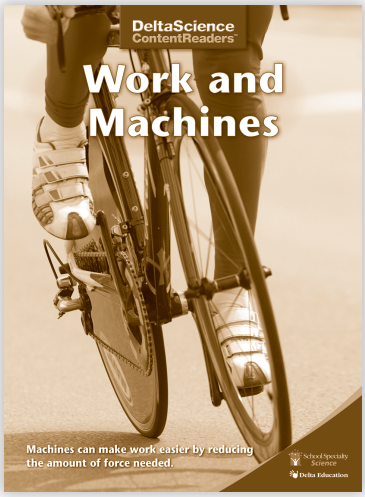


Red Edition
Grade 3–4
reading level

Purple Edition
Grade 4–5
reading level

Objectives

- Define the science meaning of *work*.
- Understand how work relates to force and energy.
- Explain how machines change force.
- Compare input force and output force.
- Explain how friction affects machines.
- List the six types of simple machines—inclined plane, wedge, screw, lever, wheel and axle, pulley.
- Explore how simple machines change force.
- Describe what a compound machine is.

Reading Comprehension Skills

Preview the Book ◆ Cause and Effect
How to Read Diagrams ◆ Main Idea and Details

Skillbuilders are available for this title.

Supporting English Learners

Activate Prior Knowledge Enhance English Learners' ability to organize what they already know about work and machines. Tie new information to students' own experiences, and then relate it to the science concepts in each section. Make explicit connections to new learning and concepts covered in previous sections.

Summary

What is work? The Delta Science Content Reader *Work and Machines* begins by defining what *work* means in science. Students learn how work is related to force and energy. Then they move on to a discussion of machines, exploring input force, output force, and friction. Next, students learn about the six types of simple machines and how they make work easier. The book concludes with a discussion of how simple machines can be combined into compound machines.

Science Background

Work *Work* has a different meaning in science from its meaning in everyday life. In science, work is done when a force moves an object over a distance. A force is a push or a pull on an object.

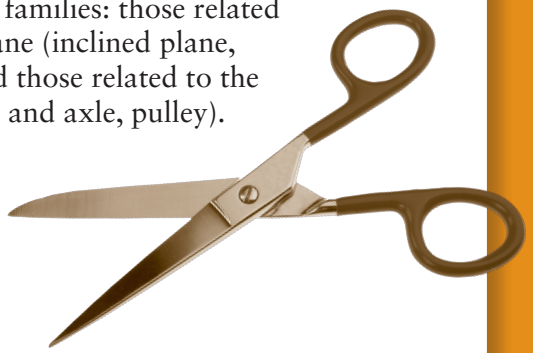
Anything that does work uses energy. Energy is the ability to cause change. Energy is used when force is applied to an object to change its position.

Changes in the speed or direction of motion are caused by forces. The greater the net force, the greater the change in motion. The net force is the force that results from all the combined forces acting on an object.

Machines A machine is a device that helps us to do work. Machines can help us move things more easily, farther, or more quickly.

Machines do not have to be complicated. A tractor is a machine, but so are a fork, a toothbrush, and scissors. Some machines need electricity or fuel to operate. Others only need the force provided by a human being or an animal.

Simple machines are machines with few or no moving parts. Simple machines can be grouped into two families: those related to the inclined plane (inclined plane, wedge, screw) and those related to the lever (lever, wheel and axle, pulley).



What Is Work? (pages 2–5)

Before Reading

Discuss the Cover

Cover Image Discuss the photograph on the cover of *Work and Machines*. Use the information on the inside front cover to support the discussion.

Science Statement Discuss the science statement. Ask: *What machines can you name? How do you think those machines reduce the amount of force needed to do work?*

Build Reading Skills (page 2)

Preview the Book Use Build Reading Skills on page 2 to review how to preview the book. Discuss the steps. Then model previewing the Table of Contents.

> **Think Aloud** *The Table of Contents shows what is in the book. It looks as if there are four major sections and a glossary. By reading the red headings, I see I am going to read about what work is, how machines help us do work, and two different types of machines: simple machines and compound machines.*

Guide students as they finish previewing *Work and Machines*. Focus on nonfiction text features.

- Prompt them to look at the headings, photographs, captions, and diagrams. Ask questions such as *Why do you think that feature is there? How will it help you understand what you read?*
- Prompt them to look at the bold Vocabulary words. Guide the class in looking up a Vocabulary word in the Glossary.

Students can apply the skill in the Reflect on Reading activity on page 5.

K-W-L Chart Have students begin a K-W-L chart. They should add to it after each section.

What I Know	What I Want to Learn	What I Learned
There are many kinds of machines.	What exactly is a machine?	

Make a Connection (page 3)

Make a Connection Discuss the Make a Connection questions. Use this discussion to build background and activate prior knowledge about work. (Possible answer: Both the people and the water are doing work. The people have paddles they are using to push and steer the boat. There are a lot of waves, so the raft is also being moved a lot by the moving water.)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary word aloud. Explain to students that they will see this word in bold in this section. Start a word web on the board with *Work* in the center. Have students add to it as they read.

During Reading

Work, Force, and Energy (page 4)

- Ask: *What do you need to do work?* (force and motion)
- Ask: *Is pushing on a wall work? Explain.* (No, because the wall does not move.)
- Remind students that energy means the ability to cause change. Ask: *What changes when you do work?* (an object changes position)
- Point out the photograph on page 5 of the woman pushing a shopping cart. Ask: *Is this woman using kinetic energy to push the cart? Why or why not?* (Yes, because she is moving.)

✔ **Checkpoint** (the amount of force used and how far the object moved)

After Reading

Reflect on Reading (page 5) Remind students to read the captions when they look at the pictures. Captions explain what is happening in the pictures and also relate the pictures to the text.

Apply Science Concepts (page 5) This activity applies a concept from Find Out About on page 3. Help students plan their paragraphs. Ask: *What are the different things that happen when you throw a ball to someone?* Have students list the steps that occur before they begin writing their paragraphs.

How Do Machines Help Us Do Work? (pages 6–9)

Before Reading

Build Reading Skills (page 6)

Cause and Effect Use Build Reading Skills on page 6 to review cause and effect. Discuss the tips. Then use the information in the first paragraph on page 8 to model identifying cause and effect.

> **Think Aloud** *I read that machines can change how forces act and that this can make work easier. What is the cause? Machines change how forces act. What is the effect of this? Machines make work easier for people.*

Guide students as they practice modeling cause and effect on page 8. Remind them to look for effects as they read, by asking *What happens?* Then they can ask *Why does this happen?* to find the causes. Students can apply the skill in the Reflect on Reading activity on page 9.

Make a Connection (page 7)

Make a Connection Discuss the Make a Connection questions. Use this discussion to build background and activate prior knowledge about what machines do. (Possible answers: It makes work easier because the beaters spin very fast so you don't have to move your hand fast; cars, elevators) Help students understand that anything that makes work easier, including a human-powered object, is a machine.

Find Out About Read each statement to help students set a reading purpose. Explain that these are important topics that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a word web on the board with *Machines* in the center. Have students add to the web as they read.

During Reading

What Machines Do (page 8)

- *Addressing Misconceptions.* Some students may think that machines must be complicated, with many moving parts and powered by electricity or fuel. Reinforce that, in science, any tool that makes work easier is a machine. Ask: *Is a car a machine? What about a fork? How do you know?* (Both are machines. A machine is any tool that makes work easier.)
- Ask: *What is the difference between input force and output force?* (Input force is the force we put into a machine. Output force is the force that comes out of the machine.)

Checkpoint (Machines can change the size, direction, speed, and distance of the force we put into them.)

Friction and Machines (page 9)

- Ask: *What makes a machine efficient?* (It changes most of the energy put into it to useful work.)
- Ask: *Why might it be a good idea to oil machine parts?* (Doing this can lower friction to make the machine more efficient and make it last longer.)
- Explain that friction can often be helpful. For example, the shoes we wear have treads so we can push off with each step. The tiny ridges that make up our fingerprints help us grasp objects.

Checkpoint (a force that acts against an object's motion)

After Reading

Reflect on Reading (page 9) Have students reread page 9 and note the effects of friction before listing these effects in their cause and effect charts. (Effects: makes heat, wears down or breaks machine parts)

Apply Science Concepts (page 9) This activity applies a concept from Find Out About on page 7. If possible, show students some machines you have in your classroom, such as scissors or a stapler.

What Are Simple Machines? (pages 10–19)

Before Reading

Build Reading Skills (page 10)

How to Read Diagrams Use Build Reading Skills on page 10 to review how to read diagrams. Discuss the tips. Then model how to read the diagram of a screw on page 15.

> **Think Aloud** *I see that the input force and the output force are labeled. It looks as if the input force goes around and around, and the output force goes down. When I read, I'll look back at the diagram. I bet it will help me understand what the text says.*

Guide students as they discuss other features of the diagram, such as the screw threads. Encourage them to draw the diagram for themselves to help them understand it better. Students can apply the skill in the Reflect on Reading activity on page 19.

Make a Connection (page 11)

Make a Connection Discuss the Make a Connection questions. Use this discussion to build background and activate prior knowledge about simple machines. (Possible answers: It could make lifting a heavy object easier. It does not have many parts.) Ask: *What have you seen a pulley used for?* (Possible answers: lifting a flag up a pole, pulling a bucket out of a well)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a word web on the board with *Simple Machines* in the center. Have students add to the web as they read.

During Reading

Simple Machines (page 12)

- Ask: *What is one good thing about simple machines?* (They let you do more work than you could do with just your body.)

Checkpoint (a machine that has few or no moving parts and often uses only the force of a person to do work)

Inclined Plane (page 13)

- Point out the photograph of the ramp on page 13. Ask: *If this ramp were longer, would you still have to use the same amount of force to push a box up it? Why or why not?* (No. The longer the inclined plane, the less force you need to use.)

Checkpoint (It helps us raise heavy objects with less force, but we must apply the input force over a longer distance.)

Wedge (page 14)

- Ask: *How can you tell that our front teeth are wedges?* (They have sloping sides that meet at a sharp edge. Also, we use them to split pieces of food when we bite down.)
- Ask: *Which wedge requires more input force, a narrow wedge or a wider wedge?* (a wider wedge)

Checkpoint (A wedge changes the direction of the input force you put in, as well as the amount of input force needed.)

Screw (page 15)

- Ask: *Think about a fan. Its blades are screws. Tell about their input force and output force.* (Input force: moves blades around and around; Output force: pushes air away from the fan)

Checkpoint (A screw is an inclined plane that is wrapped around a rod.)

Lever (page 16)

- Ask: *What is a fulcrum?* (the point that a lever turns around)
- Ask: *What changes can be caused by a first-class lever?* (direction, size, and distance of the input force)
- Ask: *How do second-class levers make work easier?* (by making the output force larger than the input force)
- Ask: *How are the three classes of levers the same?* (All levers are made of a bar that turns around a fulcrum.)

Checkpoint (They differ in where the fulcrum, the input force, and the output force are. Also, they change force in different ways.)

Wheel and Axle (page 18)

- Ask: *What parts of a wheel and axle turn when you apply a force?* (both the wheel and the axle)
- Ask: *How does the size of the wheel affect how a wheel and axle works?* (The larger a wheel is compared to its axle, the less force you have to use to do work.)

Checkpoint (It changes the input force to a larger output force. But the input force must be applied over a longer distance.)

Pulley (page 19)

- Ask: *What is the main purpose of a pulley?* (to move objects)
- Ask: *What are three kinds of pulleys?* (fixed, movable, and compound)

Checkpoint (A fixed pulley changes the direction of the input force. A movable pulley's output force is greater than the input force.)

After Reading

Reflect on Reading (page 19) Once students have drawn and labeled their diagrams, have them exchange drawings with a partner and try to interpret each other's diagrams. Be sure they explain how the force moves and changes.

Apply Science Concepts (page 19) This activity applies a concept from Find Out About on page 11. Once students have written their ideas, have them share their ideas with the class. Guide discussion to emphasize that more than one kind of simple machine, including a pulley and an inclined plane, could do the job.

What Are Compound Machines? (pages 20–23)

Before Reading

Build Reading Skills (page 20)

Main Idea and Details Use Build Reading Skills on page 20 to review identifying main idea and details. Discuss the tips. Then begin modeling how to find the main idea and details in the first paragraph on page 22.

> **Think Aloud** *Where is the main idea here? The bold words are probably important, so I'll start there:* compound machine. *The paragraph tells me that a compound machine is made up of two or more simple machines. That must be the main idea. Now I'll look for details to support that idea.*

Guide students as they find details about compound machines on page 22. Students can apply the skill in the Reflect on Reading activity on page 23.

Make a Connection (page 21)

Make a Connection Discuss the Make a Connection question. Use this discussion to build background and activate prior knowledge about compound machines. (Possible answer: It is bigger and more complicated.) Ask: *Do you think this machine can do more work than a simple machine? Why or why not?*

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary word aloud. Explain to students that they will see this word in bold in this section. Start a T-chart on the board to compare *simple machines* and *compound machines*. Have students suggest examples as they read.

During Reading

Compound Machines (page 22)

- Ask: *What is a compound machine?* (a machine made of two or more simple machines working together)
- Ask: *What two kinds of simple machines make a pair of scissors?* (first-class lever and wedge)
- Ask: *Scissors are small and not very complex. A crane is large and very complex. Why are they both compound machines?* (They both are made up of simple machines. The crane just has more.)

Checkpoint (Each simple machine in a compound machine can be the input force for the next. This means the final output force can be very great.)

After Reading

Reflect on Reading (page 23) Once students have completed their concept webs, have them pair up and read their partner's ideas. Then allow them to look for compound machines in the classroom. (Possible answers: Main idea: A compound machine is a made of two or more simple machines working together; Details: output force of compound machine can be very great; a compound machine can have hundreds of moving parts; bicycles and cars are compound machines)

Apply Science Concepts (page 23) This activity applies a concept from Find Out About on page 21. Guide students as they identify and describe the workings of one simple machine within a compound machine. Challenge them to identify the simple machine that, along with a lever, makes up a wheelbarrow. (wheel and axle)

Continued on last page

Name: Date:

Test: **Work and Machines**

Part A: Vocabulary

friction	fulcrum	inclined plane	machines
screw	wedge	wheel and axle	work

Choose the correct vocabulary word for each definition. Write the word on the line.

1. In science, _____ means the use of a force to move an object over a distance.

2. By changing how forces act, _____ can make work easier.

3. When machine parts rub against one another, a force called _____ can make heat.

4. With one end higher than the other, the _____ lets people raise heavy objects using less force.

5. The _____ has sloping sides that meet at a sharp edge so it can cut or split things.

6. A bolt and a propeller are both examples of the _____.

7. The fixed point that a lever turns around is its _____.

8. A doorknob is an example of the _____.

Part B: Science Concepts

Mark the best answer to each question.

9. What needs to happen in order for work to be done?

Ⓐ A compound machine must be used.

Ⓑ Moving machine parts must create friction.

Ⓒ One object must push against another object.

Ⓓ A force must move an object over a distance.

Test: **Work and Machines** *(continued)*

10. Which of these statements is true?

Ⓐ A machine cannot change the amount of work you must do.

Ⓑ A machine never wastes any of the energy put into it.

Ⓒ A machine cannot change the size of the input force.

Ⓓ A machine does not need energy in order to do work.

11. What is a compound pulley made of?

Ⓐ levers and fixed pulleys

Ⓑ screws and moveable pulleys

Ⓒ fixed pulleys and moveable pulleys

Ⓓ fixed pulleys and wheel and axles

12. A can opener includes a wedge, second-class levers, and a wheel and axle. The can opener is an example of a _____.

Ⓐ simple machine

Ⓑ compound machine

Ⓒ screw

Ⓓ fulcrum

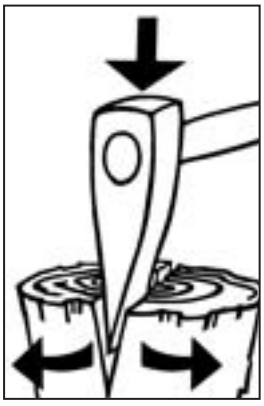
Write the answer.

13. Explain some ways a machine can change input force.

_____

_____

14. What simple machine does the picture show? What happens with input force and output force when someone uses it?



_____

_____

_____

_____

15. How are simple and compound machines alike and different?

_____

_____

_____

_____

Let's Review

(inside back cover)

Have students complete their K-W-L charts before answering these questions. Possible answers are shown.

1. **Cover Connection** (I have learned that machines can make work easier by changing the force you put in. For example, simple machines such as an inclined plane let you use less force. You just have to apply the force over a greater distance.)
2. (Energy is the ability to cause change. When work is done, an object moves over a distance. This change in position needs energy.)
3. (Input force is the force we put into a machine. Output force is the force that comes out of the machine and does work on other objects.)
4. (The most important difference between the three classes of levers is where the input force, output force, and fulcrum are. First-class: fulcrum is between input force and output force; Second-class: output force is between input force and fulcrum; Third-class: input force is between fulcrum and output force)
5. (A compound machine is made of two or more simple machines working together. Scissors are a compound machine made of levers and wedges.)
6. **Main Idea and Details** (Main idea: A pulley is a simple machine. Details: A pulley is a wheel with a groove in it that a rope goes into. A fixed pulley changes the direction of the input force. A movable pulley's output force is greater than the input force.)
7. **Write** (Students may name machines such as hammers, screwdrivers, and ramps. They should tell how they would use each machine to build a shelter.)

Try It! Be sure students focus on the locations of the fulcrum, the input force, and the output force to determine that they made a first-class lever. Have them try different setups with different numbers of pennies.

Science at Home Have students do this activity at home with a family member. Remind students not to overlook everyday objects, such as a mop, in their search for simple machines.

Answers to Test

(Teacher's Guide pages 6–7)

1. work **2.** machines **3.** friction **4.** inclined plane **5.** wedge **6.** screw **7.** fulcrum **8.** wheel and axle **9.** D **10.** A **11.** C **12.** B **13.** A machine can change the size, direction, speed, and distance of the input force. **14.** It shows a wedge. It can change the downward input force into a sideways output force. The output force of a wedge is larger than the input force. **15.** Both can make work easier. Simple machines have few or no moving parts and often use only the force of a person to do work. Compound machines are made of two or more simple machines working together. They can cause greater changes than simple machines can.

ADDITIONAL ASSESSMENT OPPORTUNITIES Use the Checkpoints, Reflect on Reading, and Apply Science Concepts features and Let's Review questions as additional assessment opportunities.

Delta Science Content Readers are 24-page nonfiction student books with informative, engaging text and full-color photos and illustrations. The readers present key science content and vocabulary found on state tests, present key reading skills and strategies useful for reading informational text, support and extend the experiences and content of hands-on activities, promote scientific inquiry, and serve as a home-school link. **They are available in two editions: Red Edition for Grades 3–4 and Purple Edition for Grades 4–5.**

School Specialty Science

Delta Education

This teacher's guide is available online at

www.deltaeducation.com

1-800-442-5444

Work and Machines
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1278146

ISBN: 978-1-60395-447-1

Printing 2—12/2009
Worldcolor, Leominster, MA