Chapter Challenge


Chapter Challenge

3

Safety

Scenario

Traveling can be dangerous. The need to get to a destination quickly and the large number of people and vehicles on the move have made traveling hazardous. There is a greater chance of being killed or injured while traveling than during any other common activity. Realizing this risk, manufacturers of vehicles and governments have begun to take action to alter the statistics. New safety systems have been designed and put into use in automobiles, trains, and airplanes. New laws and an awareness of safety are working together with these systems to reduce the danger in traveling.

What are these new safety systems? You are probably familiar with many of them. In this chapter, you will become even more familiar with some of these systems. Could you design or even build a better safety device for an automobile or a plane? Many students around the country have been doing just that and with great success!

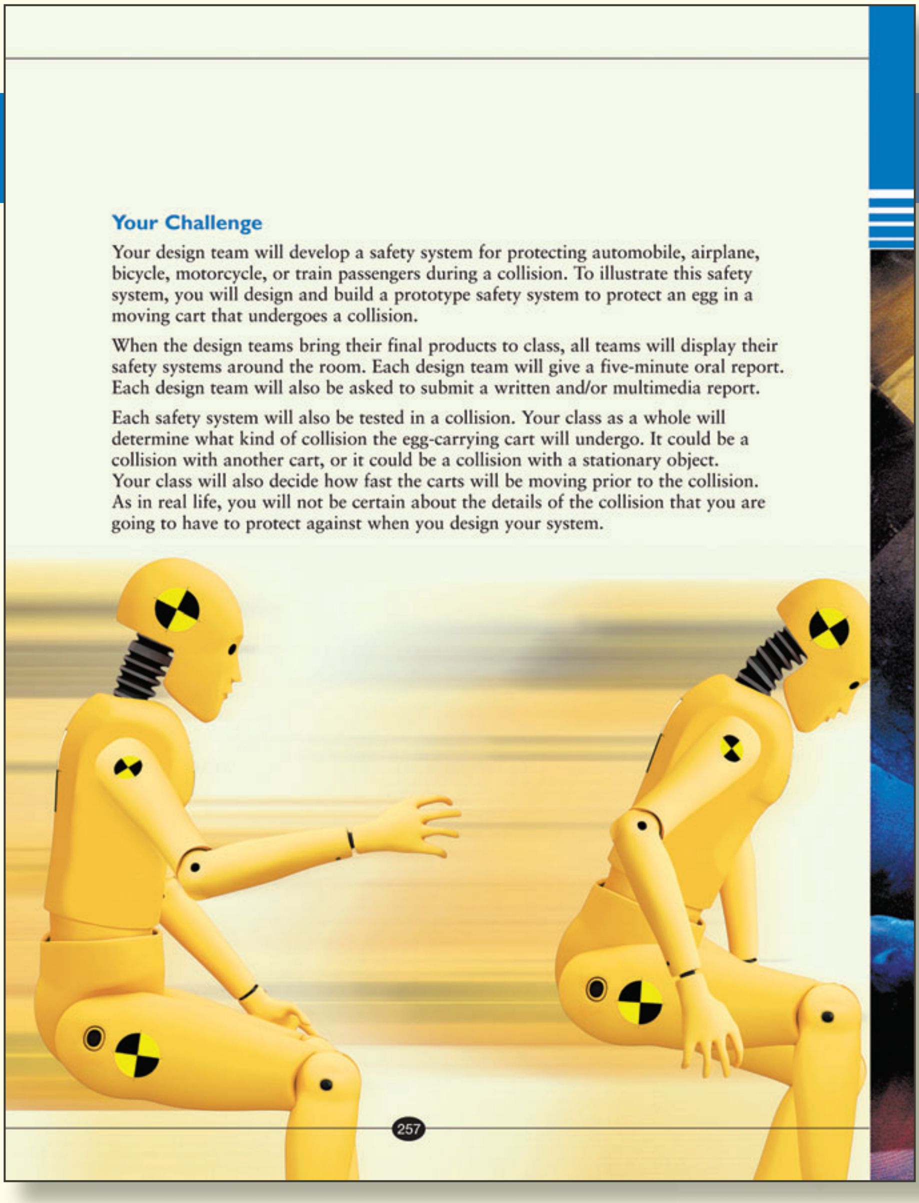
256

Scenario

Consider having students read the *Scenario* aloud. Ask them about the safety devices used in various vehicles. Have the class discuss ideas while categorizing these devices either on the board or on an overhead. Ask students how their knowledge of physics will help them build a safety system that will reduce the risk of injury or death in an accident. Encourage students to share their stories and experiences that relate to the topic.

Keep the *Scenario* focused on the main topic by prompting students to support their responses. You may want to invite a professional who can discuss the safety features in vehicles. Emphasize the importance of how the knowledge of physics will help improve the design of safety features.

Review the title of each section in the *Table of Contents,* and remind students that the content of each section corresponds to physics concepts they will need to apply to complete the challenge. Reassure the class that while they may not feel prepared now, by the end of the chapter they will have the skills and vocabulary to respond adequately. Suggest strategies to students to keep track of the information presented in each section, such as making a concept map during the chapter, outlining information, or keeping a record of concepts and examples they deem important in their *Active Physics* logs. Avoid providing students with too many examples of what could be done to complete the challenge, as this may limit their creativity and confidence in seeking their own solutions.



Your Challenge

Your design team will develop a safety system for protecting automobile, airplane, bicycle, motorcycle, or train passengers during a collision. To illustrate this safety system, you will design and build a prototype safety system to protect an egg in a moving cart that undergoes a collision.

When the design teams bring their final products to class, all teams will display their safety systems around the room. Each design team will give a five-minute oral report. Each design team will also be asked to submit a written and/or multimedia report.

Each safety system will also be tested in a collision. Your class as a whole will determine what kind of collision the egg-carrying cart will undergo. It could be a collision with another cart, or it could be a collision with a stationary object. Your class will also decide how fast the carts will be moving prior to the collision. As in real life, you will not be certain about the details of the collision that you are going to have to protect against when you design your system.

257

Your Challenge

Have a class discussion about the challenge and the expectations. Let the class know that each design team will build a prototype that will be tested in class, present an oral presentation to the class, and turn in a written report. Emphasize that all students should be able to explain the main physics concepts during their presentation.

Let the class know that each prototype will carry an egg as a passenger, and undergo a collision. The type of collision will be decided upon by the class, but not until after they have completed designing and building their prototypes. Emphasize that this means that students will be learning about collisions. If students have completed other *Active Physics* chapters, ask them what physics concepts from these chapters they think they can apply to the challenge.

Assure students that as the class progresses through the chapter, they will become more familiar with the content and will be able to connect the physics principles to their *Chapter Challenge*. Remind students that each new concept builds upon the others, providing tools to strengthen their presentation.

Criteria for Success

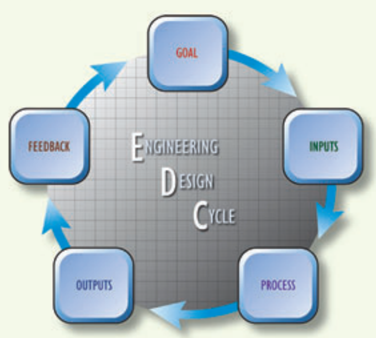
Have a class discussion about the criteria for evaluating the safety system, oral presentation, and written report. Develop a rubric with the class to use during this chapter. Consider starting the discussion by recording a list of important criteria for the *Chapter Challenge*. Make frequent references to the physics principles that are likely to be considered. The criteria should include accurate and clear explanations with original ideas. It is important to recognize each student's contribution during this discussion. This will facilitate student understanding on the assessment criteria. The criteria listed in the *Sample Criteria for Excellence* should be included, as well as any state standards and benchmarks. Consider using the Blackline Master of the *Sample Criteria for Excellence* while guiding the class discussion.

Chapter Challenge

Criteria for Success

You and your classmates will work with your teacher to define the criteria for evaluating your safety system, your presentation, and your written report. After discussion about what features should be included in the grading of each part of the project, you should then read some of the suggestions below. Then you will determine the relative importance of the assessment criteria. Next, assign point values to each. The following are suggestions of point values for each part.

Standard for Excellence	
1. The quality of your safety-system model or prototype, and the ability of the prototype to protect the egg during the collision	40 points
2. The quality of a five-minute oral report • the need for the system • the method used to develop the working model • the demonstration of the working model • the discussion of the physics concepts involved • the description of the next-generation version of the system • the answers to questions posed by the class	30 points
3. The quality of a written and/or multimedia report • the information from the oral report • the documentation of the sources of expert information • the discussion of consumer acceptance and market potential • the discussion of the physics concepts applied in the design of the safety system	30 points



Engineering Design Cycle

You have now heard about the *Chapter Challenge* to design a new safety system for a vehicle of your choice. You will use a simplified *Engineering Design Cycle* to help your group create the best safety system you can with the materials that are available to you. Defining the *Goal* is the first step in the *Engineering Design Cycle*. Since you have already read the criteria for the challenge and considered some of the constraints, you have already begun.

You probably don't have a complete vision of how you will create your safety system yet, but the chapter sections will help you. As you experience each one of the sections you will be gaining *Inputs* to use in the design cycle. These *Inputs* will include new physics concepts, vocabulary, and even calculations that will help you to create a successful design.

258

Read aloud the criteria that the class has decided upon. This may bring up other interesting points that could be used to reinforce or modify the criteria. After the class has agreed upon each criterion, develop a point system with the class for grading the challenge. Consider asking students what details of each portion of the challenge are necessary for an A, B, C, D, and so on, or have the class decide how many points each part is worth. For example, you may want to have students assign fewer points to the aesthetic qualities of the report or presentation, and more points for explanations using physics principles. The assessment rubric should place the greatest emphasis on showing understanding of physics concepts, and should include the criteria in the student text. Make sure that students understand the criteria and the rubric before they begin their work.

Standard for Excellence

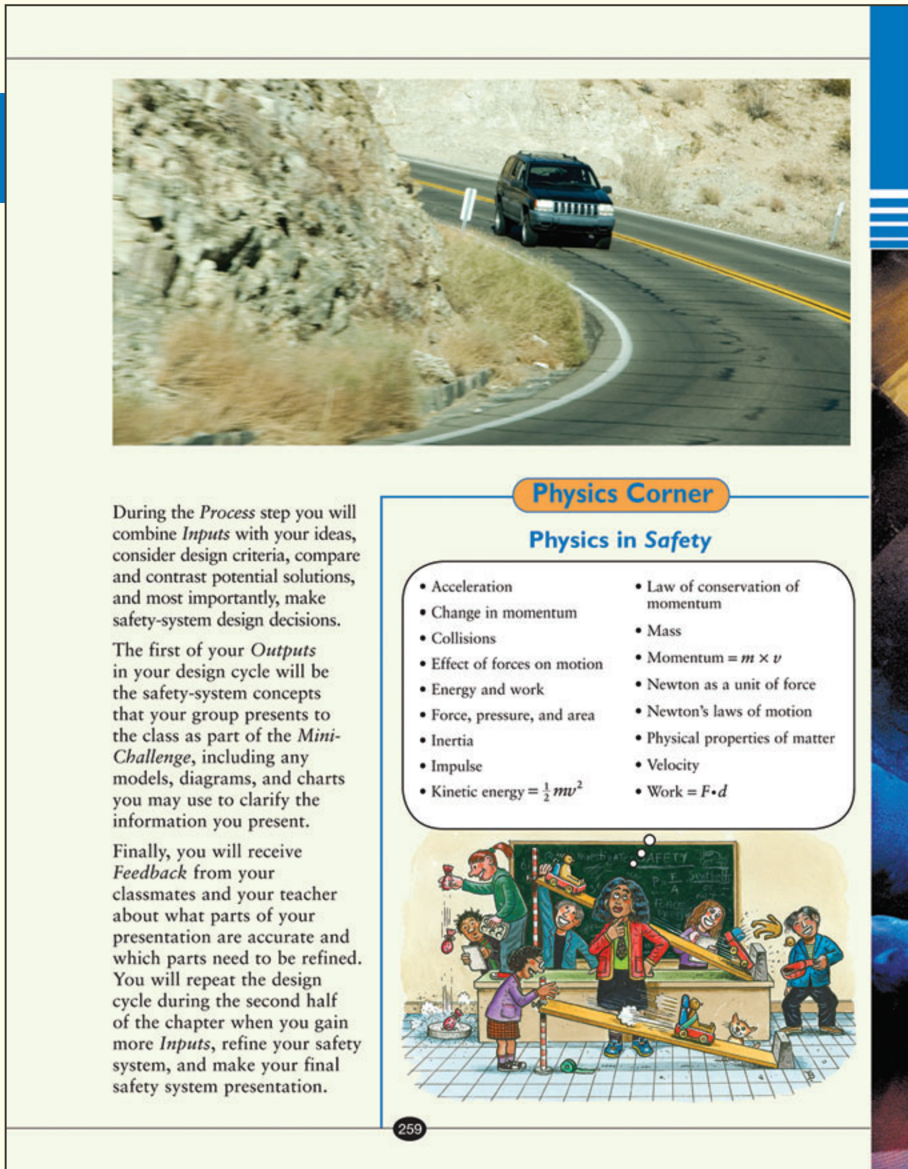
It is important for students to decide on the criteria for grading the *Chapter Challenge* themselves. Deciding the criteria will give them a voice in determining how their projects will be judged. You can help them arrive at a list of criteria by outlining those aspects of the *Chapter Challenge* that should be rated. Some criteria are listed in the *Standard for Excellence* table with suggested point values. An example of further describing and/or adding criteria and how the points could be distributed is provided in the student text. Remember the primary purpose of establishing the criteria necessary to earn an 'A' is to motivate students to succeed and to keep them focused.

As the *Chapter Challenge* approaches, you will want to develop a more comprehensive assessment rubric which will determine grading and expectations that meet your own evaluation system. A complete *Sample Assessment Rubric* for *Chapter 3* is located at the end of the chapter in this *Teacher's Edition*.

3-a **Blackline Master**

Engineering Design Cycle

Discuss with the class the *Engineering Design Cycle*. Consider using a projection of



During the *Process* step you will combine *Inputs* with your ideas, consider design criteria, compare and contrast potential solutions, and most importantly, make safety-system design decisions.

The first of your *Outputs* in your design cycle will be the safety-system concepts that your group presents to the class as part of the *Mini-Challenge*, including any models, diagrams, and charts you may use to clarify the information you present.

Finally, you will receive *Feedback* from your classmates and your teacher about what parts of your presentation are accurate and which parts need to be refined. You will repeat the design cycle during the second half of the chapter when you gain more *Inputs*, refine your safety system, and make your final safety system presentation.

Physics Corner

Physics in Safety

- Acceleration
- Change in momentum
- Collisions
- Effect of forces on motion
- Energy and work
- Force, pressure, and area
- Inertia
- Impulse
- Kinetic energy = $\frac{1}{2}mv^2$
- Law of conservation of momentum
- Mass
- Momentum = $m \times v$
- Newton as a unit of force
- Newton's laws of motion
- Physical properties of matter
- Velocity
- Work = $F \cdot d$

259

the *Engineering Design Cycle* to focus the discussion. Let the class know that they will be going through the entire cycle during the first half of the chapter. Then discuss each part of the cycle as needed. During the discussion, ask students to provide specific examples of each step. Emphasize that students will be using this simplified *Engineering Design Cycle* when designing their safety systems. Describe how students should first set their *Goal* using the criteria and then consider the *Inputs* they receive after each section. Emphasize that these *Inputs* will be important physics concepts that they will need to apply to complete their safety system and the rest of the challenge. Describe how in the *Mini-Challenge,* students are expected to complete the *Process* step that involves combining the *Inputs* with their ideas and the criteria of the challenge, along with comparing and contrasting potential solutions. Discuss the *Outputs* as the concepts that student groups present to the class in the *Mini-Challenge* and the *Challenge*. Emphasize that the entire class will be providing *Feedback* on the *Outputs*. It is important for students to realize that the *Feedback* from the *Mini-Challenge* should be used to refine their design and written report before they complete the *Chapter Challenge*.

Physics Corner

The *Physics Corner* illustrates the physics concepts presented in the chapter, which students are expected to apply to meet the *Chapter Challenge*. Ask your students if they are familiar with any of the concepts, and encourage them to provide definitions for the terms they know. Consider having students describe where in the illustration each concept is being displayed. Note any misconceptions students might have and discuss these when the concept is addressed in the chapter. Consider using the overhead of the *Physics Corner* while guiding the class discussion.

You should find that the students are motivated while they are actively engaging in the learning process. As the *Chapter Challenge* approaches, review the *Physics Corner* to help them keep track of the physics concepts they have investigated.