Chapter 6 Vibrations and Waves

Mechanical vibrations, waves, and several phenomena associated with them are introduced in this chapter. Investigations, activities, and demonstrations are used to study the characteristics of the following: transverse, longitudinal, and torsional vibrations; pulses and waves on coiled springs; periodic waves; interference of pulses and waves; wave diffraction and refraction; mechanical resonance; and standing waves and waves in two dimensions. In Chapters 7 and 8 these phenomena are applied to sound and music, so Chapter 6 is important. Two investigations and two activities, several possible demonstrations, and at least one unforgettable movie contribute to this chapter.

Diagrams are important in this chapter. Metric graph paper is recommended for the diagrams of pulses and waves.

Two-dimensional interference patterns of waves on water have been included in this text, but the treatment is qualitative. Quantitative analysis of waves in two dimensions is left until grade 12. Further discussion of this topic is covered in the appropriate section.

Related Background Resources

The following multimedia resources are available from Boreal Laboratories: (www.boreal.com or 1-800-387-9393):

- **Physics Explorer, CD-ROM by LOGAL; Waves: #74207-01 (about $150)**
- **Multimedia Sound, CD-ROM #74071-00 (about $160); Teacher’s Guide #74071-01 (about $70)**
- **Waves and Sound, VHS video #70400-10 (about $60)**
- **Waves and Vibrations, CD-ROM #744408-00 (about $140)**

The following multimedia resources are available from the American Association of Physics Teachers (www.aapt.org/catalog):

- **Audioscope: The Science of Sound, CD-ROM (Windows) #NSW-17 (about US$100)**
- **Ztek Film Collection (includes Waves), DVD series #ZK-02 (about US$200)**

Nelson Web site: www.science.nelson.com for specific Web links

**TEACHING SUGGESTIONS**

**Try This Activity**

- You should do this demonstration. Releasing the rope under tension could be dangerous if it hits a student.
- Depending on your approach and the type of class you have, you may find it inappropriate to use the first part of the Try This Activity. In the right environment, this demonstration can provide the students with the concepts of both longitudinal and transverse waves, particularly the concept of the transfer of energy, without any ultimate change in position of the medium (the student).
- The rope demonstration is best done using the length of the classroom, ensuring that the rope is firmly attached. A long length of flexible rubber hosing (surgical or lab hosing) attached to a firm point (lab fixture) works best, particularly if the hosing is under some tension.
- You may want to generate additional interest by demonstrating other examples of waves:
  - Stand dominoes on end in a long line. Knock over the first one, starting a chain of events. Point out that there is no net transport down the line of dominoes; it is the “state of falling” that travelled.
  - Send waves down a Bell wave machine.
  - Send waves down a vertically suspended Slinky toy.

**TRY THIS ACTIVITY**

**Wave Action**

- This activity provides a visual example of both transverse and longitudinal wave transmission.

**BEFORE**

**Teacher Preparation**

**Time:** 20 minutes
**Materials and Equipment:**
For the class demonstration or each group of six students, you will need:
long, light rope

**Safety and Disposal:**
- You should do this demonstration. Releasing the rubber hose under tension could be dangerous if it hits a student.

**Assessment:**
- No assessment is required for this activity.

**Student Preparation**
- Students can refer to their answers to Reflect on Your Learning question 2 on page 194.

**DURING**
See the Teaching Suggestions above.

**Extensions/Modifications:**
- See the Teaching Suggestions.