

1-2
40- to 50-minute sessions



ACTIVITY OVERVIEW

Students learn about automobile safety features that decelerate a driver's body more gradually than a driver would have experienced in an accident many years ago. They explore further the concepts of force and acceleration in the context of such safety features as seatbelts and air bags.

KEY CONCEPTS AND PROCESS SKILLS

(with correlation to NSE 5–8 Content Standards)

1. An object that is not being subjected to a force will continue to move at a constant speed in a straight line. (PHYSSCI: 2)
2. The magnitude of a change in motion can be calculated using the relationship $F = ma$, which is independent of the nature of the force. (NSES GRADES 9–12 PHYSSCI: 4; MANY STATE STANDARDS)
3. The potential for accidents and the existence of hazards impose the need for injury prevention. (PERSP: 1)
4. Engineers often build in systems that provide safety. (TECH: 2)
5. Technology influences society through its products and processes. It influences quality of life and ways people act and interact. (PERSP: 5)

KEY VOCABULARY

acceleration
deceleration
force
inertia

MATERIALS AND ADVANCE PREPARATION



For each student

- 1 Student Sheet 84.1, “Talking Drawing: Safety Features”
- 1 Student Sheet 84.2, “Three-Level Reading Guide: Decelerating Safely”

**Not supplied in kit*

TEACHING SUMMARY

Getting Started

1. Introduce the concept of deceleration as it relates to acceleration.
2. (LITERACY) Use a Talking Drawing to elicit students’ current knowledge.

Doing the Activity

3. (LITERACY) Students read about the safety features in vehicles.


Follow-Up

4. Students revise their earlier ideas about vehicle safety.

TEACHING SUGGESTIONS

■ GETTING STARTED

1. Review the concept of deceleration as it relates to acceleration.

 Ask the class to think about their experiences as passengers in cars. Ask, *How do you know when you are accelerating while traveling in a car?* Students should describe situations such as starting up from a stoplight or passing a vehicle. They may know acceleration is happening when they have the feeling of being pushed back in the seat while the car accelerates forward. Ask, *How do you know when you are decelerating while traveling in a car?* A vehicle that is decelerating, such as when a car comes to a stop, will make passengers feel like they are thrown forward as the car accelerates backward (decelerates). Use these examples to review the concept of acceleration and deceleration but also to reinforce the role of inertia within moving cars. It is a person's inertia that makes him or her continue to travel during deceleration (that "thrown forward" feeling). The same reasons cause passengers to feel like they "stay behind" and get pushed against the seatback during acceleration. Let students know that in this activity they will investigate the effects of decelerations in car collisions.

2. (LITERACY) Use a Talking Drawing to elicit students' current knowledge.

Before students start the Reading, introduce Student Sheet 84.1, "Talking Drawing: Safety Features." The Talking Drawing literacy strategy helps students construct meaning by asking them to draw images on a particular topic both before and after reading about it, and then having them explain how their drawings have changed as a result of the reading. These parts of the Talking Drawing are completed after students have completed the activity. Ask students to complete the first part of Student Sheet 84.1.

■ DOING THE ACTIVITY

3. (LITERACY) Students read about the safety features in vehicles.


During the reading, students are provided an opportunity to improve their performance in reading comprehension, particularly of informational text. Student Sheet 84.2, "Three-Level Reading Guide: Decelerating Safely," guides students through the text and through three levels of understanding: literal, interpretive, and applied. Students look at a list of statements and determine which ones are supported by the text. For more information on Three-Level Reading Guides and on Talking Drawings, see the literacy section of Teacher Resources II: Diverse Learners.

Possible responses to the reading guide are shown on the next page. Note that the statements 3a, 3b and 3c (applied level of understanding) do not have a single correct response. Students may interpret information differently and agree or disagree with each statement. Whatever their perspective, it is important that students be able to explain and support their positions.

■ FOLLOW-UP

4. Students revise their earlier ideas about vehicle safety.

Review the Analysis Questions with students. Emphasize that the major principles behind safety features are that slower deceleration results in a reduction in force and a larger area of impact results in a reduction of the force per unit area or pressure. Some devices can mitigate injuries and fatalities in more than one way. Seatbelts, for example, help reduce the collision force by increasing the area of the force across a person's body, redirecting the force from the head to the broader torso, and by decelerating the body over more time than if it hit the steering wheel or dashboard.


 When discussing Analysis Question 4, explain that the steady fatality rate has been attributed to many things and that

Activity 84 • Decelerating Safely

no one factor seems to stand out as a cause. Some of the factors that tend to keep the fatality rate about the same are:

- more distractions, such as cell phones and hand-held electronic devices
- a larger number of older drivers
- lack of seatbelt use (almost 40% of all passengers killed are not wearing seatbelts)
- reintroduction of higher speed limits
- less car uniformity (mass, bumper height) when vehicles collide



 At the end of the activity, have students complete the second part of Student Sheet 84.1, “Talking Drawing: Safety Features.” Their ideas should reflect the content of the reading and the class discussion. For example, a student may add more safety features, such as crumple zones and padded dashboards. When everyone has finished, have students share their work and discuss with the class how their ideas have changed.

Response to Student Sheet 84.2, “Three-Level Reading Guide: Decelerating Safely”

1. Check the statements below that you think say what the reading says. Sometimes the exact words found in the reading are used. At other times, other words may be used to communicate the same meaning.
 - _____ **a.** When a car stops suddenly, the passengers’ inertia keeps them moving until they hit something.
 - _____ **b.** Air bags increase the pressure on the body during an accident.
 - _____ **c.** A crumple zone helps passengers avoid harmful forces during an accident.

2. Check the statements below that you think represent the intended meaning of the reading.
 - _____ **a.** Brakes work by decreasing the friction between the brake pads and the wheels.
 - _____ **b.** Controlling the deceleration of the passengers helps reduce injuries in an accident.
 - _____ **c.** Air bags help passengers concentrate the impact on one small area of the forehead instead of spreading it out over the head, neck, and shoulders.

3. Check the statements below that you agree with, and be ready to support your choices with ideas from the reading and from your own knowledge.
 - _____ **a.** Safety features have not improved much over the years.

 - _____ **b.** Tires are the most important safety item.

 - _____ **c.** Designing safe cars is more important than reducing driver distractions.