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SCCOOS Lesson Plans designed to fit into 6th grade Earth Science classes 2008/2009

Activity Cycle: Ocean's role in temperature and Climate

Objective: All energy on Earth is derived initially from the sun. The students need to develop more detailed understanding at 6th grade about the patterns and varied microclimates that are created once that energy starts to interact with the features of the planet, including large bodies of water. The Ocean occupies more than 70% of Earth's surface and has a large impact on the Earth and its inhabitants. Support students to make connections between the data about real time ocean conditions and the weather patterns and general climate of the Earth.

Questions for Students: How are the temperature conditions and climate patterns generated on planet Earth? Does topography have anything to do with this? What are temperature and weather conditions in coastal areas? What are temperature and weather conditions inland? How are they different and alike? What could be causing the similarities? Why are they different? What causes temperature differences between these two areas?
Intro/Background: Students study the weather beginning in 2nd grade and by the sixth grade have an idea about how weather patterns are formed. The task at sixth grade is to develop the understanding to be able to add the details about how weather is create. They will explore heat transfer through radiation, convection, and conduction in other units. Students at this age generally have some misconceptions about the properties and relationships between energy and heat. They will have opportunities to make logical connections in order to understand the physical properties of currents and energy that make up the weather in their environment. These two standard components are addressed in this cycle of lessons for 6th grade
d. convection currents distribute heat in the atmosphere and oceans.
e. differences in pressure, heat, air movement, and humidity result in changes of weather.

Activity 1: The Earth's Temperature Zones
Objectives: Link prior knowledge to evidence that is unexplained and inspires questioning
Materials: world map, set of 8 colored pencils for each group, computers (second part of activity)
Time: 1 class session
Procedure:
Individual Quick write: Where do you think the coolest and warmest parts of the Earth are? Why? Using the color scale given, draw a model of what you think the temperatures are in different places on the Earth. Write an explanation for your prediction. Explain at least two possible reasons for the temperature scheme that you came up with.

-**Think Pair Share** Discuss your idea and explanation with your neighbor, be ready to share with the class.
-**Class Discussion**: Student groups share their ideas with the class, a class web of predictions is created.
-Students are asked to place their drawing and their explanation in their journals to refer to later.
-Students are given to opportunity to observe the NOAA Earth temperature charts (Teachers can use photographs, powerpoint presentation, or a direct link in a computer lab, depending on the access available to you.) Link: http://www.nodc.noaa.gov/cgi-bin/OC5/SELECT/woaselect.pl
-**Class Discussion** What is this map telling us about the temperature of the Ocean? What are some possible reasons for the temperature in specific areas? How might these differences relate to the shape of the planet?
-Students write reflections in their journals. Prompt#1: Comparing your prediction to the actual temperature of the Earth, how was your prediction like and unlike the data? How did your explanation help other people to understand and agree with your prediction? Prompt #2 What questions do you have about the temperature variations on the planet after viewing the data? How can you modify your explanation to reflect this new information?
Assessment: Journal reflections, map, group work, and class participation in discussion

Activity 2: The Ocean is All Around Us
Objectives: Review the concept that the Ocean comprises a significant portion of the Earth's surface. Remind the students of the spherical nature of the Earth to help them think in terms of air and fluid movement in and around the Earth. Practice cooperative group skills. To have experience using data to calculate percentages with real data (math standard grade 6)
Materials: One standard globe showing landforms, ten inflatable Earth globes, group of four or five, globe toss worksheet
Organization of group: two recorders, one "tosser", one observer, students will take turns doing each job
Time: One class session

Procedure: Teacher will clean globe mouthpiece before giving to a new student group with alcohol. As students work teacher will question each group for understanding and ask group members to explain what they are doing at the moment teacher visits.
Journal Prompt: (Use to focus students on activity goals)Using the globe as a model of the Earth, what do you see when you look at the planet Earth? How much of Earth is covered by water? How much is covered by land?

1. Inflate globe.
2. With partner, toss the globe back and forth 10 times, take turns catching and observing what the fingers of your partner are touching each time.
3. In your journal, record how many of your 10 fingers touched the ocean each time the globe is caught.
4. Add up your totals and calculate an average percentage for your group.

5. Discuss the findings with your group and come up with one hypothesis about the Earth's surface from your data together.
6. Discuss your data with the class
7. Write a reflection answering these questions: What did your experience and data indicate about the Earth's features? How was your data different from the data of other groups? How was it the same? Why do you think there are differences? Could you make a hypothesis from the class data?

Number of tosses	Number of fingers touching ocean
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
% Total	

Student Materials: journal, pencil or pen, group members, one blow-up globe per group
Specific student products: journal entries, data collection, calculation and percentages for each toss and an average for the percentages
Vocabulary: no new vocabulary
Resources: source of globes: Education Station
Assessment: Teacher observation during group work, group reports of data and journal entries. This is a good opportunity to note how accurately the students understand and calculate percentages.

<u>Activity 3 Local Weather and the Ocean</u>

Introduction: The circulation of the ocean's water affects regional weather. Ocean water has high heat capacity that results in slow temperature changes of the ocean in comparison to the low heat capacity of air that results in rapid changes in air temperatures. The circulation of the ocean and the ocean's high heat capacity explain why the air temperature s in coastal locations are often cooler in the summer and warmer in the winter than inland locations. Predominant wind patterns that blow air affected by ocean surface currents to coastal locations. In this exercise you will investigate the influence of the ocean by comparing coastal temperatures in coastal and inland locations.

Objectives: To obtain real time data about the temperature differences in different places on the Earth having some relationship with the Ocean.

Materials computer, internet connection, journal, questions for students to write in their journals or printed for them.
Time: 1 class session
Procedure
Find the present air temperature
1. Go to http://www.weather .com
2. Type in your city and record the air temperature at this time:_____C _____F location_____
Use the following formula to convert from Farenheit to Celsius F -32 X 5/9 =C

3. If you live inland, locate a city by the ocean nearest you at the same latitude as your city and record the temperature at this time:_____C _____F location_____

Find the ocean water temperature, Use the following formula to calculate Farenheit from Celsius

1. Go to NOAA's National Data Buoy Center website: www.ndbc.noaa.gov
2. Locate the coastal area nearest you on the map.
3. Click on the coastal buoy and scroll down to find the water temperature_____C _____F location_____

4. Compare your answer to the air temperature found for your first city.

5. Which area's temperature was closer to the water temperature?

Find the monthly average high and low temperatures

1. Return to the weather conditions for your city at http://www.weather .com
2. Scroll down to "36 hour forecast" and click on "averages"
3. Under the "monthly averages menu", select "compare locations" and enter your ocean comparison city. Compare the average high and low temperatures for the two cities.

Journal Questions:
Which cities had the highest monthly summer temperature?

Which city had the lowest monthly winter temperatures?

What effect do you think the ocean has on coastal and inland air temperatures?

What effect does the ocean have on local air temperatures?

Student products: journal reflections, chart of ocean temperatures and calculations

Vocabulary: coastal, buoy might be new to the students in this context
Resources: sccoos website
Assessment: journal entries, group work

Activity 4 The Earth's Hydrosphere
Objectives: Review of the parts of the hydrosphere, the water cycle, and energy transfer in this cycle from the atmosphere to the planet.
Materials Globe model, paper, colored pencils,
Procedure
-**Quickwrite:** Where is all of the water on the Earth? What are the different forms that water might take during the water cycle? Draw some examples from the water cycle.
-Class Discussion: Think Pair Share, volunteers write on overhead for class.
-Slide show of ocean, river, glacier, geyser, waterfall, clouds, glass of liquid with ice showing condensation.
-Demonstration for groups to observe in a station to station exhibit: models of dry ice, glass of liquid filled with ice, hot pot making steam
-Students diagram the observations at each station and place arrows showing the energy transfer at each point.
Questions for students:
Journal Reflection
-Can the temperature of one form of water change the temperature of another?
-What happened to the liquid in the glass when ice cubes were placed in it?
- How does water change form? (Remind students of the energy from the sun heating up the molecules and "exciting" then to move.)
-Can water change to a gas when it is cold? Give one example of this. (water vapor from dry ice)
-Can water change to a gas when it is hot? Give at least one example. (steam from a geyser)
-What happens to water when it changes to a gas? Can the temperature of a gas or liquid change the temperature of things around it?

Remind students that water can occur in all of these forms and that it can occur at different temperatures.

Vocabulary: hydrosphere, geyser, (need reminder vocab: condensation, evaporation,) pictures (depending upon technology available), dry ice, ice cubes, hot pot to create steam (teacher will oversee the hot pot station)
Assessment: Journal reflection responses, teacher observation, and checklist of lab activity

Activity 5 **Surface Circulation of the North Atlantic: A Model**
L. Murray and L. Spence

Introduction The ocean interacts closely with the atmosphere. Heat from the sun, evaporative, conduction and emission forces provide energy for ocean movement, while

wind and density differences provide momentum. Changes in atmospheric pressure set up wind patterns. Predominant wind patterns are among the main forces which drive ocean circulation. The shape of the coastline, bathymetry of the ocean cause changes in direction (meanders) and spin-offs (gyres) from the main current. These gyres are visible in maps of sea surface temperatures of the Gulf Stream in the North Atlantic (http://fermi.jhuapl.edu/avhrr/gs/averages/). In this activity, students will explore how wind forces water movement and how land features can change this movement.

Objectives

1. Students should be able to explain the forces which produce the circulation patterns in the Gulf Stream.
2. Students should be able to predict current patterns or eddy development with variances in bathymetry.

Materials

Heavy duty stainless steel baking tray (10 x 16)
Modeling clay
Laminated satellite images of the Gulf Stream
Laminated Bathymetric maps of the North Atlantic
Convection Fluid Bottles, Carolina Biological Supply Catalog #, Price, Qty. GEO8450,
Hair Dryer

Procedure

1. In groups of 4, use clay to build a model of the North Atlantic. Use the bathymetric maps below and be sure to include the continental shelf, continental slope, capes, seamounts, and other seafloor features.
Maps: Bathymetry of the North Atlantic
2. Create the shoreline of the North Atlantic in your container using the clay. (no more than 1-2 inches thickness of clay on edges).
3. Pour in a diluted solution of Convection Fluid to a depth which just covers the subsurface oceanic features.
4. Set up a gentle "wind" blowing from the south to start a current. Make observations on the current patterns that develop.
5. Change wind direction and speed and observe any changes in the current patterns.
6. Illustrate your notes on the observations, especially the patterns affected by the shoreline or around surface features (e.g. Cape Hatters).
7. When finished, return the Convection Fluid to the container. Remove clay from container and roll into ball. Clean up area for the next class.

8.Complete journal reflection for activity

Bathymetry of the North Atlantic

1. Did the shelf, slope or capes affect the surface current? Describe.
2. Do you think the Gulf Stream might have a greater affect on weather of the southeast vs. the northeast of the USA? Explain.
3. What other factors besides wind might affect the Gulf Stream current

Student products: journal entries, answers to questions, model
Vocabulary, bathymetry, Gulf Stream
Resources: Cabrillo Aquarium educational staff, NOAA site
Assessment: Models. Journal entries, group work

<u>Activity 6 Exploring Ocean Currents</u>
Objective
-To use the internet resources to locate data about ocean currents. To practice computer protocol for search of Ocean Observing systems
To allow students to experience the system that has been set up to provide real time data about ocean conditions and to use it in context. To obtain information relative to the movement of the water in Ocean basins and connect data to the model created in previous lesson.
Intro/Background
Questions:
1. Which current flows off the southeast coast of the United States?
What is the temperature of this current? (warm or cool) Which direction does it flow?
2. Which current flows off the California Coast? What is the temperature of this current? Which direction does it follow?

Ocean circulation

3. What current might have an effect on the weather of the Atlantic coast of the USA?
4. What current is responsible for El Nino and La Nina events off the coast of South America?

Materials: student journals blank map of the Earth, computer for each team of two students, colored pencils,

Time:1-2 class sessions
Procedure
-students copy the questions into their journal to use in the computer lab search
-Go to the website
http://www.windows.ucar.edu/cgibin/tour_def/earth/Water/ocean_currents.html
-Answer the questions in your journal
-fill in your copy of the map of currents for your journal, label and create a key, tape or glue in your journal.

Search 2
-Go to the NOAA National Buoy Data Center website: www.ndbc.noaa.gov
-Click on the area of the map nearest you. Choose a buoy and click on it.
-Answer the questions given. If your buoy does not have the data you need, choose another buoy. If the buoy is reported missing or is not operational, please write down the details to share with the class.
-data sets (parameters) currents, salinity, temperature: air and water, pressure
Student products: journal entries,
Vocabulary
Gyres, Gulf Stream, El Nino, thermohaline, Coriolis Effect, eddies, upwelling
Resources: internet sources, Cosee West, http://www.usc.edu/org/cosee-west/PDFs_010107/MovingWater8thGbackground.pdf
http://www.msc.ucla.edu/oceanglobe/ppt/oceancircNotes/OceanCirculation.htm
Assessment: reviewing student journals, group participation in lab, students receive a grade for team work and assignments in the lab.

Activity 7 Temperature Range Investigation
Objective/Question: How does the Ocean affect the air temperature on land? Which will have the largest temperature range, the water at the ocean's surface, the air at an ocean buoy, or the air at an inland location?
Intro/Background: Taking the students from the general question of the temperature variations on Earth's surface to a possible specific interaction that occur because of the movement of air molecules due to heat and heat transfer.
Materials: Temperature Range Investigation sheets from the Weather and Water Program. http://www.sccoos.org/docs/Temperature%20Range%20Investiga.pdf
Students will meet in the computer lab
Time:2 class sessions
Procedure:
-Students will answer the two questions in their science journals and make a prediction. Students will share their predictions with their group and the teacher will stamp one journal that is complete from each group.
-students will review data from printouts given for specific SCCOOS stations on land
-teacher will guide students through the process of logging data using an overhead chart

-teacher will check with each group to make sure that they are on task and complete with finding a land station on the chart and recording the data.
-Class Check in as a Whole Group to review chart that groups have created. Students will copy chart into their journals.
-students will log onto the SCCOOS website and follow the teacher's directions to find the buoys
Step 1 Select a buoy station (triangle), and click on the link
Step 2 Clock on "Download Recent Temperature Data to view the last 24 hours of data from this station. This data will include the air temperature at the buoy and sea surface temperature (SST).
Step 3 Record the data on your chart for your buoy and the surface temperature of the water (SST), the air temperature, and write down the time.
Step 4 Convert the time, which is in "military time" to standard time by using the chart in your materials.
Step 5 Find the temperature range by subtracting the lowest water temperature from the highest water temperature. Record your temperature range.
Step 6 Using the same method as for water temperature, find your buoy air temperature range.
Step 7 The inland air temperature has already been charted for one area. If you have not completed yours check with the "expert" on that region.
-Work with your groups to complete the conclusion section.
-Class discussion on the results.
-Class Check in as a Whole Group to review chart that groups have created. Students will copy completed chart into their journals if they are missing a part of the data.
Student products: journal entries, web search data, reflections, class discussion participation.
Vocabulary: parameter, concept of "military time"
Resources: SCCOOS site for teachers,
http://www.msc.ucla.edu/oceanglobe/ppt/oceancircNotes/OceanCirculation.htm
Assessment: Student journals

<u>Activity 8 Horizontal Water Movement Using "Drifters" Objective/Question</u>
Intro/Background Hands on site specific activity that uses the ocean as a laboratory and gives students some questions to ponder about why their drifters move the way that they do. I will take the students to Cabrillo beach for this activity.
Materials: Access to a stretch of beach at least 15 meters in length, measuring tapes or meter sticks, (will need to mark off 15 meters) bottle drifter, one per team, lengths of string (10 meters) timing device, wrist or stop watch, compass, wind gauge, student worksheet
Time: 1 class session
Procedure

1. On land measure out a 15 meter stretch for your drifter test parallel to the shore. Mark the starting point "point A" and the ending point "point B".

2. Make a “neutrally boyant” drifter, by filling a soda or water bottle with water and sand until it just floats under the surface but does not stick out above it. Tie one end of your string to the bottle so it does not get lost.
3. Lower bottle drifter in the water at Point A about 3 or four meters out from shore.
4. Use a timing device to record how long it takes the bottle to move from point A to point B.
5. Use a compass to record the general direction the bottle traveled. Remember that current direction is the direction it is going (as opposed to wind which is reported as the direction it is coming from).
6. Calculate your speed using the worksheet.
7. Repeat Steps 2-6 two more times and calculate an average current speed.
8. Journal reflection: What does your data tell you about the drifter’s movement? What affected your drifter the most, the air temperature or the current? Which direction did the tracker move? Was this what you expected? What do you think was moving your drifter?

Student products: Drifter tracking worksheet, journal reflection
Vocabulary: buoyant, average speed, meters per second
Resources: Cosee West, Cabrillo Aquarium staff
Assessment: group work, class discussion, journal entries

This series of lessons will be completed in February or March depending on the availability of the Field trip experience. It should be completed in about three weeks with the extra activities and I hope to tie in the current hurricane activity towards the end. It should help the students to understand the influence of the ocean on air masses that directly impact the land regions, both coastal and inland. Further investigation will include density tank experiences and revisiting SCCOOS for the salinity and temperature data. During the Ecology Unit we will be looking into upwelling and how the mixing of the deep water supports life in the ocean ecosystems.