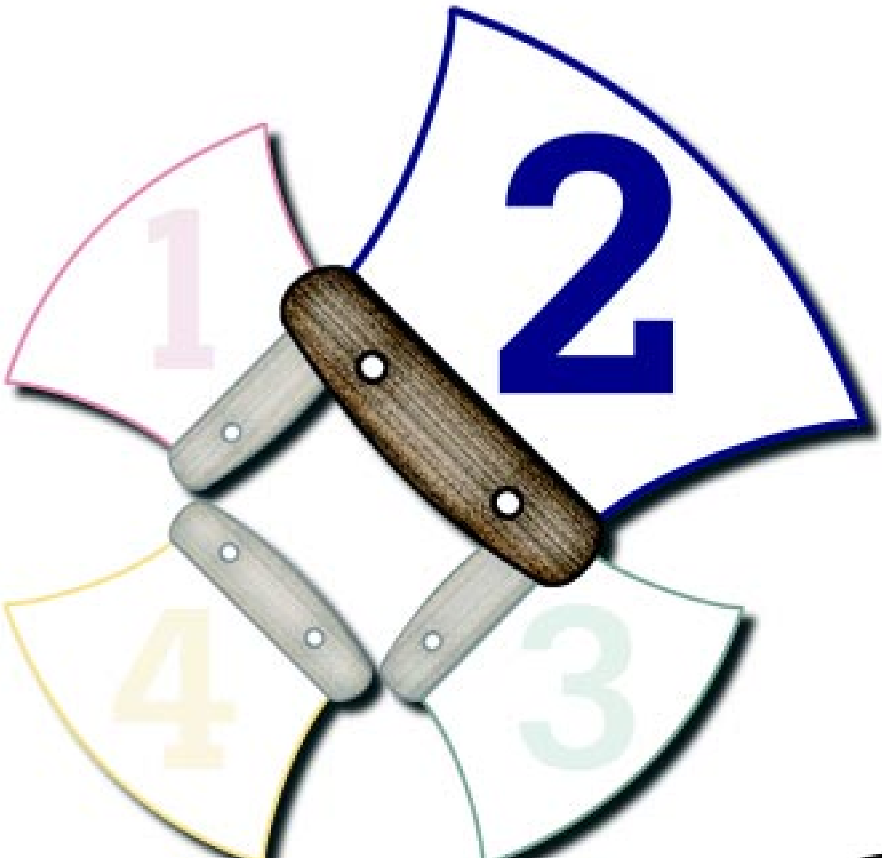
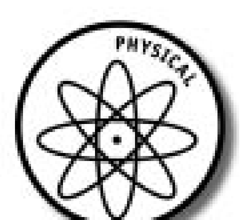
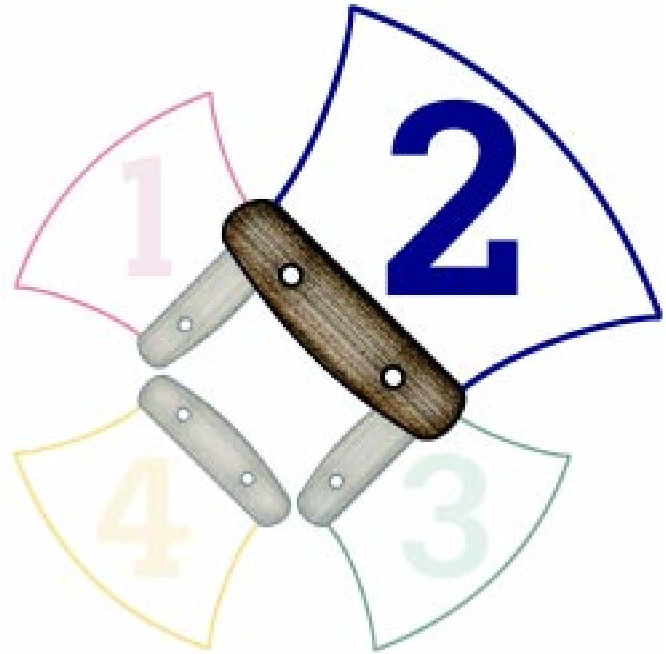
Translating Standards to Practice

A Teacher's Guide to Use and Assessment of the Alaska Science Standards

LEVEL 2, Ages 8–10







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A Teacher's Guide to Use and Assessment of the Alaska Science Standards

LEVEL 2

Developed collaboratively by the Alaska State Department of Education & Early Development and the Alaska Rural Systemic Initiative with funding provided by the National Science Foundation.

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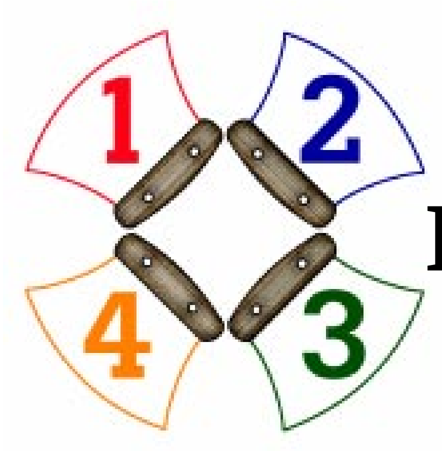

Introduction

Translating Standards to Practice: A Teacher's Guide to Assessment of the Alaska Science Standards were developed by Alaska educators and members of the business, native, and scientific communities to help promote scientific literacy and understanding for Alaska science students. As such, they were written to enhance, complement, and integrate the *Alaska Science Content Standards* and the *Alaska Standards for Culturally Responsive Schools* to further education in the sciences. These standards borrow heavily from the *National Science Education Standards* (NRC, 1995) as well as the *Benchmarks for Science Literacy* (AAAS, 1993) and are intended to help teachers provide students with an integrated and comprehensive understanding of science. Additionally, they were written to help enhance student understanding of Alaska culture, including the traditional and the scientific, and how they relate to one another. Teaching how the traditional and scientific relate to one another, through the use of *Translating Standards to Practice: A Teacher's Guide to Assessment of the Alaska Science Standards*, can provide an exciting and educational process that will invoke a sense of pride and self confidence in both students and teachers. The standards were developed collaboratively by the Alaska State Department of Education & Early Development and the Alaska Rural Systemic Initiative, with funding generously provided by the National Science Foundation.

Purpose

In 1994 the *Alaska Science Content Standards* were published with the goal of defining what students should know and be able to do in science by the time they complete their K–12 public education experience. These guidelines elaborate the expectations regarding student achievement and explain *how well* students should understand important scientific concepts and skills and how they relate to the environment around them. Corresponding assessments, supporting classroom ideas, and samples of student work were added to show how they might fit in a curriculum. These illustrate what *meeting the standard* may look like in the classroom. The sample assessments, which are in measurable terms, with a scoring guide, have been provided. The assessments can then be used to provide feedback to the students about how well they are meeting expectations. The assessments are also feedback to educators about how well their students are learning and how well they are meeting the *Alaska Science Content Standards*. It is important to note that these guidelines, assessments, and procedures were written illustratively—as ideas—not mandates. It should also be understood that this document is intended to help provide guidance to districts through the examples provided as they make choices regarding which standards to focus on at various benchmark age levels, as well as what *aspects* of the standards are focused on and when. The standards were written to reflect the diversity and richness of Alaska that makes teaching Alaskan students so exciting. Therefore, teachers may use them as guidelines for writing their own performance assessment activities or simply as examples to better understand particular aspects of the content standards at benchmark age levels. The standards were written to provide ideas relating to the wisdom of the cultural traditions of the Elders as well as the technological advances of the scientific community, bridging the gap between science and cultural practices to make learning more fun and appealing.

About This Document

This document presents an expanded view of the content standards for Alaska students. Performance standard statements have been written at each benchmark age level (5–7, 8–10, 11–14, 15–18). However, this document is really a "sampler" as examples of the expanded performance assessments, corresponding procedures, scoring guides, and in a very few cases, sample mini-units (elaborated classroom units), are provided for only a portion of the *Alaska Science Content Standards*—A, B, C, and D. The schematic shown below and "definitions" of the components of the document illustrate how the document is organized. The electronic version can be accessed via the Alaska Native Knowledge Network website at http://www.ankn.uaf.edu. Cross references to other pertinent Alaska standards, as well as to the National Research Council's *National Science Education Standards* and the American Association for the Advancement of Science's *Benchmarks for Science Literacy*, have been provided to show connections and further illuminate the intention of the *Alaska Science Content Standards*.

This document does **not** provide a list of mandated understandings and skills. The content standards provide a broad overview of essential learnings. The four domains described in the A, B, C, and D statements are elaborated by the key elements and describe what we agree are essential to the discipline and should be learned by all students in Alaska. The specific dimension of the content standards that should be taught and the performance to show mastery are the choice of the district, community, school, or classroom, not the document. This document is a guide for making the choice at the local level.

Definitions

Content Standard
What Alaskans want students to know and be able to do as a result of their public schooling.

Key Element
An important focus within a content standard.

Performance Standard
An example of how students at a specific age level demonstrate proficiency and understanding of a content standard focus (key element).

Sample Assessment Idea
A potential task designed to assess a student's proficiency and understanding of a performance standard.

Expanded Assessment Idea
A sample assessment idea elaborated to include procedure, reflection and revision, and level of performance.

Procedure
Step-by-step instructions to guide the implementation of an expanded assessment idea.

Reflection and Revision
A final step of procedure, which represents a collection of brief ideas or methods, intended to strengthen, clarify, and improve student understanding and proficiency.

Level of performance
A task-specific scoring guide used to assess how well students meet the performance standard.

Frequently Asked Questions

Why was *Translating Standards to Practice: A Teacher's Guide to Assessment of the Alaska Science Standards* document written?

It was prepared to:

- elaborate the Alaska Science Content Standards to more fully explain what students need to know and are able to do;
- help guide curriculum development in schools and districts;
- provide sample developmentally appropriate activities for each standard;
- provide educators with innovative performance assessment activities.

What are Performance Standards?

Performance standards define the nature of the evidence and quality to which a student understands the content standards.

What makes performance standards different from content standards?

The content standards are designed to broadly define what scientific concepts, skills, and applications are to be taught in Alaska's schools, whereas these guidelines are more detailed definitions of how well students need to know the science and what they ought to be able to do with that knowledge.

What are performance assessments?

Performance assessments help define how well students:

- understand science;
- show what they can do;
- relate science to society;
- communicate knowledge

by providing performance opportunities for students to demonstrate their understanding.

Why should I use performance activities with my students?

- To document student progress in meeting the Alaska Science Content Standards.
- To help students become accountable for their learning.
- To provide opportunities for students to learn by "doing."
- To give students a variety of opportunities to show that they can "meet" the content standards.

What if I can't use a particular performance assessment in my classroom?

The performance assessments were written as sample suggestions. You may use them as models for writing your own performance assessment activities.

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Alaska Science Content Standard A

Level 2, Ages 8–10

A student should understand scientific facts, concepts, principles, and theories.

Alaska Science Key Element A1

A student who meets the content standard should understand models describing the nature of molecules, atoms, and sub-atomic particles and the relation of the models to the structure and behavior of matter (Structure of Matter).

Performance Standard Level 2, Ages 8–10

Students use models to represent matter as solids, liquids or gases and the changes from one state to another.

Sample Assessment Ideas

- Students investigate snowflakes and different types of snow with a hand lens; draw the differences seen between snowflakes in a journal; investigate the properties of snow using various tools; discuss the “Dillingham Story”; learn several Alaska Native words that describe the different types of snow.
- Students make a model of the water cycle, including water as a solid (snow), a liquid (rain), and a gas (water evaporated into the air).

Expanded Sample Assessment Idea

- Students place an ice cube in a beaker and observe over several days; draw picture to show what happens.

Procedure

Students will:

1. Compare ice cubes placed in open and covered beakers in the classroom.
2. Make drawings and notes in a journal over several days.
3. Make an oral report or write a poem to describe what happens to the water.

Revision and Reflection

Explain why the two beakers looked different after several days. Would the results be different if you used water instead of ice? What would happen if you used a cloth to cover the beaker?

Levels of Performance

Stage 4 — Student work is complete, correct and shows evidence of logical reasoning. Several detailed journal entries compare the contents of the two beakers and what happens to the water in the open beaker. The report or poem shows extensive evidence of the transfer and extension of knowledge. The description of the changes from ice to water vapor are accurate and include detailed predictions of how changes in the experimental conditions would alter the observations.

Stage 3 — Student work is complete but may contain minor errors or omissions. Several journal entries compare the two beakers and what happens to the water in the open beaker. The report or poem shows some evidence of the transfer and extension of knowledge. The description of the changes from ice to water vapor are mostly accurate and include a prediction of how a change in an experimental condition would alter the observations.

Stage 2 — Student work may show evidence of skilled craftsmanship but may be incomplete, shows evidence of limited understanding or misconceptions related to what happens as ice changes to water vapor. At least one journal entry is made. The report or poem may describe the two beakers, but the explanation or prediction, if included, may be incorrect.

Stage 1 Student work is mostly incomplete and shows little or no evidence of understanding and misconceptions related to what happens as ice changes to water vapor.

Standards Cross-References

National Science Education Standards

Develop descriptions, explanations, predictions, and models using evidence. Students should base their explanations on what they observed and as they develop cognitive skills, they should be able to differentiate explanation from description—providing causes for effects and establishing relationships based on evidence and logical argument. (Page 145)

Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating and cooling. (Page 127)

Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel, or for growing the plants we use as food. Earth materials provide many of the resources that humans use. (Page 134)

Soils have properties of color and texture, capacity to retain water, and ability to support the growth of many kinds of plants, including those in our food supply. (Page 134)

Benchmarks

Seeing how a model works after changes are made to it may suggest how the real thing would work if the same were done to it. (Page 268)

No matter how parts of an object are assembled, the weight of the whole object made is always the same as the sum of the parts; and when a thing is broken into parts, the parts have the same total weight as the original thing. (Page 77)

Materials may be composed of parts that are too small to be seen without magnification. (Page 77)

Alaska Science Key Element A2

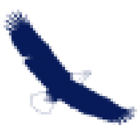
A student who meets the content standard should understand the physical, chemical, and nuclear changes and interactions that result in observable changes in the properties of matter (Changes and Interactions of Matter).

Performance Standard Level 2, Ages 8–10

Students observe physical and chemical properties of common substances and observe changes to those properties.

Sample Assessment Ideas

- Students mix baking soda and vinegar; observe and describe changes in journal.
- Students dissolve rock salt in water, evaporate and re-crystallize; draw and describe their observations.



Expanded Sample Assessment Idea

- Students develop a strategy to sink an ice cube.

Procedure

Students will:

1. Predict if they can sink an ice cube.
2. Work in teams to develop a strategy to make the ice sink.
3. Demonstrate their ice-sinking apparatus; share strategies and observations with the class.

Reflection and Revision

Why is ice so hard to sink? Discuss the properties of ice and water (what they look like, feel like, smell like, taste like and how they behave in relation to sinking and floating.) How are these two forms of water alike and how are they different? Discuss density.

Levels of Performance

Stage 4 — Student work is complete, correct, shows evidence of logical reasoning and transfer and extension of knowledge related to the physical properties of the three states of water. Explanation of water's change of state includes correct terminology, physical properties of each state of water, a description of where each phase occurs in nature, and an example of how each change in the state of water affects the local community. The student describes a detailed strategy to sink an ice cube or explains why it isn't possible

Stage 3 — Student work shows evidence of logical reasoning and transfer of knowledge related to the physical properties of the three states of water, but may contain minor errors or omissions. Student explanation of water's change of state includes correct terminology, physical properties of some of the states of water, some descriptions of where water occurs in nature and at least one example of how a change in the state of water affects the local community. The student describes a strategy to sink an ice cube

Stage 2 — Student work contains omissions or errors of science fact and reasoning. Student explanation of water's change of state may identify an example of where water occurs in nature, describes an example of how water is used within the local community, uses some appropriate terminology, and may describe some physical properties of water in one of its three states. A strategy to sink an ice cube, if included, may be incomplete or lack detail.

Stage 1 — Student explanation of the change of state of water is largely incomplete, incorrect, and shows little evidence of understanding the role of water in the local community.

Standards Cross-References

National Science Education Standard

Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. These properties can be measured using tools, such as rulers, balances, and thermometers. (Page 127)

Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling. (Page 127)

A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties. (Page 154).

Benchmarks

Heating and cooling cause changes in the properties of materials. Many kinds of changes occur faster under hotter conditions. (Page 77)

When a new material is made by combining two or more materials, it has properties that are different from the original materials. For that reason, a lot of different materials can be made from a small number of basic kinds of materials. (Page 77)

Mini-Unit: Water Dance

Performance Standard A2,Level 2

Students observe physical and chemical properties of common substances and observe changes to those properties.

Key Concepts and Skills

- Water exists in three states—solid, liquid, gas.
- Water evaporates when heated.
- Water expands when it freezes which causes problems in Alaska.
- Liquid water expands as it is heated above 4 degrees Celsius.
- Water, snow and ice have many names in Iñupiaq.
- Ice is less dense than water.
- Measuring volume, temperature, density, mass.

Timeline

2–3 weeks

Abstract

Students explore states of water and changes between these states in their community. Students investigate changes as water freezes, liquefies, evaporates, and boils. Students learn many Iñupiaq names for water, ice, and snow and the significance of each name

Alaska Science Content Standard Key Element

A student who meets the content standard should understand the physical, chemical, and nuclear changes and interactions that result in observable changes in the properties of matter.

Cross-Reference

Additional Content and Performance Standards: B1, D1 and D3

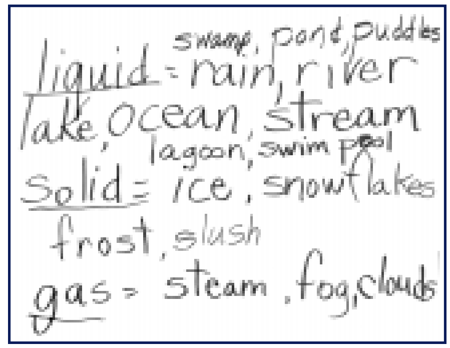
Materials

- ✔ Clipboards for note taking
- ✔ freezer to make ice cubes
- ✔ *Go Home River* by Jim Magdanz
- ✔ rulers
- ✔ List of Iñupiaq names for water (see below)
- ✔ graduated cylinders
- ✔ water
- ✔ hot plates
- ✔ plastic bottles to hold water
- ✔ balance with gram masses
- ✔ pans for boiling water

Activities

1

Read the book *Go Home River* by Jim Magdanz; ask the students what they know about the states of water, how and where it exists around the community. List.



Embedded Assessment

Check list for previous understanding of concepts.

2

Take students for a “water walk” around the community; list a variety of usual and unusual forms in which water exists in their environment and changes in the states of water that are observed at different seasons; record in journal; share with the class.

3

Students conduct an interview of Elders or adults in the community or their family. Before they go, you may want to review the relevant forms of water in all three states, such as snow, sleet, permafrost, fog, clouds, etc.

Help students generate questions to ask, such as the following: How does water’s change of state during break-up or freeze-up affect your life/job? What problems does the change of state of water cause in your community? What solutions have people found to solve these problems?

When students return from their interview, they share the information and stories they collected. Discuss. Brainstorm a list of properties of each of the states of water (local examples as well as global examples). Introduce different Iñupiaq names for water and snow. Discuss how each Iñupiaq form is different and why a new word for each type of water and snow is helpful.

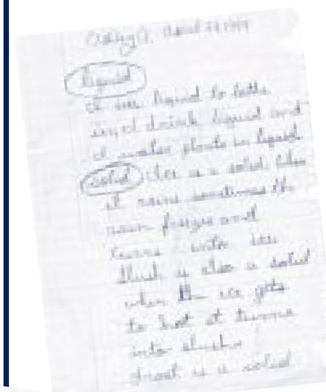
avun	powder snow	*qannatuq*	snow falling down
sigu	ice	*qilakluk*	cloud
aniu	snow on ground	*qaniq*	snowflake
kuuk	river	*iziq*	steam

4

Fill a clear plastic bottle or pop can with water. Replace cap. Ask students to predict what will happen when the bottle is frozen. Record predictions and explanations in journals using words and pictures. Make qualitative and quantitative observation of the bottle/cans of water. Record observations in journals. Put bottles/cans outside (if cold enough) or in freezer. After it is frozen record both qualitative and quantitative observations.

Expanded Sample Assessment Idea

Students develop a strategy to sink an ice cube.



Procedure

Students will:

1. Predict if they can sink an ice cube.
2. Work in teams to develop a strategy to make the ice sink.
3. Demonstrate their ice-sinking apparatus; share strategies and observations with the class.

Reflection and Revision

Why is ice so hard to sink? Discuss the properties of ice and water (what they look like, feel like, smell like, taste like and how they behave in relation to sinking and floating.) How are these two forms of water alike and how are they different? Discuss density.

Levels of Performance

Stage 4 — Student work is complete, correct, shows evidence of logical reasoning and transfer and extension of knowledge related to the physical properties of the three states of water. Explanation of water's change of state includes correct terminology, physical properties of each state of water, a description of where each phase occurs in nature, and an example of how each change in the state of water affects the local community. The student describes a detailed strategy to sink an ice cube or explains why it isn't possible

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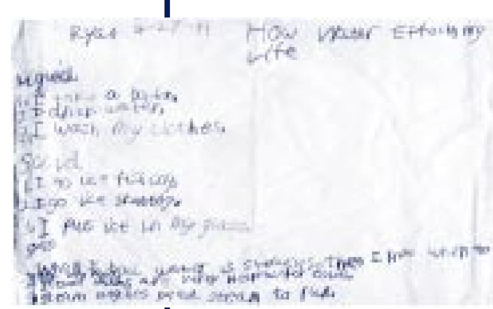

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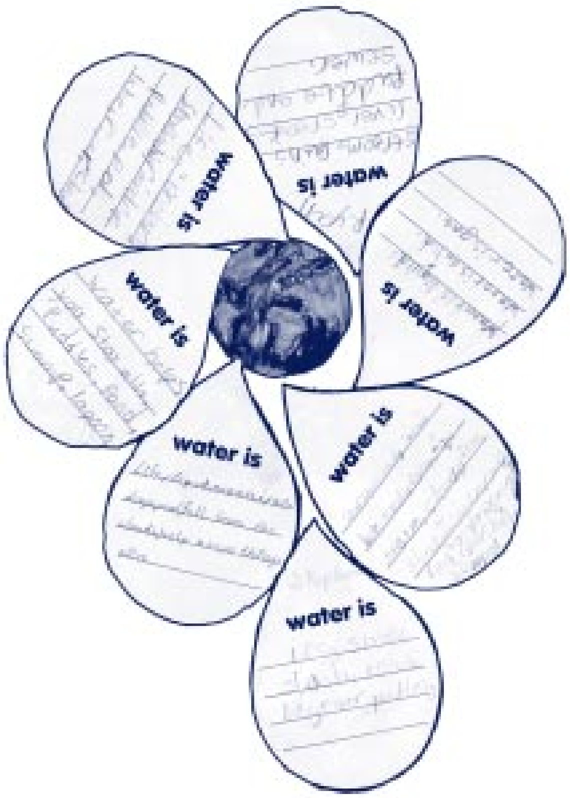
Stage 1 Student explanation of the change of state of water is largely incomplete, incorrect, and shows little evidence of understanding the role of water in the local community.

Standards Cross-References



National Science Education Standards

Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. These properties can be measured using tools, such as rulers, balances, and thermometers. (Pg. 127)

Materials can exist in different states – solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling. (Pg. 127)

A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties. (Pg. 154)

Benchmarks

Heating and cooling cause changes in the properties of materials. Many kinds of changes occur faster under hotter conditions. (Pg. 77)

When a new material is made by combining two or more materials, it has properties that are different from the original materials. For that reason, a lot of different materials can be made from a small number of basic kinds of materials. (Pg. 77)

Alaska Science Key Element A3

A student who meets the content standard should understand models describing the composition, age, and size of our universe, galaxy, and solar system and understand that the universe is constantly moving and changing (Universe).

Performance Standard Level 2, Ages 8–10

Students make observations of the daytime and nighttime sky and create a 3-dimensional model to explain the movement of the Earth and moon in our solar system.

Sample Assessment Ideas

- Students use models to demonstrate the motion and position of the sun during Alaska's summer and winter days; explain the cause of these dramatic seasonal changes.
- Students describe the daily, monthly, and yearly motion of the moon.

Standards Cross-References

National Science Education Standards

An object's motion can be described by tracing and measuring its position over time. (Page 127)

The Earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system. (Page 160)

Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses. (Page 160)

Benchmarks

The patterns of stars in the sky stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons. (Page 68)

Like all planets and stars, the Earth is approximately spherical in shape. The rotation of the Earth on its axis every 24 hours produces the night-and-day cycle. To people on Earth, this turning of the planet makes it seem as though the sun, moon, planets, and stars are orbiting the Earth once a day. (Page 63)

Planets change their positions against the background of stars. (Page 63)

The Earth is one of several planets that orbit the sun, and the moon orbits around the Earth. (Page 63)

Stars are like the sun, some being smaller and some larger, but so far away that they look like points of light. (Page 63)

Alaska Science Key Element A4

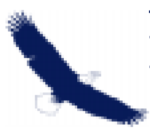
A student who meets the content standard should understand observable natural events such as tides, weather, seasons, and moon phases in terms of the structure and motion of the Earth (Earth).

Performance Standard Level 2, Ages 8–10

Students observe natural events related to weather, seasons, and phases of the moon, and identify patterns in their observations.

Sample Assessment Ideas

- Students observe, record, and describe the motion of the moon during one day or night.
- Students observe, record, and describe the phase changes of the moon during one month.
- Students discuss past ice-flow break-up dates; identify possible weather patterns regarding break-up.



Expanded Sample Assessment Idea

- Students create a song or poem to describe patterns in the weather.

Procedure

Students will:

1. Interview Elders to learn Native weather-related terminology; listen to native songs and song patterns; identify weather patterns and Native ways to predict them.
2. Collect daily weather measurements of temperature, wind speed and direction, and precipitation for two months.
3. Observe cloud formations and corresponding satellite weather pictures.
4. Analyze the data for patterns.
5. Write a song or poem that describes patterns in the weather over time. Use repeating parts of the song or poem to emphasize specific weather information.
6. Share song or poem with the class.

Reflection and Revision

What specific knowledge did you hope to impart through your song or poem? What part of the song or poem tells about the patterns in the weather? How do the repeating parts of your song or poem emphasize specific weather information? Why is this information important to emphasize?

Level of Performance

Stage 4 — The student song or poem accurately describes changing weather patterns using scientific knowledge, data collected during daily weather measurements, and indigenous knowledge or stories. The song or poem and the explanation show detailed evidence of transfer and extension of weather-related knowledge.

Stage 3 — The student song or poem accurately describes changing weather patterns using several examples of scientific knowledge, data collected during daily weather measurements, or indigenous knowledge and stories. The song or poem and the explanation show evidence of transfer and extension of weather-related knowledge, but may contain minor errors or omissions.

Stage 2 — The student song or poem may contain evidence of skilled word-play, but may be incomplete, incorrect, or lack scientific weather detail. Student work shows limited evidence of weather-related knowledge, transfer or extension of this knowledge, and may contain errors of science fact and reasoning.

Stage 1 The student song or poem and explanation are largely incomplete, incorrect, and show little or no evidence of weather-related knowledge, transfer, or extension of this knowledge.

Standards Cross-References

National Science Education Standards

Weather changes from day to day and over the seasons. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation. (Page 134)

Most objects in the sky are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses. (Page 160)

Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system. Gravity alone holds us to the Earth's surface and explains the phenomena of the tides. (Page 161)

The sun is the major source of energy for phenomena on the Earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the Earth's rotation on its axis and the length of the day. (Page 161)

Benchmarks

Things on or near the Earth are pulled toward it by the Earth's gravity. (Page 68)

Like all planets and stars, the Earth is approximately spherical in shape. The rotation of the Earth on its axis every 24 hours produces the night-and-day cycle. To people on Earth, this turning of the planet makes it seem as though the sun, moon, planets, and stars are orbiting the Earth once a day. (Page 68)

When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets of water. (Page 68)

Air is a substance that surrounds us, takes up space, and whose movement we feel as wind. (Page 68)

Level 2

Alaska Science Key Element A5

A student who meets the content standard should understand the strength and effects of the forces of nature, including gravity and electromagnetic radiation (Forces of Nature).

Performance Standard Level 2, Ages 8–10

Students observe the force and energy manifestations of nature, such as gravity, magnetism, light and electricity and their interactions with a variety of materials.

Sample Assessment Ideas

- Students describe and explain how the weight of an object will be different on the moon and on the Earth.
- Students describe and explain static electricity—create charges by rubbing rabbit fur on different materials; compare the charges created and rank each material according to amount of charge produced.
- Students measure how the push / pull of poles of magnets varies with the distance apart; chart or graph the results
- Students draw ray diagrams to explain how an image is formed in a mirror; predict where the image will appear.

Standards Cross-References

National Science Education Standards

Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system. Gravity alone holds us to the Earth's surface and explains the phenomena of the tides. (Page 161)

Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object—emitted by or scattered from it—must enter the eye. (Page 155)

Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced. (Page 155)

Benchmarks

The Earth's gravity pulls any object toward it without touching it. (Page 94)

Without touching them, a magnet pulls on all things made of iron and either pushes or pulls on other magnets. (Page 94)

Without touching them, material that has been electrically charged pulls on all other materials and may either push or pull other charged materials. (Page 94)

Alaska Science Key Element A6

A student who meets the content standard should understand that forces of nature cause different types of motion, and describe the relationship between these forces and motion (Motion).

Performance Standard Level 2, Ages 8–10

Students predict how an object's speed, motion and direction change when outside force is applied.

Sample Assessment Ideas

- Students explore how a change in ramp height or mass of car affects the speed, direction, and distance traveled by cars on ramps.
- Students observe the motion in a Newton's cradle demonstration; explain forces and motion involved.

Expanded Sample Assessment Idea

- Students build a miniature sled; measure the average speed at which it moves when different forces are applied.

Materials

Meter stick, wooden block with screw at end, length of light cord or fishing line, holder for weights (cup with hood or strings), weights (washers or small fishing weights), stopwatch

Procedure

Students will:

1. Lay out a measured track on the table by marking off 10 cm intervals. (NOTE: The speed of the sled will change as it moves, so the accuracy of the measuring marks will be very important.)
2. Attach the cord or line to the block (sled) and to the weight (mass) holder; position the sled so the holder hangs over the edge of the table and the sled is stationed at the beginning of the track.
3. Add weights to the holder until the sled just starts to move.
4. Measure the time it takes for the sled to travels the length of the track; record all measurements; calculate the speed by dividing the distance traveled by the time it took to travel that distance.
5. Repeat the experiment (steps 3–4) two or three times.
6. Double the number of weights in the holder and repeat steps 3–5.
7. Organize and tabulate data; make appropriate graphs.
8. Compare class data from different sled sizes, different materials, different masses on sleds, and so on.

Reflection and Revision

Are the results the same when you compare trials 1, 2 and 3? What causes the results to vary? How could the procedure be improved to reduce the amount of variability? How will the results change if the sled moves along a different track surface? What would happen if you had a pulley for the line to go over at the table's edge? Why? Is there a pattern with the size of sled? Mass of sled? Material for the track?

Levels of Performance

Stage 4 Student work is complete, well-organized, and shows detailed evidence of the transfer and extension of knowledge that relates forces to an object's speed, motion, and change in direction. All measurements, calculations, and graphs are accurate and clearly labeled. Student's experimental analysis includes a detailed discussion of factors that affect reliability (track surface, friction, maintaining straight-line motion, etc.) and student incorporates this information to suggest appropriate experimental design changes that will reduce variability.

Stage 3 — Student work is mostly complete, organized, and shows some evidence of the transfer or extension of knowledge that relates forces to an object's speed, motion, or change in direction. Most measurements, calculations, and graphs are accurate and labeled, although they may contain minor errors or omissions. Student's experimental analysis includes a discussion of at least two factors that affect reliability (track surface, friction, maintaining straight-line motion, etc.) and student uses some of this information to suggest an experimental design change to reduce variability.

Stage 2 — Student work may be incomplete or poorly organized and shows little evidence of knowledge relating to forces, speed, or motion of an object. Measurements, calculations, and graphs are included but are incomplete, missing labels, or incorrect. Student's experimental analysis, if included, may contain misconceptions or errors of reasoning.

Stage 1 — Student work is mostly incomplete, incorrect, or contains evidence of major misconceptions relating to forces, speed, or motion of an object.

Standards Cross-References

National Science Education Standards

The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph. (Page 154)

An object that is not being subjected to a force will continue to move at a constant speed and in a straight line. (Page 154)

Benchmarks

Changes in speed or direction of motion are caused by forces. The greater the force is, the greater the change in motion will be. The more massive an object is, the less effect a given force will have. (Page 89)

How fast things move differs greatly. Some things are so slow that their journey takes a long time; others move too fast for people to even see them. (Page 89)

Alaska Science Key Element A7

A student who meets the content standard should understand how the Earth changes because of plate tectonics, earthquakes, volcanoes, erosion and deposition, and living things (Processes that Shape the Earth).

Performance Standard Level 2, Ages 8–10

Students observe and describe changes in the local environment caused by weather, waves, wind, water, ice, and living organisms.

Sample Assessment Ideas

- Students take a field trip to observe and describe local geologic features (rivers, mountains, valleys, rock outcroppings, erosion, changes to tundra and permafrost, and so on); map the location of rocks they observe on the trip; discuss where these rocks may have originated, and what events might have caused rocks' movement to this site.
- Students identify local evidence of erosion and deposition of materials; explain the cause of erosion and deposition including forces of the river or sea.

Expanded Sample Assessment Idea

- Students build a stream table to examine erosion.

Procedure

Students will:

1. Work with a team of 3–4 students to design and build a stream table that will demonstrate the effect of moving water on the Earth's surface. (Use local soil, gravel, and rocks in a wooden box or plastic container.)
2. Draw a diagram that shows the position of the rocks, gravel, and soil in the stream table.
3. Tilt the table; pour a continuous supply of water onto the stream table.
4. Draw another diagram that shows the changes created by water.
5. Change the stream bed; make a new diagram that shows the change in the variable; add water; draw a diagram that shows the changes observed.

Reflection and Revision

What would happen if the quantity of water in the stream was increased? How can a stream table model be used to make predictions that would help the local community?

Level of Performance

Stage 4 — Student work is complete, shows evidence of logical reasoning, and knowledge of changes in stream beds caused by moving water. Before and after diagrams are clearly labeled and contain multiple details of the stream table demonstration.

Stage 3 — Student work may contain minor errors or omissions but shows evidence of logical reasoning and knowledge of changes in the stream beds caused by moving water. Before and after diagrams are labeled and contain some details related to the stream table demonstration.

Stage 2 — Student work is incomplete, incorrect, lacks detail, may contain errors of science fact and reasoning, and shows limited evidence of knowledge of changes in the stream beds caused by moving water. Diagrams may show skilled artwork but limited information related to the stream table demonstration.

Stage 1 Student work is mostly incomplete, incorrect, and contains errors of science fact and reasoning, and shows little or no evidence of knowledge of how moving water changes the steam beds. Diagrams may show skilled artwork, but do not describe the stream table demonstration.

Standards Cross-References

National Science Education Standards

The surface of the Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes. (Page 134)

Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the Earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground. (Page 160)

Living organisms have played many roles in the Earth system, including affecting the composition of the atmosphere, producing some types of rocks, and contributing to the weathering of rocks. (Page 160)

Benchmarks

Waves, wind, water and ice shape and reshape the Earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers. (Page 72)

Rock is composed of different combinations of minerals. Smaller rocks come from the breakage and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains-and also contains many living organisms. (Page 72)

Alaska Science
Key Element A8a

A student who meets the content standard should understand the scientific principles and models that describe the nature of physical, chemical, and nuclear reactions (Energy Transformations).

Performance Standard Level 2, Ages 8–10

Students observe and describe physical and chemical changes to a system.

Sample Assessment Ideas

- Students examine and describe properties of non-Newtonian fluids (such as a mixture of water and corn starch a.k.a. "Oobleck"); compare with the properties of the starting substances.
- Students saw a wooden board into pieces, compare properties; burn half the pieces; compare the resulting ash with the unburned pieces; account for gain or loss of volume and/or mass.

Expanded Sample Assessment Idea

- Students investigate and report on several mixture systems to determine characteristics of physical and chemical change.

Materials

✔ test tubes or well trays

✔ chemicals in both solid and solution form, such as sodium chloride (salt), sodium bicarbonate (baking soda), acetic acid (white vinegar), silver nitrate

Suggestions for mix systems:

- salt + water, stir
- allow (1) to evaporate
- baking soda + water, stir
- allow (2) to evaporate
- vinegar + solution (1)
- vinegar + solution (3)
- silver nitrate + solution (1)
- silver nitrate + solution (3)

Procedure

Students will:

1. Observe and record appearance of substances before and after mixing,
2. Observe and record behavior of substances during mixing.

Reflection and Revision

What properties do the substances have in common? What properties are different? What is evidence of physical change? What is evidence of chemical change? Which mixing operations fall into which category and why?

Levels of Performance

Stage 4 — Student response shows clear understanding of evidence regarding chemical reactions vs. physical changes taking place in matter rearrangements. Observations are thorough and interpreted with considerable detail and logical reasoning.

Stage 3 — Student response shows understanding of evidence regarding chemical reactions vs. physical changes taking place in matter rearrangements. Observations are thorough and interpreted with some evidence of logical reasoning. Minor errors may be present.

Stage 2 — Student response shows limited understanding of the difference between physical and chemical changes. Observations are minimal and interpreted with limited evidence of logical reasoning.

Stage 1 — Student response shows little understanding of physical or chemical change. Observations are minimal or totally incorrect, and interpretations show lack of scientific reasoning.

Standards Cross-Referenced

National Science Education Standards

Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals is an example of such a group. (Page 154)

Benchmarks

Heating and cooling cause changes in the properties of materials. Many kinds of changes occur faster under hotter conditions. (Page 77)

When a new material is made by combining two or more materials, it has properties that are different from the original materials. For that reason, a lot of different materials can be made from a small number of basic kinds of materials. (Page 77)

Alaska Science
Key Element A8b

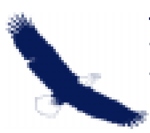
A student who meets the content standard should understand the scientific principles and models that state whenever energy is reduced in one place, it is increased somewhere else by the same amount (Energy Transformations).

Performance Standard Level 2, Ages 8–10

Students observe and describe heat flow from one object to another.

Sample Assessment Ideas

- Students examine traditional ways of heating water—putting hot rocks into a birch basket—and determine which heats water the fastest—many small rocks or a few large rocks.
- Students place a metal container with cold water in another larger insulated container containing hot water; measure temperature changes in both containers; explain the transfer of thermal energy from hot to cold object.
- Students design mittens to wear outside when they go to recess; discuss the qualities of a "good" mitten; choose the material to use to make the mittens; make a list of words that describe the material for the mittens; describe how their mitten design is better than the mittens they have right now; make an advertisement that they could use to "sell" their mittens.



Expanded Sample Assessment Idea

- Students design ways to keep an ice cube from melting

Procedure

Students will:

1. Create a container to hold an ice cube. (Have a variety of materials available for the students to choose from, including, paper, cotton, cups, sticks, fur, feathers, foil, styrofoam, tape, glue, and other materials.)
2. Put an ice cube inside the container; place it in the designated spot.
3. Check the ice cubes as necessary; record observations in a journal.
4. Compare results with other students in class.
5. Discuss the properties of insulators and conductors.

Reflection and Revision

Which containers worked best as insulators? Describe one change you would make to your container to make it work better. How will this change make the container better?

Levels of Performance

Stage 4 — Student work is complete and shows detailed evidence of the transfer and extension of knowledge related to heat flow. Journal contains evidence of the transfer or extension of knowledge related to heat flow. Journal contains observations of the melting ice cube. Student designs and constructs a container that slows the progress of melting, and describes changes that would improve the container.

Stage 3 — Student work is mostly complete and shows detailed observations of the melting ice cube. Student designs and constructs a box that prevents the ice cube from melting, and describes and explains in detail changes that would improve the container.

Stage 2 — Student work may be incomplete and shows limited evidence of knowledge related to heat flow. Journal contains incomplete observations of the melting ice cube. Student work may show evidence of skilled craftsmanship but the box design does little to slow the progress of melting. Student may describe changes to the container that would not alter its insulating capabilities.

Stage 1 Student work is mostly incomplete, inappropriate, shows little evidence of craftsmanship or knowledge related to insulating abilities of materials.

Standards Cross-References

National Science Education Standards

Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature. (Page 155)

Benchmarks

When warmer things are put with cooler ones, the warm ones lose heat and the cool ones gain it until they are at the same temperature. A warmer object can warm a cooler one by contact or at a distance. (Page 84)

Alaska Science Key Element A8c

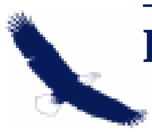
A student who meets the content standard should understand the scientific principles and models that state that whenever there is a transformation of energy, some energy is spent in ways that make it unavailable for use (Energy Transformations).

Performance Standard Level 2, Ages 8–10

Students determine heat conductivity of various materials.

Sample Assessment Ideas

- Students explain why different types of clothing are worn in different weather conditions.
- Students list several heat conductors and heat insulators found in their home; explain the different job that each does.



Expanded Sample Assessment Idea

- Students measure the conductivity of different insulation materials as a function of thickness; predict which could be used to build a home for winter or summer use.

Materials

- ✔ heat lamp (or could be done outdoors in the sunlight in summer)
- ✔ thermometer
- ✔ blocks of various materials of differing thickness such as wood, brick or concrete, fiberglass (covered and sealed), wallboard, ice blocks (where available) and so on.)

Procedure

Students will:

1. Discuss the best way to set up the lamp over the material with the thermometer underneath so that the different measurements can be compared.
2. Discuss what is the best measure to judge insulation—the temperature after a certain time, or the maximum temperature that is reached?
3. Set up each material according to the class design.
4. Measure the temperatures as a function of time; record and graph the data.
5. Compare results with other students in class; graph class data to show different thickness and different materials.

Reflection and Revision

How could measurements be improved to get more reproducible results? Identify and explain insulation in your home/community that works this way. What happens to the heat in each case? Which is the best material for building? Why? Does it depend on the weather? Is there a difference in insulating against cold rather than heat (imagine if you lived in the desert)? Why or why not?

Levels of Performance

Stage 4 — Student work is complete and shows clear evidence of ability to conduct a reproducible experiment to measure heat conduction. Data and observations are recorded in detail. Student describes an appropriate method to improve the reproducibility of the measurements. Student accurately identifies and explains in detail insulators and conductors used in their home. Building applications for both hot and cold climates are discussed in detail and shows extensive evidence of the transfer of knowledge.

Stage 3 — Student work is complete and shows evidence of ability to conduct an experiment to measure heat conduction. Data and observations are recorded. Student describes a method that affects the measurements, although it may not improve the reproducibility. Student accurately identifies and explains an insulator and a conductor used in their home. Building applications for both hot and cold climates are discussed and shows evidence of the transfer of knowledge.

Stage 2 Student work may be incomplete and shows limited evidence of ability to conduct an experiment to measure heat conduction. Data and observations are recorded but errors are made. Student may not include suggestion for improving the measurements. Student identifies an insulator or conductor used in their home but may not include an explanation of its use. Building applications, if present, lack detail and show limited transfer of knowledge.

Stage 1 Student work is mostly incomplete and shows misconceptions regarding experimental design and heat conduction. Data and observations are incomplete or incorrectly recorded. Student identifies an insulator or conductor used in their home. Building applications, if present, are incorrect and show evidence of misconceptions.

Standards Cross-References

National Science Education Standards

Heat can be produced in many ways, such as burning, rubbing, or mixing one substance with another. Heat can move from one object to another by conduction. (Page 127)

Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature. (Page 155)

Benchmarks

Things that give off light also give off heat. Heat is produced by mechanical and electrical machines, and any time one thing rubs against something else. (Page 84)

When warmer things are put with cooler ones, the warm ones lose heat and the cool ones gain it until they are at the same temperature. A warmer object can warm a cooler one by contact or at a distance. (Page 84)

Some materials conduct heat much better than others. Poor conductors can reduce heat loss. (Page 84)

Alaska Science Key Element A9

A student who meets the content standard should understand the transfers and transformations of matter and energy that link living things and their physical environment from molecules to ecosystems (Flow of Matter and Energy).

Performance Standard Level 2, Ages 8–10

Students describe the cycling of matter and transfer of energy in the local ecosystem.

Sample Assessment Ideas

- Students diagram a food chain starting with a local animal (such as salmon or small mammal) and trace the matter and energy back to plants and the sun.
- Students diagram the cycle of growth, decay, and renewal that begins in a compost pile and continues as the gardener uses the compost on a garden.

Standards Cross-References

National Science Education Standards

Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers–they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem. (Page 157)

For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs. (Page 158)

Benchmarks

Almost all kinds of animals' food can be traced back to plants. (Page 119)

Some source of "energy" is needed for all organisms to stay alive and grow. (Page 119)

Over the whole Earth, organisms are growing, dying, and decaying, and new organisms are being produced by the old ones. (Page 119)

Level 2

Alaska Science Key Element A10

A student who meets the content standard should understand that living things are made up mostly of cells and that all life processes occur in cells (Cells).

Performance Standard Level 2, Ages 8–10

Students recognize the basic requirements for all living things: food, water, waste disposal and reproduction.

Standards Cross-References

National Science Education Standards

All organisms are composed of cells–the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular. (Page 156)

Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs. (Page 156)

Benchmarks

Some living things consist of a single cell. Like familiar organisms, they need food, water, and air; a way to dispose of waste; and an environment they can live in. (Page 111)

Microscopes make it possible to see that living things are made mostly of cells. Some organisms are made of a collection of similar cells that benefit from cooperating. Some organisms' cells vary greatly in appearance and perform very different roles in the organism. (Page 111)

Alaska Science Key Element A11

A student who meets the content standard should understand that similar features are passed on by genes through reproduction (Heredity).

Performance Standard Level 2, Ages 8–10

Students identify characteristics of plants and animals that are inherited as well as characteristics of plants and animals that are influenced by the environment.

Sample Assessment Ideas

- Students examine the phenomenon of “snowballing” on dogs’ feet; identify the characteristics of the dog and factors of the environment that affect this tendency.
- Students grow FAST® plants for two generations; keep a journal with details about inherited characteristic (leaf shape, flower color, number of seeds and so on.)

Standards Cross-References

National Science Education Standards

Plants and animals closely resemble their parents. (Page 129)

Many characteristics of an organism are inherited from the parents of the organism, but other characteristics result from an individual’s interactions with the environment. Inherited characteristics include the color of flowers and the number of limbs of an animal. Other features, such as the ability to ride a bicycle, are learned through interactions with the environment and cannot be passed on to the next generation. (Page 129)

The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment. (Page 157)

Benchmarks

Some likenesses between children and parents, such as eye color in human beings, or fruit or flower color in plants, are inherited. Other likenesses, such as people’s table manners or carpentry skills, are learned. (Page 107)

For offspring to resemble their parents, there must be a reliable way to transfer information from one generation to the next. (Page 107)

Alaska Science Key Element A12

A student who meets the content standard should distinguish the patterns of similarity and differences in the living world in order to understand the diversity of life and understand the theories that describe the importance of diversity for species and ecosystems (Diversity).

Performance Standard Level 2, Ages 8–10

Students categorize groups of plants and animals according to external features and explain how these features help organisms survive in different environments.

Sample Assessment Ideas

- Students match a given external feature (for example, feet, ears, teeth, leaves, roots) with their use; describe how this external feature helps the organism to survive in its environment.
- Students design an animal that can survive in a particular environment.

Standards Cross-References

National Science Education Standards

Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking. (Page 129)

Plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms. (Page 129)

Benchmarks

A great variety of kinds of living things can be sorted into groups in many ways using various features to decide which things belong to which group. (Page 103)

Features used for grouping depend on the purpose of the grouping. (Page 103)

Alaska Science
Key Element A13

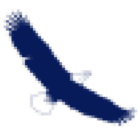
A student who meets the content standard should understand the theory of natural selection as an explanation for evidence of changes in life forms over time (Evolution and Natural Selection).

Performance Standard Level 2, Ages 8–10

Students describe how living organisms have changed over time.

Sample Assessment Ideas

- Students use fossil evidence to show how an animal species has changed over time (for example, horse, whale, elephant).
- Students reconstruct an animal using a card set of fossilized animal bones.



Expanded Sample Assessment Idea

- Students invent a new life form and describe its relatedness to other species.

Procedure

Students will:

1. Imagine they have just returned from a scientific expedition and have collected a new species of life.
2. Draw a picture or build a 3-D model of this new organism.
3. Describe the habitat in which the organism was found; describe the specialized body parts that help the organism live in its habitat.
4. Describe how the organism resembles known life forms.
5. Create a piece of fossil evidence that shows how this organism has changed over time.

Reflection and Revision

What adaptation would the species need to survive in Alaska?

Level of Performance

Stage 4 — Student work is complete, and shows evidence of logical reasoning. Student drawing or model, explanation, and fossil creation show extensive evidence of knowledge of adaptations and the change of living organisms over time.

Stage 3 — Student work shows evidence of logical reasoning, but may contain minor errors or omissions. Student drawing or model, explanation, and fossil creation show evidence of knowledge of adaptations and the change of living organisms over time.

Stage 2 — Student work may show skilled craftsmanship but is incomplete, incorrect, or may contain errors of science fact or reasoning. Student drawing or model, explanation, and fossil creation show limited evidence of knowledge of adaptations or the change of living organisms over time.

Stage 1 — Student work is largely incomplete, incorrect, shows little evidence of understanding and may contain major misconceptions.

Standards Cross-References

National Science Education Standards

An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations. (Page 129)

Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the Earth no longer exist. (Page 158)

Benchmarks

Individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing. (Page 123)

Fossils can be compared to one another and to living organisms according to their similarities and differences. Some organisms that lived long ago are similar to existing organisms, but some are quite different. (Page 123)

Alaska Science Key Element A14a

A student who meets the content standard should understand the interdependence between living things and their environments (Interdependence).

Performance Standard Level 2, Ages 8–10

Students classify familiar plants and animals based on their position in a simple food chain.

Sample Assessment Idea

- Students report on two local habitats; compare the types of plants and animals living in each habitat.
- Students report on one arctic and one non-arctic habitat; compare the plants and animals living in each habitat.

Expanded Sample Assessment Idea

- Students take a field trip to a local muskeg or pond; investigate how the needs of animals or plants are provided by the local environment.

Procedure

Students will:

1. Take a field trip to a local muskeg or pond.
2. Investigate the plant life, insects, birds, and other animals found there.
3. Investigate the physical environment including the presence of water, and type of terrain.
4. Choose one animal and one plant to focus upon.
5. Use field notes and other research to prepare a poster or written report, (include sources of food, water, shelter, air, sunlight, mates, (or pollinators), and sources of competition for resources at the site.)

Reflection and Revision

What happens to the organism when a specific resource decreases? Which plants and animals are dependent on each other? What happens when the organisms die?

Level of Performance

Stage 4 — Student work is complete, and shows evidence of logical reasoning. Student correctly identifies environmental resources that provide the basic needs of the plant and animal, and predict what happens when the resources decrease.

Stage 3 — Student work shows evidence of logical reasoning, but may contain minor errors or omissions. Student correctly identifies environmental resources that provide the basic needs of the plant and animal, but may not predict what happens when the resources decrease.

Stage 2 — Student work may be incomplete, or contain errors of science fact and reasoning. Student identifies the basic needs of plants and animals, along with some environmental resources that provide those needs.

Stage 1 — Student work may identify some basic needs of the plant or animal, however, it is largely incomplete, contains major misconceptions.

Standards Cross-References

National Science Education Standards

All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. (Page 157

Resources are things that we get from the living and non-living environment to meet the needs and wants of a population. (Page 140)

Some resources are basic materials, such as air, water, and soil; some are produced from basic resources, such as food, fuel, and building materials; and some resources are non-material, such as quiet places, beauty, security, and safety. (Page 140)

The supply of many resources is limited. If used, resources can be extended through recycling and decreased use. (Page 140)

Benchmarks

For any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all. (Page 116)

Insects and various other organisms depend on dead plant material for food. (Page 116)

Organisms interact with one another in various ways besides providing food. Many plants depend on animals for carrying their pollen to other plants or for dispersing their seeds. (Page 116)

Alaska Science Key Element A14b

Level 2

A student who meets the content standard should understand that the living environment consists of individuals, populations, and communities (Interdependence).

Performance Standard Level 2, Ages 8–10

Students identify groups of plants and animals that live within characteristic biomes.

Sample Assessment Ideas

- Students collect pictures of plants and animals, and group them according to the biome in which they live.
- Students identify four species of animals that live within 10 miles of their home.

Expanded Sample Assessment Idea

- Students prepare a class report that discusses the life-cycle and habits of a solitary living animal or an animal that lives in a group, with special attention to the environment in which the animal lives.

Procedure

Students will:

1. Choose an animal to study
2. Discuss with Elders the behavior and life cycle of the animal and how this affects the animals' survival (if the animal is endemic to Arctic region.)
3. Conduct library research and produce a report.

Reflection and Revision

What living-arrangement changes occur during the animals' life cycle? How old is the animal when it separates from its mother? What would change if the solitary animal lived in a group or the group animal lived alone? What advantage is there to living in a group? What advantage is there to living alone? What dangers are faced by the animals that live in a group? What dangers are faced by the animal that lives alone?

Level of Performance

Stage 4 — Student work is complete, shows evidence of logical reasoning and knowledge related to animal life cycles. The report is detailed and includes information related to: the animal's social behavior and behavioral changes which occur throughout the animal's life cycle; how the animal's behaviors affects other individuals of both genders and the community as a whole; and advantages and dangers of both solitary living and group-living.

Stage 3 — Student work shows evidence of knowledge related to animal life cycles as well as logical reasoning but may contain minor errors or omissions. The report includes information related to: the animal's social behavior, and at least one behavioral change that occurs during the animal's life cycle; how the animal's behaviors affect other individuals of both genders and the community as a whole; advantages and dangers of solitary living or group living.

Stage 2 — Student work is incomplete, shows limited evidence of knowledge related to animal life cycles and may contain errors of science fact and reasoning. The report may include information related to: the animal's social behavior; how the animal's behaviors affect other individuals or the community as a whole; or advantages and dangers of solitary living vs. group living.

Stage 1 — Student work is largely incomplete, shows little evidence of knowledge related to animal life cycles, and may contain major misconceptions.

Standards Cross-References

National Science Education Standards

A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. (Page 157)

Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem. (Page 157)

Benchmarks

A great variety of kinds of living things can be sorted into groups in many ways using various features to decide which things belong to which group. (Page 103)

Organisms interact with one another in various ways besides providing food. Many plants depend on animals for carrying their pollen to other plants or for dispersing their seeds. (Page 116)

Alaska Science Key Element A14c

A student who meets the content standard should understand that a small change in a portion of an environment may affect the entire environment (Interdependence).

Performance Standard Level 2, Ages 8–10

Students describe migration, hibernation, and other seasonal patterns of local animals.

Sample Assessment Ideas

- Students study caribou migration and prepare a written report.
- Students research and debate the impact of building a bicycle trail or nature trail through a local wildlife refuge.

Expanded Sample Assessment Idea

- Students study bird migration and prepare an oral or written report of their findings.

Procedure

Students will:

1. Choose a local migratory bird and study its migration habits.
2. Make personal observation and conduct interviews with Elders and other local people to learn when the birds leave and when they come back to the area.
3. Use additional resources including reference materials or Internet to discover why the birds migrate, and the environments of both habitats.
4. Prepare an oral or written report of their findings to present to the class.

Reflection and Revision

Consider the food the birds eat at both ends of the migration.

Level of Performance

Stage 4 — Student work is complete, and shows evidence of logical reasoning. Student prepares a detailed report that includes a description of when and where the birds migrate, underlying factors responsible for the migration, and the time of migration.

Stage 3 — Student work shows evidence of logical reasoning but may contain minor errors or omissions. Student prepares a report that includes: a description of when and where the birds migrate, factors that influence migration, and may include the time of migration.

Stage 2 — Student prepares a report about a migratory bird, but it may be incomplete, or contain errors of science fact and reasoning.

Stage 1 — Student report is largely incomplete, incorrect, shows little evidence of understanding, and may contain major misconceptions.

Standards Cross-References

National Science Education Standards

All organisms cause changes in the environment where they live. Some of these changes are detrimental to the organism or other organisms, whereas others are beneficial. (Page 129)

Some environmental changes occur slowly, and others occur rapidly. Students should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods of time. (Page 140)

An organism's behavior evolves through adaptation to its environment. How a species lives, obtains food, reproduces, and responds to danger are based in the species' evolutionary history. (Page 157)

The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem. (Page 158)

Benchmarks

Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. (Page 116)

Alaska Science Key Element A15

A student who meets the content standard should use science to understand and describe the local environment (Local Knowledge).

Performance Standard Level 2, Ages 8–10

Students identify the limiting factors for the survival of local plants and animals.

Sample Assessment Ideas

- Students observe and discuss local animals, including how limiting factors effect these animals.
- Students take a field trip to a wetland area and an area that has been cleared to support urban growth. List and compare plants and animals in each setting.
- Students interview community members to learn traditional practices of fish and wildlife co-management based on generational knowledge; compare with federal strategies based on annual scientific studies.

Expanded Sample Assessment Idea

- Students list local resources, determine if they are declining or increasing, and research possible causes for the changes (cold temperature, lack of precipitation, pollution, human impact, and so on.)

Procedure

Students will:

1. Generate a list of local resources.
2. Select small groups to research different resources from the list, and possible limiting factors and their impact.
3. Use research to prepare and give a presentation on their resource using visual aids (posters, charts, graphs, slides, photographs, pictures, etc.)

Reflection and Revision

Determine a method to align management of several resources.

Level of Performance

Stage 4 Student work is complete, contains extensive evidence of knowledge regarding resource and limiting factors and shows evidence of logical reasoning. Research for presentation includes multiple sources. Presentation is well organized, interesting, informative, and includes several visual aids.

Stage 3 Student work shows evidence of logical reasoning but may contain minor errors or omissions. Student work contains evidence of knowledge regarding resources and limiting factors. Research for a presentation includes more than one source. Student work is organized, interesting, informative, and includes at least one visual aid.

Stage 2 Student work is incomplete, may contain errors of science fact and reasoning, and shows limited understanding of resources and limiting factors. Research for presentation may be limited to one source. Presentation includes at least one visual aid though it may lack organization.

Stage 1 Student work is largely incomplete, may be inappropriate for age level or subject matter and may contain major misconceptions regarding resources or limiting factors.

Standards Cross-References

National Science Education Standards

All organisms cause changes in the environment where they live. Some of these changes are detrimental to the organism or other organisms, whereas others are beneficial. (Page 129)

Soils have properties of color and texture, capacity to retain water, and ability to support the growth of many kinds of plants, including those in our food supply. (Page 134)

The surface of the Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes. (Page 134)

Some environmental changes occur slowly, and others occur rapidly. Students should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods. (Page 140)

A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. (Page 157)

Benchmarks

Waves, wind, water, and ice shape and reshape the Earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers. (Page 72)

Rock is composed of different combinations of minerals. Smaller rocks come from the breakage and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains—and contains many living organisms. (Page 72)

A great variety of kinds of living things can be sorted into groups in many ways using various features to decide which things belong to which group. (Page 103)

For any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all. (Page 116)

Insects and various other organisms depend on dead plant and animal material for food. (Page 116)

Organisms interact with one another in various ways besides providing food. Many plants depend on animals for carrying their pollen to other plants or for dispersing their seeds. (Page 116)

Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. (Page 116)

Most microorganisms do not cause disease, and many are beneficial. (Page, 116)

Alaska Science Key Element A16

A student who meets the content standard should understand basic concepts about the Theory of Relativity, which changed the view of the universe by uniting matter and energy and by linking time with space (Relativity).

Performance Standard Level 1, Ages 5–7

There is no performance standard at this level.

Alaska Science Content Standard B

Level 2, Ages 8–10

A student should possess and understand the skills of scientific inquiry.

Alaska Science Key Element B1

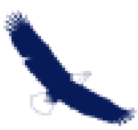
A student who meets the content standard should use the processes of science; these processes include observing, classifying, measuring, interpreting data, inferring, communicating, identifying variables, developing models and theories, hypothesizing, predicting, and experimenting.

Performance Standard Level 2, Ages 8–10

Students observe, measure, and collect data from experiments and use this information to classify, predict, and communicate about their everyday world and verify their predictions.

Sample Assessment Ideas

- Students measure the water level of a local stream, river, or ocean three times a day for one week; predict water levels for the next three days.
- Students roll marbles down an inclined plane onto surfaces of different texture to collect data on the effects of friction.



Expanded Sample Assessment Idea

- Students design their own experiment to explore the effect of sunlight on bean plants.

Procedure

Students will:

1. Plant lima beans in identical containers and soil. Place half of the containers in sun or under grow lights, and half in darkness.
2. Predict what will happen and record the predictions.
3. Observe and measure plant growth daily over the course of two weeks; record observations.
4. Divide into groups of four and classify the plants in at least two different ways.
5. Share observations and classification schemes with the class. Give students the opportunity to go back and revise their classification scheme based on class discussion.

Reflections and Revisions

Revise their classification schemes based on the class discussion and make predictions for growth of other plants.

Level of Performance

Stage 4 — Student work is correct, complete, and appropriate. Student makes accurate measurements, accurate observations, evidence-based predictions, develops reasonable classification systems, and clearly communicates their ideas. Predictions and classification systems are creative and elaborate as well as accurate. Methods of communication are detailed and creative.

Stage 3 — Student work is generally correct, complete, and appropriate. Student makes accurate measurements, accurate observations, evidence-based predictions, develops reasonable classification systems and clearly communicates their ideas. There are some elaborations in observation, measurement, prediction, data collection, and communication but there may be some flaws in accuracy in those process skills.

Stage 2 — Student measurements, observations, predictions, classifications, and communication are partially accurate with some inaccuracies or sloppy methods. There is little evidence of elaboration or extensions.

Stage 1 — Student shows little or no ability to observe, measure, predict, classify, and communicate. There is no evidence of elaboration or extension.

Standards Cross-References

National Science Education Standards

Employ simple equipment and tools to gather data and extend the senses. In early years, students develop simple skills, such as how to observe, measure, cut, connect, switch, turn on and off, pour, hold, tie, and hook. Beginning with simple instruments, students can use rulers to measure the length, height, and depth of objects and materials; thermometers to measure temperature; watches to measure time; beam balances and spring scales to measure weight and force; magnifiers to observe objects and organisms; and microscopes to observe the finer details of plants, animals, rocks, and other materials. Children also develop skills in the use of computers and calculators for conducting investigations. (Page 122)

Use data to construct a reasonable explanation. This aspect of the standard emphasizes the students' thinking as they use data to formulate explanations. Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strength of the data and information that will be used to make explanations. After students propose an explanation, they will appeal to the knowledge and evidence they obtained to support their explanations. Students should check their explanations against scientific knowledge, experiences, and observations of others. (Page 122)

Communicate investigations and explanations. Students should begin developing the abilities to communicate, critique, and analyze their work and the work of other students. This communication might be spoken or drawn as well as written. (Page 122)

Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations. (Page 148)

Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations. (Page 123)

Benchmarks

Scientific investigations may take many forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological and social questions. (Page 11)

Results of scientific investigations are seldom exactly the same, but if the differences are large, it is important to try to figure out why. One reason for following directions carefully and for keeping records of one's work is to provide information on what might have caused the differences. (Page 11)

Scientists' explanations about what happens in the world come partly from what they observe, partly from what they think. Sometimes scientists have different explanations for the same set of observations. That usually leads to their making more observations to resolve the differences. (Page 11)

Offer reasons for their findings and consider reasons suggested by others. (Page 286)

Recognize when comparisons might not be fair because some conditions are not kept the same. (Page 299)

Alaska Science Key Element B2

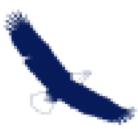
A student who meets the content standard should design and conduct scientific investigations using appropriate instruments.

Performance Standard Level 2, Ages 8–10

Students conduct simple experiments to answer a specific question about the natural or designed world.

Sample Assessment Ideas

- Students experiment with different kinds of freezer paper and identify which prevents freezer burn the best.
- Students experiment with one kind of berry and different amounts of sugar to determine fermentation rates.



Expanded Sample Assessment Idea

- Students observe bean seeds and bean plants in various stages of growth and investigate the effects of changing variables (e.g., water, light, fertilizer) on the growth of a bean plant.

Procedure

Students will:

1. Review the questions about plant growth listed at the beginning of the lesson and add additional questions of interest to students.
2. Partner with someone who would like to ask the same question. (If a student has a question that no one else has, he or she may work alone.)
3. Design their own experiment using the same kind of seeds.
4. Set up a control plant, or plants, to which no changes are made.
5. Write or select a testable question.
6. Predict what they think results will be.
7. Design an investigation to test their prediction.
8. Collect data daily. Measure and document, in words and pictures, what happens to the seed and plant. Label the plant parts at all stages.
9. Repeat the experiment three times.
10. Analyze data and write/illustrate results and conclusions.
11. Students share with the class their experimental design, results, and conclusions, including problems they had with the investigation and how they solved them.

Reflections and Revisions

Discuss what they would do differently next time and why. Discuss how each group ensured that each test was fair (control variables, etc.).

Level of Performance

Stage 4 — Student work is complete, correct, and shows evidence of elaboration, extension, and mastery of drawing inferences based on experimental data. The investigation has a testable question, makes a prediction, lists variables, controls the variables when possible, manipulates a single variable, makes accurate measurements, records results, and makes appropriate conclusions.

Stage 3 — Student work is complete but shows limited evidence of elaboration, extension and ability to draw inferences based on experimental data. The investigation includes a testable question, makes a prediction, lists some variables, controls most (but not all) variables, manipulates a single variable, makes measurements that are mostly accurate, and records results but makes inappropriate conclusions.

Stage 2 Student work may be incomplete or incorrect and shows limited evidence of understanding variables and how to manipulate them. The investigation may ask a testable question and make a prediction. However, the results are inaccurate or incomplete and the conclusions if present, does not relate to or reflect the experimental data.

Stage 1 Student work is incomplete and incorrect. Although the investigation may consider questions about plant growth, it lacks an experimental procedure that reflects variables, controls, data collection or data manipulation.

Standards Cross-References

National Science Education Standards

Plan and conduct a simple investigation. In the earliest years, investigations are largely based on systematic observations. As students develop, they may design and conduct simple experiments to answer questions. The idea of a fair test is possible for many students to consider by fourth grade. (Page 122)

Scientists use different kinds of investigations depending on the questions they are trying to answer. Types of investigations include describing objects, events, and organisms; classifying them; and doing a fair test (experimenting). (Page 123)

Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models. (Page 148)

Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data. All of these results can lead to new investigations. (Page 148)

Benchmarks

Results of similar scientific investigations seldom turn out exactly the same. Sometimes this is because of unexpected differences in the things being investigated, sometimes because of unrealized differences in the methods used or in the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations. It is not always easy to tell which. (Page 6)

Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, or social questions. (Page 11)

Seek better reasons for believing something other than “Everybody knows that . . . ” or “I just know” and discount such reasons when given by others. (Page 299)

Mini-Unit: Bean Seeds to Plants

Performance Standard B2, Level 2

Students use appropriate instruments to conduct simple experiments to answer a specific question about the natural or designed world.

Key Concepts and Skills

Students improve experimental design techniques.

Timeline

About two months.

Abstract

Students will investigate the effects of changing variables such as water, light, and fertilizer on the growth of a bean plant. Students will also closely observe bean seeds and plants in various stages of growth.

Materials

- ✔ Bean seeds
- ✔ Black plastic
- ✔ Stapler
- ✔ Soil
- ✔ Measuring cups
- ✔ Dissecting equipment
- ✔ Water
- ✔ Rulers
- ✔ Tiny Seed, by Eric Carle
- ✔ Pots
- ✔ Hand lenses
- ✔ Science journals
- ✔ Fertilizer
- ✔ Zip-close bags
- ✔ Variety of fast-growing Alaskan seeds
- ✔ Grow light
- ✔ Paper towels
- ✔ Chart paper

Alaska Science Content Standard Key Element

A student who meets the content standard should design and conduct scientific investigations using appropriate instruments.

Cross-Reference

Additional Content and Performance Standards: A15, A12, A14, B1

Activities

1

Read *Tiny Seed* by Eric Carle. Show students a variety of seeds. Ask students to describe the seeds. Ask students what they know about plant growth. Ask students what questions they have about how plants grow. List questions on chart paper and display in classrooms.

2

Soak different bean seeds in water overnight. Dissect seeds and observe with hand lenses. Record observations. Ask students what new questions they have about the seeds and how they grow. List questions on another sheet of paper. Work with students to organize their questions into the following categories:

- Questions we can investigate
- Questions we can research with our own sources
- Questions we need to ask an expert

As a class, choose one question to investigate. Work as a class to write a testable question that is appropriate for the level of students, materials available, etc. Discuss variables, how to control variables and how to manipulate a single variable. Brainstorm types of observations and measurements to make. Discuss ways to record data.

3

Pass out more seeds, bags, and wet paper towels and have students place seeds in bags with wet paper towel. Hang the bags in front of a window or under a grow light. Have students observe, measure, and record data every other day as seeds sprout. They should include measurement, sketches, and observations in their journals,

Additional Activity Ideas

- Teach students the elements of a technical report and have them write up their results and conclusions.
- Have a pot-luck with different bean and vegetable dishes.
- Have students research about the University of Alaska's experimental farm activities to produce northern-adapted seeds.
- Research where the beans or Alaskan seeds they have grown come from.

Expanded Sample Assessment Idea

Students observe bean seeds and bean plants in various stages of growth and investigate the effects of changing variables (e.g., water, light, fertilizer) on the growth of a bean plant.

Procedure

Students will:

1. Review the questions about plant growth listed at the beginning of the lesson and add additional questions of interest to students.
2. Partner with someone who would like to ask the same question. (If a student has a question that no one else has, he or she may work alone.)
3. Design their own experiment using the same kind of seeds.
4. Set up a control plant, or plants, to which no changes are made.
5. Write or select a testable question.
6. Predict what they think results will be.
7. Design an investigation to test their prediction.
8. Collect data daily. Measure and document, in words and pictures, what happens to the seed and plant. Label the plant parts at all stages.
9. Repeat the experiment three times.
10. Analyze data and write/illustrate results and conclusions.
11. Students share with the class their experimental design, results, and conclusions; including problems they had with the investigation, and how they solved them.

Reflections and Revisions

Discuss what they would do differently next time and why. Discuss how each group ensured that each test was fair (control variables, etc.).

Level of Performance

Stage 4 — Student work is complete, correct, and shows evidence of elaboration, extension, and mastery of drawing inferences based on experimental data. The investigation has a testable question, makes a prediction, lists variables, controls the variables when possible, manipulates a single variable, makes accurate measurements, records results, and makes appropriate conclusions.

Stage 3 — Student work is complete but shows limited evidence of elaboration, extension and ability to draw inferences based on experimental data. The investigation includes a testable question, makes a prediction, lists some variables, controls most (but not all) variables, manipulates a single variable, makes measurements that are mostly accurate, and records results but makes inappropriate conclusions.

Stage 2 — Student work may be incomplete or incorrect and shows limited evidence of understanding variables and how to manipulate them. The investigation may ask a testable question and make a prediction. However, the results are inaccurate or incomplete and the conclusion, if present, does not relate to or reflect the experimental data.

Stage 1 — Student work is incomplete and incorrect. Although the investigation may consider questions about plant growth, it lacks an experimental procedure that reflects variables, controls, data collection or data manipulation.

Standards Cross-References

National Science Education Standards

Plan and conduct a simple investigation. As students develop, they may design and conduct simple experiments to answer questions. The idea of a fair test is possible for many students to consider by fourth grade. (Page 122)

Scientists use different kinds of investigations depending on the questions they are trying to answer. Types of investigations include describing objects, events, and organisms; classifying them; and doing a fair test (experimenting). (Page 123)

Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models. (Page 148)

Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data. All of these results can lead to new investigations. (Page 148)

Benchmarks

Results of similar scientific investigations seldom turn out exactly the same. Sometimes this is because of unexpected differences in the things being investigated, sometimes because of unrealized differences in the methods used or in the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations. It is not always easy to tell which. (Page 6)

Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, or social questions. (Page 11)

Seek better reasons for believing something than “Everybody knows that . . . ” or “I just know” and discount such reasons when given by others. (Page 299)

Alaska Science Key Element B3

A student who meets the content standard should understand that scientific inquiry often involves different ways of thinking, curiosity, and the exploration of multiple paths.

Performance Standard Level 2, Ages 8–10

Students discuss multiple explanations for an observed phenomenon.

Sample Assessment Ideas

- Students observe the behavior of meal worms, earthworms, pond animals, etc. Record observations in journals. Discuss observations including patterns of behavior and possible explanations for behavior.
- Students explore a variety of moving air stations (fan, blow dryer). Teacher asks open-ended questions to elicit multiple explanations for observations.

Standards Cross-References

National Science Education Standards

Ask a question about objects, organisms, and events in the environment. This aspect of the standard emphasizes students asking questions that they can answer with scientific knowledge, combined with their own observations. Students should answer their questions by seeking information from reliable sources of scientific information and from their own observations and investigations. (Page 122)

Communicate investigations and explanations. Students should begin developing the abilities to communicate, critique, and analyze their work and the work of other students. This communication might be spoken or drawn as well as written. (Page 122)

Recognize and analyze alternative explanations and predictions. Students should develop the ability to listen and to respect the explanations proposed by other students. They should remain open to and acknowledge different ideas and explanations, be able to accept the skepticism of others, and consider alternative explanations. (Page 148)

Benchmarks

Scientists' explanations about what happens in the world come partly from what they observe, partly from what they think. Sometimes scientists have different explanations for the same set of observations. That usually leads to their making more observations to resolve the differences. (Page 11)

Offer reasons for their findings and consider reasons suggested by others. (Page 286)

Level 2

Alaska Science Key Element B4

A student who meets the content standard should understand that personal integrity, skepticism, openness to new ideas, creativity, collaborative effort, and logical reasoning are all aspects of scientific inquiry.

Performance Standard Level 2, Ages 8–10

Students use creativity and collaboration to investigate a question.

Sample Assessment Ideas

- Students work in groups in a bridge-building competition. The structure that holds the most weight is the winner.
- Students work in groups to design and carry out an investigation to examine the insulating qualities of fur.

Standards Cross-References

National Science Education Standards

Use data to construct a reasonable explanation. This aspect of the standard emphasizes the students' thinking as they use data to formulate explanations. Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strength of the data and information that will be used to make explanations. After students propose an explanation, they will appeal to the knowledge and evidence they obtained to support their explanations. Students should check their explanations against scientific knowledge, experiences, and observations of others. (Page 122)

Communicate scientific procedures and explanations. With practice, students should become competent at communicating experimental methods, following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations. (Page 148)

Benchmarks

Scientists do not pay much attention to claims about how something they know about works unless the claims are backed up with evidence that can be confirmed and with a logical argument. (Page 11)

Offer reasons for their findings and consider reasons suggested by others. (Page 286)

Alaska Science Key Element B5

A student who meets the content standard should employ ethical standards, including unbiased data collection and factual reporting of results.

Performance Standard Level 2, Ages 8–10

Students practice factual reporting of data and identify techniques that ensure the fair collection and comparison of evidence.

Sample Assessment Ideas

- Students compete for a prize to be awarded to the student or group that can grow the tallest plant. Share data and ask if anyone was tempted to exaggerate their results. Discuss what effect this would have on the conclusions.
- Students compete in teams to build and test a model car to see which one rolls the farthest off an inclined plane. Teams will be responsible for monitoring themselves. At the end of the competition, ask if anyone was tempted to exaggerate data and whether exaggeration would be fair.

Standards Cross-References

National Science Education Standards

Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations. (Page 123)

Scientists review and ask questions about the results of other scientists' work. (Page 123)

Benchmarks

Keep records of their investigations and observations and not change the records later. (Page 286)

Buttress their statements with facts found in books, articles, and databases, and identify the sources used and expect others to do the same. (Page 299)

Recognize when comparisons might not be fair because some conditions are not kept the same. (Page 299)

Alaska Science Key Element B6

A student who meets the content standard should employ strict adherence to safety procedures in conducting scientific investigations.

Performance Standard Level 2, Ages 8–10

Students examine laboratory and community safety procedures, identify how an individual affects the safety of the group, and practice safe behavior in the classroom and laboratory.

Sample Assessment Ideas

- Students review lab safety procedures; draw lab safety posters illustrating the procedures.
- Students identify ten safety features in the community (guard on snow-machine clutch, kill-switch on outboard motor or snow-machine, railings on stairs, and so on).

Expanded Sample Assessment Idea

- Students review lab safety procedures and model incorrect and correct approaches for the critique of their peers.

Procedure

Students will:

1. Review lab safety procedures.
2. Witness demonstrations of procedures by instructor.
3. Practice proper procedures.
4. Pantomime performing a task in the laboratory until stopped by the observation of their peers of a non-safe behavior.
5. Pantomime the proper approach after it is described by peers.

Reflections and Revisions

Develop a list of other areas of the school that can benefit from safety procedures.

Level of Performance

Stage 4 — Student work is complete, correct, and shows evidence of elaboration, extensions, and creativity. Student actively participates in a pantomime or critique that shows ability to interpret and incorporate a variety of laboratory safety procedures.

Stage 3 — Student work is generally complete, correct, and shows some evidence of elaboration, extensions, or creativity. Student participates in a pantomime or critique that interprets or incorporates some laboratory safety procedures.

Stage 2 — Student work is incomplete or shows limited ability to interpret or incorporate laboratory safety procedures.

Stage 1 — Student work fails to address the topic of laboratory safety. It may be entertaining, but misses major safety concerns and fails to communicate either lab safety or unsafe procedures.

Standards Cross-References

National Science Education Standards

The potential for accidents and the existence of hazards imposes the need for injury prevention. Safe living involves the development and use of safety precautions and the recognition of risk in personal decisions. Injury prevention has personal and social dimensions. (Page 168)

Benchmarks

One person's exercise of freedom may conflict with the freedom of others. Rules can help to resolve conflicting freedoms. (Page 172)

Alaska Science Content Standard C

Level 2, Ages 8–10

A student should understand the nature and history of science.

Alaska Science Key Element C1

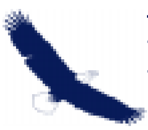
A student who meets the content standard should know how the words “fact,” “observation,” “concept,” “principle,” “law,” and “theory” are generally used in the scientific community.

Performance Standard Level 2, Ages 8–10

Students will observe and record an event, then explore concepts associated with those observations and facts.

Sample Assessment Ideas

- Students attempt to roll a variety of differently shaped objects down a ramp; record their observations; generalize how the shape of the object is related to the way it rolls down the ramp.
- Students pass sugar water and silty river water through separate coffee filters; hypothesize about the differences between the filtrates and the suspensions.



Expanded Sample Assessment Idea

- Students grow plants under a variety of conditions and compare growth rates.

Procedure

Students will:

1. Divide into small groups.
2. Grow plants under a variety of conditions (amount of light, amount of water, type of soil).
3. Observe general appearance and measure the rate of growth; record observations in their science journals.
4. Make graphs comparing growth rates.
5. As a class talk about the difference between their observations and the measurements (identifying facts); discuss and generalize concepts from everyone’s data.
6. Clarify the observations and facts in their findings.

Reflection and Revision

Discuss factors other than frequency of watering that will affect plant growth.

Level of Performance

Stage 4 — Student observations are correct, complete, and appropriate, and contain elaboration, extension, and evidence of higher-order thinking and relevant knowledge. There is no evidence of misconceptions. Minor errors do not necessarily lower the score.

Stage 3 — Student observations are correct, complete, and appropriate; although minor inaccuracies are present. There may be limited evidence of elaboration, extension, higher-order thinking, and relevant knowledge; or there may be significant evidence of these traits, but other flaws (e.g. inaccuracies, omissions, inappropriateness) are evident.

Stage 2 — Student observations are inaccurate, incomplete or inappropriate, although may contain some elements of proficient work. There is little, if any, evidence of elaboration, extension, higher-order thinking or relevant knowledge. There may be evidence of significant misconceptions.

Stage 1 — Student work, although it may be on topic, fails to address the question, or addresses the question in a very limited way. There is evidence of serious misconceptions.

Standards Cross-References

National Science Education Standards

Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations. (Page 123)

Communicate scientific procedures and explanations. With practice, students, should become competent at communicating experimental methods, and following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations. (Page 148)

Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. When such displacement occurs, science advances. (Page 148)

Benchmarks

Buttress their statements with facts found in books, articles, and databases and identify the sources used and expect others to do the same. (Page 299)

Alaska Science
Key Element C2

A student who meets the content standard should understand that scientific knowledge is validated by repeated specific experiments that conclude in similar results.

Performance Standard Level 2, Ages 8–10

Students conduct simple experiments, compare their results with the work of others, and explain any differences.

Sample Assessment Ideas

- Students determine which wood smoke best repels flies while drying salmon; repeat their experiment to validate their results with the work of others.
- Students determine which brand of dog food is the favorite among a dog team; repeat the experiment with another dog team; determine generalization of findings. Any differences must be explained.

Standards Cross-References

National Science Education Standards

Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations. (Page 123)

Communicate scientific procedures and explanations. With practice, students should become competent at communicating experimental methods, following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations. (Page 148)

Science advances through legitimate skepticism. Asking questions and querying other scientists' explanations is part of scientific inquiry. Scientists evaluate the explanations proposed by other scientists by examining evidence, comparing evidence, identifying faulty reasoning, pointing out statements that go beyond evidence, and suggesting alternative explanations for the same observations. (Page 148)

Benchmarks

Results of similar scientific investigations seldom turn out exactly the same. Sometimes this is because of unexpected differences in the things being investigated, sometimes because of unrealized differences in the methods used or in the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations. It is not always easy to tell which. (Page 6)

Results of scientific investigations are seldom exactly the same, but if the differences are large, it is important to try to figure out why. One reason for following directions carefully and for keeping records of one's work is to provide information on what might have caused the differences. (Page 11)

Level 2

Alaska Science Key Element C3

A student who meets the content standard should understand that society, culture, history, and environment affect the development of scientific knowledge.

Performance Standard Level 2, Ages 8–10

Students identify how various cultures throughout history have developed different units and tools for measurement.

Sample Assessment Ideas

- Students compare how various cultures throughout history have developed different methods for linear measurement.
- Students measure objects with the English and metric systems; add measurements in both systems; list pros and cons of each system.

Standards Cross-References

National Science Education Standards

Women and men of various social and ethnic backgrounds, and with diverse interests, talents, qualities, and motivations engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others. (Page 170)

Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society. (Page 171)

In historical perspective, science has been practiced by different individuals in different cultures. In looking at the history of many peoples, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture. (Page 171)

Benchmarks

Science is an adventure that people everywhere can take part in, as they have for many centuries. (Page 16)

Level 2

Alaska Science Key Element C4

A student who meets the content standard should understand some personal and societal beliefs accept non-scientific methods for validating knowledge.

Performance Standard Level 2, Ages 8–10

Students observe a phenomenon; record a personal (non-scientific) belief about that phenomenon; compare their personal (non-scientific) belief to the scientific explanation.

Sample Assessment Ideas

- Students compile a list of beliefs about a phenomenon (tides, sunset, moonrise, day and night, etc.); discuss which beliefs are personal (non-scientific) and which are scientific in nature.
- Students brainstorm reasons for plant growth and identify scientific and non-scientific statements.

Standards Cross-References

National Science Education Standards

People have always had questions about their world. Science is one way of answering questions and explaining the natural world. (Page 138)

Recognize and analyze alternative explanations and predictions. Students should develop the ability to listen to and respect the explanations proposed by other students. They should remain open to and acknowledge different ideas and explanations, be able to accept the skepticism of others, and consider alternative explanations. (Page 148)

Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot. For example, new technologies often will decrease some risks and increase others. (Page 169)

Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations. (Page 171)

Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted. (Page 171)

Benchmarks

Seek better reasons for believing something than “Everybody knows that” or “I just know” and discount such reasons when given by others. (Page 299)

Level 2

Alaska Science Key Element C5

A student who meets the content standard should understand that sharing scientific discoveries is important to influencing individuals and society and in advancing scientific knowledge.

Performance Standard Level 2, Ages 8–10

Students work together to explore and share scientific discoveries about their environment.

Sample Assessment Ideas

- Students work together in teams to test different insulators (a material wrapped around a container containing water and a thermometer) under similar conditions; share results with class.
- Students share information about the dates of “ice break-up” in communities across Alaska to determine weather trends.

Standards Cross-References

National Science Education Standards

Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations. (Page 123)

Women and men of various social and ethnic backgrounds, and with diverse interests, talents, qualities, and motivations engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others. (Page 170)

Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities such as reasoning, insight, energy, skill, and creativity as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (Page 170)

Benchmarks

Clear communication is an essential part of doing science. It enables scientists to inform others about their work, expose their ideas to criticism by other scientists, and stay informed about scientific discoveries around the world. (page 16)

Doing science involves many different kinds of work and engages men and women of all ages and backgrounds. (Page 16)

Level 2

Alaska Science Key Element C6

A student who meets the content standard should understand that scientific discovery is often a combination of an accidental happening and observation by a knowledgeable person with an open mind.

Performance Standard Level 2, Ages 8–10

Students describe an historical scientific discovery that happened as a result of an accident.

Sample Assessment Ideas

- Students interview a local person who has discovered a better way to work or use a scientific principle in doing work.
- Students describe how gold or gas was discovered in Alaska.

Standards Cross-References

National Science Education Standards

Recognize and analyze alternative explanations and predictions. Students should develop the ability to listen to and respect the explanations proposed by other students. They should remain open to and acknowledge different ideas and explanations, be able to accept the skepticism of others, and consider alternative explanations. (Page 148)

Science advances through legitimate skepticism. Asking questions and querying other scientists' explanations is part of scientific inquiry. Scientists evaluate the explanations proposed by other scientists by examining evidence, comparing evidence, identifying faulty reasoning, pointing out statements that go beyond evidence, and suggesting alternative explanations for the same observations. (Page 148)

Benchmarks

Scientists' explanations about what happens in the world come partly from what they observe, partly from what they think. Sometimes scientists have different explanations for the same set of observations. That usually leads to their making more observations to resolve the differences. (Page 11)

Alaska Science Key Element C7

A student who meets the content standard should understand that major scientific breakthroughs may link large amounts of knowledge, build upon the contributions of many scientists, and cross different lines of study.

Performance Standard Level 2, Ages 8–10

Students design a timeline to show the historical development of an object or tool that they use.

Sample Assessment Ideas

- Students design concept webs that show how contributions across a variety of fields are used to produce inventions.
- Students identify commonly used objects and ask Elders what they used before the object was available.

Standards Cross-References

National Science Education Standards

Many different people in different cultures have made and continue to make contributions to science and technology. (Page 166)

Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies. (Page 169)

Scientists and engineers work in many different settings, including colleges and universities, businesses and industries, specific research institutes, and government agencies. (Page 169)

Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted. (Page 171)

Benchmarks

Science is an adventure that people everywhere can take part in, as they have for many centuries. (Page 16)

Alaska Science Key Element C8

A student who meets the content standard should understand that acceptance of a new idea depends upon supporting evidence and that new ideas that conflict with beliefs or common sense are often resisted.

Performance Standard Level 2, Ages 8–10

Students observe and describe examples of how scientific ideas that conflict with beliefs or common sense are resisted.

Sample Assessment Ideas

- Students do library search on historic cases of resistance to new ideas (e.g., Galileo's universe, the flat world vs. spherical world).
- Students explain how fish tenders made of heavy metal float when full of fish.

Expanded Sample Assessment Idea

- Students compare the prediction of what is in the beaker using the sense of sight and then the sense of touch.

Procedure

Students will:

1. Visually inspect two beakers that appear to contain only water.
2. Predict what the beaker contains; record their predictions.
3. Fish around in each of the beakers to discover that one beaker contains only water and one beaker contains "invisible" glass test tubes (made of glass with the same refractive index as water, available from Flinn Scientific).

Reflection and Revision

Describe how visual clues about the contents of the beakers proved incorrect and changed as counter-intuitive evidence was collected and examined.

Level of Performance

Stage 4 — Student work is complete, correct, and contains evidence of elaboration, extension, higher-order thinking skills, and relevant knowledge. Students actively participate in demonstration, make accurate observations, and clearly describe their findings, conclusions, and the evidence used to "change their mind."

Stage 3 — Student work is generally complete and correct although it may contain evidence of some inaccuracies or omissions. Student participates in demonstration, makes accurate observations, and describes their findings and conclusions.

Stage 2 — Student work may be incomplete and inaccurate. Student is a reluctant participant in the demonstration. Observations and descriptions of findings are minimal and contain evidence of misconception and errors.

Stage 1 — Student work is incomplete and inaccurate. Student does not participate in class discussion or describe the findings.

Standards Cross-References

National Science Education Standards

Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. When such displacement occurs, science advances. (Page 148)

Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations. (Page 171)

In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from the same data. Ideally, scientists acknowledge such conflict and work toward finding evidence that will resolve their disagreement. (Page 171)

It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretation of data, or about the value of rival theories, they do agree that questioning, response to criticism, and open communication are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists. (Page 171)

Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted. (Page 171)

Benchmarks

Scientists do not pay much attention to claims about how something they know about works unless the claims are backed up with evidence that can be confirmed and with a logical argument. (Page 11)

Alaska Science Content Standard D

Level 2, Ages 8–10

A student should be able to apply scientific knowledge and skills to make reasoned decisions about the use of science and scientific innovations.

Alaska Science Key Element D1

A student who meets the content standard should apply scientific knowledge and skills to understand issues and everyday events.

Performance Standard Level 2, Ages 8–10

Students use science knowledge and reasoning to explain the science of everyday events.

Sample Assessment Ideas

- Students explain how a teeter totter works.
- Students locate, describe and explain why erosion has occurred in two places in their community.

Expanded Sample Assessment Idea

- Students compare a variety of snowshoes and use them under various conditions; identify the advantages and disadvantages of each. Explain the underlying scientific concepts.

Procedure

Students will:

1. Gather traditional snowshoes from parents and staff (1 pair of each for every group of 4).
2. Set up a relay race; run a specified distance.
3. Run one lap with traditional snowshoes, one lap with modern snowshoes. Repeat for each student.
4. After each loop, list pros and cons of the snowshoes. Decide which snowshoes are preferred by the most students; support the decision based on the relay results.

Reflection and Revision

Students consider how the different materials used in snowshoe construction affect performance.

Level of Performance

Stage 4 Student work is complete, correct, and contains evidence of elaboration, extension, higher order thinking skills, and relevant knowledge. Student actively participates with group to perform an accurate and reliable test of the snowshoes and uses the results of the test to support the decision about which snowshoe works best.

Stage 3 Student work is generally complete and correct but may contain evidence of some inaccuracies or omissions. Student participates with group to perform a test of the snowshoes though the test may be inaccurate or unreliable. Student decision about which snowshoe works the best is based on limited evidence from the test or on non-test related evidence.

Stage 2 Student work may be incomplete or inaccurate. Student may be a reluctant group participant. The snowshoe test is inaccurate and unreliable. Student decision about which snowshoe works the best is not supported.

Stage 1 Student work is incomplete and inaccurate. Student does not participate in group task or participate in a relay race or snowshoe test.

Standards Cross-References

National Science Education Standards

Use data to construct a reasonable explanation. This aspect of the standard emphasizes the students' thinking as they use data to formulate explanations. Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strengths of the data and information that will be used to make explanations. After students propose an explanation, they will appeal to the knowledge and evidence they obtained to support their explanations. Students should check their explanations against scientific knowledge, experiences, and observations of others. (Page 122)

Develop descriptions, explanations, predictions, and models using evidence. Students should base their explanation on what they observed, and as they develop cognitive skills, they should be able to differentiate explanation from description—providing causes for effects and establishing relationships based on evidence and logical argument. This standard requires a subject matter knowledge base so the students can effectively conduct investigations, because developing explanations establishes connections between the content of science and the contexts within which students develop new knowledge. (Page 145)

Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. When such displacement occurs, science advances. (Page 148)

Benchmarks

Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, and social questions. (Page 11)

Scientists' explanations about what happens in the world come partly from what they observe, and partly from what they think. Sometimes scientists have different explanations for the same set of observations. That usually leads to their making more observations to resolve the differences. (Page 11)

Alaska Science
Key Element D2

A student who meets the content standard should understand that scientific innovations may affect our economy, safety, environment, health, and society and that these effects may be short-term or long-term, positive or negative, and expected or unexpected.

Performance Standard Level 2, Ages 8–10

Students describe the various effects of an innovation on the safety, health and environment of the local community.

Sample Assessment Ideas

- Students examine advantages and disadvantages of traditional sinew used for thread compared with commercial threads and dental floss.
- Students examine the positive and negative, long- and short-term effects of using dog teams vs. snow machines for travel.

Standards Cross-References

National Science Education Standards

People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems. (Page 138)

People continue inventing new ways of doing things, solving problems, and getting work done. New ideas and inventions often affect other people; sometimes the effects are good and sometimes they are bad. It is helpful to try to determine in advance how ideas and inventions will affect other people. (Page 140)

Science and technology have greatly improved food quality and quantity, transportation, health, sanitation, and communication. These benefits of science and technology are not available to all of the people in the world. (Page 141)

Benchmarks

Technology extends the ability of people to change the world: to cut, shape, or put together materials; to move things from one place to another; and to reach farther with their hands, voices, senses, and minds. The changes may be for survival needs, such as food, shelter, and defense, for communication and transportation, or to gain knowledge and express ideas. (Page 45)

The solution to one problem may create other problems. (Page 50)

Technology has been part of life on the Earth since the advent of the human species. Like language, ritual, commerce, and the arts, technology is an intrinsic part of human culture, and it both shapes society and is shaped by it. The technology available to people greatly influences what their lives are like. (Page 54)

Alaska Science Key Element D3

A student who meets the content standard should recommend solutions to everyday problems by applying scientific knowledge and skills.

Performance Standard Level 2, Ages 8–10

Students identify a community problem or issue and describe the information needed to develop a scientific solution.

Sample Assessment Ideas

- Students examine rocks used in steam baths and determine characteristics, location and possible geologic origin of the stones.
- Students study local landfill capacity constraints; brainstorm problems and research possible solutions.

Expanded Sample Assessment Idea

- Students identify where the residue collects in wood-burning stove pipes and discuss what can be done to prevent this fire hazard.

Procedure

Students will:

1. Help an adult “dissect” a wood stove that has been used; observe and record location of residue.
2. Observe characteristics of residue.
3. Consult with knowledgeable adult regarding best way to clean or prevent the residue build-up.
4. Test a variety of cleaning methods; record results.
5. Compare results from stoves that are cleaned differently or from stoves that have burned different woods.

Reflection and Revision

Report back to the adult who “dissected” the wood stove.

Level of Performance

Stage 4 — Student work is complete, correct, appropriate, and shows evidence of elaboration, extension, higher-order thinking skills, and relevant knowledge. Student actively participates in the dissection and cleaning of a wood-burning stove. Student accurately reports the location and characteristics of the residue, identifies the “best” methods to prevent and clean out the residue; and uses evidence to support their methods.

Stage 3 — Student work is complete and but may show limited evidence of elaboration and extension or may contain minor misconceptions or inaccuracies. Student participates in the dissection and cleaning of a wood-burning stove. Student reports the location and characteristics of the residue and identifies a method to prevent or clean out the residue.

Stage 2 — Student work may be incomplete or inappropriate and may show evidence of misconceptions and inaccuracies. Student may be a reluctant participant in the dissection and cleaning of a wood-burning stove. Student report on the residue left by the burning wood may lack detail or contain errors.

Stage 1 — Student work is incomplete, inappropriate or inaccurate. Student may not participate in the dissection or cleaning of a wood-burning stove. Student report lacks detail and contain errors.

Standards Cross-References

National Science Education Standards

Identify appropriate problems for technological design. Students should develop their abilities by identifying a specified need, considering its various aspects, and talking to potential users or beneficiaries. They should appreciate that for some needs, the cultural backgrounds and beliefs of different groups can affect the criteria for a suitable product. (Page 165)

Design a solution or product. Students should make and compare different proposals in the light of the criteria they have selected. They must consider constraints such as cost, time, trade-offs, and materials needed and communicate ideas with drawings and simple models. (Page 165)

Benchmarks

There is no perfect design. Designs that are best in one respect (safety or ease of use, for example) may be inferior to other ways (cost or appearance). Usually some features must be sacrificed to get others. How such trade-offs are received depends upon which features are emphasized and which are down-played. (Page 49)

The solution to one problem may create other problems. (Page 50)

Scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. Other factors, such as cost, safety, appearance, environmental impact, and what will happen if the solution fails also must be considered. (Page 55)

Alaska Science Key Element D4

A student who meets the content standard should evaluate the scientific and social merits of solutions to everyday problems.

Performance Standard Level 2, Ages 8–10

Students evaluate multiple solutions to the same problem.

Sample Assessment Ideas

- Examine a variety of ways to preserve berries; evaluate the scientific and social merits of each.
- Students consider the availability, cost, quality, and characteristics of various oils (traditional oils such as seal, bear, etc., as well as commercial oils) to determine which one is "best" for a given purpose.

Standards Cross-References

National Science Education Standards

Scientific inquiry and technological design have similarities and differences. Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs, and aspirations. Technological solutions are temporary; technologies exist within nature and so they cannot contravene physical or biological principles; technological solutions have side-effects; and technologies cost, carry risks, and provide benefits. (Page 166)

Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Engineers often build in back-up systems to provide safety. Risk is part of living in a highly technological world. Reducing risk often results in new technology. (Page 166)

Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted, others cannot. (Page 166)

Benchmarks

Scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. Other factors, such as cost, safety, appearance, environmental impact, and what will happen if the solution fails also must be considered. (Page 55)

Technologies often have drawbacks as well as benefits. A technology that helps some people or organisms may hurt others—either deliberately (e.g., weapons) or inadvertently (e.g., pesticides). When harm occurs or seems likely, choices have to be made or new solutions found. (Page 55)

Alaska Science Key Element D5

A student who meets the content standard should participate in reasoned discussions of public policy related to scientific innovation and proposed technological solutions to problems.

Performance Standard Level 2, Ages 8–10

Students debate the usefulness of various science tools and technological innovations in their community.

Sample Assessment Ideas

- Students debate the usefulness of snow machines and four-wheel drives.
- Students hold a community forum to discuss the usefulness of diverse tools and innovations used in the community such as an ice auger and a berry picker; a fish trap and rain gear.

Standards Cross-References

National Science Education Standards

The potential for accidents and the existence of hazards imposes the need for injury prevention. Safe living involves the development and use of safety precautions and the recognition of risk in personal decisions. Injury prevention has personal and social dimensions. (Page 168)

Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes. (Page 168)

Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others and the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental. (Page 169)

Benchmarks

Any invention is likely to lead to other inventions. Once an invention exists, people are likely to think up ways of using it that were never imagined at first. (Page 54)

Transportation, communication, nutrition, sanitation, health care, entertainment, and other technologies give large numbers of people today the goods and services that once were luxuries enjoyed only by the wealthy. These benefits are not equally available to everyone. (Page 54)

Technologies often have drawbacks as well as benefits. A technology that helps some people or organisms may hurt others—either deliberately (as weapons can) or inadvertently (as pesticides can). When harm occurs or seems likely, choices have to be made or new solutions found. (Page 55)

Because of their ability to invent tools and processes, people have an enormous effect on the lives of other living things. (Page 55)

Alaska Science Key Element D6

A student who meets the content standard should act upon reasoned decisions and evaluate the effectiveness of the action.

Performance Standard Level 2, Ages 8–10

Students work scientifically to improve a situation that exists in their local school or community.

Sample Assessment Ideas

- Students research food waste in their school; suggest and implement corrective actions; evaluate the results.
- Students examine litter patterns in their school neighborhood; come up with class actions to improve the litter problem.

Standards Cross-References

National Science Education Standards

Design a solution or product. Students should make and compare different proposals in the light of the criteria they have selected. They must consider constraints, such as cost, time, trade-offs, and materials needed, and communicate ideas with drawings and simple models. (Page 165)

Implement a proposed solution. Students should organize materials and other resources, plan their work, make good use of group collaboration where appropriate, choose suitable tools and techniques, and work with appropriate measurement methods to ensure adequate accuracy. (Page 165)

Evaluate completed technological designs or products. Students should use criteria relevant to the original purpose or need, consider a variety of factors that might affect acceptability and suitability for intended users or beneficiaries, and develop measures of quality with respect to such criteria and factors; they should also suggest improvements and, for their own products, try proposed modifications. (Page 165)

Communicate the process of technological design. Students should review and describe any completed piece of work and identify the stages of problem identification, solution design, implementation, and evaluation. (Page 166)

Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others. (Page 169)

Benchmarks

Because of their ability to invent tools and processes, people have enormous effect on the lives of other living things. (Page 55)