

## 13.1: Introduction and Learning Objectives

The concept of a wave is a central part of much of physics, and by extension this includes chemistry, geology, engineering, astronomy, biology and more. Each discipline is interested in the behavior of particular types of waves, and each discipline uses waves to describe different aspects of the objects being investigated.

Most of the ways that we gather information involve the production and/or detection of waves and whether we use our eyes, cameras or telescopes to look at objects doesn't matter. All these systems gather information from electromagnetic waves. So do our RADAR systems, radio and cell phones. Our microwave ovens also utilize electromagnetic waves to heat our food. Our ears gather information from pressure waves in the surroundings, and our seismographs examine the results of pressure waves traveling through the earth.

In the end, wave behavior is usually used to describe the process by which energy moves through different materials. We use language that describes the outcomes, i.e. "That sound is loud", or "That light is bright", or "That was a small earthquake", and most people will understand in a general way what you mean when you say these things. This chapter will make some fundamental definitions that can be applied to any system that involves waves and will give us a common language to describe waves of all kinds. Examining the relationship between materials and the types of waves that can be created will help us to better understand the universe.

Although the idea of a wave is ephemeral, the study of waves is readily available to everyone. The ability to link the abstract explanation to a concrete example is useful at all levels of education. Whether water waves in a ripple tank, light waves through lenses or sound waves from instruments, there are numerous physical examples of waves that help students appreciate the utility and importance of understanding the fundamentals of wave behavior.

The chapter begins with a discussion of oscillations, then moves on to classification of waves and general behaviors. Types of waves and the relationship between the wave and the medium are explored. Specific applications of waves such as light (vision) and sound (hearing) are discussed in later chapters.

### Chapter Learning Objectives

#### 1. Differentiating Longitudinal and Transverse Waves:

- Define and distinguish between longitudinal and transverse waves.
- Identify natural and technological examples of each type (e.g., sound waves, electromagnetic waves).

#### 2. Exploring the Properties of Longitudinal Waves:

- Investigate properties like compression, rarefaction, wavelength, frequency, amplitude, and speed.
- Understand sound wave production and propagation through different mediums.
- Analyze applications in acoustics and communication.

#### 3. Studying the Properties of Transverse Waves:

- Explore properties like crest, trough, wavelength, frequency, amplitude, and speed.
- Examine generation and propagation with examples from light waves and mechanical waves.
- Discuss applications in optics, telecommunications, and seismic studies.

#### 4. Wave Phenomena in Longitudinal and Transverse Waves:

- Understand reflection, refraction, interference, and diffraction in both wave types.
- Examine polarization in transverse waves.
- Explore scientific and technological uses of these phenomena.

#### 5. Teaching Longitudinal and Transverse Waves in the Classroom:

- Develop strategies to teach wave concepts using age-appropriate examples.
- Conduct experiments and demonstrations to reinforce understanding.
- Use multimedia resources to visualize wave motion.
- Address misconceptions and provide clear explanations.

- Connect wave concepts to real-life applications in various fields.

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