UNIT OVERVIEW

Whenever we use force to move something, we are doing work. Pushing, pulling, lifting, turning, and twisting are all examples of work. The Doing Work unit helps students explore the concepts of work and force. Students will learn that the amount of work required to move an object depends on the amount of force needed to move it as well as the distance the object will be moved. This unit also explains how machines help make work faster and easier. Machines may be simple or complex, but each machine is well suited to help us perform certain tasks.

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

Work is happening all the time. Whenever something moves, a force is required to move it. We are able to move things by only using our bodies, but using machines makes work easier and faster. Machines allow us to do work with less effort or in less time. Machines can also relieve us of repetitive tasks and can make certain types of work safer. Advances in civilization have gone hand in hand with advances in how people get work done. For example, farming has changed greatly throughout history as cultures have developed more efficient ways to do work. Civilizations progressed from building small structures with hand tools to building pyramids and skyscrapers with machines. Doing work is an integral part of our existence.

Other topics

This unit also addresses topics such as: machines that move people, robots, and finding the best tool to perform a task.

SPARK

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

Materials

- three objects of different weights: one very light, one heavy, one in between (such as a crumpled paper, a heavy book, and a coin)
- a toy car or other small rolling toy

Activity

Place students in small groups and distribute materials to each group. Their job is to move the objects and make observations about what it's like to move them.

Before students begin their work, ask them to make the following predictions:

- Which object will be easiest to move?
- Which object will be hardest to move?
- Which object is heaviest?
- Which object is lightest?
- How far can you make each object move with just one finger?

Allow students to lift the objects and compare their weights. They should also push and pull the objects back and forth along the ground using just the flick or push of one finger. Make sure each student has the opportunity to try lifting and moving all four objects. Then ask students to reflect on their predictions and the results.

Below are questions to spark discussion.

Why was it easier to lift or push some of the objects?

What made the objects move?

What is needed to move a heavy object?

Did it take as much effort to move the (rolling toy) as another object of similar weight? Why or why not?

Why did some objects move farther than others when you pushed them?

Use this activity to begin an introductory discussion about doing work. Explain that what students did was work. Also explain that the wheels on the rolling toy are simple machines that help make work easier or faster. Throughout the unit, students will learn more about machines and doing work.

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

Invite students to explain their understanding of what it means to do work. Ask them to give some examples of things they consider to be work.

Probing Questions to Think About

Use the following questions to have students begin thinking of what they know about doing work.

- What does it mean to *do work?*
- What has to happen for work to take place?
- Who are some people you know who do work?
- Is thinking about a math problem an example of doing work?
- What is needed in order to move something?
- What are some ways things can be moved?
- Does it take more work to move something heavy or something light?
- Does it take more work to move something a short way or a long way?
- What are some things that can help us do work?
- How can a hammer help you do work? A shovel? A wagon? A ramp?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

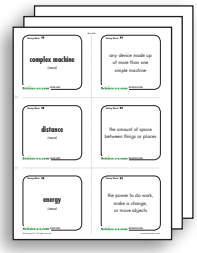
Each unit provides a wide variety of resources related to the unit topic. Students may read books and other passages, work in groups to complete hands-on experiments and investigations, discuss science ideas as a class, watch videos, complete writing tasks, and take assessments.

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 Doing Work 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.

complex machine	any device made up of more than one simple machine
force	the strength or energy that moves an object
lift	to raise to a higher position

machine	any device that uses energy to help a person do work
move	to change the place or position of something
pull	to use force to move something closer
push	to use force to move something away
simple machine	any basic device that works with the use of a single force
turn	to move something in a circle or change its direction
twist	to move something in a bending, curling, or crooked direction
work	the act of moving something

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
energy	the power to do work, make a change, or move objects
fast	moving in a quick or speedy way
heavy	having a lot of weight
light	having only a little weight
motion	the act of going from one place to another
motor	a machine that turns electricity into motion
pedal	to move one's feet to make a bicycle go
robot	a machine that performs tasks for people on its own
slowly	moving without very much speed
strength	physical power
task	a piece of work that needs to be done
tool	any object that makes a job or task easier
wheel	a round object that turns around a center

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: *Is work something you get paid to do?*

A: It can be, but that is not how scientists define work. People call their jobs—what they get paid to do—work. But what they get paid to do may not fit the scientific meaning of *work.* If someone's job involves moving things, it is work in a scientific sense. Someone who digs ditches is doing work because he is moving dirt from one place to another. A surgeon does work by using medical tools to cut or stitch. But someone who thinks about a problem to try and solve it isn't doing work in a scientific sense because nothing is being moved. If that person writes a report or enters data into a computer, he or she does work by moving a pencil across a page or by pushing keys on a keyboard.

Q: *Is work always something that makes you tired or is hard to do?*

A: Work can be tiring or hard to do, but it doesn't have to be difficult to be considered work. Since moving a full bookcase takes a lot of force, you can get tired from moving it. But some work takes very little force. Turning the pages of a book is work, but it's not tiring and is usually not difficult to do.

Q: *Is work something people don't like to do?*

A: Because people refer to their jobs as "work," and because some people dislike their jobs, students may think that work is always unpleasant. But kicking or hitting a ball, pushing a scooter, and swimming are also examples of work, and these activities are fun. Even eating an ice cream cone takes work!

Q: *You use force when you push on something heavy, but it doesn't move. Why isn't that work?*

A: In order for work to take place, it's true that a force must be used, but by definition, something also has to move. No matter how much force you use, if it doesn't move, it isn't work.

Q: *Are all machines made of metal? Do they all run on electricity?*

A: The image some children have of a machine may be a piece of factory equipment or a large appliance, such as a washer/dryer or dishwasher. But machines take many forms, are made of many different materials, and are powered by a variety of forces. You might invite students to compare the properties of machines shown in photographs and illustrations throughout this unit.

Q: *Do machines take away the work people put into moving something?*

A: No. Machines *change* the form of work people put into moving something. Imagine that you need to move a box of books from the ground to a porch four feet off the ground. Carrying the box up a ramp takes less force than jumping four feet high! But you will carry the box farther than if you were able to jump straight up. The ramp reduces the force needed but increases the distance. Another example is a screw. The turning force applied to the screw is changed into a forward motion that sinks the screw into wood.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when you search for the term *work* or *machine.* Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- force, motion, and energy for kids
- complex (or compound) machines
- How does an elevator work?
- inclined plane, lever, pulley, screw, wedge, wheel and axle, or gear
- definition of work
- What is force?
- simple machines
- wheelbarrow diagram

Projects and Activities

- **Project:** Hold a machine scavenger hunt in the classroom. Ask students to form teams and find examples of simple and complex machines.
- **Project:** Play a version of Simon Says related to doing work. Students should only do what Simon says if asked to do actual work. For example, if Simon says, "Lift your pencil," players should do so. But if Simon says, "Think of your favorite color," players shouldn't comply because they aren't moving anything and thus are not doing work.
- **Arts:** Challenge students to invent a machine. Have them think about what they want the invention to do (for example, automatically give the dog water or squeeze toothpaste) and how it will work. They can draw a design of the invention or even make a working model.
- **Math:** Use a force meter to compare the amount of force used when students pull on the spring. Ask two students to pull on the spring and note the readings. Which student pulled with more force? Students may not understand the meaning of the unit of measure (newton), but they can still compare the numbers to understand whether a pull required more or less force.
- **Social Studies:** Find pictures of machines that have a related function from several different time periods. Challenge students to sort them from oldest to most modern. For example: horse and cart, steam train, modern shipping truck; Wright Flyer, propeller plane, modern jet; needle and thread, antique sewing machine, modern sewing machine.
- **Field Trip:** Go to a playground and see how many types of work students can spot in action. Remind them to look for any activity that involves pulling, pushing, lifting, turning, or twisting. Are there examples of any simple or complex machines? Examples may include slides or ramps (inclined planes); seesaws (levers); a flagpole pulley; screws that hold the equipment together; a sand shovel (wedge); and skateboards, scooters, or bikes (wheel and axle).
- **Guest:** Invite someone who works with machines every day to come to your class to talk about the machines they use and what each one does. Construction workers, factory workers, plumbers, and farmers are just a few options.
- **Literature:** *Machines We Use* by Sally Hewitt, *Machines at Work* by Byron Barton, *Move It! Work It! A Song About Simple Machines* by Laura Purdie Salas, and *Simple Machines* by Allan Fowler are all appropriate for early readers or to be read aloud.
- **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.