Bell Work

Complete the two OGT practice problems.

Be sure to explain your answer.

Turn it over when you are done.

This will count toward a grade.

Open your text to page 586…

What is happening in the picture?

What is an ocean wave?

How is the surfer able to move with the wave?

Why are some surfers not able to stay up and ride out the wave?

What causes ocean waves?

Are there kinds of waves other than ocean waves?

How are these wave like ocean waves?

Chapter Twenty-Three: Waves

23.1 Nature of Waves

I can explain what a wave is in terms of energy.

I can identify a few examples of wave.

I can compare and contrast mechanical waves and electromagnetic waves.

Demonstration of what waves can do….

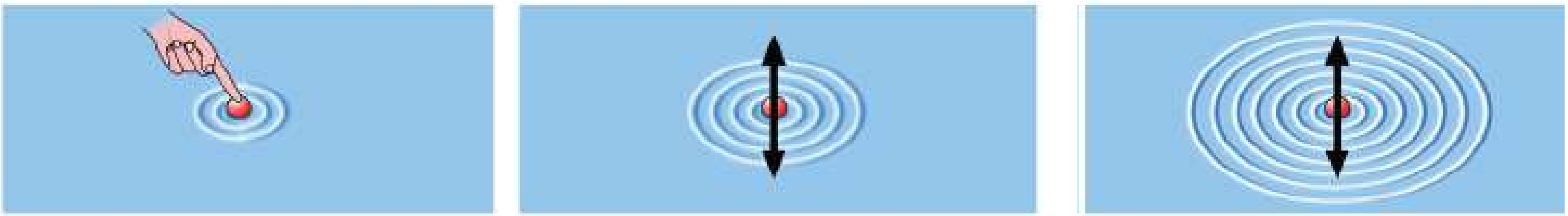
- Radio
- Light stick
- Bridge
- The Tacoma Narrows Bridge Collapse (1940)

A *wave* is an traveling disturbance that carries energy from one place to another.

If you poke a floating ball, it oscillates (vibrates) up and down.

The oscillation (vibration) spreads outward from where it started.

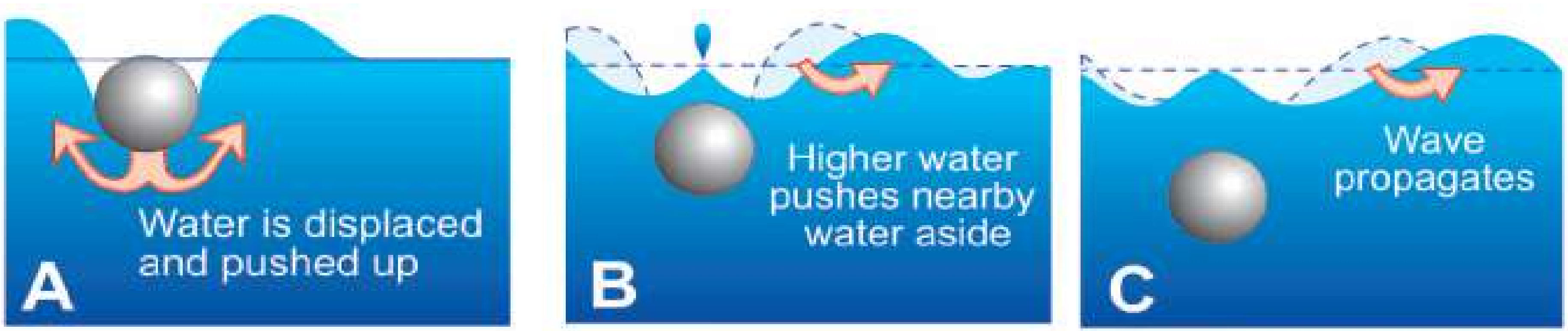
Vibration is movement that follows the same path repeatedly.



Energy is the ability to do work or cause change.

Vibrating objects are moving and have energy.

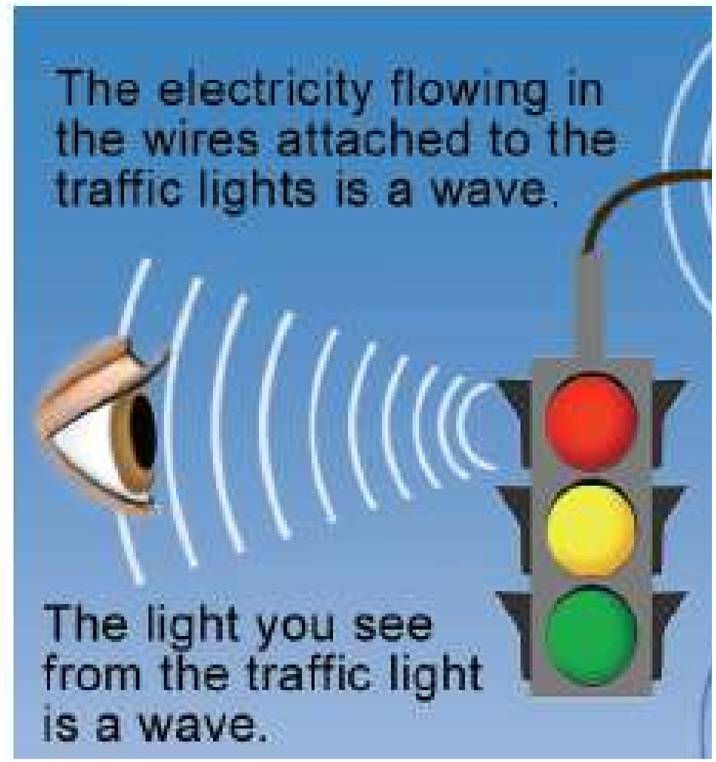
When you drop a ball into water, some of the water is pushed aside and raised by the ball.



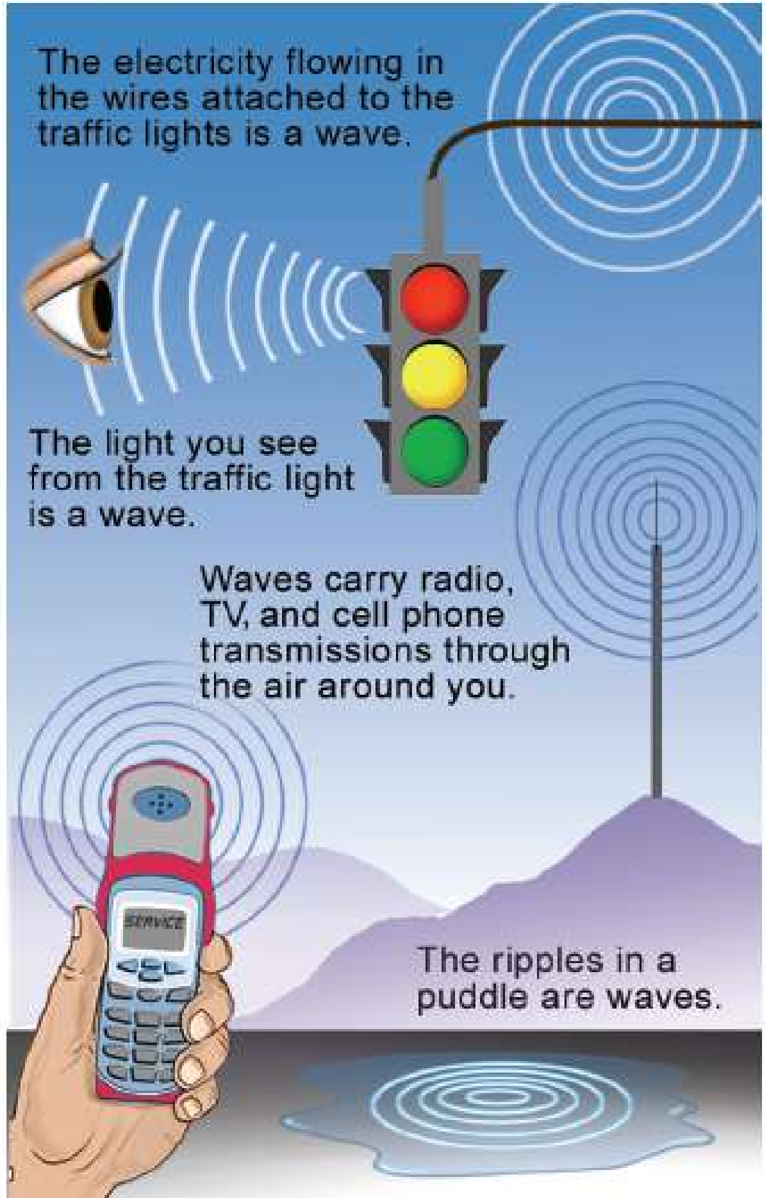
Waves are a traveling form of energy because they can change motion.

Waves also carry information, such as sound, pictures, or even numbers.

Vibration of your eardrum allows you to be able to hear sound waves.



Types of Waves



Mechanical Waves
Waves through Matter & Space

- The matter through which a wave is transmitted is a ***medium***.

  - Water is the medium for ocean waves.
  - Air is the medium for sound waves.

- Solids, liquids and gases can act as a medium.

- ***Mechanical waves*** require a medium.

Electromagnetic Waves

- Not all waves require a medium.
- Transmitted through a vacuum and disturb electric and magnetic fields
- These waves are called electromagnetic waves
- Examples: Light from the sun can travel to the Earth through the vacuum of space.
- Microwaves in an oven and x-ray us in medicine.

Chapter Twenty-Three: Waves

23.1 Nature of Waves

I can explain what a wave is in terms of energy.

I can identify a few examples of wave.

I can compare and contrast mechanical waves and electromagnetic waves.

23.2 Characteristics of Waves

- I can define wavelength, frequency, and amplitude.

- I can compare the characteristics of waves.

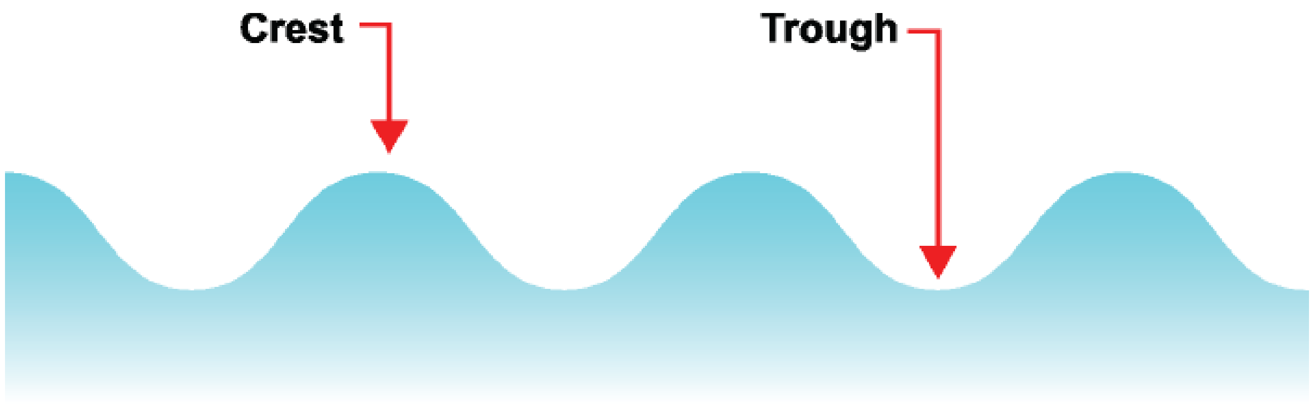
Let’s play with slinkies

Characteristics of Waves

You can think of a wave as a moving series of high points and low points.

A *crest* is the high point of the wave.

A *trough* is the low point.

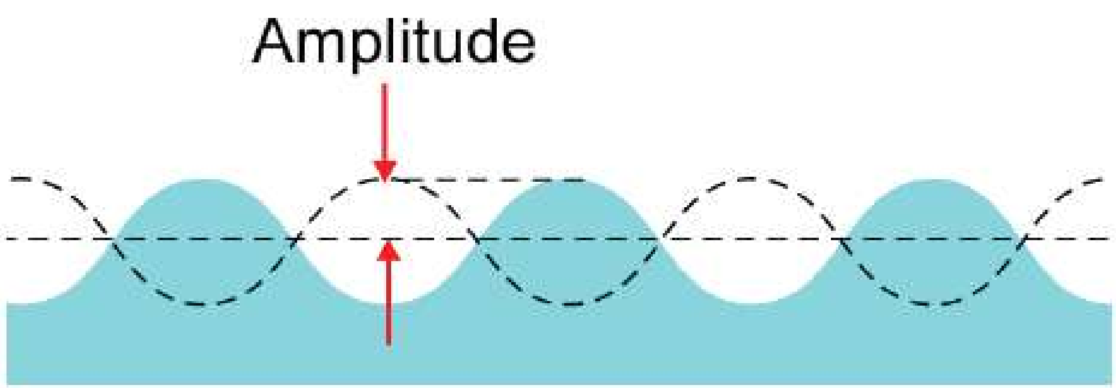


Amplitude is the maximum movement from rest.

Amplitude indicates the amount of energy carried by they wave.

Increase in energy, give an increase in amplitude.

Measure from resting position to crest or resting position to trough.



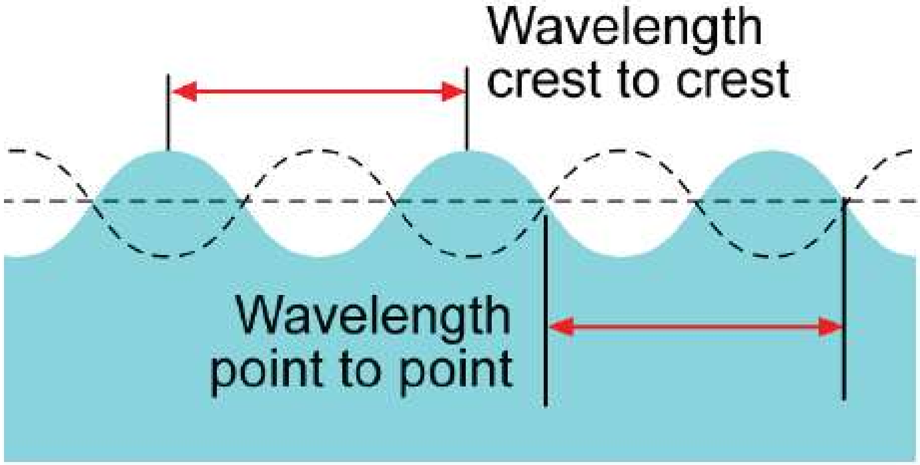
Resting Positio

Wavelength is the distance from any point on a wave to the same point on the next cycle of the wave.

The distance between one crest and the next crest is a wavelength.

Measured in meters (m) or centimeters (cm).

Symbol is the greek letter lambda (λ).

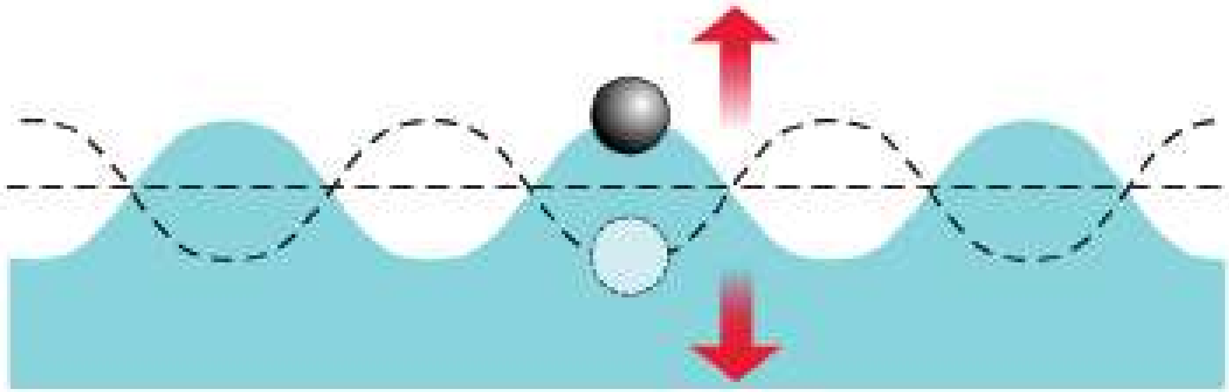


The *frequency* of a wave is number of complete waves per unit of time.

Units are hertz (Hz).

1 Hz = 1 wave/sec

The faster something vibrates, the higher the frequency.



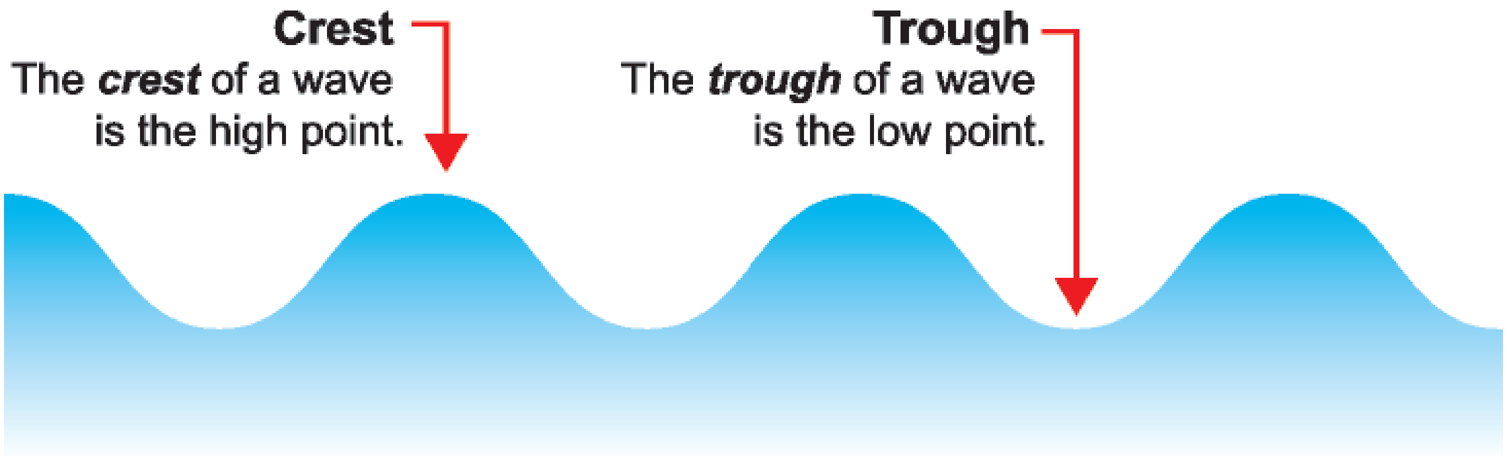
Frequency:

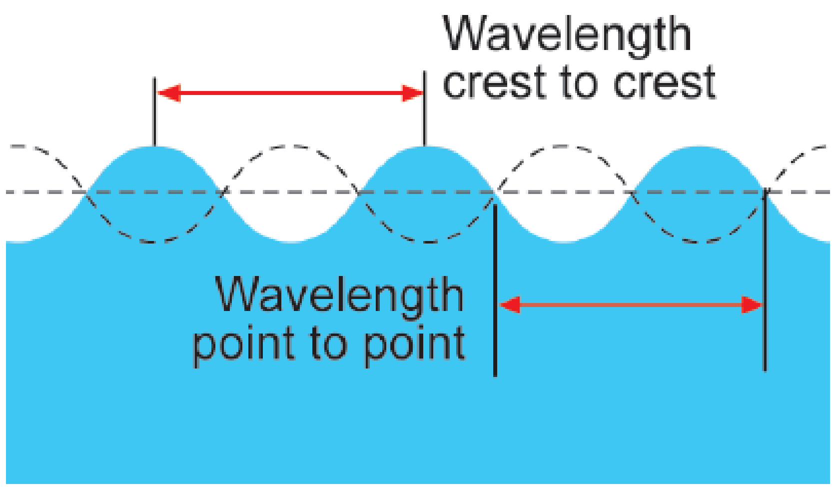
- If six complete vibrations occur in 2.0 seconds, what is the frequency of the wave?

- If ten complete vibrations occur in 20 seconds, what is the frequency of the wave?

- λ= wavelength measured in (m) meters
- f = frequency = time/cycle
  measured in (Hz) hertz

Frequency, Amplitude and Wavelength





23.2 Characteristics of Waves

- I can define wavelength, frequency, and amplitude.

- I can compare the characteristics of waves.

Terms to Know

Wave	Crest
Vibration	Trough
Medium	Amplitude
Mechanical wave	Wavelength
Electromagnetic wave	Frequency

* Make flashcards for the term*

Bookwork

- Section 23-1 Page 591
  - #1-5

- Section 23-2 Page 594
  - # 1-4

Bell Work

Complete the two OGT practice problems.

Be sure to explain your answer.

Turn it over when you are done.

This will count toward a grade.

23.3 Types of Waves

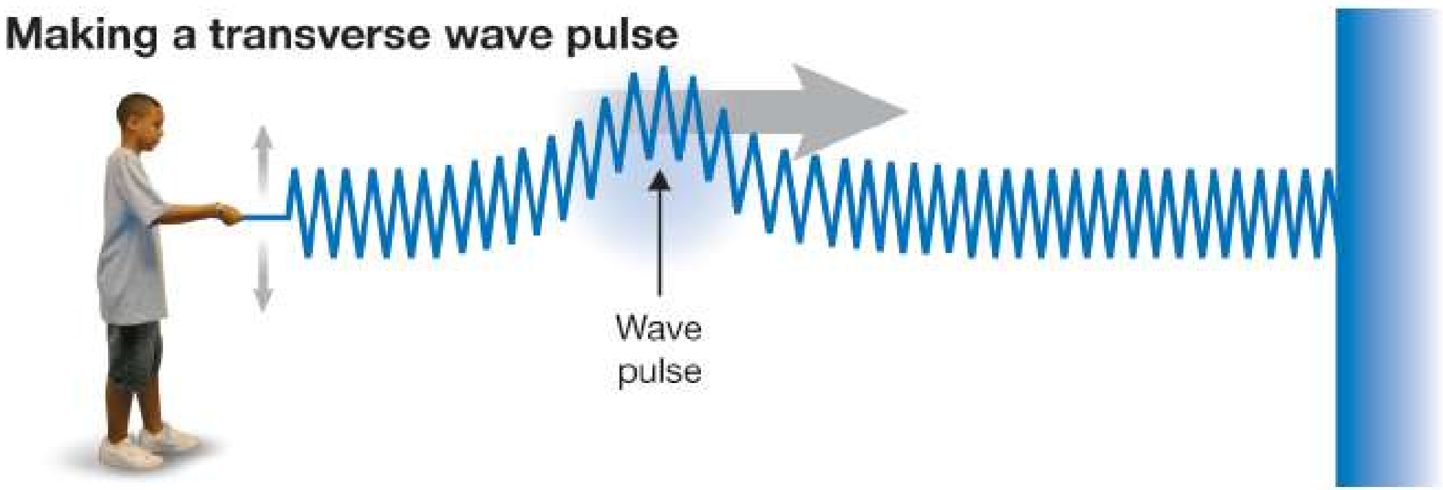
- I can classify waves as transverse, longitudinal, or surface waves.
- I can cite examples of each type of wave.
- I can distinguish between compressions and rarefactions.

Types of Waves

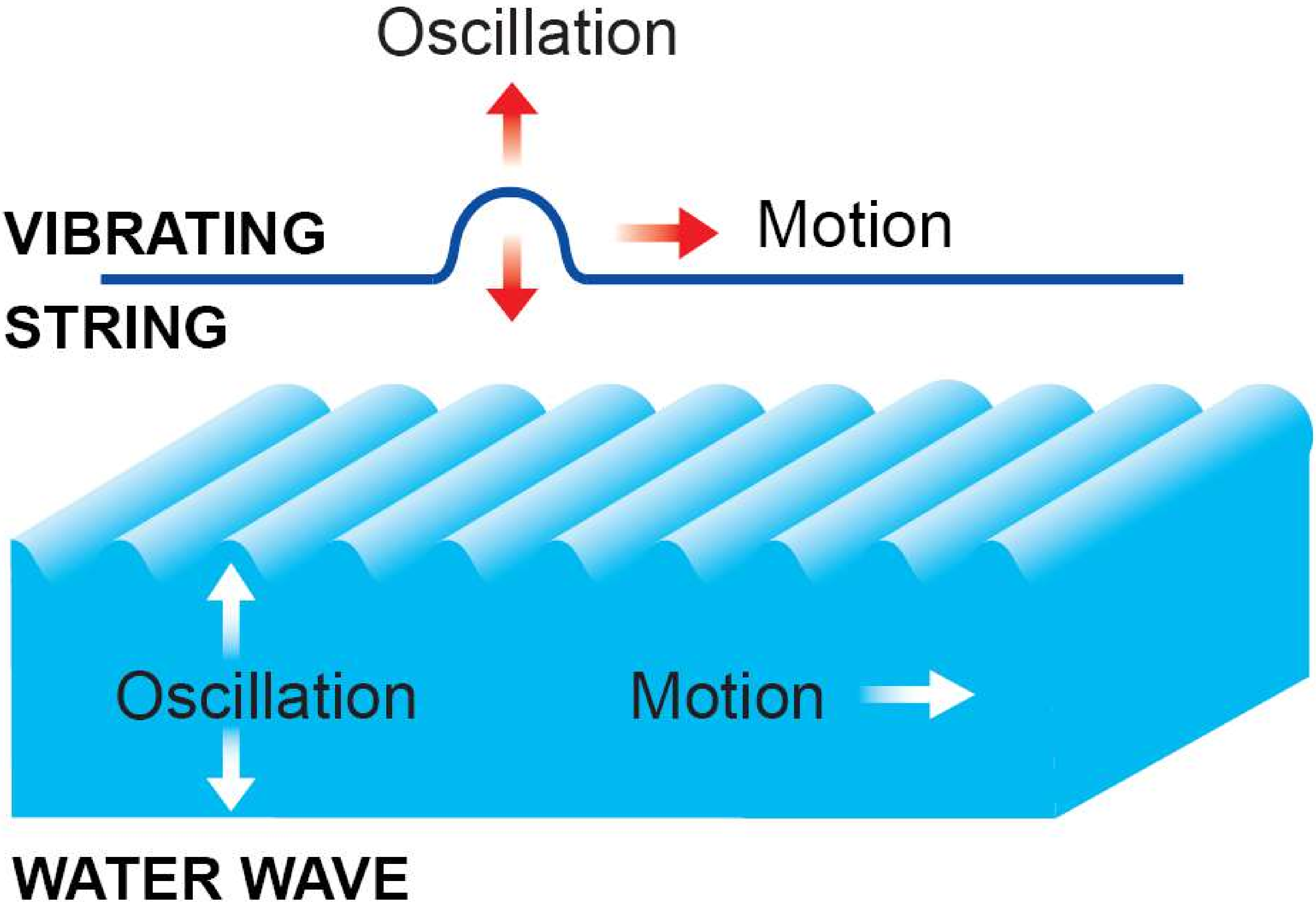
Depending on the motion of the medium as compared to the movement of the wave, waves are classified as either *transverse* or *longitudinal*.

Transverse Waves

- Motion of the medium is at right angles to the direction of the wave.
- Particles move up and down (vertical), while movement of wave is across (horizontal).
- Light and other electromagnetic waves



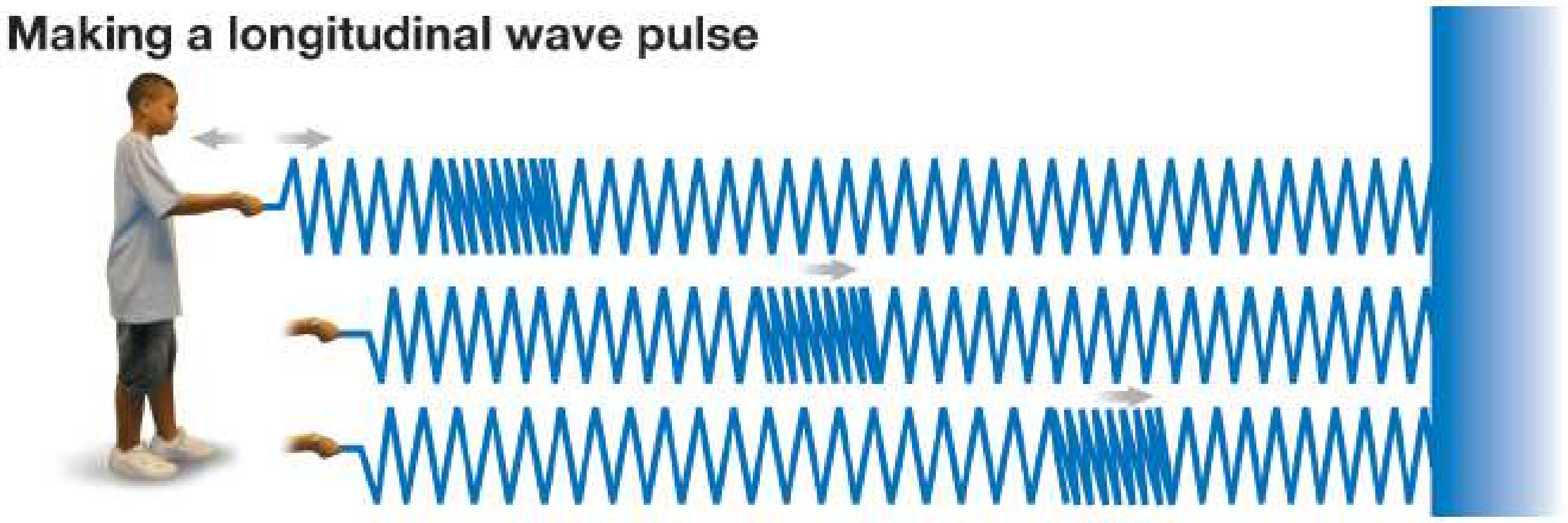
Transverse Waves



Longitudinal Waves

Compressions – space in the medium in which the particles are crowded together.

Rarefaction – space in the medium in which there are fewer particles.

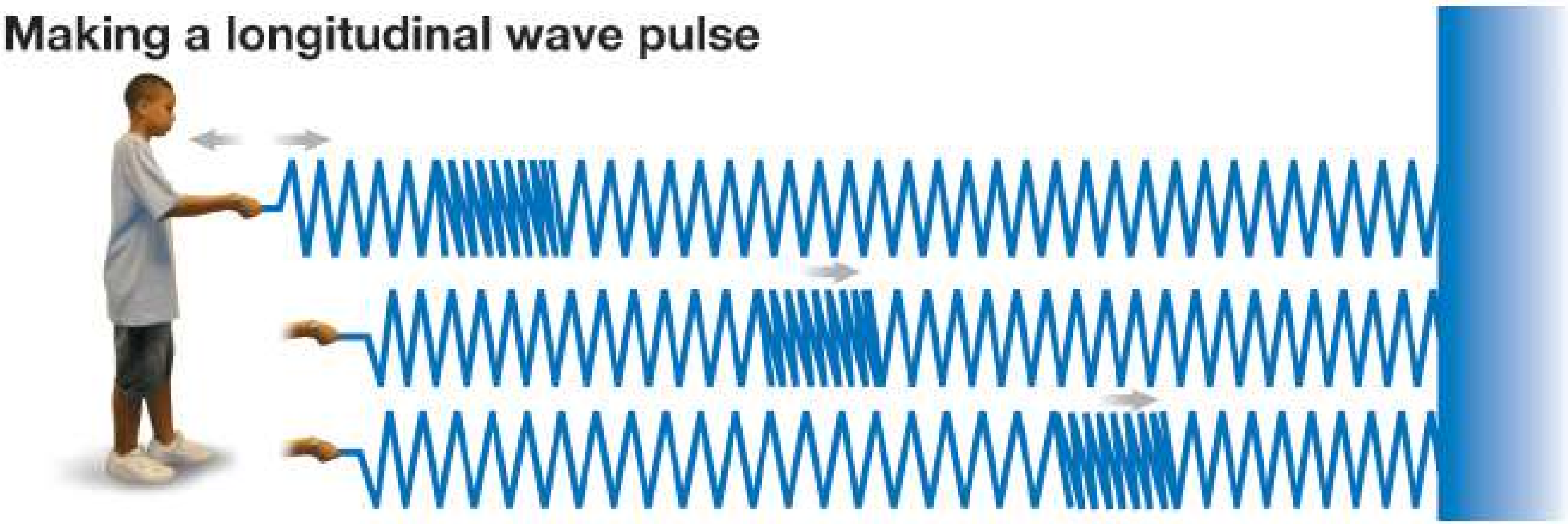


Longitudinal Waves

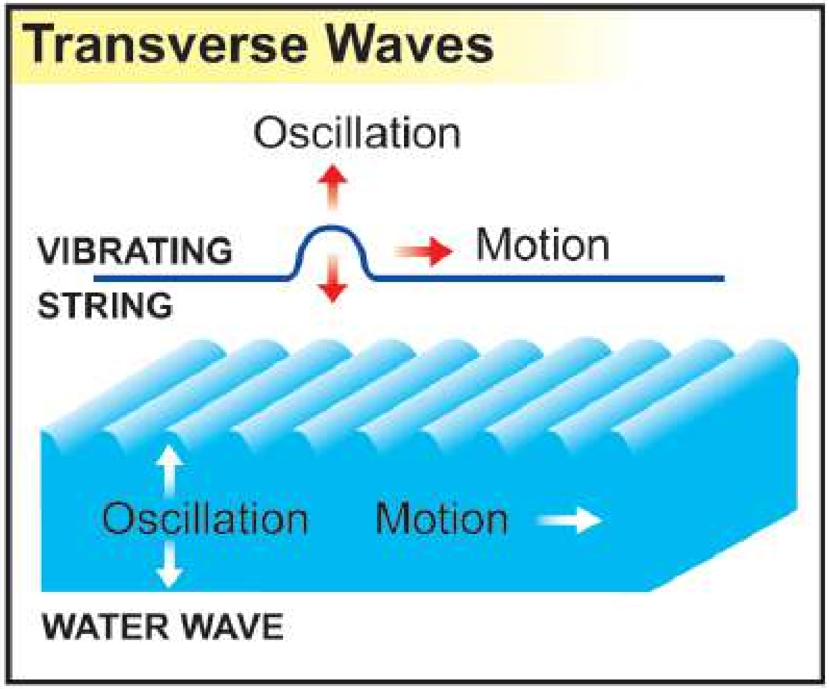
- Longitudinal waves consists of a series of compressions and rarefactions.
- The motion of the medium is parallel to the direction of the wave.
- The particles of the medium move in the same direction in which the wave moves.
- Sound waves

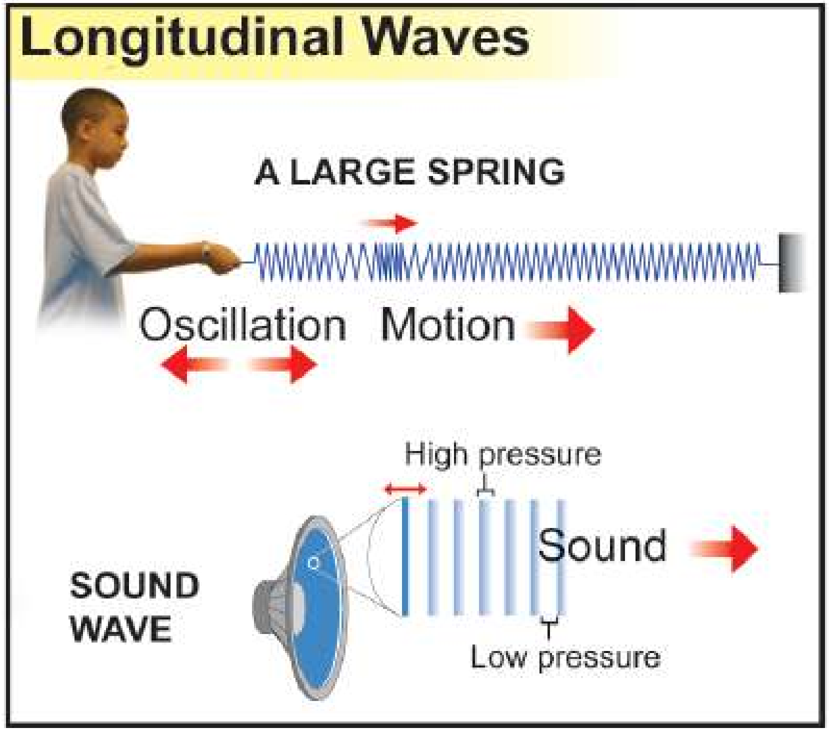
Longitudinal Waves

- Wavelength of longitudinal waves is the distance between compressions or rarefactions.
- Frequency is the number of compressions that pass a point per second.



Transverse and Longitudinal Waves





Combination Waves

- Some waves cannot be described as only transverse or longitudinal but a combination of both.
- Example: Surface waves (between water and air)
- They travel through two mediums.
- Particles move in a circle instead of vertical or horizontal motion.

23.3 Types of Waves

- I can classify waves as transverse, longitudinal, or surface waves.
- I can cite examples of each type of wave.
- I can distinguish between compressions and rarefactions.

Terms to Know

Transverse Wave	
Longitudinal Wave	
Surface Wave	

* Make flashcards for the term*

Bookwork

- Section 23-3 Page 597
  - #1-5

Bell Work

Complete the two OGT practice problems.

Be sure to explain your answer.

Turn it over when you are done.

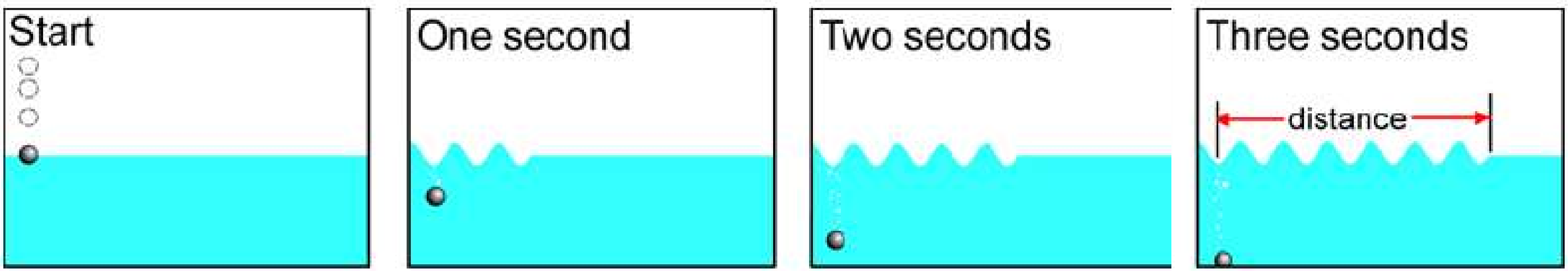
This will count toward a grade.

23.4 Speed of Waves

- I can predict increases or decreases in wavelength for a given increase or decrease in frequency.
- I can relate speed, frequency, and wavelength.
- I can solve mathematical problems involving speed of waves.

Speed of Waves

The speed of a water wave is how fast the wave spreads, NOT how fast the water surface moves up and down or how fast the dropped ball moves in the water.



How do we measure the wave speed?

Speed of Waves

The *speed* is the number of waves passing a point in a certain amount of time (frequency) and the wavelength.

Speed = Frequency X Wavelength

Speed is measured in meters per second (m/s).

A wave with a frequency of 4Hz (1/s) and a wavelength of 2m has a speed of 8m/s.

4Hz X 2m = 8m/s

Speed of Waves

- In a given medium, the speed of a wave is constant (does not change).
- Increase in frequency, means a decrease in wavelength.
- Speed of a wave only depends upon the medium through which it is traveling.

Speed of Waves

- *Density* of the medium affects the speed of mechanical waves.
  - A wave moves slower through a medium with higher density.
  - It is harder to get all the particles of a denser medium to move the energy through.

- *Elasticity* also affects speed of waves.
  - Elasticity is the ability of a medium to return quickly to its original shape after being disturbed.
  - Waves move faster in a more elastic medium.

Solving Problems: Wave Speed

WAVE SPEED

$$v = f\lambda$$

Speed (m/s)

Frequency (hertz or $\frac{1}{T}$)

Period (s)

Wavelength (m)

Calculating Wave Speed

The wavelength of a wave on a string is 1 meter and its frequency is 5 Hz.

Calculate the wave speed

The frequency of a wave on a string is 2 Hz and the wavelength is 4 meters.

Calculate the wave speed

23.4 Speed of Waves

- I can predict increases or decreases in wavelength for a given increase or decrease in frequency.
- I can relate speed, frequency, and wavelength.
- I can solve mathematical problems involving speed of waves.

Bookwork

- Section 23-4 Page 599
  - #1-5

Bell Work

Complete the two OGT practice problems.

Be sure to explain your answer.

Turn it over when you are done.

This will count toward a grade.

23.5 Interactions of Waves

I can identify examples of each type of wave interaction.

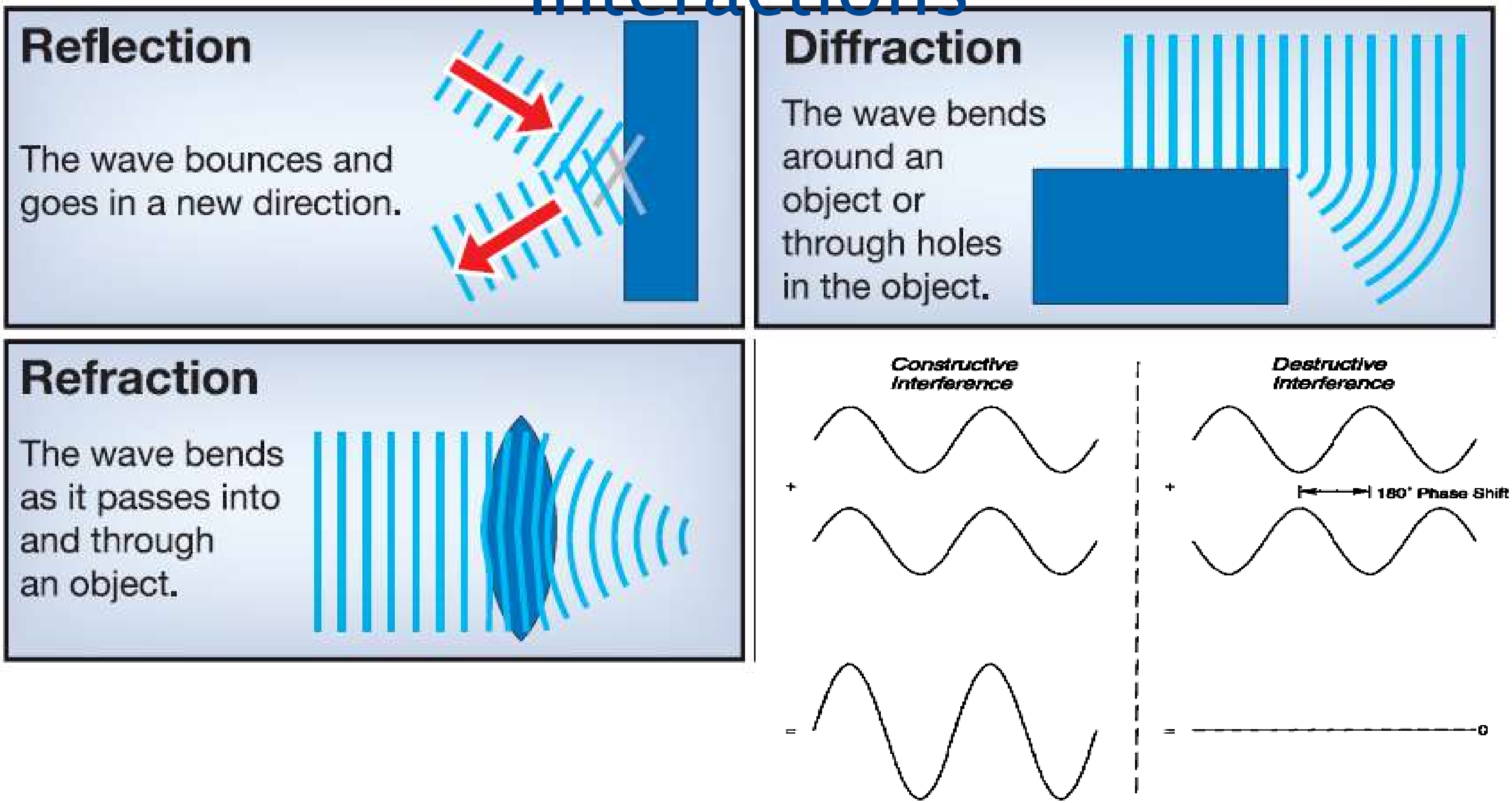
I can explain some common phenomena based on wave interaction.

4 Interactions of Waves

When a wave encounters a surface, four interactions can occur:

1. reflection
2. refraction
3. diffraction
4. interference

Interactions



Interference – When two waves meet a the same place, either constructive or destructive occurs

Changing Mediums

A *boundary* is an edge or surface where things change.

Reflection, refraction, and diffraction usually occur at boundaries.

Reflection

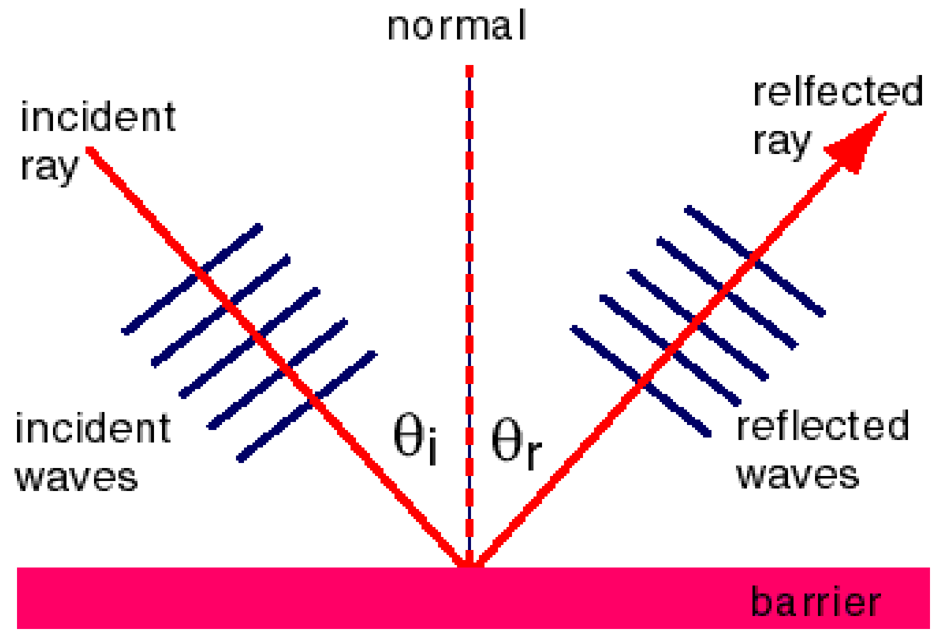
- **Reflection** is the bouncing back of a wave after it strikes a boundary that does not absorb all of the wave's energy.
- A line drawn in the direction of motion of a wave is called a **ray**.
- **Incident** wave is the incoming wave.
- **Reflected** wave is the wave bouncing back.

Reflection

- **Angle of incidence (i) –** formed by the incident ray and the imaginary normal line.

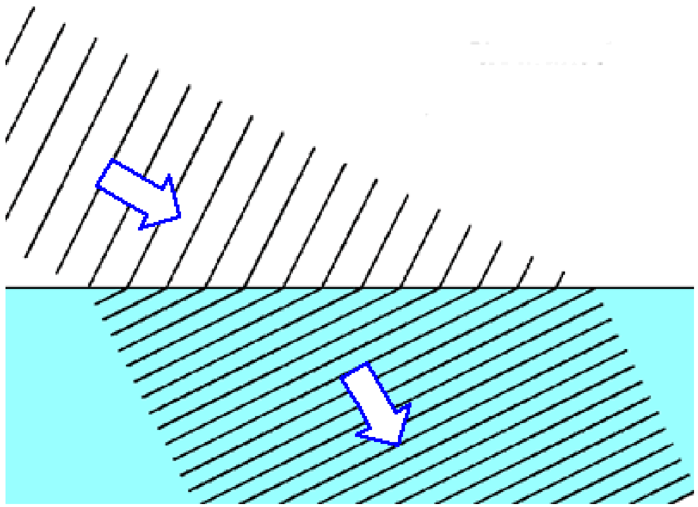
- **Angle of reflection (r)** – formed by the reflected ray and the imaginary normal line.

Law of reflection – the angle of incidence (i) is equal to the angle of reflection (r).



Refraction

- Waves travel straight until they hit a new medium.
- **Refraction** – the bending of waves due to a change in speed (different speeds through different mediums)

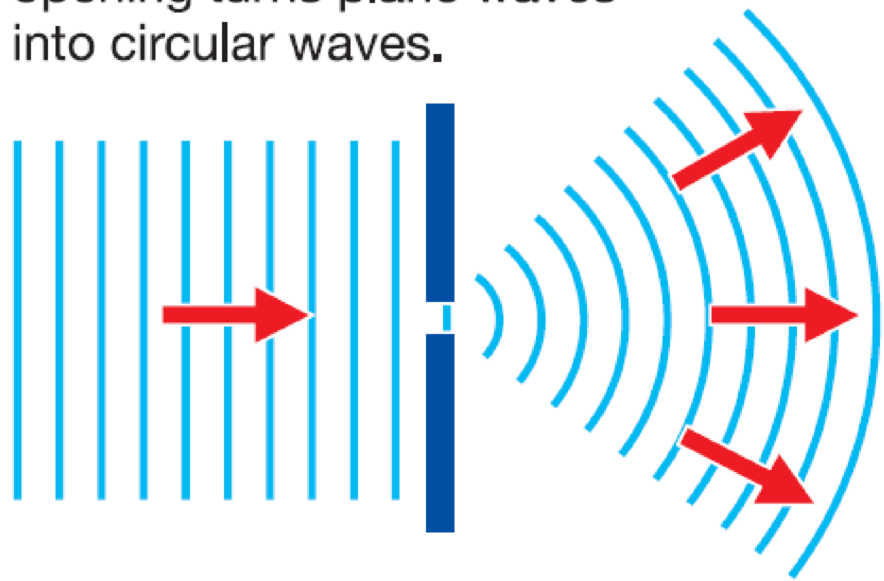


Diffraction Interactions

Diffraction – bending of waves around the edge of an obstacle.

When a plane wave passes through a small hole diffraction turns it into a circular wave.

Diffraction through a small opening turns plane waves into circular waves.



Interference

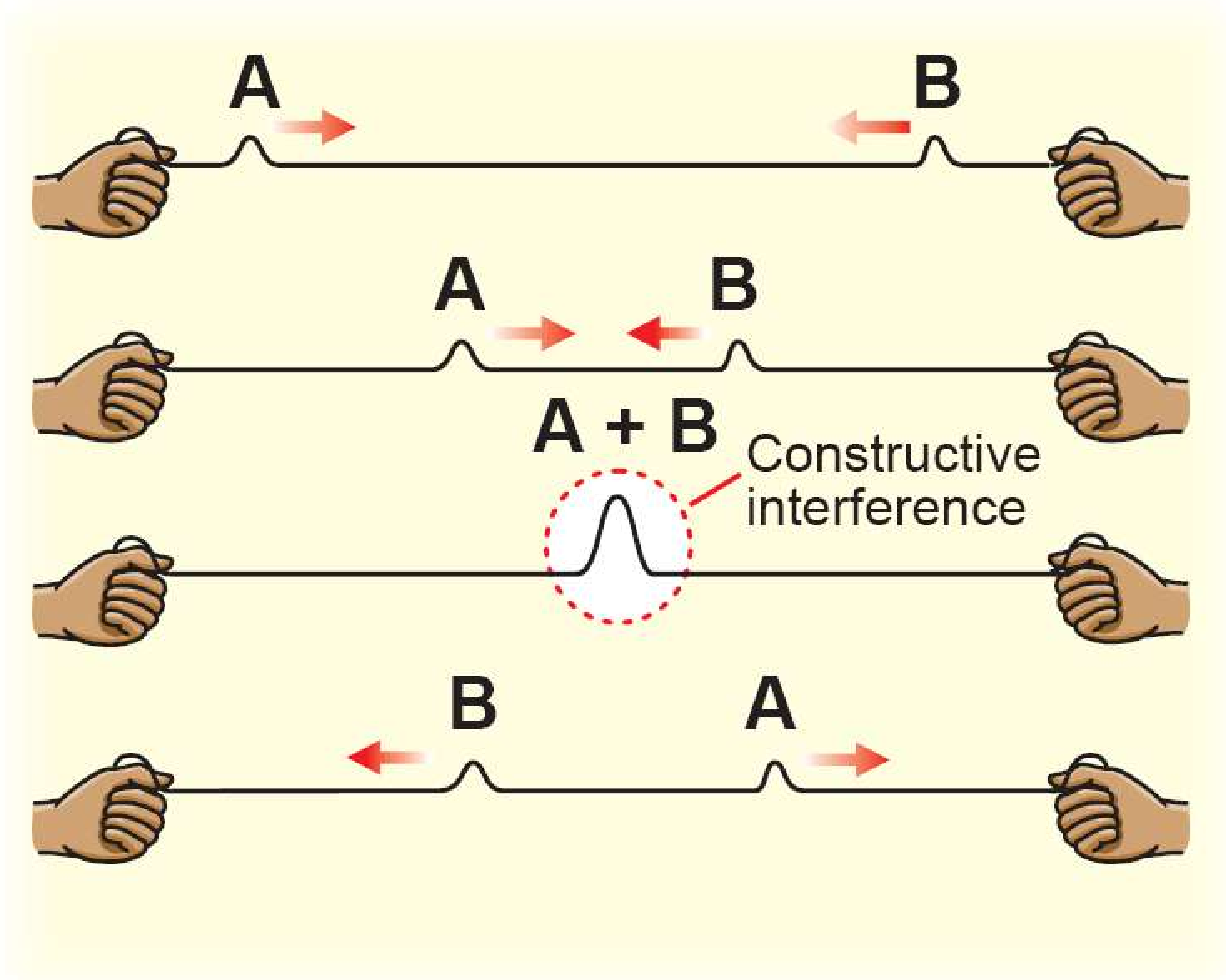
Interferenc*e* – when two or more waves arrive at the same place at the same time.

There are two type of interference: constructive and destructive

Constructive Interference

- **Constructive interference** happens if waves combine in such a way that the disturbance that results is greater than either wave alone.
- Crests of the two waves add together to form a single wave.
- The amplitude is of the single wave is equal to the sum of the amplitudes of the two original waves.

Constructive Interference



Two wave pulses that are in phase can add up to make a single, bigger pulse when they meet.

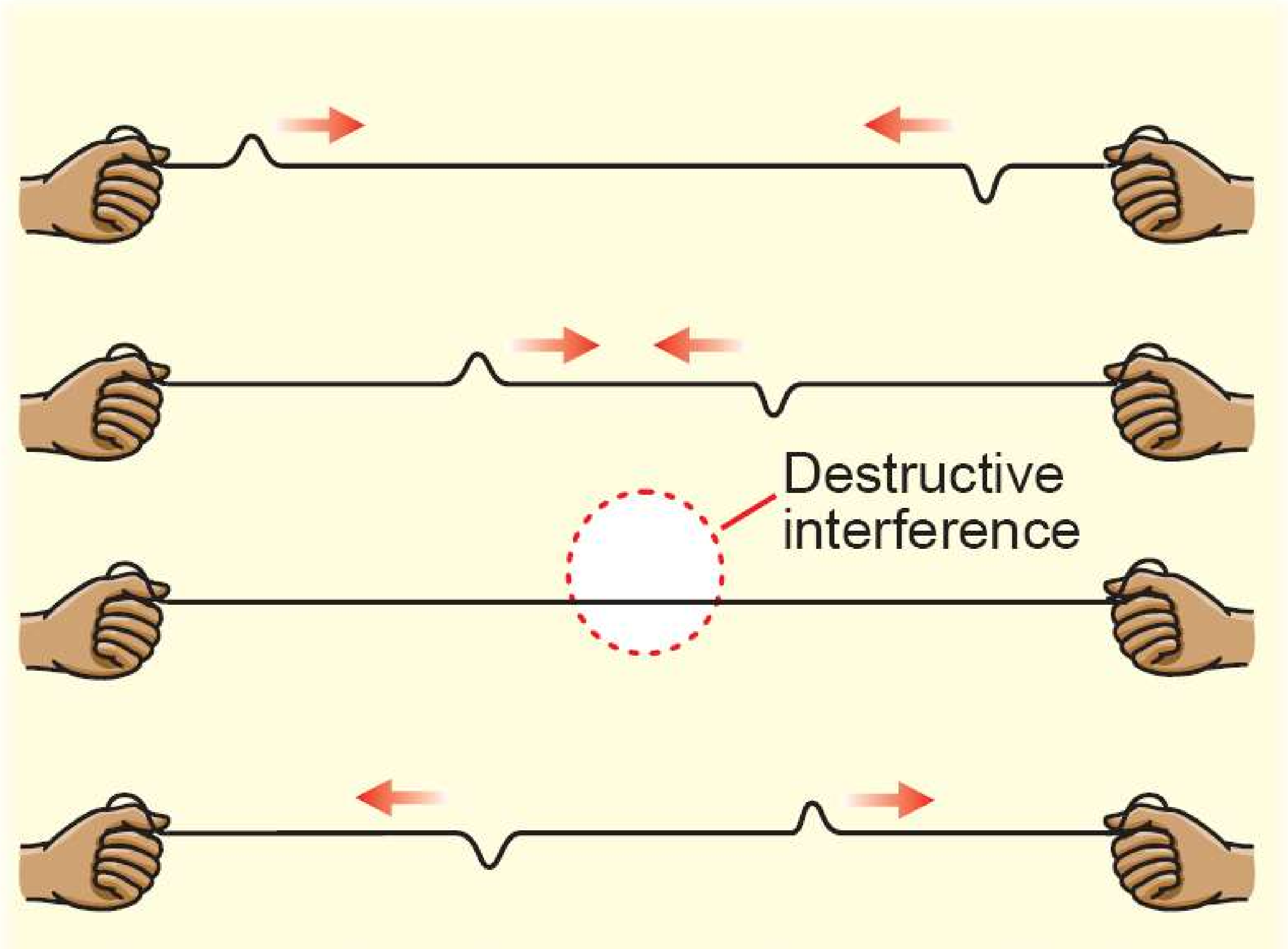
Destructive Interference

Destructive interference – waves combine in such a way that the disturbance that results is less than either wave alone.

Crests and troughs combine by subtracting from each other to form a single wave.

If the crest of one wave occurs at the trough of the other wave and both waves have the same amplitude, the waves will cancel each other out.

Destructive Interference



Two equal wave pulses that are out of phase will subtract when they meet. The upward movement of one pulse can exactly cancel the downward movement of the other.

Standing Waves

- Vibrating the a rope at just the right frequency can cause a standing wave.
- Standing waves do not appear to be moving.
- **Nodes** are where destructive interference results in no energy displacement.
- **Antinodes** are where constructive interference causes maximum energy displacement (any crest or trough).

Standing Waves

- The frequency at which a standing wave occurs is called natural frequency or **resonant frequency**.
- Less effort is required to achieve a large amplitude at its natural frequency.
- **Resonance** is the ability of an object to vibrate by absorbing energy of its own natural frequency.
- Singer can shatter glass by singing at the same natural frequency that a glass has. Glass is not flexible and when it absorbs the energy it breaks.

23.5 Interactions of Waves

I can identify examples of each type of wave interaction.

I can explain some common phenomena based on wave interaction.

Terms to Know

Reflections	Refraction
Diffraction	Interference
Standing Wave	Resonant Frequency

* Make flashcards for the term*

Bookwork

- Section 23-5 Page 606
  - #1-6
- Chapter Review Page 610
  - Multiple Choice #1-9
  - True/False #1-8
  - Concept Mastery #1-3, 5-9

TECHNOLOGY ▶▶ CONNECTION

Cell Phones: How they work

The process that allows a cell phone to communicate is the same as for a radio or walkie-talkie. All of these devices use electromagnetic waves of within a specific frequency range to send information.