Lesson 46: Properties of Waves


Illustration 1: Is that Mr.C???

When you hear the word "waves" you probably have visions of hanging ten off of Waikiki.

- Although these are "waves", we will be looking at a more detailed definition of waves in the following lessons.
- Specifically we will be looking at **mechanical waves**, waves that travel through a **medium** (***substance***) like air, water, a rope, etc.

The plural of **medium** is **media**.

Always remember that any wave we discuss is just is a way of transferring energy from one place to another.

- The difference between transferring energy using waves compared to regular matter moving around (like a baseball) is that
  - a wave **pulse** starts in one spot and, except for a small amount of movement, the particles of the medium stay in one spot.
  - matter must actually move (kinetic energy) all the way over to something and strike it.

A wave **pulse** is a single crest or single trough (as defined in the next section) traveling through a medium.

Wavelength

Wavelength is a property of a wave that most people (once they know what to look for) can spot quickly and easily, and use it as a way of telling waves apart. Look at the following diagram...

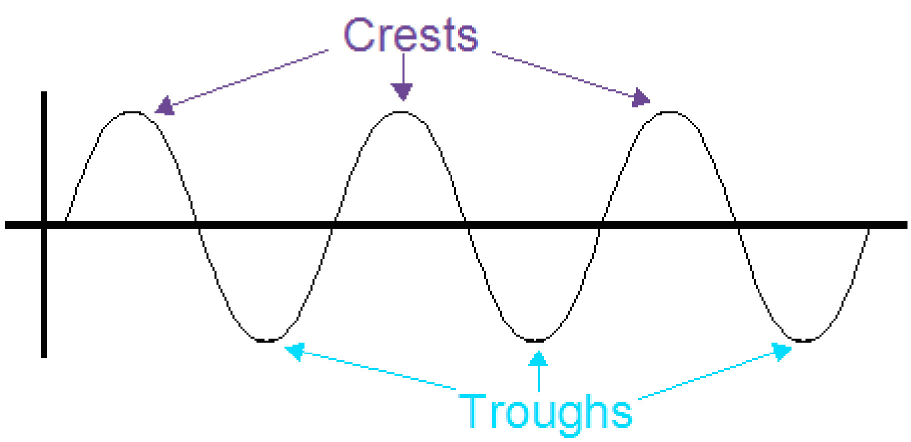

Illustration 2: Crests and troughs.

- Any of the parts of the wave that are pointing up like mountains above the equilibrium position are called **crests**. Any part that is sloping down like a valley is a **trough**.
- **Wavelength** is defined as the distance from a particular height on the wave to the next spot on the wave where it is at the same height and going in the same direction.
  - Usually it is measured in metres, just like any length.
  - Since we do not want to overuse the letter "W" as a variable in physics, we switch to Greek and use the symbol **λ** (*lambda*) to represent **wavelength** in formulas.
- There isn't a special spot you have to start on a wave to measure wavelength, just make sure

you are back to the same height going in the same direction. Most people do like to measure from one **crest** to the next **crest (**or **trough** to **trough),** just because they are easy to spot.

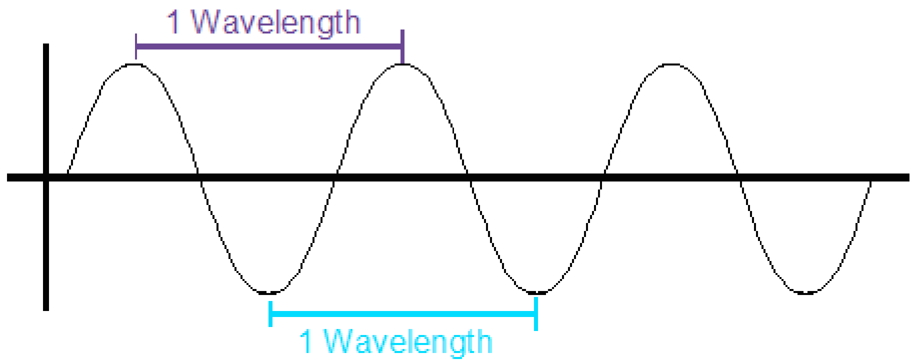

Illustration 3: Wavelength.

Amplitude

Amplitude is a measure of how big the wave is.

- Imagine a wave in the ocean. It could be a little ripple or a giant tsunami.
    - What you are actually seeing are waves with different amplitudes.
    - They might have the exact same **wavelength,** but the **amplitudes** of the waves can be very different.

The **amplitude** of a wave is measured as:

1. the height from the equilibrium point to the highest point of a crest or
2. the depth from the equilibrium point to the lowest point of a trough

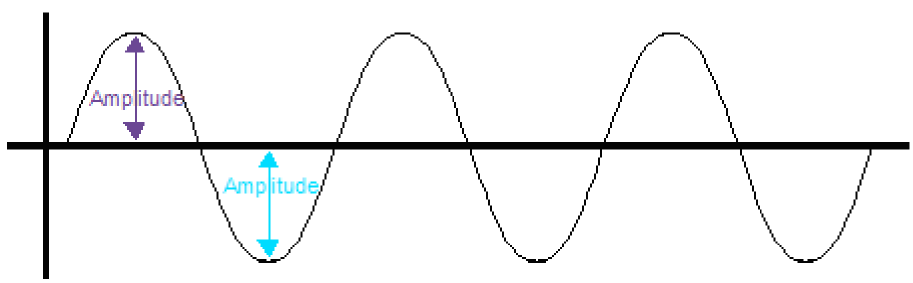

Illustration 4: Amplitude of a wave.

When you measure the **amplitude** of a wave, you are really looking at the energy of the wave.

- It takes more energy to make a bigger **amplitude** wave.
- Anytime you need to remember this, just think of a home stereo's amplifier… it makes the **amplitude** of the waves bigger by using more electrical energy.

Wave Diagrams

When you throw a rock into a lake, you will see waves moving as a series of round ripples moving outwards.

- You might see a bunch of waves rippling outwards (like circles within circles, called *concentric circles*), which forms a **wave train**. The waves shown in previous illustrations could be considered a wave train, since you can see a series of multiple crests and troughs, one after another.
- The leading part of the wave (in front of the rest of the wave is called the **wave front**.

It can become difficult to see exactly what the waves are doing in a medium, since the disturbance might be really small or hard to track.

- To try to simplify things, we often draw diagrams as a top down view of the waves, showing the **crests** of the waves as lines. **Troughs** are the gaps exactly in between crests.
- This wave train is being created by a **point source** exactly in the the centre. The **point source** could be a simple as a rock that had been thrown into water.

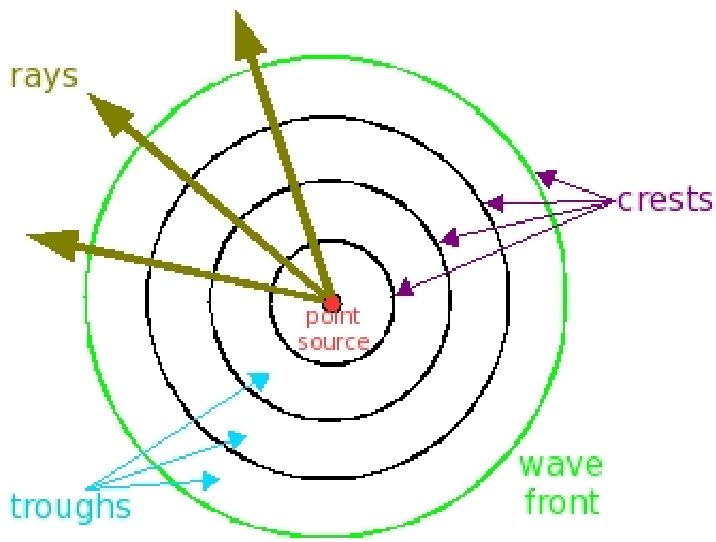

Illustration 5: A wave train shown from above. Notice that the wave front is the furthest out.

- We know that the wave train will spread outwards, the circles of the ripples getting bigger and bigger as the **wave front** spreads out.
    - We show this as the **rays** drawn in the diagram. The rays show the direction the wave is traveling outwards from the source. These **rays** are always drawn perpendicular to the **wave front**.
- Notice how the **rays** in this diagram are spreading away from each other as they move away from the point source. These are **diverging** (*spreading apart*) **rays**.
    - Since the rays are spreading out, this means that the energy of the wave is also being spread out over a larger and larger area. The wave will become weaker, until it finally vanishes.