Grade 3 Science, Quarter 1, Unit 1.1

Force and Motion

Overview

Number of instructional days: 8 (1 day = 45 minutes)

Content to be learned

- 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).
- Predict whether or not an object will be attracted to a magnet, using prior knowledge and investigations.
- Describe what happens when like and opposite poles of a magnet are placed near each other.
- Explore the relative strength of magnets (e.g., size of magnets, number of magnets, properties of materials).

Science processes to be integrated

- Make predictions based on given examples and prior knowledge.
- Experiment and observe how forces interact with objects within systems.
- Collect and use experimental data to classify materials and draw conclusions.
- Describe the effect of force on objects.
- Explore how changes to a system affect the interactions between forces and objects.

Essential questions

- How do magnets interact with various objects?
- What effects can be observed when like or opposite poles of magnets are placed near each other?
- How does the size or number of magnets affect the strength of the magnetic force?

Written Curriculum

Grade-Span Expectations

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

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 …

8a using prior knowledge and investigating to predict whether or not an object will be attracted to a magnet.

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

In grades K-2, students demonstrated an understanding of motion by showing how pushing and pulling moves or does not move an object, and they predicted the direction an object will or will not move if a force is applied to it. Students showed that different objects fall to earth unless something is holding them up, and they exhibited an understanding of magnetic force by observing and sorting objects that are and are not attracted to magnets.

Current Learning

In grade 3, force and motion focuses on magnets and the force of magnetism. At the reinforcement level of instruction, students use observations of magnets in relation to other objects to describe the properties of magnetism. Students use prior knowledge and investigations to predict whether or not an object will be attracted to a magnet.

At the developmental level of instruction, students explore the relative strength of magnets. They should have opportunities to observe and describe the effect of different sizes and quantities of magnets on various objects. Students describe what happens with like and opposite poles of magnets when placed near each other. When observing how magnets interact with one another, students should discover that like poles attract, while opposite poles repel.

It is important to note that all the concepts in this unit of study must be to be taught through the drill and practice level of instruction because they are not revisited in fourth grade.

In this unit, students should also understand that magnetism is both a force and a physical property. Magnets exert a force that can attract or repel certain objects from a distance, and objects that contain iron are attracted to magnets, or are magnetic, which is a physical property. Students can use magnets to sort

and classify objects, and then record their observations and data in a graphic organizer, such as a T-chart or Venn diagram. After discussing findings, students can make predictions about other objects that will or will not be attracted to a magnet. Students can explore and change the strength of a magnetic force by changing the size of the magnet or the number of magnets. Students can also describe the effects of magnets on one other by conducting experiments in which they place like and opposite poles near each other and draw diagrams of their results.

Future Learning

In grade 4, students will predict the direction and describe the motion of objects of different weights, shapes, and sizes if a force is applied to it. They will describe changes in position relative to other objects and background, and will describe or show that heat can be produced by friction. Students will investigate and describe that different amounts of force can change direction/speed of an object in motion, and will conduct experiments to demonstrate that different objects fall to earth unless something is holding them up.

In grades 5–6, students will recognize that a force is a push or pull, and will use data or graphs to compare the relative speed of objects. They will explain that changes in speed or direction of motion are caused by forces. Students will show that electric currents and magnets can exert a force on each other, and they will investigate how vibrations in materials set up wavelike disturbances that spread away from the source.

Additional Findings

Relatively little research has been published in relation to children's ideas about magnetism, although some studies of ideas about gravity have touched upon it. Researchers studying ideas about gravity have found that students are inclined to link magnetism with gravity. They sometimes account for gravity in terms of a magnetic force drawing objects towards the earth. Conversely, students have been found to account for the way magnets act by calling magnetism "a type of gravity." Students generally have some background knowledge of what magnets do, such as picking up nails or pins and sticking notices to refrigerators. Before teaching, most students offered no explanation of magnetism. After teaching, references were made to a type of gravity and energies, but very few students appeared to have the idea of poles, although some were able to respond accurately when tested on attraction and repulsion of poles. However, students tended to think of poles only at the ends of magnets, and researchers suggest that students should be encouraged to focus on the magnetic force and find the part of the magnet were attraction and repulsion are strongest. Educators should also keep in mind that children often think that all metals, rather than certain metals, are attracted to magnets. Therefore, teaching approaches which draw on everyday experience and focus upon the uses of magnets is advisable. (*Making Sense of Secondary Science,* pp. 126–127).

Elementary school students are usually aware of the behavior of magnets but may not explain the behavior in terms of forces. They may think of a magnet sticking to or moving towards another magnet but may not recognize this as the effect of a pull or force. In addition, students of all ages may think of gravity and magnetism interchangeably. They may refer to magnetism as a "type of gravity," but they may also explain gravity in terms of the earth acting like a magnet on objects (*Atlas of Science Literacy,* Vol. 2*,* p. 26). Prior to third grade, students should know the way to change how something is moving is to give it a push or a pull, and that magnets can be used to make some things move without being touched. In grades 3–5, students should learn that magnets exert forces on objects without touching them. They pull on things made of iron and either push or pull on other magnets (*Atlas of Science Literacy*, Vol. 2, p. 27).

In grades 3–5, the main notion to convey is that forces can act at a distance. Students should also carry out investigations to become familiar with the pushes and pulls of magnets. By the end of 5th grade, students should know that without touching them, a magnet pulls on all things made of iron, and either pushes or pulls on other magnets (*Benchmarks for Science Literacy*, p. 94).

Grade 3 Science, Quarter 1, Unit 1.2

Sound Energy

Overview

Number of instructional days: 12 (1 day = 45 minutes)

Content to be learned

- Experiment to identify and classify different pitches and volumes of sounds produced by different objects.
- Use data to explain what causes sound to have different pitch or volume.
- Use experimental data to classify a variety of materials as conductors or insulators.
- Given a specific example or illustration, predict the observable effects of sound energy.

Science processes to be integrated

- Conduct experiments in order to identify and classify observed events.
- Make observations and collect data in order to explain changes that occur.
- Make predictions about the interactions between energy and objects.
- Observe and describe changes caused by the interaction between objects and energy.

Essential questions

- What is the difference between pitch and volume?
- How can sound be changed in volume and pitch?
- What is the difference between a conductor and an insulator in relation to sound?
- Given an example (such as loud thunder or an action movie), what would you predict the effects would be on the *objects* around you?

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 -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…

4a experimenting to identify and classify different pitches and volumes of sounds produced by different objects.

4b using data to explain what causes sound to have different pitch or volume

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

Clarifying the Standards

Prior Learning

In grades K–2, students experimented and described how vibrating objects make sound. For example, students may have observed vibrating guitar strings and salt bouncing on a drum.

Current Learning

In grade 3, students conduct experiments in order to identify and classify different pitches and volumes of sound produced by a variety of objects, and they collect and use data to explain what causes sound to have different pitches or volumes. *Conductor* and *insulator* are new terms for students in grade 3 as they learn to use experimental data to classify a variety of materials into these two categories. All concepts should be taught at the developmental through the drill-and-practice level of instruction, because sound concepts will not be addressed again in fourth grade.

In the classroom, students should experiment with a variety of materials to learn that sound travels through all types of matter. Through this process, students observe that some materials are more effective conductors of sound energy, while other materials are better insulators of sound. In addition, students should have opportunities to apply their knowledge of sound by predicting the effects of sound energy on various objects, when given a specific example or illustration. Some examples include the vibration of theater seats during a loud action movie, or a house shaking during a thunderstorm.

In this unit, students can also use a variety of objects, such as nails, rulers, palm pipes, and boom-whackers, to create sounds of various volumes and pitches. Students can investigate and observe how different forces create different volumes, such as tapping an object like a tuning fork with varying amount of force. Students should also record data, including drawing and labeling diagrams, to identify how the size and shape of an object affects the pitch. Students will sort and classify a variety of objects as

conductors or insulators of sound by tapping items, such as a nail, on a variety of objects, such as a piece of foam. As a culminating activity, students should be able to design an instrument that can change its volume and pitch, and explain how it works. (This website is a valuable resource: www.smm.org/sound/nocss/activity/handson.htm.)

Future Learning

In grade 4, sound energy is not addressed.

In grades 5–6, students will demonstrate an understanding of energy by describing sound as the transfer of energy through various materials. Students will differentiate among the properties of various forms of energy, including sound, and will explain how energy may be stored in different ways.

Additional Findings

Energy is a mysterious concept, even though its various forms can be precisely defined and measured. At its simplest level, children can think of energy as something needed to make things go, run, or happen. 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. Although learning about energy does not make it much less mysterious, it is worth trying to understand because a wide variety of scientific explanations are difficult to follow without some knowledge of the concept of energy. Therefore, 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 (*Benchmarks for Science Literacy*, pp. 81, 83).

Forms of energy can be described in different ways. For example, sound energy is chiefly the regular back and forth motion of molecules, caused by the vibration, or back and forth motion, of an object (*Science for All Americans,* p. 50). Even though students may have previously learned that vibrations produce sounds, research shows that this concept is difficult for students to understand when the vibrations are not obviously visible (*Making Sense of Secondary Science*, p. 134). Many opportunities for students to experiment with various materials are needed to solidify this concept. Even though there has been little research on the subject of students' misconceptions about pitch and loudness, studies have suggested that students may be confused about the speed and size of vibrations: bigger vibrations were thought to be slower than small vibrations and consequently difficulties arose in discussing pitch and volume (*Making Sense*, p. 136). Therefore, many classroom discussions and investigations focusing on these differences would be beneficial to students' understanding. The use of rulers, rubber bands, guitar strings, and various sizes of drums might help to make this 'visible' to students.