IN HOT WATER

This lesson plan developed by:

Overview:

Due to human activities, the Earth's climate is warming. The ocean does an excellent job of absorbing, storing and distributing the extra heat from the atmosphere, but a warming ocean can impact our environment in a variety of ways. This fun activity demonstrates how our oceans absorb heat and the potential impacts of a warming ocean on our planet.

Materials:

For demonstration:

- Safety goggles
- 2 balloons
- Lighter and/or candle
- Tap water

For activity:

- Red and blue food dye
- Ice
- Cold tap water
- Warm/hot tap water
- Spoon
- Rocks or shells
- Large, shallow, clear or white container/dish
- 2 pitchers to hold water

Duration:

30 minutes

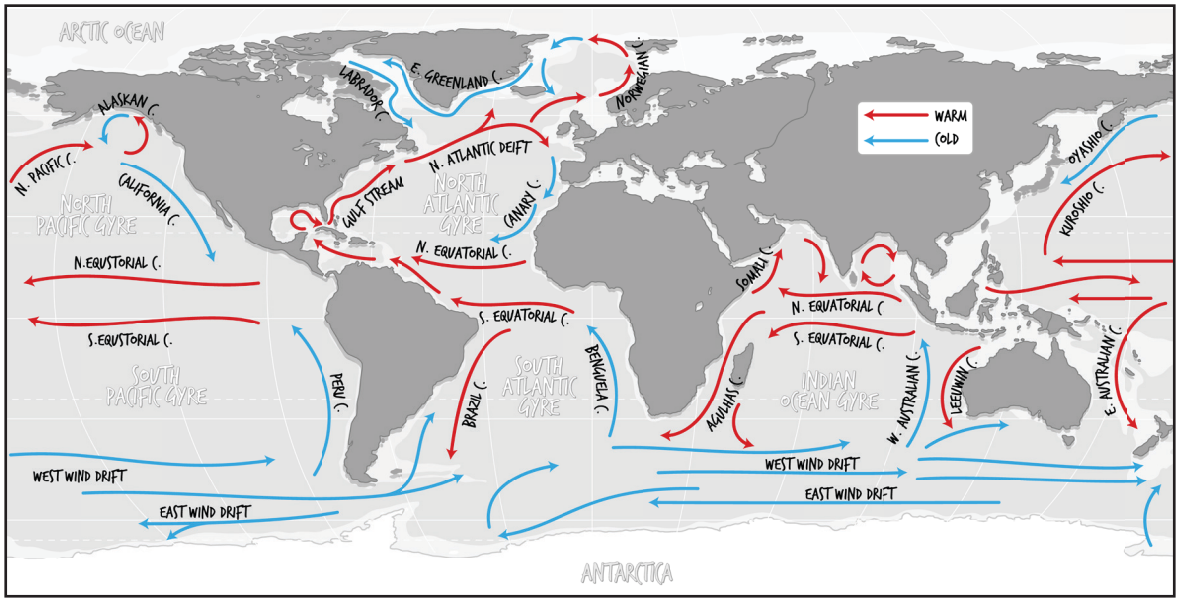
In Hot Water (cont.)

Physical Activity:
Moderate

Background:
Our oceans cover about 70% of the Earth's surface and play a crucial role in regulating our climate. The oceans absorb solar radiation, distribute heat and moisture around the globe, and absorb carbon dioxide from the atmosphere.

Heat is trapped near Earth's surface through a process called the greenhouse effect. Greenhouse gases create a "cozy blanket" enveloping our planet, helping to maintain a warmer temperature. These gases consist of carbon dioxide, methane, ozone, nitrous oxide, chlorofluorocarbons, and water vapor. Over the last century, human activities, primarily from burning fossil fuels have led to the release of carbon dioxide and other greenhouse gases into the atmosphere, which is trapping extra heat near the Earth's surface, causing temperatures to increase.

Due to its high heat capacity and large surface area, the ocean absorbs a significant amount of the excess heat and solar radiation. In fact, about 80-90% of global warming has been absorbed into the ocean. However, if the temperature of the ocean continues to increase, it can have a variety of impacts on the environment, including shifting species distributions, coral bleaching, disrupted ecosystems, increase in severe weather events, and changes in ocean circulation.



Ocean circulation plays a key role in distributing heat, nutrients and gases around the globe. Ocean currents act as a global conveyor belt, transporting warm water from the equator towards the poles, while cold dense water flows back, influencing weather patterns and temperatures. Climate change can disrupt ocean circulation patterns, potentially leading to changes in weather and climate, and impacting marine life and ecosystems.

In Hot Water (cont.)

Activity:

Part 1: Introduction to Climate Change

1. Ask the whole group the following questions:
   - What is the greenhouse effect?
   - What causes climate change?
2. Discuss what some of the impacts of warming oceans may be on currents, weather, climate, habitat and wildlife.

Part 2: Demonstrating the Heat Capacity of the Ocean

Our oceans help absorb extra heat from the atmosphere because water is good at storing heat. Water has a high heat capacity, meaning it absorbs a lot of heat before it begins to get hot. Air, on the other hand, is not great at storing heat.

1. Fill one balloon with air, representing the atmosphere, and one balloon with tap water, representing the ocean. The lighter or candle will represent the sun.
2. Ask the students what they think will happen if you hold the "sun" close to the "atmosphere." Then ask the students what they think will happen if you hold the "sun" close to the "ocean."
3. Hold the lighter or candle up to the balloon with air. It should immediately pop because air has a low heat capacity.
4. Hold the lighter or candle up to the balloon with water. It should not pop because the water is absorbing the heat because it has a high heat capacity. This demonstrates that our oceans are absorbing most of the excess heat involved in global warming.

Part 3: Influence of Global Warming on Ocean Currents

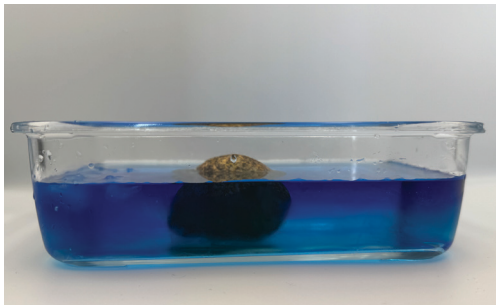
Our global ocean is connected by the global ocean conveyor belt, a circulating system of currents that is driven by differences in seawater temperature, density, and salinity. When warm and cool water masses meet, their different temperatures mean that the cool, dense water sinks underneath the warm, less dense water, which drives the ocean circulation. Strong winds can also influence circulation. This circulation can move warm and cold air with them, which influences weather patterns and climate on land. Currents can also carry nutrients, oxygen, plants and animals around with them, playing an important role in marine food webs.

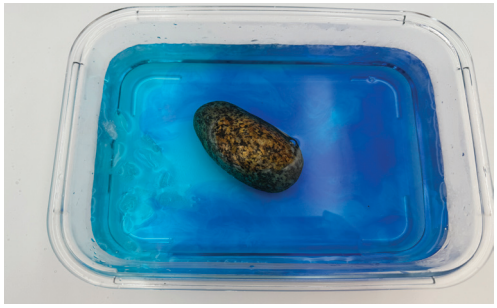
1. One pitcher will have ice and cold tap water. Add a few drops of blue food dye and mix with spoon. The other pitcher will have hot water. Add a few drops of red food dye and mix with spoon.
2. Put the ice and blue water, which represents water coming from the poles, into the dish until it fills 1/3 to 1/2 of the container. Move all the ice to one end of the container.
3. Add a couple of shells or rocks to represent land in the middle of the dish.
4. At the opposite end from the ice, slowly pour the warm, red water at one corner. Observe what happens. You should see the hot, red water stay towards the top, while the cold, blue water sinks toward the bottom since the cold water is denser. You may also notice eddies, or spiral structures, which help mix different water masses together.

In Hot Water (cont.)

Before:

After:





Discussion:

You have just shown how the ocean absorbs excess heat and how currents form in our ocean.

- What are some human activities that contribute to warming ocean water?
- What do you think would happen to our global ocean currents if ocean temperatures continue to increase?
- What are some other impacts of either warming waters or changing ocean currents?
- What are some ways humans can reduce carbon emissions?

Ocean Literacy Principles:

Ocean literacy is an understanding of the ocean's influence on us, and our impact on the ocean. There are seven Ocean Literacy Essential Principles that all people of our blue planet should have an opportunity to learn and understand. This activity touches upon the following Essential Principles:

1. The Earth has one big ocean with many features
3. The ocean is a major influence on weather and climate
5. The ocean supports a great diversity of life and ecosystems
6. The ocean and humans are inextricably interconnected
7. The ocean is largely unexplored

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In Hot Water (cont.)

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