North Carolina K-12 Science Support Documents

Fourth Grade

Purpose:
The 2023 North Carolina K-12 Science Standards were officially approved by the State Board of Education on July 6, 2023. The Standard Course of Study is designed to help students continually grow their science knowledge and abilities. The standards are intended to foster conceptual understanding, develop scientifically literate students, and provide opportunities to build knowledge and practices within each grade band or course.
The K-12 Science Support Documents serve as resources for teachers, administrators, science specialists, instructional coaches, parents, and other stakeholders in understanding the standards and planning instruction. They do not serve as curricula nor as a means to limit instruction in the classroom, but rather are intended to serve as a guide for discerning and describing features of students and their work necessary to meet grade level proficiency.

Science Teaching and Learning:
A coherent and consistent approach throughout grades K-12 is key to realizing the vision for science education embodied in *A Framework for K-12 Science Education*. Students should actively engage in science and engineering practices and apply crosscutting concepts in every grade level to deepen their understanding of each field's disciplinary core ideas.

Science Safety:
It is the responsibility of teachers and school administrators to use appropriate legal standards and best professional practices under duty of care to make the science laboratory safe. Follow the Public School Unit's guidelines regarding safety in the classroom. For more information, review the National Science Teaching Association's position statement on safety and school science instruction.

Thank You:
We wish to express sincere appreciation for the many hours dedicated to this process by nonformal science educators, representatives of higher education, business and industry representatives, community members, parents, and especially the K-12 science educators.

Resources:
The resources used to inform the development of the K-12 Science Support Documents include:

- Benchmarks for Science Literacy
- Earth Science Literacy Principles
- National Assessment of Educational Progress (NAEP) Science Assessment Framework (2019 & 2028)
- National Research Council: A K-12 Framework for Science Education:Practices, Crosscutting Concepts, and Core Ideas
- National Science Teaching Association: Three-Dimensional Progression Matrix on Science and Engineering Practices
- Ocean Literacy Principles
- STEM Teaching Tool #41: Prompts for Integrating Crosscutting Concepts into Assessment and Instruction
- Trends in International Mathematics and Science Study (TIMSS) 2023 Assessment Framework

This template illustrates the organization of the K-12 Science Support Documents and provides detailed explanations regarding the standards to inform curriculum development and support both instruction and classroom assessment.

K-12 Vertical Alignment
Progression of the K-12 Science Standards for each strand

Strand
Organizes the standards into broader contexts within a K-12 vertical progression. The standards are organized within 11 strands which articulate vertical alignment. As students progress from one grade to the next, the depth of knowledge and level of sophistication increases.

Standards Organization
The 2023 Science Standards are grouped in three domains: Physical Science, Life Science, and Earth & Space Science. The standards are organized in K-12 strands which increase in sophistication through the grade bands. The eleven strands include:

- Matter and Its Interactions
- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Applications in Technologies for Information Transfer
- From Molecules to Organisms: Structures and Functions
- Ecosystems: Interactions, Energy, and Dynamics
- Heredity: Inheritance and Variation

- Biological Evolution: Unity and Diversity
- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

Standards and Objectives: The North Carolina Standard Course of Study sets expectations for student learning in K-12 Science. Standards and objectives communicate what students should know and be able to do to master the content.

Standard - Broader content that frames the objectives
Objectives - Specific content that support the standard. Each standard contains two or more objectives. Each objective contains a Science and Engineering Practice (SEP), a Revised Bloom's Taxonomy (RBT) verb, and a Disciplinary Core Idea (content).

Standard - Broader content that frames the objectives

Objective - Objectives are specific content that support the standard. Each standard contains two or more objectives.
The objectives in 2023 Science Standards represent what students at the "standard" level should know, understand, and be able to do. For high school honors level course implementation, refer to the Honors Level Course Development and Evaluation Tool.

Clarification Statement(s): Some objectives are followed by statements which supply additional information or clarification.

Boundary Statement(s): The purpose of this section is to provide limits on classroom assessment.

Dimension 1: Science and Engineering Practice (SEP)

[Science and Engineering Practice included in Objective]
Practices refer to the things that scientists and engineers do and how they actively engage in their work. This section provides further clarification for what students should be doing to engage in this practice. There are various ways that each practice can be used, as articulated in *A Framework for K-12 Science Education* (NRC, 2012) and the *NSTA's SEP Matrix*.

The Framework identifies a small number of disciplinary core ideas that all students should learn with increasing depth and sophistication, from Kindergarten through grade twelve. Key to the vision expressed in the Framework is for students to learn these disciplinary core ideas in the context of science and engineering practices. The importance of combining science and engineering practices and disciplinary core ideas is stated in the Framework as follows: Standards and performance expectations that are aligned to the framework must take into account that students cannot fully understand scientific and engineering ideas

without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content (NRC Framework, 2012, p. 218).
The eight practices of science and engineering that the Framework identifies as essential for all students to learn and describes in detail are listed below:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Dimension 2: Crosscutting Concepts (CCC)

Crosscutting concepts are conceptual tools used along with the SEP and DCI to help students explain and predict science phenomena. They support students in making connections between disciplines and provide a context for sense-making. Teachers should encourage students to frame their thinking around the terminology of the CCC through questions and classroom discussions.

The most relevant Crosscutting Concepts may vary in light of the specific learning objectives and how the teacher structures the topic. Teachers should choose the one(s) that best support(s) their instructional goals and help(s) students make connections across different aspects of the content.

Suggested Crosscutting Concept(s): [Crosscutting Concept Name(s)] *A Framework for K-12 Science Education* identifies seven crosscutting concepts that bridge disciplinary boundaries and unite core ideas. Their purpose is to help students deepen their understanding of the disciplinary core ideas and develop a coherent and scientifically based view of the world (p. 83).

The seven crosscutting concepts of the Framework are:

1. **Patterns**
2. **Cause and effect: Mechanism and explanation**
3. **Scale, proportion, and quantity**
4. **Systems and system models**
5. **Energy and matter: Flows, cycles, and conservation**.

6. **Structure and function**
7. **Stability and change**

Dimension 3: Disciplinary Core Ideas (DCI)

[DCI Code]: [DCI Name]The purpose of this section is to articulate the conceptual ideas students should know and be able to use **within specific grade bands** to support the explanation of science phenomena. Although these core ideas primarily are found in *A Framework for K-12 Science Education*, information may be included from other sources such as the Benchmarks for Science Literacy, Ocean Literacy Principles, Earth Science Literacy Principles, NAEP 2028 Framework, and TIMSS 2023 Framework. *This section is not intended to be a checklist of content for students to memorize.*

What does it look like to demonstrate proficiency?
This section provides statements of what students should know and be able to do to demonstrate proficiency of a standard. These statements can be used to plan learning goals, tasks, and assessments during the instructional sequence, and should address how the dimensions of *The Framework* interact. *These proficiency statements are not intended to be used as curriculum or to dictate instruction.*

Academic Language: The tools in this section help teachers encourage classroom discussion and facilitate science discourse.

[*Question/Sentence Stems that utilize academic language]:)
Effective science instruction requires discipline-specific communication skills. This means that effective science learning occurs when students are expected to speak, listen, read, and write in ways that are appropriate to science.

*Resource: *STEM Teaching Tool #41: Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction*

[Words to support student discourse]:
This section is not intended to be an exhaustive vocabulary list of terms students need to know; rather it is a list of words meant to support classroom discussion. Teaching words or concepts in isolation or prior to experiences that give context (frontloading) does not allow students the opportunities for sense-making that lead to a greater depth of conceptual understanding.

How do I send Feedback? We intend the explanations and examples in this document to be helpful and specific. That said, we believe that as this document is used, teachers and educators will find ways in which it can be improved and made ever more useful. Please use this Google form to send us feedback. Thank You!

Grade 4 Science

K-12 Vertical Alignment

Formative Assessment Examples

Strands

- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Applications
- From Molecules to Organisms: Structures and Processes
- Biological Evolution: Unity and Diversity
- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

Motion and Stability: Forces and Interactions

Standard and Objectives:

PS.4.1 Understand how various forces affect the motion of an object.

PS.4.1.1 Ask questions to summarize the relationship of magnetic interactions between two objects not in contact with each other.

PS.4.1.2 Carry out investigations to explain how electrically charged objects push or pull on other objects to produce motion.

Objective: PS.4.1.1 Ask questions to summarize the relationship of magnetic interactions between two objects not in contact with each other.

Dimension 1: Science and Engineering Practice: Ask Questions: Students will ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS2.B Objects in contact exert forces on each other (friction, elastic pushes and pulls). Magnetic forces between a pair of objects do not require that the objects be in contact. Magnets push and pull at a distance. The sizes of the forces depend on the properties of the objects and their distances apart, and for magnets their orientation relative to each other (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

***Revised Bloom's Taxonomy**: **Summarize** -* Condensing larger information into a general theme or major point(s)

- Students recognize the difference between contact and non-contact forces.
- Students know a magnet pulls on all things made of iron (and some other magnetic metals) without contact, and that this pulling can result in motion (e.g., two permanent magnets, an electromagnet and paper clips).
- Students classify objects as magnetic or non-magnetic, noting some patterns such as some metals being magnetic.
- Students explain the size of the force (push or pull) depends on the force exerted (e.g. one magnet versus the force exerted by two magnets) and the distance between the object and the magnet.
- Students know a magnet has two poles: the like poles repel (push), unlike poles attract (pull).
- ***Asking Questions and Defining Problems***- Ask questions that come from observations of two objects not in contact with each other interacting through electric or magnetic forces. Questions relate to the size of the force due to distance; the orientation of magnets- and whether they attract or repel; how magnetic forces interact with metallic or nonmetallic objects.

Academic Language
Questions/Sentence Stems that utilize academic language:

- How do magnets interact with metallic objects? (e.g., some metallic objects cause a push or pull; others do not attract or repel.)
- How do magnets interact with objects containing iron to produce motion without contact? (*e.g., causes a push or pull that depends on distance between objects, and orientation of the magnetic poles*)
- How do magnets interact with nonmetallic objects (e.g., paper, wood, air(gas), liquids, plastic)? (*do not attract or repel*)
- What happens when like poles are placed near each other? (*repel*) What happens when unlike poles are placed near each other?(*attract*)

Words to support student discourse: repel, force, magnetic poles, North, South, attract, magnetism, non-metallic, motion, iron, metallic

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Objective: PS.4.1.2 Carry out investigations to explain how electrically charged objects push or pull on other objects to produce motion.

Dimension 1: Science and Engineering Practice: Plan and Carry Out Investigations: Students will plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Systems and System Models, Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS2.B Objects in contact exert forces on each other (friction, elastic pushes and pulls). Electric and magnetic forces between a pair of objects do not require that the objects be in contact. Magnets push and pull at a distance. The sizes of the forces in each situation depend on the properties of the objects and their distances apart (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy*:* ***Explain*** - Constructing a cause-and-effect model of a system

- Students recognize the difference between contact and non-contact forces.
- Students know an object that has been electrically charged pulls or pushes on all other charged objects and that this can result in motion.
- Students know charged objects with like charges repel, and unlike charges attract.
- Students know that electrical charges can result in attraction, repulsion or electrical discharge (e.g., lightning, static electricity).
- ***Planning and Carrying Out Investigations-*** Students explain the variables in their investigation and make predictions about what would happen if a variable changes (e.g., rubbing feet across carpet while wearing socks, plastic combs combing through hair).

Academic Language
Questions/Sentence Stems that utilize academic language:

- A change in (*amount of rubbing*) in the model may result in (*an increase in charge*).
- How does your model show changes in the system that are difficult to see directly? (*e.g. pushes or pulls*)
- How can you test whether two objects have like or unlike charges?

- How can you investigate how charged objects can create motion?

Words to support student discourse: charged, electrically charge and discharge, static electricity, variables, like and unlike charges, friction, attract, repel

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Energy

Standard and Objectives:
PS.4.2 Understand that energy can be transferred from place to place by sound, light, heat, and electric currents.

PS.4.2.1 Ask questions to identify basic forms of energy (light, sound, heat, and electrical) that cause motion or create change.
PS.4.2.2 Use models to explain a simple electrical circuit and the necessary components.
PS.4.2.3 Carry out investigations on common materials to classify them as insulators or conductors of electricity.

Objective: PS.4.2.1 Ask questions to identify basic forms of energy (light, sound, heat, and electrical) that cause motion or create change.

Dimension 1: Science and Engineering Practice: Ask Questions: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Energy and Matter, Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS3.A Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (Boundary: At this grade level, no attempt is made to give a precise or complete definition of energy) (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Identify*** - Locating knowledge in long-term memory that is consistent with presented material

- Students explain energy exists in many forms (i.e., light, sound, heat, and electrical).
- Students know changes in energy can cause changes in motion (e.g., adding energy can cause some things to move or some things to move faster).
- Students infer how energy can change form and be transferred in various ways between objects (e.g., sound from a radio, sound causing objects to vibrate, light from a flashlight, the sun heating a window pane, currents to electronic devices, and electric currents being used to produce motion or light).
- ***Asking Questions-*** Students ask questions based on observations to find more information about the forms of energy.

Academic Language
Questions/Sentence stems that utilize academic language:

- What is happening to energy in this system? *(e.g., in an oven energy is changing form from electrical energy to heat energy; in power lines energy is being transferred from place to place).*
- How can you test whether _____caused _____to happen? *(e.g., energy, motion).*
- What form of energy does a _____ (*e.g., lamp*) use to produce _____ (*e.g. light*) energy? (*e.g. electrical).*
- Where does the _____ (*e.g., fan, house, flashlight)* get its energy? *(e.g., electricity, generator or power station, batteries).*

Words to support student discourse: slow, fast, motion, relationship, light, sound, heat, change, energy

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Objective: PS.4.2.2 Use models to explain a simple electrical circuit and the necessary components.

Dimension 1: Science and Engineering Practice: Develop and Use Models: Use a model to test cause and effect relationships or interactions concerning the functioning of a designed system (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Systems and System Models Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS3.B Energy can also be transferred from place to place by electric currents, which can then be used locally to produce

motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine which generates electric currents)(A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy*: *Explain - Constructing a cause-and-effect model of a system

- Simple circuits include a *source* (battery or other energy source), *energy user* (a light bulb or other device that uses energy), and an *energy pathway* or *circuit* (conducting wires that connect the two terminals of the battery).
- Students know circuits are the pathway for energy flow.
- Students know circuits can be open or closed.
    - Energy only flows in closed circuits.
    - Energy flow can be interrupted when the circuit is opened (e.g., with a switch or disconnecting the energy source)
- Students recognize that electrical energy in a circuit can be transformed into other forms of energy (e.g., heat, light, sound, motion).
- **Ask Questions-** Students identify questions that can be answered by an investigation (e.g., How do I light the lightbulb?)
- **Develop and Use Models-** Students develop and use models to show their understanding of the flow of energy within a circuit. Students can test different models of the circuits with switches, energy sources, and energy users.

Academic Language
Questions/Sentence Stems that utilize academic language:

- What do you think would happen to the system if you increased/decreased _____ (*e.g. the number of batteries*)? (*the light bulb would glow brighter; dimmer).*
- Under what conditions does the energy flow through the system? (*In a closed circuit, properly attached to the wires, a source, and user).*
- What are the components of a simple circuit? *(e.g., wires, battery, lightbulb, switch)*
- How is energy transformed in the circuit? (*energy from the battery is transformed into light energy in the light bulb)*

Words to support student discourse: electric circuit model, pathway, loop, insulators, conductors, open and closed circuits, switch, energy transfer, electric current, source, user

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Objective: PS.4.2.3 Carry out investigations on common materials to classify them as insulators or conductors of electricity.

Dimension 1: Science and Engineering Practice: Plan and Carry Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Patterns Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS3.B Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine which generates electric currents) (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy*:* ***Classify*** - Determining that something belongs to a category based on relevant features or patterns

- Students know electrical energy can be transferred through certain materials (conductors- *e.g., copper, aluminum, iron, steel, gold and silver).*
- Students know that some materials do not allow energy to flow through them (insulators- *e.g., glass, air, cotton, plastic, rubber, and wood).*
- Students classify good conductors and poor conductors (insulators) of electricity.
- ***Plan and Carry out Investigations-*** Students plan and conduct an investigation to classify different materials and provide evidence for their classifications. Students explain the variables (e.g., type of material used) in their investigation. Students make predictions about what would happen if the material changes.
- ***Obtain, Evaluate and Communicate -*** Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, diagrams, pictures, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. Students communicate information on observed relationships (e.g., some materials do not conduct electricity (insulators - glass, air, cotton, etc.) and some do (conductors - copper, aluminum, iron, etc.).

Academic Language
Questions/Sentence Stems that utilize academic language:

- What would happen if you changed the connecting materials from conductors to insulators in a closed circuit? (*insulators would slow/stop the flow of energy)*
- What can be done to control the flow of electricity using different materials? *(insulators can slow the flow of energy; conductors can speed up the flow of energy)*
- What are the benefits of conductors and insulators in our world? *(Powerlines, fences for livestock, battery jumper cables, light rail transit systems, powering electronic devices)*
- ***Plan and Carry Out Investigations-***
    - How can you design an investigation to classify materials as insulators or conductors?
    - What material(s) could be tested?
    - Where should the materials be placed in the circuit?
    - What can be expected if the material is a conductor? If the material is an insulator?
    - How can data be collected during the investigation?
    - What did the results reveal about the materials?
    - How can the materials be classified?

Words to support student discourse: electricity, conductors, classify, insulators, circuit, energy

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Waves and Their Applications

Standard and Objectives:
PS.4.3 Understand the nature of light and how light interacts with objects.

PS.4.3.1 Carry out investigations to infer the path light travels from a light source to a mirror and how it is reflected (by the mirror) using different angles.
PS.4.3.2 Carry out investigations to explain how light is refracted and absorbed.

Objective: PS.4.3.1 Carry out investigations to infer the path light travels from a light source to a mirror and how it is reflected (by the mirror) using different angles.

Dimension 1: Science and Engineering Practice: Plan and Carry Out Investigations: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect, Energy and Matter Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS4.B Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them when the light cannot reach. Mirrors and prisms can be used to redirect a light beam. A great deal of light travels through space to Earth from the sun and from distant stars. An object can be seen when light reflected from its surface enters the eyes; the color people see depends on the color of the available light sources as well as the properties of the surface. (Boundary: This phenomenon is observed, but no attempt is made to discuss what confers the color reflection and absorption properties on a surface. The stress is on understanding that light traveling from the object to the eye determines what is seen) (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Infer*** - Drawing a logical conclusion from presented information

- Students infer that light travels in a straight line.
- Students know mirrors and other surfaces reflect light.
- Students explain that to see objects
  - some light must be present to reflect off of the object
  - there is a path light travels from the light source, to the object, to the eye.
- ***Plan and Carry Out Investigations-*** Students plan and develop investigations (using common light sources such as the sun or flashlights) to collect data demonstrating the path of light and show how mirrors reflect light.
- ***Ask questions-*** Students ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships relating light with common physical phenomena (*e.g., shadows, reflections)*.

Academic Language
Question/Sentence Stems that utilize academic language:

- Give examples of objects that reflect light _____(*e.g., mirror, shiny objects, water, any visible object*).
- When I change the _____ , there is a change in _____ is affected *(e.g., the angle of the mirror, the direction of the light).*
- ***Plan and Carry Out Investigations-***
  - How can we investigate the pathway of light?
  - What will be the light source?
  - Where will the light source be placed?

- What will reflect the light?
- How will the path of the light be determined?
- How can the path of the light be changed?

Words to support student discourse: light, light source, reflection/reflect, absorption/absorb, ray or beam, straight, bounce off, redirect, change

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Objective: PS.4.3.2 Carry out investigations to explain how light is refracted and absorbed.

Dimension 1: Science and Engineering Practice: Plan and Carry Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS4.B Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them when the light cannot reach. Mirrors and prisms can be used to redirect a light beam (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Explain*** - Constructing a cause-and-effect model of a system

- Students explain light travels in a straight line until it strikes an object.
- Students know that when light travels from one medium (air, water) into a different medium, the straight line of light changes direction slightly.
- Students know that light can be refracted, and/or absorbed.
- Students infer darker colors absorb more light than lighter colors.
- ***Plan and Carry Out Investigations***- Students make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of how light changes direction.

Academic Language
Questions/Sentence Stems that utilize academic language:

- Give examples of refracting light _____(*e.g., When light travels through water objects appear bent or moved)*
- Give examples of absorbing light_____ (*e.g., light absorbed by objects, dark-colored t-shirts absorb more energy and feel warmer, and light-colored t-shirts reflect more energy and do not feel as warm*).
- What would happen to the path of light if you changed the medium? (*e.g., shadows could be formed if the object blocked the light; objects could appear bent or broken if the light was refracted in water.)*
- How can a small change to _____ have a big effect on _____? (*e.g., the color of the object being used, the amount of light being absorbed)*
- **Plan and Carry Out Investigations-**
  - How can we investigate how light is absorbed?
  - What properties of materials cause light to be absorbed more than others? (*e.g. colors)*
  - How would the properties of objects change how light is absorbed? (e.g., light-colored materials vs. dark-colored materials) (e.*g., dark-colored feels warmer to the touch).*
  - What materials can be used for the investigation?
  - How will data be collected?
  - What does the data reveal?
  - What caused the change in the light path you observed? (*e.g., light refracted through a liquid)*

Words to support student discourse: medium, refraction, light, rays, light source, reflection/reflect, absorption/absorb, to infer/inference, light path

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From Molecules to Organisms: Structures and Processes

Standard and Objectives:
LS.4.1 Understand the effects of environmental changes, adaptations, and behaviors that enable organisms to survive in changing habitats.

LS.4.1.1 Use models to explain that plants and animals have external structures that function to support survival.
LS.4.1.2 Use models to explain that animals receive different types of information through their senses, process the information, and respond to the information in different ways.
LS.4.1.3 Engage in argument from evidence to explain how differences among animals of the same population sometimes gives individuals an advantage in surviving and reproducing in changing habitats.

Objective: LS.4.1.1 Use models to explain that plants and animals have external structures that function to support survival.

Dimension 1: Science and Engineering Practice: Develop and Use Models: Use a model to test cause and effect relationships or interactions concerning the functioning of a natural system (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Structure and Function Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- LS1.A. Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior and reproduction (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Explain*** - Constructing a cause-and-effect model of a system

- Students identify and describe the functions of external structures. *(e.g., structures could include thorns, stems, roots, colored petals, pollen, claws, horns, fur)* on selected plants and animals.
- Students make a claim about the external structures that aid in survival of organisms *(e.g., Plants- thorns for protection; roots to anchor the plant and obtain water to support growth; waxy coating to prevent water loss from plants; methods of seed dispersal- water, wind, relying on other organisms; Animals- sharp horns for defense; thick fur or blubber in Arctic/Antarctic areas for warmth; long claws for digging or climbing).*
- Students make a supported claim that plants and animals have structures that work together as a part of a system for survival (e.g., adaptations).
- ***Develop and Use Models-*** Develop a diagram or simple prototype to convey a process (e.g., seed dispersal, different beak shapes in birds to eat different types of foods).

Academic Language
Question/Sentence stems that utilize academic language:

- How do the parts of [an organism described in a scenario] work together? (*e.g., eating - claws tear flesh; roots help plants absorb nutrients; stem transports nutrients up plant to leaves)*
- What are the external structures of plants and animals? (*e.g., flower, fruit, stem, fur, hooves, claws, horns, eyes, nose, ears, etc.)*
- How do the external structures aid an organism in survival? (*e.g., gather food; protect against predators; move around their environment; aid in heat absorption/retention/or cooling)*

- How do the parts of an animal or plant work together for survival? (*e.g., rodents- squirrels, beavers, etc. have teeth that are continually growing because eating their food wears them down (e.g., nuts, chewing wood, etc.); gray foxes can climb trees to escape predators; the pitcher plant has vibrant colors and a pleasant scent to attract insects which it digests)*
- **Develop and Use Models-**
  - Develop a model using an analogy, example, or abstract representation to describe external structures of an organism and how they aid in survival.

Words to support student discourse: structures, function, survival, growth, external, adaptation/adapted, predators

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Objective: LS.4.1.2 Use models to explain that animals receive different types of information through their senses, process the information, and respond to the information in different ways.

Dimension 1: Science and Engineering Practice: Develop and Use Models: Use a model to show cause and effect relationships or interactions concerning the functioning of a natural system (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Systems and System Models Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- LS1.D Different sense receptors are specialized for particular kinds of information, which may then be processed and integrated by an animal's brain, with some information stored as memories. Animals are able to use their perceptions and memories to guide their actions. Some responses to information are instinctive—that is, animals' brains are organized so that they do not have to think about how to respond to certain stimuli (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Explain*** - Constructing a cause-and-effect model of a system

- Emphasis is on how systems transfer information (*e.g., An animal's response to stimuli- a dog is hot and lies in the shade; a rabbit hears a noise and runs away; a person is cold so they put on a jacket).*
- Students know that animals have behaviors in response to their environments and these behaviors help them survive *(e.g., migration or hibernation helps an animal to stay alive when food is scarce).*
- Students describe how different animals respond to changes in environmental conditions (*e.g., light, temperature, danger).*

- Students explain that sensory input, the brain, and behavioral responses are parts of a system that allow animals to engage in appropriate behaviors for survival (*e.g., owls are excellent hunters as an owl's face is shaped like a disk, allowing for sounds to hit the face and funnel to ear holes which is why an owl can hear a mouse on the forest floor).*
- Students describe how information sent to the brain allows experiences and behaviors to be shaped (*e.g., a black bear finds unsecured human trash cans an easy source of food, associating humans with food; a coyote that has been chased by a black bear will avoid that area in the future).*
- ***Develop and Use Models-*** Using a model, students summarize relevant information about the surroundings of the natural environment (sounds, light, smell, temperature; the brain receptors, animals' responses) and describe how information in the environment interacts with animal behaviors (*e.g., the temperature warms and an eastern diamondback rattlesnake comes out of hibernation; a loud noise can make a white-tailed deer run away; some insects can see in infrared light which draws them to certain plants for pollination).*
    - Students can describe components of their model (*e.g., information received by each of the senses, information sent to the brain, animals' responses to information).*

Academic Language
Questions/Sentence Stems that utilize academic language:

- Draw the parts of the system described in the scenario (*e.g., stimuli, animal's response).*
- How do the parts of [organism described in the scenario] work together? (*e.g., animal uses sense, send information to the brain, animal responds).*
- What part of the system does the model show? Why are these parts shown?
- Why do animals respond to stimuli? (*i.e., to survive).*
- What are examples of stimuli in an environment that an animal would respond to? (*e.g., light, sound, smell, movement, touch)*
- Compare how two different animals respond to similar stimuli (*e.g. temperature - reptiles and mammals and internal temperature regulation). Reptiles (lizards, turtles, snakes) are ectotherms, meaning they cannot generate their own body heat but instead must move to a warm/sunny spot to absorb heat from the environment in order to have energy to digest food, etc. Mammals (humans, rabbits, dolphins/whales, bears, etc.) are endotherms, meaning they can generate their own body heat and do not have to warm up in order to digest food, etc. They may be active in colder temperatures than reptiles).*
- **Develop and Use Models-**
    - What animal will you use in the model?
    - What will the environmental stimuli be?
    - What sense will the animal use to detect the stimuli?
    - What is the response?
    - How can a model explain/show these components?

Words to support student discourse: surroundings, natural environment, senses, information transfer, information (smell/odor, temperature, etc.); processing (perception/memories), response (behaviors/actions), systems

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Objective: LS.4.1.3 Engage in argument from evidence to explain how differences among animals of the same population sometimes gives individuals an advantage in surviving and reproducing in changing habitats.

Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten; animals with camouflage may avoid danger making them more likely to survive and reproduce.

Dimension 1: Science and Engineering Practice: Engage in Argument from Evidence: Construct and/or support an argument with evidence, data, and/or a model (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- LS2.C When the environment changes in ways that affect a place's physical characteristics, temperature or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.
- LS4.B Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates and reproducing (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy*: *Explain - Constructing a cause-and-effect model of a system

- Students know the physical features of plants and animals are suited to the environments in which they live.
- Students explain a phenomenon that relates to variations in characteristics among individuals of the same species (*e.g., coyote's fur color. Some individuals are better able to survive if they have a lighter vs. darker coat, depending on what camouflages best in their environment)*
- Students use evidence and reasoning to construct an explanation for the phenomenon (*e.g., looking at the surrounding environment for animal coloration).*
- Students describe the given evidence necessary for the explanation, including:
    - a given characteristic of a species *(e.g., thorns on a plant, camouflage of an animal, the coloration/patterns of caterpillars or moths)*.

    - the patterns of variation of a given characteristic among individuals in a species (*e.g., longer or shorter thorns on individual plants, dark or light coloration of animals*)
    - potential benefits of a given variation of the characteristic *(e.g., the light coloration of some moths makes them difficult to see on the light-colored bark of a tree*).
- Students explain some characteristics make it easier for organisms to survive, and reproduce; and those characteristics give some organisms an advantage over other organisms of the same species that don't have those characteristics (*e.g., an individual predator can run faster than their peers- they might be able to catch more prey, a more brightly colored male attracts more females. Note: Sometimes the fact that a particular species has such narrow adaptations (e.g. the endangered red-cockaded woodpecker prefers old growth longleaf pines to nest in) makes it more difficult for those animals to survive in the landscape compared to others (e.g. the northern flicker, another woodpecker, is more of a generalist and can nest in various tree species in lots of different types of environments).*

Academic Language
Questions/Sentence Stems that utilize academic language:

- What are the specific structures of a given animal? (*e.g., eyes, beaks, feathers, fur, claws, webbed feet, etc.)*
- What are the variations of structures in a given animal? *(e.g., birds have different shaped beaks).*
- How does variation provide an advantage for an organism? (*e.g.,* aid in survival)
- How does the environment impact which characteristics provide an advantage to a given animal? (*e.g., certain moth species that adapted to have unique coloration for better camouflage are now becoming easier for predators to find due to certain tree species dying out; animals that have previously adapted to a pattern of colder, snowier weather (e.g. snowshoe hares or weasels changing their fur color to white in the winter to better camouflage in snow, will be at a disadvantage if the climate warms and there is less/no snow in winter).*

Words to support student discourse: characteristics, variation, species, survival, reproduction/reproduce, adaptation, hibernation, migration, adaptation, camouflage, habitat, survival, instinct

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Biological Evolution: Unity and Diversity

Standard and Objectives:
LS.4.2 Understand the use of fossils as evidence of the history of Earth and its changing life forms.
LS.4.2.1 Analyze and interpret data to compare fossils to one another and living organisms.
LS.4.2.2 Analyze and interpret data to explain how fossils suggest ideas about Earth's early environment.

Objective: LS.4.2.1 Analyze and interpret data to compare fossils to one another and living organisms.

Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms.

Dimension 1: Science and Engineering Practice: Analyze and Interpret Data: Compare data collected by different groups in order to discuss similarities and differences in their findings (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Patterns Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- LS4.A Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Compare*** - Finding similarities and differences between two or more objects, events, ideas, problems, or situations

- Students know fossils are evidence of living organisms (plants and/or animals) that once existed on Earth.
- Students know fossils (molds, casts, preserved parts of plants and animals) share some characteristics based on where, how, and from what they formed (*e.g. certain plants and animals left behind impression fossils versus others that had their skeletons fossilized).*
- Students compare fossils to find similarities and differences in fossil characteristics.
- Students know some organisms that lived long ago are similar to existing organisms, while others are quite different (*e.g., ancient alligators, crocodiles, and mollusks are still very similar to the animals we see now, but present day mammals look very different than their predecessors).*
- Students infer organisms that are alive today, under the right conditions, will leave fossil evidence (*e.g. right conditions include a plant and animal being quickly buried by sediment or preserved in certain environments- peat bogs).*
- ***Analyze and Interpret Data-*** Use a data table to make comparisons of the body structure of fossilized organisms and organisms that exist today. Compare two organisms to determine similarities and differences (e.g., present day and fossilized horseshoe crabs; American alligator and Deinosuchus).

Academic Language
Questions/Sentence Stems that utilize academic language:

- Fossils help explain how _____(organisms) have changed over time.
- How are fossilized _____(*ferns*) similar to modern day (*ferns*)? (*e.g., they have similar structures- leaves).*
- How are fossilized _____(*ferns*) different from modern day (*ferns*)? *(e.g., they are nonliving and the modern day fern is living).*
- How are fossilized _____(*insects*) similar to modern day (*insects*)? *(e.g., they have similar structures e.g., wings, number of legs, divided body).*
- How are fossilized _____(*insects*) different from modern day (*insects*)? *(e.g., some(not all) were much larger than current day insects e.g., dragonflies; lived in different areas, etc.*).

Words to support student discourse: characteristics, examine, infer, investigate, reasoning, fossils, surface, organisms, molds, casts, impression, preserved parts, fossil evidence, early environments, environmental conditions, slow processes, sediments

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Objective: LS.4.2.2 Analyze and interpret data to explain how fossils suggest ideas about Earth's early environment.

Clarification Statement:

- Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.
- Students are not expected to know eras of time.

Dimension 1: Science and Engineering Practice: Analyze and Interpret Data: Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Patterns Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- LS4.A Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments.
- ESS1.C Earth has changed over time. The presence and location of certain fossil types indicate the order in which rock layers were formed (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Explain*** - Constructing a cause-and-effect model of a system

- Recognize some remains (fossils) of animals and plants that lived on Earth a long time ago are found in rocks and make simple deductions about changes in Earth's surface from the location of these remains.(TIMSS)
- Students know fossils provide information about the environmental conditions that existed when the fossil organism was alive, as well as information about where, when and how, the organism lived.

Academic Language
Questions/Sentence Stems that utilize academic language:

- What can fossils tell us about the environment of a certain area in the past? ?(*e.g. it may have once been an aquatic environment if fossilized marine organisms are found there today.*)
- If fossilized dragonflies had similar body structures to a modern day dragonfly what type of environment would you infer that the fossilized dragonflies lived in? *(e.g. an environment similar to modern day).*
- How is _____ changing over time? *(e.g. the environment - the present day coastal plain of North Carolina used to be underwater which is why Megalodon teeth and ancient whales can be found there)*
- What is one way you could classify or group these _____ (*fossils*), to create groups of _____ (animals or plants) that are similar to each other? Describe the attributes (characteristics) you are using to classify the _____ (*fossils*).
- ***Analyze and Interpret Data-*** *A*nalyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Fossil location should provide information about where, when, (early environment) and how the organism lived.

Words to support student discourse: fossils, surface, preserved parts, organism, early environments, environmental conditions

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Earth's Place in the Universe

Standard and Objectives:
ESS.4.1 Understand the causes of day and night and phases of the moon.

ESS.4.1.1 Use models to explain the cause of day and night based on the rotation of the Earth on its axis.
ESS.4.1.2 Use models to explain the repeating pattern of the phases of the moon (new, crescent, quarter, gibbous, and full).

Objective: ESS.4.1.1 Use models to explain the cause of day and night based on the rotation of the Earth on its axis.

Dimension 1: Science and Engineering Practice: Develop and Use Models: Develop and use models to describe and predict phenomena (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Patterns, Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- ESS1.B The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the moon; and different positions of the sun, moon, and stars at different times of the day, month, and year (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy*: *Explain - Constructing a cause-and-effect model of a system

- Students know the Earth is spherical in shape and that it rotates on an axis.
- Students know each complete rotation takes about 24-hours (a day).
- Students use models to show how Earth's rotation causes one side of the planet to receive light rays from the sun (day) while the other side remains dark (night).
- ***Engage in Argument from Evidence-*** Students use the changing appearance of shadows during the day as evidence of the Earth's rotation. Students can describe Earth's patterns of motion in a 24-hour cycle.
- ***Develop and use Models-*** Students collaboratively build and revise models of day and night based on evidence collected on the positions of the sun and Earth.

Academic Language
Questions/Sentence Stems that utilize academic language:

- Is the model presented at a (smaller/larger/the same) scale than the phenomenon as you might observe it directly? (*e.g., an Earth/moon/sun system model is going to be smaller than the actual scale of these things).*
- Does the model describe processes that are (faster/slower/the same speed) than the phenomenon as you might observe it directly? *(e.g., faster because modeling the day/night cycle will take a shorter time than the actual 24-hour process)*
- What evidence supports the claim that rotation causes the day/night cycle? *(e.g., light shining on half of the Earth while the other half of the Earth is dark, and the continuous 24-hour cycle).*

- What caused the patterns of day and night you observed in your model? (*e.g. the rotation of the Earth and the light from the flashlight/sun).*

Words to support student discourse: axis, day/night, rotation/rotates, position orbit, models, evidence, shadow, cycle, relationship, three-dimensional, sphere/spherical, 24-hours, patterns

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Objective: ESS.4.1.2 Use models to explain the repeating pattern of the phases of the moon (new, crescent, quarter, gibbous, and full).

Dimension 1: Science and Engineering Practice: Develop and Use Models: Develop and use models to describe and predict phenomena (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Patterns; Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- ESS1.B The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the moon; and different positions of the sun, moon, and stars at different times of the day, month, and year (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy*:* ***Explain*** - Constructing a cause-and-effect model of a system

- Students recognize the Earth has one moon that revolves around it.
- Students know the appearance of the moon changes in a specific pattern (waxes- more illuminated area; and wanes- less illuminated area) and repeats this sequence over the course of approximately 28 days.
- Students know the moon's appearance (phase) is determined by its position relative to the Earth and the sun.
- Students recognize the following phases of the moon: new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, last quarter, and waning crescent.
- ***Develop and Use Models-*** Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events including the phases of the moon.

Academic Language
Questions/Sentence Stem that utilize academic language:

- Why does the moon look different over the course of a month? *(e.g., moon reflects light, and the changing positions of Earth/moon/sun system causes the phases we observe from Earth)*.
- What causes the phases of the moon? (*e.g. explain the reflection of light, and the position of the sun, moon and Earth).*
- **Develop and Use Models-**
  - How can you model the relationships among the Earth/moon/sun system?
    - How will you represent the components of the Earth/moon/sun system?
    - How will each object move in relation to each other?
  - How can you model the moon phases?

Words to support student discourse: moon phases, rotate, revolve, month, waxes, wanes, new moon, first quarter, full moon, last quarter, waning gibbous, waxing gibbous, waning crescent, waxing crescent, patterns, light, reflects, position, Earth/moon/sun system

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Earth's Systems

Standard and Objectives:
ESS.4.2 Understand patterns of change in the Earth's surface over time.

ESS.4.2.1 Carry out investigations to classify minerals using tests for the physical properties of hardness, color, luster, cleavage and streak.
ESS.4.2.2 Carry out investigations to classify rocks as metamorphic, sedimentary, or igneous based on their composition, how they are formed, and the processes that create them.
ESS.4.2.3 Use models to explain changes in Earth's surface over time (to include slow changes of erosion and weathering, and fast changes of earthquakes, landslides, and volcanic activity).

Objective: ESS.4.2.1 Carry out investigations to classify minerals using tests for the physical properties of hardness, color, luster, cleavage and streak.

Dimension 1: Science and Engineering Practice: Plan and Carry Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered (NSTA SEP Matrix)

Dimension 2: Crosscutting Concepts: Patterns, Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- PS1.A Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify particular materials (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Classify*** - Determining that something belongs to a category based on relevant features or patterns

- Students know matter has observable properties that can be measured and described based on its characteristics *(e.g., strength, hardness, flexibility, ability to conduct heat, ability to be attracted by a magnet*, reactions to water (dissolve) and heat/fire (melt/evaporate).
- Students know minerals can be identified using particular tests *(e.g. hardness, streak).*
- Students describe the color, luster, and cleavage of a mineral.
- Students classify minerals based on physical properties.
- ***Plan and Carry Out Investigations-*** Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation *(e.g., students record observations on various minerals indicating hardness, color, luster, etc.).*
- ***Analyzing and Interpreting Data -*** Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships *(e.g., students organize their observations (data) on minerals into charts, finding patterns (color, hardness, ability to float or sink, magnetic, etc.).*

Academic Language
Questions/Sentence Stems that utilize academic language:

- What are some physical properties of the minerals? *(e.g., color, hardness, luster, etc.)*
- What are some similarities and differences among the minerals? *(e.g., same hardness, or streak).*
- How do size and shape affect color or streak? *(e.g., it does not affect color or streak).*
- If *Mineral Sample one* scratches *Mineral Sample two*, we know that *Mineral Sample one* is (*harder*) than *Mineral Sample two.*
- **Plan and Carry Out investigations-**
    - What property of the mineral will be tested?
    - How will you test the mineral's properties without changing other variables?
    - How will you collect data?
    - What did the investigation reveal?

Words to support student discourse: physical properties, weight/mass, solid, liquid, conduct, heat, float, sink, magnetic, minerals, hardness, streak, tiles, color, luster, cleavage, scratch test

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Objective: ESS.4.2.2 Carry out investigations to classify rocks as metamorphic, sedimentary, or igneous based on their composition, how they are formed, and the processes that create them.

Dimension 1: Science and Engineering Practice: Plan and Carry Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect, Systems and System Models Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- ESS2.A Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Classify*** - Determining that something belongs to a category based on relevant features or patterns

- Students know:
  - Igneous rocks are formed from molten rock.
  - Sedimentary rocks are formed from deposited rock particles (sediments) that are then compacted.
  - Igneous and sedimentary rocks can be transformed into metamorphic rocks through the application of heat and pressure over long periods of time.
- Students classify rocks as metamorphic, igneous, or sedimentary.
- Students know these classifications are based on the processes that created the rock.
- ***Plan and Carry Out Investigations-*** Make predictions about what would happen if a variable changes *(e.g., water is added to the process, temperature changes drastically, etc.)*

Academic Language
Questions/Sentence Stems that utilize academic language:

- Provide a collection of various rocks to students. Ask-What is one way you could classify or group these rocks?
- Describe the attributes (characteristics) you are using to sort or classify the rocks. *(e.g., size, shape, color, composition, etc.)*
- How can a small change to _____ have a big effect on _____? *(e.g. the temperature, rock type (e.g. melting rock can form new igneous rocks). Pressure, rock type (e.g., pressure applied to sedimentary rock- limestone may turn it into metamorphic rock -marble)*
- What are the key parts of the formation of _____? *(e.g., igneous rocks = magma, heat, melting; sedimentary rocks = pressure, various particles/sediments; metamorphic rocks = heat and pressure)*
- What are the key parts in the formation of rock? (*e.g. pressure, heat, time, water, minerals).*

Words to support student discourse: rocks, minerals, metamorphic, igneous, sedimentary, sediment, deposited, heat, pressure, solid, liquid, attributes (characteristics)

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Objective: ESS.4.2.3 Use models to explain changes in Earth's surface over time (to include slow changes of erosion and weathering, and fast changes of earthquakes, landslides, and volcanic activity).

Dimension 1: Science and Engineering Practice: Develop and Use Models: Develop a model using an analogy, example, or abstract representation to describe a scientific principle (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: System and System Models; Stability and Change Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- ESS1.C Earth has changed over time. Understanding how landforms develop, are weathered (broken down into smaller pieces), and erode (get transported elsewhere) can help infer the history of the current landscape. Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes.
- ESS2.A Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Explain*** - Constructing a cause-and-effect model of a system

- Students know Earth materials include rocks, minerals, soil and water.
- Students explain Earth's surface is made of rock and soil and it changes over time.
- Students explain how Earth's surface changes over time due to weathering (wind and water- including ice, and chemicals breaking down rock) and erosion (carrying earth materials from one place to another).
- Students know changes in the Earth's surface may be slow or rapid, subtle or drastic and include:
    - Landslides which occur when gravity causes large sections of soil and rock to move suddenly down an incline.
    - Volcanic eruptions which are openings in the Earth's crust that release hot gases and magma when they erupt.
    - Earthquakes which occur when large masses of rock move beneath the surface causing the ground to shake.
- Students know volcanoes and earthquakes are often found along the boundaries between continents and oceans.
- ***Develop and Use Models-*** Develop and/or use models to describe and/or predict phenomena (*e.g., students observe media to detect patterns in the movement of the natural world).*

Academic Language
Questions/Sentence Stems that utilize academic language:

- How does water change the Earth's surface? *(e.g., washes away soil and sediment to other areas, erodes earth's surface)*
- What evidence is there to support the claim that ice causes change? *(e.g., repetitive freezing and thawing can cause rocks to crack-weathering; large glaciers can carve out valleys in the landscape over time)*
- What are changes that happen slowly? (*e.g., weathering-such as water dissolving minerals or physically breaking down rocks when water freezes and thaws on and in the cracks of rocks).*
- What are changes that happen rapidly? (*e.g., volcanic eruptions, landslides, earthquakes)*
- How does/do _____ change the Earth's surface? (*e.g., weathering- breaks down earth's surface; erosion-carries weathered material away).*

Words to support student discourse: surface, erosion, weathering, rapid, drastic, slow, changes, landslide, volcano, earthquake

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Earth and Human Activity

Standard and Objectives:
ESS.4.3 Understand changes caused by human impact on the environment.

ESS.4.3.1 Ask questions to infer whether changes in an organism's environment are beneficial or harmful.
ESS.4.3.2 Engage in argument from evidence to explain how humans can adapt their behavior to live in changing. environments (e.g. recycling wastes, establishing rain gardens, planting native species to prevent flooding and erosion).
ESS.4.3.3 Obtain, evaluate and communicate information to compare solutions to environmental problems impacting plants and animals.

Objective: ESS.4.3.1 Ask questions to infer whether changes in an organism's environment are beneficial or harmful.

Dimension 1: Science and Engineering Practice: Ask Questions: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education)

Dimension 3: Disciplinary Core Ideas:

- LS4.C Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Infer*** - Drawing a logical conclusion from presented information

- Students know organisms have basic needs and can only survive in environments in which their needs are met (*e.g., air, light, water, space, food and shelter.)*
- Students know for any particular environment, some plants and animals survive well, some survive less well and some cannot survive at all. [*e.g. Pocosins (a type of freshwater, evergreen shrub wetland with standing water), which occur in North Carolina's coastal plain, are environments with extremely acidic soils making them nutrient poor. The Atlantic white cedar or many carnivorous plants (which have adapted to get nutrients through insect eating) and the pine barrens treefrog may flourish, whereas the red-cockaded woodpecker (endangered) can survive if the pond pine tree is present. The eastern hellbender, a large aquatic salamander, would not survive in a pocosin because they rely on clear, cold, flowing*

water of mountain streams to survive, and large rocks under which to make nests and lay their eggs.]

- ***Ask Questions-*** Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships *(e.g., when a wooded area is cut down what is the impact on organisms that live in the area?)*

Academic Language
Questions/Sentence Stems that utilize academic language:

- What structures, functions or behaviors help organisms survive in their environments? *(e.g., adaptations)*
- How are some organisms suited for a particular environment? *(e.g., coloring, fur, speed, etc).*
- If the amount of water in a pond environment decreased what could be a harmful effect? (*e.g., frogs laying eggs in areas with low water risk their eggs drying up or when the eggs hatch, not enough space and food for their offspring)*
- What change in an environment could be beneficial to an organism? (*e.g., planting native plants can benefit multiple organisms- birds, insects).*
- What change in an environment would be harmful to an organism? (*e.g., removing plants along a stream or river can result in more soil entering the water creating issues for aquatic organisms living there).*
- What are ways animals might survive changes in their ecosystem? (*e.g., if trees are cut down, animals who live in the area will move to another location(migration) or die).*

Words to support student discourse: environment, changes/alter, beneficial, harmful, survive, organism, habitat

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Objective: ESS.4.3.2 Engage in argument from evidence to explain how humans can adapt their behavior to live in changing environments (e.g. recycling wastes, establishing rain gardens, planting native species to prevent flooding and erosion).

Dimension 1: Science and Engineering Practice: Engage in Argument from Evidence: Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model by citing relevant evidence and posing specific questions. (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- ESS3.C Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. For example, they are treating sewage, reducing the amounts of materials they use, and regulating sources of pollution such as emissions from factories and power plants or the runoff from agricultural activities (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Explain*** - Constructing a cause-and-effect model of a system

- Students explain how humans impact (positive or negative) the environment (*e.g., littering; recycling*).
- Students know humans can adapt their behavior in order to conserve materials and natural resources.
- Students know humans need to preserve the ecological systems they depend on for survival (*e.g., water, land resources*).
- ***Engage in Argument-*** Construct and/or support an argument with evidence, data, and/or a model on how humans can adapt their behavior in changing environments (*e.g., recycling helps with waste -plastic bags, bottles, etc.- entering landfills and impacting animals and plants).*

Academic Language
Questions/Sentence Stems that utilize academic language:

- How is the environment changing? (*e.g. natural change over time versus human impacts on the environment).*
- How can humans change their behavior as the environment changes? [*e.g., humans previously living in areas at risk of frequent flooding (near rivers, low-lying areas, or coastlines) may want to move to higher ground over time]*
- Why is it important to reuse, reduce, and recycle? (*e.g., to keep items out of the landfills; to reduce the amount of natural resources consumed; to conserve resources; and to reduce energy consumption*)

Words to support student discourse: conserve, preserve, adapt, behavior, environments, recycling, native species, rain gardens, flooding, erosion

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Objective: ESS.4.3.3 Obtain, evaluate and communicate information to compare solutions to environmental problems impacting plants and animals.

Dimension 1: Science and Engineering Practice: Obtain, Evaluate and Communicate Information: Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts (NSTA SEP Matrix).

Dimension 2: Crosscutting Concepts: Cause and Effect Note: Crosscutting concepts (CCC) are used in combination with SEPs to help students with sensemaking in science. Please note teachers may choose one or more of the seven Crosscutting Concepts for a given standard (A Framework for K-12 Science Education).

Dimension 3: Disciplinary Core Ideas:

- ETS1.C Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and constraints (A Framework for K-12 Science Education).

What does it look like to demonstrate proficiency?

Revised Bloom's Taxonomy: ***Compare*** - Finding similarities and differences between two or more objects, events, ideas, problems, or situations

- Students recognize human behavior has negative and positive effects on the environment (*e.g., negative effects of air and water pollution; positive effects of reducing air and water pollution*).
- Students provide general descriptions and examples of the effects of pollution on plants, and animals (including humans).
- Students compare solutions to human made issues in the environment (*e.g., recycling plastic versus biodegradable packaging materials.)*
- ***Obtain, Evaluate and Communicate Information-*** Obtain and combine information from books and/or other reliable media to explain phenomena.

Academic Language
Questions/Sentence Stems that utilize academic language:

- What are positive effects humans have on the environment? *(e.g., helping endangered species populations recover; monitor plant and species populations; providing a safe and protected environment for sea turtle hatching)*
- What are negative effects humans have on the environment? *(e.g., deforestation, littering, pollution)*
- What effect does pollution have on humans, plants, and animals? *(e.g., harmful to plants, and animals (including humans).*
- How are humans addressing the negative effects on the environment? *(e.g., recycling, planting native gardens, reducing waste).*
- How can you share/communicate those solutions? *(e.g., sharing with family members; presenting to your peers; writing letters).*

Words to support student discourse: solutions, environmental problems

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