

Grade 4 Science, Quarter 2, Unit 2.1

Matter

Overview

Number of instructional days: 10 (1 day = 45 minutes)

Content to be learned

- Describe the properties of solids, liquids, and gases.
- Identify, compare, and classify materials as solids, liquids, and gases.
- Observe and describe physical changes in matter.
- Observe, describe, and predict changes in state of matter when adding or taking away heat.
- Describe how heat moves from warm objects to cold objects until both objects are the same temperature.
- Measure the weight of objects to prove that all matter has weight.
- Use balances to prove that the weight of an object equals the sum of the weight of its parts.

Processes to be used

- Observe and describe physical changes.
- Collect and organize data about physical properties.
- Classify objects using physical properties.
- Make predictions about changes caused by adding or taking away heat.
- Use tools to collect data about physical properties, including weight and temperature.
- Select materials and conduct investigations in order to draw conclusions.

Essential questions

- What might happen to an object when heated or cooled?
- What happens when a warm object comes into contact with a cold object? Give two examples
- What are some physical changes that can be observed in water?
- How would you prove that the weight of an object equals the sum of the weight of its parts?
- How can you distinguish between different types of matter based on their physical properties?

Written Curriculum

Grade Span Expectations

PS1 - All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size or amount of substance).

PS1 (K-4) POC –2

Make a prediction about what might happen to the state of common materials when heated or cooled or categorize materials as solid, liquid, or gas.

PS1 (3-4) –2 Students demonstrate an understanding of states of matter by ...

2a describing properties of solids, liquids, and gases.

2b identifying and comparing solids, liquids, and gases.

PS1 (K-4) INQ –1

Collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their characteristic properties (e.g., temperature, color, size, shape, weight, texture, flexibility).

PS1 (3-4)–1 Students demonstrate an understanding of physical changes by ...

1c observing and describing physical changes (e.g. freezing, thawing, torn piece of paper).

PS1 (K-4) POC –2 [See above]

PS1 (3-4) –2 Students demonstrate an understanding of states of matter by ...

2c making logical predictions about the changes in the state of matter when adding or taking away heat (e.g., ice melting, water boiling or freezing, condensation/evaporation).

PS1 (K-4) SAE –3

Use measures of weight (data) to demonstrate that the whole equals the sum of its parts.

PS1 (3-4)–3 Students demonstrate an understanding of conservation of matter by ...

3a measuring the weight of objects to prove that all matter has weight.

3b using measures of weight to prove that the whole equals the sum of its parts.

Clarifying the Standards

Prior Learning

Students in second grade identified, described, and compared the physical properties of solids and liquids. In third grade, students were introduced to gases. Students explored physical changes to matter and made logical predictions about changes in states of matter when adding or taking away heat. Primary students determined weight by using simple tools, and third-grade students used balances to prove that the weight of an object equals the sum of the weight of its parts.

Current Learning

Students continue to practice describing, identifying, and comparing solids and liquids, which should be taught at the reinforcement level to the drill-and-practice level of instruction. Students need multiple opportunities to investigate various objects in order to determine the properties of solids, liquids, and gases. Using this knowledge, children will be able to distinguish one state of matter from another, and will be able to make logical predictions about changes in the state of matter.

Since the concept of gases was introduced in third grade, it is taught in fourth grade at the reinforcement level of instruction. Students will apply their understanding of physical changes by observing and describing physical changes such as freezing, thawing, and tearing a piece of paper. Students prove that matter has weight and that the whole equals the sum of its parts, which is also taught at a reinforcement level of instruction.

Future Learning

Using their knowledge of solids, liquids, and gases, students will recognize that different substances have properties that allow them to be identified, regardless of the size of the sample. They will also classify and compare substances using their properties. Students are introduced to the concept of mass and that the mass of the whole is always equal to the sum of its parts.

Additional Research Findings

Making Sense of Secondary Science indicates that children are not initially aware that air and other gases have material characteristics. For example, although young children know that air and smoke exist, they regard such materials as having transient characteristics similar to that of thoughts. In many children's thinking, air and gas appear to have contrasting affective connotations: air, which is "good," is used for breathing and life; gas is "bad" because it may be poisonous or dangerous. When students develop an awareness of the material characteristics of gases, they come to understand gases as materials that spread, and that some gases can be seen even though most are colorless, odorless, and transparent. However, students may not regard gas as having weight or mass. This misconception forms because children's most commonly related experience is that gases tend to rise or float. Many children predict that gases have "negative weight," meaning that the more gas that is added to a container, the lighter the container becomes (p. 80).

Benchmarks for Science Literacy encourages teachers to allow students to measure, estimate, and calculate sizes, capacities, and weights of objects. If children cannot feel the weight of something, they may believe it to have no weight at all. Many experiences of weighing—including weighing piles of small things and dividing to find the weight of each—will help. It is not obvious to elementary students that whole objects weigh the same as the sum of their parts. That idea is a preliminary to the conservation principle that weight doesn't change in spite of changes in other properties, as long as all the parts, including invisible gases, are accounted for. Students should use magnifiers to inspect substances composed of large collections of particles, such as salt and powder, to discover unexpected details at smaller scales. They should also observe and describe the behavior of large collections of pieces—powders, marbles, sugar cubes, or wooden blocks—and consider that the collections may have new properties that the pieces do not (p. 76).

Heat is one of the most confusing scientific concepts for many students. They tend to think of heat as a substance that flows from place to place, similar to air. Students do not necessarily think of *hot* and *cold* as part of the same continuum. Rather, they perceive these as two different phenomena, with *cold* often thought to be the opposite of heat. Distinguishing between heat and temperature is also one of the most difficult tasks for children. They tend to view temperature as the mixture of heat and cold inside an object

or simply as a measure of the amount of heat possessed by that object, with no distinction between the intensity of heat and the amount of heat possessed. Misconceptions regarding heat include that cold—rather than heat—is transferred, and that objects that keep us warm (mittens and sweaters) are sources of heat (*Making Sense of Secondary Science*, p. 138).

Notes About Resources and Materials

Houghton Mifflin Science: Discovery Works, Unit B, chapters 1–3

Websites

- http://Wings.avkids.com/Curriculums/Forces_Motion/penny_howto.html
- www.chem4kids.com
- www.neok12.com
- www.science.pppst.com
- www.matter.html
- Cranston Public Schools Homepage
(Click on RIEPS access, click on RITTI)

Trade Books

- Green, D., Basher, S. (2010). *Physics: Why Matter Matters!* New York: Macmillan.
- Tocci, S. (2002). *Experiments with Solids, Liquids, and Gases*. Danbury, CT: Children's Press.
- Cooper, C. (1999). *Eyewitness: Matter*. New York: DK Publishing.
- Bayrock, F., McMullen, A. *States of Matter: A Question and Answer Book*. Mankato, MN: Capstone.

Grade 4 Science, Quarter 2, Unit 2.2

Forms of Energy

Overview

Number of instructional days: 10 (1 day = 45 minutes)

Content to be learned

- Investigate observable effects of light using a variety of light sources.
- Predict, describe, and investigate how light rays are reflected, refracted, or absorbed.
- Describe how heat can be produced in many ways.
- Draw, diagram, build, and explain a complete electrical circuit.
- Use experimental data to classify a variety of materials as conductors or insulators.

Essential questions

- What happens when light comes into contact with objects?
- In what ways can heat be produced?

Processes to be used

- Collect and record data.
 - Use data to sort and classify objects.
 - Draw, diagram, and build models of simple systems.
 - Observe and describe the interactions between the structures and processes within simple systems.
 - Use science processes to make predictions, conduct investigations, make observations, collect data, and draw conclusions.
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- What happens when you introduce an object into an electrical circuit?

Written Curriculum

Grade Span Expectations

PS 2 - Energy is necessary for change to occur in matter. Energy can be stored, transferred, and transformed, but cannot be destroyed.

PS2 (K-4) SAE – 5

Use observations of light in relation to other objects/substances to describe the properties of light (can be reflected, refracted, or absorbed).

PS2 (3-4)-5 Students demonstrate an understanding of energy by...

5a investigating observable effects of light using a variety of light sources (e.g., light travels in a straight line until it interacts with an object, blocked light rays produce shadows).

5b predicting, describing, and investigating how light rays are reflected, refracted, or absorbed.

PS2 (K-4) SAE -4

Given a specific example or illustration (e.g., simple closed circuit, rubbing hands together), predict the observable effects of energy (i.e., light bulb lights, a bell rings, hands warm up (e.g., a test item might ask, “what will happen when...?”)).

PS2 (3-4)-4 Students demonstrate an understanding of energy by...

4c describing or showing that heat can be produced in many ways (e.g. electricity, friction, burning).

4d drawing, diagramming, building, and explaining a complete electrical circuit.

4e using experimental data to classify a variety of materials as conductors or insulators

Clarifying the Standards

Prior Learning

Students in K–2 had experience observing and creating shadows. In third grade, students investigated the observable effects of light. Third-grade students also demonstrated an understanding of energy by predicting, describing, and investigating how light rays are reflected, refracted, and absorbed.

In K–2, students learned that the sun warms the land and water. They observed that the temperature of objects changes when adding or taking away heat. In third grade, students learned that heat moves from warm objects to cold objects until both are the same temperature. Students also demonstrated an understanding of energy by using experimental data to classify a variety of materials as conductors or insulators.

Current Learning

Students in grade 4 investigate observable effects of light using a variety of light sources. Students predict, describe, and investigate how light rays are reflected, refracted, and absorbed. They also describe

or show that heat can be produced in many ways. These concepts should be taught at the reinforcement level of instruction.

Fourth-grade students demonstrate an understanding that heat moves from warm objects to cold objects until both objects are the same temperature. Students draw, diagram, build, and explain a complete electrical circuit, which should be taught at the reinforcement level to the drill-and-practice level of instruction. In addition, students use experimental data to classify a variety of materials as conductors or insulators.

Future Learning

Students in grade 5 will identify real-world applications where heat energy is transferred and show the direction that the heat energy flows. At this grade level, students will complete the observable effects of energy and move on to the transformation of energy using real-world examples.

Additional Research Findings

According to *Benchmarks for Science Literacy*, energy is a mysterious concept, even though its various forms can be precisely defined and measured. Energy is a major exception to the principle that students should understand ideas before being given labels for them. Children benefit from talking about energy before they are able to define it (p. 81).

Benchmarks for Science Literacy also tells us that investing a lot of time and effort in developing formal energy concepts can wait. The importance of energy lies in the fact that it helps us make sense of a large number of things that occur in the natural world (p. 83).

When learning about energy concepts related to the transfer of heat, students should be alerted to look for objects and processes that give off heat—such as lights, radios, television sets, the sun, sawing wood, polishing surfaces, bending things, running motors, people, animals, etc. (*Benchmarks*, p. 83).

Children often believe that light is white and that our eyes see the color of an object rather than the color of the reflected light (*Making Sense of Secondary Science*, pp. 131–132). The fact that the path light takes is not itself directly visible presents special difficulties for children. Many students conceive light as a source (an electric bulb, the sun), an effect (patch of light), or a state (such as brightness). Children do not recognize light as a physical entity that exists in the space between a light source and its produced effect (*Making Sense*, p. 128).

Notes About Resources and Materials

Houghton Mifflin Science: Discovery Works

- Grade 2 – Unit B – Energy and Motion
- Grade 3 – Unit C – Matter, Energy, and Forces
- Grade 4 – Unit D – Magnetism and Electricity
Ch. 2, Ch 3 Investigation 1

Websites

- www.eia.doe.gov/kids
- www.physics4kids.com
- www.edtech.kennesaw.edu
- www.teachersdomain.org

Trade Books

- Stille, D. (2002). *Electricity: Bulbs, Batteries, and Sparks*. Mankato, MN: Picture Window Books.
- Challoner, J. (2000). *Energy*. New York: Houghton Mifflin-Harcourt.
- Murphy, B. (1992). *Experiment with Light*. Columbus, OH: McGraw-Hill.
- Sohn, E. (2008). *The Illuminating World of Light with Max Axiom, Super Scientist*. Mankato, MN: Capstone.
- Cole, J. (1999). *The Magic School Bus and the Electric Field Trip*. New York: Scholastic Books.