Waves Activity 1.1 Name:_____

4-27-20 to 5-1-20

Read the attached textbook pages (Prentice Hall: chapter 1, section 1.)

Answer the section review questions

1. How are waves and energy related?

2. Where do waves get their energy?

3. What is a medium? What is a mechanical wave?

4. Describe an electromagnetic wave. How does it differ from a mechanical wave?

5. The programs you watch on television are made up of all sorts of sounds and colors. How do waves make television possible?

Characteristics of Waves

1

Guide for Reading

After you read the following sections, you will be able to

1–1 Nature of Waves
- Explain how waves are related to energy.

1–2 Characteristics of Waves
- Describe the basic characteristics of waves.

1–3 Types of Waves
- Classify waves as transverse, longitudinal, or both.

1–4 Speed of Waves
- Relate wave speed to frequency and wavelength.

1–5 Interactions of Waves
- Identify basic wave interactions.

Way out in the ocean, far from the eyes of eager surfers, the wind stirs a small ripple into the water's calm surface. As the wind continues to blow, gaining speed and strength, the ripple grows into a full, surging wave. By the time it travels thousands of kilometers to the Hawaiian shore, the wave rises several meters above the surface—forming the famous Hawaiian Pipeline.

Uninterested in its origin and development, the surfers see the wave as the challenge of the day. They run into the water, surfboards in hand. A few quick strokes and they catch the monstrous wave. Most cannot keep ahead of the crushing weight of water for long and are soon pulled under. But one surfer holds on. She steers back and forth as the wave towers over her. The water thunders around her, but success is hers. With a sense of accomplishment and an appreciation of nature's power, she rides the wave all the way to shore.

What is a wave? What do ocean waves have to do with wind? How can a wave travel several thousand kilometers? As you read this chapter, you will find the answers.

Journal Activity

You and Your World If you have ever been under an ocean wave as it broke, you know how powerful waves can be. In your journal, describe an experience you have had with any type of water waves—ocean waves, waves in a lake, waves that you made in a pan of water or bathtub. Explain what you were doing and how the waves affected you. Then describe three scenes that illustrate different aspects of ocean waves. Center each description around one of the following words: beauty, destruction, fun.

Although the powerful wave can't last forever, its awesome energy has given this surfer a wonderful ride.

Guide for Reading

Focus on these questions as you read.

- *How are waves related to energy?*
- *What is the difference between mechanical waves and electromagnetic waves?*

1–1 Nature of Waves

Have you ever dropped a pebble into a still pond and observed the circular waves moving outward? Maybe you have watched the waves moving across a field of wheat on a windy day. Or perhaps you have observed huge waves in the ocean during a storm. All these examples illustrate waves. You might be surprised to learn that even light and sound are examples of waves.

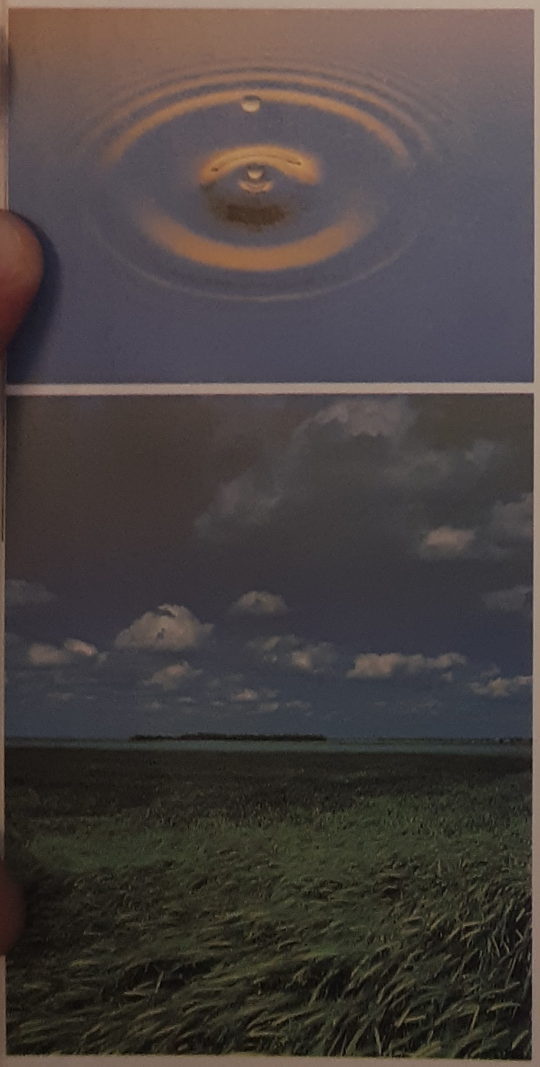
Waves and Energy

Think again about ocean waves. Ocean waves continuously roll into the shore, one after the other, night and day. Have you ever wondered how ocean waves can do this without flooding the beaches? The reason is that ocean waves do not actually carry water. As a wave rushes to the shore, the ocean water is moved up and down—but its forward movement is limited. So even though it looks as if the water itself is moving toward shore, it is actually not. Only the wave moves forward.

To help you understand this, consider another example of waves. What happens to a nearby canoe or pile of leaves on a lake when a motorboat speeds by? The motorboat creates waves that move past the object, causing the object to bob up and down. The waves continue to move forward, but the object remains in approximately the same place. Why? The motorboat disturbs the flat surface of the lake. It is this disturbance that moves outward along the surface of the water as a series of **waves.**

The meaning of the word disturbance should not be new to you. Suppose that you are taking a nap one day in a comfortable hammock when a friend comes along and tilts you out. Your friend has moved you from your resting position. Among other things, you might say that your friend has disturbed you from your rest, or that your friend is a disturbance! After your friend leaves, you return to your nap. In much the same way, particles of water are disturbed from their resting positions by water waves. Once the disturbance has passed, the water particles return to their resting positions. They are not carried by the wave.

Figure 1–1 *A pebble tossed into a still pond creates a disturbance that moves outward along the surface of the water as a wave. The continuous blowing of the wind causes wheat to move in a wavelike pattern.*



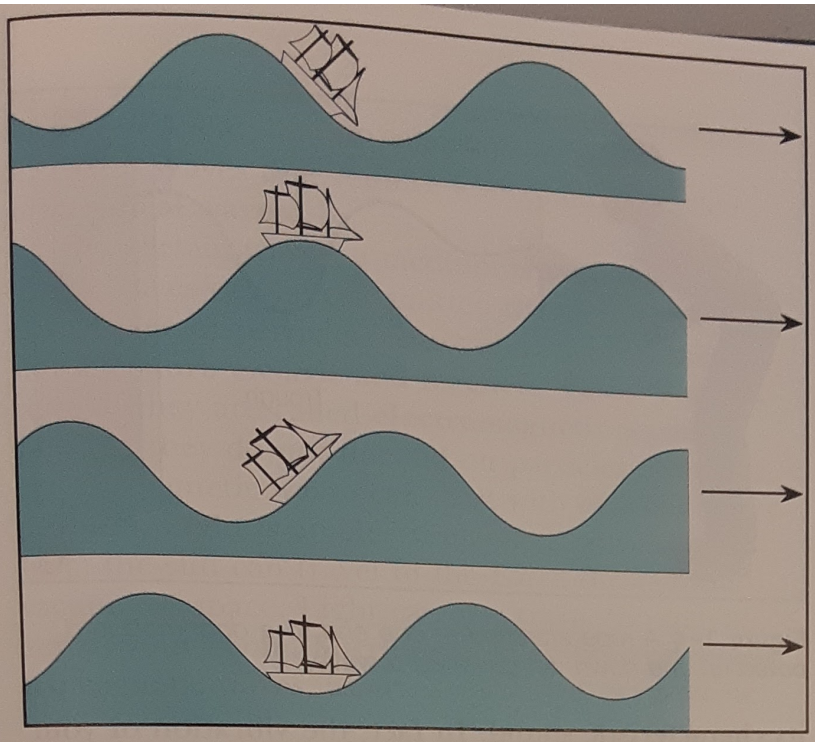


Figure 1–2 *The boat in the water simply bobs up and down as waves roll by. What is a wave?*

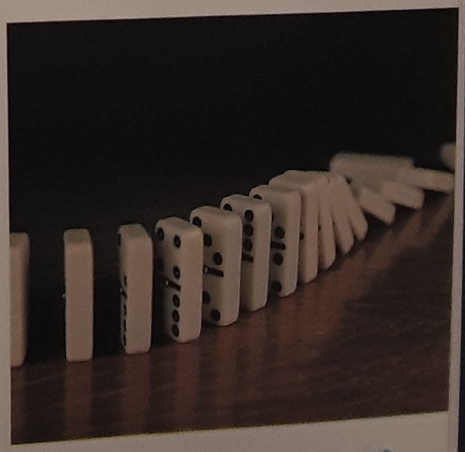
What, then, makes up the disturbance? You already learned that it is not matter. The fact that water waves do not carry matter—such as water, canoes, or piles of leaves—is true of any wave. So what then is carried by a wave? Waves carry energy. (Energy is the ability to do work or cause change.) **A wave is a traveling disturbance that carries energy from one place to another.**

Where Do Waves Get Energy?

To understand how waves are made, try making a wave on your own. Tie a rope to a fixed object such as a doorknob or post. See Figure 1–4 on page 14. Jerk the free end of the rope and observe the "bump," or wave motion, that travels to the other end. Now try moving your hand up and down or back and forth over and over again. You have just created a series of waves. How did you do this?

You made the wave motion on the rope by moving your hand up and down or back and forth. Any movement that follows the same path repeatedly is called a **vibration.** You created a vibration. Vibrations are probably quite familiar to you already. The top of a drum vibrates after it is struck by a drumstick. It moves up and down several times, creating

Figure 1–3 *Just the slightest touch, carried like a signal, knocks over a long row of dominoes. Like a falling row of dominoes, a wave can move over a long distance. The substance through which it moves, however, has limited movement.*



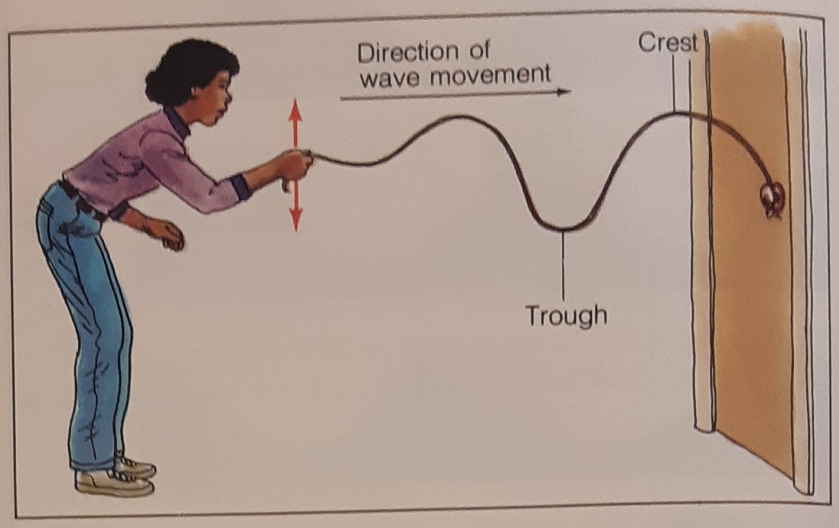


Figure 1–4 *A rope attached at one end to a doorknob and pulled up and down will generate a wave.*

Activity Bank
Seeing Sound, p.138

its characteristic sound. In fact, the vibration of your eardrum in response to sound enables you to hear. A stretched rubber band that is plucked also vibrates for a few seconds. So does a guitar string. Even the Earth can vibrate during a powerful earthquake.

An object that is vibrating is moving. And an object that is moving has energy. A vibrating object gives off some of its energy to nearby particles, causing them to vibrate as well. These particles, in turn, give off energy to the particles next to them, and so on. This movement of energy from a vibrating source outward is a wave. Waves—whether they be ocean waves, waves on a rope, sound waves, or microwaves—have a vibration as their source. The motorboat you just read about gave energy to the water particles in the lake. You gave some of your energy to the rope by moving your hand. Wind blowing back and forth over the ocean creates ocean waves. Electric charges (like the ones you see and feel when you receive a shock) can vibrate to create light and microwaves. Energy is given to the air by the vibration of a guitar string to create a sound wave.

Figure 1–5 *When a piano key is struck, a string is hit and set into vibration. Notice the vibrating string in the center of the photo. Energy is given to the string by the player's finger. What gives energy to the sound wave?*

Waves Through Matter and Space

In most of the previous examples, energy from a vibration traveled through a substance. The matter, or substance, through which a wave is transmitted is called a **medium**. Water is a medium for ocean

waves. Air is a medium for sound waves. All phases of matter (solid, liquid, and gas) can act as a medium. Waves that require a medium are called **mechanical waves**.

For certain waves, a medium is not required. These waves can be transmitted through a vacuum (space free of particles). Instead of matter, these waves disturb electric and magnetic fields. For this reason, they are called **electromagnetic waves**. Because they do not depend on particles of matter, electromagnetic waves can exist with or without a medium. Light is an electromagnetic wave. Light from the sun can travel to the Earth through the vacuum of space. Light can also travel through air across your room. Microwaves in an oven are electromagnetic waves, as are X-rays used in medicine.

Figure 1–6 *The telescopes of the Very Large Array in New Mexico collect invisible waves that travel with or without a medium. What are these types of waves called?*

1–1 Section Review

1. How are waves and energy related?
2. Where do waves get their energy?
3. What is a medium? A mechanical wave?
4. Describe an electromagnetic wave. How does it differ from a mechanical wave?

Connection—*You and Your World*

5. The programs you watch on television are made up of all sorts of sounds and colors. How do waves make television possible?

1–2 Characteristics of Waves

Guide for Reading

Focus on this question as you read.

- *What are the basic characteristics of a wave?*

You just learned that there are many different kinds of waves. Sound waves, light waves, X-rays, microwaves, and ocean waves are but a few examples. All waves, however, share certain basic characteristics. **All waves have amplitude, wavelength, and frequency.**

In order to understand these characteristics of waves, it may help you to represent a wave as a drawing on a graph. The X-axis (the horizontal line)