

Teaching Engineering Keeps Us Safe

ENGINEERING KEEPS US SAFE

Interest Level: Grades 4–6

Reading Level: Grade 4

LERNER  SOURCE™

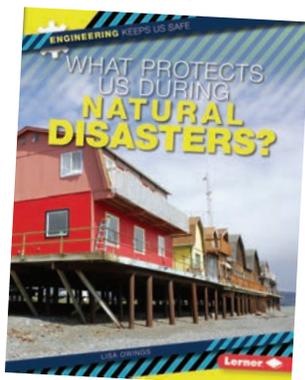
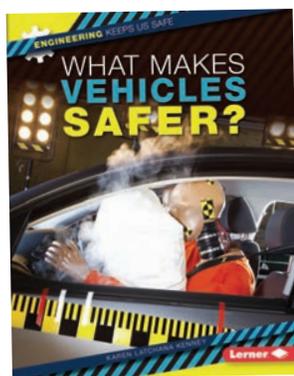
Titles in this series:

What Makes Medical Technology Safer?

What Makes Sports Gear Safer?

What Makes Vehicles Safer?

What Protects Us during Natural Disasters?



Standards

Next Generation Science Standards

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Common Core State Standards

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

RI.4.4 Describe the overall structure (e.g. problem/solution) of events, ideas, concepts, or information in a text or part of a text.

Multiple Intelligences Utilized

Bodily-kinesthetic, interpersonal, intrapersonal, linguistic, logical-mathematical, visual-spatial

Lesson 1

Problem and Solution

Purpose

Students will find problems and solutions identified in the text.

Materials

- *What Makes Medical Technology Safer?*
- Problem and Solution p. 6

Pretest

- What is a problem you've had today?
- How did you solve the problem?
- Why is it important to be able to solve problems?

Read

- Read *What Makes Medical Technology Safer?* with students. You may read this aloud, assign it as independent reading, or read the book with students in small groups.

Discuss

- What types of medical technology did you learn about in this book?
- Why did engineers create these different technologies?
- What is an example of a medical problem that hasn't been solved yet?

Model

- Pass out Problem and Solution p. 6.

- Pass out copies of *What Makes Medical Technology Safer?* or display the pages using a document camera.
- Explain to students that much of medical technology is created to solve a problem. However, before engineers can create a solution, they must identify the problem. In this lesson, students will be focusing on finding problems and solutions within a text.
- Display or ask students to turn to chapter 1.
- Read through the first few paragraphs of chapter 1. Identify the first medical problem mentioned in the text: sometimes our immune systems can't protect us from disease. Lead students in writing this problem on Problem and Solution p. 6.
- Then read the rest of the page aloud as you model searching for the medical technology solution mentioned in the text. When you find the solution, lead students in recording it on Problem and Solution p. 6.

Guided Practice

- Turn to "Disease Detectives" (pp. 8–9).

- Ask students to find a problem on these pages. Call on a student volunteer to identify the problem. Then lead the class in recording the problem on Problem and Solution p. 6.
- Next, give students time to find a solution in the text. Again, call on a student. Then lead the class in recording the solution on the Problem and Solution page.

Independent Practice

- Allow students independent work time to find three more problems and solutions in the text.

Discuss

- What problems did you find in the text?
- What solutions have engineers come up with to solve these problems?
- What is a medical problem that doesn't have a solution yet?
- What ideas could you come up with to solve this problem?

Evaluate

- Review students' Problem and Solution pages for accurate identification of problems and solutions within the text.

Lesson 2

Design a Safety Vehicle

Purpose

Students will design toy cars to keep eggs safe during a crash.

Materials

- *What Makes Vehicles Safer?*
- plastic eggs
- hard-boiled eggs
- toy wheels
- plastic straws
- rubber bands
- craft sticks
- glue
- masking tape
- other craft materials as you see fit
- smooth floor
- downhill ramp

Prepare

- Using the items listed in the materials section, build a small car designed to protect a hard-boiled egg during a crash. Since this is merely an example, it is not necessary that the car be effective at protecting the egg.
- Next, set up a ramp facing a wall in your classroom. Sending a car down the ramp will allow it to build up speed before crashing into the wall, allowing a consistent way for testing and comparing the safeness of students' car designs.

Pretest

- Why is it important to wear a seat belt?
- How do cars keep us safe?
- How do planes keep us safe?

- What can you do to keep yourself safe on a boat?
- What keeps you safe on a train?
- Who helps make vehicles safe?

Read

- Read *What Makes Vehicles Safer?* aloud to students. You may also opt to read the book with students in small reading groups.

Model

- Tell students that during this lesson they will get to think and work like engineers.
- Explain that the class will be broken up into small groups. Each group will be designing a small car. The goal is to see who can make the safest car. After students build their cars, the class will test each car's safety by placing an egg passenger inside and then checking the egg after a crash.
- Place a hard-boiled egg inside the car you prepared. Then place the car at the top of the ramp. Release the car so that it crashes into the wall.
- Remove the egg and examine how well the car protected it.

Activity

- Divide students into small groups. Remind students that each group will be designing a small car to keep an egg safe during a crash.

- Ask groups to name themselves. Make a list of group names on the board.
- Show students the available supplies. Then allow them time to brainstorm with group members and draw possible designs.
- Provide each group with a plastic egg for testing the safety of the car. Then provide each group with an equal number of supplies.
- Allow students time to design, build, and test their car designs.
- Finally, test the safety of each car by placing a hard-boiled egg inside and then sending it down the ramp and into the wall.
- On the board, next to each team name, describe the condition of each egg after a test run. Did the shell crack? Was any of the egg crushed? What shape was the egg after the crash?

Discuss

- Which group did the best job of keeping the egg safe? How can you tell?
- What car designs did the best job of keeping the egg safe?
- If you could redesign your car, what would you change?

Evaluate

- Review the effort and design work of each group's car.

Lesson 3

Preparing for Natural Disasters

Purpose

Students will design ways to protect the school, their families, and themselves during natural disasters.

Materials

- *What Protects Us during Natural Disasters?*
- Disaster Designs p. 7
- writing paper
- drawing paper

Pretest

- What is a natural disaster?
- What is a tornado?
- What is a hurricane?
- What is an earthquake?
- What is a wildfire?
- What is a flood?

Introduction

- Lead students in practicing a fire, flood, earthquake, or tornado drill. Remind students that the school has many procedures to keep students safe during a natural disaster. These drills are just one way that engineers and educators work to keep people and buildings safe during natural disasters. During this lesson, students will learn about other ways engineering keeps us safe.

Read

- Read *What Protects Us during Natural Disasters?* with students. You may read this aloud, assign it

as silent reading, or read the book with students in small groups.

Discuss

- What have engineers done to make buildings and people safer during hurricanes?
- What have engineers done to keep us safer during tornadoes?
- What have engineers done to keep us safer during floods?
- What have engineers done to make buildings safer during earthquakes?
- What systems have engineers designed to help put out fires?

Model/Guided Practice

- Pass out Disaster Designs p. 7, writing paper, and blank paper for drawing designs.
- Select one of the scenarios to use as a model. Read the scenario aloud to the class and then give students time to brainstorm solutions in small groups.
- Call on volunteers to share possible solutions. Talk through these solutions with the class. Brainstorm and discuss until a feasible solution is reached.
- On the board, draw a model of the solution design. Then

write three paragraphs. The first paragraph should explain the design goals. What problems did this design need to fix? The second paragraph should explain how the design solves these problems. Finally, the third paragraph should explain why students chose this design. What made this design better than other designs they considered? Why is this design a good one?

Independent Practice

- Have students turn back to their small groups. Ask each group to choose one of the remaining scenarios on their Disaster Designs pages. Then allow students time to create their design solutions.

Expand

- If time permits, allow students to create designs that solve each of the four scenarios on the Disaster Designs page.

Evaluate

- Review students' designs for feasibility and creative problem solving. Evaluate their written work for completion, evidence of deep thinking, and writing mechanics.

Lesson 4

History of Sports Gear

Purpose

Students will research and present on the history of a piece of sports safety equipment.

Materials

- a variety of sports safety equipment such as shin guards, mouth guards, shoulder pads, helmets, and kneepads
- *What Makes Sports Gear Safer?*
- Safety Gear Research Project p. 8

Pretest

- What do people wear when they play football?
- What should you wear when you play soccer?
- Why do we wear special clothes when we play sports?
- Why do people wear helmets?

Introduction

- Allow students to touch, examine, and try on different types of sports gear. Ask students to think about which sport the gear was designed for and how the gear might protect players.

Read

- Read *What Makes Sports Gear Safer?* with students.

Discuss

- What are examples of sports gear that keep us safe?
- Even though athletes wear safety gear, people sometimes still get hurt playing sports. What equipment could you invent to help keep people even safer?
- What safety gear do you think could be improved? How?

Project

- Pass out Safety Gear Research Project p. 8.
- Review the directions and deadline with students.

Present

- Set aside time for students to share their findings with the class. Each presentation should include a visual aid and should last about three minutes.

Evaluate

- Grade student presentations based on completion and accuracy of research. Did they follow the project's directions? Was it turned in on time? Did they use a visual aid during their presentation?

Name _____

Date _____

Problem and Solution

1. Problem: _____

Solution: _____

Page number(s) _____

2. Problem: _____

Solution: _____

Page number(s) _____

3. Problem: _____

Solution: _____

Page number(s) _____

4. Problem: _____

Solution: _____

Page number(s) _____

5. Problem: _____

Solution: _____

Page number(s) _____

Name _____

Date _____

Disaster Designs

Choose one of the following scenarios. Then work with your group to design a solution to this problem. Draw a picture of your design on a separate piece of paper. Then write a three-paragraph essay explaining the problems you needed to solve, how your design solves these problems, and why you chose your final design over other ideas.

1. Tornado

Businesspeople in your town want to build a new grocery store on Main Street. These businesspeople wanted their grocery store to feel like an outdoor farmers' market, so they've designed a building with huge windows so customers can enjoy natural light while shopping. There's just one problem: Every spring, your town has many tornado warnings. And sometimes you even have real tornadoes! The businesspeople want to keep their original grocery store design, but they can't afford to use impact glass for all the windows. What can they do to protect their store and its customers during a tornado?

2. Earthquake

Your town is near a fault line, a place where pieces of Earth's crust rub together. Scientists have been monitoring the fault, and they think an earthquake might happen any day.

In the center of town is the old city hall. It's one of the oldest buildings in the state! Because it was built so long ago, it wasn't designed to survive an earthquake. Now historians are worried that the city hall will be destroyed when an earthquake eventually happens. What can you do to help protect the building before an earthquake hits in the next few days?

3. Flood

Last year, the town library was damaged when the Mississippi River overflowed, flooding the town. Water poured in through the doors and windows, destroying many of the library's books. After the flood, the library spent thousands of dollars replacing the books, shelves, and flooring ruined by the flood. This year, scientists are predicting that huge snowmelts and heavy rainfalls will cause a flood even larger than last year's. What can you do to keep the library and its books safe?

4. Fire

Your state has been having a terrible drought. It hasn't rained in weeks! The grass in people's yards has died, and the nearby forests are dry as a bone. Town citizens are worried that a wildfire will soon break out. Create a plan to prevent wildfires from damaging the town's buildings and citizens.

Name _____

Date _____

Safety Gear Research Project

Engineering keeps us safe in many different ways. Engineers design buildings to keep us safe during natural disasters. They create vehicles that keep us safe during crashes and vaccines to keep us safe from disease. The work that engineers do develops over time. A modern engineer uses the work of past engineers to make his work even stronger and safer.

For this project, you'll be researching the history of a piece of sports safety equipment, such as a football helmet or a shin guard. Once you finish your research, please prepare a three-minute oral presentation to share with the class. Your presentation should include at least one visual aid. During your presentation, you should answer the following questions:

- What piece of sports safety equipment did you choose?
- When was this item invented?
- Who invented it?
- Why was it invented?
- How has this piece of sports safety equipment changed over the years?
- Why has the design of this equipment changed?
- Are engineers still working to improve this equipment? If so, how are they trying to make it better?
- What ideas do you have to make this piece of sports safety equipment even better?

You presentation will be due on _____.