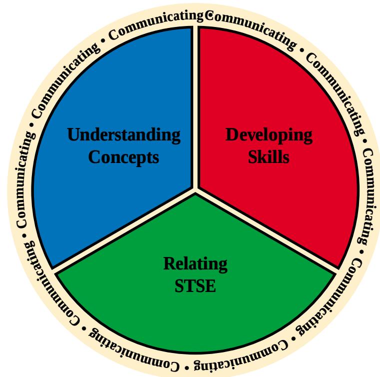
How does *Nelson Physics 11* match the curriculum?

Balanced Instruction and Assessment

- *Nelson Physics 11* reflects the overall aim of the secondary science program, which is to "ensure scientific literacy for every secondary school graduate." (*The Ontario Curriculum, Grades 11 and 12, Science*, p. 6), as well as the primary objective of the *Physics, Grade 11, University Preparation* curriculum, which is to "equip students with the knowledge and skills they need to meet the entrance requirements for university programs."

  The Ontario Curriculum, Grades 9 to 12 Program Planning and Assessment, p. 3



- *Nelson Physics 11* addresses 100% of the *Physics, Grade 11, University Science Preparation* (SPH3U) course curriculum expectations

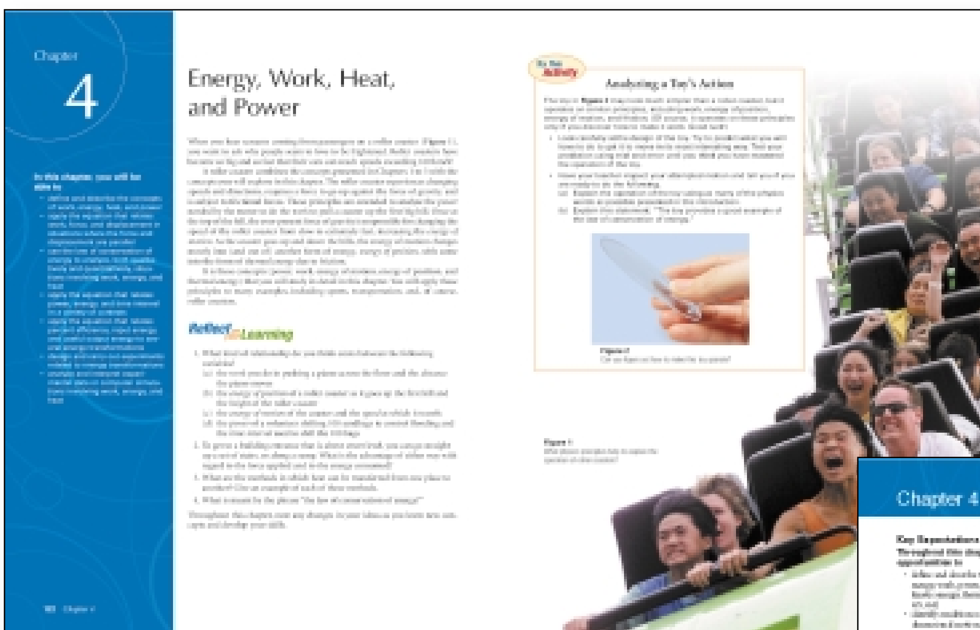
- *Nelson Physics 11* provides a balance of instruction and assessment, reflecting the three goals of secondary science curriculum, which are:

  A Understand the basic concepts of science

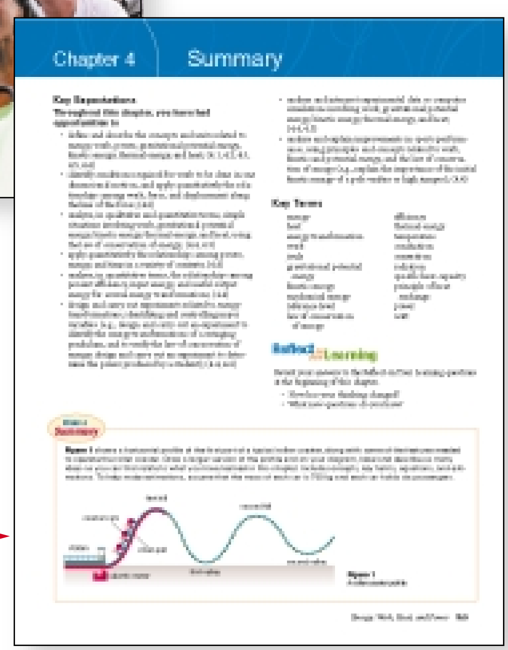
  B Develop the skills, strategies, and habits of mind required for scientific inquiry

  C Relate science to technology, society, and the environment

  The Ontario Curriculum, Grades 11 and 12, Science, p. 6



The Chapter Opener describes the key student expectations for the unit. Curricular expectations are synthesized into an easy-to-understand "student language" format.



The chapter-ending Summary feature lists the specific Key Expectations addressed, and points to where the expectations have been addressed in the chapter. The expectations are expressed in the same language used in the curriculum document.

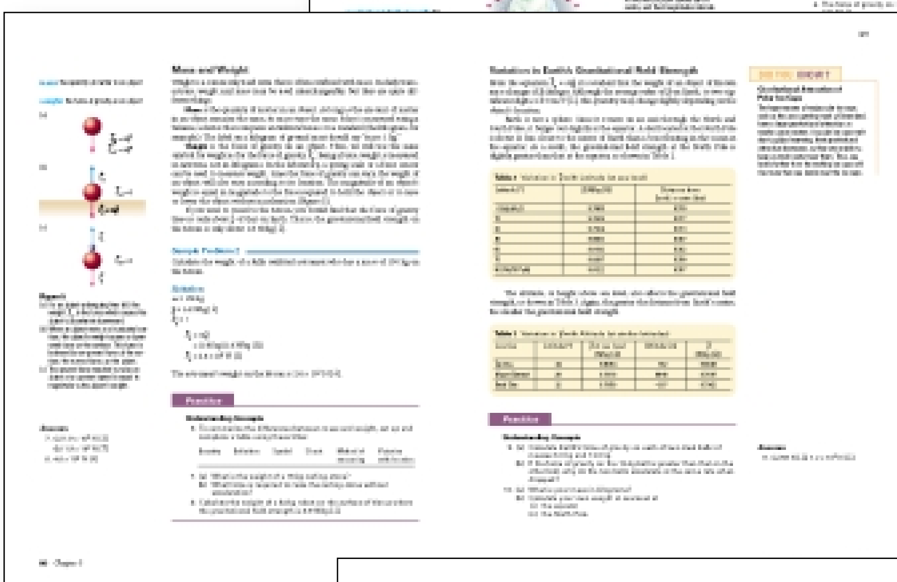
A Understand the Basic Concepts of Science

Nelson Physics 11 provides complete and accurate coverage of all content in Ontario's *Physics*, *Grade 11, University Preparation* Science Curriculum (SPH3U). The goal of the program is to adequately prepare students for success in *Physics, Grade 12, University Preparation* (SPH4U), and future post-secondary studies. Concepts fundamental to each strand in the curriculum are developed with text and images. Students learn to apply a number of strategies, such as using headings, reading labels, and interpreting diagrams to assist their understanding of concepts.

Specific Expectation Addressed

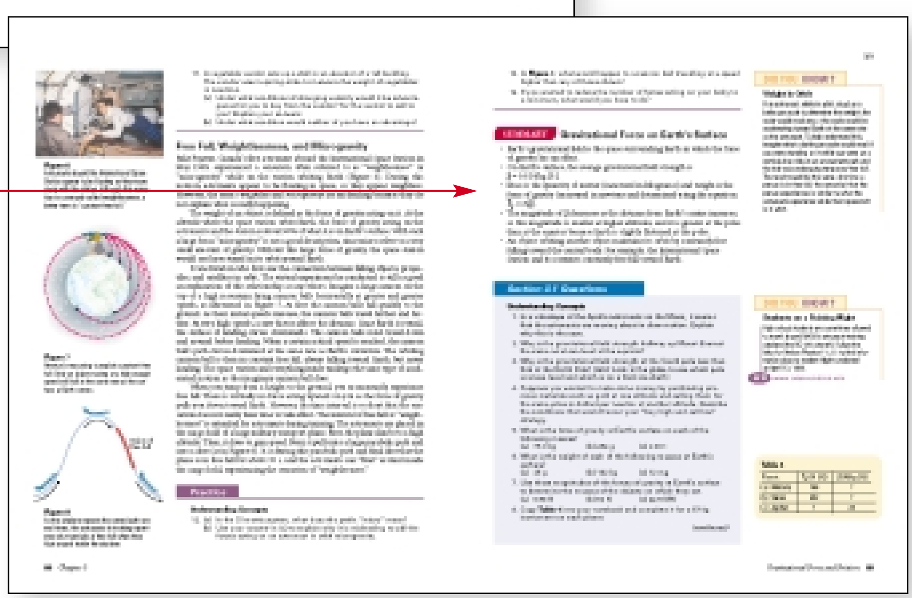
- analyse and describe the forces acting on an object near, and at a distance from, the surface of the Earth

Ontario Curriculum, Grades 11 and 12, Science, p. 91



Concept/Skill Summary

A point-form summary of the major concepts or skills presented in the section intended to aid in study. It could be a summary of the steps required to solve a particular class of problems.



B Develop the Skills, Strategies, and Habits of Mind Required for Scientific Inquiry

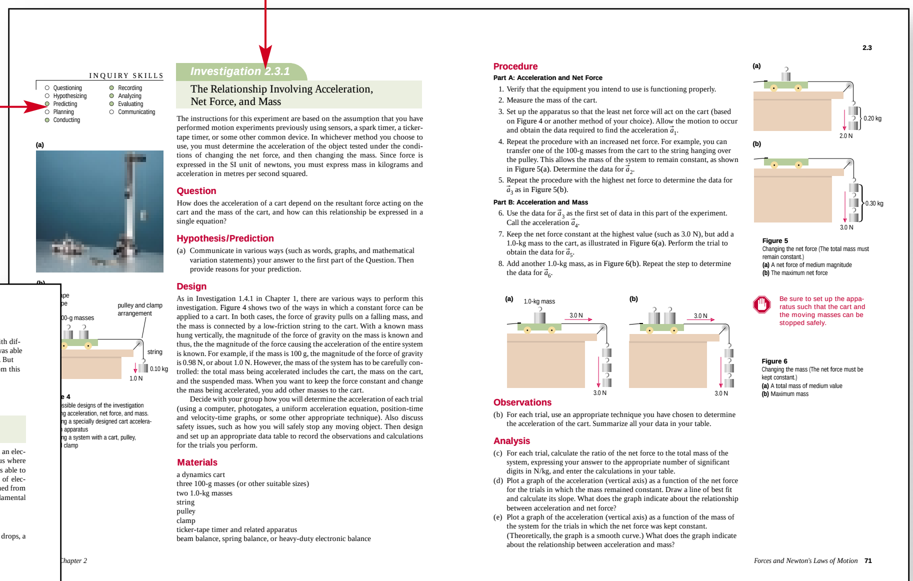
Investigations, Activities, Lab Exercises ("Dry labs"), and *Try This Activities* give students the opportunity to develop scientific inquiry and communications skills. "Directed" investigations strategically integrated throughout the text engage students in observing and experimenting. "Open-ended" investigations require students to plan and conduct their own investigations, form hypotheses, or choose their own questions to investigate. *Inquiry Skills Menus* indicate the skills being developed in investigations. Additional lab-based activities, including computer interface labs, are provided in the teacher support materials.

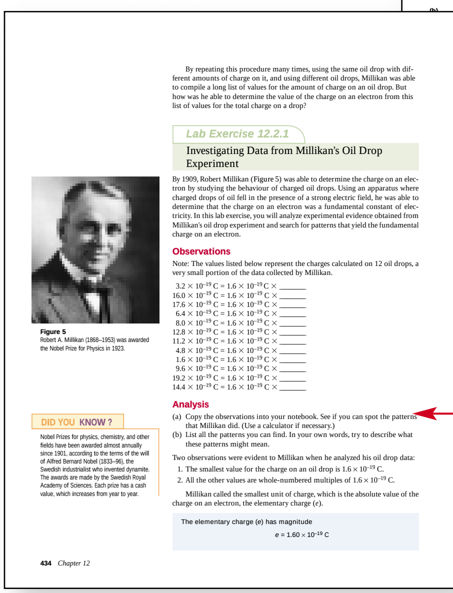
Specific Expectation Addressed

- carry out experiments to verify Newton's second law of motion

Ontario Curriculum, Grades 11 and 12, Science, p. 91

Inquiry Skills Menu





Lab Exercises (Dry Labs) give students an opportunity to analyze experimental evidence and answer questions based on the evidence supplied. The students do not actually carry out a "real" experiment. Students may be asked to evaluate the procedure, the experimental design, provide alternatives, and possibly even arrive at a synthesis of ideas using knowledge gained from various previous experiences.

Try This Activity boxes are short hands-on activities using readily available materials. These activities appear periodically throughout each chapter and give students an informal opportunity for skill development.

Try This Activity

The Bicycle Braking System

Look carefully at the braking system of a bicycle with hand brakes and obtain the Owner's Manual for the same bike, or find another resource that features the technology of bicycle brakes.

(a) Describe in words and/or diagrams how the brakes operate. Include any discussion of friction.
(b) Describe how to adjust the brakes to increase their ability to help the rider stop. Why are such adjustments needed?
(c) Under what conditions does maximum braking occur?
(d) List suggestions to maintain the safety of brakes used on a bicycle.
(e) Use at least one of Newton's laws of motion to describe why you think you should transfer your weight backward when you are braking hard.

C Relate Science to Technology, Society, and the Environment

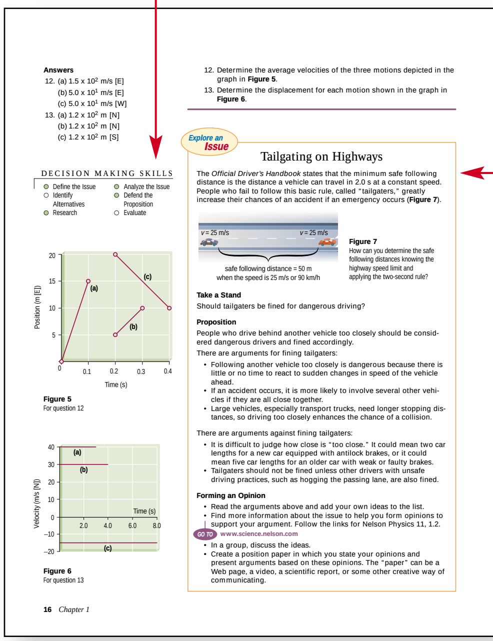
The important goal of relating science to technology, society, and the environment (STSE) is integrated throughout the student text and is linked to students' learning of scientific concepts and skills in real-world contexts.

Decision Making Skills Menu

Specific Expectation Addressed

• analyse and explain the relationship between an understanding of forces and motion and an understanding of political, economic, environmental, and safety issues in the development and use of transportation technologies (including terrestrial and space vehicles) and recreation and sports equipment.

Ontario Curriculum, Grades 11 and 12, Science, p. 92



Answers
12. (a) 1.5 x 10² m/s [E] (b) 5.0 x 10¹ m/s [E] (c) 5.0 x 10¹ m/s [W]
13. (a) 1.2 x 10² m [N] (b) 1.2 x 10² m [N] (c) 1.2 x 10² m [S]

12. Determine the average velocities of the three motions depicted in the graph in Figure 5.
13. Determine the displacement for each motion shown in the graph in Figure 6.

DECISION MAKING SKILLS: Define the Issue, Identify Alternatives, Research, Analyze the Issue, Defend the Proposition, Evaluate

Explore an Issue — Tailgating on Highways

The *Official Driver's Handbook* states that the minimum safe following distance is the distance a vehicle can travel in 2.0 s at a constant speed. People who fail to follow this basic rule, called "tailgaters," greatly increase their chances of an accident if an emergency occurs (Figure 7).

Figure 7: How can you determine the safe following distances knowing the highway speed limit and applying the two-second rule?

Take a Stand: Should tailgaters be fined for dangerous driving?

Proposition: People who drive behind another vehicle too closely should be considered dangerous drivers and fined accordingly.

There are arguments for fining tailgaters:
- Following another vehicle too closely is dangerous because there is little or no time to react to sudden changes in speed of the vehicle ahead.
- If an accident occurs, it is more likely to involve several other vehicles if they are all close together.
- Large vehicles, especially transport trucks, need longer stopping distances, so driving too closely enhances the chance of a collision.

There are arguments against fining tailgaters:
- It is difficult to judge how close is "too close." It could mean two car lengths for a new car equipped with antilock brakes, or it could mean five car lengths for an older car with weak or faulty brakes.
- Tailgaters should not be fined unless other drivers with unsafe driving practices, such as hogging the passing lane, are also fined.

Forming an Opinion
- Read the arguments above and add your own ideas to the list.
- Find more information about the issue to help you form opinions to support your argument. Follow the links for Nelson Physics 11, 1.2. GO TO www.science.nelson.com
- In a group, discuss the ideas.
- Create a position paper in which you state your opinions and present arguments based on these opinions. The "paper" can be a Web page, a video, a scientific report, or some other creative way of communicating.

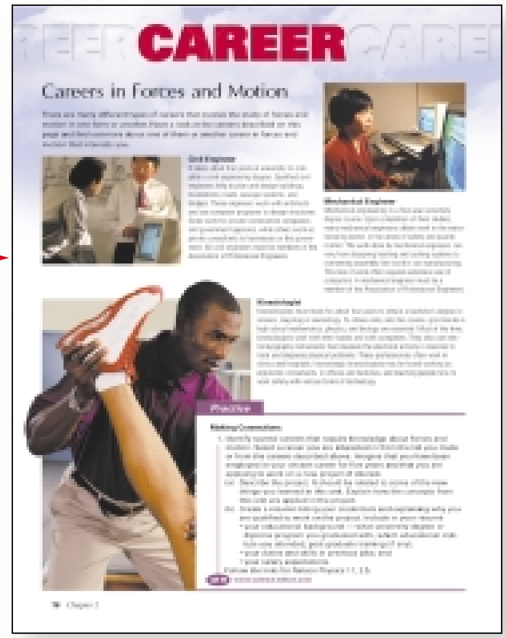
Figure 5: For question 12
Figure 6: For question 13

16 Chapter 1

Specific Expectation Addressed

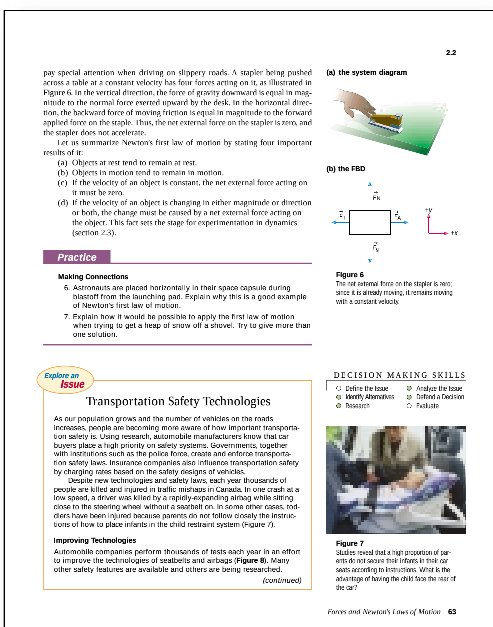
• identify and describe science- and technology-based careers related to forces and motion

Ontario Curriculum, Grades 11 and 12, Science, p. 90



CAREER

Careers in Forces and Motion



pay special attention when driving on slippery roads. A stapler being pushed across a table at a constant velocity has four forces acting on it, as illustrated in Figure 6. In the vertical direction, the force of gravity downward is equal in magnitude to the normal force exerted upward by the desk. In the horizontal direction, the backward force of moving friction is equal in magnitude to the forward applied force on the stapler. Thus, the net external force on the stapler is zero, and the stapler does not accelerate.

Let us summarize Newton's first law of motion by stating four important results of it:
(a) Objects at rest tend to remain at rest.
(b) Objects in motion tend to remain in motion.
(c) If the velocity of an object is constant, the net external force acting on it must be zero.
(d) If the velocity of an object is changing in either magnitude or direction or both, the change must be caused by a net external force acting on the object. This fact sets the stage for experimentation in dynamics (section 2.3).

Practice — Making Connections
6. Astronauts are placed horizontally in their space capsule during blastoff from the launching pad. Explain why this is a good example of Newton's first law of motion.
7. Explain how it would be possible to apply the first law of motion when trying to get a heap of snow off a shovel. Try to give more than one solution.

Explore an Issue — Transportation Safety Technologies

As our population grows and the number of vehicles on the roads increases, people are becoming more aware of how important transportation safety is. Using research, automobile manufacturers know that car buyers place a high priority on safety systems. Governments, together with institutions such as the police force, create and enforce transportation safety laws. Insurance companies also influence transportation safety by charging rates based on the safety designs of vehicles.

Despite new technologies and safety laws, each year thousands of people are killed and injured in traffic mishaps in Canada. In one crash at a low speed, a driver was killed by a rapidly-expanding airbag while sitting close to the steering wheel without a seatbelt on. In some other cases, toddlers have been injured because parents do not follow closely the instructions of how to place infants in the child restraint system (Figure 7).

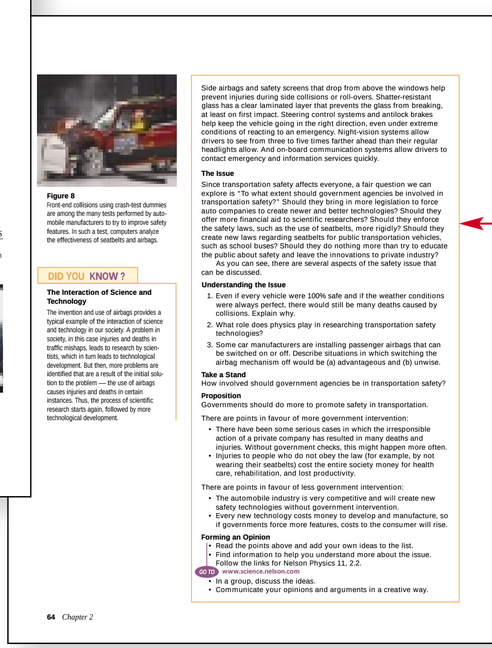
Improving Technologies: Automobile companies perform thousands of tests each year in an effort to improve the technologies of seatbelts and airbags (Figure 8). Many other safety features are available and others are being researched. (continued)

(a) the system diagram (b) the FBD

Figure 6: The net external force on the stapler is zero; since it is already moving, it remains moving with a constant velocity.

Figure 7: Studies reveal that a high proportion of parents do not secure their infants in their car seats according to instructions. What is the advantage of having the child face the rear of the car?

Forces and Newton's Laws of Motion 63



Side airbags and safety screens that drop from above the windows help prevent injuries during side collisions or roll-overs. Shatter-resistant glass has a clear laminated layer that prevents the glass from breaking, at least on first impact. Steering control systems and antilock brakes help keep the vehicle going in the right direction, even under extreme conditions of reacting to an emergency. Night-vision systems allow drivers to see from three to five times farther ahead than their regular headlights allow. And on-board communication systems allow drivers to contact emergency and information services quickly.

The Issue: Since transportation safety affects everyone, a fair question we can explore is "To what extent should government agencies be involved in transportation safety?" Should they bring in more legislation to force auto companies to create newer and better technologies? Should they offer more financial aid to scientific researchers? Should they enforce the safety laws, such as the use of seatbelts, more rigidly? Should they create new laws regarding seatbelts for public transportation vehicles, such as school buses? Should they do nothing more than try to educate the public about safety and leave the innovations to private industry? As you can see, there are several aspects of the safety issue that can be discussed.

Understanding the Issue
1. Even if every vehicle were 100% safe and if the weather conditions were always perfect, there would still be many deaths caused by collisions. Explain why.
2. What role does physics play in researching transportation safety technologies?
3. Some car manufacturers are installing passenger airbags that can be switched on or off. Describe situations in which switching the airbag mechanism off would be (a) advantageous and (b) unwise.

Take a Stand: How involved should government agencies be in transportation safety?

Proposition: Governments should do more to promote safety in transportation.

There are points in favour of more government intervention:
- There have been some serious cases in which the irresponsible action of a private company has resulted in many deaths and injuries. Without government checks, this might happen more often.
- Injuries to people who do not obey the law (for example, by not wearing their seatbelts) cost the entire society money for health care, rehabilitation, and lost productivity.

There are points in favour of less government intervention:
- The automobile industry is very competitive and will create new safety technologies without government intervention.
- Every new technology costs money to develop and manufacture, so if governments force more features, costs to the consumer will rise.

Forming an Opinion
- Read the points above and add your own ideas to the list.
- Find information to help you understand more about the issue. Follow the links for Nelson Physics 11, 2.2. GO TO www.science.nelson.com
- In a group, discuss the ideas.
- Communicate your opinions and arguments in a creative way.

Figure 8: Front-end collisions using crash-test dummies are among the many tests performed by automobile manufacturers to try to improve safety features. In such a test, computers analyze the effectiveness of seatbelts and airbags.

DID YOU KNOW? The Interaction of Science and Technology: The invention and use of airbags provides a typical example of the interaction of science and technology in our society. A problem in society, in this case injuries and deaths in traffic mishaps, leads to research by scientists, which in turn leads to technological development. But then, more problems are identified that are a result of the initial solution to the problem — the use of airbags causes injuries and deaths in certain instances. Thus, the process of scientific research starts again, followed by more technological development.

64 Chapter 2

Specific Expectation Addressed

• evaluate the design of technological solutions to transportation needs and, using scientific principles, explain the way they function

Ontario Curriculum, Grades 11 and 12, Science, p. 92