

Name: \_\_\_\_\_ Period: \_\_\_\_\_ Date: \_\_\_\_\_

## Ms. Randall Marine Science

### Physical Oceanography

#### Ocean waves, currents, and tides

**Guiding Questions:** 1) How do waves, currents, and tides affect our planet?

**Introduction:** You are about to embark on an exciting quest to learn more about the ocean tides, currents, and waves and how they affect our planet. You won't be traveling on a Magic School Bus, but on the Information Super Highway. Your task note packet contains the URL's for several different web sites that you will visit and use. At each site there will be information to locate and record. At various points you will encounter an "Assessment Check". This is when you should reflect and silently ask yourself "Do I understand the concepts I just discovered" before moving on. If you do not believe you understand the concepts, ask for assistance from the teacher or review what you missed again.

Link: <http://www.enchantedlearning.com/subjects/ocean/>

Oceans Cover about 70 % of the Earth's surface. The oceans contain roughly 97 % of the Earth's water supply.

Name the Earth's five main oceans

- a. Pacific
- b. Atlantic
- c. Indian
- d. Southern
- e. Arctic

Link: <http://www.nationalgeographic.com/environment/habitats/ocean/>

List three ways in which humans have impacted our oceans.

spilling garbage and sewage into the ocean. Fertilizer runoff from farms turns vast swaths of the ocean into dead zones, including a New Jersey-size area in the Gulf of Mexico. The greenhouse gas carbon dioxide is turning ocean waters acidic

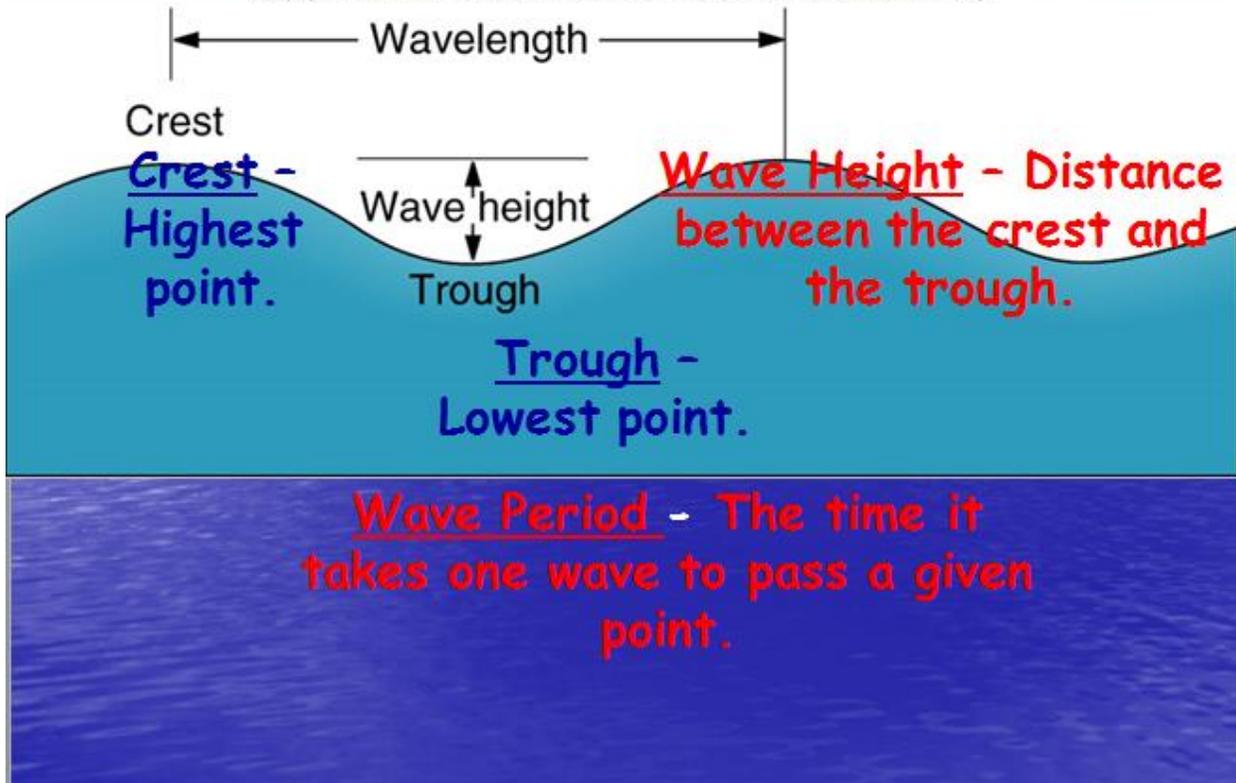
### **Part 1: Waves**

Link: <http://www.montereyinstitute.org/noaa/lesson09.html>

1. **Label** the wave with the following components: crest, trough, wave height, wave length.
2. **Define:**

## Wavelength - Distance between crests.

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- Crest – highest point of a wave
- Trough – lowest point of a wave
- Wave Height – vertical distance between the crest and the trough
- Wavelength – horizontal distance between two crests or two troughs

a. Wave train: a group of waves of equal or similar wavelengths traveling in the same direction.\_

Link: <http://www.mos.org/oceans/motion/wind.html>

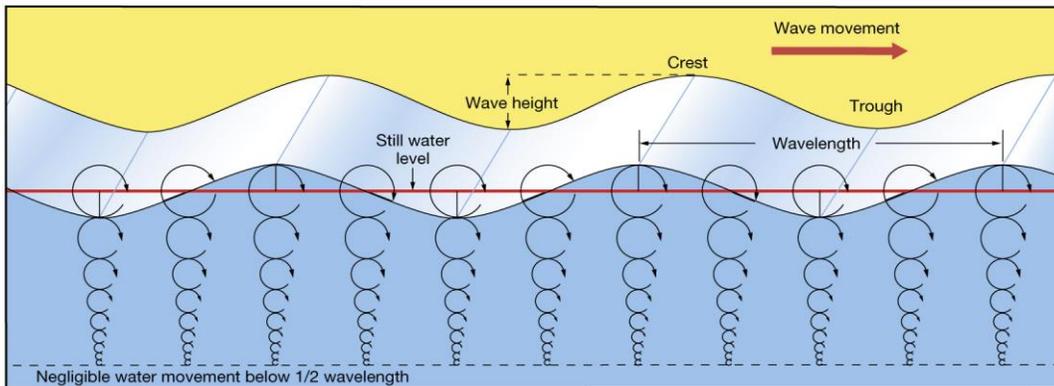
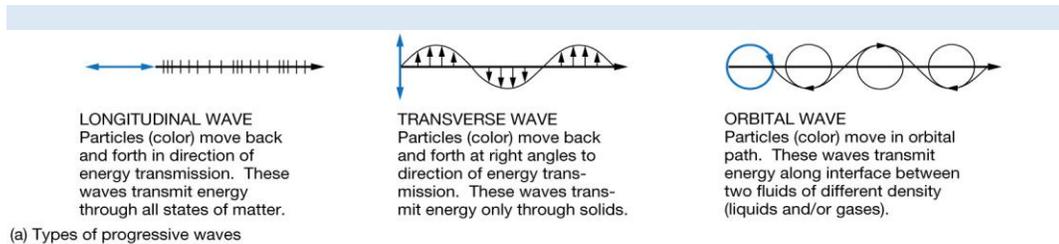
Link : <http://mocomi.com/how-are-waves-formed/>

Animation:

[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es1604/es1604page01.cfm?chapter\\_no=visualization](http://www.classzone.com/books/earth_science/terc/content/visualizations/es1604/es1604page01.cfm?chapter_no=visualization)

1. What is an ocean wave? How is it formed?

A rhythmic movement that carries energy through matter or space. in the ocean = the up and down movement of the ocean surface.



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Fig. 8.3

2. What are the 3 causes of ocean waves?

a. wind

b. earthquakes

c. gravity of sun and moon

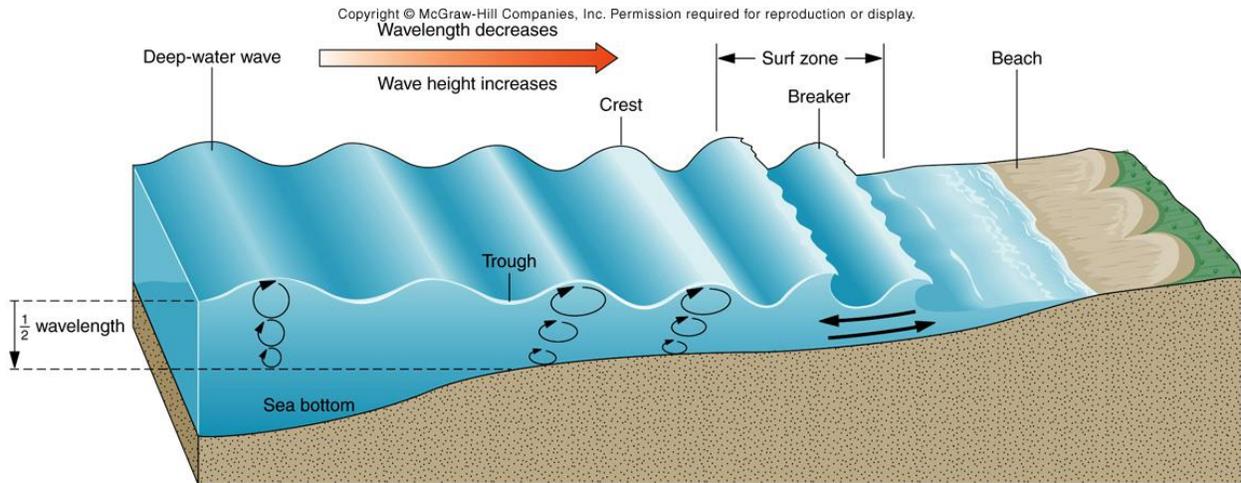
3. The size of a wave depends on how far, how fast and how long the wind blows. (fetch)

4. Waves travel through water, they do not take water with them.

Link: [http://oceanexplorer.noaa.gov/edu/learning/9\\_ocean\\_waves/activities/breaking\\_waves.html](http://oceanexplorer.noaa.gov/edu/learning/9_ocean_waves/activities/breaking_waves.html)

5. Explain how a breaker changes as it gets closer to shore.

- As it approaches shore, the wave hits bottom.
- Friction slows down the bottom.



Link: <https://sciencing.com/swell-ocean-5052569.html>

6. What is an ocean swell and how do they form?
- Waves that extend beyond the windy area in which they were generated
  - Swells may travel thousands of miles until they hit shore and release energy in crashing waves

Link: <http://www.enchantedlearning.com/subjects/tsunami/>

7. Tsunamis are sometimes called tidal waves, and are different from surface waves: they are usually caused by \_\_\_\_\_ earthquakes \_\_\_\_\_.

8. Describe the steps to form a tsunami and travel to shore.

- waves formed end up having very small heights (1 - 2 ft.)
- very long wave lengths (up to 150 miles)
- move at high speed (up to 435 miles)

Link: <http://noaacontent.nroc.org/lesson09/191a2.htm>

9. Describe how scientists can predict and provide Tsunami warnings.

A **tsunami warning system** (TWS) is used to detect **tsunamis** in advance and issue **warnings** to prevent loss of life and damage. It is made up of two equally important components: a network of sensors to detect **tsunamis** and a communications infrastructure to issue timely alarms to permit evacuation of the coastal areas.

## **Part 2: Tides**

Link: <http://www.enchantedlearning.com/subjects/ocean/Tides.shtml>

Link: <http://www.onr.navy.mil/focus/ocean/motion/tides1.htm>

Link: <http://www.astronomyknowhow.com/moon-tides.htm>

Link: <http://co-ops.nos.noaa.gov/restles1.html>

Animation-

Link: <http://www.mmscrusaders.com/newscirocks/tides/tideanim.htm>

1. What does the word tide mean?

- The rise and fall in sea levels
- Tides are actually shallow water waves and depend heavily upon topography.
- Tides are very long-period waves that move through the oceans in response to the forces exerted by the moon and sun. Tides originate in the oceans and progress toward the coastlines where they appear as the regular rise and fall of the sea surface.

Link: <http://studyjams.scholastic.com/studyjams/jams/science/weather-and-climate/tides.htm>

2. Define high tide.

3. Define low tide.

When the highest part, or crest, of the wave reaches a particular location, high tide occurs; low tide corresponds to the lowest part of the wave, or its trough. The difference in height between the high tide and the low tide is called the tidal range.

4. Why does the moon have a stronger effect on tides?

The earth and moon rotate around each other, each pulling the other towards itself. The moon attracts every piece of matter on earth. Since gravity is inversely proportional to the square of the distance, this force is greater on the side of the earth closer to the moon, and lesser on the side of the earth further from the moon.

Although the gravitational pull of the sun on the earth is larger than that of the moon, due to the much greater distance, the force changes very little from one end of the earth to the other. Since it is the difference in the force than the average magnitude of the force that matters for creating tides, the net effect is much less than that for the moon.

5. Why are there 2 bulges when there is a high tide?

The combination of gravity and inertia create two bulges of water. One forms where the Earth and moon are closest, and the other forms where they are furthest apart.

6. How many neap tides and spring tides are there every month?

- Spring Tides -every 2 weeks

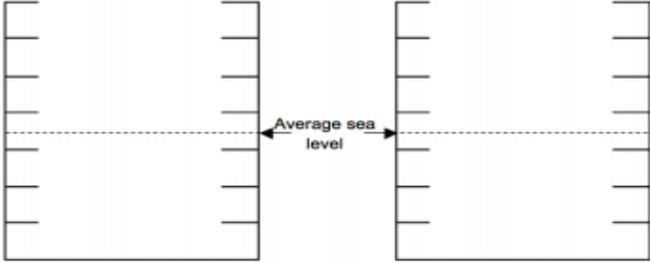
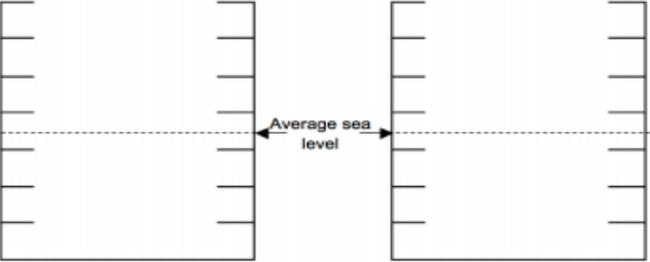
- **Earth, Moon, and Sun are lined up**
- **High Tides** ~20% higher than normal
- **Low Tides are lower than normal**

- Neap Tides-

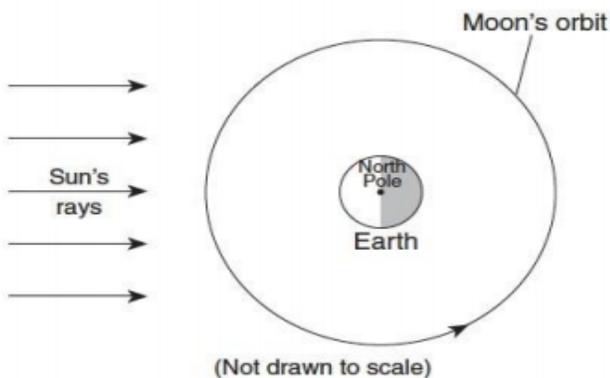
- **Earth, Moon, and Sun form right angles**
- **High Tides are** ~20% lower than normal **and Low Tides are higher than normal**

Watch this animation

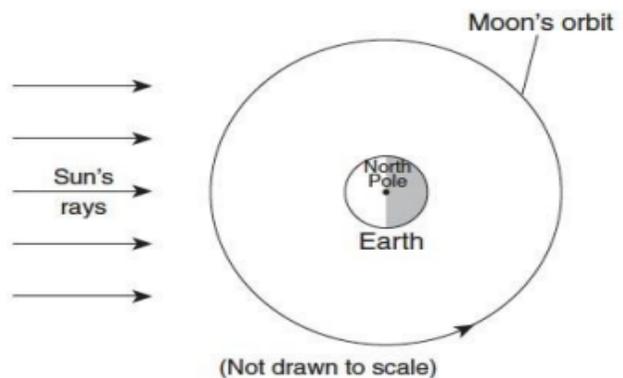
Link: <http://www.islc.net/~fripplog/springt.htm>

Spring Tides	Neap Tides
<p data-bbox="133 1325 732 1413">On the diagram below, estimate and draw the height of the water level at high tide and low tide during <b>spring tides</b>.</p> <div data-bbox="142 1528 792 1822"><p data-bbox="228 1528 326 1549">High Tide</p><p data-bbox="618 1528 716 1549">Low Tide</p></div>	<p data-bbox="841 1325 1440 1413">On the diagram below, estimate and draw the height of the water level at high tide and low tide during <b>neap tides</b>.</p> <div data-bbox="850 1528 1500 1822"><p data-bbox="937 1528 1034 1549">High Tide</p><p data-bbox="1326 1528 1424 1549">Low Tide</p></div>

On the diagram below, draw the two positions of the Moon on the Moon's orbit that will cause **spring tides**. Label the moon phases. Draw a dotted line to show the relationship of the Sun, Earth and moon.



On the diagram below, draw the two positions of the Moon on the Moon's orbit that will cause **neap tides**. Label the moon phases. Draw a dotted line to show the relationship of the Sun, Earth and moon



Link: <http://oceanmotion.org/html/background/tides-types.htm>

7. What is the difference between semi-diurnal, diurnal and mixed tides?

- **Diurnal**  
**One high and one low tide each lunar day**
- **Semidiurnal**  
**Two high and two low tides of about the same height daily**

Link: [http://oceanservice.noaa.gov/education/kits/tides/tides08\\_othereffects.html](http://oceanservice.noaa.gov/education/kits/tides/tides08_othereffects.html)

8. What effects tides in addition to the Sun and the Moon?

The shape of bays and estuaries also can magnify the intensity of tides

9. Why are the tides in the Bay of Fundy so extreme?

Funnel-shaped bays in particular can dramatically alter tidal magnitude. The Bay of Fundy in Nova Scotia is the classic example of this effect, and has the highest tides in the world—over 15 meters

Link: <https://www.nationalgeographic.org/encyclopedia/tidal-bore/>

10. What is a tidal bore?

- **A high wave caused by an extreme incoming tidal flow.**
- **Shape of estuary must be shallow and uniform.**
- **Only occur in about 100 rivers in the world.**

## Currents

Link: <https://cimss.ssec.wisc.edu/sage/oceanography/lesson3/concepts.html>

Link: <http://science.howstuffworks.com/environmental/earth/oceanography/ocean-current3.htm>

Link: <https://earth.usc.edu/~stott/Catalina/Oceans.html>

Link: <http://www.scienceclarified.com/Co-Di/Currents-Ocean.html>

Link: <http://www.mos.org/oceans/motion/currents.html>

Link:

[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es1604/es1604page01.cfm?chapter\\_no=visualization](http://www.classzone.com/books/earth_science/terc/content/visualizations/es1604/es1604page01.cfm?chapter_no=visualization)

1. What are the characteristics and causes of surface currents?

- **Horizontal, stream-like movements of water that occur at or near the surface of the ocean**
- **Can reach depths of several hundred meters**

Controlled by three factors

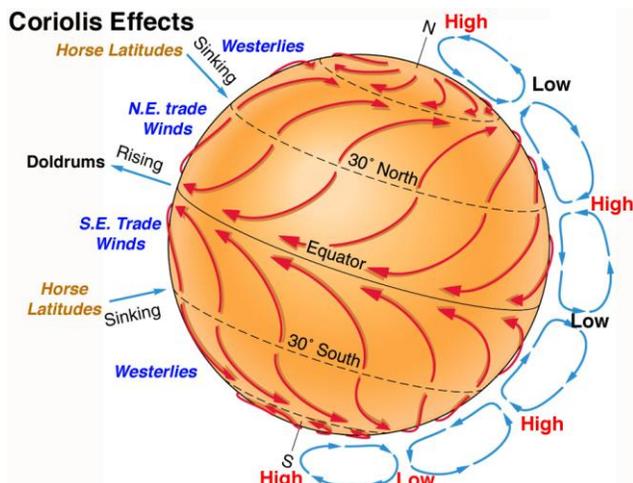
- Global winds
- Coriolis Effect
- Continental Deflections

Link:

[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es1904/es1904page01.cfm?chapter\\_no=vis%20ualization](http://www.classzone.com/books/earth_science/terc/content/visualizations/es1904/es1904page01.cfm?chapter_no=vis%20ualization)

2. What is the Coriolis Effect?

- Northern Hemisphere = clockwise
- Southern Hemisphere = counter clockwise



- a. In the 1st animation: The target location in the Northern Hemisphere where the plane was headed when it took off has moved with Earth's rotation, so the plane would end up to the right of its original target.
  
- b. In the 2nd animation: The target location in the Southern Hemisphere where the plane was headed when it took off has moved with Earth's rotation, so the plane would end up to the left of its original target.

Link:

[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es2401/es2401page01.cfm?chapter\\_no=visualization](http://www.classzone.com/books/earth_science/terc/content/visualizations/es2401/es2401page01.cfm?chapter_no=visualization)

3. Currents flowing toward the equator are generally cold and currents flowing away from the equator are warm.

Link: [http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es2405/es2405page01.cfm](http://www.classzone.com/books/earth_science/terc/content/visualizations/es2405/es2405page01.cfm)

4. Upwelling In this animation, winds blowing along the coast push the coastal surface water. When combined with the Coriolis effect, this motion moves surface water away from the coast. As surface water moves outward, cold, plankton-rich water from the ocean bottom moves toward the coast and rises to replace the displaced surface water.

Link: [https://oceanservice.noaa.gov/education/tutorial\\_currents/03coastal2.html](https://oceanservice.noaa.gov/education/tutorial_currents/03coastal2.html)

5. Describe a Long shore current  
**A longshore current is an ocean current that moves parallel to shore. It is caused by large swells sweeping into the shoreline at an angle and pushing water down the length of the beach in one direction.**
  
6. What does a Long shore current do to the shape of the shoreline?

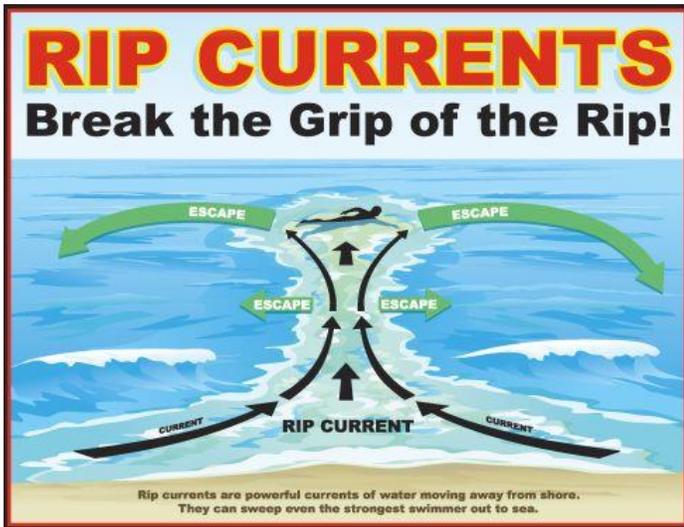
As this sheet of water moves on and off the beach, it can “capture” and transport beach sediment back out to sea. This process, known as “longshore drift,” can cause significant beach erosion.

Link: <http://www.usla.org/page/ripcurrents>

6. Describe a Rip current

Caused when winds and waves push water over a sand bar. When the water moves back out towards the ocean it rips an opening in sand bar and pulls water along with it.

7. If you are swimming and enter a rip current what should you do to get to safety?



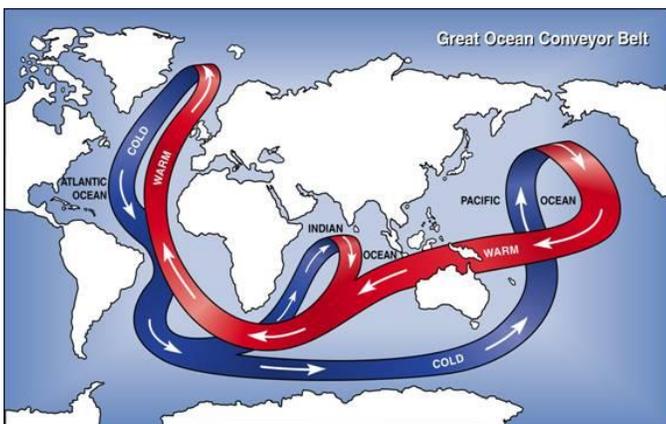
Link: [https://pmm.nasa.gov/education/sites/default/files/videos/thermohaline\\_conveyor\\_30fps.mp4](https://pmm.nasa.gov/education/sites/default/files/videos/thermohaline_conveyor_30fps.mp4)

Link: <https://www.nationalgeographic.org/encyclopedia/ocean-conveyor-belt/>

Link: <https://www.windows2universe.org/earth/Water/circulation1.html>

8. Define and describe Thermohaline circulation(Conveyor Belt)

Winds drive ocean currents in the upper 100 meters of the ocean's surface. However, ocean currents also flow thousands of meters below the surface. These deep-ocean currents are driven by differences in the water's density, which is controlled by temperature (*thermo*) and salinity (*haline*). This process is known as thermohaline circulation.



Link: <http://www.mnn.com/earth-matters/translating-uncle-sam/stories/what-is-the-great-pacific-ocean-garbage-patch> and answer the following questions.

9. What is a “Gyre”?

A ring like system of ocean currents rotating clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere.

11. What is the “*Great Pacific Ocean Garbage Patch*”? Explain very briefly how the GGP is formed.

The patch is actually comprised of the Western Garbage Patch, located near Japan, and the Eastern Garbage Patch, located between the U.S. states of Hawaii and California.

These areas of spinning debris are linked together by the North Pacific Subtropical Convergence Zone, located a few hundred kilometers north of Hawaii. This convergence zone is where warm water from the South Pacific meets up with cooler water from the Arctic. The zone acts like a highway that moves debris from one patch to another.

Go to the Flash Player Image and click **REPLAY** about 4 times and watch the movement of the bluish-purple dots in 6-second intervals.

12. What do the dots represent?

\_\_\_\_\_garbage\_\_\_\_\_

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13. Where is The Great Garbage Patch (GGP) located and around what ocean currents?

See above

14. How far stretched is the GGP in miles and what American State do scientists say it’s close to the size of?

"You see these quotes that it's the size of Texas, then it's the size of France, and I even heard one description of it as a continent," Bamford says. "That alone should lend some concern that there's not consistency in our idea of its size. It's these hot spots, not one big mass. Maybe if you added them all up it's the size of Texas, but we still don't know. It could be bigger than Texas."

15. What does Biodegradable mean?

A substance or object capable of being decomposed by bacteria or other living organisms.

16. What does Photogradable mean?

Capable of being decomposed by the action of light, especially sunlight.

17. Since plastic is one of the major pollutants in the GGP and it is photodegradable, why is it still such a huge problem?

swallow plastic bags, resin pellets eventually photodegrade, but that takes many years. In the meantime, they wreak havoc with sea birds like the short-tailed albatross.