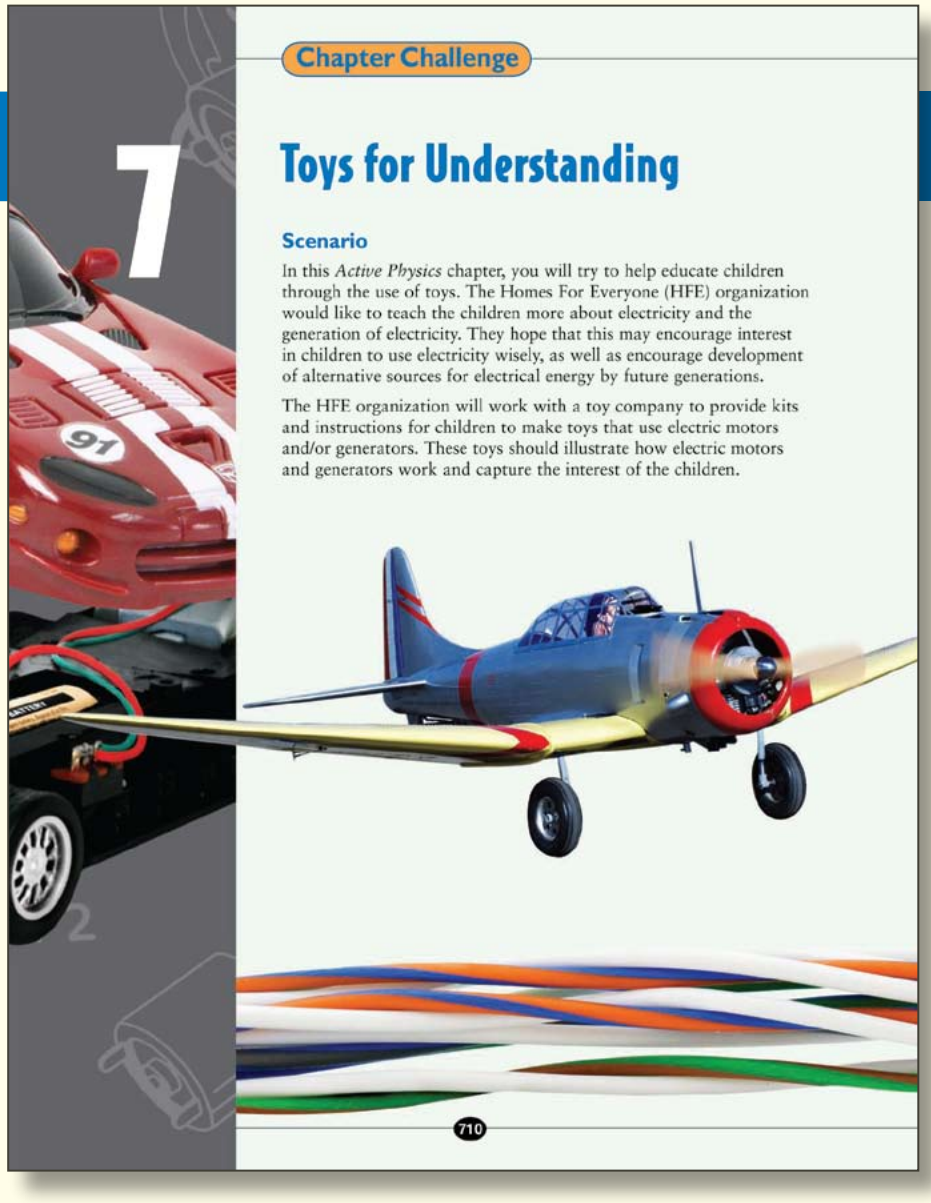
Chapter Challenge

Scenario

Consider having students read the *Scenario* aloud. Ask them about how they could teach children through the Homes for Everyone (HFE) organization about electricity and the generation of electricity through the use of toys. Record students' responses and refer back to them as you progress through the chapter. Students should understand that they will be required to work with a toy company to provide kits and instructions for children to make toys that use electric motors and/or generators. These toys will have to illustrate how motors and/or generators work, as well as capture the interest of a child. Emphasize that for safety reasons their toy should not use more voltage than that provided by 4 D-cell batteries, and if a generator is used, it should not exceed 6 V. Find out if students know how motors and generators operate. Tell them that they will be learning more about motors and generators during their study of this chapter.

Have students brainstorm for ideas on what toys they might want to design and why. Keep the *Scenario* focused on the main topic by prompting them to support their responses. Remind students that the content of each section also corresponds to physics concepts they will need to apply to complete the challenge. 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.


Chapter Challenge

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Toys for Understanding

Scenario

In this *Active Physics* chapter, you will try to help educate children through the use of toys. The Homes For Everyone (HFE) organization would like to teach the children more about electricity and the generation of electricity. They hope that this may encourage interest in children to use electricity wisely, as well as encourage development of alternative sources for electrical energy by future generations.

The HFE organization will work with a toy company to provide kits and instructions for children to make toys that use electric motors and/or generators. These toys should illustrate how electric motors and generators work and capture the interest of the children.

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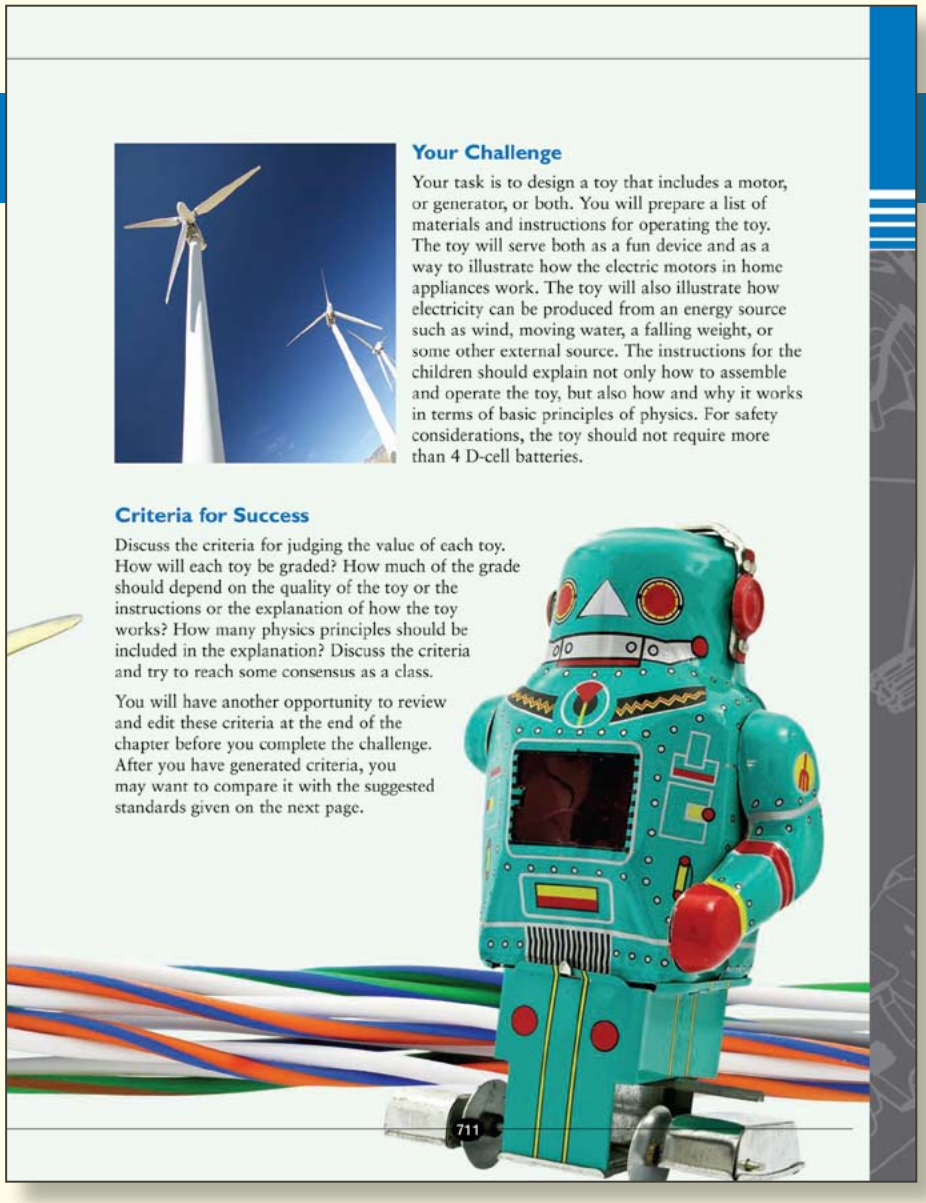
CHAPTER 7



Criteria for Success

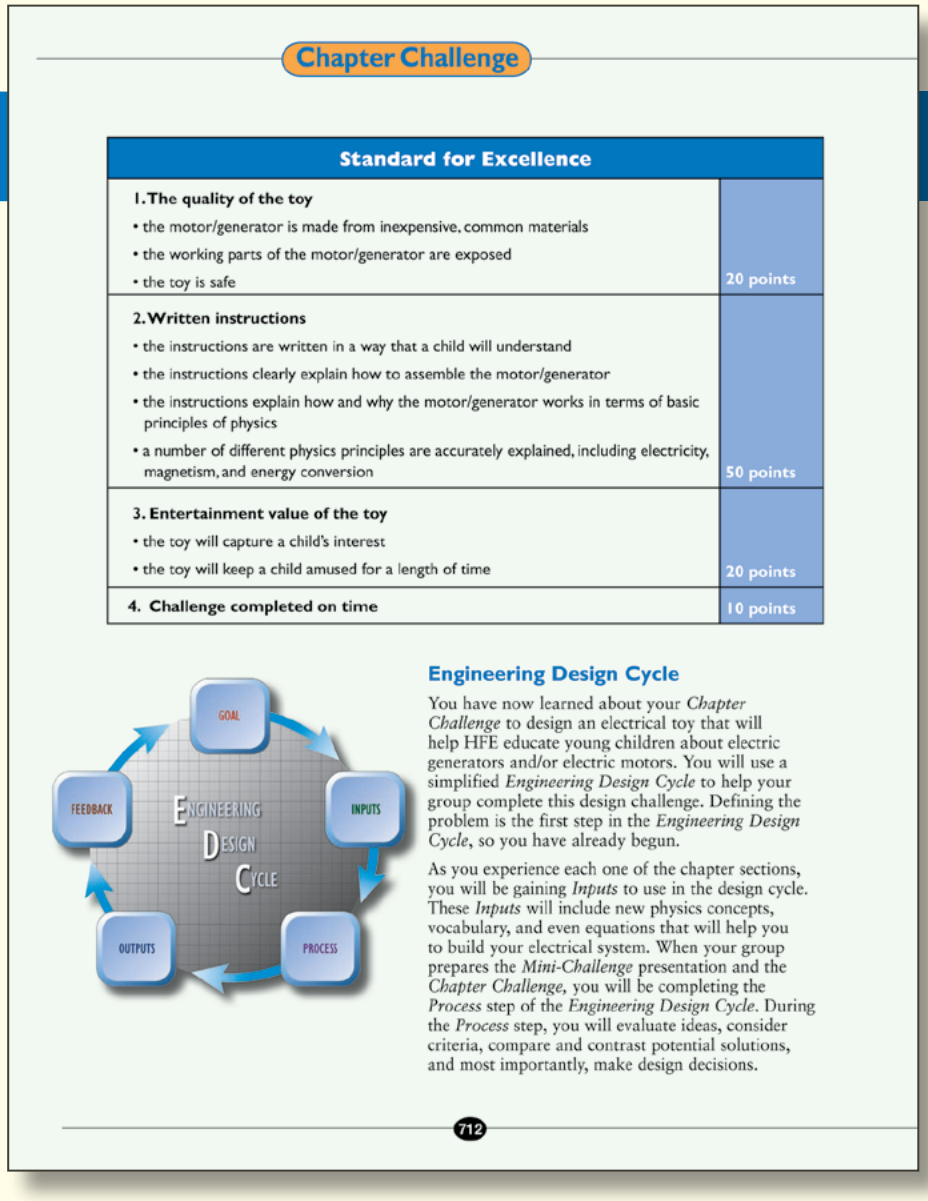
Continue the class discussion about the criteria for evaluating the toy's design. Develop further criteria, such as those recommended in the student text and other ideas that your class suggests. Students may include more details on what the oral and written presentations contain. Develop a rubric with your class to use, making frequent references to the physics principles that are likely to be considered. The criteria should have original ideas with accurate and clear explanations. Encourage each student to respond during the discussion of the criteria to facilitate an understanding of the assessment. Include the criteria listed in the *Standard for Excellence* and consider using the Blackline Master of the *Standard for Excellence*.

Your Challenge

Have a class discussion about the *Chapter Challenge* and the tasks students are required to complete to successfully meet the challenge. Use the information in the student text and emphasize the criteria and constraints. Let students know that their instructions and explanations should include physics concepts. Consider having students construct a chart that lists the criteria and constraints similar to the following:

Criteria	Constraints
• Design toy that includes a motor and/or generator. • Toy should be fun for children. • Toy should illustrate how electric motors work. • Toy should illustrate how electricity can be produced from an energy source, such as wind, water, a falling weight, or some other source. • Prepare a list of materials and instructions for operating the toy, and explain how the toy works in terms of basic principles of physics. • Instructions should explain how to assemble and operate the toy.	• Materials • Age group • Safety: no more than 6 V (4 D-cell batteries)

Chapter Challenge



Chapter Challenge

Standard for Excellence	
1. The quality of the toy • the motor/generator is made from inexpensive, common materials • the working parts of the motor/generator are exposed • the toy is safe	20 points
2. Written instructions • the instructions are written in a way that a child will understand • the instructions clearly explain how to assemble the motor/generator • the instructions explain how and why the motor/generator works in terms of basic principles of physics • a number of different physics principles are accurately explained, including electricity, magnetism, and energy conversion	50 points
3. Entertainment value of the toy • the toy will capture a child's interest • the toy will keep a child amused for a length of time	20 points
4. Challenge completed on time	10 points

Engineering Design Cycle

You have now learned about your *Chapter Challenge* to design an electrical toy that will help HFE educate young children about electric generators and/or electric motors. You will use a simplified *Engineering Design Cycle* to help your group complete this design challenge. Defining the problem is the first step in the *Engineering Design Cycle*, so you have already begun.

As you experience each one of the chapter sections, you will be gaining *Inputs* to use in the design cycle. These *Inputs* will include new physics concepts, vocabulary, and even equations that will help you to build your electrical system. When your group prepares the *Mini-Challenge* presentation and the *Chapter Challenge*, you will be completing the *Process* step of the *Engineering Design Cycle*. During the *Process* step, you will evaluate ideas, consider criteria, compare and contrast potential solutions, and most importantly, make design decisions.

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Read aloud the criteria that you and your class listed. This may bring up other interesting points that could be used to reinforce or modify the criteria. Consider asking students what details of the challenge are necessary to earn an A, B, or C, and have the class decide how many points each part is worth. The assessment rubric should place the greatest emphasis on showing an understanding of physics concepts. Make sure that students understand the criteria and the rubric before they begin their work.

Standard for Excellence

Some criteria are listed in the *Standard for Excellence* table with suggested point values, but it is important for students to decide on the final criteria to grade the *Chapter Challenge*. 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 evaluated. Consider sharing these with the class. Remember, the primary purpose of establishing the criteria necessary to earn an A is to motivate students to succeed and to keep them focused.

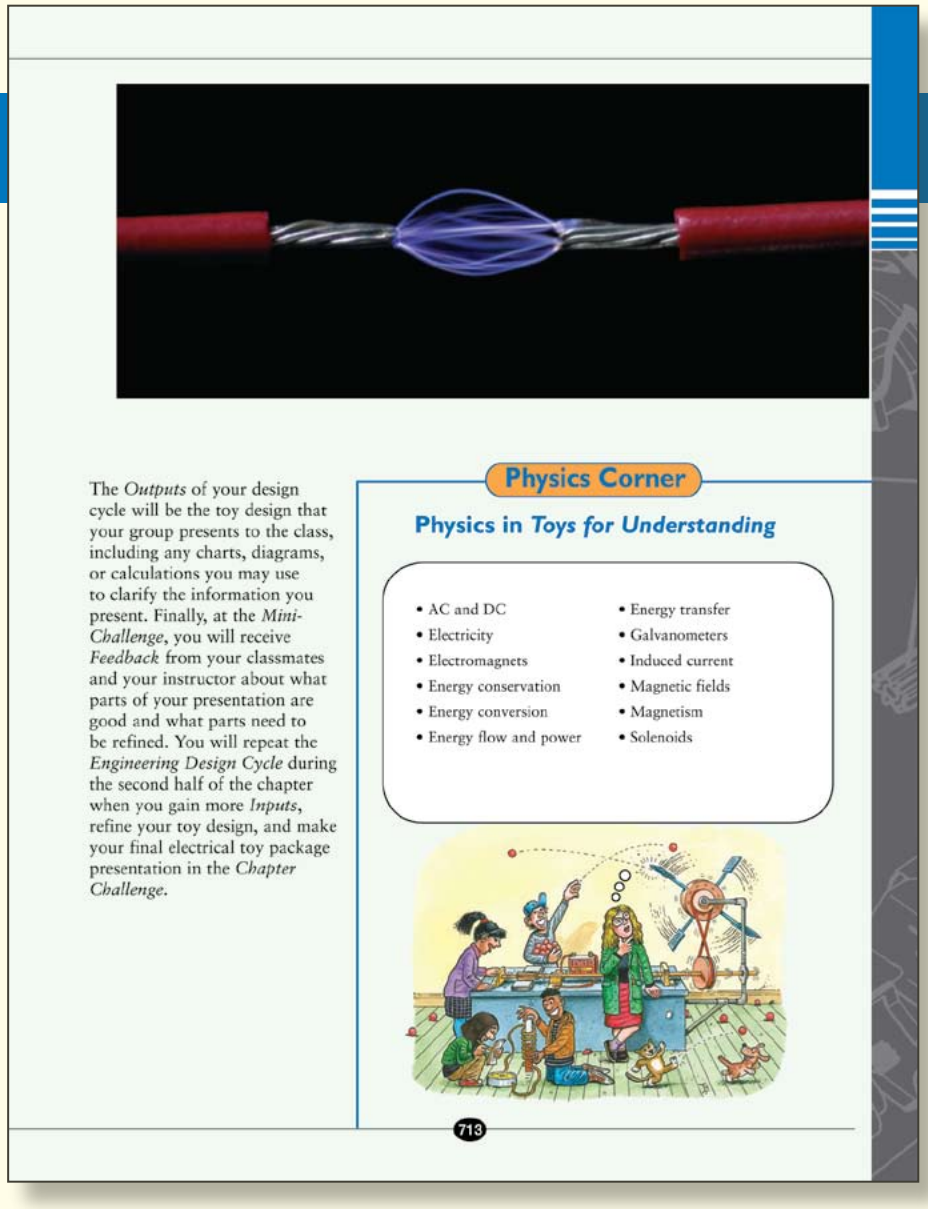
As the *Chapter Challenge* approaches, the class should revisit the rubric and develop a more comprehensive assessment rubric, which will determine grading and expectations that meet your own evaluation system. For an example, a complete *Sample Assessment Rubric* for this chapter is provided at the end of the chapter in this Teacher's Edition.

7a **Blackline Master**

Engineering Design Cycle

Consider using a projection of the *Engineering Design Cycle* to focus the discussion on the *Engineering Design Cycle* or hand out a copy of the Blackline Master. Discuss each part of the cycle as needed and ask students to provide specific examples for each step. Emphasize that the *Engineering Design Cycle* will be used to design the electrical

CHAPTER 7



The *Outputs* of your design cycle will be the toy design that your group presents to the class, including any charts, diagrams, or calculations you may use to clarify the information you present. Finally, at the *Mini-Challenge*, you will receive *Feedback* from your classmates and your instructor about what parts of your presentation are good and what parts need to be refined. You will repeat the *Engineering Design Cycle* during the second half of the chapter when you gain more *Inputs*, refine your toy design, and make your final electrical toy package presentation in the *Chapter Challenge*.

Physics Corner

Physics in *Toys for Understanding*

- AC and DC
- Electricity
- Electromagnets
- Energy conservation
- Energy conversion
- Energy flow and power
- Energy transfer
- Galvanometers
- Induced current
- Magnetic fields
- Magnetism
- Solenoids

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toy. Ask students to 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 and that they will need to be applied to complete the challenge. Refer to the *Mini-Challenge* and how it forms part of the *Process* step that involves combining the *Inputs* with students' 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 eventually the *Chapter 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 their final electrical package before they complete the *Chapter Challenge*.

Physics Corner

The *Physics Corner* illustrates the physics concepts that students are expected to apply to meet the *Chapter Challenge*. Students might be familiar with concepts they are about to study. Encourage them to define those concepts, or what they think the concepts mean. Do not teach the vocabulary. They will learn the vocabulary as it is introduced and used in each appropriate section. Record their ideas and revisit them as they are discussed in the chapter. Consider having students describe where in the illustration the concept is being displayed. Emphasize that an understanding of these concepts is needed to complete the challenge, and that they will need to incorporate them in their presentation. Consider using the overhead of the *Physics Corner* during the discussion. As the *Chapter Challenge* approaches, review the *Physics Corner* to help students keep track of the physics concepts they have investigated. Students are motivated when they actively engage in the learning process.