Name_______________________________________

Ocean Currents

Purpose:

1. Define ocean currents and understand overall surface circulation.
2. Show the relationship between global air circulation and oceanic currents.
3. Learn about the influences of wind, water temperature, landmasses, and water density on currents.

Background Information:

BIG SCIENCE IDEAS:

1. **The sun warms the Earth's surface, which controls global currents and climate, keeping the earth habitable.**
2. **The ocean is one continuous body of water with global currents that interact, with water surrounding all landforms**.

The oceans are the major surface feature of Earth, covering about two thirds of the planet. Because water gains and loses heat much more slowly than air or land, oceans are the most important factor influencing global and regional climates.
One way oceans affect climate is by transporting heat from equatorial towards Polar Regions and giving off heat in latitudes that receive less direct sunlight.

Oceans also affect climate by absorbing and releasing huge amounts of carbon dioxide, one of the most important heat-trapping gases in the atmosphere.
A **current** is defined as a large mass of continuously moving oceanic water (Greene, 1998).

Surface ocean currents are mainly wind-driven and occur in all of the world's oceans. Examples of large surface currents that move across vast expanses of ocean are the Gulf Stream, the North Atlantic Current, the California Current, the Atlantic South Equatorial Current, and the Westwind Drift.

Surface ocean currents are move to the right in the Northern Hemisphere and to the left in the Southern Hemisphere because of the Coriolis Effect.

The **Coriolis Effect** states that because the Earth is spinning, surface waters move in a clockwise direction in the Northern Hemisphere and in a counterclockwise direction in the Southern Hemisphere.

Adapted from:
http://www.msc.ucla.edu/oceanglobe/pdf/climatecurents/currents6.pdf

The currents eventually come into contact with the continents that redirect them, creating giant oceanic current circles known as **gyres**.

Vertical (up and down) and **ocean bottom currents** are mainly caused by density differences caused by changes in temperature and salinity.

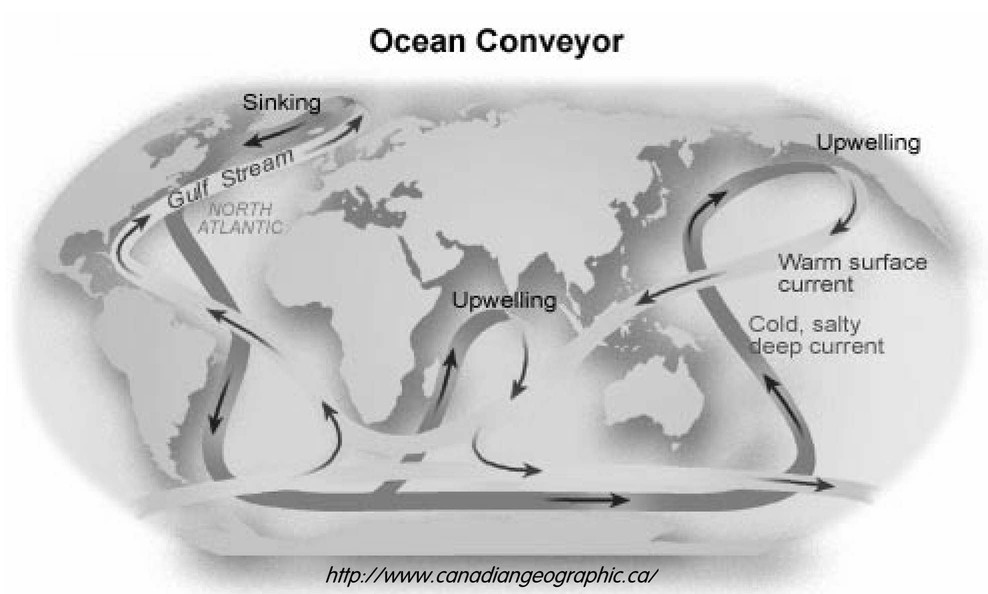
Starting in Polar Regions, cold, salty waters sink to the ocean bottom and move toward the opposite poles where they again surface.

Vertical **upwelling** (The rising of cold water from the deeper areas of the ocean to the surface.) currents can also be caused by winds "blowing off" a coastline. The displaced waters are then replaced by underlying bottom waters.

This investigation models how cold surface temperatures in Polar Regions can increase water density, causing it to sink. In these far northern regions, sinking or "**downwelling**" water is replaced at the surface by water from warmer regions, a process which pulls relatively warm water at the surface in the North Atlantic Ocean toward the cold high latitudes. As the warm water moves toward these areas, much of its heat is lost and is carried to northern Europe by the atmosphere, warming the climate there.

An important factor influencing sinking is the **salinity**, or saltiness, of the water. Salt increases the density, or mass per unit volume, of water. The warm water transported to high latitudes in the North Atlantic is very salty since it comes from the warm regions near the equator where evaporation removes much water vapor.

The very cold, salty water is dense so it sinks and flows slowly (over the course of about 1000 years) at depth around the globe as part of what is called the "**ocean conveyor**"
The density-driven circulation of ocean water caused by differences in temperature and salinity is called **thermohaline circulation**.



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Currents are important to marine life as they help to move food and nutrients, making them available for consumption, metabolic requirements, and/or photosynthesis.

Studying ocean currents is important in understanding the relationship between the ocean, atmosphere, and weather.

Materials:

2 Beakers	Cold Water	Warm Water colored with red food coloring
Ice cubes colored with green food coloring	Thermometer	

Procedure:

1. Fill the beaker ¾ full of cold water. Wait two minutes and record the temperature here
   ____.
2. ***Gently*** place a green ice cube in the water. Wait for the water to stop moving and observe. Record your observations here, using words and a diagram.
   ____
   ____
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3. Fill another beaker ¼ full of warm, red water. ***<u>Gently</u>*** pour the water down the inside edge of the beaker. <u>Don't disturb the rest of the water</u>.
4. Wait 2 minutes and record the temperature here

   ____.
5. Record your observations here, using words and a diagram.

   ____

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Conclusion Questions:

1. Was the colored water moving away from the ice cube colder or warmer than the water in the glass?
2. Was the warm colored water that was added colder or warmer than the water in the glass?
3. Where would floating ice be found in the ocean? Why?
4. Where would cold water be found? Why?

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5. Where would cold water flow in the ocean? Why?

6. Where would you expect to find the warmest waters in the ocean? Why?

7. Where would warm moving water flow in the ocean? Why?

8. Which direction would cold water move in the ocean?

9. Which direction would warm water move in the ocean?

10. Scientists have found that water in the ocean is well mixed. How do differences in temperatures mix ocean waters?

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