ED 5641 Global Change Teacher Institute – Teaching Unit

Times are a Changing

By Dan Carey, Kingsford Middle School, Grade 7 Science

Unit Overview: This unit is composed of six days of global change investigation. This will be entirely new to my current seventh grade curriculum. Students will be introduced to global change and its potential effects on the Great Lakes Region. Students will learn how to measure pH and how we can monitor it in our environment and its potential negative effect on the ecosystem. Also, students will be involved in establishing a long running scientific study at a local lake. More importantly, students will find out how it affects them currently and in the future. The goal of the unit will be to increase their involvement and concern for a changing global environment.

Resources:
Grant, Tim & Littlejohn, G. Teaching About Climate Change: Cool schools tackle global warming. (2001)

Student and Teacher websites:
http://www.koshland-science-museum.org/exhibitgcc/index.jsp
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsGHGCalculator.html
http://www.middleschoolscience.com
http://www.science-house.org/learn/CountertopChem/exp27.html
http://www.miamisci.org/ph/lpexplore1.html

Excerpts from PowerPoints:
Bradley, Kate L. An introduction to global change issues. 2006
Burton, Andrew. Acid Rain, Nitrogen Deposition and Nitrogen Saturation. 2006
Holmes, Bill. Introduction to Elevated CO₂ and Ozone. 2006

Teaching and Learning Objectives
Upon completion of this unit the learner will be able to:
♦ Determine how much Earth’s average temperature has increased over the last 100 years.
♦ Determine the increase of CO₂ over the last 100 years.
♦ Design experiments to test for global change: temperature, amount of precipitation, pH of precipitation and bodies of water, and invasive species.
♦ Use technology to gather, analyze, and represent their scientific findings.
♦ Measure the pH of several house substances.
♦ Measure the pH of water samples to determine their pH and how it can possibly affect the environment.
♦ Determine the sources of pollutants created by humans and their impact on the environment.
♦ Explain the consequences of global change on the ecosystems in the Great Lakes Region.
MICHIGAN SCIENCE CONTENT STANDARDS AND BENCHMARKS

Science

CONSTRUCTING NEW SCIENTIFIC KNOWLEDGE
Content Standard: All students will ask questions that help them learn about the world.
SCI. MS. BM: 1. Generate scientific questions about the world based upon observation.

Content Standard: All students will design and conduct investigations using appropriate methodology and technology.
SCI. MS. BM: 2. Design and conduct scientific investigations.
SCI. MS. BM: 3. Use tools and equipment appropriate to scientific investigations.
SCI. MS. BM: 4. Use metric measurement devices to provide consistency in an investigation.

Content Standard: All students will learn from books and other sources of information.
SCI. MS. BM: 5. Use sources of information in support of scientific investigations.

Content Standard: All students will communicate findings of investigations, using appropriate technology.

REFLECTING ON SCIENTIFIC KNOWLEDGE
Content Standard: All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge.

GEOSPHERE (EG)
Content Standard 1: All students will describe the Earth’s surface.
SCI. MS. BM: 1. Describe and identify surface features using maps.

Content Standard: All students will analyze effects of technology on the Earth’s surface and resources.
SCI. MS. BM: 5. Explain how technology changes the surface of the earth.

HYDROSPHERE (EH)
Content Standard 2: All students will analyze the interaction of human activities with the hydrosphere.
SCI. MS. BM: 4. Describe the origins of pollution in the hydrosphere.

ATMOSPHERE AND WEATHER (EAW) V.3
Content Standard: All students will investigate and describe what makes up weather and how it changes from day to day, from season to season, and over long periods of time.
SCI. MS. BM: 1. Explain patterns of changing weather and how they are measured.

Content Standard: All students will analyze the relationships between human activities and the atmosphere.

Lesson Plans

Day 1
Outcomes: Students will learn the basics of how the climate has changed over the last 100 years. Students will see that the amount of CO₂ has increased and this has affected the global mean temperature average.

Introduction: Students will be given the following scenario: You are a scientist that is investigating the effects of global climate change. You have just received notice that global warming is affecting your local area. There have been reports that the average temperature for your area has increased 1 degree Celsius over the last 10 years and is raising the levels the Great Lakes with possible negative results in your area such as flooding, as well as increased water levels in lakes and rivers. There could be severe damage to your roads, buildings, homes, and recreation areas. You and your team of scientists need to investigate this phenomenon and the possible consequences to your area. Your team will have to perform several tasks and science investigations to help you report the facts of the risk your city is facing to your local government.
**Activities/Strategies:** Students will visit the following web site and answer the questions on the worksheet:  http://www.koshland-science-museum.org/exhibitgcc/index.jsp

**Closure:** Discuss student’s answers and thoughts regarding global warming.

### Day 2

**Outcomes:** Students will determine the amount of CO₂ their families produce on average and how to take steps on reducing their “carbon fingerprint” on earth.

**Introduction:** Now that your team of scientists has determined how global change is occurring, including the increase in the earth’s temperature over the last 100 years and the associated increase in CO₂, your team needs to understand the human impact on this issue. After your investigation you will be able to apply your knowledge of the causes of global warming.

**Activities/Strategies:** Students will go to the following web site to investigate how much CO₂ gas each of their family’s vehicles/engines emits into the atmosphere. Students will begin to formulate how they and their families can reduce their carbon fingerprint on the earth.
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsGHGCalculator.html

**Closure:** The teacher will ask students to write down three to four ideas in their journals on how they can reduce the amount of carbon dioxide being emitted from their vehicles.

### Day 3

**Outcomes:** Students will be introduced to acid rain and how humans have influenced the amount of acid rain precipitation due to increase industrialization and other human created factors.

**Introduction:** Global change involves all aspects of our world and one of the resulting factors is acid rain. The teacher will show students the pH scale and how it can be used to identify different substances. Students will also be introduced to the harmful effects of acids and bases and why it is important to understand the pH of substances.

**Activities/Strategies:** The teacher will have the students perform pH on tests on several liquids to determining if it is an acid, neutral, or basic. See the student lab handout “Cabbage Juice Indicator – pH”.

**Closure:** The teacher will ask students to share their results with the class. Key question: What would you predict if an acid rain fell on a sensitive brook trout stream?

### Day 4

**Outcomes:** Students will make real world scientific observation of a local lake. Students will collect water and vegetation samples during their field trip.
**Introduction:** Today you and your scientific team will begin to apply what you learned earlier in the week by conducting research at one of our local lakes.

**Activities/Strategies:** Students will be taken to a local lake located within walking distance of the school to begin long term monitoring of the lake. Students will take observations on what they see on their visit today; these include the type of plant and animal life, the apparent health of the water, and aquatic vegetation. Students will also be collecting water samples to monitor the lakes’ pH, water temperature, and dissolved oxygen.

**Closure:** The teacher will ask students to share their results with the class.

**Day 5 and 6**

**Outcomes:** Students will make real world scientific observation of a local lake. Students will collect water and vegetation samples during their field trip.

**Introduction:** As scientists investigating global change your team will need to determine the base line of your investigation area. Your team will need to perform several tests on the samples you collected yesterday. You will then compare your data with data that has been collected from the site in previous years and also with other locations in the Upper Peninsula.

**Activities/Strategies:** Students will perform laboratory tests on the samples they collected yesterday for pH, dissolved oxygen, and macro invertebrates, and aquatic vegetation.

**Closure:** The teacher will ask students to share their results with the class.
EXPLORING GLOBAL CLIMATE CHANGE

Answer the following questions before exploring this website.

1. How do you think that the Earth’s climate has changed over the last 10 years? Provide at least two examples to support your answer.

2. What is global warming or global change?

3. If there is a significant change in our climate what are the major contributors to global warming?

GO TO: http://www.koshland-science-museum.org/exhibitgcc/index.jsp

DIRECTIONS: Please follow the directions below to help guide you through this web site and answer the questions.

Step 1: Start with by clicking the icons in order on the right side of your screen to help you answer the following questions.

Step 1: Click twice on the “Century of Change” icon to answer the following questions.
1. Between 1900 and 2000 how would you describe the amount of CO₂ levels?

2. How do the CO₂ levels compare to the temperatures in the same time period?

3. Review the map that indicates the average temperature on Earth. Hypothesize why certain parts of the Earth are warmer than average or cooler than average.

   My hypothesis: ________________________________

   ________________________________

Step 2: Click twice on the “A Changing Future” icon to answer the following questions.
4. Scientists have created two computer models of climate change. Both models show what happening to the levels of CO₂ and temperature doing over the next 100 years. Why do the two models differ in their predictions?

Step 3: Click twice on “CO₂ Emissions Calculator”

You as an individual have a large impact on how much CO₂ is placed into the atmosphere. Select the different options to lower CO₂ emissions in the United States.

5. If every American were to adopt these personal “lifestyle options” changes what percentage of CO₂ would we reduce?

6. What percentage would the CO₂ levels decrease if we adopted the Nation Options?

Step 4: Watch the brief videos by clicking on the icon and take the three surveys as part of a Penn State University Study. Please make sure that you answer truthfully.

7. How do your decisions compare to others that have taken the survey?

8. Do you think that your family would be able to afford those monthly increases to insure that you have fresh water, have wildlife, and wetlands? Explain your answer.
Cabbage Juice Indicator - pH

Objectives:
- to test household solutions with litmus paper
- to test household solutions using red-cabbage juice indicator
- to classify household substances as acids or bases
- to determine the pH range of red cabbage juice

Materials: (per group or station)
- Beaker of Red Cabbage Juice - [recipe](#)
- Red and Blue Litmus Paper
- 6 Plastic cups
- Beakers of the following solutions: water, baking soda, vinegar, salt, sugar, lemon juice, soda, etc...
- Plastic spoon
- black marker

Procedure:
1. Label your plastic cups #'s 1-6
2. Choose one solution and pour a small amount into plastic cup #1.
3. Write the name of the solution in your data table.
4. Place a drop of the solution onto red and then blue litmus paper. Record results
5. Add 1 - 2 tablespoons of red cabbage juice to the cup. Record color change.
6. Determine if the solution is a acid, base or neutral
7. Repeat with solutions #2-6.
8. Clean up. Pour contents into sink and throw out used cups.
Data Table:

<table>
<thead>
<tr>
<th>Plastic Cup #</th>
<th>Solution</th>
<th>Red Litmus</th>
<th>Blue Litmus</th>
<th>Red Cabbage Juice</th>
<th>Acid/Base or Neutral</th>
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</table>

Results:

1. Name the acids, name the bases, were there any neutral solutions?
2. What color did the cabbage juice turn to indicate a neutral substance?
3. Why is it important to use both blue and red litmus paper to determine pH?

Conclusion:

2-3 sentences on what you learned

How to read pH paper:

Red Litmus Paper – Stays Red = Acid or Neutral
Turns Blue = Base

Blue Litmus Paper – Stays Blue = Base or Neutral
Turns Red = Acid

Colors of Cabbage Juice:

acid neutral base

http://www.middleschoolscience.com

Modified from these lessons:
http://www.science-house.org/learn/CountertopChem/exp27.html
http://www.miamisci.org/ph/lpexplore1.html