

Grade 4 Science, Quarter 3, Unit 3.1

Force and Motion

Overview

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

Content to be learned

- Use data to predict the direction and describe the motion of an object if force is applied to it.
- Describe a change in position relative to other objects or the background.
- Investigate, describe, and predict how different amounts of force can change the direction/speed of an object in motion.
- Conduct experiments to demonstrate that different objects fall to earth unless something is holding them up.
- Describe what happens when like and opposite poles of a magnet are placed near each other.
- Explore the relative strength of magnets.
- Observe how magnets interact with various objects in order to describe the properties of magnetism.

Essential questions

- What effect do different amounts of force have on an object?
- How does gravity affect objects?

Processes to be used

- Observe and describe physical properties.
- Observe how the parts of a system interact.
- Observe and describe changes that occur within a system.
- Observe and describe how forces affect objects.
- Demonstrate safe practices during classroom investigations.
- Use scientific processes, including making predictions, conducting investigations, making observations, collecting and organizing data, conducting multiple trials to verify results, making comparisons, and drawing conclusions.

Written Curriculum

Grade Span Expectations

PS 3 - The motion of an object is affected by forces.

PS3 (K-4)-INQ+SAE –7

Use data to predict how a change in force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls).

PS3 (3-4)–7 Students demonstrate an understanding of motion by...

7a predicting the direction and describing the motion of objects (of different weights, shapes, sizes, etc.) if a force is applied to it.

7b describing change in position relative to other objects or background.

7c investigating and describing that different amounts of force can change direction/speed of an object in motion.

7d conducting experiments to demonstrate that different objects fall to earth unless something is holding them up. (tied to ideas/concepts of 7a)

PS3 (K-4) INQ+ SAE –8

Use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect)

PS3 (3-4)–8 Students demonstrate an understanding of (magnetic) force by ...

8b describing what happens when like and opposite poles of a magnet are placed near each other.

8c exploring relative strength of magnets (e.g., size of magnets, number of magnets, properties of materials).

Clarifying the Standards

Prior Learning

Students in grades K–2 investigated how forces affect the behavior of objects. Students predicted the direction an object would move when a force was applied, and they demonstrated an understanding of force by showing that different objects fall to earth unless something is holding them up. In grade 3, students began making predictions and describing the motion of objects of different weights when a force was applied.

Students in K–3 made observations and demonstrated an understanding of magnetic force. They described the properties of magnetism, and sorted objects that were and were not attracted to magnets.

Current Learning

At the reinforcement level of instruction, students in grade 4 continue to make predictions and describe the direction and motion of objects. They describe changes in position relative to other objects or the background. Students investigate and describe how varying amounts of force can change the direction/speed of an object in motion.

At the developmental level of instruction, fourth-graders investigate the effects of a force on objects of different shapes and sizes. They conduct experiments to demonstrate that different objects fall to earth unless something is holding them up. Students describe what happens when like and opposite poles of magnets are placed near each other, and they explore the relative strength of magnets with regard to the magnets' size and number, as well as the properties of materials.

Future Learning

Students in grades 5 and 6 will use data and graphs to compare the relative speed of objects. They will also demonstrate understanding of force (friction, gravitational, magnetic) by recognizing that a force is a push or pull. They will explain that forces cause changes in speed or direction of motion. In this grade span, students will also show that electric currents and magnets can exert a force on each other.

Additional Research Findings

When teaching force and motion to elementary students, a qualitative understanding of force is sufficient. Investigations in force and motion should help students develop a conceptual understanding of Newton's first law, i.e., when a force is applied to an object, it may change the position and/or motion of an object (*Benchmarks for Science Literacy*, p. 87). By the end of fifth grade, students should know that forces cause changes in the speed or direction of objects' motion. The greater the force, the greater the change in motion. The more massive an object, the less effect a given force will have (*Benchmarks*, p. 89).

Children need to understand that some forces, such as gravity, can act at a great distance. However, the term *gravity* may be confusing for some children. The important idea is that the earth's gravity "pulls" on objects. Teachers should use hands-on investigations to familiarize students with the pull of gravity as well as the push and pull of magnets. By the end of grade 5, students should know that the earth's gravity pulls any object toward it without touching it, that a magnet pulls on objects made from iron, and that magnets push or pull on other magnets (*Benchmarks*, p. 94).

Students bring their own meanings for some vocabulary into a learning situation. According to *Making Sense of Secondary Science*, seven- to nine-year-olds thought of the word *force* in terms of a feeling such as anger. They also thought of a *force* as something acting to cause a change in motion, although they tended to think of *forces* as getting things going rather than making things stop (pp. 148–149). Teachers should reinforce the concept that force and motion are interrelated.

Students are also inclined to account for the way magnets act by thinking of magnetism as a type of gravity. Students tend to think of the poles only at the end of the magnets, therefore, they need opportunities to observe and describe the magnetic force of the whole magnet (*Making Sense of Secondary Science*, pp. 126–127).

Notes About Resources and Materials

Houghton Mifflin Science, Discovery Works—Grade 4

- Unit D (Magnetism and Electricity)—Chapter 1

Websites

- www.firstschoolyears.com
- www.physics4kids.com
- www.studyjams.scholastic.com
- www.kids-science-experiments.com
- www.essortment.com/hobbies/magnetslearning
- www.factmonster.com

Resource Books and Trade Books

- Ansberry, K. and Morgan, E. (2010). *Picture Perfect Science Lessons Using Children's Books to Guide Inquiry Gr. 3–6*. Arlington, VA: National Science Teachers Association.
- Ardley, N. (1992). *The Science Book of Motion*. Boston, MA: Houghton Mifflin Harcourt.
- Gianopoulos, A. (2007). *The Attractive Story of Magnetism with Max Axiom, Super Scientist*. Mankato, MN: Capstone.
- Hewitt, S. (2003). *Forces and Motion*. Mankato, MN: Chrysalis Education.
- Lafferty, P. (1999). *Eyewitness: Force and Motion*. New York: DK Publishing.
- Twist, C. (2009). *Forces & Motion*. United Kingdom: TickTock Books.
- Rosinsky, N. (2004). *Magnets: Pulling Together, Pushing Apart*. Mankato, MN: Picture Window Books.
- Sohn, E. (2007). *A Crash Course in Forces and Motion with Max Axiom, Super Scientist*. Mankato, MN: Capstone.

Grade 4 Science, Quarter 3, Unit 3.2
The Solar System

Overview

Number of instructional days: 5 (1 day = 45 minutes)

Content to be learned

- Demonstrate an understanding of the relationship between the sun and the earth by recognizing that the rotation of the earth on its axis every 24 hours produces the day/night cycle.
- Recognize that the sun is the center of our solar system.
- Recognize that the earth is one of several planets that orbits the sun, and that the moon orbits the earth.
- Recognize that it takes approximately 365 days for the earth to orbit the sun.
- Recognize that people throughout history have identified patterns of stars called constellations.

Processes to be used

- Identify the structures found in a system.
- Describe the interactions between the structures within in a system.
- Describe patterns of change within a system.
- Use models to understand the relationships between the components of a system.

Essential questions

- Why do we experience day and night?
- What patterns of change occur within the sun, earth, and moon system?
- What patterns can be observed in the stars?

Written Curriculum

Grade Span Expectations

ESS2 - The earth is part of a solar system, made up of distinct parts that have temporal and spatial interrelationships.

No further targets for EK ESS2 at the K-4 Grade Span

ESS2 (3-4)-7 Students demonstrate an understanding of temporal or positional relationships between or among the Earth, sun, and moon by ...

7c recognizing that the rotation of the Earth on its axis every 24 hours produces the day/night cycle.

No further targets for EK ESS2 at the K-4 Grade Span

ESS2 (3-4)-8 Students demonstrate an understanding of characteristics of the solar system by ...

8a recognizing that: the sun is the center of our solar system; the Earth is one of several planets that orbits the sun; and the moon orbits the Earth.

8b recognizing that it takes approximately 365 days for the Earth to orbit the sun.

ESS3 - The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time

No further targets for EK ESS3 at the K-4 Grade Span

The GSEs listed below are assessed at the local level only

ESS3 (3-4)-9 Students demonstrate understanding of processes and change over time within the system of the universe (Scale, Distances, Star Formation, Theories, Instrumentation) by...

9a recognizing that throughout history people have identified patterns of stars that we call constellations.

Clarifying the Standards

Prior Learning

In grades K–2, students observed patterns of change in the objects in the sky, including the day/night cycle. In third grade, students recognized that the rotation of the earth produces the day and night cycle. In addition, students in third grade began to learn about the sun, moon, and earth system, recognizing that the sun is the center of the solar system.

With regard to stars and constellations, students in grades K–2 observed that there is a vast number of stars unevenly scattered throughout the sky and that stars vary in brightness. Third-graders observed that the stars appear to move slowly across the sky.

Current Learning

Fourth-graders recognize that the earth rotates on its axis every 24 hours producing the day/night cycle, and that the sun is the center of our solar system. These concepts are taught at the reinforcement level of instruction.

Students also recognize that the earth is one of several planets that orbits the sun and that the moon orbits the earth. They recognize that it takes 365 days for the earth to orbit the sun, and that humans throughout history have identified patterns of stars that we call constellations. These concepts are new to fourth grade and are taught at a developmental level of instruction.

Future Learning

In the 5–6 grade span, students will identify and compare the size, location, distance, and movement of objects in the solar system. They will also compare the composition, atmosphere, and surface of objects in the solar system. Students will use models to describe the relative motion and position of the earth, sun, and moon, and they will recreate phases of the moon.

Additional Research Findings

According to *Making Sense of Secondary Science*, as children learn about the solar system and the universe, they naturally bring preconceived ideas about the size and shape of the earth. Children’s ideas progress from belief in a flat earth with a limited sky and an absolute view of down, to a spherical earth surrounded by sky with “down” directed toward the center of the planet. With regard to the cause of the day/night cycle, children’s thinking ranges from “covering” ideas (such as: *the sun goes behind hills*; *clouds cover the sun*; and *the moon covers the sun*), to orbital theories (such as: *the sun goes behind the earth once a day*; *the earth goes around the sun once a day*; and *the earth spins on its axis once a day*).

As children age and gain greater understanding of the sun/earth/moon system, thinking progresses from an earth-centered to a sun-centered solar system. However, even at an older age, children are much less certain of the moon’s position. Ideas about the shapes of the earth, sun, and moon appear to change with age. Younger children think these bodies are two-dimensional or non-spherical three-dimensional shapes, while older children think they’re spheres. There is also a lack of understanding about the relative sizes and distances between the earth, sun, and moon. These misconceptions may be compounded or caused by the models used in classrooms or by the diagrams in books, which do not use the true scale for size and distance (pp. 168–170).

When teaching and discussing the solar system, we must stress to students that the earth, not the sun, is moving. According to *Benchmarks for Science Literacy*, films, computer simulations, planetariums, and telescopic observations will help when teaching the earth’s relation to the sun, moon, and other planets. However, it is essential for all students to make physical models and explain what the models show. At the same time, students can begin learning about scale (comparative distances, times, sizes, etc.), keeping in mind that scale factors larger than thousands may be difficult before early adolescence (p. 67).

According to the *National Science Education Standards*, in order to develop an understanding of the relationships between the objects in the solar system, young students need to begin with direct observations of objects in the sky. By observing the day and night sky regularly, children in grades K–4 will learn to identify sequences of change and to look for patterns in these changes. As they observe changes, such as the movement of an object’s shadow during the course of a day, and the positions of the sun and the moon, they will find the patterns in these movements. These understandings should be confined to observations, descriptions, and finding patterns (pp. 130, 134). Because the sun, moon, and earth system can’t be observed directly, teachers must use carefully selected models. Students should

understand that certain models are used to help them understand the relationships and interactions between the sun, earth, and moon, and should also understand the limitations of the models used, to include scale (size and distance).

Notes About Resources and Materials

- *Houghton Mifflin Science, Discovery Works*—Grade 3, Unit B—Chapters 1, 2

Websites

- NASA Kids' Club
<www.science.nasa.gov/kids/kids-solar-system>
- Kids Astronomy
<www.kidsastronomy.com>
- How Stuff Works—Earth Has a Perfect Orbit
<<http://videos.howstuffworks.com/nasa/3570-earth-has-a-perfect-orbit-video.htm>>

Resource Books and Trade Books

- Branley, F. (1991). *The Big Dipper*. New York: Harper Collins.
- Cole, J. (1992). *Magic School Bus, Lost in the Solar System*. New York: Scholastic.
- Couper, H. (2000). *DK Space Encyclopedia*. New York: DK publishing.
- DK Publishing. (1993). *Eyewitness Visual Dictionary of the Universe*. New York: DK Publishing.
- Lauber, P. (1996). *Seeing Earth from Space*. New York: Scholastic.
- Sipiera, D. and Sipiera, P. (1997). *Constellations*. Danbury, CT. Children's Press.

Grade 4 Science, Quarter 3, Unit 3.3
Characteristics of Plants

Overview

Number of instructional days: 6 (1 day = 45 minutes)

Content to be learned

- Record and analyze observations and data about external features of plants.
- Sort and classify plants based on external features.
- Cite evidence to explain why plants are alike or not alike.
- Analyze the structures needed for survival of populations of plants in a particular habitat or environment.
- Observe changes, record data, and scientifically draw and label the stages in the life cycle of a familiar plant.
- Predict, sequence, and compare the life cycles of two plants when given a set of data or pictures.

Essential questions

- What kinds of structures help populations of plants survive in a habitat or environment?

Processes to be used

- Record and analyze observations and data.
 - Draw and label organisms scientifically.
 - Identify and describe the structures found in a system.
 - Describe the functions of the structures found in a system.
 - Observe and describe patterns of change within a system.
 - Use scientific processes, including making observations; citing evidence; comparing, collecting, and analyzing data; and drawing conclusions.
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- How do the life cycles of various plants compare?

Written Curriculum

Grade Span Expectations

LS1 - All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).

LS1 (K-4) - INQ+POC –1

Sort/classify different living things using similar and different characteristics. Describe why organisms belong to each group or cite evidence about how they are alike or not alike.

LS1 (3-4) –1 Students demonstrate an understanding of classification of organisms by ...

1c recording and analyzing observations/data about external features (e.g., within a grouping, which characteristics are the same and which are different).

LS1 (K-4) FAF –4

Identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire).

LS1 (3-4)–4 Students demonstrate understanding of structure and function-survival requirements by...

4b analyzing the structures needed for survival of populations of plants and animals in a particular habitat/environment (e.g. populations of desert plants ~~and animals~~ require structures that enable them to obtain/conserves/ retain water).

LS1 (K-4) POC –3

Predict, sequence or compare the life stages of organisms – plants and animals (e.g., put images of life stages of an organism in order, predict the next stage in sequence, compare two organisms).

LS1 (3-4)–3 Students demonstrate an understanding of reproduction by ...

3a observing changes and recording data to scientifically draw and label the stages in the life cycle of a familiar plant ~~and animal~~.

3c comparing the life cycles of 2 plants or 2 animals when given a set of data/pictures.

Clarifying the Standards

Prior Learning

In grades K–2, students made and recorded observations of the external features of plants and animals. They identified the functions of the physical structures of plants and identified what plants need to survive. Students also sequenced and labeled the life cycle of familiar plants.

In grade 3, students used prior knowledge to distinguish between living organisms and nonliving objects. Students identified, sorted, and compared characteristics of plants based on external features. They identified and explained how the physical structures/characteristics of organisms help them to survive and

defend themselves in their environment. They observed that plants need water, air, food, light, and space to grow and reproduce. Students compared the life cycle of two plants when given a set of data/pictures.

Current Learning

Students in fourth grade record and analyze observations and data about the external features of plants. They analyze the structures needed for survival of populations of plants in a particular habitat. They observe changes and record data to scientifically draw and label the stages in the life cycle of a familiar plant. These concepts are taught at the developmental level of instruction.

At the reinforcement level of instruction, students learn to identify and explain how the physical structures of plants allow them to survive and defend themselves. They also compare the life cycles of two plants when given a set of data or pictures.

Future Learning

In grade 5, students will use data and observations about the biodiversity of an ecosystem and will make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem by recognizing that organisms have different features and behaviors for meeting their needs to survive. They will continue to investigate a variety of plant life cycles.

Additional Research Findings

According to the *National Science Education Standards*, elementary children build understanding of biological concepts through direct experience with living things, their life cycles, and their habitats. Making sense of the way organisms live in their environments will develop some understanding of the diversity of life and how all living organisms depend on the living and nonliving environment for survival. Because the child's world at grades K–4 is closely associated with the home, school, and immediate environment, the study of organisms should include observations and interactions within the natural world. These experiences provide a concrete foundation for the progressive development in the later grades of major biological concepts, such as interdependence and the behavior of organisms (pp. 127–128).

As students investigate the life cycles of organisms, teachers might observe that young children do not understand the continuity of life from, for example, seed to seedling to adult. But by second grade, most students will know that children resemble their parents. Students can also differentiate between learned and inherited characteristics (*NSES*, p. 128).

Young children think concretely about individual organisms. The idea that organisms depend on their environment is not well developed in young children. In grades K–4, the focus should be on establishing the primary association of organisms with their environments and the secondary ideas of dependence on various aspects of the environment and of structures that help organisms survive (*NSES*, pp. 128–129).

According to *Benchmarks for Science Literacy*, by the end of second grade, students should know that plants have features that help them live in different environments. Students need opportunities to observe a variety of plants in many natural settings. Students should have reasons for their observations and those reasons should prompt them to do something with the information that they collect (p. 102).

In grades 3–5, students should have the opportunity to learn about an increasing variety of living organisms, both familiar and exotic, and should become more precise in identifying similarities and differences among them. Although the emphasis can still be on external features, this should be done with finer detail. Therefore, students should use hand-lenses routinely. As students become increasingly

familiar with the characteristics of more and more organisms, they should be asked to invent schemes for classifying them. Hopefully, their classification schemes will vary according to their uses as well as gross anatomy, behavior patterns, habitats, and other features. The aim is to move students toward the realization that there are many ways to classify things, but the measure of classification depends on its usefulness (*Benchmarks for Science Literacy*, p. 103).

It is not difficult for students to grasp the general notion that species depend on one another and on the environment for survival. But their awareness must be supported by knowledge of the kinds of relationships that exist among organisms, the kinds of physical conditions with which organisms must cope, the kinds of environments created by the interaction of organisms with one another and their physical surroundings, and the complexity of such systems. Students should become acquainted with many different examples of ecosystems, starting with those near at hand (*Benchmarks*, p. 115).

Notes About Resources and Materials

Textbook

Houghton Mifflin Science, Discovery Works—Grade 4

- Unit C—Classifying Living Things, Ch.1
- Investigation 4, pp. C34–C38

Websites

- www.kidskonnnect.com
- www.sciencekid.co.nz/gamesactivities/lifecycles.html
- www.worksheetplace.com
- www.enchantedlearning.com
- www.teachersdomain.org
- www.naturefootage.com

Resource Books and Trade Books

- Guiberson, B. (1993). *Cactus Hotel*. New York: Henry Holt & Co.
- Hewitt, S. (2007). *Amazing Plants*. New York: Crabtree Publishing.
- Sherman, J. (2004). *Sunshine: A Book About Sunlight*. Mankato, MN: Picture Window Books.
- Yolen, J. (1997). *Welcome to the Greenhouse*. New York: Putnam Juvenile.

Videos

- Eyewitness Video: Plants
- Magic School Bus: Goes to Seed