

## Chapter and Challenge Overview

Chapter 4 challenges groups of students to produce a two-to four-minute light show. In addition, each student must write a report that lists the physics concepts used in the show, gives an example of each, and explains why each concept is important. The shows are evaluated for creativity, and the reports are evaluated for the understanding of the concepts.

Sound and light are the basis of much of the entertainment industry. Beyond fireworks and light shows, sound is transmitted by radio, sound and light are transmitted by television, and the videotape and CD store the information for bringing us the sound and light on demand. A sound and light show is an excellent opportunity for your students to show what they have learned and to have some fun at the same time.

Students begin the unit in **Activity 1** by making pulses and standing waves on the Slinky®. They determine the relationship among speed, frequency, and wavelength. Also, they build a model to help understand wave motion. Next, students begin the study of musical instruments. In **Activity 2** they investigate the sounds made by a vibrating string. They observe the effect of changes in string length and tension on the pitch the string produces. Students continue the study of musical instruments by investigating the resonance of pipes in **Activity 3**. They observe how the pitch produced depends on the length of the pipe and whether or not one end is closed. Through reading, they then relate these observations to the patterns of standing waves in a tube. To further explore sound, students build in **Activity 4** an electronic circuit that produces sound. Students discover that by changing the values of the resistors and capacitors, they change the pitch of this sound. They also feel the vibrations in a speaker and read about how vibrations produce sound.

Next, the students begin the investigation of mirrors. In **Activity 5**, they investigate reflection from a plane mirror. They measure the angles of incidence and refraction for reflected light beams, locate the reflected image, and observe the reversals in reflections of letters of the alphabet. Finally they investigate multiple reflections. In this activity, students investigate concave and convex mirrors. **Activity 6** introduces curved mirrors. Students begin by shining parallel light beams at curved mirrors to find the focal length and the location of the focus. With a light bulb, students look for real and virtual images and investigate image distance vs. object distance.

To prepare for the study of lenses, students investigate refraction in **Activity 7** by shining a beam of light into a rectangular block of clear gelatin. The students measure the angles of incidence and refraction. They also observe total internal reflection and measure the critical angle. Having studied refraction, students then explore convex lenses in **Activity 8**. They observe the real image made by a convex lens and how its size and position change as the object distance changes. To prepare for the light show, the students project the image of a slide onto a wall. In **Activity 9** the students investigate additive color mixing. They observe shadows of objects illuminated by combinations of colored lights. For each such combination they make a drawing to record the pattern of the shadow colors.