* Modified work
L. Cable

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Springfield High School Physical Science Learn-At-Home Packet

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(9th) Physical Science - Chapter 14 Waves

This completed packet is due upon return to school.

Recommended Learning Sequence

Day 1	• Read textbook pages 454-462. • Answer #1-6 on page 462 on page 2 in this packet.
Day 2	• Complete Concept Review 14.1 on page 3 in this packet. • Complete Cross-Disciplinary Earthquake Waves worksheet on page 4 in this packet.
Day 3	• Read textbook pages 463-471. • Answer #1-9 on page 471 on the page 5 in this packet.
Day 4	• Complete Concept Review 14.2 on page 6 in this packet. • Complete the Cross-Disciplinary Architectural Acoustics worksheet on page 7 in this packet.
Day 5	• Complete the Math Skills Wave Speed problems #1-15 on pages 8-11 in this packet.
Day 6	• Read textbook pages 472-478. • Answer #1-8 on page 478 on page 12 in this packet.
Day 7	• Complete Concept Review 14.3 on page 13 in this packet. • Complete the Cross-Disciplinary Bending Light Waves to Magnify worksheet on page 14 in this packet.
Day 8	• Answer Chapter 14 Review questions #1-17 on page 480 on pages 15-16 in this packet.
Day 9	• Answer Chapter 14 Review questions #18-29 on page 481 on pages 17-18 in this packet.
Day 10	• Complete the Chapter 14 Vocabulary Review on pages 19-20 in this packet.

This completed packet is due upon return to school.

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Skills Worksheet 14.1

Concept Review

p. 454-462

Section: Types of Waves

1. **Give** three examples of mechanical waves, and identify the medium through which they travel.

(1) Sound waves → air (2) seismic waves → the Earth

(3) Water waves → the ocean

2. **a. Name** the one type of wave that does not require a medium.

b. State what oscillates in this type of wave.

3. **Describe** the motion of the particles in the medium for each type of wave. How does this motion compare to the direction the wave travels?

a. transverse wave

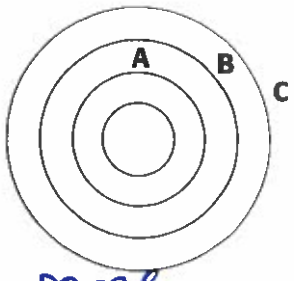
b. longitudinal wave

4. **Explain** what happens to the motion of a particle as a wave passes through a medium. How is the motion of the particle like the motion of a mass on a spring?

Particles in a medium oscillate, or vibrate back/forth, as a wave passes by.

5. **Use** the figure below to answer the following questions. The figure shows a pattern of wave fronts that are formed when a pebble is dropped into a pool of water.

a. Compare the height of the wave fronts in circles A, B, and C.



b. Indicate the wave front in which the energy of the wave is most spread out.

c. Compare the amount of total energy in each of the wave fronts.

Each wave front has the same total amount of energy

p. 471

m
λc

1.

2.

3. Frequency and period are the inverse of each other.

4.

5.

6.

7. $\boxed{V = f \times \lambda}$

$V = (440\ Hz)(1.5\ m) = 660\ m/s$

8. $\boxed{\lambda = \frac{V}{f}}$ $\lambda = \frac{340\ m/s}{440\ Hz} =$ _____ m

9. $\boxed{f = \frac{V}{\lambda}}$ $f = \frac{3 \times 10^8\ m/s}{0.05\ m}$ $f = 3 \times 10^{10}\ Hz$

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Skills Worksheet

CONNECTION TO ARCHITECTURE

Cross-Disciplinary

Architectural Acoustics

Read the following paragraphs, and complete the exercises below.

The speed of sound waves depends on the medium in which the sound travels. The table below shows the speed of sound in some common materials. People who work in the field of architectural acoustics are concerned with controlling sound that travels in a closed space. Their goal is to make rooms and buildings quiet yet suitable for people to enjoy talking and listening to music.

Material	Speed (m/s)
Air	344
Water	1 433
Concrete	3 231
Glass	3 962
Hard wood	3 962
Brick	4 176
Aluminum	4 877
Steel	5 029

One factor that affects the acoustical quality of a room is the way the room reflects sound waves. Sound waves bounce off surfaces including floors, ceilings, and walls. Using materials that absorb sound reduces sound wave reflection. Materials that have small pockets of air that can trap the sound vibrations and keep them from reflecting are most sound absorbent. Sound-absorbing floor and ceiling tiles, curtains, and upholstered furniture all help to control sound wave reflection.

When the goal is to try to keep sound from leaving a room, standard approaches include absorbing vibrations, blocking the vibration path, and breaking the vibration path. Installing insulation materials such as fiberglass between the walls and floors can absorb vibrations. Building extra thick walls, floors, and ceilings also helps block the path of vibrations.

Exercises

1. Through which material does sound travel slowest?

Sound travels the slowest in air

2. If you wanted to control sound reflection in an office, would you install metal, wood, or cork partitions? Why?

Cork → (why?)

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2c

4. A 10.0 m wire is hung from a high ceiling and held tightly below by a large mass. Standing waves are created in the wire by air currents that pass over the wire, setting it in motion. If the speed of the standing wave is 335 m/s and its frequency is 67 Hz, what is its wavelength?

$\lambda = \frac{v}{f} = \frac{335\ m/s}{67\ Hz} =$ _____ m

5. Sonar is a device that uses reflected sound waves to measure underwater depths. If a sonar signal has a frequency of 288 Hz and the speed of sound in water is 1.45×10^3 m/s, what is the wavelength of the sonar signal?

Problem

A buoy bobs up and down in the ocean. The waves have a wavelength of 2.5 m, and they pass the buoy at a speed of 4.0 m/s. What is the frequency of the waves? How much time does it take for one wave to pass under the buoy?

Solution

Step 1: List the given and unknown values.

Given:	wavelength, $\lambda = 2.5$ m
	wave speed, $v = 4.0$ m/s
Unknown:	frequency, $f = ?$ Hz
	period, $T = ?$ s

Step 2: Write the equation for wave speed, and rearrange it to solve for frequency. Write the equation for period.

$$v = f \times \lambda \qquad f = \frac{v}{\lambda}$$

$$T = \frac{1}{f}$$

Step 3: Insert the known values into the equations, and solve.

$$f = \frac{4.0\ \text{m/s}}{2.5\ \text{m}}$$

$$f = 1.6\ \text{Hz}$$

$$T = \frac{1}{1.6\ \text{Hz}}$$

$$T = 0.62\ \text{s}$$

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Practice

10. A wave with a frequency of 60.0 Hz travels through vulcanized rubber with a wavelength of 0.90 m. What is the speed of this wave?

11. A wave with a frequency of 60.0 Hz travels through steel with a wavelength of 85.5 m. What is the speed of this wave?

Mixed Practice

12. Earthquakes generate shock waves that travel through Earth's interior to other parts of the world. The fastest of these waves are longitudinal waves, like sound waves, and are called *primary waves*, or just *p-waves*. A p-wave has a very low frequency, typically around 0.050 Hz. If the speed of a p-wave with this frequency is 8.0 km/s, what is its wavelength?

$\lambda = \frac{v}{f} = \frac{8.0 \times 10^3 \text{ m/s}}{0.050 \text{ Hz}} = 1.6 \times 10^5$ _____

13. Earthquakes also produce transverse waves that move more slowly than the p-waves. These waves are called *secondary waves*, or *s-waves*. If the wavelength of an s-wave is 2.3×10^4 m, and its speed is 4.5 km/s, what is its frequency?

$f = \frac{v}{\lambda} = \frac{4.5 \times 10^3 \text{ m/s}}{2.3 \times 10^4 \text{ m}}$ _____ Hz

14. A dolphin can typically hear sounds with frequencies up to 150 kHz. What is the speed of sound in water if a wave with this frequency has a wavelength of 1.0 cm?

15. A ship anchored at sea is rocked by waves that have crests 14 m apart. The waves travel at 7.0 m/s. How often do the wave crests reach the ship?

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Skills Worksheet 14.3

Concept Review p. 472-478

Section: Wave Interactions

1. **Describe** the behavior of the waves in the following situations, and give an example of each type of behavior.

   a. Waves strike a surface or boundary.

   Waves would bounce, or reflect off the surface or boundary

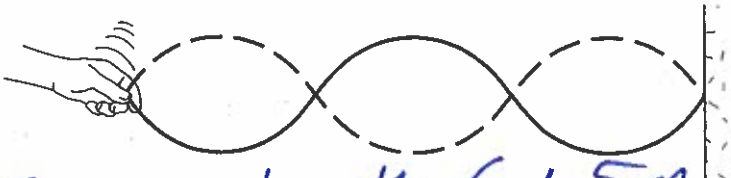
   b. Waves pass an edge or an opening.

   c. Waves pass from one medium to another.

   d. Waves pass through another wave.

2. **Draw** two waves that will interfere constructively and two waves that will interfere destructively, and draw the resulting wave produced in each case. Label each case constructive or destructive interference.

3. **Determine** the wavelength of the standing waves in the figure below. The string is 1.5 m long.



1 = 1 wavelength $\left(\frac{1.5\text{ m}}{1.5\text{ wavelength}}\right)$ = _____ m

p. 480

M & C

1. C - energy
2.
3.
4.
5. C - move in circles
6.
7. A - frequency
8.
9.
10. The amplitude of a wave is half the vertical distance between the crest and the trough.
11.
12.

p. 481

m/2c

18. To cause a longitudinal wave in a rod, you would strike the end of the rod, along the axis of the rod. To cause a transverse wave, you would strike the rod at right angles to the axis.

19.

20. $\boxed{V = f \cdot \lambda}$

$V = (2.0\ Hz) \cdot (1.5\ m) =$ _____ m/s

21. X

22. $\boxed{f = \frac{V}{\lambda}}$ $\frac{V}{\lambda} = \frac{340\ m/s}{0.77\ m} =$ _____ Hz

23.

pg. 966 - Glossary for use ch. 14

m
2C

Chapter 14 – Waves: Vocabulary Review

Define the following terms.

1. wave – a periodic disturbance in a solid, liquid, or gas as energy is transmitted through a medium.

2. medium –

3. mechanical wave –

4. electromagnetic wave – a wave that consists of oscillating electric and magnetic fields which radiate outward at the speed light. (p. 453)

5. transverse wave –

6. longitudinal wave –

7. crest – the highest point of a wave (p. 464)

8. trough –

9. amplitude –

10. wavelength – the distance from any point on a wave to an identical point on the next wave. (p. 464)