

## Chapter Challenge

### Scenario

The use of sound and light in the entertainment industry provides the Scenario for this chapter. Students are challenged to design a sound and light show that demonstrates the physics principles they learned. They are limited to using only sounds that come from human voices or homemade instruments and light from conventional household lamps.

Read, or have a student read aloud, the *Scenario*. Check students' comprehension by pausing after each paragraph and ask questions to generate interest. You may wish to expand on the *Scenario* by using videos or multimedia technologies. Encourage students to share their own ideas on the design of instruments familiar to them. Keep your discussion brief.



### Chapter Challenge

## Let Us Entertain You

### Scenario

Most entertainment today, such as movies, television and video games, all involve the communication of sound and light signals. The sound signals that entertain you usually come from voices or musical instruments. Light signals make the images you see on TV or in the movies, and specially designed light patterns add to the effect of an event.



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**Your Challenge**

You have been made part of a committee to design a two- to four-minute sound and light show to entertain other students your age. Unlike music stars or TV producers, you have neither the funds nor the technology they use available to you. All the sounds you use must come from musical instruments that you build yourself, or from human voices. Some of these sounds may be prerecorded and then played back during your show. If your teacher has a laser and is willing to allow you to use it, you may do so. All other light must come from conventional household lamps. You will then have to follow up the show with an explanation of the physics principles that allowed you to be so creative.

**Criteria for Success**

What criteria should be used to evaluate your sound and light show? Since the intention is to entertain students your age, your show will need to be interesting and enjoyable. You are restricted in the funds and technology you can use, so you will need to be innovative in your presentation to capture the attention of other students.

You will have to follow up the show with an explanation of the physics principles you used, so you will need to understand the physics concepts behind your show. However, remember that physics principles are not enough. Your sound and light show will also need to be entertaining. Your class will decide on a way to assign points for creativity. Note that an entertaining and interesting show need not be loud or bright.

Work with your classmates to brainstorm what features are important for your sound and light show and your explanation of the physics principles. As a class, you will decide if your explanation will be given in an oral report or presented as a written report. Next, with your class, determine the relative importance of the assessment criteria. Assign point values to each.

After you and your classmates make a list of features and point values, you may wish to compare it to the list on the next page. Each item in the list has been given a point value, but the values are only suggestions. Your class must decide what kind of grading system you will use.



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**Your Challenge**

You may wish to lead a class discussion about the challenge and the expectations. Familiarize students with the structure of each section. Have them recall their experiences of entertaining shows that they have seen and how they could use their prior knowledge to build on what they learn in the chapter. Point out to students when they are reading *Reflecting on the Section and the Challenge*

that the content of each section is related to the *Chapter Challenge*. As you discuss the challenge, reassure students that while they may feel incompetent now, by the end of the chapter, they will have the necessary skills to design their light and sound show.

**Criteria for Success**

You and your class must establish a set of criteria that guides each student toward completing the

task with a prior knowledge of clear expectations. Students should know how they can earn an A and how each grade for the *Chapter Challenge* is assigned. As students brainstorm the features that are important for their sound and light show, remind them that their criteria should carry points for the physics principles on which their show will be based. List some suggestions for the class to consider and ask them to incorporate a variety of physics concepts. When you are determining whether an oral report or a written one is required for the presentation, stress that an explanation should be accurate, clear, and concise.

The relative importance of each criterion is another step. Students should know clearly how certain criteria are distinctly valued on a grading scale. The relative importance of each will determine the time spent on different stages of the *Chapter Challenge*, and will set the standard for how physics principles are valued against the entertainment aspect of the sound and light show. For instance, students should be encouraged to design an entertaining and creative show, but at the same time, the points assigned to this criterion should be fewer than those established for the criterion that assesses an explanation of the physics principles.

## Chapter Challenge

### Standard for Excellence

Students determine the *Standard for Excellence*, which assigns points to criteria in a rubric. You facilitate this process and provide a framework of Standards and important guidelines. You then prompt responses from the class and list relevant suggestions on the board. For students to come up with the criteria for assessing their work, they should clearly comprehend the *Chapter Challenge*.

In the beginning stages of an assessment, a broad set of criteria are written for the rubric. It is important for students to know that they have ownership of the rubric, and at various stages of the chapter they will be reassessing the rubric to see if all standards are being met with clearly defined expectations. Discuss the list of criteria given in the *Student Edition of Active Physics*. A sample rubric is also provided at the end of this chapter.

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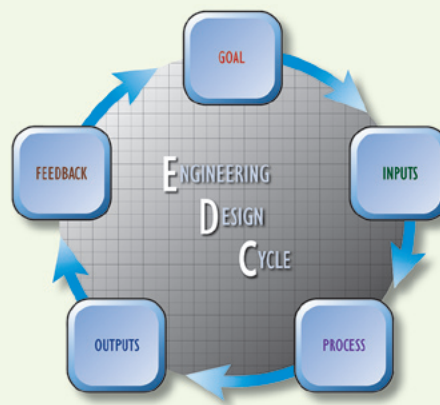
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### Engineering Design Cycle

The *Engineering Design Cycle* is a powerful tool that students use to establish a *Goal* by meeting its requirements through a series

Standard for Excellence	
1. The variety and number of physics principles used to produce the sound and light show	30 points
2. The quality of the oral or written explanation	40 points
• name of the physics principles that you used	10 points
• explanation of each principle	10 points
• example of something that each principle explains or an example of how each principle is used	10 points
• explanation of why each concept is important	10 points
3. Entertainment value	25 points
4. Meet the time limitations	5 points

You will have a chance later in the chapter to discuss these criteria again. At that time, you may have more information on the concepts and how you might produce your show. You may then want to propose changes in the criteria and the point values.



#### Engineering Design Cycle

Your *Chapter Challenge* is to create and present an entertaining sound and light show. You will use a simplified *Engineering Design Cycle* to help your group create your production. Establishing a clear *Goal* is the first step in this cycle. You have defined the problem you need to solve, identified the *Criteria for Success*, and thought about some of the constraints that you will need to face. You may also already be thinking of some possible ways to entertain an audience. You are on your way to establishing your *Goal*.

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 some unique techniques to help you create and explain your show.

of procedural steps. Each step is a unique strategy that allows students to refine the process of identifying relevant information and channeling it through a cycle pattern of *Inputs*, *Process*, *Outputs* and *Feedback*. This pattern of steps eventually leads to the *Chapter Challenge*.

Point out to students that *Inputs* will include all the new concepts they will be learning in each section, along with new

vocabulary and techniques to explain the sound and light show. Highlight the importance of the *Process* phase and how it leads to helpful design decisions through an evaluation of ideas. Potential solutions are compared during this phase and the criteria are revised.

Students should know that the first presentation of their show will be the *Outputs* stage. At this stage, physics principles involved



When your group prepares the *Mini-Challenge* 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 make design decisions.

The first *Outputs* of your design cycle will be an entertaining sound show accompanied by a short explanation of the physics principles involved. After completing several sections, you will work on part of your presentation. Finally, you will receive *Feedback* from your classmates and your instructor about which parts of your presentation are solid and which parts are shaky and need to be refined. You will then repeat the *Engineering Design Cycle* during the second half of the chapter when you gain more *Inputs* about light and refine your production into a complete sound and light show.

### Physics Corner

#### Physics in Let Us Entertain You

- Color addition, color shadows
- Frequency and pitch
- Law of reflection
- Law of Refraction (Snell's law)
- Lens equation
- Lenses: focal point, focal length
- Longitudinal (compressional) and transverse waves
- Periodic waves
- Real images formed by curved mirrors
- Reflection of light
- Refraction of light
- Shadows
- Sound and vibration
- Sound waves in air-filled tubes
- Standing waves
- Tension, string length, and pitch
- Virtual images
- Wave motion
- Wave pulses
- Wavelength, frequency, speed



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## Physics Corner

The *Physics Corner* provides a preview of physics concepts presented throughout the chapter. Your students may be familiar with a few terms already. Ask them if they can provide definitions for them. Do not teach the vocabulary. They will learn the vocabulary as it is introduced and used in each appropriate section. Students will be motivated to answer if you acknowledge their familiarity with the concepts in this chapter.

Encourage students to offer ideas that relate the concepts in the *Physics Corner* to the sound and light show they will be producing. Discuss the illustration in this section and ask your students how they are expected to learn physics principles and master the skills necessary to complete their challenge. Engage students to use their imagination and explore their creative talents.

As the *Chapter Challenge* approaches, you may wish to remind students that they should review the *Physics Corner* to keep a record of the physics concepts they are learning, since they will need to draw on them to complete their *Chapter Challenge*.

in the show will have to be explained. Initial *Feedback* during the *Chapter Mini-Challenge* will prepare each student for their final *Outputs* and is also the time that you and the class can collaborate for a more refined *Goal*, sifting out the weaker parts of the presentation.