Waves Classwork #1 – What is a wave?
8th Grade PSI Science

Name ________________________________

1) What causes a wave?
   *A disturbance that travels through space or matter.*

2) In terms of wave motion, define medium.
   *The type of matter a wave moves through is the medium.*

3) In your own terms, define equilibrium position.
   *The position the medium is found in when there is NO wave passing through it.*

4) Compare/Contrast Pulse and Wave.
   *Both create disturbances in a medium. However, a pulse is a single disturbance that moves outward while a wave is a series of pulses that produce repeating and periodic disturbances in the medium.*

5) In a transverse wave, compare the direction of vibration of the particles in the medium to the direction that the wave is moving.
   *The particles vibrate in right angles to the direction the wave is moving.*

6) List at least 3 examples of wave motion as witnessed in your daily life.
   *Air molecules and gases, water, and a slinky.*
Waves Homework #1 – What is a wave?
8th Grade PSI Science

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1) Explain how a disturbance in a medium causes a wave to form.
   *Particles of the medium are disturbed and move away from their rest position and then bounce back to it.*

2) List 3 examples of wave motion. List the medium for each type of wave.
   *Medium – rope. Raising and lowering a rope will create a wave.*
   *Medium – water. Dropping a stone into a lake will cause the water to ripple out from point of contact.*
   *Medium – slinky. As the slinky is moved, a wave is created throughout the rest of the metal until it rests again.*

3) Make a sketch that shows the difference between a pulse and a wave.
   *(A pulse will be one point of disturbance and a waves is a series of pulses).*

4) Make a sketch of a transverse wave. Include directions of particle vibration and direction of wave motion.
   *(particle vibration will be at right angles to the direction of wave motion).*

5) Define the concept of equilibrium/rest position and explain what causes matter in the medium to move away from this position during wave motion.
   *Rest position is the position of the medium when there is no wave moving through it. When particles in the medium are disturbed they move AWAY from rest position, and then back, creating a wave.*
1) Label the parts of a wave seen below including Crests, Troughs, Equilibrium/Rest position, Amplitude, and wavelength.

2) Define the following terms:

- **Crest** - Point of maximum displacement
- **Trough** - Point of minimum displacement
- **Equilibrium/Rest Position** - Medium without a wave moving through it.
- **Amplitude** - Distance away from rest position.
- **Wavelength** - Distance a wave travels before its cycle repeats.

3) Define/Compare Frequency and Period. 
_Both deal with the wave’s vibration, but they are inversely related. Period is the time it takes for one vibration or full wavelength to occur. Frequency is the number of vibrations a wave makes per second._

4) If a wave has a period of .5 s, what is its frequency? 
2 Hz.

5) If a wave has a frequency of 100 Hz, What is its period? 
.01 s.

6) What happens to the frequency of a wave as the period of the wave INCREASES? 
_It decreases._
1) Produce a sketch of a wave that labels the wave’s crests, troughs, amplitude, wavelength, and equilibrium position.  
*(See classwork from this section, question #1.)*

2) What is the SI unit for frequency? 
   *The Hertz (Hz).*

3) What is the equation for calculating frequency when we know the wave period? 
   *Frequency = 1/Period.*

4) What is the wave period when the frequency is 250 Hz? 
   *0.004 s.*

5) What is the wave frequency when the period is 0.2 s? 
   *5 Hz.*
Waves Classwork #3 – The Wave Equation
8th Grade PSI Science

Name______________________________

1) Write the wave equation and list the units for each variable in this equation.

\[ v = \lambda f \]

\( v \) – wave velocity, \( \lambda \) - wavelength, and \( f \) is frequency.

2. What is the wave velocity when a water wave has a wavelength of 2 m and a frequency of 2 Hz?

4 m/s

3. What is the wave velocity when a sound wave has a frequency of 512 Hz and a wavelength of 0.67 m?

343.04 m/s

4. What is the wavelength of a sound wave that has a frequency of 800 Hz, and a velocity of 340 m/s?

0.425 m

5. What is the wavelength of a slinky wave that travels at 35 m/s and has a frequency of 7 Hz?

5 m

6. What is the frequency of a tidal wave that travels at a velocity of 100 m/s and has a wavelength of 33.33 m?

3 Hz.
Waves Homework #3 – The Wave Equation
8th Grade PSI Science

Name______________________________

1) This is the wave equation, define each symbol & list the unit for each variable.

\[ v = \lambda f \]

\( v \) – wave velocity (m/s), \( \lambda \) – wavelength(m), and \( f \) is frequency(Hz).

2) What is the velocity of a sound wave with a frequency of 300 Hz and a wavelength of 1.14 m?

342 m/s

3) What is the wavelength of a water wave that travels at a velocity of 33 m/s with a frequency of 11 Hz?

3 m

4) What is the velocity of a seismic wave that has a wavelength of 3m and a frequency of 500 Hz?

1500 m/s

5) What is the frequency of a vibration that travels at a velocity of 99 m/s with a wavelength of 9 m?

11 Hz
1) Waves can be altered by striking boundaries, moving around objects and colliding with one another. What are the four major wave characteristic behaviors?  
   *Reflection, refraction, diffraction, and interference.*

2) Draw and describe what happens to a reflected wave.  
   *A reflected wave hits a boundary, and then bounces back.*

3) Compare and contrast free end and fixed end reflection for a wave in a string.  
   *The free end reflection is in phase with the incident pulse. The fixed end reflection is out of phase with the incident pulse.*

4) Define refraction and describe what happens to a wave’s velocity and wavelength as it moves from a) a less dense to a denser medium (example: air to water) and b) a denser to less dense medium (example: diamond to air).  
   *Refraction is the change in direction of a wave due to a change in its transmission medium.*  
   a. The velocity decreases and the wavelength decreases.  
   b. The velocity increases and the wavelength increases.

5) Draw a diagram of diffraction and list a basic definition of the phenomenon.  
   *Diffraction is the bending of waves around small obstacles and the spreading out of waves past small openings.*

6) Define Constructive and Destructive Interference  
   *Constructive Interference - Waves that are in phase (both vibrating in the same direction) with each other will add up in amplitude to reinforce each other and they get bigger.*  
   *Destructive Interference - Waves that are out of phase (both vibrating in the opposite direction) with each other will cancel out their amplitudes to and they get smaller.*
Waves Homework #4 – Properties of Waves
8th Grade PSI Science

1) Compare and contrast wave reflection and refraction. Draw a diagram and provide an example of each.

Reflection

Refraction

2) Draw a sketch of 2 wave pulses in a string that are undergoing constructive interference a) before they collide, b) during the collision, and c) after the collision.

Before

During

After

3) Draw a sketch of 2 wave pulses in a string that are undergoing destructive interference a) before they collide, b) during the collision, and c) after the collision.

Before

During

After

4) What is diffraction? What factors increase the amount of diffraction?

Diffraction is the bending of waves around small obstacles and the spreading out of waves past small openings. The amount can be increased when the wavelength of the waves are similar in size to the opening they are passing through.

5) What is refraction? What happens to the a) velocity, b) frequency, and c) wavelength of a wave as it changes medium?

Refraction is the change in direction of a wave due to a change in its transmission medium. As a wave changes medium, the velocity and wavelength change while the frequency does not change.
1) What is the source of any sound wave?

   *Vibrating objects.*

2) Compare the sound waves produced by longer/shorter vibrating objects.

   *Longer vibrating objects – longer sound waves.*
   *Shorter vibrating objects – shorter sound waves.*

3) Relate the terms frequency and pitch in terms of sound waves.

   *High frequency sound waves are heard as high pitched sounds. Low frequency sound waves are heard as low pitched sounds.*

4) Relate the terms Amplitude and Loudness in terms of sound waves.

   *High amplitudes make sound waves louder. Low amplitudes make sound waves softer.*

5) What is the hearing frequency range for most human beings?

   *20 Hz – 20 kHz.*
1) How do vibrating objects create sound waves?

*The vibrating objects create disturbances in the air (medium) and this creates sound waves.*

2) What is the unit for wave amplitude? How does the ear interpret amplitude of sound waves?

*Decibel. The ear hears loudness or softness of a sound wave.*

3) What is the unit for wave frequency? How does the ear interpret frequency of sound waves?

*Hertz. Frequency of sound waves is interpreted as higher or lower pitches.*

4) Explain how the length of a musical instrument affects the frequency/pitch of the sound waves it produces.

*Larger and longer musical instruments vibrate slower than shorter musical instruments. They (larger instruments) produce lower frequency/pitched sound waves than the higher frequency/pitched sound waves of smaller instruments.*

5) Speculate on the effect of aging on the frequency range that is detectible by the human ear. (use the internet as a research tool if necessary)

*As humans age, higher frequency sounds are more indiscernible, if impossible to hear altogether.*
Waves Classwork #6 – Sound as a Mechanical Wave
8th Grade PSI Science

1) What is a mechanical wave?
A wave that has a medium or substance to move through.

2) Why can you hear in space?
The gas molecules in space are not dense enough for sound waves to move through.

3) Define a longitudinal wave. Draw a diagram to illustrate the compressions and rarefactions.
Waves that vibrate the medium parallel (in the same plane) to the direction of wave motion.

4) Compare/Contrast Compressions and rarefactions.
As a vibrating object swings forward, it creates a compression in the medium that moves outward. When the vibrating objects swing backwards, it creates a region of low pressure called a rarefaction.

5) Compare vibrational direction of a medium to wave direction for a longitudinal wave.
Longitudinal Waves vibrate the medium parallel to the direction of wave motion.
1) How are longitudinal waves similar and different to transverse waves?
Both waves vibrate through a medium, however, transverse waves vibrate at right angles to the direction of energy movement, while longitudinal waves vibrate parallel to the direction of wave motion.

2) Draw a diagram that makes the analogy of a longitudinal wave into a transverse drawing.

3) Why does a vibrating object require a medium to produce sound?
Without a medium, sound waves will not propagate.

4) Where is pressure greatest? In a compression or rarefaction. Explain.
In a compression when the object swings forward and moves the medium outward.

5) Write a paragraph on how the ear detects sound waves during hearing.
The sound strikes the eardrum and vibrates three bones (hammer, anvil, stirrup). Then, the Cochlea changes the vibrations into electrical impulses. Finally, a signal is sent through the auditory nerve to brain.
1) How is the wave property of reflection used in SONAR?

   *SONAR uses the reflection of sound waves to map the sea floor of our oceans.*

2) What is the speed of sound in air if it travels a distance of 3740 m in 11 seconds?

   *340 m/s.*

3) Explain the effect of increasing air temperature on the speed of sound in air.

   *As the temperature increases, the speed of sound increases.*

4) How far are we away from a mountain if an echo returns in 15 seconds if the speed of sound in air is 340 m/s?

   *5100 meters away.*

5) Explain the concept of “echolocation” as used by dolphins and bats.

   *Animals use echolocation to "see" how far food is away by judging how fast the sound waves return after reflection.*
1) When would you hear thunder the sooner, on a hot day or a cold day?

   On a hot day, as the speed of sound increases with increasing temperature.

2) What is an echo? How do animals utilize echoes in feeding?

   An echo is the reflection of sound off of an object. Animals use echolocation to "see" how far food is away by judging how fast the sound waves return after reflection.

3) What is the speed of sound in air if it travels a distance of 5610 m in 12 seconds?

   467.5 m/s.

4) How far are we away from a mountain if an echo returns in 9 seconds if the speed of sound in air is 340 m/s?

   3060 meters away.
1) Define the Doppler Effect.
   *It is the change in frequency of a wave (or other periodic event) for an observer moving relative to its source.*

2) Explain an example of the Doppler Effect that you have observed in your daily life.
   *As the ice cream man comes down the street, the music, at first sounds higher pitched. Then, as the ice cream man passes and moves down the road, the music sounds lower pitched. The frequency of the sound wave increases as he approaches, and decreases as he drives away.*

3) This is a diagram of the Doppler Effect. In your own terms, explain what happens in front/in back of the moving sound source.
   *In front, decreased wavelength, increased frequency, and a higher pitch.

   *In back, increased wavelength, decreased frequency, and a lower pitch.*

4) What happens to the frequency heard by an observer that is moving toward a stationary sound source?
   *The frequency is increasing and a higher pitched sound is observed.*

5) What happens to the sound waves of a sound source that is moving at the speed of sound? Draw a diagram to illustrate this event.
   *The sound source “catches up” to the sound waves it produces. Constructive interference is undergone, and wave with increased amplitude is produced. This creates an intense “sonic boom”.*

   ![Diagram of sonic boom](http://uprepcharlie.files.wordpress.com/2013/05/mach1.png?w=158&h=156)
Waves Homework #8– The Doppler Effect
8th Grade PSI Science

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1) Draw a diagram of the Doppler Effect and explain it in your own terms.

http://commons.wikimedia.org/wiki/Doppler_effect#mediaviewer/File:Doppler_effect_diagrammatic.svg

*It is the change in frequency of a wave (or other periodic event) for an observer moving relative to its source.*

2) What happens to the wavelength and frequency of sound waves a) In front and b) in back of a moving sound source?
   a. Wavelength decreases, frequency increases.
   b. Wavelength increases, frequency decreases.

3) Draw a diagram of a sound source moving at supersonic speeds. Explain your diagram.
   *At supersonic speeds, the source of sound is ahead of the sound.*

4) Draw a diagram of the sound waves surrounding a stationary sound source. Does the Doppler Effect apply to this situation? Why or Why not?

*It does not. By definition, the Doppler Effect is a change in frequency and wavelength of a wave when the source is in motion compared to the observer.*

5) When a car drives by us blowing its horn, how does the Doppler Effect apply to this situation?
   *As the car approaches, the frequency of the sound increases, producing a higher pitched sound. When the car passes us, the frequency decreases creating a lower pitched sound.*