2023-2024

Elementary Science ISAT Specifications

IDAHO STATE DEPARTMENT OF EDUCATION
ASSESSMENT AND ACCOUNTABILITY | ISAT

650 W STATE STREET, 2ND FLOOR
BOISE, IDAHO 83702
208 332 6800 OFFICE / 711 TRS
WWW.SDE.IDAHO.GOV

CREATED 10/20/2023

TABLE OF CONTENTS

INTRODUCTION

Item specifications set the framework for items on the Idaho Standards Achievement Test (ISAT) in science that align to the 2022 Idaho Content Standards in Science. The specifications define the properties of each test item, including the allowable vocabulary, possible phenomena, and task demands that may be used to assess students' knowledge and skills for each standard.

Stakeholders can use this document to view each Idaho Content Standard for elementary science alongside its assessment specifications, to plan for assessment and guide instruction.

Dimensions in the Idaho Content Standards in Science

The 2022 Idaho Content Standards reflect a three-dimensional learning framework that shifts the focus of science education away from the memorization of discrete facts or the development of specific sets of skills in separated content areas and towards an integrated approach that recognizes the interconnectedness of science education. Science is comprised of themes that cut across and incorporate all science content areas and practices, and the Idaho Content Standards in Science aim to reflect this interconnectedness through three-dimensional learning that will engage Idaho students to think critically, solve problems, and be better prepared to engage with the world as well-informed citizens. The three dimensions are as follows.

1. **Disciplinary Core Ideas (DCI):** DCIs to prepare students with sufficient knowledge surrounding major ideas within the disciplines of Earth Science, Life Science, and Physical Science. In a rapidly changing world where technology allows for information to be instantly available, the purpose of teaching disciplinary core ideas is not for students to memorize facts, but rather to develop a solid foundation of understanding of core ideas that can be built upon as more knowledge is acquired.
2. **Science and Engineering Practices (SEP):** SEPs describe the major practices that scientists and engineers employ as they investigate the world, develop models to learn more about phenomena, and design systems to solve problems.
3. **Crosscutting Concepts (CCC):** CCCs are skills and concepts that are employed across all areas of science. Many content areas of science revolve around similar concepts that aid students in making sense of knowledge from various fields of science and engineering. Crosscutting concepts reflect the cyclical nature of science education—as students progress from elementary school

through high school, they will engage with and employ similar patterns of thinking to understand and solve increasingly complex phenomena and problems.

Test Development

Item Development Cycle

Items on the Science ISAT undergo a rigorous development process, outlined below.

1. **Item Development:** Test developers create items that are aligned to the Idaho Content Standards in Science and according to the item specifications set forth by the SDE.
2. **SDE Review:** These items are reviewed and edited by professional test developers and by professionals at the SDE.
3. **Stakeholder Review:** After review by the SDE, items are examined and approved by science educators and stakeholders from across Idaho through the following processes:
    i. **Content Review**: Science educators in all grade levels and content areas review items to ensure science content is accurate and aligned with the standards.
    ii. **Rubric Validation**: Idaho educators analyze student responses generated from field tests to finalize scoring metrics and rubrics used to assess student achievement.
    iii. **Data Review:** Idaho educators review item performance statistics and determine if items are eligible to assess student achievement.
    iv. **Bias and Sensitivity Review**: Stakeholders, including teachers, parents, administrators, and community members, review items to ensure fairness and lack of bias for all Idaho students.

Test Structure

Items on the Science ISAT begin with a stimulus, which is a phenomenon (a discrete observation about the natural world) or engineering/design problem. The stimulus can include text, graphics, tabular or graphical data, and/or animations. Items engage the student in a meaningful, grade-appropriate activity that allows them to demonstrate their three-dimensional knowledge, skills, and scientific thinking.

All Items on the Science ISAT are aligned to one Idaho Content Standard and follow one of two formats to assess students' knowledge and skills:

1. **Clusters:** Clusters engage students with a phenomenon or engineering design problem by asking students to perform a series of related interactions. Each associated interaction is crafted using the Task Demand statements found in the specifications. A cluster will assess a student in all three dimensions of the aligned standard.
2. **Standalones:** Standalone items engage students with a phenomenon or engineering design problem by asking students to perform a single task or interaction with the stimulus. A standalone item will assess students in two or three dimensions of the aligned standard.

Interaction Types

The Science ISAT includes several different interaction types that allow students to engage in grade-appropriate science activities. These interactions allow students to demonstrate their two- and three-dimensional scientific knowledge, skills, and abilities. Each of the interaction types listed are included in the science Practice and Training Test, which is accessible to the public via the Idaho Portal. Interaction types are as follows.

- Multiple Choice (MC)
- Multi-Select (MS)
- Edit Task Choice (ETC)
- Grid Item (GI)
- Hot Text (HT)
- Simulation (SIM)
- Table Input (TI)
- Table Match (TM)
- External Copy Interactions (EC)
- Equation Interaction (EQ)

Scoring Assertions

Scoring assertions set forth the inferences that can be made about a student's knowledge, skills, and abilities based on their interaction with the test item. Scoring assertions convey two pieces of information:

1. The task completed by the student.
2. Evidence of the student's knowledge, skills, and abilities (KSA) can be inferred from the completion of that task.

Each cluster and stand-alone have their own unique scoring assertions. The number of scoring assertions for each cluster and stand-alone varies.

Sections of ISAT Science Item Specifications

For each standard, the following information is available.

Idaho Content Standard Code and Language
The standard code (e.g., MS-PS-1.1) and standard language (Develop models to describe the atomic composition of simple molecules.) are taken directly from the published 2022 Idaho Content Standards in Science.

Dimensions

The science content/disciplinary core idea for each standard is taken directly from the published 2022 Idaho Content Standards in Science. The science and engineering practice and crosscutting concepts of each standard are taken from the Idaho Content Standards in Science along with additional context from other three-dimensional science standards.

Further Explanation and Content Limit

The Further Explanation and Content Limit information comes from the published Idaho Content Standards in Science with additional context and language added by the professional test developers, writers of other three-dimensional science standards, and Idaho science educators. All additional context and language added from those various sources has been vetted and approved by Idaho science educators.

Science Vocabulary

For each standard, vocabulary is listed in two sections: vocabulary that may be used in assessment items and vocabulary that should not be used in assessment items. Vocabulary lists are aligned to grade-appropriate words that students should be familiar with and ensure that words used on assessment items are within content limits.

It is important to note that neither vocabulary list is exhaustive. The lists are **not** intended to be used by educators for memorization purposes in the classroom. Science assessment items will never require students to simply recall the definition of words found in the vocabulary section of this document.

Context/Phenomena

Each assessment item begins with a phenomenon, a discrete observation about the natural world, or an engineering/design problem.

The phenomena or design problems listed in this section give the professional test developers ideas as to the grade-appropriate observations about the natural world or engineering/design problems that are fitting for an assessment item aligned to the standard. Please note that the

phenomena and engineering/design problems listed in this section are examples and will not appear in any actual test items on the Science ISAT.

Task Demands

Each interaction in an assessment item is crafted using task demand statements found in the specifications. The task demands inform the professional test developers how to construct interactions that are two- or three-dimensionally aligned. The task demands give the professional test developers ideas as to which interaction types could be used to engage the student in grade-appropriate, meaningful scientific activities. When constructing associated interactions in a cluster, the task demands can be used in any combination or any number of times.

ELEMENTARY SCIENCE ISAT SPECIFICATIONS

3rd Grade Earth Science

3-ESS-1.1 Students who demonstrate understanding can:
Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Dimensions:

- **SEP:** *Analyzing and Interpreting Data:* Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.
- **DCI:** *Earth's Systems, Weather and Climate*: Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
- **CCC:** *Patterns*: Patterns of change can be used to make predictions.

Further Explanation and Content Limit:

- Further Explanation: Examples of data could include average temperature, precipitation, and wind direction.
- Content Limits:

        - Assessment of graphical displays is limited to pictographs and bar graphs.
        - Assessment does not include climate change.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - Season
    - Weather
    - Temperature
    - Precipitation
    - Patterns
    - Average
    - Latitude
    - Longitude
- Vocabulary that should not be used in assessment items:
    - Probability
    - Anthropogenic Change

Phenomena

- Vienna, Austria, records more sunny days in the summer than in the winter. Data: Average sunshine hours by month for the city, given as a table or graph.
- People in Florida can often go outside without jackets during the winter. Data: Months and Temperatures for Florida, given as table or graph.
- Visitors to the desert in Death Valley, California, were surprised to be rained on. Data: Months and Precipitation Averages for the region given as table or graph.
- Flags in California's San Joaquin Valley are seen blowing to the SE for most of the year but are seen blowing to the NW in winter months. Data: Monthly average wind direction (and maybe speed) for the region, given as a table or graphic with wind direction arrows.

Task Demands

- Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in weather patterns.
- Generate/construct graphs, tables, or assemblages of illustrations and/or labels of data that document patterns, trends, or correlations in weather patterns. This may include sorting out distractors.
- Use relationships and patterns identified in the data to predict weather.
- Identify patterns or evidence in the data that support conclusions about weather.

3-ESS-1.2 Students who demonstrate understanding can:
Obtain and combine information to describe climates in different regions of the world.

Dimensions:

- **SEP:** *Obtaining, Evaluating, and Communicating Information:* Obtain and combine information from books and other reliable media to explain phenomena.
- **DCI:** *Earth's Systems, Weather and Climate*: Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.
- **CCC:** *Patterns*: Patterns of change can be used to make predictions.

Further Explanation and Content Limit:

- Further Explanation: None.
- Content Limits:
    i. Students do not need to know complex interactions that cause weather patterns and climate.
    ii. Students do not need to know the role of the water cycle in weather.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    i. Precipitation
    ii. Prediction
    iii. Glacier
    iv. Ocean
    v. Region
    vi. Climate
    vii. Atmosphere
    viii. Freeze
    ix. Vegetation
    x. Latitude
    xi. Longitude
    xii. Drought
    xiii. Temperature
- Vocabulary that should not be used in assessment items:
    i. Average
    ii. High Pressure
    iii. Low Pressure
    iv. Radiation
    v. Water Cycle
    vi. Air Mass

vii. Altitude
viii. Humidity

Phenomena

- Anchorage, Alaska has cool summers and very cold winters with a lot of snowfall.
- It often snows in Colorado in July, but it does not often snow in Kansas in July.
- On the western side of the Cascade Mountains of Oregon, it rains frequently, but on the eastern side, it does not.
- The temperature in London, England does not get very hot in summer or very cold in winter.

Task Demands

- Organize and/or arrange data (including labels and symbols) regarding the climates in different regions to highlight/identify trends or patterns or make comparisons/contrasts between different regions and/or climatically relevant aspects of their geology and/or geography.
- Generate or construct tables or assemblages of data (including labels and symbols) that document the similarities and differences between climates of different regions (this includes completing incomplete maps).
- Analyze and interpret scientific evidence (including textural and numerical information as well labels and symbols) from multiple sources (e.g., texts, maps, and/or graphs) that help identify patterns in weather in regions of different climates. This includes communicating the analysis or interpretation.
- Analyze and interpret patterns of information on maps (including textural and numerical information as well labels and symbols) to explain, infer, or predict patterns of weather over time in a region.
- Based on the information that is obtained and/or combined, identify, assert, describe, or illustrate a claim regarding the relationship between the location of a region and its climate, or the relationship between geological and/or geographical aspects/characteristics of a region and its climate.
- Use spatial and/or temporal relationships identified in the obtained and/or combined climate data to predict typical weather conditions in a region.
- Organize and/or arrange data regarding the climate of a region to highlight/identify trends or relationships between the weather patterns of a region and its geology and/or geography.
- Analyze and interpret scientific evidence (including textural and numerical information as well labels and symbols) from multiple sources (e.g., texts,

maps, and/or graphs) that help identify patterns in climate based on geography and/or geology. This includes communicating the analysis or interpretation.

3-ESS-2.1 Students who demonstrate understanding can:
Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
- **DCI:** *Earth and Human Activity, Natural Hazards*: A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.
- **CCC:** *Cause and Effect*: Cause-and-effect relationships are routinely identified, tested, and used to explain change.

Further Explanation and Content Limit:

- Further Explanation: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lighting rods.
- Content Limits: None.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - Natural process
  - Earthquake
  - Tsunami
  - Tornado
  - Flooding
  - Severe Weather
  - Coastal Erosion
  - Landslide
  - Avalanche
  - Dam
  - Levee
  - Lightning
  - Lightning rod
  - Forecast
  - Drought

- Vocabulary that should not be used in assessment items:
  - Fault Line
  - Names of clouds
  - Names of storms
  - Magma
  - Types of volcanoes
  - Low pressure
  - High pressure
  - El Niño, La Niña
  - Jet Stream

Phenomena

- A building with a lightning rod is struck by lightning more often than the surrounding buildings.
- When the water level of the Feather River was high in February 2017, the water never rose higher than the levees around it, and no flooding occurred. When the water level of the Russian River was high in February 2017, the surrounding area flooded.
- A house built near the ocean in Surfside, New Jersey, sits on stilts/posts.
- A basement in a building fitted with a sump pump does not have mold while the basements of other nearby buildings have mold.

Task Demands

- Identify or assemble from a collection, including distractors, the relevant aspects of the hazard that a given design solution resolves/improves.
- Using the given information, select or identify the criteria against which the design solution should be judged.
- Using the given information, select or identify constraints that the design solution must meet.
- Identify missing components, relationships, or other limitations of the design solution.
- Use an explanation to predict the outcome of a hazard given a change in the design solution.
- Make a claim about the merit of the design solution that can be defended.

3rd Grade Physical Science

3-PS-1.1 Students who demonstrate understanding can:
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Dimensions:

- **SEP:** *Planning and Carrying 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.
- **DCI:** *Motion and Stability, Forces, and Interactions*: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces is used at this level.)
- **CCC:** *Cause and Effect*: Cause and Effect Relationships are routinely identified.

Further Explanation and Content Limit:

- Further Explanation: Examples could include an unbalanced force on one side of a ball can make it start moving, and balanced forces pushing on a box from both sides will not produce any motion at all.

- Content Limits:
    i. Assessment is limited to one variable at a time: number, size, or direction of forces.
    ii. Assessment does not include quantitative force size, only qualitative and relative.
    iii. Assessment is limited to gravity being addressed as a force that pulls objects down.
    iv. Assessment does include normal force, but not by name or magnitude.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - Strength
    - Direction
    - Speed
    - Gravity
    - Net
    - Sum
    - Weight
- Vocabulary that should not be used in assessment items:

- Velocity
- Acceleration
- Mass
- Friction
- Vector
- Quantitative
- Relative
- Scale
- Weight (in terms of mass times gravity)
- Newtons
- Normal force

Phenomena

- Kids of the same size and strength play a game of tug of war. When the same number of kids are on each side, a ribbon tied to the rope does not move. When more kids are on one side, the rope moves in that direction.
- A ball rests on the ground, unmoving. When it is gently kicked, it moves slowly in the direction it was kicked. When it is kicked harder, it moves more quickly in the direction it was kicked.
- A box is sitting in the center of a table. Strings attached to the left and right sides of the box hang over the sides of the table. Identical weights can be attached to the end of these strings.
- A flat track with posts and rubber bands on either end of the track. The student can pull a car back different distances to gather data.

Task Demands

1. Assemble, complete, or identify, from a collection including distractors, the essential components of an investigation that studies balanced and unbalanced forces on an object at rest and/or in motion.
2. Identify the variables in the investigation that are held constant, and which are changing, and define important factors in the design including number of trials, methods, and techniques.
3. Identify the observations that should be collected in an investigation of an object's motion to determine the forces on the object and the causes of those forces.
4. Observe, collect, and record data from observations of the forces acting on an object at rest and/or in motion after forces of different strengths and/or directions are applied, including both balanced and unbalanced forces.
5. Identify from a list, including distractors, the effects of forces on an object's motion and the cause of those forces.

6. Make predictions about the effects of changes in the motion of an object given specific forces. Predictions can be made by manipulating components of the investigation, completing illustrations, or selecting from lists with distractors.

3-PS-1.2 Students who demonstrate understanding can:
Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Dimensions:

- **SEP:** *Planning and Carrying Out Investigations:* Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or to test a design solution.
- **DCI:** *Motion and Stability: Forces and Interactions*: Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
    - The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.
    - The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)
- **CCC:** *Patterns*: Patterns of change can be used to make predictions.

Further Explanation and Content Limit:

- Further Explanation: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.
- Content Limits:
    - Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.
    - Students do not need to know Newton's laws of motion or the Law of Conservation of Energy.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - Speed

    - Distance
    - Height
    - Time
    - Mass
    - Force
    - Gravity
    - Electrical Field
    - Static Electricity
    - Distribution of Charged Particles
    - Electrical Charge
    - Negatively Charged
    - Positively Charged
    - Neutrally Charged
    - Magnetic Field
    - Polarity
    - North pole
    - South pole
    - Attraction
    - Repulsion
    - Electromagnet
- Vocabulary that should not be used in assessment items:
    - frequency
    - amplitude
    - displacement
    - equilibrium position
    - oscillate
    - momentum
    - velocity
    - vector
    - elastic collision
    - inelastic collision
    - friction
    - acceleration of gravity
    - work
    - power
    - controlled variable
    - dependent variable
    - independent variable
    - kinetic energy
    - potential energy

Phenomena

- A boy and a girl play on a swing set. In 10 tries, the girl cannot get the boy to swing higher than the height she released him.
- A ball can be thrown farther when a person launches the ball from a plastic ball thrower rather than from his/her bare hand.
- A marble is rolled down a slide. It takes five seconds for the marble to reach the bottom of the slide. The same marble is rolled down another slide. This time, it takes the marble two seconds to reach the bottom of the slide.

Task Demands

- Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in weather Identify the output data that should be collected in an investigation of an object's motion.
- Make and/or record observations about an object's motion as it repeats a pattern over time.
- Generate or construct graphs, tables, assemblages of illustrations and/or labels of data that highlight patterns, trends, or correlations in the pattern of an object's motion. This may include sorting out distractors.
- Summarize data to highlight trends, patterns, or correlations in the motion of an object.
- Use relationships identified in the data to predict/infer the future motion of an object.
- Identify patterns or evidence in the data that supports predictions/inferences about an object's future motion.

3-PS-1.3 Students who demonstrate understanding can:
Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Dimensions:

- **SEP:** *Asking Questions and Defining Problems:* Ask questions that can be investigated based on patterns such as cause and effect relationships.
- **DCI:** *Motion and Stability, Forces, and Interactions: Types of Interactions*: Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.
- **CCC:** *Cause and Effect*: Cause and effect relationships are routinely identified, tested, and used to explain change.

Further Explanation and Content Limit:

- Further Explanation:
  - Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets.
  - Examples of cause-and-effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.
- Content Limits:
  - Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.
  - Limit strictly to qualitative observations.
  - Limit content to ask questions about how electric and magnetic objects interact, and the investigation of these phenomena within the scope of the classroom.
  - Students should be able to identify the direction of the force, but not the shape of the magnetic or electric field.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - attraction
  - repulsion
  - north pole
  - south pole
  - positive charge
  - negative charge
  - static electricity
- Vocabulary that should not be used in assessment items:
  - force fields
  - test charge
  - protons
  - neutrons
  - electrons
  - field gradients
  - insulator

- conductor

Phenomena

- A balloon rubbed against a sweater attracts a whole grain oat O-shaped cereal attached to a string.
- A magnet floats on top of another magnet when aligned correctly.
- A magnet touching the underside of a glass table can move a piece of metal sitting above it on top of the table.
- Two opposite poled magnets suspended by strings in air will levitate.

Task Demands

- Select or identify from a collection, questions that will help clarify the properties that are correlated with the strength or direction of the forces in the phenomenon. In addition to plausible distractors, distractors may also include non-testable ("nonscientific") questions.
- Make and/or record observations about how the size of the forces, both magnetic and electric, depend on different characteristics such as strength/orientation of the magnet, the amount of electric charge, materials, etc.
- Identify, describe, or select from a collection, characteristics, properties, features, and/or processes to be manipulated or held constant, while gathering information to answer a well-articulated question about the cause-and-effect relationships of electric or magnetic interactions.
- Select or describe conclusions relevant to the question posed which are supported by the data, especially inferences about causes and effects, related to static electricity and/or magnetism.
- Predict outcomes when properties or proximity of the objects are changed, given the inferred cause and effect relationships, related to static electricity and/or magnetism.

3-PS-1.4 Students who demonstrate understanding can:
Define a problem that can be solved by applying scientific ideas about magnets.

Dimensions:

- **SEP:** *Asking Questions and Defining Problems:* Ask questions that can be investigated based on patterns such as cause and effect relationships.
- **DCI:** *Motion and Stability, Forces, and Interactions: Types of Interactions*: Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.
- **CCC:** *N/A*

Further Explanation and Content Limit:

- Further Explanation:
    - Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.
- Content Limits:
    - Assessment is limited to forces produced by objects that can be Students only need to know the basics about magnets. They do not need to know about the magnetic field and how it is shaped for different objects, etc.
    - Students do not need to know how a magnet can magnetize other objects; they just need to know that it does. For example, a paper clip is not magnetic but will be attracted to a magnet. (The student does not need to know anything about magnetic domains.)
    - Students do not need to know how electricity and magnetism are coupled (that moving electrons create a magnetic field and that a changing magnetic field creates a current).
    - Students do not need to know anything about magnets except that they can repel/attract each other based on their orientation relative to each other.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - magnetic
    - attraction
    - repulsion
    - non-contract force
    - north pole
    - south pole
    - bar magnet
- Vocabulary that should not be used in assessment items:
    - force fields
    - field gradients
    - conductor
    - orientation
    - magnetic field
    - exert interaction
    - electromagnetism

Phenomena

- The shower leaks because the curtain is not secured to the bottom of the bathtub.
- Things continually fall out of a handbag because the latch is not secure.
- While working on a project, pencil shavings were dropped on the carpet and the vacuum may not have cleaned them all up.

- Two carts used in experiments keep damaging each other when they collide.

Task Demands

- Identify or assemble from a collection, including distractors, the relevant aspects of the problem that given design solutions, if implemented, will resolve/improve.
- Articulate, describe, illustrate, or select the relationships, interactions, and/or processes to be explained OR to be used to solve the problem. This may entail sorting relevant from irrelevant information or features.
- Express or complete a causal chain explaining how the repulsion or attraction of magnets will solve the problem that has been identified. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause-and-effect chains.
- Using given data, propose/illustrate/assemble a potential device (prototype) or solution.
- Describe, identify, and/or select information needed to support an explanation about the proposed solution.

3rd Grade Life Science

3-LS-1.1 Students who demonstrate understanding can:
Develop models to show that living things, although they have unique and diverse life cycles, all have birth, growth, reproduction, and death in common.

Dimensions:

- **SEP:** *Developing and Using Models:* Develop a model using an example to describe a scientific principle.
- **DCI:** *From Molecules to Organisms*: *Structure and Processes:* Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.
- **CCC:** *Structure and Function:* Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Further Explanation and Content Limit:

- Further Explanation:
    - Changes organisms go through during their life form a pattern.
- Content Limits:
    - Assessment of plant life cycles is limited to those of flowering plants.
    - Assessment does not include details of human reproduction.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - brain

    - body
    - flow
    - flower
    - heart
    - lung
    - muscle
    - movement
    - grasp
    - habit
    - moisture
    - organization
    - petal
    - predator
    - prey
    - roots
    - skin
    - stem
    - stomach
    - temperature
- Vocabulary that should not be used in assessment items:
    - cell
    - detect
    - response
    - body plan
    - elastic
    - external
    - intellectual
    - internal
    - invertebrate
    - organ
    - vertebrate
    - multicellular
    - stimulus
    - tissue

Phenomena

- A flowering plant can produce seeds that grow more flowering plants.
- A mother bear takes her young bear cubs to look for food.
- A plant develops roots to obtain nutrients and grow.

Task Demands

- Identify evidence or patterns in the data that support inferences and/or determine relationships between a particular structure of an organism and a function that supports survival, growth, behavior, and reproduction.
- Understand and generate simple bar graphs or tables to document patterns, trends, or relationships between a particular structure of an organism and a function that supports survival, growth, behavior, and reproduction.
- Sort observations/evidence into those that appear to support or not support an argument.

3-LS-2.1 Students who demonstrate understanding can:
Construct an argument that some animals form groups that help members survive.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Construct an argument with evidence, data, and/or a model.
- **DCI:** *Ecosystems: Interactions, Energy, and Dynamics:* Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.
- **CCC:** *Cause and Effect*: Cause and effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation: Focus is on how being part of a group helps animals obtain food, defend themselves, and cope with changes, and does not cover how group behavior evolved because of a survival advantage.
- Content Limits:
    - Assessment does not include the evolution of group behavior.
    - Students do not need to know social hierarchy in animal groups (pecking order, dominance, submissive, altruism).

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - environment
    - prey
    - predator
    - characteristic
    - habitat
    - species
    - herd
    - inherit

    - trait
    - diet
    - mate
    - parent
- Vocabulary that should not be used in assessment items:
    - organism
    - social
    - relative
    - predation
    - hereditary
    - harmful
    - beneficial
    - variation
    - probability
    - adaptation
    - decrease
    - increase
    - behavioral
    - variation
    - ecosystem
    - pecking order
    - dominance/submissive behavior
    - hierarchy
    - migrate
    - defend

Phenomena

- In Yellowstone National Park, a wolf preys on a much larger bison.
- In the Willamette Valley, a colony of beavers builds a dam.
- A colony of ants protects its nests.
- A male honeybee returns to a hive each day.

Task Demands

- Identify patterns or evidence in the data that support inferences and/or determine relationships about the effect of group membership on survival of an animal.
- Understand and generate simple bar graphs or tables that document patterns, trends, or relationships between group membership and survival.
- Sort observations/evidence into those that appear to support or not support an argument.
- Based on the provided data, identify, or describe a claim regarding the relationship between survival of an animal and being a member of a group.

- Identify, summarize, select, or organize given data or other information to support or refute a claim regarding the relationship between group membership and survival of an animal.
- Using evidence, explain the relationship between group membership and survival.

3-LS-3.1 Students who demonstrate understanding can:
Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

Dimensions:

- **SEP:** *Analyzing and Interpreting Data:* Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.
- **DCI:** *Heredity: Inheritance and Variation of Traits*: Many characteristics of organisms are inherited from their parents.
- **CCC:** *Patterns*: Patterns of change can be used to make predictions.

Further Explanation and Content Limit:

- Further Explanation: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.
- Content Limits:
    - Assessment does not include genetic mechanisms of inheritance and prediction of traits, including concepts of dominant/recessive traits or sex-linked traits.
    - Assessment is limited to non-human examples.
    - Graphs and charts can include bar graphs, pictographs, pie charts, tally charts.
    - Types of math can include simple fractions, simple addition/subtraction.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - parent
    - sibling
    - characteristic
    - offspring
    - parent-offspring similarity
    - feature
    - inherit
    - inherited characteristic
    - reproduce
- Vocabulary that should not be used in assessment items:
    - transfer
    - variation

    - allele
    - hereditary information
    - identical
    - Punnett square
    - transmission
    - gene
    - genetic
- genetic variation
- dominant trait
- recessive trait

Phenomena

- Two corn plants in a garden reproduce. In the next generation, the offspring vary in height. (Augmentation: We will provide a data table displaying each member of the subsequent generation and the relevant trait possessed.)
- Over a four-year period, the offspring of two tall blueberry plants always grow taller than the offspring of two nearby short blueberry plants. (Augmentation: We will provide a data table of the number of offspring of each plant height over a four-year period, correlated with the parent plants.)

Task Demands

- Organize or summarize data to highlight trends, patterns, or correlations between the traits of offspring and those of their parents and/or siblings.
- Generate graphs or tables that document patterns, trends, or correlations in inheritance of traits.
- Identify patterns or evidence in the data that support inferences about inheritance of traits from parents to offspring.

3-LS-3.2 Students who demonstrate understanding can:
Use evidence to support the explanation that traits can be influenced by the environment.

Dimensions:

- **SEP:** *Constructing Explanations and Designing Solutions:* Use evidence (e.g., observations, patterns) to support an explanation.
- **DCI***: Heredity: Inheritance and Variation of Traits:* Many characteristics involve both inheritance and the environment. Characteristics result from individuals' interactions with the environment, which can range from diet to learning.
- **CCC:** *Cause and Effect:* Cause-and-effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation:
    - Examples of the environment affecting a trait could include normally tall plants that are grown with insufficient water and are stunted; and a pet dog that is given too much food and little exercise and becomes overweight.
- Content Limits:
    - Assessment should focus on physical traits.
    - Content should not include human traits.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - offspring
    - feature
    - inherit
    - diet
    - survival
    - flood
    - drought
    - habitat
    - reproduce
- Vocabulary that should not be used in assessment items:
    - organism
    - variation
    - version
    - harmful
    - beneficial
    - increase
    - decrease
    - trend

Phenomena

- The arctic fox is white in winter but turns brown in the summer.
- Flamingoes are born gray, but some become very pink as they grow.
- Trees growing on the edge of cliffs are often bent.
- A goldfish in a pond grows larger than one in a fishbowl.

Task Demands

- Describe or select the relationships, interactions, or processes to be explained. This may entail sorting relevant from irrelevant information or features.
- Express or complete a causal chain explaining that traits can be influenced by the environment. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause-and-effect-chains.

- Identify evidence supporting the interference of causation that is expressed in a causal chain.
- Use an explanation to predict changes in the trait of an organism given a change in environmental factors.
- Describe, identify, and/or select information needed to support an explanation of environmental influence of traits.

3-LS-3.3 Students who demonstrate understanding can:
Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Construct an argument with evidence.
- **DCI:** *Heredity: Inheritance and Variation of Traits:* For any environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.
- **CCC:** *Cause and Effect*: Cause and effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.
- Content Limits:
    - While students are not expected to know the definitions of vocabulary terms such as extinction, climate, and mimic, they are expected to know the general concepts behind these terms.
    - Students do not need to know mechanisms of natural selection and evolution of species.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - habitat
    - health
    - species
    - population
    - region
    - resource
    - behavior
    - growth
    - petal
    - thorn
    - structure

    - characteristics
    - mate
    - trait
- Vocabulary that should not be used in assessment items:
    - organism
    - threaten
    - impact
    - terrestrial
    - climate change
    - response
    - body plan
    - external function
    - internal
    - invertebrate
    - adaptation
    - beneficial change
    - detrimental change
    - species diversity
    - gene
    - variation
    - artificial selection
    - natural selection

Phenomena

- Desert plants can survive where there is little to no rain.
- Black bears survive the harsh winter months of their forest habitats by going into a deep sleep.
- The artic fox is better able to survive in colder climates than the red fox.
- Emperor penguins have special traits which help them survive in Antarctica.

Task Demands

- Organize or summarize data to highlight trends, patterns, and/or determine relationships between the traits of an organism and survival in its environment.
- Understand and generate simple bar graphs or tables that document patterns, trends, or relationships between traits of an organism and its survival in a particular environment.
- Identify patterns or evidence in the data that supports inferences about characteristics of an organism and those of its environment.
- Based on the provided data, identify, or describe a claim regarding the relationship between the characteristics of an organism and survival in a particular environment.
- Evaluate the evidence to sort relevant from irrelevant information regarding survival of an organism in a particular environment.

4th Grade Earth Science

4-ESS-1.1 Students who demonstrate understanding can:

Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Dimensions:

- **SEP:** *Constructing Explanations and Designing Solutions:* Identify the evidence that supports particular points in an explanation.
- **DCI:** *Earth's Place in the Universe*: Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. There are three classifications of rocks produced within the rock cycle: sedimentary, metamorphic, and igneous.
- **CCC:** *Patterns*: Patterns of change can be used to make predictions.

Further Explanation and Content Limit:

- Further Explanation: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time, and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.
- Content Limits:
    - Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers.
    - Assessment is limited to relative time.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - weathering
    - erode
    - glacier
    - climate
    - fossil
    - landscape
    - shell
    - river
    - mountain
    - canyon
    - deposit
    - marine

- Vocabulary that should not be used in assessment items:
    - rock strata
    - ocean basins
    - glaciation
    - watersheds
    - geological
    - mountain chains
    - igneous rock
    - metamorphic rock
    - sedimentary rock
    - terrestrial
    - aquatic

Phenomena

- The rock walls on both sides of the Grand Canyon contain layers with marine fossils, interspersed with layers containing terrestrial fossils.
- Church Rock, New Mexico, is a very dry place far from the sea. However, exposures of rocks in the area contain many fossils of marine organisms.
- Axel Heiberg Island in the Canadian Arctic is too cold for trees to grow. However, sedimentary rocks on the island preserve hundreds of fossil stumps from large evergreen trees.
- Sichuan, China, is dry and mountainous. Sedimentary rocks exposed in the area preserve thousands of fish fossils. These sedimentary rocks are sandwiched between lava flow rocks. There are no active volcanoes in this part of China.

Task Demands

- Describe, identify, and/or select evidence from patterns of rock formations and/or patterns of fossils in rock layers to support the explanations of changes in the landscape over time.
- Express or complete a causal chain explaining changes in patterns of fossils in rock layers.
- Identify patterns of rock formations and/or patterns of fossils in rock layers.

4-EE-2.1 Students who demonstrate understanding can:
Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Dimensions:

- **SEP:** *Planning and Carrying out Investigations:* Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

- **DCI:** *Earth's Systems:* Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
    i. *Biogeology:* Living things affect the physical characteristics of their regions.
- **CCC:** *Cause and Effect*: Cause and effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation: Examples of variables to test could include the angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.
- Content Limits:
    - Students are not expected to know the flow of energy that causes the phenomena.
    - Assessment is limited to one form of erosion.
    - Assessment does not include chemical erosion.
    - Students do not need to know sedimentation, Earth's interior, crystallization, minerals, the rock cycle, dynamic forces, feedback interactions, constructive forces, or deformation.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - erosion
    - freeze
    - movement
    - cycle
    - weathering
    - ocean
    - sediment
    - vegetation
    - particle
    - earthquake
    - volcanoes
    - thaw
- Vocabulary that should not be used in assessment items:
    - composition
    - slope
    - continental boundaries
    - trench

- minerals
- plate tectonics
- topography

Phenomena

- Rocks at the bottom of a river are usually smooth, but the rocks sitting on the ground nearby often have sharp edges and corners.
- Near its start in Colorado, the bed of the North Platte River is covered with boulders. Some five hundred miles away in Nebraska, the bed of the river is mostly sand.
- New gullies appear in a gravel driveway after a heavy rain.
- Over the course of a summer there is a series of major storms. At the end of the season, the channel of a small stream running through a grassy park is significantly wider than it was before the storms.

Task Demands

- Identify the factors that affect weathering or the rate of erosion by water, ice, wind, or vegetation.
- Identify from a list the materials/tools needed for an investigation of how wind affects the factors that affect weathering or the rate of erosion by water, ice, wind, or vegetation.
- Identify, among distractors, the outcome data that should be collected in the investigation.
- Make and/or record observations about how input factors affect relevant outcomes while using fair tests in which variables are controlled.
- Make or communicate the conclusions from the investigation. Conclusions will be causal relationships.

4-EE-2.2 Students who demonstrate understanding can:
Analyze and interpret data from maps to describe patterns of Earth's features.

Dimensions:

- **SEP:** *Analyzing and Interpreting Data:* Analyze and interpret data to make sense of phenomena using logical reasoning.
- **DCI:** *Earth's Systems:* The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes appear in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.
- **CCC:** *Patterns*: Patterns can be used as evidence to support an explanation.

Further Explanation and Content Limit:

- Further Explanation: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.
- Content Limits:
    - Students do not need to know the tectonic processes that form Earth's features.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - earthquake
    - Earth's surface
    - crust
    - volcanic eruption
    - region
    - barrier
    - global
    - local
    - physical
    - characteristic
    - ocean
    - force
    - landscape
    - mountain chain
    - mountain range
    - continental boundary
    - sea
    - floor
    - collide
    - properties
    - ocean trench
    - pressure
    - topographic map
- Vocabulary that should not be used in assessment items:
    - geologic
    - impact
    - magnitude
    - frequency
    - sediment deposition
    - ancient
    - ocean basin
    - rock layer

- movement
- formation
- continental shelf
- deform
- density
- tectonic process
- distribution
- oceanic crust
- plate boundary/collision
- seafloor spreading

Phenomena

- There are active volcanoes in Alaska. There are no active volcanoes near Buffalo, New York. (If this statement were to be used to describe the map, then the student's task would have to be something more than simply pointing out that there are volcanoes in Alaska and none near Buffalo, such as figuring out that Alaska is closer to a tectonic plate boundary than is New York.)
- Earthquakes occur often in western South America. Earthquakes almost never occur on the eastern side of the continent. (If this statement were to be used to describe the map, then the student's task would have to be something more than simply pointing out that there are earthquakes on the eastern side more often than the western, such as figuring out that a plate boundary lies along the eastern coast of South America.)
- Many volcanoes are found in a ring around the Pacific Ocean. There are fewer found on the edges of the Atlantic Ocean. (If this statement were to be used to describe the map, then the student's task would have to be something more than simply pointing out that there are many volcanoes around the Pacific and few around the Atlantic, such as figuring out that tectonic plate boundaries surround the Pacific Ocean.)
- There are no mountain ranges in Kansas. There are many mountains in Washington State. (If this statement were to be used to describe the map, then the student's task would have to be something more than simply pointing out that there are mountains in Washington and none in Kansas, such as figuring out that Washington is closer to a tectonic plate boundary than Kansas.)

Task Demands

- Organize, arrange, or summarize map data and/or symbols to highlight/describe patterns of geological features on Earth's surface.

- Generate/construct graphs, tables, or assemblages of illustrations and/or labels, of map data that document patterns of geological features on Earth's surface. This may include sorting out distractors.

- Use relationships identified in the presented map data to predict the location of geological features on Earth's surface, such as mountain ranges, volcanoes, earthquake foci, and deep ocean trenches.
- Identify evidence or patterns in map data that support inferences about the patterns of geological features on Earth's surface.

4-ESS-3.1 Students who demonstrate understanding can:
Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Dimensions:

- **SEP:** *Obtaining, Evaluating, and Communicating Information:* Obtain and combine information from books and other reliable media to explain phenomena.
- **DCI:** *Earth and Human Activity*: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.
- **CCC:** *Cause and Effect*: Cause and effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

Further Explanation:

- Examples of renewable energy resources could include:
    - Wind energy
    - Water behind dams
    - Sunlight
- Examples of non-renewable energy resources are:
    - Fossil fuels
    - Fissile materials
- Examples of environmental effects could include:
    - Loss of habitat due to dams
    - Loss of habitat due to surface mining
    - Air pollution from burning fossil fuels.
- Content Limits: The following things should be avoided:
    - Casting fossil fuels in a negative light and alternative fuels in a positive light
    - Pros and cons of one energy source vs. another
    - Negative effects of extracting and burning coal
    - Negative effects of fracking
    - Cause and effect of acid rain
    - The term "global warming"

- Students do not need to know how natural resources are used to generate energy (scientific specifics regarding how burning coal creates energy/how wind produces energy etc.).

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - recycle
  - reuse
  - coal
  - habitat
  - pollution
  - dam
  - population
  - atmosphere
  - oil
  - resource
  - fossil fuel
  - renewable
  - nonrenewable
  - conservation
- Vocabulary that should not be used in assessment items:
  - agricultural
  - biosphere
  - mineral
  - geological
  - hydrothermal
  - metal ore
  - organic
  - deposition
  - petroleum
  - derive
  - extract
  - natural gas
  - oil shade
  - sustainability
  - tar sand

Phenomena

- A pipeline is built to transport oil from one location to another. As the oil moves across the landscape it leaks into a river along the way.

- The Three Gorges dam was built along the Yangtze River in China to generate electricity. The Chinese dove tree lives along the Yangtze River. Building the dam affected this tree.
- Several wind turbines are placed in a field to provide electricity to neighboring areas. To do this, forest land had to be cut down to provide space for the wind turbines.
- Oil can be used to generate electricity. Oil can be found under the ocean. Seismic waves are used to locate the oil. Because of this, 100 melon head whales were displaced off the coast of Madagascar.

Task Demands

- Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data/information to highlight trends, patterns, or correlations.
- Express or complete a causal chain explaining how energy and fuel that are derived from natural resources affect the environment. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause and effect chains.
- Identify evidence supporting the inference of causation that is expressed in a causal chain.
- Identify patterns or evidence in the data that supports inferences about the effects that the usage of certain natural resources has on the environment.
- Describe, identify, and/or Select information needed to support an explanation.

4-ESS-3.2 Students who demonstrate understanding can:
Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Dimensions:

- **SEP:** *Constructing Explanations and Designing Solutions:* Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
- **DCI:** *Earth and Human Activity*: A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. Testing a solution involves investigating how well it performs under a range of likely conditions (secondary).
- **CCC:** *Cause and Effect*: Cause and effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.
- Content Limits: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - environment
  - nature
  - recycle
  - reuse
  - coal
  - habitat
  - pollution
  - dam population
  - atmosphere
  - oil
  - resource
  - fossil fuel
  - renewable
  - nonrenewable
  - conservation
- Vocabulary that should not be used in assessment items:
  - agricultural
  - biosphere
  - mineral
  - geological
  - hydrothermal
  - metal ore
  - organic
  - deposition
  - petroleum
  - derive
  - extract
  - natural gas
  - oil shale
  - sustainability
  - tar sand

Phenomena

Engineering standards are built around meaningful design problems rather than phenomena. In this case, the design problems involve reducing the impact of earthquakes, floods, tsunamis, and volcanic eruptions on humans. For this standard, the design problem and competing solutions replace phenomena.

- Hurricanes generate high winds. Several building designs are being considered to construct buildings that could withstand the force of the wind.
- Eyjafjallajökull is an active volcano in Iceland. In preparation for future volcanic activity, several evacuation routes are being considered.

Task Demands

- Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data/information to highlight trends, patterns, or correlations in data regarding human activity and natural hazards.
- Express or complete a causal chain explaining how humans can reduce the impact of natural hazards.
- Identify evidence supporting the inference of causation that is expressed in a causal chain.
- Identify patterns or evidence in the data that supports inferences about the ways humans can reduce impacts of natural hazards.
- Use an explanation to compare the two solutions and select which one is better for addressing the problem of the impact of natural hazards on humans and explain how well each solution meets the criteria and constraints of the design solution.
- Describe, select, or identify components of competing design solutions.

4th Grade Physical Science

4-PS-1.1 Students who demonstrate understanding can:
Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Dimensions:

- **SEP:** *Constructing Explanations and Designing Solutions:* • Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
- **DCI:** *Energy*: The faster a given object is moving, the more energy it possesses.
- **CCC:** *Energy and Matter*: Energy can be transferred in various ways and between objects.

Further Explanation and Content Limit:

- Further Explanation: N/A
- Content Limit:
  - Assessment does not include quantitative measures of changes in the speed of an object or any precise or quantitative definition of energy.
  - Students are expected to know that energy can be expressed through sound, heat, light, and motion.

- Students do not need to know how to calculate speed, the change in speed (acceleration), or energy. This standard is limited to making strictly qualitative or comparative observations.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - volume
  - collision
  - heat transfer
  - spring (coil)
  - forms of energy (sound, heat, light, motion)
  - conservation of energy
  - stored energy
  - energy transfer
  - gravity
- Vocabulary that should not be used in assessment items:
  - potential energy
  - kinetic energy
  - thermal energy
  - acceleration
  - velocity

Phenomena

- One drum can be used to produce loud or quiet percussion sounds.
- A small bouncing basketball sounds louder than a large bouncing basketball.
- Damage caused during a high-speed collision is greater than when speeds are slower.
- A ceramic bowl dropped from a greater height will have a larger debris pattern.

Task Demands

- Articulate, describe, illustrate, or select the relationships, interactions, and/or processes to be explained. This may entail sorting relevant from irrelevant information or features.
- Express or complete a causal chain explaining that changes in energy and speed are related. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause-and-effect chains.
- Identify evidence supporting the inference of causation that is expressed in a causal chain.
- Use an explanation to predict how the speed of an object changes given a change in energy or how the expression of energy will change given a change in speed.
- Describe, identify, and/or select information needed to support an explanation.

4-PS-1.2 Students who demonstrate understanding can:
Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

Dimensions:

- **SEP:** *Planning and Carrying Out Investigations:* Make observations to produce data to serve as the basis for evidence for an explanation of a phenomena or to test a design solution.
- **DCI:** *Energy*: Energy can be moved from place to place by moving objects — or through sound, light, or electric currents.
    - Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated, and sound is produced.
    - Light also transfers energy from place to place.
    - 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.
- **CCC:** *Energy and Matter*: Energy can be transferred in various ways and between objects.

Further Explanation and Content Limit:

- Further Explanation: N/A
- Content Limit:
    - Assessment does not include quantitative measurements of energy.
    - Identifying how energy is transferred (example: conduction vs. convection) is not part of this standard.
    - Students do not need to know how to do energy calculations. This standard is limited to strictly making observations.
    - Students should know that energy can be given off as heat or light, but not specifics such as convection, thermal radiation, etc.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - collision
    - speed
    - flow
    - heat conduction
    - conversion
- Vocabulary that should not be used in assessment items:
    - kinetic energy

- potential energy
- radiation
- convection
- transmission
- reflection
- decibels
- resonance
- friction
- hertz
- electromagnetic radiation
- magnitude
- motion energy
- electric circuit
- thermal
- conservation of energy

Phenomena

- A light bulb can be powered using the motion of a hamster wheel.
- A drinking glass can be broken by a person singing a certain note.
- A fan (with blades angled at 45 degrees) will spin when placed safely over burning candles.
- Touching a Van der Graaf generator will make your hair stick up.

Task Demands

- Identify the materials/tools needed for an investigation of how energy is transferred from place to place through heat, sound, light, or electric currents.
- Identify the data that should be collected in an investigation of how energy is transferred from one place to another through heat, sound, light, or electric currents.
- Make and/or record observations about the transfer of energy from one place to another via heat, sound, light, or electric currents.
- Interpret and/or communicate the data from an investigation.
- Select, describe, or illustrate a prediction made by applying the findings from an investigation.

4-PS-1.3 Students who demonstrate understanding can:
Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Dimensions:

- **SEP:** *Asking Questions and Defining Problems:* Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.

- **DCI:** *Energy*: Energy can be moved from place to place by moving objects — or through sound, light, or electric currents.
    - Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated, and sound is produced.
    - When objects collide, the contact forces transfer energy to change the objects' motions.
- **CCC:** *Energy and Matter*: Energy can be transferred in various ways and between objects.

Further Explanation and Content Limit:

- Further Explanation: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.
- Content Limit:
    - Assessment does not include quantitative measurements of energy.
    - Students do not need to know the names of energy types, how to calculate energy or forces.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - electric currents
    - speed
    - flow
    - conversion
    - motion
    - magnets
    - magnetism
    - heat conduction
- Vocabulary that should not be used in assessment items:
    - kinetic energy
    - potential energy
    - friction
    - force fields
    - vector
    - magnitude
    - elastic
    - inelastic

Phenomena

- A large wave crashes into the cliffs of Étretat and some rocks are knocked loose. A small wave then crashes into the cliffs.
- A person hits a nail with a hammer and the nail is driven into a board. The person swings the hammer again but misses the nail.
- A person walks down a hallway. The sound of their shoes on the floor can be heard many feet away. The person then runs down the hallway.
- A bowler rolls a ball down a lane. It slams into the pins and knocks several of them down. After the pins are reset, the bowler rolls the ball down the lane again. The ball misses and knocks down no pins.

Task Demands

- Select or identify from a collection, including distractors, questions that will help clarify the properties that are correlated with the changes in energy that occur in the phenomenon. In addition to distractors that are plausible responses, distractors may include non-testable ("nonscientific") questions.
- Identify, describe, or select from a collection, including distractors, characteristics to be manipulated or held constant while gathering information to answer a well-articulated question.
- Select or describe conclusions relevant to the question posed and supported by the data, especially conclusions about causes and effects.
- Predict outcomes when properties or proximity of the objects are changed, given the inferred cause-and-effect relationships.
- Describe, identify, gather, and/or select information needed to identify patterns that can be used to predict outcomes about the changes in energy.

4-PS-1.4 Students who demonstrate understanding can:
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Dimensions:

- **SEP:** *Constructing explanations and designing solutions:* Apply scientific ideas to solve design problems.
- **DCI:** *Energy*: Energy can be moved from place to place by moving objects — or through sound, light, or electric currents.
    - 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.
    - The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

    - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared based on how well each one meets the specified criteria for success or how well each takes the constraints into account.
- **CCC:** *Energy and Matter*: Energy can be transferred in various ways and between objects.

Further Explanation and Content Limit:

- Further Explanation: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.
- Content Limit: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - magnetic
    - motion
    - speed
    - conservation
    - gravitational
    - battery
    - conversion
    - properties
    - chemical
- Vocabulary that should not be used in assessment items:
    - mass
    - net force
    - velocity
    - relative position
    - constant speed
    - direction of motion
    - direction of a force
    - deceleration
    - independent
    - economic
    - control
    - impact
    - inertia

- Newton's laws (1st, 2nd, 3rd)
- stationary
- frame of reference
- potential energy
- mechanical energy
- kinetic energy
- conserve
- relative
- chemical energy

Phenomena

Engineering practices are built around meaningful design problems rather than phenomena. For this standard, a design problem and associated competing solutions will replace phenomena.

- A front door does not have an alarm. Any alarm that is added needs to be heard in the back hallway.
- A person hiking on a hot day needs to take a fan to stay cool. The fan must be small so that it does not add to the weight of the hiker's pack but must also last the entire hike.
- The water in a house is heated with electricity purchased from a power company. A decision is made to instead heat the water using electricity generated with solar panels on the roof. The water heater must heat enough water to meet the needs of the home but the cost of installation and/or maintenance cannot exceed the family's budget.
- A motor is added to a toy car for a race. The motor must be able to move the car across a room at a high speed.

Task Demands

- Express or complete a causal chain explaining how energy can be transferred via electric current to produce light, sound, heat, and/or motion. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause-and-effect chains.
- Identify evidence supporting the inference of causation that is expressed in a causal chain.
- Use an explanation to predict how the motion, sound, heat, or light of an object changes, given a change in electrical energy—or, how the expression of energy will change, given a change in the conversion of stored energy.
- Identify or assemble from a collection, including distractors, the relevant aspects of the problem that given design solutions, if implemented, will resolve/improve. The design solution must convert energy from one form to another within the content limits.

- Using the given information, select or identify constraints that the device that converts energy from one form to another must meet OR criteria against which it should be judged.
- Using given information, design, propose, illustrate, assemble, test, or refine a potential device (prototype) that converts energy from one form to another.

4-PS-2.1 Students who demonstrate understanding can:
Develop a model of a simple mechanical wave to describe patterns of amplitude and wavelength and that waves can cause objects to move.

Dimensions:

- **SEP:** *Developing and Using Models:* Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
- **DCI:** *Waves*:
    - Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
    - Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).
- **CCC:** *Patterns*: Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.

Further Explanation and Content Limit:

Further Explanation:

- Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.
- Acceptable clusters may include amplitude and wavelength, motion of an object, or both.

Content Limit:

- Limited to physically visible mechanical waves.
- Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.
- Examples of objects being moved by waves are limited to up and down motion. Horizontal motion is above grade level due to the other factors involved.
- Do not directly reference energy. Energy is addressed in “PS1-4 Energy”.
- Students do not need to know:
    - Types of waves: sound, light, non-periodic, compression
    - Particle movement

- Quantitative models
- Behaviors of waves: absorption, reflection, refraction, transmission, interactions with different materials (angle of incidence, amount of reflection or absorption, light being refracted into colors). Reflection is limited to the concept. How waves are reflected, and the details of reflection (as well as other behaviors) are covered in PS4-MS-2.
- Wave calculations
- Motion of objects in the ocean due to ocean currents

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - crest
  - trough
  - peak
  - rate
  - property
  - medium
  - period
- Vocabulary that should not be used in assessment items:
  - particle
  - transmission
  - angle of incidence
  - angle of reflection
  - concave
  - convex
  - diffraction
  - constructive interference
  - destructive interference
  - refraction
  - absorption
  - wave
  - field
  - illuminate
  - diffuse reflection
  - specular reflection
  - spectrum
  - prism

Phenomena

- A person can see a cat in the mirror. The cat is otherwise hidden from view.

- A performance is being watched by a person. Another person stands up and blocks the view.
- A flashlight is pointed at a door in a dark room. The door is the only object seen in the room.
- The moon is seen at night.
- The surface of a lake is very still. The reflection of a tree on the bank can be seen on the lake's surface.

Task Demands

- Identify the components needed to model the phenomenon. Components might include the light, the light source, the object, the path the light follows, and the eye.
- Complete an illustration or flow chart that can represent how light reflecting from objects and entering the eye allows objects to be seen. This does not include labeling an existing diagram.
- Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.
- Make predictions about the effects of changes in the model, particularly using mirrors, changing positions of light sources, objects, and the eye. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.
- Identify missing components, relationships, or other limitations of the model.
- Describe, select, or identify the relationships among components of a model that describe how light reflecting from objects and entering the eye allows objects to be seen.

4-PS-2.2 Students who demonstrate understanding can:
Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

Dimensions:

- **SEP:** *Developing and Using Models:* Develop a model to describe phenomena.
- **DCI:** *Electromagnetic Radiation*:
    - An object can be seen when light reflected from its surface enters the eyes.
- **CCC:** *Cause and Effect*: Cause-and-effect relationships are routinely identified.

Further Explanation and Content Limit:

Further Explanation: N/A

Content Limit: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - energy
  - light ray
  - reflection
  - reflective
  - surface
- Vocabulary that should not be used in assessment items:
  - particle
  - transmission
  - angle of incidence
  - angle of reflection
  - concave
  - convex
  - diffraction
  - constructive interference
  - destructive interference
  - refraction
  - absorption
  - wave
  - field
  - illuminate
  - diffuse reflection
  - specular reflection
  - spectrum
  - prism

Phenomena

- A person can see a cat in the mirror. The cat is otherwise hidden from view.
- A performance is being watched by a person. Another person stands up and blocks the view.
- A flashlight is pointed at a door in a dark room. The door is the only object seen in the room.
- The moon is seen at night.
- The surface of a lake is very still. The reflection of a tree on the bank can be seen on the lake's surface.

Task Demands

- Identify the components needed to model the phenomenon. Components might include the light, the light source, the object, the path the light follows, and the eye.

- Complete an illustration or flow chart that is capable of representing how light reflecting from objects and entering the eye allows objects to be seen. This does not include labeling an existing diagram.
- Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.
- Make predictions about the effects of changes in the model, particularly using mirrors, changing positions of light sources, objects, and the eye. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.
- Identify missing components, relationships, or other limitations of the model.
- Describe, select, or identify the relationships among components of a model that describes how light reflecting from objects and entering the eye allows objects to be seen.

4-PS-2.3 Students who demonstrate understanding can:
Generate and compare multiple solutions that use patterns to transfer information.

Dimensions:

- **SEP:** *Constructing Explanations and Designing Solutions:* Generate and compare multiple solutions to a problem, based on how well they meet the criteria and constraints of the design solution.
- **DCI:** *Waves*:
    - Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.
    - Different solutions need to be tested to determine which of them best solves the problem, given the criteria and the constraints.
- **CCC:** *Patterns*: Similarities and differences in patterns can be used to sort and classify designed products.

Further Explanation and Content Limit:

- Further Explanation: Examples of solutions could include:
    - Drums send coded information through sound waves.
    - Using a grid of 1's and 0's, representing black and white, to send information about a picture.
    - Using Morse code to send text.
- Content Limit- Students do not need to know:
    - The different parts of the electromagnetic spectrum (visible, microwave, x-ray, radio wave, etc.)
    - Binary coding or how it works.
    - That light is made up of an electric and magnetic field.

    - Transverse vs. longitudinal waves.
    - How information gets encoded.
    - How different forms of communicating information work (Morse code vs. something like a telephone).

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - amplitude
    - wavelength
    - reflect
    - vibrate
    - vibration
    - absorb
    - properties
    - sound wave
    - wave
    - communicate
    - electricity
    - coded
    - Morse code
    - digital
    - store
    - transfer
    - convert
- Vocabulary that should not be used in assessment items:
    - light emission
    - light refraction
    - transmit
    - wave peaks
    - light wave
    - electromagnetic
    - frequency
    - radiation
    - wave packet
    - light scattering
    - light transmission
    - electric field
    - magnetic field
    - photon
    - radio wave
    - x-ray

- binary
- electron
- pixel
- CCD
- transverse
- longitudinal

Phenomena

- In July 2015, the New Horizons Space Probe flew past Pluto. The space probe is tasked with taking detailed pictures of Pluto so that scientists on Earth can study its features. However, the spacecraft can only send sequences of numbers back to Earth.
- A man wants to send an urgent message to his wife who is a long distance away. It would take too long to drive to his wife and deliver the message himself. The only way he can communicate is through an electrical wire that is set up between the two locations.
- Two people want to communicate a number 1 through 10 over a large distance. They have no telephones or other means of communication. They are close enough that they can see or hear each other, however, a river separates them so they cannot reach each other.
- Two people want to communicate over a large distance. However, the power is out and so they cannot use the telephone. All they have is a string that is stretched between their two houses. Attached to the end of each string is a metal can. The messages they want to be able to send consists of numbers 1 through 10.

Task Demands

- Articulate, describe, illustrate, or select the relationships, interactions, and/or processes to be explained. This may entail sorting relevant from irrelevant information or features.
- Express or complete a causal chain explaining how each pattern is used to transmit information. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause-and-effect chains.
- Identify evidence supporting the inference of causation that is expressed in a causal chain.
- Use an explanation to compare the two solutions and select which one is better for the transmitting of information.
- Describe, identify, and/or select information needed to support an explanation.

4th Grade Life Science

4-LS-1.1 Students who demonstrate understanding can:
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Construct an argument with evidence, data, and/or a model.
- **DCI:** *From Molecules to Organisms: Structure and Process:*
    - Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
    - Animals have various body systems with specific functions for sustaining life: skeletal, circulatory. respiratory, muscular, digestive, etc.
- **CCC:** *Systems and System Models:* A system can be described in terms of its components and their interactions.

Further Explanation and Content Limit:

- Further Explanation: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.

- Content Limits:
    - Assessment is limited to macroscopic structures within plant and animal systems.
    - Students do not need to know about cellular structures like the nucleus, mitochondria, the Golgi apparatus, or the endoplasmic reticulum.
    - Students do not need to know about organ systems like the circulatory system, reproductive system, or nervous system.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - brain
    - body
    - flow
    - flower
    - heart
    - lung
    - muscle
    - movement
    - grasp
    - habit
    - moisture
    - organization

    - petal
    - predator
    - prey
    - roots
    - skin
    - stem
    - stomach
    - temperature
- Vocabulary that should not be used in assessment items:
    - cell
    - detect
    - response
    - body plan
    - elastic
    - external
    - intellectual
    - internal
    - invertebrate
    - organ
    - vertebrate
    - multicellular
    - stimulus
    - tissue
    - enzyme
    - xylem
    - phloem
    - parenchyma
    - cambium cells

Phenomena

- In a field of grass, a butterfly lands on one of the only red poppy flowers in sight.
- A manta ray has a flat circular body. Its fins spread out like wings from its body.
- A pelican can hold up to three gallons of water in its pouch.
- A student sees a hollow, brown copy of a cicada insect attached to the bark of a tree.

Task Demands

- Identify evidence or patterns in the data that support inferences and/or determine relationships between a particular structure of an organism and a function that supports survival, growth, behavior, and reproduction.

- Understand and generate simple bar graphs or tables to document patterns, trends, or relationships between a particular structure of an organism and a function that supports survival, growth, behavior, and reproduction.
- Sort observations/evidence into those that appear to support or not support an argument.
- Based on the provided data, identify, or describe a claim regarding the relationship between a structure of an organism and a function that supports survival, growth, behavior, and reproduction.
- Summarize or organize given data or other information to support or refute a claim regarding an organism's structure and its function.
- Sort, tabulate, classify, separate, and/or categorize relevant from irrelevant information regarding an organism's structure and its function.

4-LS-1.2 Students who demonstrate understanding can:
Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Dimensions:

- **SEP:** *Developing and Using Models:* Use a model to test interactions concerning the functioning of a natural system
- **DCI:** *From Molecules to Organisms: Structure and Process:* Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals can use their perceptions and memories to guide their actions.
- **CCC:** *Systems and System Models:* A system can be described in terms of its components and their interactions.

Further Explanation and Content Limit:

- Further Explanation: Emphasis is on systems of information transfer.
- Content Limits: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - lens
    - vision
    - hearing
    - muscle
    - ear
    - middle ear
    - outer ear
    - inner ear

    - eardrum
    - response
    - habitat
    - eye
    - lens
    - memory
- Vocabulary that should not be used in assessment items:
    - sensory
    - brain cells
    - retina
    - pupil
    - saliva
    - salivary glad
    - vibration
    - cornea
    - iris
    - brainstem
    - consumer
    - nerve
    - optic nerve
    - nerve cell
    - nerve impulse
    - connecting nerve
    - nerve fiber
    - organ system
    - reflex
    - reflex action
    - reaction time
    - cue

Phenomena

- A bear cub in the woods cries out. Its mother immediately runs toward it.
- A deer walks in the woods. It turns suddenly and moves off in a different direction. A few minutes later, a skunk appears from the bushes.
- A cat sits on a stone wall. A mouse appears at the base of a nearby tree. The cat springs after the mouse.
- A hawk flies overhead. Suddenly, it dives toward the tall grass. A moment later, it returns to the sky, a snake in its claws.

Task Demands

- Select or identify from a collection of potential model components the components needed to model the phenomenon. Components might represent organ systems or parts of a system needed for collection and/or processing of sensory information.
- Assemble or complete, from a collection of potential model components, an illustration or flow chart that can represent the flow and/or processing of sensory information in an animal. This does not include labeling an existing diagram.
- Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.
- Given models or diagrams of the flow and/or processing of sensory information in an animal, identify responses to sensory inputs and how they change in each scenario OR identify the properties of organs and/or organ systems that allow animals to respond to sensory information.
- Identify missing components, relationships, or other limitations of a model that shows the flow and/or processing of sensory information in an animal.
- Describe, select, or identify the relationships among components of a model that describes how sensory information is processed or explain how an animal responds to sensory inputs.

5th Grade Earth Science

5-ESS-1.1 Students who demonstrate understanding can:
Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Construct an argument with evidence, data, and/or a model.
- **DCI:** *Earth's Place in the Universe*: The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.
- **CCC:** *Scale, Proportion, and Quantity:* Natural objects exist from the very small to the immensely big.

Further Explanation and Content Limit:

- Further Explanation: N/A
- Content Limits:
    - Assessment is limited to relative distances, not sizes, of stars.

- Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage, etc.).
- Assessment does not include absolute brightness.
- Students do not need to know:
    - Specific stars and their names.
    - Luminosity and how that is affected by the size/age of a star.
    - Flux or how to calculate it.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - space
    - planet
    - sun's size
    - solar system
    - moon
    - burn
    - star brightness
    - constellation
    - galaxy
    - visible
    - astronomical
- Vocabulary that should not be used in assessment items:
    - lunar phase
    - eclipse
    - celestial
    - mass
    - comet
    - light year
    - astronomical unit
    - emit
    - interstellar
    - fission
    - fusion
    - radiation
    - spectrum
    - star size
    - star composition
    - star formation
    - star types
    - luminosity
    - flux

Phenomena

- Most stars cannot be seen during the daytime but can be seen at night.
- The sun is never seen at the same time as other stars in the sky.
- Alpha Centauri A is larger than the sun but does not look as bright in the sky.
- Streetlights that are farther away from you look dimmer.

Task Demands

- Organize, arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in how the brightness of stars is based on their relative distance from Earth.
- Generate/construct graphs, tables, or assemblages of illustrations and/or labels of data that document patterns, trends, or correlations in how the brightness of stars is based on their relative distance from Earth. This may include sorting out distractors.
- Describe, identify, and/or select information needed to support an explanation.
- Use relationships identified in the data to predict the distance of a star depending on its brightness, or vice versa.
- Identify patterns or evidence in the data that supports inferences about how the brightness of stars depends on their relative distance from Earth.

5-ESS-1.2 Students who demonstrate understanding can:
Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Dimensions:

- **SEP:** *Analyzing and Interpreting Data:* Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.
- **DCI:** *Earth's Place in the Universe*: 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 changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.
- **CCC:** *Patterns:* Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.

Further Explanation and Content Limit:

- Further Explanation: N/A
- Content Limits:
    - Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.
    - While the names of celestial objects, stars, or constellations can be included, students are not expected to identify them.

- Objects to be used to assess this PE are limited to the sun, Earth's moon, Earth, and stars/constellations visible in Earth's night sky.
- "Positions of the moon" refers to its location in Earth's sky and not its appearance (phase).
- Assessment does not include cause of seasons, lunar phases, or the position of the sun in the sky throughout the year.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - circular motion
  - universe
  - Earth's rotation
  - galaxy
  - axis
  - solar system
  - Milky Way
  - constellation
  - moon phases
  - lunar
  - astronomical
  - orbit
  - tilt annual
  - rotation
  - revolution
- Vocabulary that should not be used in assessment items:
  - eclipse
  - celestial
  - comet
  - light year
  - astronomical unit
  - stellar

Phenomena

- The shadow cast by a sundial changes position and size throughout the day.
- A constellation that is viewed right above someone's house at 8:00 p.m. one night can no longer be seen at 8:00 p.m. in a few months.
- The sun is seen in the sky only during the day.
- It gets dark out after the sun goes below the horizon.

Task Demands

- Organize, arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in how the data changes over time.
- Generate/construct graphs, tables, or groups of illustrations and/or labels of data that document patterns, trends, or correlations in how the data change over time. This may include sorting out distractors.
- Use relationships identified in the data to predict whether or not the pattern will continue OR how the data will look at some time in the future.
- Identify patterns or evidence in the data that supports inferences about the phenomena.

5-ESS-2.1 Students who demonstrate understanding can:
Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Dimensions:

- **SEP:** *Developing and Using Models:* Develop a model using an example to describe a scientific principle.
- **DCI:** *Earth's Systems*: 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. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.
- **CCC:** *Systems and System Models:* A system can be described in terms of its components and their interactions.

Further Explanation and Content Limit:

- Further Explanation:
  - Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere.
  - The geosphere, hydrosphere, atmosphere, and biosphere are each a system.
- Content Limits:
  - Assessment is limited to the interactions of two systems at a time.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - core
  - mantle
  - crust

    - solid
    - liquid
    - gas
    - vapor
    - tundra
    - boreal forest
    - deciduous forest
    - grassland
    - desert
    - savannah
    - tropical rainforest
    - freshwater
    - marine
    - high pressure
    - low pressure
    - currents
    - circulation
- Vocabulary that should not be used in assessment items:
    - troposphere
    - stratosphere
    - mesosphere
    - thermosphere
    - ionosphere
    - chaparral

Phenomena

- The land area found on the beaches around Nantucket Sound in 2016 was about three times the land area in the same location in 1984.
- In 2016, Tucson, Arizona received more rain between June and September than Yuma, Arizona received during the entire year.
- The amount of carbon dioxide in the atmosphere measured at Mauna Loa Observatory in April is 397 parts per million. The amount measured at the same location the previous September was 2% less.
- In 1980, the salt content in the freshwater Biscayne Aquifer in Florida was fifty milligrams per liter. In 1997, the salt content of the same water was 1,000 milligrams per liter.

Task Demands

- Select or identify from a collection of potential model components, including distractors, the components needed to model the phenomenon. Components might include labels, text, steps in a process.

- Assemble or complete, from a collection of potential model components, an illustration or flow chart that can represent how the geosphere, biosphere, hydrosphere, and/or atmosphere interact. This does not include labeling an existing diagram.
- Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.
- Make predictions about the effects of changes in the geosphere, biosphere, hydrosphere, or atmosphere on each other. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.
- Given models or diagrams of ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact, identify relationships between the spheres and how a change in one causes a change in another.
- Identify missing components, relationships, or other limitations of the model.

5-ESS-2.2 Students who demonstrate understanding can:
Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Dimensions:

- **SEP:** *Using Mathematics and Computational Thinking:* Describe and graph quantities such as area and volume to address scientific questions.
- **DCI:** *Earth's Systems*: Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- **CCC:** *Scale, Proportion and Quantity:* Standard units are used to measure and describe physical quantities such as weight and volume.

Further Explanation and Content Limit:

- Further Explanation: N/A
- Content Limits:
    - Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - cycle
    - fresh water
    - glacial movement
    - global
    - ground water
    - moisture
    - polar ice caps
    - properties of soil

    - reservoir
    - soil composition
    - water capacity
    - feature
    - glacial
    - hydrosphere
    - surface feature
    - water cycle
    - wetland
- Vocabulary that should not be used in assessment items:
    - coastal
    - crust
    - internal
    - distribution
    - hydrological cycle
    - percentage

Phenomena

- Melting ice from the Arctic ice cap is currently adding fresh water to the very salty Arctic Ocean.
- Melting ice from the Greenland Ice Sheet is currently adding fresh water to the very salty Arctic Ocean.
- The Potomac River in the eastern United States is tidally influenced over XX% of its length. This tidal influence from the ocean results in the portion of the river near the ocean being a mixture of salt and fresh water and the portion of the river far from the ocean being fresh water.
- Saltwater intrusion on Cape Cod, Florida, or California.

Task Demands

- Illustrate, graph, or identify relevant features or data that can be used to calculate or estimate relationships between the relative volumes of water in different reservoirs on Earth.
- Calculate or estimate properties or relationships of the relative volumes of water in different reservoirs on Earth, based on data from one or more sources.
- Compile, from given information, the data needed for a particular inference about the relative volumes of water in different reservoirs on Earth. This can include sorting out the relevant data from the given information.

5-ESS-3.1 Students who demonstrate understanding can:
Obtain and combine information about ways communities protect Earth's resources and environment using scientific ideas.

Dimensions:

- **SEP:** *Obtaining, Evaluating, and Communicating Information:* Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
- **DCI:** *Earth and Human Activity*: 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.
- **CCC:** *Systems and System Models:* A system can be described in terms of its components and their interactions.

Further Explanation and Content Limit:

- Further Explanation: N/A
- Content Limits: N/A

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - atmosphere
    - cycle
    - freshwater
    - global
    - ground water
    - moisture
    - polar ice caps
    - properties of soil
    - soil composition
    - water cycle
- Vocabulary that should not be used in assessment items:
    - atmosphere
    - cycle
    - freshwater
    - global
    - ground water
    - moisture
    - polar ice caps
    - properties of soil
    - soil composition
    - water cycle

- Vocabulary that Should Not be Used in Clusters/Standalones
    - coastal
    - crust
    - internal
    - distribution
    - hydrological cycle
    - reservoir
    - glacial movement
    - water capacity
    - glacial
    - hydrosphere
    - reservoir
    - feature
    - surface feature
    - wetland
    - percentage

Phenomena

Engineering practices are built around meaningful design problems rather than phenomena. For this PE, there are two phenomena and 2 design problems.

- In England in 1965, there were about 182,000 bee colonies. By 2010, there were about 83,000 bee colonies.
- There is a haze in the air in Beijing, China's capital city, which makes it hard to see long distances. The haze becomes worse on cold winter days.
- A company is going to put a new logging road in an area where grizzly bears live. The US Forest Service tells them that they need to pay attention to where they are going to put the road. The path of the road should be chosen so that it does not disturb grizzly bear habitat very much.
- A flower garden to attract honeybees is being built. The type and color of flowers, garden placement, flower placement, and other features are chosen to attract honeybees.

Task Demands

- Identify, evaluate, combine, organize, and/or communicate information (from texts, illustrations, animations, simulations, tables, or graphs) that is needed to make an informed decision related to human impacts on natural systems, solve a particular design problem, or complete a specified task.
- Assemble or complete an illustration, graph, set of labels, or a flow chart that shows how the various pieces of information, which are needed to make an informed decision, solve a particular design problem, or complete a specified task, are interrelated. This does not include labeling an existing diagram.
- Identify patterns or evidence in the data that supports inferences about human impacts on natural systems or a particular solution to a design problem or task.
- Examine, identify, or select positive or negative effects/implications of a community idea or design problem. This would include identifying potential positive or negative effects, especially when dealing with design solutions, and classifying the effects/implications as positive or negative and supporting those classifications with the relevant data.
- Formulate a design or make an inference or conclusion, based on identified or combined information, evidence or data related to human impacts on natural systems, solution of a particular design problem, or completion of a specified task.
- Evaluate a design or make an inference or conclusion, based on identified or combined information, evidence or data related to human impacts on natural systems, solution of a particular design problem, or completion of a specified task.

5th Grade Physical Science

5-PS-1.1 Students who demonstrate understanding can:
Develop a model to describe that matter is made of particles too small to be seen.

Dimensions:

- **SEP:** *Developing and Using Models:* Use models to describe phenomena.
- **DCI:** *Matter and Its Interactions*: Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.
- **CCC:** *Scale, Proportion, and Quantity:* Natural objects exist from the very small to the immensely big.

Further Explanation and Content Limit:

- Further Explanation: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.
- Content Limits:
    - Assessment does not include the atomic-scale mechanism of evaporation and condensation or the defining of the unseen particles.
    - Students are expected to know that matter can neither be destroyed nor created.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - substance
    - particle
    - solid
    - liquid
    - gas
    - vapor
    - steam
    - air
    - phase change
    - evaporate
    - boil
    - condense
    - freeze
    - melt
    - dissolve
    - mixture
    - chemical reaction
    - energy

- Vocabulary that should not be used in assessment items:
    - atom
    - compound
    - molecule
    - chemical bond
    - solution
    - homogenous
    - heterogenous
    - colloid
    - solute

- solvent
- precipitant
- precipitate
- reactant
- product
- air pressure
- law of conservation

Phenomena

- A hissing sound can be heard as a bicycle wheel deflates.
- A sour odor can be smelled from milk that has been kept too long (or expired).
- When you pump air out of a closed bottle that is partially filled with marshmallows, the marshmallows expand in size. However, when you open the bottle, the marshmallows shrink back to their original size.
- When you place a lit match into a glass bottle and a boiled egg is set on the bottle opening, the egg eventually gets sucked into the bottle.

Task Demands

- Select or identify from a collection of potential model components, including distractors, the components needed to model the phenomenon. Components might include solid, liquid, or gas particles; particles of different substances; and representations of particle movement.
- Assemble or complete — from a collection of potential model components — an illustration, flow chart, or causal chain that is capable of representing the particle nature of matter. This does not include labeling an existing diagram.
- Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.
- Make predictions about the effects of changes in the movements of, distances between, or phases of the particles of matter under investigation. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.
- Provided with models or diagrams of the particles of matter under investigation, identify the properties of the particles under investigation and how they change in each scenario. The properties of the particles may include the relative motions of, distances between, and phases of the particles.
- Describe, select, or identify the relationships among components of a model that explains the observed effects of the particle nature of matter.

5-PS-1.2 Students who demonstrate understanding can:
Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

Dimensions:

- **SEP:** *Using Mathematics and Computational Thinking:* Measure and graph quantities such as weight to address scientific and engineering questions and problems.
- **DCI:** *Matter and Its Interactions*: The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. No matter what reaction or change in properties occurs, the total weight of the substances does not change.
- **CCC:** *Scale, Proportion, and Quantity:* Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Further Explanation and Content Limit:

- Further Explanation: Examples of reactions or changes could include mixing, dissolving, and phase changes that form new substances.
- Content Limits:
    - Assessment does not include distinguishing mass and weight.
    - Students do not need to know the structure of atoms, specific chemical equations.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - weight
    - substance
    - matter
    - conservation
    - temperature
    - mixing
    - phase change
    - dissolving
    - properties
    - reaction
    - particles
    - gas
    - solid
    - liquid
- Vocabulary that should not be used in assessment items:
    - mass
    - atoms
    - molecules
    - rates

Phenomena

- A cup of water is taken out of the freezer and left on a counter. After some time, the frozen water melts.
- A cup of hot tea can dissolve more sugar than a cup of cold tea, but they both weigh the same after the mixing is complete.
- When mixed, silver nitrate and sodium chloride forms a white solid that weighs the same as the individual silver nitrate and sodium chloride weighed.
- When water, baking soda, and calcium chloride are mixed inside a freezer bag, the bag gets hot and expands. The expanded freezer bag weighs the same as the ingredients did when they were separated.

Task Demands

- Make simple calculations using given data to calculate or estimate the total weight of a substance after heating, cooling, or mixing.
- Measure or graph data that can be used to calculate or estimate the total weight of a substance after heating, cooling, or mixing.
- Describe and/or summarize data (e.g., using illustrations and/or labels) to identify/highlight trends, patterns, or correlations concerning the weight of the substances being investigated at the beginning and end of an investigation.
- Compile and/or select, from given information, the particular data needed for a specific inference about the total weight of substances. This can include sorting out the relevant data from the overall body of given information.
- Select, describe, or illustrate a prediction made by applying the findings from measurements or an investigation.
- Use relationships identified in the data to explain that regardless of the type of change, the total weight of matter is conserved.

5-PS-1.3 Students who demonstrate understanding can:
Make observations and measurements to identify materials based on their properties.

Dimensions:

- **SEP:** *Planning and Carrying out Investigations:* Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- **DCI:** *Matter and Its Interactions*: Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)
- **CCC:** *Scale, Proportion, and Quantity:* Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Further Explanation and Content Limit:

- Further Explanation:

    - Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids.
    - Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.

- Content Limits:
    - Assessment does not include density or distinguishing between mass and weight.
    - Students do not need to know chemical reaction equations, balancing reaction equations, atomic-level processes.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - electric
    - electrically charged
    - magnetic
    - magnetic attraction
    - conductor
    - change of state
    - substance
    - absorbency
    - evaporate
    - metal
    - vapor
    - conduction
    - relative
    - conservation of matter
    - phase change
    - dissolve
    - react
    - product
- Vocabulary that should not be used in assessment items:
    - insulator
    - element
    - reaction
    - boiling point
    - melting point
    - molecule
    - forms of matter
    - reactant
    - chemical compound

- chemical reaction
- atom

Phenomena

- Sugar and flour are white powdery substances. Sugar is soluble in water and flour is not.
- Three mineral crystals sit on a table. The three crystals are all the same color, resembling clear glass. However, they are all different minerals. One of them is quartz, one of them is halite, and the third is calcite.
- Two nails are on a table. When a magnet is placed over the nails, one of them moves from the table and sticks to the magnet.
- Two pieces of wood are hit with a hammer. One piece of wood has a depression/dent where the hammer hit it. The other does not have a dent/depression.

Task Demands

- Identify from a list, including distractors, the materials or tools needed to observe or measure properties of matter to identify unknown materials.
- Identify from a list, including distractors, the output data needed to identify or differentiate materials.
- Make and/or record observations or measurements from the investigation of the properties of materials.
- Interpret and/or communicate the data from the investigation of the properties of materials.
- Make or communicate conclusions from the investigation of the properties of materials.

5-PS-1.4 Students who demonstrate understanding can:
Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Dimensions:

- **SEP:** *Planning and Carrying out Investigations:* 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 is considered.
- **DCI:** *Matter and Its Interactions*: When two or more different substances are mixed, a new substance with different properties may be formed.
- **CCC:** *Cause and Effect:* Cause-and-effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation:
  - Students are not expected to be able to balance chemical equations but should be able to complete simple mathematical (addition and subtraction) calculations regarding starting materials and ending materials.

Content Limits:

- Students are expected to know that matter is neither destroyed nor created.
- Students do not need to know chemical names, chemical symbols, general balanced equation {reactant + reactant → products}, and isotopes, specific chemical reaction types (e.g., oxidation, reduction, decomposition, and combustion).

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - matter
    - substance
    - particle
    - chemical property
    - mass
    - volume
    - density
    - melting point
    - boiling point
    - freezing point
    - dissolve
    - flammable
    - odor
    - gas
    - solid
    - liquid
    - mixture
    - chemical reaction
    - gram(s)
    - physical change
    - chemical change
- Vocabulary that should not be used in assessment items:
    - reactant
    - product
    - atom
    - molecule
    - compound
    - chemical bond
    - law of conservation of mass
    - law of conservation of energy
    - intramolecular attractions
    - intermolecular attractions
    - solubility

- solvent
- solute
- precipitant
- rate of chemical reaction
- acid
- base
- salt (as an ionic crystal)
- fusion
- fission
- homogenous mixture
- heterogenous mixture
- plasma
- pH

Phenomena

- A peach shrivels and becomes covered with mold.
- Over time, one metal changes color when exposed to rainwater. However, another metal exposed to rainwater does not.
- A bottle partially filled with vinegar sits on a counter. An empty balloon is partially filled with baking soda. When the open end of the balloon is stretched over the bottle top, a hissing/fizzing sound can be heard, and the balloon expands.
- When sugar crystals are added to vinegar in a bowl, the crystals disappear. When crystals of baking soda are added to vinegar in a bowl, the mixture begins to bubble and foam.

Task Demands

- Identify from a list, including distractors, the properties that should be tested or the materials/tools needed in an investigation of the physical and chemical properties of the starting and ending substances involved in mixing.
- Identify the outcome data that should be collected in an investigation of the physical and chemical properties of the starting and ending substances under investigation.
- Make and/or record observations/data about the physical and chemical properties of the substances that are mixed and the substances resulting from the mixture.
- Interpret and/or communicate the data from an investigation. This may include identifying/describing trends, patterns, or correlations among observations and data concerning the physical and chemical properties of the beginning and ending substances being investigated.
- Explain or describe the causal processes that lead to the observed data.

5-PS-2.1 Students who demonstrate understanding can:
Support an argument that Earth's gravitational force exerted on objects is directed downward.

Dimensions:

- **SEP:** *Engaging in Argument with Evidence:* Support an argument with evidence, data, or a model.
- **DCI:** *Matter and Stability: Forces and Interactions*: The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.
- **CCC:** *Cause and Effect:* Cause-and-effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation:
  - "Down" is a local description of the direction that points toward the center of the spherical Earth.
- Content Limits:
  - Assessment does not include mathematical representation of gravitational force.
  - The study of gravity is limited to gravity on Earth.
  - Students do not need to know:
    - Calculations for weight (weight = mass • gravity), free fall, terminal velocity, weightlessness, air resistance, friction, black holes, inertia, Newton's law of universal gravitation, vacuum.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - sun
  - gravity
  - space
  - flow
  - magnet
  - period (time)
  - charge
  - Earth's rotation
  - solar systems
  - spherical
  - exert
  - transfer
  - mass
  - orbital
  - mass
  - volume

- Vocabulary that should not be used in assessment items:
    - attractive
    - direction of force
    - direction of motion
    - field
    - linear
    - nonlinear
    - gravitational energy
    - gravitational field
    - magnetic field
    - permeate

Phenomena

- A hard rubber ball dropped in a pool falls more slowly than the same ball dropped on land.
- A feather released on top of a cliff on a breezy day seems to fly away, while a similar feather dropped on flat ground on a breezy day lands on the ground.
- A small piece of clay set on the top of a globe stays in place, but when you put it on the bottom of the globe it drops off. A piece of clay put at the real north pole stays in place and stays in place on the real south pole.
- A basketball flies in an arc before going through the basket.

Task Demands

- Sort observations into those that appear to support competing (given) arguments, or into those that support, contradict, or are not relevant to a given argument. Observations are from animations, simulations, or other given material.
- Sort, tabulate, classify, separate, and/ or categorize relevant from irrelevant evidence (observations) or data.
- Select from a given collection additional relevant observations that would help distinguish between competing arguments or the veracity of a single argument.
- Select, identify, or describe apparent counterexamples to a supported argument.
- Identify from a given collection or explain in writing flaws in observation that lead to an apparent counterexample or explain the counterexample in terms of grade-level appropriate properties gravity, or other simple forces from earlier grade levels.
- Sort statements into categories such as facts, reasonable judgments based on available facts, and speculation.
- Clearly articulate the evidence supporting and contradicting an argument, noting how the evidence supports or contradicts the argument.
- Predict outcomes when properties or proximity of the objects are changed, given the inferred cause and effect relationships. This can be done by describing outcomes or selecting or identifying outcomes from lists.

5-PS-3.1 Students who demonstrate understanding can:
Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Dimensions:

- **SEP:** *Developing and Using Models:* Use models to describe phenomena.
- **DCI:** *Energy:* The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter. Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary)
- **CCC:** *Energy and Matter:* Energy can be transferred in various ways and between objects.

Further Explanation and Content Limit:

- Further Explanation:
  - Examples of models could include diagrams and flow charts.
- Content Limits:
  - Assessment does not include photosynthesis.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - energy
  - matter
  - transfer
  - light
- Vocabulary that should not be used in assessment items:
  - photosynthesis
  - metabolism
  - atoms
  - chemicals
  - reaction
  - radiation

Phenomena

- Cows eat grass that grows in the sun.
- Termites eat the wood in trees.
- Caterpillars eat leaves and grow big.
- Koalas mainly eat eucalyptus leaves.

Task Demands

- Select or identify, from a collection of potential model components, including distractors, the parts of a model need to describe the flow of energy among plants, animals, and the sun.
- Assemble or complete a model representing the flow of energy among plants, animals, and the sun.
- Manipulate the components of a model to demonstrate properties, processes, and/or events that result in the flow of energy among plants, animals, and the sun, including the relationships of organisms and/or the cycles of energy and/or matter.
- Articulate, describe, illustrate, select, or identify the relationships among components of a model that describe the movement of matter among plants, animals, and the sun.
- Make predictions about the effects of changes in model components including the substitution, elimination, or addition of energy and/or an organism and the result.

5th Grade Life Science

5-LS-1.1 Students who demonstrate understanding can:
Support an argument that plants get the materials they need for growth chiefly from air, water, and energy from the sun.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Support an argument with evidence, data, or a model.
- **DCI:** *From Molecules to Organisms: Structure and Processes:* Plants acquire their material for growth chiefly from air and water. The energy released from food was once energy from the Sun that was captured by plants in the chemical process that forms plant matter (from air and water)
- **CCC:** *Energy and Matter:* Matter is transported into, out of, and within systems.

Further Explanation and Content Limit:

- Further Explanation:
  - Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.
- Content Limits:
  - Assessment does not include photosynthesis or the photosynthesis reaction equation. Students should know that plants carry out photosynthesis for energy, but they do not need to know the specifics of the process or equation.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - organism
  - algae

    - atmosphere
    - consumer
    - cycle
    - matter
    - product
    - transport
    - chemical
    - convert
    - transfer
    - energy flow
    - flow chart
    - conservation
    - nutrients
- Vocabulary that should not be used in assessment items:
    - plant structure
    - producer
    - chemical process
    - carbon
    - carbon dioxide
    - aerobic
    - anaerobic
    - molecule
    - sugars
    - photosynthesis

Phenomena

- A neoregelia plant sits on the branch of a much larger kapok tree in the Cloud Forest of South America.
- A plant grows in a classroom and the students weigh the soil every day. The weight of the soil does not change over time, but the plant continues to grow.
- Spanish moss hangs from the branches of a live oak tree in the swamps of Louisiana.
- Strawberries sold in a supermarket were grown inside of a greenhouse without soil.

Task Demands

- Sort observations into those that appear to support competing (given) arguments, or into those that support, contradict, or are not relevant to a given argument. Observations are from animations, simulations, or other given material.
- Sort, tabulate, classify, separate, and/or categorize relevant from irrelevant evidence (observations) or data.
- Select from a given collection additional relevant observations that would help distinguish between competing arguments or the veracity of a single argument.

- Select, identify, or describe apparent counterexamples to a supported argument.
- Identify from a given collection—or explain in writing—flaws in observation that lead to an apparent counterexample or explain the counterexample in terms of grade-level appropriate properties of plant growth.
- Sort statements into categories such as facts, reasonable judgments based on available facts, and speculation.
- Articulate the evidence supporting and/or contradicting an argument that plants chiefly need air and water for growth.

5-LS-2.1 Students who demonstrate understanding can:
Analyze and interpret data from fossils to provide evidence of the types of organisms and the environments that existed long ago and compare those to living organisms and their environments.

Dimensions:

- **SEP:** *Analyzing and Interpreting Data:* Analyze and interpret data to make sense of phenomena using logical reasoning, mathematics, and/or computation.
- **DCI:** *Biological Adaptation: Unity and Diversity:*
  - Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
  - Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.
- **CCC:** *Scale, Proportion, and Quantity:* Observable phenomena exist from very short to very long periods.

Further Explanation and Content Limit:

- Further Explanation:
  - Examples of data could include type, size, and distributions of fossil organisms.
  - 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.
  - Focus is on the fossils and environment in which the organisms lived, not how the fossils got to where they are today.
  - Data can be represented in tables and/or various graphic displays.
  - Data collected by different groups can be compared to discuss similarities and differences in their findings.
- Content Limits:
  - Assessment does not include identification of specific fossils or present plants and animals.
  - Assessment is limited to major fossil types and relative ages.
  - Graphs and charts can include bar graphs, pictographs, pie charts, and tally charts.

    - Types of math can include simple addition/subtraction.
    - Standard units that can be used to measure and describe physical quantities such as weight, time, temperature, and volume.

Science Vocabulary

- Vocabulary that may be used in assessment items:
    - exist
    - existence
    - ecosystem
    - characteristic
    - habitat
    - species
    - volcanic eruption
    - climate
    - extinct
    - extinction
    - predator
    - time period
    - earthquake
    - erosion
    - weathering
- Vocabulary that should not be used in assessment items:
    - chronological order
    - fossil record
    - radioactive dating
    - descent
    - ancestry
    - evolution
    - evolutionary
    - genetic
    - relative
    - rock layer

Phenomena

- Fossil trees are found in sedimentary rocks in Antarctica.
- The Red wall Limestone in the Grand Canyon contains many different fossils including corals, clams, octopi, and fish.
- Whale fossils have been found in rocks in the Andes Mountains.
- Fossils of corals and snails are found in Iowa.

Task Demands

- Organize or summarize data to highlight trends, patterns, or correlations between plant and animal fossils and the environments in which they lived.
- Generate graphs or tables that document patterns, trends, or correlations in the fossil record.
- Identify evidence in the data that supports inferences about plant and animal fossils and the environments in which they lived.
- Sort statements into categories such as facts, reasonable judgments based on available facts, and speculation.
- Articulate the evidence supporting and/or contradicting an argument that plants chiefly need air and water for growth.

5-LS-2.2 Students who demonstrate understanding can:

Construct an argument with evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Dimensions:

- **SEP:** *Constructing Explanations and Designing Solutions:* Use evidence (e.g., observations, patterns) to construct an explanation.
- **DCI:** *Biological Adaptation: Unity and Diversity:*
  - Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.
  - Populations of animals are classified by their characteristics.
- **CCC:** *Cause and Effect:* Cause and effect relationships are routinely identified and used to explain change.

Further Explanation and Content Limit:

- Further Explanation:
  - Examples of cause-and-effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten, and animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.
- Content Limits:
  - Differences between individuals helping or hurting chances of survival and reproduction should be included.
  - Data sets can include not only common trends but also outliers and anomalous data points.
  - Analysis of data should be limited to patterns and trends.
  - Students are not expected to evaluate the extent to which the sample is representative of a population.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - variation
  - advantage
  - reproduce
  - relationship
  - mating
  - breeding
  - behavior
  - plumage
  - pollination
  - camouflage
- Vocabulary that should not be used in assessment items:
  - natural and artificial selection
  - evolution
  - genetics
  - adaptation

Phenomena

- The same species of walking stick in California has two different color variations. The green walking sticks are found on bushes with thick green leaves, whereas the striped walking sticks are found on bushes with needle-like leaves.
- In a given population, there are more male [X Bird] with larger, brighter feathers in the population than males with smaller, muted feathers.
- Acacia trees that are browsed upon by X animal grow longer thorns at X height. Acacia trees that are browsed upon by Y animal grow longer thorns at Y height. Acacia trees that are not browsed upon at all do not grow longer thorns.
- Io moths use eyespots on their inner wings to frighten predators away. Larger eyespots are more effective.

Task Demands

- Articulate, describe, illustrate, or select the variations of characteristics to be explained. This may entail sorting relevant from irrelevant information or features.
- Identify evidence supporting the conclusion that the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
- Describe, identify, and/or select information needed to support an explanation that a characteristic provides advantages in surviving and reproducing.
- Select or identify a prediction about survival or reproduction rates given a change in a characteristic. The prediction should follow from an explanation or causal relationship supported in earlier items.

- Identify additional evidence that would help clarify, support, or contradict a hypothesized relationship between characteristics of individuals and their chances of survival and reproductive rates.
- Express or complete a causal chain that explains how different characteristics among individuals of the same species provide advantages in survival and reproduction. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause and effect chains.
- Use evidence to construct an explanation for differences in survival and/or reproduction given a difference in traits between individuals of the same species.

5-LS-2.3 Students who demonstrate understanding can:
Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Dimensions:

- **SEP:** *Engaging in Argument from Evidence:* Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
- **DCI:** *Biological Adaptation: Unity and Diversity:*
  - Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
  - Populations live in a variety of habitats and change in those habitats affects the organisms living there.
- **CCC:** *Systems and System Models:* A system can be described in terms of its components and their interactions.

Further Explanation and Content Limit:

- Further Explanation:
  - Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.
- Content Limits:
  - Assessment is limited to a single environmental change.
  - Assessment does not include the greenhouse effect or climate change.
  - Students do not need to know greenhouse effect, ultraviolet (UV) radiation, nuclear disasters.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - population
  - organism
  - community

    - habitat
    - resource
    - reproduce
    - shelter
    - temperature
    - matter
    - predator
    - prey
    - flood
    - frost
    - tide
- Vocabulary that should not be used in assessment items:
    - ecosystem
    - biotic
    - abiotic
    - food web
    - producer
    - consumer
    - decomposer
    - photosynthesis
    - pollinate
    - adapt
    - energy flow
    - biosphere
    - sustain
    - predation
    - mutualism
    - carrying capacity
    - volcano
    - earthquake
    - drought
    - arid
    - blight

Phenomena

- To help ornamental bushes grow, no other plants should grow in their immediate vicinity.
- Before stocking a lake with fish, the lake pollution needs to be reduced.
- A late frost threatens the orange groves in Georgia.

Task Demands

- Articulate, describe, illustrate, or select the relationships, interactions, and/or processes involved when the types of plants and/or animals change as a result of environmental changes. This may entail sorting relevant from irrelevant information or features.
- Identify a problem that results when the types of plants and/or animals change because of environmental changes.
- Express or complete a causal chain explaining a solution to a problem that results when the types of plants and/or animals change because of environmental changes. The causal chain should include the ecosystem before the environmental change, the environmental change, the problem to plants and animals resulting from the environmental change, the solution to the problem, and the effect(s) of the solution on the ecosystem. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause-and-effect chains.
- Identify and/or evaluate evidence related to a solution to a problem caused when the types of plants and/or animals change because of environmental changes. The evidence may support or refute the solution, or students may identify missing evidence.
- Evaluate a solution to a problem that results when the types of plants and/or animals change because of environmental changes, including how the solution may affect plants, animals, and/or other aspects of the ecosystem.
- Identify information or data needed to support or refute a claim regarding a problem resulting from an environmental change affecting native plants and animals.

5-LS-2.4 Students who demonstrate understanding can:
Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Dimensions:

SEP: *Developing and Using Models:* Develop a model to describe phenomena.

DCI: *Biological Adaptation: Unity and Diversity:*

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.
- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the

environment and release waste matter (gas, liquid, or solid) back into the environment.

CCC: *Systems and System Models:* A system can be described in terms of its components and their interactions.

Further Explanation and Content Limit:

- Further Explanation:
  - Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food.
  - Examples of systems could include organisms, ecosystems, and Earth.
- Content Limits:
  - Assessment does not include molecular explanations.

Science Vocabulary

- Vocabulary that may be used in assessment items:
  - organism
  - bacteria
  - fungus
  - algae
  - gas
  - nutrients
  - producer
  - consumer
  - decomposer
  - cycle
  - conserve
  - products
  - relationship
  - waste
  - recycle
  - species
  - balance
- Vocabulary that should not be used in assessment items:
  - chemical process
  - reaction
  - molecule
  - carbon
  - carbon dioxide
  - oxygen
  - sugar
  - aerobic

- anaerobic
- photosynthesis

Phenomena

- Insects in a terrarium only survive when bacteria and plants are present.
- A new fish tank must rest for 2–3 weeks with water before introducing fish or the fish die.
- Under a microscope, a sample of soil contains many bacteria, but a sample of desert sand does not.
- Farmers put fish in stock tanks to keep them clean.

Task Demands

- Select or identify from a collection of potential model components, including distractors, the parts of a model needed to describe the movement of matter among plants, animals, decomposers, and the environment.
- Manipulate the components of a model to demonstrate properties, processes, and/or events that result in the movement of matter among plants, animals, decomposers, and the environment, including the relationships of organisms and/or the cycle(s) of matter and/or energy.
- Articulate, describe, illustrate, select, or identify the relationships among components of a model that describe the movement of matter among plants, animals, decomposers, and the environment.
- Make predictions about the effects of changes in model components, including the substitution, elimination, or addition of matter and/or an organism and the result.
- Evaluate a solution to a problem that results when the types of plants and/or animals change because of environmental changes, including how the solution may affect plants, animals, and/or other aspects of the ecosystem.