitational force pulls any object toward it. S:PS3:4:1.5 Use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect). [PS3(K-**4**)INQ+SAE-**8**]
2. MOTION	S:PS3:2:2.1 Describe the many different ways things can move, such as in a straight line, zigzag or circular motion, back and forth, and fast and slow. S:PS3:2:2.2 Describe and demonstrate how the position and motion of an object can be changed by applying force, such as pushing and pulling; and explain that the greater the force, the greater the change. S:PS3:2:2.3 Describe the position of an object by referencing its location in relation to another object or background.	S:PS3:4:2.1 Use data to predict how a change in force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls). [PS3(K-**4**)INQ+SAE-**7**]

Physical Science		
PS4– The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	K-2	**3-4**
1. DESIGN TECHNOLOGY	S:PS4:2:1.1 Recognize that new objects can be made out of physical materials, such as cloth and paper.	S:PS4:4:1.1 Understand that materials are used in certain products based on their properties, such as strength and flexibility. S:PS4:4:1.2 Recognize that products are made using a combination of technologies, such as how an escalator uses both a pulley system and an electrical motor.
2. TOOLS	S:PS4:2:2.1 Identify tools and simple machines, such as a wheel, and explain how they work. S:PS4:2:2.2 Demonstrate how to use tools, such as rulers, scales, balances, magnifiers and thermometers to measure properties of objects, such as size, weight, temperature.	S:PS4:4:2.1 Demonstrate how to use tools, such as magnifiers, scales, balances, rulers, and thermometers to gather data and extend the senses. S:PS4:4:2.2 Describe how some tools can be used to modify natural materials by processes such as separating, shaping, and joining, to produce new materials.
3. SOCIAL ISSUES (LOCAL AND GLOBAL) ENERGY, POWER, AND TRANSPORTATION MANUFACTURING	S:PS4:2:3.1 Provide examples of how man uses energy in everyday life, such as providing light, warmth in winter, cooling in summer, TVs, computers, telephones, transportation, factories. S:PS4:2:3.2 Provide examples of items that are manufactured or produced.	S:PS4:4:3.1 Give examples of transportation systems used in New Hampshire, such as buses, trains, cars, and bicycles; and describe the sources of energy they use. S:PS4:4:3.2 Explain that manufactured products are designed to solve a problem or meet a need. S:PS4:4:3.3 Provide an example to illustrate that manufacturing involves changing natural materials into finished products; and explain that this results in the production of a large number of objects that look almost identical.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:PS4:2:4.1 Recognize that some jobs/careers require knowledge and use of physical science content and/or skills.	S:PS4:4:4.1 Identify some jobs/careers that require knowledge and use of physical science content and/or skills.

Physical Science		
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).		
	5-6	**7-8**
1. COMPOSITION	S:PS1:6:1.1 Recognize that all matter is composed of minute particles called atoms; and explain that all substances are composed of atoms, each arranged into different groupings. S:PS1:6:1.2 Identify elements as substances that contain only one kind of atom; and explain that elements do not break down by normal laboratory reactions, such as heating, exposure to electric current, and reaction to acid. S:PS1:6:1.3 Recognize that over one hundred elements exist, and identify the periodic table as a tool for organizing the information about them.	S:PS1:8:1.1 Explain that atoms often combine to form a molecule or formula unit (crystal). S:PS1:8:1.2 Recognize that elements can combine in a variety of ways to form compounds. S:PS1:8:1.3 Differentiate between an atom and an molecule. S:PS1:8:1.4 Differentiate between a mixture and a pure substance. S:PS1:8:1.5 Identify methods used to separate mixtures, such as boiling, filtering, chromatography and screening. S:PS1:8:1.6 Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter). [PS1(5-**8**)INQ+SAE-**3]** S:PS1:8:1.7 Given graphic or written information, classify matter as atom/molecule or element/compound (not the structure of an atom). [PS1(5-**8**)MAS-**5]**

Physical Science		
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).		
	5-6	**7-8**
2. PROPERTIES	S:PS1:6:2.1 Identify elements according to their common properties, such as highly reactive metals, less reactive metals, highly reactive non-metals and almost non-reactive gases. S:PS1:6:2.2 Identify substances by their physical and chemical properties, such as magnetism, conductivity, density, solubility, boiling and melting points. S:PS1:6:2.3 Differentiate between weight and mass. S:PS1:6:2.4 Identify energy as a property of many substances.	S:PS1:8:2.1 Differentiate between volume and mass and define density. S:PS1:8:2.2 Explain how different substances of equal volume usually have different weights. S:PS1:8:2.3 Identify a molecule as the smallest part of a substance that retains its properties. S:PS1:8:2.4 Investigate the relationships among mass, volume and density. [PS1(5-**8**)INQ-**1**] S:PS1:8:2.5 Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility), identify, compare, or classify different substances. [PS1(5-**8**)INQ+POC-**2**] S:PS1:8:2.6 Represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter. [PS1(5-**8**)SAE+MAS-**4**]

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	5-6	**7-8**
1. CHANGE	S:PS2:6:1.1 Differentiate between a physical change, such as melting, and a chemical change, such as rusting.	S:PS2:8:1.1 Explain how substances react chemically with other substances to form new substances, known as compounds, and that in such recombinations, the properties of the new substances may be very different from those of the old. S:PS2:8:1.2 Identify factors that affect reaction rates, such as temperature, concentration and surface area; and explain that dissolving substances in liquids often accelerates reaction rates. S:PS2:8:1.3 Explain that oxidation involves combining oxygen with another substance, as in burning or rusting. S:PS2:8:1.4 Explain that states of matter depend on the arrangement of the molecules and their motion. S:PS2:8:1.5 Given a real-world example, show that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical). [PS2(5-**8**)SAE+POC-**6**]
2. CONSERVATION	S:PS2:6:2.1 Describe how mass remains constant in a closed system and provide examples relating to both physical and chemical change.	S:PS2:8:2.1 Explain the law of conservation of energy. S:PS2:8:2.2 Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter). [PS1(5-**8**)INQ+SAE-**3**]

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	5-6	**7-8**
3. ENERGY	S:PS2:6:3.1 Explain that the pitch of a sound is dependent on the frequency of the vibration producing it. S:PS2:6:3.2 Explain that sound vibrations move at different speeds, have different wavelengths; and establish wave-like disturbances that emanate from the source. S:PS2:6:3.3 Recognize that energy, in the form of heat, is usually a by-product when one form of energy is changed to another, such as when machines convert stored energy to motion. S:PS2:6:3.4 Explain that heat energy moves from warmer materials or regions to cooler ones through conduction, convection, and radiation. S:PS2:6:3.5 Explain how electrical circuits can be used to transfer energy in order to produce heat, light, sound, and chemical changes.	S:PS2:8:3.1 Differentiate between kinetic energy, which is the energy of motion and potential energy, which depends on relative position. S:PS2:8:3.2 Recognize the Sun is a major energy source for the Earth, and describes how it affects the planet's surface. S:PS2:8:3.3 Describe ways light can interact with matter, such as transmission (which includes refraction), absorption, and scattering (which includes reflection). S:PS2:8:3.4 Explain that the human eye can only detect wavelengths of electromagnetic radiation within a narrow range; and explain that the differences of wavelength within that range of visible light are perceived as differences in color. S:PS2:8:3.5 Recognize that most chemical and nuclear reactions involve a transfer of energy. S:PS2:8:3.6 Use data to draw conclusions about how heat can be transferred (convection, conduction, radiation). [PS2(5-**8**)INQ+SAE+POC-**7**]

Physical Science		
PS3– The motion of an object is affected by force.		
	5-6	**7-8**
1. FORCES	S:PS3:6:1.1 Recognize that just as electric currents can produce magnetic forces, magnets can cause electric currents. S:PS3:6:1.2 Explain that when a force is applied to an object, it reacts in one of three ways: the object either speeds up, slows down, or goes in a different direction. S:PS3:6:1.3 Describe the relationship between the strength of a force on an object and the resulting effect, such as the greater the force, the greater the change in motion.	S:PS3:8:1.1 Explain that the force of gravity gets stronger the closer one gets to an object and decreases the further away one gets from it. S:PS3:8:1.2 Recognize the general concepts related to gravitational force. S:PS3:8:1.3 Use data to determine or predict the overall (net) effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects. [PS3(5-**8**)INQ+POC-**8**]
2. MOTION	S:PS3:6:2.1 Explain the how balanced and unbalanced forces are related to an object's motion. S:PS3:6:2.2 Explain that an object's motion can be tracked and measured over time and that the data can be used to describe its position.	S:PS3:8:2.1 Explain that an object in motion that is unaffected by a force will continue to move at a constant speed and in a straight line. S:PS3:8:2.2 Explain how the motion of an object can be described by its position, direction of motion, and speed; and illustrate how that motion can be measured and represented graphically.

Physical Science		
PS4– The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	5-6	**7-8**
1. DESIGN TECHNOLOGY	S:PS4:6:1.1 Understand that scientific principles are used in the design of technology.	S:PS4:8:1.1 Understand that design features, such as size shape, weight, and function, must be considered when designing new technology.
2. TOOLS	S:PS4:6:2.1 Recognize that manufacturing processes use a variety of tools and machines to separate, form, combine and condition natural and synthetic materials.	S:PS4:8:2.1 Demonstrate appropriate use of tools, such as rulers, calculators, balances, and graduated cylinders to measure and calculate volume and mass.
3. SOCIAL ISSUES (LOCAL AND GLOBAL) ENERGY, POWER, AND TRANSPORTATION MANUFACTURING	S:PS4:6:3.1 Explain how a battery changes chemical energy into electrical energy. S:PS4:6:3.2 Demonstrate how to produce a magnetic force with an electric current, such as an electromagnet, and how to produce an electric current with a magnet, such as a generator. S:PS4:6:3.3 Provide an example to show that manufacturing processes involve changing natural materials into finished products through a series of processes that involve physical and/or chemical changes.	S:PS4:8:3.1 Explain how humans use natural resources, such as flowing water and burning of coal, oil, or natural gas to generate electrical energy in power plants. S:PS4:8:3.2 Describe how natural resources, such as coal, oil and natural gas are tapped for use in power plants, and how alternative sources, such as solar, wind, water, nuclear are tapped for power; and compare the advantages and disadvantages of each source. S:PS4:8:3.3 Differentiate between durable goods, which are designed to operate for a long period of time, and non-durable goods, which are only intended to operate for a short period of time.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:PS4:6:4.1 Understand that some form of science is used in most jobs/careers and that some jobs/careers specifically require knowledge of physical science.	S:PS4:8:4.1 Understand that some scientific jobs/careers involve the application of physical science content knowledge and experience in specific ways that meet the goals of the job.

Physical Science		
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).		
	9-11	**11-12 (Advanced)**
1. COMPOSITION	S:PS1:11:1.1 Recognize and describe the structure of an atom and explain how the major components interact with one another. S:PS1:11:1.2 Recognize how elements are arranged in the periodic table; and explain how this arrangement illustrates the repeating patterns among elements with similar properties, such as the relationship between atomic number and atomic mass. S:PS1:11:1.3 Explain that neutrons and protons are made up of even smaller constituents. S:PS1:11:1.4 Define isotopes; recognize that most elements have two or more isotopes; and explain that although the number of neutrons has little affect on how the atom interacts with others, they do affect the mass and stability of the nucleus. S:PS1:11:1.5 Scientific thought about atoms has changed over time. Using information (narratives or models of atoms) provided, cite evidence that changed our understanding of the atom and the development of atomic theory. [PS1(9-**11**)MAS+NOS-**2**] S:PS1:11:1.6 Model and explain the structure of an atom or explain how an atom's electron configuration, particularly the outermost electron(s), determines how that atom can interact with other atoms. [PS1(9-**11**)MAS+FAF-**4**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.* S:PS1:12:1.1 Understand the basic building blocks of matter are quarks and leptons. S:PS1:12:1.2 Recognize the main ideas of string theory. S:PS1:12:1.3 Identify the sub-orbital shapes and geometric orientations of the orbitals electrons can occupy in atoms.

Physical Science		
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).		
	9-11	**11-12 (Advanced)**
2. PROPERTIES	S:PS1:11:2.1 Explain that the physical properties of a compound are determined by its molecular structure and the interactions among the molecules. S:PS1:11:2.2 Determine whether an atom is either electrically neutral or an ion by referring to its number of electrons. S:PS1:11:2.3 Explain how the chemical properties of an element are governed by the electron configuration of atoms, and describe how atoms interact with one another by transferring or sharing the outermost electrons. S:PS1:11:2.4 Explain that radioactive materials are unstable and undergo spontaneous nuclear reactions, which emit particles and/or wavelike radiation. S:PS1:11:2.5 Explain that states of matter rely on the arrangement and motion of molecules; and differentiate between the structures of solids, liquids, and gases. S:PS1:11:2.6 Use physical and chemical properties as determined through an investigation to identify a substance. [PS1(9-**11**)INQ-**1**] S:PS1:11:2.7 Explain how properties of elements and the location of elements on the periodic table are related. [PS1(9-**11**)POC-**3]**	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	9-11	**11-12 (Advanced)**
1. CHANGE	S:PS2:11:1.1 Recognize and explain that atoms may be bonded together into molecules or formula units (crystalline solids). S:PS2:11:1.2 Recognize that atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus; and explain that the outer electrons govern the chemical properties of an element. S:PS2:11:1.3 Explain that compounds are formed through both ionic and covalent bonding. S:PS2:11:1.4 Recognize that the rates of chemical reactions can vary greatly; and identify the factors that influence these reaction rates, such as how often the reacting atoms and molecules encounter one another, the temperature, and the properties of the reacting species, including shape. S:PS2:11:1.5 Explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles. [PS2(9-**11**)SAE-**7**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.* S:PS2:12:1.1 Explain the complete mole concept and identify ways in which it can be used, such as to differentiate between actual and relative mass.

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	9-11	**11-12 (Advanced)**
2. CONSERVATION	S:PS2:11:2.1 Explain that chemical reactions either release or consume energy. S:PS2:11:2.2 Explain that chemical reactions can be accelerated by catalysts, such as enzymes. S:PS2:11:2.3 Recognize that a large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. S:PS2:11:2.4 Identify the variety of structures that may be formed from the bonding of carbon atoms, and describe their roles in various chemical reactions, including those required for life processes. S:PS2:11:2.5 Demonstrate how transformations of energy produce some energy in the form of heat and therefore the efficiency of the system is reduced (chemical, biological, and physical systems). [PS2(9-**11**)POC+SAE-**5**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	9-11	**11-12 (Advanced)**
3. ENERGY	S:PS2:11:3.1 Explain that all energy can be considered to be either kinetic energy, potential energy, or energy contained by a field. S:PS2:11:3.2 Provide examples of how kinetic and potential energy can be transformed from one to the other. S:PS2:11:3.3 Describe how the energy associated with individual atoms and molecules can be used to identify the substances they comprise; and explain that each kind of atom or molecule can gain or lose energy only in particular discrete amounts, absorbing and emitting light only at wavelengths corresponding to these amounts. S:PS2:11:3.4 Explain the range of the electromagnetic spectrum as it relates to both wavelength and energy; and provide examples of practical applications of the different wavelengths in the spectrum. S:PS2:11:3.5 Recognize that the human eye can only see a narrow range of wavelengths within the electromagnetic spectrum; and explain how the variations of wavelength within that range of visible light are perceived as differences in color. S:PS2:11:3.6 Describe the relationship between heat and temperature, explaining that heat energy consists of the random motion and vibrations of atoms, molecules, and ions; and that the higher the temperature, the greater the atomic or molecular motion.	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.* S:PS2:12:3.1 Explain the concept of entropy. S:PS2:12:3.2 Understand that activation energy is required to make a chemical reaction proceed, whether or not it is exothermic or endothermic.

Physical Science		
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
	9-11	**11-12 (Advanced)**
	S:PS2:11:3.7 Explain that waves, such as light, seismic, sound waves, have energy and can transfer energy when they interact with matter. S:PS2:11:3.8 Explain that nuclear reactions convert a fraction of the mass of interacting particles into energy and release much greater amounts of energy than atomic interactions. S:PS2:11:3.9 Describe how electrons flow easily in some materials, such as metals, whereas in insulating materials, such as glass, they can hardly flow at all. S:PS2:11:3.10 Using information provided about chemical changes, draw conclusions about the energy flow in a given chemical reaction (e.g., exothermic reactions, endothermic reactions). [PS2(9-**11**)INQ+SAE-**6**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.*

Physical Science		
PS3– The motion of an object is affected by force.		
	9-11	**11-12 (Advanced)**
1. FORCES	S:PS3:11:1.1 Explain that magnetic forces are related to the action of electrons and can be thought of as different aspects of a single electromagnetic force; and describe how the interplay of these forces is the basis for electric motors, generators, radio, television, and many other modern technologies. S:PS3:11:1.2 Recognize that the strength of the electric force between two charged objects is proportional to the charges and, as with gravitation, is inversely proportional to the square of the distance between them. S:PS3:11:1.3 Recognize that the strength of the gravitational force between two masses is proportional to the masses and inversely proportional to the square of the distance between them. S:PS3:11:1.4 Compare the strength of nuclear, electromagnetic and gravitational forces; and explain that the strength of nuclear forces account for the great amounts of energy released from the nuclear reactions in atomic or hydrogen bombs, and in the Sun and other stars. S:PS3:11:1.5 Recognize that electromagnetic forces exist within and between atoms. S:PS3:11:1.6 Recognize that different kinds of materials respond to electric forces in various ways; and differentiate between insulators, semiconductors, conductors and superconductors. S:PS3:11:1.7 Describe the difference between materials that contain equal proportions of positive and negative charges and those that have a very small excess or deficit of negative charges. S:PS3:11:1.8 Given information (e.g., graphs, data, diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects. [PS3(9-**11**)INQ+POC-**8**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.* S:PS3:12:1.1 Understand the four fundamental forces found in nature: gravitation, electromagnetism, strong nuclear force, and weak nuclear force. S:PS3:12:1.2 Describe the gauge particles that are exchanged by each of the fundamental forces. S:PS3:12:1.3 Understand the basic principles of unified field theories.

Physical Science		
PS3– The motion of an object is affected by force.		
	9-11	**11-12 (Advanced)**
2. MOTION	S:PS3:11:2.1 Interpret and apply the laws of motion to determine the effects of forces on the motion of objects. S:PS3:11:2.2 Recognize that apparent changes in wavelength can provide information about changes in motion; explain that the observed wavelength of a wave depends upon the relative motion of the source and the observer; and relate these to the differences between shorter and longer wavelengths. S:PS3:11:2.3 Apply the concepts of inertia, motion, and momentum to predict and explain situations involving forces and motion, including stationary objects and collisions. [PS3(9-**11**)POC-**9**] S:PS3:11:2.4 Explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky). [PS3(9-**11**)SAE-**10**]	*Schools should include expectations and competencies from Advanced Science Courses and Science-related Career and Technical Education Courses.* S:PS3:12:2.1 Explain general concepts related to the theory of special relativity: time dilation, length contraction, and mass expansion. S:PS3:12:2.2 Understand the basic idea behind the theory of general relativity. S:PS3:12:2.3 Describe the predictions made by the theory of general relativity, and the evidence that supports it.

Physical Science		
PS4– The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.		
	9-11	**11-12 (Advanced)**
1. DESIGN TECHNOLOGY	S:PS4:11:1.1 Recognize that the basic principles of energy, work and power are related to design technology.	S:PS4:12:1.1 Relate the transfer of energy through conduction, convection and radiation to design technologies.
2. TOOLS	S:PS4:11:2.1 Identify tools, such as thermostats and thermal sensors, and explain their use in environmental control systems.	S:PS4:12:2.1 Demonstrate the appropriate use of a variety of input devices, such as scanners, voice/sound recorders, and digital cameras.
3. SOCIAL ISSUES (LOCAL AND GLOBAL) ENERGY, POWER, AND TRANSPORTATION MANUFACTURING	S:PS4:11:3.1 Explain that power systems have a source of energy, a process, loads, and some have a feedback system. S:PS4:11:3.2 Demonstrate and explain how an engine converts chemical energy in the form of fuel, into mechanical energy in the form of motion. S:PS4:11:3.3 Calculate the efficiency of an engine, and explain why a perfectly efficient engine is impossible. S:PS4:11:3.4 Explain the relationship between energy and power. S:PS4:11:3.5 Explain the benefits of standardization of parts.	S:PS4:12:3.1 Compare two different energy systems that are used to produce large amounts of electrical power for New Hampshire residents, and describe the advantages and disadvantages of each system. S:PS4:12:3.2 Design a transportation system that meets most humans' need for reliable and affordable transportation, while having a minimal impact on the environment. S:PS4:12:3.3 Describe the various types of manufacturing systems, such as customized production, batch production, and continuous production, and explain that manufacturing results in two types of good, durable and non-durable goods. S:PS4:12:3.4 Understand that a manufacturing system includes design of the product and methods of obtaining raw materials, as well as actual production, marketing, sales, maintenance, servicing, repair, and final disposal of the remains of the product.
4. CAREER TECHNICAL EDUCATION CONNECTIONS	S:PS4:11:4.1 Explain the kinds of applications of knowledge and skills necessary for jobs/careers specific to the physical sciences.	S:PS4:12:4.1 Understand the various scientific fields that use scientific content and skills and distinguish between professional and skilled science jobs/careers in the physical sciences.

Measurement Specifics for Science

(Adapted from NECAP Mathematics Assessment GLEs grades 3-8)

The following is a list of the measurement benchmarks and equivalences that ***can be used*** in mathematics problems across the science domains at each specific grade. In addition to measurement benchmarks identified below students should be expected to use the appropriate units when solving problems involving area, volume, surface area, conversions, and rates (e.g., miles per hour, price per pound, and pounds per square inch) in science.

Connection to the Mathematics GLEs is **M:G&M:2.7 (Uses units of measures appropriately and consistently, and makes conversions within systems when solving problems across the content strands.)**

Measures	By Grade 2	By Grade 4	End of Grade 8
Length	**Unit (accuracy):** Inch (to whole inch); Foot (to whole inch); Centimeter (to whole centimeter); Meter (to whole centimeter) **Equivalencies:** 12 inches in 1 foot; 100 centimeters in 1 meter	**Unit (accuracy):** Inch (to 1/4 inch); Foot; Centimeter (to 0.5 centimeter); Meter (to 0.5 centimeter); Yard; Mile (use in scale questions); Kilometer (use in scale questions) **Equivalencies:** 12 inches in 1 foot; 100 centimeters in 1 meter; 3 feet in 1 yard; 36 inches in 1 yard	**Units (accuracy):** Inch (to 1/16 inch); Foot; Centimeter (to 1/10 centimeter); Meter (to 1/100 meter); Yard; Mile (use in scale and rate questions); Kilometer (use in scale and rate questions) **Equivalencies:** 12 inches in 1 foot; 100 centimeters in 1 meter; 3 feet in 1 yard; 36 inches in 1 yard; 10 millimeters in 1 centimeter; 1000 millimeters in 1 meter
Time	**Unit (accuracy):** Hour (to 15 minute interval) **Equivalencies:** 60 minutes in 1 hour	**Unit (accuracy):** Hour (to 5 minute interval); Day; Year **Equivalencies:** 24 hours in 1 day; 7 days in 1 week; 365 days in 1 year; 60 seconds in 1 minute; 60 minutes in 1 hour	**Unit (accuracy):** Hour (to 1 minute); Day; Year **Equivalencies:** 24 hours in 1 day; 7 days in 1 week; 365 days in 1 year; 60 seconds in 1 minute; 60 minutes in 1 hour
Temperature	**Unit (accuracy):** Degree (to 1 degree)	**Unit (accuracy):** ºC and ºF (to 1 degree)	**Unit (accuracy):** ºC and ºF (to 1 degree)
Capacity		**Unit (accuracy):** Quart (to whole quart)	**Unit (accuracy):** Quarts (to 1 ounce); Gallon; Pint; Liter **Equivalencies:** 32 ounces in 1 quart; 4 quarts in 1 gallon; 2 pints in 1 quart; 1000 milliliters in 1 liter
Mass		**Unit (accuracy):** Kilogram (to whole kilogram); Gram (to whole gram)	**Unit (accuracy):** Kilogram; Gram (to 1/10 gram)
Weight		**Unit (accuracy):** Pound (to whole pound)	**Unit (accuracy):** Pound (to 1 ounce) **Equivalencies:** 16 ounces in 1 pound
Angles and Rotation			**Unit (accuracy):** Degree (to 2 degrees) **Equivalencies:** 360º in 1 circle; 90º in 1 right angle

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