**STUDENT NAME:**

Build Your Own Wave Machine

Time: 20 Minutes

Materials:

* (2) cans of soup or (2) glasses of water
* Roll of scotch tape (or other kind of tape)
* Toothpicks
* (1) Bag of mini marshmallows or candy

**Procedure:**

1. Place your two cans of soup or glasses of water on a flat surface no less than 48 inches apart
2. Take a piece of tape, flip it upside down so it’s sticky side-up and connect it from one can of soup/glass to the other
3. Make sure both cans or glasses are secured to the table (tape them down or add water to each of the glasses)
4. Next you will need to assemble the toothpicks and marshmallows. For each toothpick, place one marshmallow (or other item) on each side
	1. Be sure to make enough to place along your piece of tape
5. Once you have assembled your toothpicks, place each of them on the tape next to one another (you want them close but not touching)
6. Tap the toothpick on the far left down and see the wave move before your eyes

**Description:**

When you think of a wave in your mind you probably think of a transverse wave. It kind of looks like a squiggly line with peaks and valleys that we call crests and troughs. In a longitudinal wave these peaks and valleys are referred to as compressions and rarefactions. But have you ever stopped to think about what the motion of a wave looks like? Today we’re going to make our very own wave machines.

Now that we’ve assembled our wave machine, let's think about waves. A wave is the transfer of energy from a medium from one point to another. By lifting up one of the marshmallows you’re causing a vibration that sends a disturbance from one marshmallow to the tape and down the line.

Some properties of a wave include Amplitude, Frequency, and Wavelength.

In a transverse wave the crests and troughs are the locations of maximum displacement of particles up or down on the wave itself.

* An example of a transverse wave is a light or radio wave

In a longitudinal wave compressions and rarefactions are the areas of maximum displacement.

* An example of a longitudinal wave is a sound wave.

**Amplitude** is the maximum displacement of a particle on the medium from its resting position, or its highest point. In longitudinal waves such as sound waves, amplitude is represented by the loudness of the sound.

* We can change the amplitude of a wave by lifting the marshmallow higher or lower

**Wavelength** is the length of one complete cycle. We can measure this by going from crest to crest or trough to trough.

**Frequency** is the number of waves that pass in a given amount of time. If we were to measure one wave cycle (wavelength – crest to crest) and count that one cycle we could then count the remaining waves in that same given amount of time. For example, if we have 3 waves in one second our frequency is 3.

* Frequency is measured in Hertz
* We can also calculate frequency using the formula Frequency = Velocity / Wavelength

The **velocity** of a wave is commonly referred to as the speed and direction. The velocity of a wave can be calculated using wavelength and frequency. For example, if we had a wavelength of 4 meters (show diagram) and a frequency of 10 Hz we could solve for the velocity.

* Velocity = Wavelength x Frequency
* V = 4 x 10
* **V = 40 meters per second**

We can change the wavelength and frequency of our wave by jiggling the marshmallow a few times. You’ll notice each wavelength is shorter and the frequency is either higher or lower.

* A shorter wavelength has a higher frequency whereas a longer wavelength has a lower frequency.

Now that we’ve learned a little about the properties of waves, let’s learn about some of the other characteristics. As mentioned, when we think of a wave, we think of a transverse wave. A transverse wave is a wave which moves the medium perpendicular to the motion of the wave.

Imagine a line of people all holding hands, if the person on the left jumped up and down it would pull the hand of the person next to them causing them to jump up and down and so forth until the end of the line.

* For this experiment our marshmallows represent our line of people and particles in a medium. If one person jumps, you’ll notice it causes a chain reaction and moves down the line. The marshmallows represent the particles in a medium, they move up and down while the wave moves left and right. If you tap it again, you’ll notice the wave moving sideways but that marshmallows are moving up and down.

A transverse wave gets its name because the particles move in a direction transverse to the direction of the wave.

Another type of wave is a longitudinal wave, such as a sound wave. In a longitudinal wave, the particles of the medium move parallel to the wave’s direction of travel.

If you imagine that same line of people holding hands, instead of the person on the left jumping up and down, now they would bump into the person next to them. Then the next person being knocked off balance will bump into the person beside them, and so on down the line. As each person regains their balance, they return back to the place where they were standing before being disrupted.

Imagine if the marshmallows on our wave machine bumped into one another left and right instead of up and down.

* The best way to think of a longitudinal wave is to think of a slinky. If we take one end of the slinky and push it towards the other, you’ll notice that the coils bump into one another left and right and down the line. The coils represent the particles, they’re moving in the same direction as the wave itself and then return to their resting position prior to being disrupted. In some areas of the wave the particles get bunched together, which is called compression.

In addition to transverse and longitudinal waves we can categorize these waves as mechanical or electromagnetic.

**Mechanical** waves must have a medium to travel through such as a solid, liquid or gas. A sound wave is mechanical and longitudinal.

**Electromagnetic** waves are produced by the vibration of charged particles, these waves are capable of transmitting energy through a vacuum. All light waves are electromagnetic. An electromagnetic wave is electromagnetic and transverse.