# All About Waves: Background Info

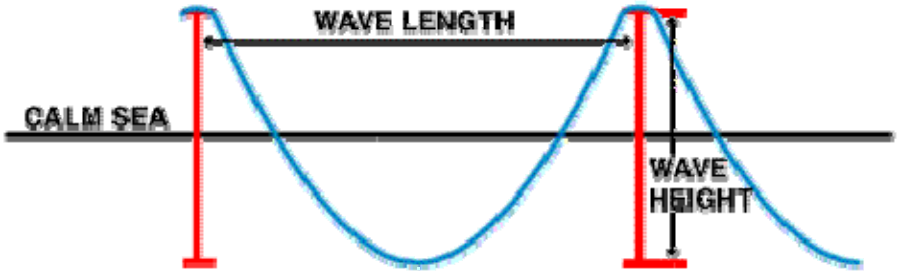
http://oceanworld.tamu.edu/

Review this information and check your knowledge with the Wave Quiz!

## What is a Wave?

An ocean wave is the undulation (rising and falling movement) of the sea surface and is usually caused by winds. Waves are "born" (generated) in the **fetch** area (where wind and water interact) and travel across the sea until their "death" (collapse) as breakers on some distant shore. You might call this the life cycle of a wave. The wind and the water were and are its parents.

The highest part of the wave is called the "**crest**." The lowest part of the wave is called the "**trough**." Waves can be described by their: **height**, **wave-length**, and **wave period**. The **wave-height** is the vertical distance from the crest to the trough. The wavelength is the horizontal distance between the crest of one wave and the crest of the successive (next) wave.




**Wave model from www.ndbc.noaa.gov/educate/educate.shtml**

The wave period is the time it takes for two successive (one after the other) waves to pass a fixed point. Wave period is used to classify waves.

## Types of Waves

The table below describes some of the characteristics of different waves.

| WAVE | PERIOD | WAVELENGTH | WAVE TYPE | CAUSE |
|---|---|---|---|---|
| Capillary | < 0.1 sec | < 2 cm | deep to shallow | local winds |
| Chop | 1-10 sec | 1-10 m | deep to shallow | local winds |
| Swell | 10-30 sec | up to hundreds of m | deep or shallow | distant storm |
| Seiche | 10 min-10 hr | up to hundreds of km | shallow or intermediate | wind, tsunami, tidal resonance |
| Tsunami | 10-60 min | up to hundreds of km | shallow or intermediate | submarine disturbance i.e. earthquakes or volcanic eruptions under (or near) the ocean |
| Tide | 12.4-24.8 hr | thousands of km | shallow | gravitational attraction of sun and moon |

## How do Waves Form?

A trip to the beach will reveal the connection between the wind and the size of the waves. The stronger the wind, the bigger the waves. The variety and size of wind-generated waves are controlled by four principal factors: **wind velocity**, **fetch**, **wind duration** , and **original sea state** (condition present before the onset of recent winds). Take a look at the overhead of **TOPEX/Poseidon** satellite data and showing the correlation between wind speed and **wave-height**.

The ocean produces larger waves than a lake or pond because it has a larger fetch area. One fast-moving (velocity) puff of wind will not create large waves, but the same fast-moving wind over a sustained (long) period of time will. A slow-moving wind over a long period of time will not create large waves. You might say that wind velocity and wind duration in different combinations create different wave sizes. The **original sea-state** original sea state (choppy or smooth) has an effect on the conditions that will be created by the newly arrived winds.

Waves traveling in water deeper than one-half their wavelength are called **deep water waves**. Waves traveling in water shallower than one-twentieth of their wavelength are called **shallow-water waves**. Shallow-water waves interact with the ocean floor. As waves enter shallow water their speed and wavelength decrease, but their height increases.

How large can waves grow? Waves will continue to grow in size until they reach a maximum size that is determined by the wind speed and **fetch**. When the waves can no longer grow in size because the energy supplied by the existing winds equals the energy lost by waves breaking and leaving the fetch area, we refer to it as a **fully developed sea**.

Giant waves can be caused by storm surges. One type of giant wave mistakenly referred to as a tidal wave is created by seismic activity under or near the ocean.

These waves actually have nothing to do with tides. Scientist use the Japanese word, **tsunami** (the "t" is pronounced the same as the "ts" in "lets"), for these large waves caused by underwater earthquakes and volcanoes. Tsunamis contain a tremendous amount of energy. As they approach the shore (shallow water), they grow in height (sometimes 30m) causing great destruction and loss of life.

**How do Waves Impact the Coast?**

The coast of all continents bear the marks of the sea. Some coastlines, like California's are narrow and rugged. Others, like the Atlantic coastal plain, rise gradually for hundreds of kilometers inland.

Breaking waves shape and form our coastlines. Waves can deposit (deposition) and carry away (erosion) sediment. As waves batter against the coast, they constantly erode and grind away the shore. Rocks and cliffs that are undercut by wave action fall into the sea where waves weather them into sand. Sometimes the eroded material is carried seaward where it is deposited--sometimes forming sand bars. The shape of the coastline is determined by the original materials (i.e. rock types) and their resistance to wave erosion. How quickly erosion along the shore takes place depends on several factors one of which is the amount of energy released by the waves as they approach the coast or shore. Not all waves expend their energy on the shore. They may break farther seaward on sand bars or reefs.

We've only touched the surface of the ocean (waves). You may want to expend (spend) more energy and surf the wave issue further. Some suggested topics for future investigation are: Types of waves (breaker, plunger, spiller, etc.), Kelvin and Rossby waves, types of coastlines and how they are formed, and human interactions that attempt to control erosion of coasts.