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## Ocean– Waves

The vast ocean that covers over seventy percent of Earth is in constant motion. One type of motion that occurs throughout the ocean is wave motion which is caused by local winds. Waves caused by local winds are called simply wind waves. Once a wave is formed, it travels across the surface of the ocean. Most of the water molecules affected by a wave do not travel forward; instead the energy and momentum of the wave passes through the water. This is why sea birds bob in the water, remaining in the same spot as the waves pass beneath them.

### Wind Waves

Three main factors are involved with wind waves: 1) wind velocity; 2) fetch length; and 3) how long the wind has blown in the area. However, this is a greatly simplified explanation of the complex phenomena involved with wind waves. Fetch length, or fetch, is a term used by geographers and meteorologists that refers to the distance the wind has blown over open water such as in the ocean. It makes sense that if a strong wind is blowing across a large area of ocean for a long time that higher waves will result.

If you have trouble visualizing this, think instead of your hand pushing against a level stretch of soft sand. The harder you push and the further you push, the higher the pile of sand will become. Eventually, however, the pile of sand can topple due to its own weight. Likewise, waves will “break” or topple over in the ocean when they become too heavy or too tall to be supported by their base. During stormy, windy weather waves generally break at sea. Alternatively, waves dissipate at sea, that is, lose their energy and momentum when the wind velocity decreases or they hit waves traveling from a different direction. The final choice is waves will break when they reach the shore of a land mass. There the dynamics of a wave are influenced by shallow water and by the shape of the coastline.

Wave energy traveling through the water causes the characteristic peaks and troughs that are associated with a wave. The crest is the highest point at the top of the wave and the trough is the low point between two waves. Wave height is the distance between the crest and the trough and the distance between crests is called wavelength. The amount of time between crests passing a fixed point is called the wave’s period. Some of this terminology is consistent with other kinds of waves like

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Sine waves in trigonometry, but the science of ocean waves relies on significantly more complicated mathematics.

The World Meteorological Organization has designated certain terminology that is associated with wave height that is called sea state. For example, moderate seas have 4 to 8 foot waves; rough seas, 8 to 13 foot waves; and high seas, 20 to 30 foot waves. There are nine designations total in this scale and the sea state code is based on meters. Meters were converted to feet for this lesson.

### **Hurricanes**

Hurricanes, also called typhoons or tropical cyclones in other parts of the world, by definition generate sustained winds that exceed 75 miles per hour (mph). The United States National Weather Service rates hurricanes in categories numbered 1 to 5 based on the Saffir-Simpson Hurricane Scale. Category 5 hurricanes are the worst with sustained winds in excess of 155 mph. Obviously hurricane force winds generate huge waves in the ocean, often up to 45 feet high. A storm surge is the water that is driven ashore by the winds of a hurricane. A storm surge combines with the normal rise and fall of the tides to create a hurricane storm tide. The wind driven waves are then added to the hurricane storm tide. The combination of these factors often results in severe coastal flooding during a hurricane, especially if the hurricane storm tide occurs along with the normal high tide for the area.

### **Tsunamis**

Some people call a tsunami "a tidal wave" but this form of ocean wave is not related to tides. A tsunami is a giant wave that can exceed 100 feet in height, well above any wind wave, even those created by hurricanes. A tsunami is a result of major geologic event, such as an underwater volcanic eruption or earthquake, that occurs somewhere in the deep ocean. Undersea volcanoes can be found especially in the Pacific Ocean where the Pacific Ring of Fire exists. Pacific Ring of Fire is the name given to the numerous volcanoes that encircle the Pacific Ocean. Volcanoes usually exist at the junction of tectonic plates where lava from the earth's mantle can erupt. The junction of tectonic plates is also where earthquakes occur.

A tsunami tends to be visualized as a single giant wave but in reality multiple tsunami waves radiate out from the location of the volcanic eruption or earthquake

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like ripples from a stone tossed into a pond. Due to the energy forces released into the ocean from within the earth's mantle, tsunami waves can travel 500 mph across the surface of the ocean. When this wall of extremely fast moving water reaches land, it creates massive devastation.

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Circle True or False after analyzing each of the following statements.

1. True False Three main factors are involved with wind waves: wind velocity; fetch length; and how long the wind has blown in the area.
2. True False Sea birds bob in the water, remaining in the same spot as the waves pass beneath them.
3. True False Fetch length is a term used by geologists and mineralogists that refers to the distance the particles are blown over open water such as in the ocean.
4. True False The dynamics of how waves break at a coastline is influenced by shallow water and shape of the coastline.
5. True False The distance between the crest and the trough of a wave is called wavelength.
6. True False According to definitions established by the World Meteorological Organization, wave heights of 10 feet are called high seas.
7. True False A hurricane's winds are determined to be 75 mph. It is a category 1 hurricane according to National Weather Service standards.
8. True False A hurricane causes increased coastal flooding if the storm surge occurs about the same time as high tide.
9. True False Tsunamis affect coastlines along the Atlantic Ocean because of the number of volcanoes located in this ocean.
10. True False A tsunami results in great devastation when it reaches land because of the height of the water and the speed that it is traveling.

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**Answers**

1. True
2. True
3. False
4. True
5. False
6. False
7. True
8. True
9. False
10. True