Make Convection Currents!

Unit: Cycles
Lesson: 3

Materials & Preparation

Time:
- Preparation: 10 min (plus time for ice to freeze)
- Teaching: 20 min

Materials for Student Teams:
- Clear plastic container about the size of a shoebox
- Red food coloring
- Ice cubes made with water dyed with blue food coloring

Materials for Students:
- *Student Page*
- Pen or pencil
- Colored pencils, crayons or markers red and blue)

National Science Standards
- Physical Science: Content Standard B
- Earth and Space: Content Standard D

Learning Goals
Students will
- Students will understand that temperature changes can cause density changes in water and express that the same phenomenon happens in air.
- Students will understand that temperature-driven density changes will produce currents in a fluid medium.
- Learn that convection happens in both the atmosphere and oceans (among other places).

What Students Do in this Lesson
Students observe convection in water due to temperature differences and describe the pattern of water movement with words and pictures. During a class discussion students learn that the same process happens in both the oceans and the atmosphere.

Sources
Web Weather for Kids http://eo.ucar.edu/webweather/tornact2.html
Project LEARN http://www.ucar.edu/learn

Key Concepts
- Heat moves in fluids through several processes, including convection.
- Convection is the transfer of heat by movement of the heated material.
- Cold fluids are more dense and will sink.
- Warm fluids are less dense and will rise.
- Convective motions in the atmosphere are responsible for the redistribution of heat from the warm equatorial regions to higher latitudes and from the surface upward.

Make Convection Currents!

Advanced Preparation

- Make ice cubes that have blue food coloring in them (enough for one or two for each group of 2-4 students.
- Copy *Student Page* for all students.
- Fill box containers 2/3 full of room temperature water.
- For a very dramatic effect, warm the red food coloring bottles slightly by setting them in a glass of hot water.
- Note: If you do not have a sink in your classroom, you might want to have a large bucket on hand to facilitate clean up.

Introducing the Lesson

- Ask students to think answer the following questions based on their own experience.
    - *Does the air in the atmosphere stay in the same place? How do you know?*
    - *Does the water in the oceans stay in the same place? How do you know?*
- Explain that in this activity students will learn about a major reason that air in the atmosphere and ocean water move around. It is a process called convection.

Facilitating the Lesson

1. Divide students into groups of 2-4. Provide each student with a copy of the *Student Page* and each group with a set of materials.
2. Instruct students to let the water in the plastic box to sit for 30 seconds or until it is completely still. Tell students to try not to bump the table during the experiment.
3. Instruct student groups to place a blue ice cube at one end of the plastic container.
4. Visit each group and add two drops of red food coloring to the water at the opposite end of the plastic container. Be careful not to disturb the water.
5. Instruct students to observe where the red and blue food coloring goes by looking trough the side of the plastic box. (The blue food coloring is cold and will travel along the bottom of the box. The red food coloring is warm as so will travel across the top of the water.)
6. After the colored water has travelled in the box, have students answer the questions and make the drawing on their *Student Page*.

Summarizing and Reflecting

Discussion questions:

- *Where did the red go? Why?*
- *Where did the blue go? Why?*

Follow this activity with short web readings to connect the plastic box experiment with the Earth system:

- Read The Active Atmosphere from NCAR Kids' Crossing http://eo.ucar.edu/kids/green/cycles4.htm
- Read The Ocean in Motion from NCAR Kids' Crossing http://eo.ucar.edu/kids/green/cycles5.htm

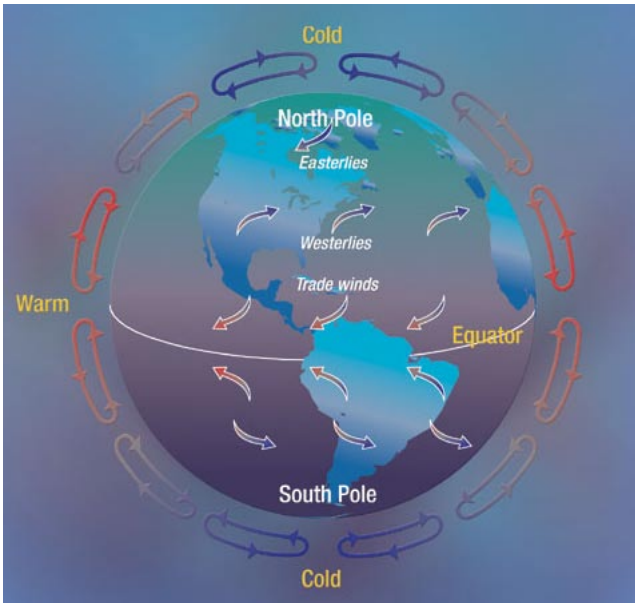
Background Information

Heat moves in fluids through several processes, including convection. Convection is the transfer of heat by the actual movement of the heated material.

Make Convection Currents!

Consider what happens to the water in a pot as it is heated over an open camp stove. The water at the bottom of the pot heats up first. This causes it to expand. Since the warmed water has a lower density than the water around it, it rises up through the cooler, dense water. At the top of the pot, the water cools, increasing its density, which causes it to sink back down to the bottom. This up and down movement eventually heats all of the water. The continual cycling of the fluid is called a convection current.

Convection currents are found in many places and on many scales, from huge convection currents in the atmosphere, oceans, and even in the earth's interior to smaller convection currents found in a cup of hot cocoa or a fish tank. Meteorologists usually use "convection" to refer to up and down motions of air. Heat gained by the lowest layer of the atmosphere from radiation or conduction is most often transferred by convection.



Convective motions in the atmosphere are responsible for the redistribution of heat from the warm equatorial regions to higher latitudes and from the surface upward.

Additional Resources

- Project LEARN: Cycles of the Earth and Atmosphere
  http://www.ucar.edu/learn/
- NCAR Kids' Crossing: Cycles of the Earth
  http://eo.ucar.edu/kids/green/cycles1.htm
- Web Weather for Kids
  http://eo.ucar.edu/webweather/

Make Convection Currents

Name _____

Date _____ Class _____

Directions:

1. Allow the water in the box to be still. *Don't move the table or the box.*
2. **Make a prediction** about what will happen when you put the ice cubes and warm red dye into the plastic box

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3. Place a blue ice cube at one end of the plastic container.
4. Add two drops of red food coloring to the water at the opposite end of the plastic container.
5. Observe where the red and blue food coloring goes by looking trough the side of the plastic box.
6. **Draw a picture** of the side view of the box to show what happened to the cold blue and warm red water. Use red and blue markers or colored pencils to indicate where the blue and red water travelled.

7. **Imagine** a situation in which the water in the box was very warm and blue ice water were to one end of the box. *Where would the cold blue water travel? Where would the ice cubes go?*

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