

## Chapter Mini-Challenge

The *Chapter Mini-Challenge* offers many possibilities for students to be creative. Students should get started on their initial design for the *Chapter Challenge*. A list of what their initial design would need is provided in the *Student Edition* of this section. Students should note that at this stage, they are required to produce a one or two-minute sound presentation because they have only studied the physics of sounds so far. They are also limited by the constraints of producing sounds using techniques similar to the ones used in *Section 1* through *Section 4*. In fact, reviewing the list of important concepts during the *Inputs* phase will assist in generating innovative sound-show ideas.

As students review the physics concepts they have studied, ask them to brainstorm a list of possible techniques. They should work in groups and not be held back by constraints or criticisms when they are initially involved in the *Process* phase. Point out that using adjectives to describe potential sound shows might actually result in many ideas that could be later refined according to the requirements for the show. Encourage students to organize their ideas according to the physics concepts they have learned.

Chapter Mini-Challenge

**GOAL**

Your challenge for this chapter is to create a sound and light show to entertain students your age. The show should be between two and four minutes long, and must contain sound and light effects that you create using classroom materials. While you might be able to imagine an awesome display of blinding lights and deafening sound effects, you will have to work to incorporate those ideas in a show that works within the constraints of the challenge. The success of this challenge will likely rely more on your group's creativity than your access to technical equipment. For your initial design you will need the following:

- Sound-producing devices based on classroom activities
- Light effects based on classroom activities
- Entertaining ideas and additional props
- A script for your show
- A written explanation of the physics concepts behind your effects

Your *Mini-Challenge* for this chapter is to entertain your classmates for one or two minutes using sounds that your group creates and to explain the physics concepts that make your show possible.

At this point, you can only address one half of the *Chapter Challenge*. Since you have only studied sounds and waves so far in this chapter, you will be making an entertaining sound show to present to your class. It may be argued that a sound show will not be very interesting without lights, but think of your radio. Not too far back in time, radio was the only entertainment media available and entire families would gather around their radio to be entertained by radio programs. Competing with today's image-rich media options will be difficult, so that is why your group's creativity will be very important.

Go back and quickly revisit the *Goal* you established at the start of the chapter. Review your *Goal* as a class. To prepare for and get the most out of the *Mini-Challenge*, you will need to make sure you have all the criteria and necessary constraints.

**INPUTS**

The *Inputs* phase of the *Engineering Design Cycle* are also constraints. Your group is limited to using sounds that you can create using techniques similar to the ones used in *Sections 1 to 4* of this chapter. Remember, you are also required to explain the physics involved, so using different types of sound makers will complicate that part of your presentation.

Your team should review the physics content from the first four sections to help you compose your sound and light show.

**Section 1:** You created sounds of different pitch by independently changing the length and tension of a vibrating string.

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**Section 2:** You produced both transverse and longitudinal (compressional) waves in a spring. You also characterized many wave properties including amplitude, wavelength, wave speed, and frequency.

**Section 3:** You characterized the relationship between wave speed, wavelength, and the frequency of vibration for a vibrating string. You also considered a human model for that relationship. Remember, the relationship could be expressed in the equation  $v = f\lambda$ .

**Section 4:** You explored the sounds produced by vibrating air in a tube. You learned that you could change the pitch by changing the length of the straw or by covering one end of the straw. Both methods resulted in a change in the wavelength of the sound you produced. You also learned about the bending of sound waves, called diffraction.



The *Process* phase is when you decide what information you have to help you meet the criteria of the *Goal*. This *Mini-Challenge* will rely heavily on your group's ability to come up with an entertaining idea. One way you can generate a lot of ideas is to research existing ideas and then brainstorm using those ideas as starting points. One of the most important rules of brainstorming is to ignore constraints and avoid criticisms until you have a long list of ideas. You can shorten the list later.

Make a short list of different sorts of sound presentations that people in your group enjoy. Have each student research one or two ideas to see what types of equipment are used to produce the sounds involved in those shows. Finally, make a list of adjectives that describe any of the types of shows on your list. These adjectives will give you an idea of what your show might include.

Now, assign a recorder for your group and start brainstorming. For each adjective on your list, ask your group to come up with ten ideas that would match it. For example, if funny is on your list, you might write a silly song about your teacher, play a popular children's tune, or play the melody of a current pop song. Repeat this step for each adjective you started with. You should end up with a long list of ideas that can be refined to fit the constraints of the challenge.



Your group's *Outputs* of your *Engineering Design Cycle* will be to perform your sound show for the class and explain the physics concepts you used to make it happen. You should make sure you take notes on the instruments you used and your explanation should be written out to hand in. Remember, anything you create for your *Mini-Challenge* can be used to complete your final *Chapter Challenge*.



Your classmates will give you *Feedback* on the entertainment value and the overall appeal of your presentation based on the criteria of the design *Mini-Challenge*. This *Feedback* will become an important *Input* for your final design in the *Chapter Challenge*. You will have enough time to make corrections and improvements, so pay attention to the valuable information provided by your classmates' feedback.

At this point, remember to correct any parts of your explanation that were not complete or correct. It will be harder to remember the changes you need to make if you wait until the chapter is complete to go back and correct your mistakes. Then, store all of your information in a safe place so that it will be ready to use in the *Chapter Challenge*.

If you were satisfied with your sound show, you will want to keep your idea in mind as you complete the remaining sections on light so you can add appropriate lighting effects to improve your show. If you liked other groups' ideas you may want to change your presentation to include those new ideas. In either case, keep your final design *Goal* in mind as you complete the remaining sections of the chapter.

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During the *Outputs* phase of the *Engineering Design Cycle*, students should have a clearly written explanation of their sound-show. Remind them that this is a trial presentation, and when they receive their *Feedback*, they should remember to make corrections to improve their final presentation of the *Chapter Challenge*.

The *Mini-Challenge* relies on cooperative group work and a productive environment in the classroom that promotes student potential and constructive *Feedback*. The main purpose of this challenge is to allow students to grow in their understanding of sound and light, using interaction among students as a platform to test their ideas. Emphasize that the *Mini-Challenge* is used to contribute toward the final *Goal* as the chapter progresses.