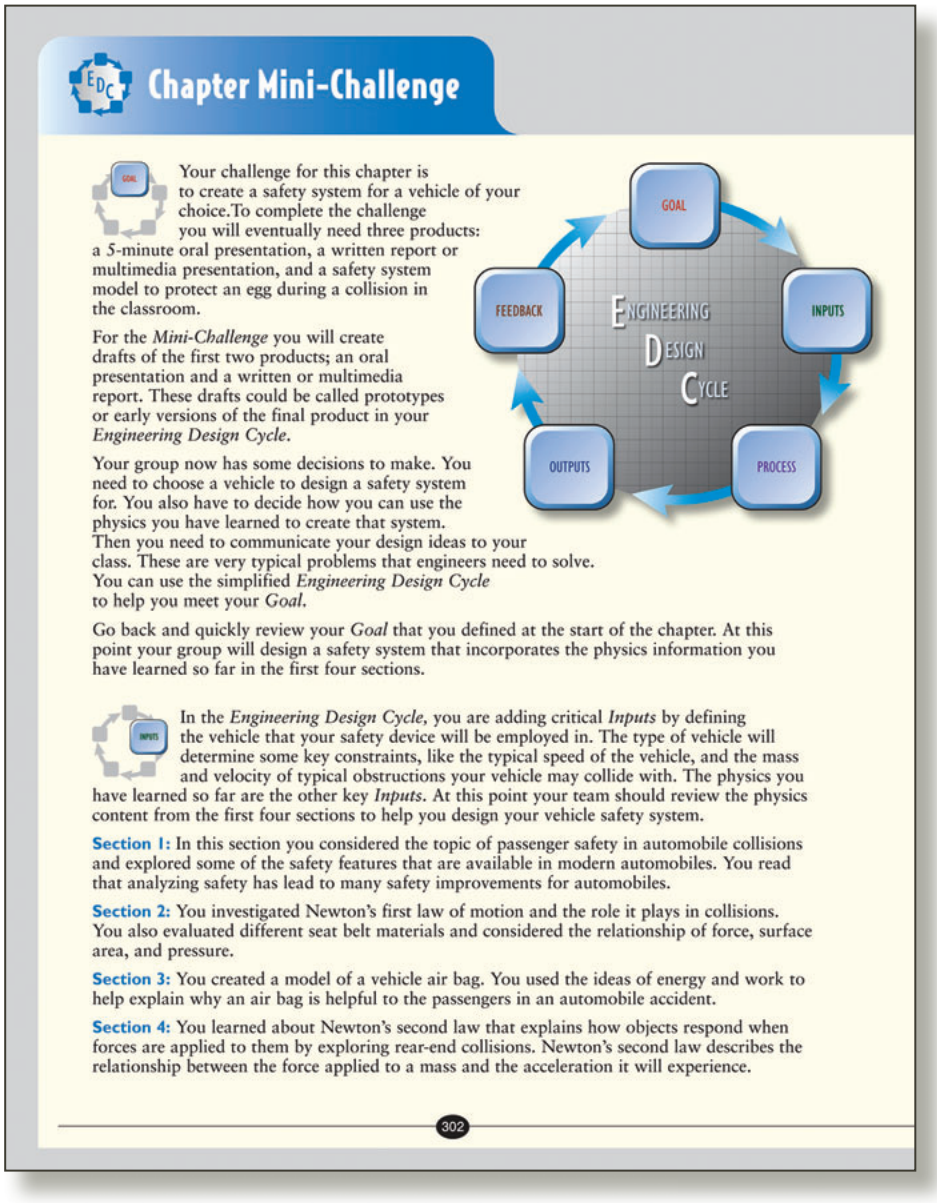
Chapter Mini-Challenge

The *Chapter Mini-Challenge* marks the midpoint of *Chapter 3*. Briefly review the *Engineering Design Cycle*, and have students review their goals for the *Chapter Challenge*.

Remind students that the *Inputs* have been the information introduced in each section, and in each section, they have reflected on how the physics content can be applied to their *Chapter Challenge*. Review the physics content that the class has been introduced to so far by asking students about each section and/or reviewing the list in the student text.

Let students know that the *Mini-Challenge* is part of the *Process* in the *Engineering Design Cycle*. Describe how they should create drafts of their five-minute oral report and their written report or multimedia report for the *Mini-Challenge*. Students should draw detailed plans of the model safety system they intend to build. Emphasize that they should select the vehicle that they will use to design a safety system, write a description of how the physics concepts introduced so far will be used to create a safety system, and a presentation method of this information to the class.



Chapter Mini-Challenge

Your challenge for this chapter is to create a safety system for a vehicle of your choice.To complete the challenge you will eventually need three products: a 5-minute oral presentation, a written report or multimedia presentation, and a safety system model to protect an egg during a collision in the classroom.

For the *Mini-Challenge* you will create drafts of the first two products; an oral presentation and a written or multimedia report. These drafts could be called prototypes or early versions of the final product in your *Engineering Design Cycle*.

Your group now has some decisions to make. You need to choose a vehicle to design a safety system for. You also have to decide how you can use the physics you have learned to create that system. Then you need to communicate your design ideas to your class. These are very typical problems that engineers need to solve. You can use the simplified *Engineering Design Cycle* to help you meet your *Goal*.

Go back and quickly review your *Goal* that you defined at the start of the chapter. At this point your group will design a safety system that incorporates the physics information you have learned so far in the first four sections.

In the *Engineering Design Cycle*, you are adding critical *Inputs* by defining the vehicle that your safety device will be employed in. The type of vehicle will determine some key constraints, like the typical speed of the vehicle, and the mass and velocity of typical obstructions your vehicle may collide with. The physics you have learned so far are the other key *Inputs*. At this point your team should review the physics content from the first four sections to help you design your vehicle safety system.

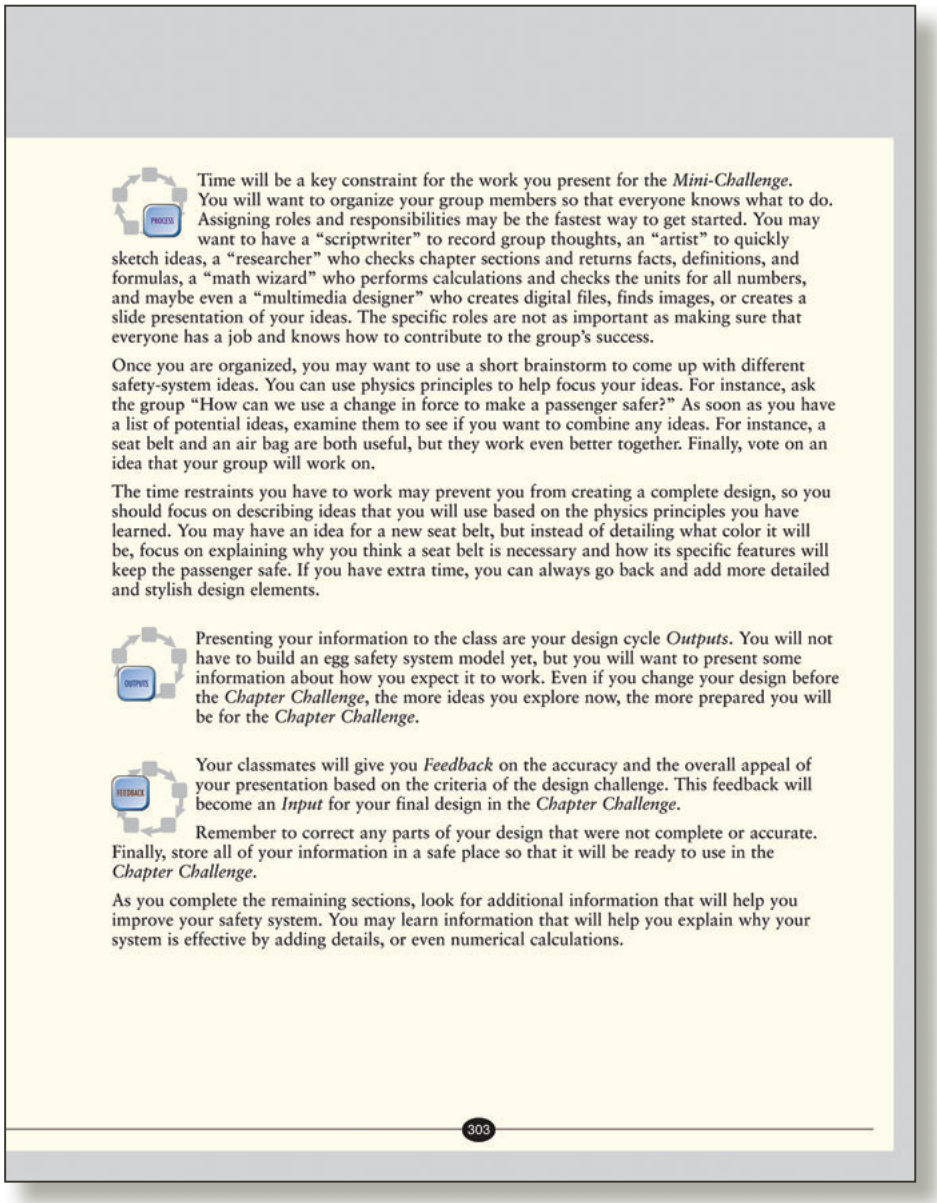
Section 1: In this section you considered the topic of passenger safety in automobile collisions and explored some of the safety features that are available in modern automobiles. You read that analyzing safety has lead to many safety improvements for automobiles.

Section 2: You investigated Newton's first law of motion and the role it plays in collisions. You also evaluated different seat belt materials and considered the relationship of force, surface area, and pressure.

Section 3: You created a model of a vehicle air bag. You used the ideas of energy and work to help explain why an air bag is helpful to the passengers in an automobile accident.

Section 4: You learned about Newton's second law that explains how objects respond when forces are applied to them by exploring rear-end collisions. Newton's second law describes the relationship between the force applied to a mass and the acceleration it will experience.

302



Time will be a key constraint for the work you present for the *Mini-Challenge*. You will want to organize your group members so that everyone knows what to do. Assigning roles and responsibilities may be the fastest way to get started. You may want to have a "scriptwriter" to record group thoughts, an "artist" to quickly sketch ideas, a "researcher" who checks chapter sections and returns facts, definitions, and formulas, a "math wizard" who performs calculations and checks the units for all numbers, and maybe even a "multimedia designer" who creates digital files, finds images, or creates a slide presentation of your ideas. The specific roles are not as important as making sure that everyone has a job and knows how to contribute to the group's success.

Once you are organized, you may want to use a short brainstorm to come up with different safety-system ideas. You can use physics principles to help focus your ideas. For instance, ask the group "How can we use a change in force to make a passenger safer?" As soon as you have a list of potential ideas, examine them to see if you want to combine any ideas. For instance, a seat belt and an air bag are both useful, but they work even better together. Finally, vote on an idea that your group will work on.

The time restraints you have to work may prevent you from creating a complete design, so you should focus on describing ideas that you will use based on the physics principles you have learned. You may have an idea for a new seat belt, but instead of detailing what color it will be, focus on explaining why you think a seat belt is necessary and how its specific features will keep the passenger safe. If you have extra time, you can always go back and add more detailed and stylish design elements.

Presenting your information to the class are your design cycle *Outputs*. You will not have to build an egg safety system model yet, but you will want to present some information about how you expect it to work. Even if you change your design before the *Chapter Challenge*, the more ideas you explore now, the more prepared you will be for the *Chapter Challenge*.

Your classmates will give you *Feedback* on the accuracy and the overall appeal of your presentation based on the criteria of the design challenge. This feedback will become an *Input* for your final design in the *Chapter Challenge*.

Remember to correct any parts of your design that were not complete or accurate. Finally, store all of your information in a safe place so that it will be ready to use in the *Chapter Challenge*.

As you complete the remaining sections, look for additional information that will help you improve your safety system. You may learn information that will help you explain why your system is effective by adding details, or even numerical calculations.

303

Discuss the time constraints with your class—about one class period to prepare and another to present. Emphasize that this will require groups to be organized. Use the information in the student text to suggest tasks group members might tackle to help them complete the *Mini-Challenge*, and eventually the *Chapter Challenge*. While students are preparing, assess their understanding and how they are working within their groups.

During the presentations, determine if students need extra help and address misconceptions that may have arisen. Students should refer to their list of criteria to see how closely they are meeting each criterion. Have each student in the audience provide written *Feedback* to the presenting group. This allows the presenting group to refer back to, reflect upon, and build on the comments and suggestions they receive. To promote constructive criticism, have students include at least two positive comments for each safety system presented.

Remind students that as they complete the remaining sections of this chapter, they should look for ways to improve their safety system, and for information that will assist them in explaining their system. Encourage the students to lead the discussion by having them ask and answer questions, as well as discuss ideas for improvement they would like to include in their own safety system.