UNIT OVERVIEW

The world around us is in motion, full of living and nonliving things that move in ways that can be predicted and described. The Things Move unit addresses how forces affect objects at rest and in motion. It gives examples of types of forces, and it describes the movement of objects, including what can slow them, stop them, and change their direction. The unit also introduces friction and gravity, and their effects on moving objects. Everyday examples are used to help students understand the concepts.

Certain reading resources are provided at three reading levels within the unit to support differentiated instruction. Other resources are provided as a set, with different titles offered at each reading level. Dots on student resources indicate the reading level as follows:

- low reading level
- middle reading level
- high reading level

THE BIG IDEA

Knowing how and why things move is important because so much of everyday life depends on motion. We have to judge the amount of force to use when causing things to move, stop, or change direction. We are able to make those decisions because we learn how things move when forces act upon them. If the motion of objects were random or not easily predicted, we would be living in an unsafe and chaotic world. But we do know how forces affect objects. If we push something, it moves away from us. If we pull it, it moves toward us. If we apply force to a moving object, it will change direction and move in the opposite direction from the force. Knowing how things move allows us to work, play, get around, and complete everyday tasks.

Other topics

This unit also addresses topics such as: amusement park rides, swings operating like pendulums, and vehicles that move people.

SPARK

The spark is designed to get students thinking about the unit's topics and to generate curiosity and discussion.

Materials

- a small, soft ball
- a thin book or notebook
- books or other items to make an 8-centimeter (3 in.) support for a ramp

Activity

Set a ball on a table. Invite student volunteers to try moving the ball by just looking at it. Ask them why they couldn't move the ball and ask what they could do to make it move. Then allow volunteers to demonstrate several ways they can make the ball move (for example, pushing the ball, tapping the ball with another object, blowing on the ball, tilting the table).

Place students in pairs and give them a soft ball. Tell them that they are going to experiment with motion by observing how things move. Let students work at a large table or on the floor, but require that the ball stay on the table or in their area and tell them not to make it move too fast. Have them try moving the ball in each of the following ways and ask them to observe what happens:

1. Have students slowly roll the ball back and forth to each other. Partners should use their hands to stop it from rolling. Students may vary how hard they push the ball—within limits—and observe the results.
2. While the ball is rolling, have students gently bump one of its sides and observe what happens.
3. Have students use their hands as barriers to stop the rolling ball.
4. Invite students to set up a simple ramp by stacking books to a height of about 8 centimeters (3 in.). They should set one edge of a thin book or notebook on top of the stack and place the opposite edge on the table or floor. Have students release the ball at the top of the ramp and observe its motion.
5. Have students drop their ball from different heights and observe its motion.

Below are questions to spark discussion.

What made the ball move, and what made it stop?

What happened when you pushed the ball harder?

What happened when you bumped the side of a moving ball?

What happened to the ball when it ran into something?

Why did the ball roll down the ramp?

Why did the ball move toward the ground when you let it go?

Use this activity to begin an introductory discussion about how things move. Explain that things do not move on their own; something is always needed to make them move. And no matter what is moving, it will always move according to certain rules. Students will learn that the movement of things can be described and even predicted. Throughout the unit, students will learn more about how things move.

Many of the unit's vocabulary terms are related to the spark activity and can be introduced during the spark. For vocabulary work, see the Vocabulary section in this *Unit Guide*.

PRIOR KNOWLEDGE

Ask students to list some things that move and briefly describe how they move. What do students think causes each of these things to move?

Probing Questions to Think About

Use the following questions to have students begin thinking of what they know about how things move.

- How would you describe something that isn't moving?
- What are some words you might use to describe how something is moving?
- What are some things that can make objects move?
- What are some things you can move, and what are some things you can't move? What makes them different?
- How do different living things move?
- How might you describe someone or something that wins a race?
- Why does a bowling ball move down a bowling lane? What happens when it hits the pins? Why?
- What might cause a moving object to slow down or stop?
- Why doesn't a ball keep rolling forever once you kick it?
- What makes something you drop fall to the ground?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

Each unit provides a wide variety of resources related to the unit topic. Students may read books and other passages, work in groups to complete hands-on experiments and investigations, discuss science ideas as a class, watch videos, complete writing tasks, and take assessments.

Resources are available for printing or projecting, and many student resources are also available for students to access digitally on Kids A–Z.

Selected unit resources are available in more than one language.

For a complete list of materials provided with the unit, see the Things Move unit page on the Science A–Z website.

VOCABULARY

Use the terms below for vocabulary development throughout the unit. They can be found in boldface in the *Nonfiction Book*, the *Quick Reads*, and/or other unit resources. These terms and definitions are available on *Vocabulary Cards* for student practice. Additional vocabulary lists are provided in the teaching tips for *Investigation Packs* and *FOCUS Books*.

Core Science Terms

These terms are crucial to understanding the unit.

direction	the place toward which something is moving or facing
energy	the power to do work, make a change, or move objects
force	the strength or energy that moves an object
friction	the force that builds up when two objects rub against each other
gravity	the force that pulls things toward the center of Earth
motion	the act of going from one place to another
move	to go from one place to another
speed	how fast something is moving
weight	how heavy something is

Other Key Science Terms

The following vocabulary is not essential for comprehending the unit but may enrich students' vocabulary.

distance	the amount of space between things or places
fast	moving in a quick or speedy way
heavy	having a lot of weight
launch	to use force to start something moving
light	having only a little weight
mass	how much of something there is, measured by its weight
motor	a machine that turns electricity into motion
pendulum	a weight that hangs from a nonmoving point and swings from side to side
pull	to use force to move something closer
push	to use force to move something away
rest	a pause when no force is moving an object
roll	to move by turning over and over
slow	moving without very much speed
spin	to move in circles
swing	a seat hanging from ropes or chains that moves back and forth in a curved path

Vocabulary Activities

You may choose to introduce all the terms that will be encountered in the unit before assigning any of the reading components. *Vocabulary Cards* with the key science terms and definitions are provided. Dots on the cards indicate the reading levels of the *Nonfiction Book* or the *Quick Reads* in which each term can be found. If all level dots appear, the term may come from another resource in the unit. Students can use these cards to review and practice the terms in small groups or pairs. The cards can also be used for center activity games such as Concentration.

The *Word Work* activity sheets offer fun puzzles and practice with key vocabulary terms from the unit. For further vocabulary practice and reinforcement, you can choose from the vocabulary *Graphic Organizers*. To build customized vocabulary lessons with terms related to the topic, see Vocabulary A-Z.

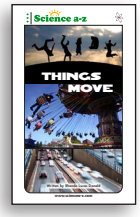
Students can use the *Word Smart* vocabulary *Graphic Organizer* to organize information on the science terms. You may want to assign each student one to three words to share his or her *Word Smart* knowledge with classmates. Students who have the same word should first compare their *Word Smart* sheets with each other and then report to the larger group.

The science terms can be used in oral practice. Have students use each term in a spoken sentence.

As students read, encourage them to create a science dictionary by recording new vocabulary terms and definitions in their *SAZ Journal*.

BACKGROUND AND MISCONCEPTIONS

Use this section as a resource for more background knowledge on unit content and to clarify the content for students if misconceptions arise. Refer to Using the Internet below for more ways to extend the learning.



Q: *I've heard that there are laws of motion? Am I in danger of breaking those laws?*

A: The laws in question are not the kinds of laws made and enforced by governments. Students at this age may not need to know Sir Isaac Newton's three laws of motion as such, and they are not introduced in this unit, but the principles in these laws are fundamental to a study of motion:

1. An object at rest remains at rest unless a force acts on it. Likewise, an object in motion remains in motion unless a force acts on it (inertia).
2. An object's momentum is directly proportional to the force applied to it. (The greater the force, the greater an object's momentum will be.)
3. For every action, there is an equal and opposite reaction. (This law is illustrated in the blastoff of a rocket. As the rocket pushes exhaust away from its engines, the exhaust pushes back toward the rocket, lifting it.)

Q: *Are objects at rest because no forces are acting on them?*

A: No. Even an object at rest is affected by gravity. A chair stays at rest because the forces acting on it are balanced. Gravity pulls it toward the ground, but the ground also exerts an upward force on the chair, preventing it from moving. This is because of Newton's third law (see above). It may be challenging for students to understand that even a stationary object such as a wall applies force to an object pushing against it, such as a person leaning against the wall. But if the wall did not "push back" against the person, he or she would fall right through it!

Q: *In the book, it says that once something is moving, it keeps moving until a force stops it. But moving things stop all the time without people doing anything to make them stop. What makes a moving object stop if nothing touches it?*

A: While students may not be able to see them, forces are at work on everything that moves. Friction between a moving object and the air helps slow the object. There is friction between objects and the surfaces they move across, too, even if the surface seems smooth. So a marble rolling across a floor will eventually stop because the forces of gravity and friction will slow it down. Additionally, gravity is always pulling objects toward Earth, affecting the forward motion of objects parallel to the ground. Finally, when the energy source causing something to move is removed—such as the force of the wind that had been carrying dandelion seeds diminishing or the force of pedaling a bike being stopped—the forward motion will succumb to the other forces acting on the object, including gravity and friction.

Q: *Is it true that only living things can apply a force to something?*

A: No. While it may be easier to notice when a person or other animal applies a force to an object, nonliving things such as water, air, and land all apply forces to objects as well. For example, while we may say that a captain is piloting a boat, he or she is not actually propelling the vessel across the water. Sails may capture the force of the wind as a sailboat crosses a bay, rushing river water may push a raft through a descending canyon, or fuel burning in an engine may power a large ship across the sea. These movements are not directly caused by a living thing expending energy to move the boats.

Q: *Do objects move because <u>they</u> have force?*

A: No. Students may think force is a property of an object. They may think that the object stops moving when the force inside it "wears off" or "runs out." But forces act upon objects; they are not parts of those objects.

Q: *Is there anything that is truly not moving at all?*

A: In practical terms, yes, plenty of things are motionless in our world. While a bird may fly past a window, the window itself is at rest relative to our position. But all things on Earth—even the mountains, buildings, parked cars, and biggest boulders—are in motion all the time as Earth rotates on its axis, revolves around the Sun, and speeds through space. In a simpler model, while sitting in a moving car, the window does not appear to move compared to our position. Yet we know that the window is part of a moving car, so it is in motion after all. Additionally, there is motion on a very small scale deep within every common object—even a hard glass window—as particles move within atoms. But for the age group targeted by this unit, the practical answer is that many objects are indeed not moving at all.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when you type in the term *force* or *motion.* You may wish to add your students' grade level or examples of things that move to the searchable keywords. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- Why do things move?
- How fast does a(n) _____ move?
- What makes things stop?
- Isaac Newton's laws of motion
- friction
- speed/velocity
- gravity
- magnetism

Projects and Activities

- **Project:** Ask one student at a time to cross an open space by moving in an interesting way (for example, sidestepping, crawling backward, or spinning). Challenge each subsequent student to cross the same space without using the style of movement used by any prior students.
- **Arts:** Ask students to work in pairs to create a dance that shows the ways that various objects behave when at rest and while in motion. Invite students to perform their dance for the class.
- **Arts:** Students can make paintings using various moving objects. For example, they can dip marbles or small balls into paint and roll them across a large piece of paper to create designs. They can dip other items in paint and drop them onto the paper. They might even hold a paintbrush still and move the paper below it. Encourage students to experiment with different types of moving objects and see how many kinds of motion they can capture.

- **Inquiry Science:** Encourage students to ask their own questions about motion and design their own experiments to investigate the answers. For example, students might explore ways to make a toy car go faster, find out how a car's shape and weight affect its speed, or learn about the body parts of their favorite animals that allow them to move the way they do.
- **Home Connection:** Invite students to play a game with their family members in which everyone tries to remain motionless (at rest) for as long as possible. How long can they hold out? Discuss why it's so hard to stay still. Talk about how motion is found nearly everywhere. Ask students to share their experiences with the group.
- **Field Trip:** Let students observe motion by going to a park, playground, or natural area. How many different examples of motion can students see? Have them record notes and sketches in a science journal.
- **Guest:** Invite a physicist or a physics teacher from a high school or local college to your classroom to conduct age-appropriate demonstrations dealing with forces and motion, and to answer students' questions.
- **Math:** Help students create a simple graph that compares how fast something like a ball or toy car moves in relation to how hard it is pushed. Graphing the results will be somewhat subjective, as the amount of force applied is difficult to quantify, but students should be able to conclude that the harder something is pushed, the faster and farther it will go.
- **Literature:** *Forces Make Things Move* by Kimberly Brubaker Bradley and *Gravity Is a Mystery* by Franklyn M. Branley are suitable books for young readers. *A Crash Course in Forces and Motion with Max Axiom, Super Scientist* by Emily Sohn explores this topic in the form of a graphic novel. It is geared toward older children but may be a good choice to read aloud to the class.
- **Research/Home Connection:** Students can conduct research as a family/home project or in the library/media center to extend the learning about a topic in one of the *Quick Reads* or other unit resources.