

STEAM Subject: Ocean (Earth) Science
Lab: Ocean Currents and Plastic Pollution

Grades: 4-8

Learning objective:

Students will be able to

- explore how the Earth generates currents.
- model ocean currents created by wind and temperature/salt content.
- define and identify marine debris and garbage patches
- find solutions to plastic pollution

ENGAGE:

Ask students the following questions:

- What are ocean currents?
 - A continuous movement of ocean water in a single direction. They are categorized as wind or **thermohaline** (heat/salt) currents.
- As the Earth rotates to the right, which direction will ocean currents move?
 - In the Northern Hemisphere, ocean currents move clockwise
 - In the Southern Hemisphere, ocean currents move counter-clockwise
 - The shifting of directions in the North and Southern Hemisphere is called the **Coriolis Effect**
- What is the name for a collection of currents?
 - A **gyre**, there are 5 gyres: North Pacific, South Pacific, North Atlantic, South Atlantic, and Indian.
 - The **Antarctic Circumpolar Current** describes the movement of cold salty water around Antarctica

EXPLORE:

The Five Major Ocean Gyres (Why are some currents red and blue?)

(Image: <https://www.mytomra.com/en/talking-trash-gyres>)



Watch this YouTube video and compare the movement of gyres to the rotation of the Earth: <https://www.youtube.com/watch?v=Lmmp9UfNQhU>

Activity: Wind Currents

Students will participate in an activity where they will simulate the Earth's rotation to create wind-produced ocean currents.

Materials (needed per student):

- A clear rectangular pan
- Water
- Dish soap
- A spoon
- A small bowl
- Measuring cup
- Measuring spoon (Tablespoon)
- A marker
- A piece of paper
- Scissors
- Blue and red food coloring
- Salt
- Ice cube tray

Directions:

1. Each student will use the marker to write "North" "East" "South" and "West" on the piece of paper. Use the scissors to cut out the words.
2. Use the measuring cup to add two cups of water to their clear rectangular pan. Arrange the pan so the long sides are facing the top and bottom. Add the cut-out words around the pan. ("North" at the top, "East" to the right, "South" at the bottom, and "West" on the left)
3. In the bowl, add one drop of dish soap and three tablespoons of water. Use the spoon to mix the soap and water to create a foamy solution.
4. Scoop one spoonful of foam into the pan, placing it on the "East" side of the pan.
5. Standing on the "East" side of the pan, gently blow across the surface of the water.

Discussion:

When air blows across the surface of the pan, the foam is pushed to the other side of the pan. As our breath moves across the water, the foam splits into two, with one side of the foam moving in a clockwise form (toward the right) and the other side of the foam moving counter-clockwise (toward the left). What is the direction of the foam on the "North" side of the pan? The "South"? What occurs when the foam reaches the "West" side of the pan? This will lead into a discussion of the Earth's rotation and the movement of the Earth creates an air current that "pushes" water across the surface. The continents can act as barriers to change the direction of water.

Activity: Thermohaline Currents

Directions:

1. With the help of an adult, add two to three drops of blue food coloring into a small bowl of water.
2. Add a tablespoon of salt and stir to dissolve.
3. Use an ice cube tray to freeze the blue, salty water.
4. In a large, clear and rectangular container, fill the pan with water until it is 2/3 full. Set the container aside.
5. With the help of an adult, heat six tablespoons of water in a small cup inside the microwave. Add red food coloring.
6. In the large pan, take the frozen blue ice cubes and add them to one side of the pan. Carefully pour the hot red water to the other side of the pan. Observe how the hot red water and cold blue water interact through the side of the pan.

Activity: Plastics in the Ocean

- Based on what we learned about ocean circulation and gyres, what would happen if we add something lightweight and durable to the ocean currents? Let's watch the YouTube video from TedEd "How do ocean currents work? - Jennifer Verduin: <https://www.youtube.com/watch?v=p4pWafuvdrY>
 - What happened in 1992 to a cargo ship transporting rubber duckies?
- Listen to a Podcast from the National Oceanic Atmospheric Administration (NOAA) <https://oceanservice.noaa.gov/podcast/mar18/nop14-ocean-garbage-patches.html>
- Observe carefully the following NOAA images.
 - What is a Garbage Patch?
 - Where are they located?



- How does the trash get into the ocean?
- What kind of trash we can find in the ocean?
- What we can do to prevent our trash from becoming marine debris?



EXPLAIN:

Watch some videos and/or movie about wind and heat ocean currents

- o "In a Nutshell" <https://www.youtube.com/watch?v=UuGrBhK2c7U>
- o Earth's Rotation & Revolution: Crash Course Kids 8.1: <https://youtu.be/l64YwNI1wr0>
- o Bill Nye The Science Guy on Ocean Currents (oceanography (Full Clip) https://youtu.be/w_8mw-1HYFg
- o Documentary: A Plastic Ocean (available on Netflix). Interviews with scientists like Dr. Sylvia Earle. "An epic global adventure following a filmmaker and a world record free-diver as they travel the earth discovering the shocking impact plastic is having on our oceans and the marine animals that live there"
- o How can we can help with the marine debris problem?
 - ✓ We prevent the trash from getting into the ocean by not littering to make sure it doesn't reach the storms drains or the beaches.
 - ✓ We can participate in a watershed, community, or beach clean-up.
 - ✓ Use less plastics, and if you must use plastics, make sure you reuse and then recycle!
 - ✓ Share what you learned with friends and family!
 - ✓ For more information about plastics and volunteer opportunities visit: <https://www.sdcoastkeeper.org/>
- **Review Science Vocabulary**
 - o **Gyre:** a large system of moving ocean currents, particularly those caused by the movement of air
 - o **Wind Currents:** currents that are created by the movement of air. As the Earth rotates, wind pushes water across the surface of the ocean. On the equator, air becomes very hot, and carries the heat away from the equator, driving the movement of water.
 - o **Thermohaline Currents:** currents created by the temperature and the amount of salt in ocean water. Much like wind currents, the water becomes warmer at the equator, and evaporates. Fresh warm water stays

at the top, and the cold salty water sinks. This rotation of warm to cold distributes heat and nutrients through the Earth.

- o **Coriolis Effect:** as the Earth rotates from East to West, water and air moves in a perpendicular direction. In the Northern Hemisphere, water and air move toward the right. In the southern Hemisphere, water and air move toward the left.
- o **Marine Debris:** a type of pollution, trash (like plastics) that can reach the oceans and other waterways through our storm drains.
- o **Garbage Patches:** Garbage patches are areas of increased concentration of marine debris that are formed from rotating ocean currents called gyres
- o **Great Pacific Garbage Patch:** located in the North Pacific Gyre. The most famous example of a gyre's tendency to take out our trash.

EVALUATE:

Have students discuss how the movement of air and water impacts life on land.

- Ask students to draw the gyres on a map of the Earth. Locate San Diego on the map and draw a dot on its location.
- Google images of different locations on Earth, such as tropics, deserts, and tundra. Take note of their distance from the equator, or their latitude. Mark them on the map.
- How would the movement and direction of water impact the appearance of the various coastal and land locations?
- How do they compare or contrast as you move further away from the equator?
- [Create a poster with your solutions to marine debris and share with us on social media!](#)

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