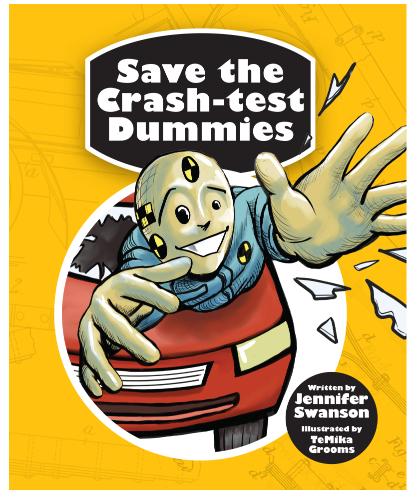
PEACHTREE

TEACHER'S GUIDE

Includes Common Core Standards Correlations

Save the Crash-test Dummies



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Ages 8–12
Lexile • F&P • GRL Y; Grade 6

ABOUT THE BOOK

This entertaining book navigates readers through the history of car production and offers a front-seat view of the science and engineering that makes the world's most important vehicle safe for us to drive.

Cars take us to work. To school. To soccer practice. To the grocery store and home again. Can you imagine a world without them? It's not easy! One of the reasons we can use cars so much in our everyday lives is because they are safe to drive. But that hasn't always been the case. If it weren't for the experiments conducted over decades that involved all kinds of crash-test volunteers—dead, alive, animal, or automated—cars as we know them might not be around. And then how would you get to school?

Filled with fun four-wheeled nuggets of history and explanations of how cars actually work, this nonfiction book will appeal to lovers of all things that go and readers who are interested in getting in under the hood.

TIME TO GO

- Imagine taking a self-driving car to work, as described in this introductory section. How would your experience differ from being driven by a human?
  - Name three possible benefits to driverless cars.
  - Name three possible drawbacks to driverless cars.
- Do you think you would feel safer in an autonomous car?

Chapter One: Under the Hood and Behind the Wheel

- Page 9 lists some of the odd solutions that car engineers conceived to solve some safety issues in the past. For each of the four solutions given:
  - What problem do you think the engineers were attempting to solve?
  - What questions do you think the engineers asked?
  - What problems can you see with the solution?
  - What modern-day safety features solve this problem?
- Describe the job of a car safety engineer, as discussed on page 12.
- What is an anthropomorphic test device (ATD) and what is it used for?
- How are crash-test dummies used to help create safe cars?
- Who are the members of the crash-test dummy family?
- Why do you think it's important to have so many different types and sizes of crash-test dummies?
- Search YouTube for some of the crash-test dummies commercials that the National Highway Traffic

Safety Administration created in the 1980s and 1990s. How would you account for the increase in seat belt-usage following this campaign?
- Create your own crash-test dummies commercial, using the original campaign as inspiration. How do you think people would react to this campaign? What elements could make it appeal more to today's drivers?

Chapter Two: Bumper Cars

- Who was Henry Bliss?
- Have you ever ridden the bumper cars at an amusement park or fair? Why do you think it's safe for bumper cars to crash into each other? Would it be safe to do with a real car?
- Describe how these early versions of the bumper worked:
  - bumper on a Simms-Welbeck car
  - cowcatcher
  - roller safety device
  - bumper on a Ford Model T
  - water-filled bumper
- Before crash-test dummies, there were limited options for safety-testing cars. Some engineers used cadavers. What is a cadaver?
- What are the benefits of using cadavers in this way? What are the drawbacks? Would you donate your body to be used for this kind of scientific research?
- Who was Colonel John Stapp?
- Would you take a job as a human crash-test dummy?
- What invention changed the safety testing-process for the Air Force's ejection seats?
- What changes were made to earlier ATDs like Sierra Sam to make them appropriate for car testing?
- Do cars have bumpers today?
- What is the crumple zone? How does it contribute to the safety of a car?

Engineering Challenge!

Most vehicular accidents are caused by human error. Therefore, it is important to be a safe and focused driver. Choose one of the following human issues. Research your topic online and design a bumper sticker to support safe motor vehicle operation.

- Parking on a hill
- Adjusting mirrors and headrest
- Wearing seatbelts
- Driving in fog
- Using high beams
- Stopping for school buses
- Driving in the rain
- Hydroplaning
- Driving in the snow
- Stopping at a four-way stop
- Sharing the road with cyclists
- Avoiding distractions
- Tailgating
- Giving tractor-trailers space
- Driving tired

Chapter Three: Belt Me In!

- What is the purpose of a seat belt?
- Why did manufacturers not see a need for seat belts in the earliest models of cars? Why did some doctors disagree?
- How is a lap belt different from the seat belt in your car today?
- In 1958, a New Hampshire-based motor vehicle research organization called seat belts "dangerous to the average user under most crash conditions" and "a tool of commercialism." Given this statement, would you have paid extra money to install seat belts in your car at that time?
- Create a chronological timeline of the development of seat belts.
- What was the impact of seat belts on the safety of cars, according to the 1996 statistic?
- Using Isaac Newton's Laws of Motion, explain how a seat belt can prevent injury in a car crash.
- Who was Nils Bohlin and how did his invention save over a million lives?
- What is an automatic seat belt? Why is it no longer in use?
- Why are four-point seat belts not currently used? Why do you think they are used in infant car seats and not in cars?

Engineering Challenge!

This challenge allows students to test the Scientific Method as they create a capsule to protect an egg from a six-foot drop. Of course, a little imagination is going to go a long way here too!

The Scientific Method is an eight step process that engineers, scientists, and inventors use to conceive and problem solve solutions to problems.

Step 1: Ask a Question
Step 2: Do Research
Step 3: Guess an Answer (also called a Hypothesis)
Step 4: Test Your Guess/Hypothesis

Step 5: Did it Work? Could it Be Better? Try Again
Step 6: Draw a Conclusion
Step 7: Write a Written Report of Your Results
Step 8: Retest

After introducing the eight steps to the class, have them form groups:

- Provide a variety of craft items, such as rulers, paper, cardboard tubing, empty boxes, tape, glue, or tin cans. Check the recycling for other materials.
- Provide each group with an egg. Use hard-boiled eggs so that they will crack but not make a mess.
- Have each group create a capsule for their egg that will protect it during a six-foot drop. Most will want to create a container that the whole egg will fit inside for ultimate protection.
- Each group must create an eight-page Scientific Notebook for their capsule, in which they will carefully document their use of the Scientific Method throughout the process.

Once each group has created a prototype, test each one as a class. Did it work? If not, have the group head back to the drawing board like real engineers and then retest their revised design.

Offer awards to increase the competition.

- Strongest Capsule
- Most Attractive Capsule
- Capsule That Used the Most Materials
- Capsule That Used the Least Materials

Chapter Four: Hit the Brakes!

- How does friction affect the brake system of a car?
- How do drum brakes work? Why are they not ideal?
- How do hydraulic brakes work? Why are they preferred over drum brakes?
- How do disc brakes work? What are some issues that affect their performance?
- How do antilock brakes alleviate skidding?
- Search "how car crash testing works" on YouTube to find videos of actual crash tests.

Engineering Challenge!

This challenge allows students to test friction and the concept behind car-braking systems. You will need:

- toy car or truck (at least 4 inches in length, with wheels that turn freely)
- long, wide, smooth board
- rubber bands
- pen or pencil
- lab notebook

1. Place the car on one end of the board. Lift the board until the car begins to roll. Calculate the slope of the incline at the point at which the car began to roll. To do this, divide the length of the board by the height of the incline. Record your data. What does this tell you about the friction between the car wheels and the board?
2. Now wrap rubber bands around both the front and back wheels of the car so that they can't turn. Will the car slide down the incline now? If you raise the board higher, will the car move? If so, calculate the slope and record your data. How does the friction between the board and the locked wheels compare to the friction between the board and the wheels when they were free to move?
3. Next, remove the rubber band from the front wheels, leaving them free to turn. Raise the board again until the car begins to move. Calculate the slope. What happens to the car as it slides down the hill?
4. This time, wrap the rubber band around the front wheels, but remove the rubber band from the back wheels, leaving them free to turn. What happens when you lift the board this time?
5. Analyze all of your data.
6. In a real car, do you think the front or the rear brakes lock first when the driver applies pressure to the brake pedal?
7. Older cars only had brakes on one set of wheels. Do you think the brakes were on the front wheels or the back wheels?

Chapter Five: Airbag Away

- What is an airbag and what is its purpose?
- John W. Hetrick developed the earliest airbag. What were some of the issues with his prototype?
- Explain the chemical reaction that takes place during the deployment of an airbag.
- Why is it important for an airbag to deflate just as fast as it inflates?
- How does an airbag know when to deploy?
- Take a close look at the advantages and disadvantages of airbags. You can even do some of your own research. Do you think the advantages outweigh the disadvantages?
- Why is it necessary for new crash-test dummies to reflect the average weights and heights of humans?
- Explain the use of greasepaint in crash tests.

Chapter Six: Look Out Behind You!

- It is important to focus on what is going on around the outside of the car when you are driving. But drivers are constantly distracted. List at least five reasons a driver may become distracted. How can you eliminate these distractions?
- How many mirrors are found on a car today? Describe each and what it is used for.
- Who was Dorothy Levitt? What did she suggest women use in lieu of rearview mirrors in her book?
- What event made people take note of the rearview mirror in 1911?
- Why do you think calling Elmer Berger's rearview mirror a "Cop-Spotter" made it more popular? What does this say about drivers' priorities?
- Why do you think it took until the 1970s for the rearview mirror to become a standard part of a car?
- What change in roads and highway systems made side-view mirrors a necessity?
- What is a blind spot? Research which of today's cars have the biggest and smallest blind spots.
- Why is a flat side-view mirror used instead of the convex mirror invented by R. Andrew Hicks, which allows drivers to see a wider view behind the car?
- Explain the phrase "objects in mirror are closer than they appear."
- Create a timeline of the development of the backup camera.
- Why did it take so long for backup cameras to be standard in cars?
- What is the benefit of using a backup camera?
- How is the Hybrid III Pedestrian dummy different from other crash-test dummies? What valuable safety information can be gathered using it?

Chapter Seven: Robot Drivers

- Would you feel safe riding in a self-driving car? What aspects might make you feel insecure?
- Describe the early self-driving cars below and explain why they never were mass-produced:
    - American Wonder or the Phantom Auto
    - GM Firebird II
    - VaMoRs
- How did a contest lead to the development of today's self-driving vehicles?
- What three tasks are necessary for a self-driving car? How are each of these tasks achieved?
- Take a close look at the advantages and disadvantages of self-driving cars. Do you think the advantages outweigh the disadvantages?
- How have the developments in self-driving cars changed the design of crash-test dummies?
- Are you looking forward to the future of self-driving cars?

THE ACTIVITIES IN THIS GUIDE DIRECTLY ADDRESS THE FOLLOWING STANDARDS:

Common Core Aligned for Grades 4–7
4th grade: ELA. RI.4.1–4, 7–9; W.4.1, 2, 4, 6–9; SL.4.1–4; L.4.4
5th grade: ELA. RI.5.1–4, 7–9; W.5.1, 2, 4, 6–9; SL.5.1–5; L.5.4
6th grade: ELA. RI.6.1–8; W.6.1–2, 4, 6, 9; SL.6.1–5; L.6.4; RST.6–8.1–3, 7, 9; WHST.6–8.7, 8, 9
7th grade: ELA. RI.7.1–6, 8; W.7.1–2, 4, 6, 7, 8; SL.7.1–5; L.7.4; RST.6–8.1–3, 7, 9; WHST.6–8.7, 8, 9

Next Generation Science Standards for Grades 4–7
4th and 5th grades: 3–5-ETS1–1, 3–5-ETS1–2, 3–5-ETS1–3; 5-PS1–1, 5-PS1–2, 5-PS1–3; 4-PS3–1
6th and 7th grades: MS–ETS1–1, MS–ETS1–2, MS–ETS1–3

REVIEWS

"[An] innovative blend of history, technology, and engineering…insightful fun. STEM at its best."
—***Booklist*, STARRED REVIEW**

"Attractively designed and engagingly written—sure to appeal to readers with a taste for the scientific and technical."
—***Kirkus Reviews***

"The information presented here is interesting, and most readers will find it fascinating to learn how car safety has changed over time."
—***School Library Connection***

ABOUT THE AUTHOR

The author of more than thirty-five nonfiction books for young readers, Jennifer Swanson holds a BS in chemistry from the United States Naval Academy and an MS in K–8 science from Walden University. In addition to being an award-winning author, she is also a middle school science instructor. She lives in Florida.

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