

Wave Interactions

SECTION 4

WAVE INTERFERENCE

When two bumper boats collide, as shown in **Figure 14**, each bounces back in another direction. The two bumper boats cannot occupy the same space, and so they are forced to change the direction of their motion. This is true not just of bumper boats but of all matter. Two different material objects can never occupy the same space at the same time.



SECTION OBJECTIVES

- Apply the superposition principle.
- Differentiate between constructive and destructive interference.
- Predict when a reflected wave will be inverted.
- Predict whether specific traveling waves will produce a standing wave.
- Identify nodes and antinodes of a standing wave.

Figure 14

Two of these bumper boats cannot be in the same place at one time. Waves, on the other hand, can pass through one another.

When two waves come together, they do not bounce back as bumper boats do. If you listen carefully at a concert, you can distinguish the sounds of different instruments. Trumpet sounds are different from flute sounds, even when the two instruments are played at the same time. The sound waves of each instrument are unaffected by the other waves that are passing through the same space at the same moment. Because mechanical waves are not matter but rather are displacements of matter, two waves can occupy the same space at the same time. The combination of two overlapping waves is called *superposition*.

Figure 15 shows two sets of water waves in a ripple tank. As the waves move outward from their respective sources, they pass through one another. As they pass through one another, the waves interact to form an *interference pattern* of light and dark bands. Although this superposition of mechanical waves is fairly easy to observe, these are not the only kind of waves that can pass through the same space at the same time. Visible light and other forms of electromagnetic radiation also undergo superposition, and they can interact to form interference patterns.

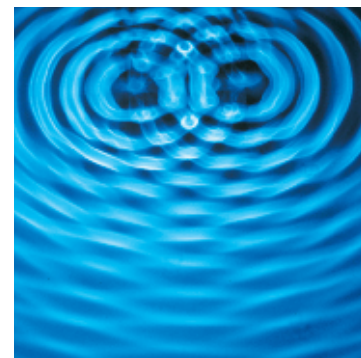


Figure 15

This ripple tank demonstrates the interference of water waves.