Unit 1 Technology and the Design Process

How can technology affect our lives?

Lesson Plan

Unit Opener & Lesson 1 What is a machine?			
	Activity	**Pages**	**Time**
Engage	• Unit Opener: Think! *How will this tiny robot help people in the future?*	SB p. 4	5 min
	• Unit Opener: Describe what certain machines are used for.	SB p. 4	10 min
	• Unit Opener: Discuss how machines can help people solve problems.	SB p. 4	10 min
	• Think! *Which simple machine did the pole vaulter use?*	TB p. 6	5 min
	• Think! *How do you know when a complex machine is at work?*	SB p. 8	5 min
Explore	• Digital Lab: *How can a simple machine solve a problem?* (ActiveTeach)	SB p. 5	15 min
Explain	• What work is	SB p. 5	20 min
	• Six simple machines	SB p. 6–7	25 min
	• Complex machines	SB p. 8–9	20 min
	• *Got it? 60-Second Video* (ActiveTeach)	TB p. 9	5 min
Elaborate	• The Six Simple Machines Cards	TB p. 6	30 min
	• Six Simple Machines Quiz	TB p. 7	30 min
	• Science Notebook: My Simple Machine	TB p. 7	30 min
	• A Bicycle Simple Machines Poster	TB p. 9	30 min
Evaluate	• *Lesson 1 Check* (ActiveTeach)	TB p. 15a	10 min
	• Assessment for Learning	TB p. 9	10 min
	• Review (Lesson 1)	SB p. 15	10 min
	• *Got it? Self Assessment* (ActiveTeach)	TB p. 15b	10 min
	• *Got it? Quiz* (ActiveTeach)	TB p. 15b	10 min

Lesson 2 What is the design process?			
	Activity	**Pages**	**Time**
Engage	• Think! *Why do engineers sometimes research problems in different ways?*	SB p. 11	5 min
	• Think! *How can this car prototype help engineers?*	SB p. 12	5 min
Explore	• Digital Lab: *Which design transfers sound the best?* (ActiveTeach)	SB p. 10	20 min
Explain	• The design process	SB p. 10	20 min
	• Identify the problem and do research	SB p. 11	15 min
	• Develop possible solutions, choose one solution, design and construct a prototype, and test the prototype	SB p. 12	20 min
	• Communicate results and evaluate and redesign	SB p. 13	20 min
	• *Got it? 60-Second Video* (ActiveTeach)	TB p. 13	5 min
Elaborate	• Earlier Models	TB p. 10	30 min
	• Problems and Solutions	TB p. 11	30 min
	• Go Green: Saved Solutions	TB p. 11	40 min
	• Car Prototype Characteristics	TB p. 12	10 min
	• Internet Research: Evolving Audio Player	TB p. 13	30 min
Evaluate	• *Lesson 2 Check* (ActiveTeach)	TB p. 15a	10 min
	• Assessment for Learning	TB p. 13	10 min
	• Review (Lesson 2)	SB p. 15	10 min
	• *Got it? Self Assessment* (ActiveTeach)	TB p. 15b	10 min
	• *Got it? Quiz* (ActiveTeach)	TB p. 15b	10 min
Lab	• *Let's Investigate! What makes a bridge strong?* (ActiveTeach)	SB p. 14	30 min

Flash Cards

wheel and axel

wedge

lever

inclined plane

pulley

screw

can opener

work

research

Lesson 1	
Key Words	**ELL Support**
work, wheel and axle, wedge, lever, inclined plane, pulley, screw	**Present Tense Verb Forms:** *My father uses his car every day. We all watch TV on Saturday, but my dad uses the remote control.* **Gerund after Prepositions:** *We use the can opener for opening a can of tuna.*

Lesson 2	
Key Words	**ELL Support**
design process, engineer, research, prototype	**Comparatives:** *The computer the children are using is simpler to use.*

Unit 1 Technology and the Design Process

Unit Objectives

Lesson 1: Students will describe simple and complex machines.

Lesson 2: Students will learn the steps of the design process and identify its benefits.

Vocabulary: *machine, wheel, seesaw, axe, scissors, can opener, screw, robot, used for*

Introduce the Big Question

How can technology affect our lives?

Build Background *Look around and tell me which machines we use every day. A stapler and scissors are machines we use every day.* Write on the board: *Machines we use every day.* Pair students and have them brainstorm. Write students' ideas on the board.

ELL Language Support

Point out and review present tense verb forms.

- *My father uses his car every day.*
- *We all watch TV on Saturday, but my dad uses the remote control.*
- *My brother uses his tablet every day.*

Engage

Think!

How will this tiny robot help people in the future? A robot is a machine that can be programmed to perform tasks by itself. Among other tasks, robots can move around and move things. In factories, they look like pieces of equipment that work without a human operator. Robots can also look like humans or animals. Look at the picture. What does this robot look like? In pairs, have students describe the robot in the picture and discuss what they think it can do.

1 Look and label.

Use the photos to elicit vocabulary and teach new words. Have students label the photos.

2 What are each of the machines used for? Discuss with a partner.

Look at the scissors. What do we use them for? Have students work in pairs and say what the machines are used for. (Possible answer: *We use a can opener for opening a can of tuna.* Refer to the ELL Language Support box.)


Unit 1 Technology and the Design Process

How can technology affect our lives?

I will learn
- about simple and complex machines.
- the steps of the design process.

1 Look and label.

can opener axe scissors seesaw wheel screw

wheel seesaw axe

scissors can opener screw

2 What are each of the machines used for? Discuss with a partner.

3 How can machines help you solve problems? Discuss as a class.

Think!
How will this tiny robot help people in the future?

4 Unit 1

3 How can machines help you solve problems? Discuss as a class.

Read the question out loud and write students' ideas on the board. (Possible answers: *They can help us to make our work easier and faster. They can do many different things.*)

Think! Again!

Revisit the question *How will this tiny robot help people in the future?* (Possible answer: *It might be able to fly and take and send pictures of places people might not be able to get to.*)

Lesson 1

What is a machine?

Objective: Understand what work is and design a simple machine to solve a problem.

Vocabulary: *work, force, kick a ball, pedal a bike, pole, vaulter*

Digital Resources: *Let's Explore!* Digital Lab

Materials: clay, rulers, pencils

Unlock the Big Question

Write the following text on the board: *I will learn how simple and complex machines can help us do work.*

Build Background Write the names of the six machines pictured on page 4 on one side of the board: *wheel, seesaw, axe, scissors, can opener, screw.* Write the following description on the other side of the board: *We use this machine for cutting hair, paper, cardboard, etc.* Then have students guess which machine is described. Invite five volunteers to describe the remaining objects for the class to guess.

Explore

Let's Explore! Lab **How can a simple machine solve a problem?**

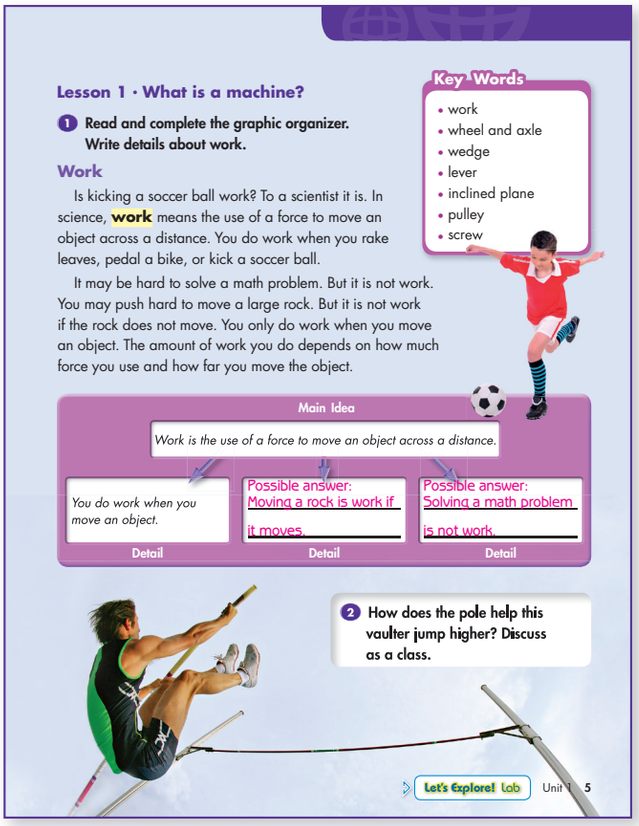
Objective: Design a simple machine to solve a problem.

Digital Resources: *Let's Explore!* Digital Lab, *Let's Explore! Activity Card* (1 per student) (*Optional:* Do the lab in class; refer to the *Activity Card* for materials and steps.)

- Draw a balance on the board. *Look at the balance. What can you use it for?* (*A balance is a machine used to find out how heavy things are.*)
- Draw two girls' faces, two small balls, a ruler, and a pencil on the board. Explain: *Pat and Chris have a problem. They each have a clay ball, but they want to know whose clay ball is heavier.*
- Show the Digital Lab and have students complete the *Activity Card*.
- Have students check their answers in pairs or small groups. Provide support as needed.

ELL Content Support

Write the word *work* on the board. Tell students that *work* has several meanings and is used as different parts of speech. *In the sentence* I have lots of work to do, *the word* work *is being used as a noun.* Reinforce that the common use of the word *work* is different from its use in science.



Explain

1 Read and complete the graphic organizer. Write details about work.

Use the photos to pre-teach the word *work*. *Is the boy doing work? Is the man doing work? Why or why not?* (Answer: *Yes, they are doing work because they are using a force to move an object.*) Have students read the first paragraph. Point out that, to a scientist, students do work when they kick a ball or pedal a bike. Then have students read the second paragraph and complete the graphic organizer in pairs.

2 How does the pole help this vaulter jump higher? Discuss as a class.

Read the question out loud and write students' ideas on the board. (Possible answer: *The pole helps push the vaulter into the air. Without the pole, the vaulter would not be able to jump so high.*) Explain that the pole is being used as a tool or machine.

Lesson 1

What is a machine?

Objective: Identify some simple machines and understand how they help people do work.

Vocabulary: *simple machine, work* (n), *wheel and axle, wedge, lever, inclined plane, pulley, screw*

Digital Resources: *I Will Know...* Digital Activity

Build Background *Today's lesson is about simple machines.* Write the word *work* on the board. *How does a scientist define work?* (Answer: Work *means* to use a force to move an object.) *What can we use to move an object? For example, the wheel is a simple machine that helps us move a car.*

Explain

3 Read and write the names of the six machines shown on pages 6 and 7.

Have students read the introductory text. *Are the objects in the pictures machines? Why?* (Answer: *They are machines because people use them to do work.*) Have students read the captions and write the names of the six machines. Check answers as a class. *Why are they called simple machines?* (Answer: *Because they have just one or two parts.*)

ELL Vocabulary Support

Give students ample time to read the captions and underline words they do not know. Elicit unfamiliar vocabulary and write the words on the board. Encourage volunteers to explain the terms if possible. Teach any remaining words.

4 What is the common name for the wedge you use to cut a cake? Discuss with a partner and write its name.

Have students discuss in pairs the common name for the wedge used to cut a cake.

I Will Know...

Have students do the *I Will Know...* Digital Activity.

Elaborate

The Six Simple Machines Cards

Have students make picture cards for the six simple machines. Provide students with index cards and have them write the name of a simple machine and draw a picture of it on the front of each card. On the back, have students add a description of the machine and what it does.

ELL Content Support

Remind students that in the *Let's Explore* Digital Lab they learned how a lever works. Have students look back at the pictures on page 4 and identify the name of the machine that is a lever. (Answer: *seesaw*)

Think!

Have students look at the picture of the pole vaulter on page 5. *Which simple machine did the pole vaulter use in the picture on page 5?* (Answer: *a lever*) Draw students' attention to the pictures and descriptions of the three simple machines. Explain that simple machines do not always look the same. For example, there are three classes of levers, depending on where the balancing point is located.

Lesson 1

What is a machine?

Objective: Identify some simple machines and understand how they help people do work.

Vocabulary: *wheel and axle, wedge, lever, inclined plane, pulley, screw, pole*

Digital Resources: Flash Cards (*wheel and axle, wedge, lever, inclined plane, pulley, screw*)

Build Background *What are the six simple machines?* (Answer: *wheel and axle, wedge, lever, inclined plane, pulley, screw*) Display the six simple machine Flash Cards on the board and have students name them. Ask a volunteer to come to the board and point to the machine you can use when you want to cut a cake. (Answer: *the wedge*) Continue the same process to describe the remaining five machines.

Explain

5 Look at this shape ▼. Draw an ✗ on the simple machine that has this shape. How does the shape help this machine work? Discuss with a partner.

In pairs, have students look at the pictures of the six simple machines and describe their shapes, using the white lines and the captions as guides. Have students draw an ✗ on the simple machine that has two slanted sides that end in a sharp edge. Have pairs discuss how the shape helps the machine work.

6 Which simple machine would you use for each task below? Discuss with a partner.

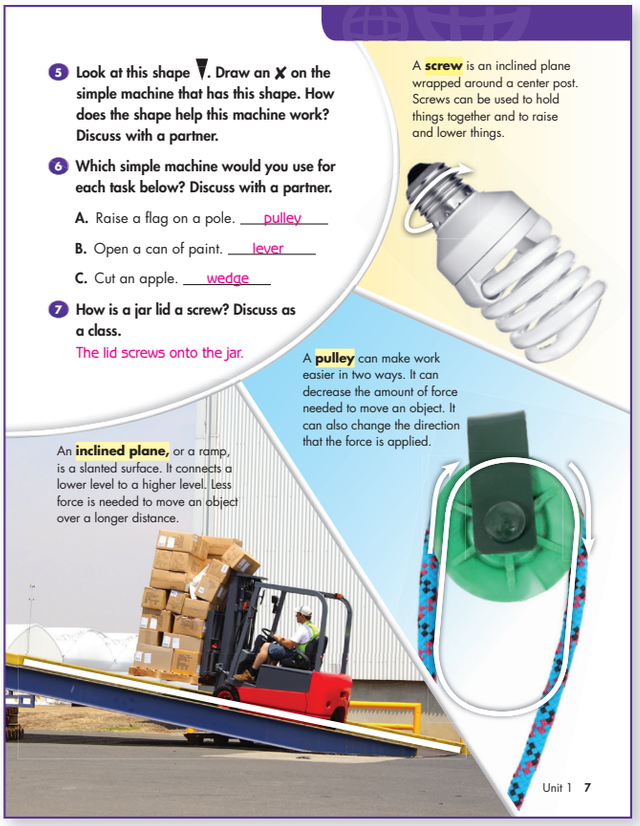
Draw a flag, a flag pole, a can of paint, and an apple on the board. Have students identify what they are and predict what work is required to be able to use or eat those things. Have pairs read the tasks and decide which machine they would use for each task.

7 How is a jar lid a screw? Discuss as a class.

Read the question out loud and write students' ideas on the board.

ELL Content Support

Remind students that they use simple machines when they cut food, turn a wheel, or walk up a ramp.



Elaborate

Six Simple Machines Quiz

Have students take out their sets of *The Six Simple Machines Cards* they made in the previous class. Have students work in pairs to quiz each other. In turns, have one student pick a card and describe as many examples as they can of things they can do with that simple machine for the other student to guess which simple machine is being described.

Science Notebook: My Simple Machine

Have students write a paragraph in their Science Notebooks describing the use of a simple machine in their everyday lives. Have them draw a diagram that illustrates how the machine they chose functions.

Lesson 1

What is a machine?

Objective: Understand that complex machines are made of several simple machines.

Vocabulary: *can opener, complex machines, wheel and axle, wedge, lever*

Digital Resources: Flash Cards (*complex machine (can opener), wheel and axle, wedge, lever, inclined plane, pulley, screw*)

Build Background Use the six simple machine Flash Cards to review vocabulary. Display the *wedge* and *complex machine* Flash Cards. *Compare these two machines. With a partner, discuss one way they are the same and one way they are different.* (Possible answers: *Both of them can cut things. The axe is a simple machine. The can opener is composed of more than one machine. The can opener is more difficult to operate.*)

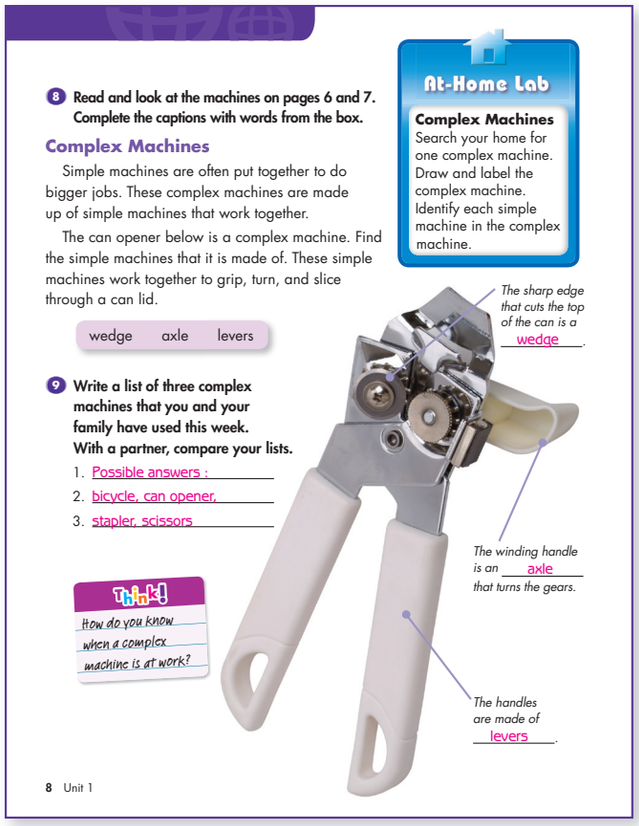
Explain

8 Read and look at the machines on pages 6 and 7. Complete the captions with words from the box.

Have students read and underline the definition of *complex machines*. *What are complex machines?* (Answer: *They are machines that are made up of simple machines that work together.*) Have pairs complete the captions with words from the box. Check answers as a class.

9 Write a list of three complex machines that you and your family have used this week. With a partner, compare your lists.

Have each student write a list and compare it with a partner, explaining why they think the machines are complex machines.



8 Read and look at the machines on pages 6 and 7. Complete the captions with words from the box.

Complex Machines

Simple machines are often put together to do bigger jobs. These complex machines are made up of simple machines that work together.

The can opener below is a complex machine. Find the simple machines that it is made of. These simple machines work together to grip, turn, and slice through a can lid.

wedge axle levers

9 Write a list of three complex machines that you and your family have used this week. With a partner, compare your lists.

1. Possible answers :
2. bicycle, can opener,
3. stapler, scissors

Think!
How do you know when a complex machine is at work?

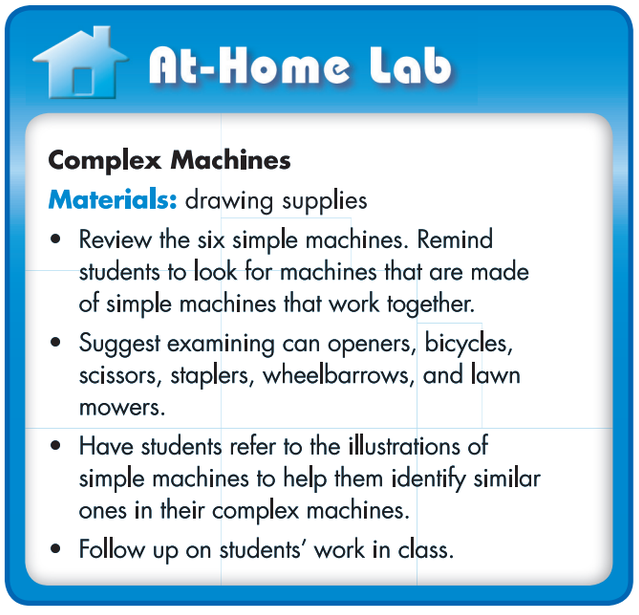
At-Home Lab
Complex Machines
Search your home for one complex machine. Draw and label the complex machine. Identify each simple machine in the complex machine.

The sharp edge that cuts the top of the can is a wedge.

The winding handle is an axle that turns the gears.

The handles are made of levers.

8 Unit 1



Point to the photo of the can opener. *How do you know when a complex machine is at work?* Encourage students to share ideas. (Possible answer: *You see more than one simple machine working together to change the position of something.*)

Lesson 1

What is a machine?

Objective: Identify the simple machines that make up complex machines.

Vocabulary: *lawn mower, complex machines, wheel and axle, lever, pulley, wedge*

Digital Resources: *Lesson 1 Check* (print out 1 per student), *Got it? 60-Second Video*

Build Background Write the following words on the board: *seesaw, pole, balance, scissors*. *What do these machines have in common?* Pair students and have them brainstorm. (Possible answers: *Three of them are simple machines. They are all levers or have levers.*) Remind students that the six simple machines are sometimes difficult to identify because they do not always look the same.

Explain

10 Read. Where would you find a wedge inside a lawn mower? Discuss with a partner and write your answer.

Have students look at the picture and say what complex machine it is and what it is used for. Ask students if they have ever seen someone using a lawn mower, either in person or on television. Have students describe how the boy in the picture operates the lawn mower. Also ask students to discuss what the machine looks like and whether it produces any sounds or smells. Have students read through the text and answer the question in pairs. Elicit some other simple machines that make up a lawn mower and what they are used for. (Answers: *A wheel and axle help it move. Screws hold its pieces together.*)

11 Draw a line from each simple machine to its correct part on the bicycle.

Have pairs draw a line from each simple machine to its correct part on the bicycle. Explain that there may be several examples of each simple machine in the bicycle. For example, the pedals are types of levers.

Elaborate

A Bicycle Simple Machines Poster

Divide the class into small groups. Have them research what the job of each simple machine in a bicycle is. Then ask them to illustrate and label the simple machines in the bicycle. Have each group present their poster to the class.

10 Read. Where would you find a wedge inside a lawn mower? Discuss with a partner and write your answer.

Lawn Mowers

Engineers design and develop large and small machines. These machines are made of simple and complex machines. A simple machine can be a lever, wheel and axle, pulley, wedge, inclined plane, or screw.

Simple machines are often put together to make a complex machine, such as a lawn mower. It is made of different parts. Some of these parts are simple machines, such as a wheel and axle. A wheel and axle is used in a lawn mower to help it move. A screw is another simple machine. Screws are used to hold the lawn mower pieces together. Lawn mowers have wedges that end in sharp edges. Where would you find a wedge inside a lawn mower?

Possible answer: The blades that cut the grass are wedges.

Bicycles

The bicycle is a complex machine, too. What simple machines make it up? How does each simple machine help make the bicycle work?

11 Draw a line from each simple machine to its correct part on the bicycle.

A. lever
B. pulley
C. wheel and axle

Lesson 1 Check | Got it? 60-Second Video | Unit 1 9

Evaluate

Lesson 1 Check Assessment for Learning

Distribute the *Lesson 1 Check* and allow students sufficient time to complete it. Check answers as a class. Then ask students to grade their progress on the topic of simple and complex machines from 1 to 3: 3 = *I understand simple and complex machines*; 2 = *I need to study more*; 1 = *I need help!* Encourage students giving themselves a 2 or 1 to describe what they found difficult and need to study more.

Got it? 60-Second Video

Review Key Words for Lesson 1 (see Student's Book page 5). Play the *Got it? 60-Second Video* to review the lesson material.

Lesson 2

What is the design process?

Objective: Understand the importance of the design process and learn how to evaluate different designs.

Vocabulary: *design process, step-by-step method, problem, solution, engineer*

Digital Resources: *Let's Explore!* Digital Lab

Materials: cellular phone or picture of a cellular phone

Unlock the Big Question

Write the following text on the board: *I will learn how to carry out investigations using the design process.*

Build Background Show students a cellular phone and ask them what problems they can solve with it. (Possible answer: *The telephone was designed to allow people to talk to each other from different locations.*) Discuss how the design of telephones has changed.

Explore

Let's Explore! Lab **Which design transfers sound the best?**

Objective: Observe three model telephones to test which material best transfers sounds.

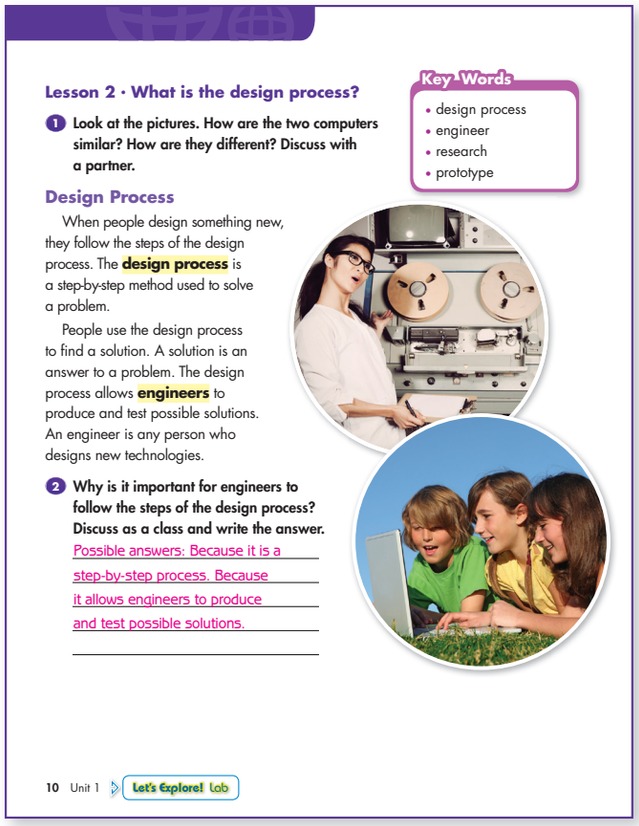
Digital Resources: *Let's Explore!* Digital Lab, *Let's Explore! Activity Card* (1 per student) (*Optional:* Do the lab in class; refer to the *Activity Card* for materials and steps.)

- Show the Digital Lab. Check comprehension by eliciting the characteristics of the three models.
- Have students complete the *Activity Card* and check their answers in small groups or pairs. Provide support as needed.

Explain

1 Look at the pictures. How are the two computers similar? How are they different? Discuss with a partner.

Call students' attention to the two pictures. Read the questions and have pairs brainstorm. Write students' ideas on the board. (Possible answers: *The computer the children are using is smaller and simpler to use. The other computer looks older, bigger, and more difficult to use.*)



Lesson 2 · What is the design process?

Key Words
- design process
- engineer
- research
- prototype

1 Look at the pictures. How are the two computers similar? How are they different? Discuss with a partner.

Design Process

When people design something new, they follow the steps of the design process. The **design process** is a step-by-step method used to solve a problem.

People use the design process to find a solution. A solution is an answer to a problem. The design process allows **engineers** to produce and test possible solutions. An engineer is any person who designs new technologies.

2 Why is it important for engineers to follow the steps of the design process? Discuss as a class and write the answer.

Possible answers: Because it is a step-by-step process. Because it allows engineers to produce and test possible solutions.

10 Unit 1 Let's Explore! Lab

ELL Language Support

Point out and review comparative forms.
- *The first computer is bigger and older.*
- *The computer the children are using is simpler to use.*

2 Why is it important for engineers to follow the steps of the design process? Discuss as a class and write the answer.

Have students reread the text and underline the definition of the design process. (Answer: *The design process is a step-by-step method used to solve a problem.*) Read the question out loud and write students' ideas on the board.

Elaborate

Earlier Models

Organize students in small groups. Ask each group to choose an object they use now and research to find earlier models of the object they chose. Ask each group to illustrate a poster that shows the earlier models. Have each group present its poster to the class.

Lesson 2

What is the design process?

Objective: Learn how to identify a problem and do research as part of the design process.

Vocabulary: *design process, design* (n), *engineer, inventor, digital audio player, problem, research articles*

Digital Resources: Flash Card (*research*)

Build Background Display the *research* Flash Card. *Where is this man?* (Possible answer: *He is in a laboratory.*) *What do you think his job is?* (Possible answer: *He is a scientist or an engineer.*) *What is he doing?* (Possible answer: *He is doing some research.*) *Why do you think engineers or scientists do research?* (Possible answer: *To find solutions to problems.*)

Explain

3 **Read and complete the information related to Kramer's invention. Check your answers with a partner.**

Kane Kramer is an inventor. Read and complete the information about his invention. Explain that Kramer used the design process to work on his invention. Have students read and complete the information. Have pairs compare their answers and check them as a class.

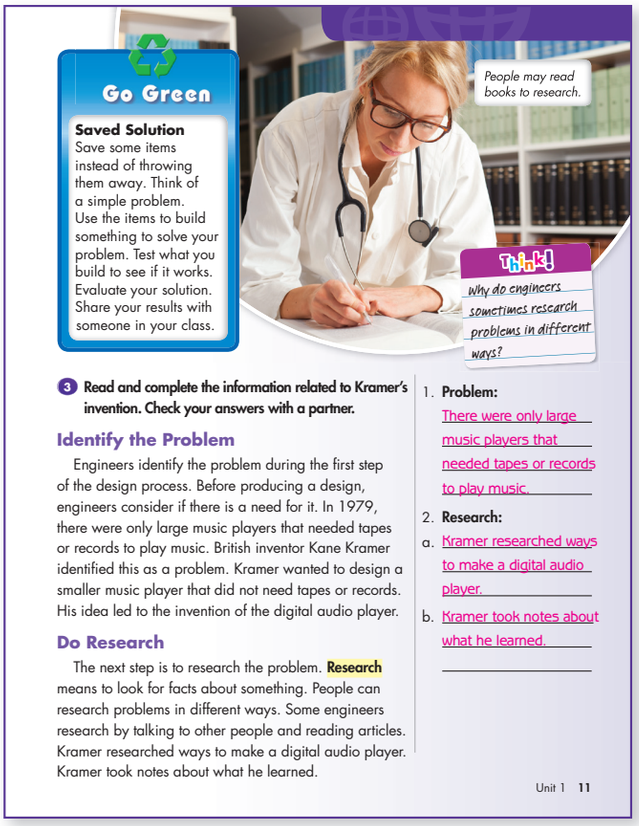
Elaborate

Problems and Solutions

Have students think of an object they use every day. In small groups, have them describe what purpose it serves, identifying the problem and solution. Allow time for students to present their results to the class.

Think!

Point to the photo of the researcher doing research. *Why do engineers sometimes research problems in different ways?* Have students discuss in pairs. (Answers: *Engineers get different information from research. They can talk to people or read articles. It helps them to design better solutions.*)



Go Green

Saved Solution
Save some items instead of throwing them away. Think of a simple problem. Use the items to build something to solve your problem. Test what you build to see if it works. Evaluate your solution. Share your results with someone in your class.

People may read books to research.

Think!
Why do engineers sometimes research problems in different ways?

3 **Read and complete the information related to Kramer's invention. Check your answers with a partner.**

Identify the Problem

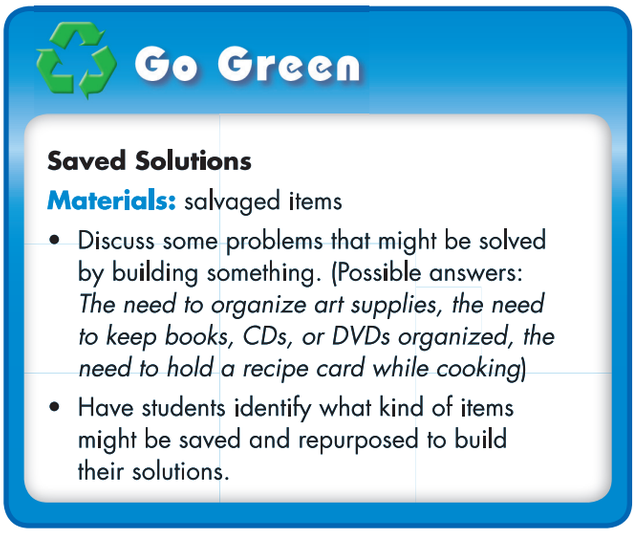
Engineers identify the problem during the first step of the design process. Before producing a design, engineers consider if there is a need for it. In 1979, there were only large music players that needed tapes or records to play music. British inventor Kane Kramer identified this as a problem. Kramer wanted to design a smaller music player that did not need tapes or records. His idea led to the invention of the digital audio player.

Do Research

The next step is to research the problem. **Research** means to look for facts about something. People can research problems in different ways. Some engineers research by talking to other people and reading articles. Kramer researched ways to make a digital audio player. Kramer took notes about what he learned.

1. **Problem:**
There were only large music players that needed tapes or records to play music.
2. **Research:**
a. Kramer researched ways to make a digital audio player.
b. Kramer took notes about what he learned.

Unit 1 11



Go Green

Saved Solutions

Materials: salvaged items

- Discuss some problems that might be solved by building something. (Possible answers: *The need to organize art supplies, the need to keep books, CDs, or DVDs organized, the need to hold a recipe card while cooking*)
- Have students identify what kind of items might be saved and repurposed to build their solutions.

Lesson 2

What is the design process?

Objective: Learn more about the design process and the importance of a prototype.

Vocabulary: *solutions, design, materials, sketches, design* (v), *test* (v), *prototype, construct, test*

Digital Resources: *I Will Know...* Digital Activity

Build Background Have students recall Kramer's first steps in the design process. Write the following questions on the board: *Who is Kane Kramer? What problem did he try to solve? How did he research the problem?* Have pairs discuss the answers. (Answers: *Kane Kramer is a British inventor. He wanted to design a smaller music player. He researched ways to make a digital audio player. He took notes about what he learned.*)

4 Read and underline what Kramer did at each stage.

Elicit the two first steps of the design process students have read about and write them on the board. (Answer: *Identify the problem. Do research.*) Explain that they will learn the next steps Kramer followed in order to design a digital music player. Have students read and underline what Kramer did at each stage.

5 What did Kramer learn from his test? Discuss as a class.

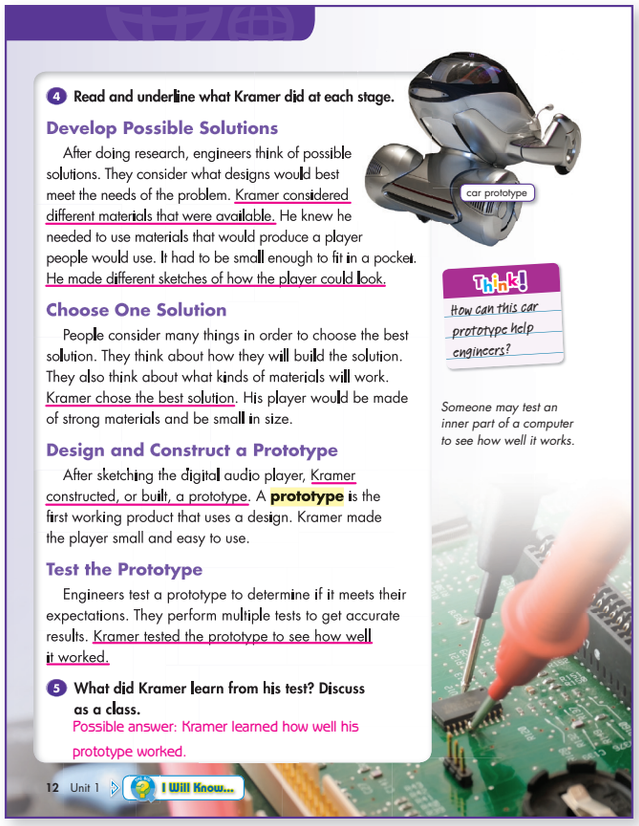
Write the question on the board and discuss the answer as a class. (Possible answer: *He probably learned how well the digital audio player worked.*)

Think!

Read the question out loud. *How can this car prototype help engineers?* Elicit answers from the class. (Possible answer: *It can help engineers decide whether or not the design works.*)

I Will Know...

Have students do the *I Will Know...* Digital Activity.


4 Read and underline what Kramer did at each stage.

Develop Possible Solutions

After doing research, engineers think of possible solutions. They consider what designs would best meet the needs of the problem. Kramer considered different materials that were available. He knew he needed to use materials that would produce a player people would use. It had to be small enough to fit in a pocket. He made different sketches of how the player could look.

Choose One Solution

People consider many things in order to choose the best solution. They think about how they will build the solution. They also think about what kinds of materials will work. Kramer chose the best solution. His player would be made of strong materials and be small in size.

Design and Construct a Prototype

After sketching the digital audio player, Kramer constructed, or built, a prototype. A **prototype** is the first working product that uses a design. Kramer made the player small and easy to use.

Test the Prototype

Engineers test a prototype to determine if it meets their expectations. They perform multiple tests to get accurate results. Kramer tested the prototype to see how well it worked.

5 What did Kramer learn from his test? Discuss as a class.
Possible answer: Kramer learned how well his prototype worked.

12 Unit 1 I Will Know...

ELL Content Support

Remind students that in the *Let's Explore!* Digital Lab they evaluated the effect of three different materials on the transfer of sound. Explain that the same kind of thinking process would be used to evaluate materials that could make a digital audio player.

Car Prototype Characteristics

Have students describe the car prototype. Have pairs list what characteristics they think this car prototype might have. (Possible answers: *It may fly. People might be able to use it underwater. It may work with solar energy. It might be very expensive.*) Elicit answers from the class.

Lesson 2

What is the design process?

Objective: Learn the last two stages of the design process.

Vocabulary: *communicate, results, evaluate, redesign*

Digital Resources: *Lesson 2 Check* (print out 1 per student), *Got it? 60-Second Video*

Build Background Elicit the steps of the design process students have already read about and write them on the board: (Answer: *Identify the problem. Do research. Develop possible solutions. Choose one solution. Design and construct a prototype. Test the prototype.*) Have students explain what happens at each stage.

Explain

6 Read and answer the questions.

Before students read, ask what they think the last two steps are. *What do you think a scientist or engineer would do after testing the prototype?*

7 Look at the photos. How are these audio players different? Discuss with a partner.

Have students read and answer the questions. Have students look at the three pictures of the audio players. In pairs, have students discuss their differences.

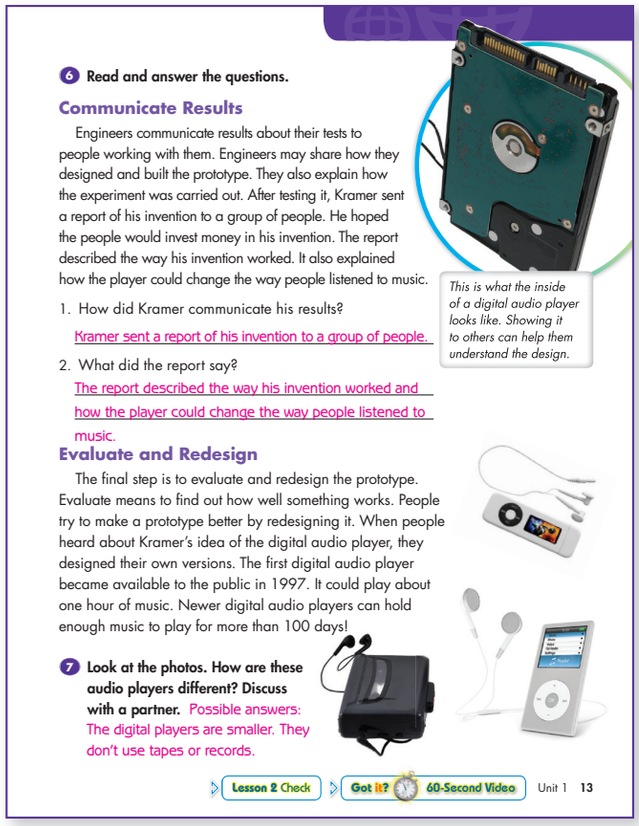
Elaborate

Internet Research: Evolving Audio Player

Organize students in small groups. Assign each group one of the pictures of the digital audio players. Then have each group research to find earlier models of the player. As students evaluate each model, have them discuss how it changed. Have groups present their findings about each model.

ELL Content Support

The steps described in this lesson are part of the engineering design process. This process is the way new products are imagined, developed, tested, and redesigned. Explain to students that the engineering design process does not have one specific set of steps that must be followed each time. Instead, it is cyclical and can begin at any step.



6 Read and answer the questions.

Communicate Results

Engineers communicate results about their tests to people working with them. Engineers may share how they designed and built the prototype. They also explain how the experiment was carried out. After testing it, Kramer sent a report of his invention to a group of people. He hoped the people would invest money in his invention. The report described the way his invention worked. It also explained how the player could change the way people listened to music.

1. How did Kramer communicate his results?
Kramer sent a report of his invention to a group of people.
2. What did the report say?
The report described the way his invention worked and how the player could change the way people listened to music.

This is what the inside of a digital audio player looks like. Showing it to others can help them understand the design.

Evaluate and Redesign

The final step is to evaluate and redesign the prototype. Evaluate means to find out how well something works. People try to make a prototype better by redesigning it. When people heard about Kramer's idea of the digital audio player, they designed their own versions. The first digital audio player became available to the public in 1997. It could play about one hour of music. Newer digital audio players can hold enough music to play for more than 100 days!

7 Look at the photos. How are these audio players different? Discuss with a partner. Possible answers: The digital players are smaller. They don't use tapes or records.

Lesson 2 Check | Got it? 60-Second Video | Unit 1 13

Evaluate

Lesson 2 Check Assessment for Learning

Distribute the *Lesson 2 Check* and allow students sufficient time to complete it. Check answers as a class. Then ask students to grade their progress on the topic of the design process from 1 to 3: 3 = *I understand the design process;* 2 = *I need to study more;* 1 = *I need help!* Encourage students giving themselves a 2 or 1 to describe what they found difficult and need to study more.

Got it? 60-Second Video

Review Key Words for Lesson 2 (see Student's Book page 10). Play the *Got it? 60-Second Video* to review the lesson material.

Let's Investigate!

In this unit, students learn about simple and complex machines and the importance of the design process. In this lab, students will conduct an investigation using the design process.

Let's Investigate! Lab **What makes a bridge strong?**

Objective: Carry out an investigation to find out what makes a bridge strong.

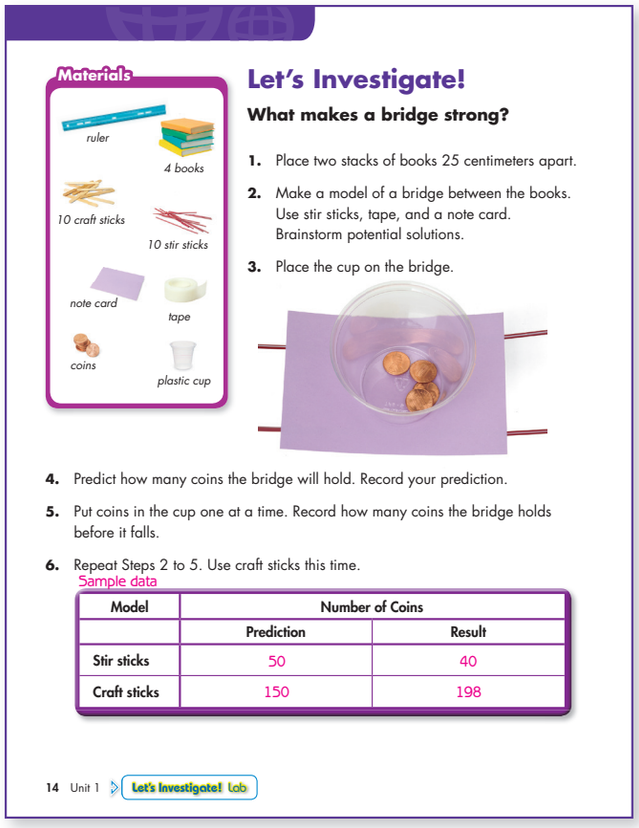
Materials: 1 set of materials per small group of students: 4 books, a metric ruler, 10 stir sticks, clear tape, 10 craft sticks, a clear plastic cup, a note card (10 x 12 cm), 200 small coins

Digital Resources: *Let's Investigate!* Digital Lab, *Let's Investigate!* Activity Card (1 per group)

Advance Preparation: Cut the note cards for each group.

- Divide the class into small groups and distribute materials.
- Students will place two stacks of books of the same height 25 cm apart.
- Demonstrate how to make a model of a bridge between the books, using stir sticks, tape, and a note card.
- Have students place the cup on each bridge and predict how many coins the bridge will hold.
- Students will record their predictions before putting coins in the cup.
- At the end of the activity, have groups compare their results and discuss why results may differ.

Teacher Time-Saving Option: Show the *Let's Investigate!* Digital Lab as an alternative to the hands-on lab activity. Have students complete the *Activity Card*.


Materials

ruler

4 books

10 craft sticks

10 stir sticks

note card

tape

coins

plastic cup

Let's Investigate!

What makes a bridge strong?

1. Place two stacks of books 25 centimeters apart.
2. Make a model of a bridge between the books. Use stir sticks, tape, and a note card. Brainstorm potential solutions.
3. Place the cup on the bridge.

4. Predict how many coins the bridge will hold. Record your prediction.
5. Put coins in the cup one at a time. Record how many coins the bridge holds before it falls.
6. Repeat Steps 2 to 5. Use craft sticks this time.

Sample data

Model	Number of Coins	
	Prediction	Result
Stir sticks	50	40
Craft sticks	150	198

14 Unit 1 Let's Investigate! Lab

Class Project: Our New Digital Audio Player

Materials: writing and drawing supplies, cardboard

Instructions: Divide the class into groups of four. Have students think of important features in a digital audio player and list them. Then have students survey classmates, asking which features they would like in a digital audio player. Students can then plan and draw a design based on the class survey. Ask students to include a description of all the features of their new design. Allow time for students to present their designs to the class.

Unlock the Big Question

Have students refer to the Big Question on the Unit Opener page. In pairs, have them discuss what they know about simple and complex machines and how they affect our lives. Have pairs discuss how the scientific investigation helped them determine which bridge was stronger. Invite students to share their answers to questions 6 and 7 on the *Let's Investigate! Activity Card*.

Unit 1 Review

How can technology affect our lives?

Digital Resources: Print out 1 of each per student: *Got it? Self Assessment, Got it? Quiz*

Evaluate

Strategies for Targeted Review

The following are strategies for providing targeted review for students if they encounter challenges with the content.

Lesson 1 What is a machine?

Question 1

If… students are having difficulty identifying the simple machines that make up a nail clipper, then… direct students to review the six simple machines in Lesson 1. Explain that a lever moves things when you push down on one end and that a wedge's sharp edge can be used to cut things.

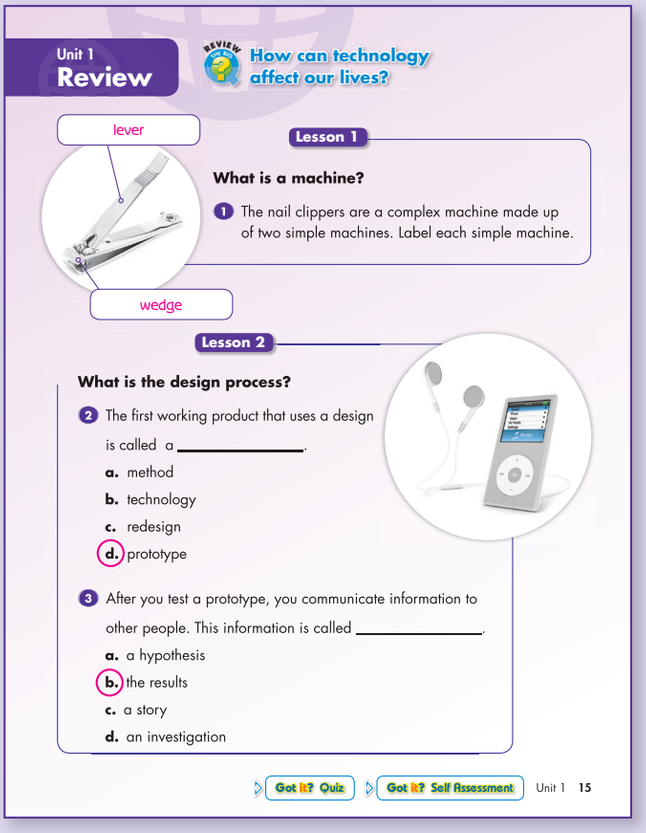
Lesson 2 What is the design process?

Question 2

If… students are having difficulty identifying the first working product that uses a design, then… direct students to the information on the Design and Construct a Prototype stage in Lesson 2. Explain that engineers often sketch the desired product before building a prototype or first working model.

Question 3

If… students are having difficulty identifying the stage of the design process when information is communicated, then… direct students to the information on the Communicate Results stage in Lesson 2. Help students to understand the importance of communicating results, for example, because it can encourage people to invest money in an invention.


Unit 1 Review

How can technology affect our lives?

lever

wedge

Lesson 1

What is a machine?

1 The nail clippers are a complex machine made up of two simple machines. Label each simple machine.

Lesson 2

What is the design process?

2 The first working product that uses a design is called a _____.

a. method
b. technology
c. redesign
d. prototype

3 After you test a prototype, you communicate information to other people. This information is called _____.

a. a hypothesis
b. the results
c. a story
d. an investigation

Got it? Quiz | Got it? Self Assessment | Unit 1 15

ELL Language Support

Before students start working on the Review activities, read each question aloud.

Got it? Self Assessment

Immediately after students have completed the Review activities, distribute a *Got it? Self Assessment* to each student. Have students complete the *Stop! Wait!* and *Go!* statements for each lesson, allowing them to look back through the lesson material if necessary.

Got it? Quiz

Distribute a Unit 1 *Got it? Quiz* to each student. Quizzes may be used for assessing students' understanding of unit concepts as well as for grading purposes.

Lesson 1 Check

Name _____ Date _____

Words to Know

Write the word next to the description it matches.

work	wheel and axle	wedge	lever
inclined plane	pulley	screw	

1. inclined plane — a ramp
2. screw — an inclined plane wrapped around a center post
3. pulley — a machine that changes the direction of the force that is applied to an object
4. lever — a stiff bar that rests on a support
5. work — to use a force to move an object
6. wedge — two slanted sides that end in a sharp edge
7. wheel and axle — a round wheel attached to a post

Explain

Answer the question on the line below.

8. What is a complex machine?

A complex machine has two or more simple machines that work together.

Apply Concepts

9. Choose one simple machine. Describe how it helps people in everyday life.

Answers will vary, but students should name a simple machine and describe how people use it.

Lesson 2 Check

Name _____ Date _____

Words to Know

Write the word that goes with each definition.

design process	research	prototype

1. research — to look for facts about something
2. design process — a step-by-step method used to solve a problem
3. prototype — the first working product that uses a design

Explain

4. What is the design process? How does it help engineers?

Possible answer: The design process is a method used to solve a problem. It helps engineers organize information and test to see if their solutions work.

Apply Concepts

5. An engineer made a prototype of a new bike and tested it many times. Each time there was a problem with the brakes. How can the engineer use the design process to fix the prototype?

Possible answer: She could research different designs for the brakes, talk to other people, and redesign her bike.

Lesson 1 Let's Explore! Activity Card

Name _____ Date _____

Materials

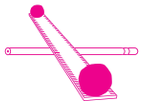
- 2 clay balls of different weights
- unsharpened pencil
- ruler

How can a simple machine solve a problem?

Pat and Chris want to know whose clay ball is heavier. All they have is a ruler and a pencil.

1. Design a way to solve this problem. Use a simple machine.

2. Work with a group. Draw your solution.



3. Test your design. Which clay ball is heavier?

Answers will vary.

Explain Your Results

4. Name the simple machine you used.

The simple machine was a lever.

5. What is another way you could use your simple machine?

I could move the pencil closer to one end and use the machine to lift an object.

What might happen if both clay balls weighed the same amount?

Possible answer: The ruler might balance on the pencil, with neither end being weighed down enough to touch the desk.

Lesson 2 Let's Explore! Activity Card

Name _____ Date _____

Materials

- 2 paper cups
- 2 plastic cups
- 2 foam cups
- string

Which design transfers sound the best?

1. Make a small hole in each cup. Use 2 of the cups and 3 meters of string. Thread the string through the hole in the bottom of each cup. Make a big knot.

2. Test your model by talking into the cup. Have your partner listen. The string must be tight. Record how well you hear the sound.

Possible answer: The sound I heard was faint and unclear.

3. Change at least one of the cups in your model. Repeat Step 2.

Possible answer: The sound I heard was louder and clearer.

Explain Your Results

4. Think about your redesign and that of others. Which material worked best for transferring sound?

Possible answer: Plastic worked best.

What do you think would happen if you used a longer string?

Possible answer: The sound would have to travel a greater distance, and I might not hear sounds as clearly as when they travel a shorter distance.

Let's Investigate! Activity Card

Name _____ Date _____

Analyze and Conclude

7. How did this scientific investigation help you determine which bridge was stronger?
Possible answer:
I knew the bridge made from craft sticks was stronger because it held more coins.

8. How are your models like real bridges? How are they different?
Possible answers:
The models are like real bridges because they cross from one high point to another.
They are different because they are smaller and made of weaker materials.

Lessons 1 & 2 Got it? Self Assessment

Name _____ Date _____

Got it? Self Assessment

Complete the statements for each lesson.

Lesson 1 What is a machine?

Stop! I need help with _____

Wait! I have a question about _____

Go! Now I know _____

Lesson 2 What is the design process?

Stop! I need help with _____

Wait! I have a question about _____

Go! Now I know _____

Got it? Quiz

Name _____ Date _____

Got it? Quiz

Circle the choice you think is correct for each multiple choice question.

1. What is the first step of the design process?
- **A** Construct a prototype.
- **B** Identify a problem to be solved.
- **C** Do research.
- **D** Develop possible solutions.

2. A scientist uses what he knows to modify a wedge. The new invention will help keep roads clear of ice and snow in winter. What did the scientist develop?
- **A** a new inquiry
- **B** a new design process
- **C** a new scientific method
- **D** a new technology

3. Which simple machine helps you to hold things together?
- **A** a screw
- **B** an inclined plane
- **C** a pulley
- **D** a wheel and axle

4. What can you do with a lever?
- **A** lift up a box
- **B** hold two boards together
- **C** slice through an object
- **D** turn an axle

5. Which of the following is an example of work?
- **A** solving a math problem
- **B** pushing a rock that does not move
- **C** pushing on a bike pedal
- **D** reading a book

6. An inventor decides on a solution to a problem. What happens next?
- **A** He designs a prototype.
- **B** He communicates his results.
- **C** He redesigns the prototype.
- **D** He does research.

Got it? Quiz

Name _____ Date _____

7. Identify the simple machine that is an inclined plane wrapped around a center post.
- **A** an inclined plane
- **B** a wedge
- **C** a pulley
- **D** a screw

8. What is the best description of a pair of scissors?
- **A** a wedge and a lever
- **B** two cutting wedges and two levers that move the wedges
- **C** two wedges held together by a wheel and axle
- **D** two inclined planes and two levers

9. Explain the steps of the process people follow to design something new.
Possible answer: First, they identify a problem and do research. They develop possible solutions and choose the one they think will work best. They design, construct, and test a prototype. They keep records so they can share their results with others. Finally, they evaluate their prototype and redesign it as necessary.

10. Dave is helping his family load a moving van with boxes. He lifts up each box and places it in the van. He then climbs into the van and moves the box to the back of the truck. What simple machine could help Dave with this task?
Possible answer: Dave could push the boxes up an inclined plane instead of lifting the boxes and then climbing into and out of the van.

Unit 1 Study Guide

How can technology affect our lives?

Lesson 1

What is a machine?

- Machines help people to do work.
- Simple machines have just one or two parts.
- Complex machines are made up of simple machines that work together.

Lesson 2

What is the design process?

- The design process is a step-by-step method used to solve a problem.
- A prototype is the first working product that uses a design.

Review the Big Question

How can technology affect our lives?

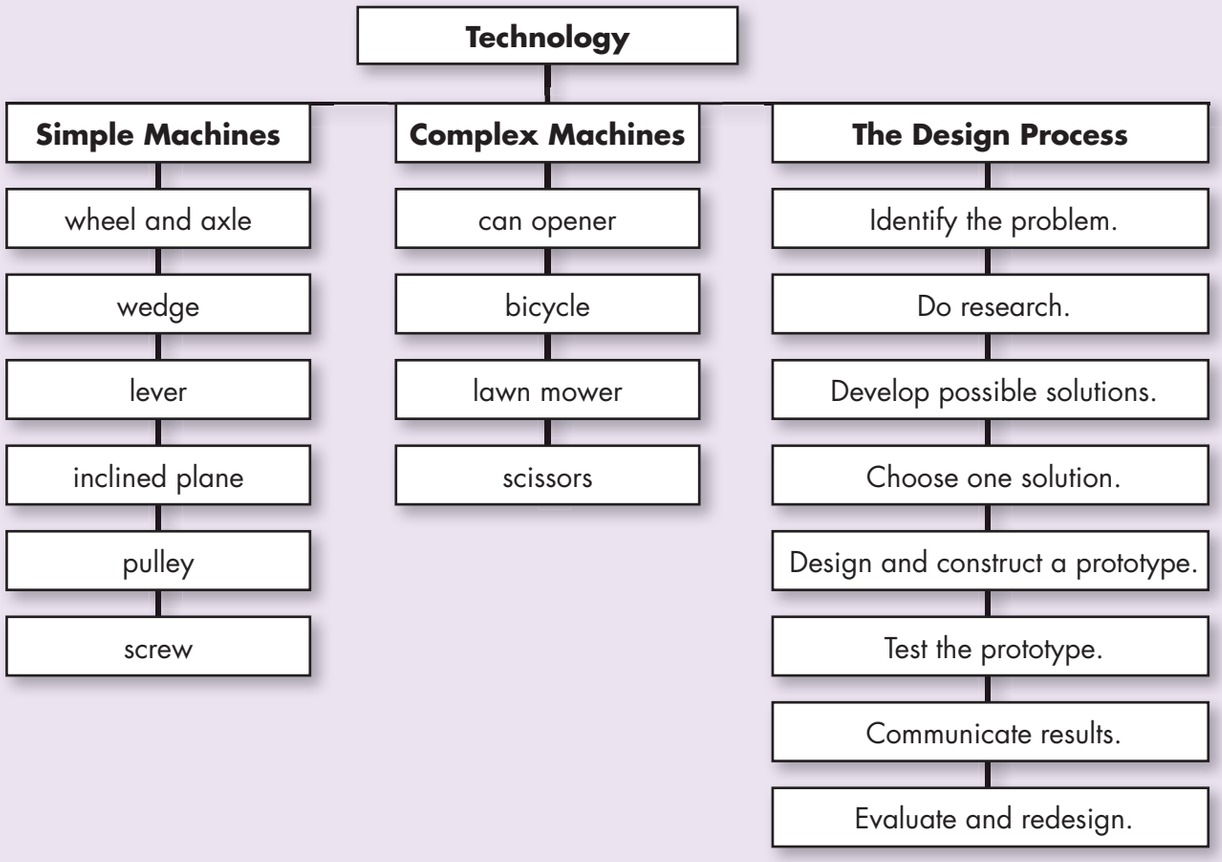
Encourage students to answer the following question in their own words:

How has your answer to the Big Question changed since the beginning of the unit? What are some things you learned that caused your answer to change?

Make a Concept Map

Have students make a concept map like the one shown on this page to help them organize key concepts.

Unit 1 Concept Map



Students can make a concept map to help review the Big Question.

Teacher's Notes