POLAR TREC
Learning Resources

Details


Completion Time: About a week

Permission: Download, Share, and Remix

Climate Ocean Currents

Overview
This lesson includes a variety of research activities and a lab that all help demonstrate the science behind convection currents.

Objectives
Through the following activities and lab students will discover:
• that temperature and salinity affect the density of fluids (liquids and gases)
• how fluids with different densities interact with each other

Lesson Preparation
Background: How does convection work?
Imagine that you are in a hot air balloon. All the passengers in the basket are waiting to take off, but nothing happens. At last, the pilot turns on the burner (located above your head, near the mouth of the balloon). There is a loud rushing sound and a huge flame comes from the burner. The balloon starts to rise. Up it goes, higher and higher. Why? The balloon rises because hot air is less dense than cold air. When the air in the balloon was heated by the burner, the hot air inside it became less dense than the cooler air of the atmosphere around it. Hot air (less dense air) is lighter and rises up, while heavier cool air (denser air) remains below.

Procedure
Day 1:
Students will learn the direction of the world's ocean currents using the NYS ESRT (Earth Science Reference Tables: http://newyorksciencteacher.com/sci/pages/reftables/). Students will take a red colored pencil and shade in all arrows that indicate a warm current and then they will take a blue colored pencil and shade in all arrows that indicate a cool current.

Materials

- 1 water tank with mechanism for dividing it into two sections
- 1 beaker, containing red food color
- 1 beaker, containing blue food color
- 1 beaker, containing green food coloring
- hot and cold water, salt water
- maps (attached)
- Internet access

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Part I- In your Earth Science Reference Tables, use pg 4.
1. Use a blue pencil to shade in the cool currents
2. Use a red pencil to shade in the warm currents

Part II- Use the map to answer the following questions:
1. How does the California current affect the temperatures in California?
2. Compare the current on the east coast of the United States with the current on the West coast of the United States.
3. How does the Gulf Stream and North Atlantic current affect the climate in Europe?
4. Which side of North America is affected by a warm ocean current?
5. What is the name of this current?
6. Which current completely circles the Earth? What is its name? Is it a cold or warm current?
7. Where do warm currents originate? Cool currents?
8. What is the name of the current found in the Gulf of Mexico?
9. What is the name of the current that flows south past Spain/Portugal and Africa?
10. What causes the ocean currents to move in the direction they move?

Homework: Sample NYS regents exam questions regarding ocean currents.

Day 2:
Students will demonstrate the flow of ocean currents by experimenting with different densities of water. In a tank full of water, students will see how cold water (colored blue) and warm water (colored red) flow, thereby simulating the way cool and warm ocean currents flow throughout the world.

Students will then experiment by adding in salt water to demonstrate how salinity can affect the density of water. By the end of the lab exercise, students will be able to see how temperature and salinity can affect the density of water and understand how ocean currents flow throughout the Earth.

Convection Lab: Convection of Water
This activity demonstrates convection currents in a very colorful fashion. In this activity you will discover:
• That temperature and salinity affect the density of fluids (liquids and gases)
• How fluids with different densities interact with each other

Procedure 1:
1. Gather the materials listed in the Materials section at your work table
2. Add 200 mL of cold water to the beaker containing BLUE food color
3. Add 200 mL of hot water to the beaker containing RED food color
4. Make sure that the divider in the middle of the water tank is pushed firmly to the bottom of the tank.
5. One student in your group pours 200 mL of the hot water into one side of the tank at the

same time as another student in your group pours 200 mL of cold water into the other side of the tank.
6. Wait a few seconds until the water in the tank stops moving. Have a group member slowly and carefully remove the divider. Watch the movement of the water in the tank. Describe what happened when the divider between the hot water and the cold water was pulled out. Why did this happen? Draw a diagram of the tank before and after the divider was removed.
7. Without disturbing the water, have each member of the group – one at a time – slide a finger slowly down into the water. Describe how your finger felt when you slid it down to the bottom of the tank.
8. Carefully place the divider back into the tank AND using the appropriate tool, stir the water in only one side of the tank. Now there is hot and cold water on one side and warm water on the other side. Predict what will happen when the divider separating the layers of hot and cold water from the warm water is removed from the tank.
9. Slowly and carefully remove the divider from the tank. Was your predication correct? If your predication was not correct, describe what really happened.

Procedure 2:
10. Repeat steps 1-6 from Procedure 1.
11. Carefully pour in the beaker filled with green colored cold salt water. Observe and describe what happens. Why does this happen?
12 From this activity, what can you conclude about the interactions of fluids of different densities? (For differentiation- lower level students will get this sentence starter…When the warm water mixes in the split demo tank, the more dense cold water stays at the……When the salt water was added….)

Day 3:
Integration of life science with earth science: cold (polar) seawater is very salty, because when sea ice forms, the salt is left behind. The colder and saltier the water gets, the denser it becomes, and then it will start to sink toward the bottom. The water at the surface is pulled in to replace the sinking water, which results in eventually becoming cold and salty enough to sink which helps to create currents. Students will examine how organisms are affected by ocean currents. Bowhead whales near Alaska, for example are reliant on krill for food. These krill actually get carried from the Bering Sea to the Alaska area by ocean currents.

Research Activity:
Students will work with a clock buddy and explore these 2 websites on currents and marine life. They will then answer the questions to check for understanding on upwelling and downwelling. They will then choose a marine organism and research how its food supply is reliant on the ocean and the currents interacting with them.

http://www.windows2universe.org/earth/polar/arctic_currents.html
http://oceanexplorer.noaa.gov/edu/learning/8_ocean_currents/activities/currents.

Learning Resources

html#activity

Extension
n/a

Resources
n/a

Assessment
n/a

Credits
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Learning Resources

National Science Education Standards (NSES)

Content Standards, Grades 5-8

Content Standard B: Physical Science
b. Motions and forces

Content Standard C: Life Science
d. Populations and ecosystems

Content Standards, Grades 9-12

Content Standard B: Physical Science
d. Motions and forces

Other Standards
NYS Learning Standards:

MST Standard 4: Science- Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Key Idea 2:
Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

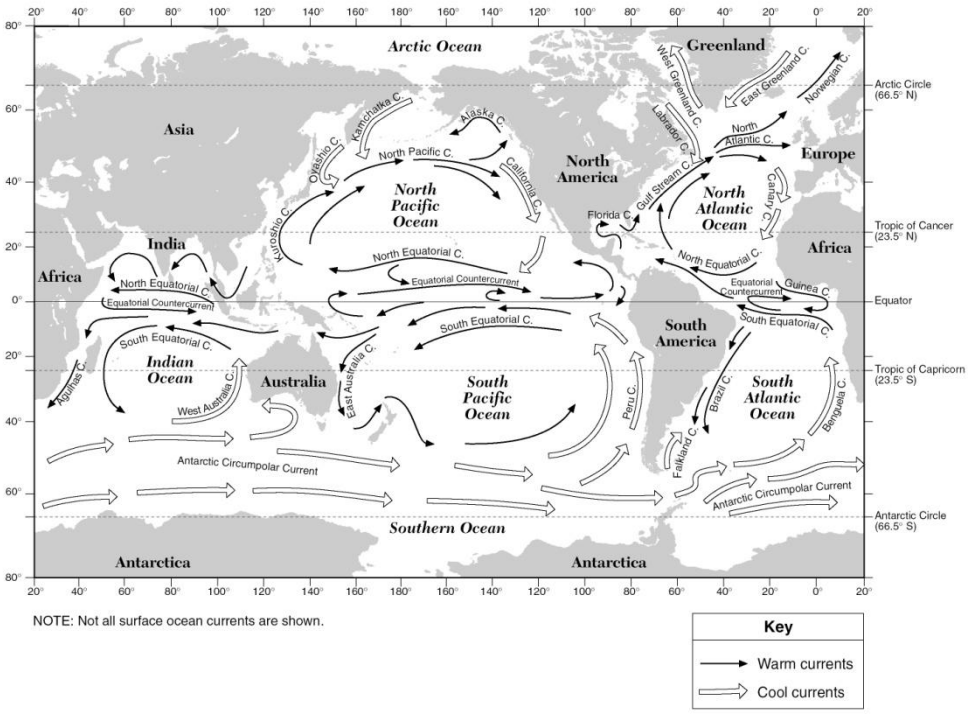
Global climate is determined by the interaction of solar energy with Earth's surface and atmosphere. This energy transfer is influenced by dynamic processes such as cloud cover, and Earth rotation, and the positions of mountain ranges and oceans.

Major Understandings:
2.1a Earth systems have internal and external sources of energy, both of which create Heat.
2.1b the transfer of heat energy within the atmosphere, the hydrosphere, and Earth's Interior results in the formation of regions of different densities. This density Differences result in motion.
2.1i Seasonal changes can be explained using concepts of density and heat energy. These changes include the shifting of global temperature zones, the shifting of planetary Wind and ocean current patterns, the occurrence of monsoons, hurricanes, flooding, and Severe weather.
2.1o Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution.

Explain how incoming solar radiation, ocean currents, and landmasses affect weather and climate.

Major Understandings:
2.2a Insolation (solar radiation) heats Earths surface and atmosphere unequally due to variations in:
- The intensity caused by differences in atmospheric transparency and angle of incidence which vary with time of day, latitude, and season
- Characteristics of the materials absorbing the energy such as color, texture, transparency, state of matter, and specific heat
-duration, which varies with seasons and latitude.
2.2b the transfer of heat energy within the atmosphere, the hydrosphere, and Earth's surface occurs as the result of radiation, convection, and conduction.
- Heating of Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents.
2.2c A location's climate is influenced by latitude, proximity to large bodies of water, ocean currents, prevailing winds, vegetative cover, elevation, and mountain ranges.

Surface Ocean Currents

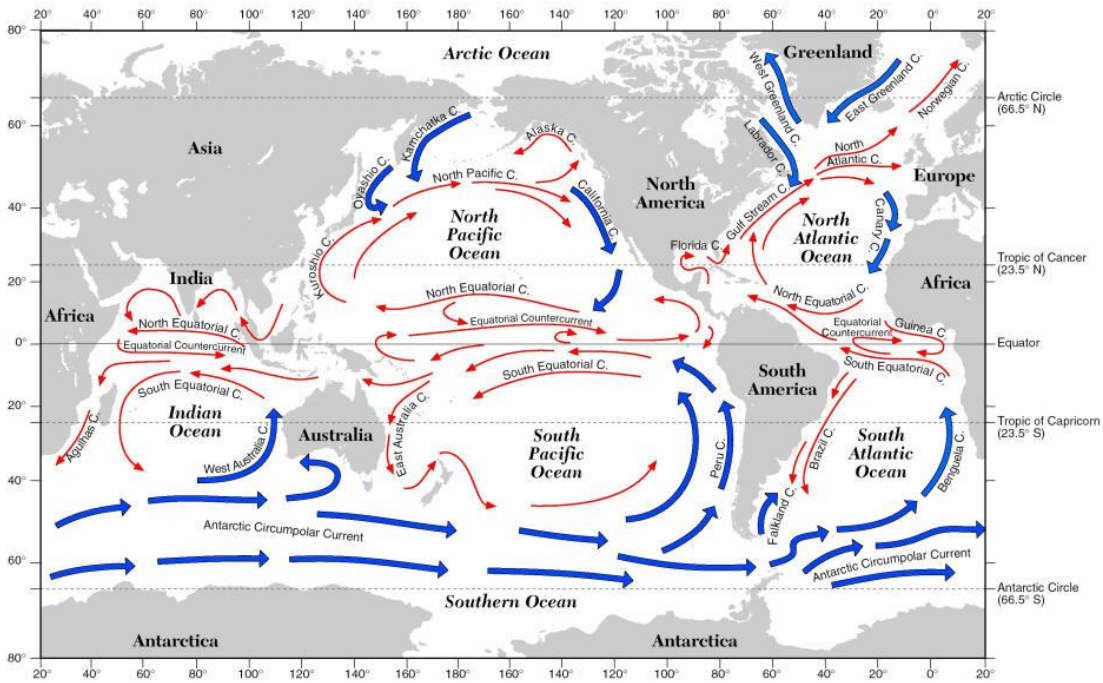


NOTE: Not all surface ocean currents are shown.

Key

- Warm currents
- Cool currents

Surface Ocean Currents



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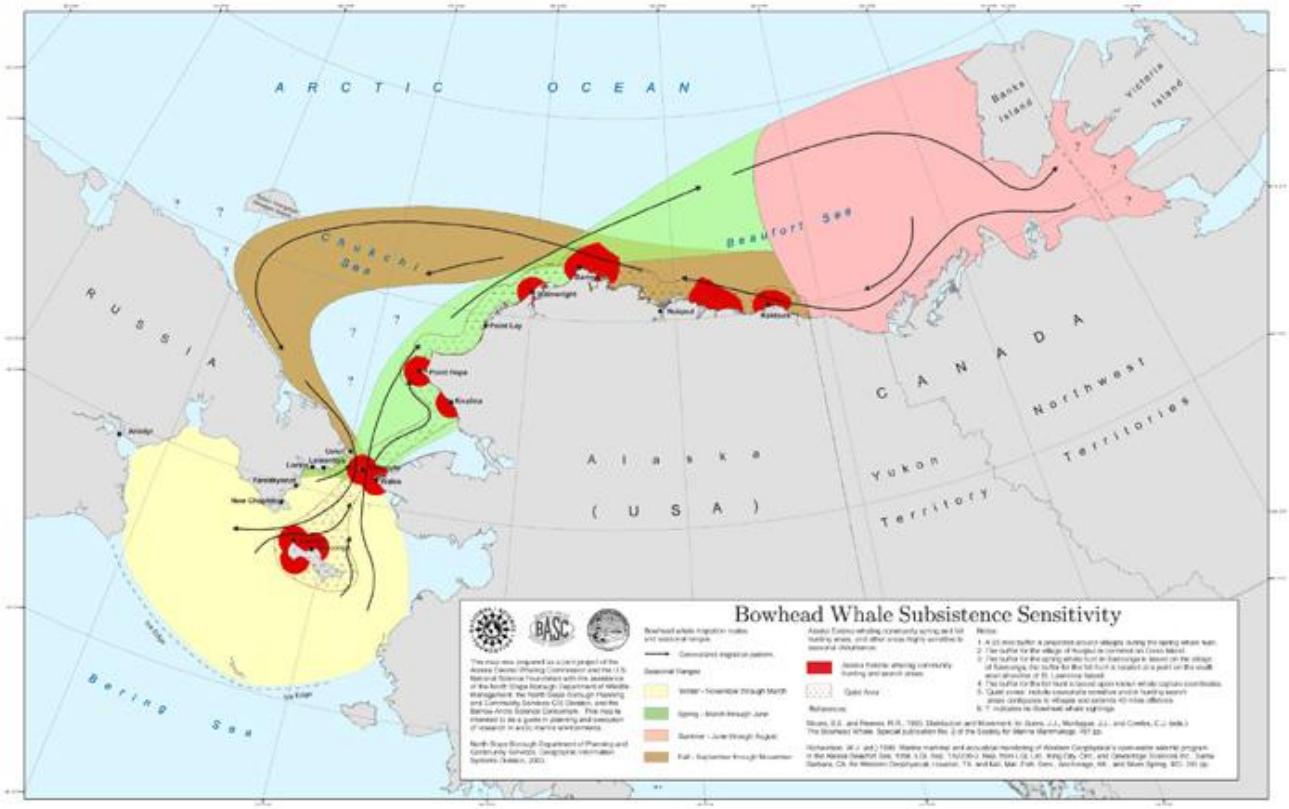
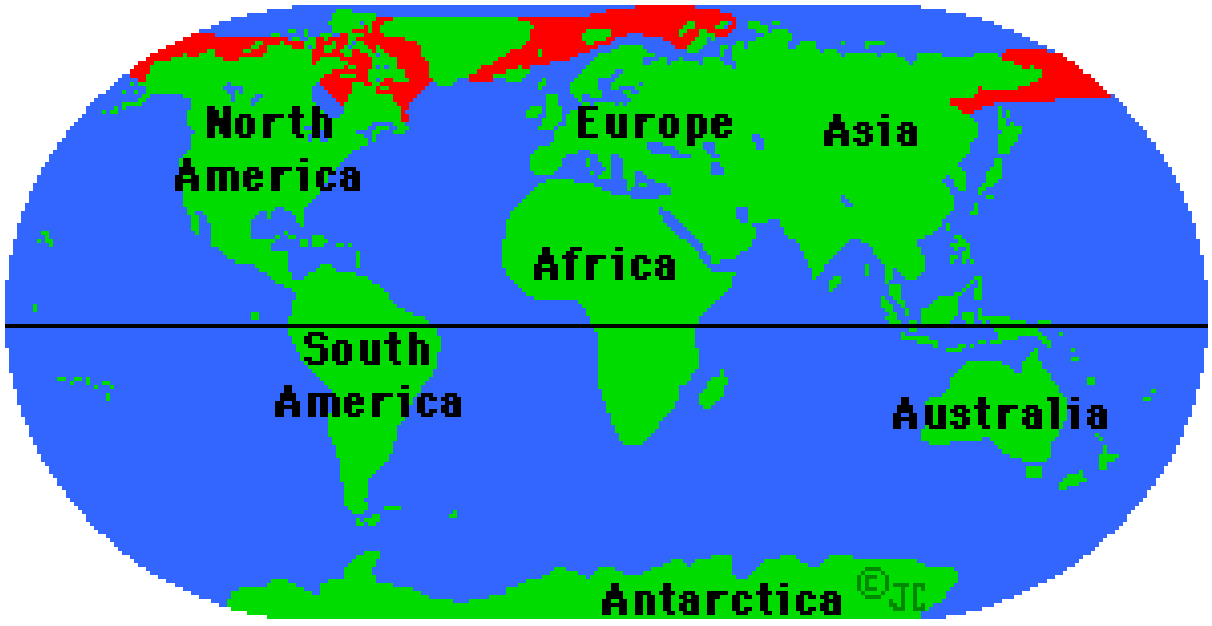


Bowhead whale distribution



Bowhead whales live in cold arctic seas.