Global Climate Change

A problem based lesson plan

Purpose: This unit is designed to expose the students to the idea of global warming and address whether it is a new phenomenon or one of the natural cycles the Earth undergoes. Then the students will investigate what is causing the current changes and how it may be affecting the hydrosphere, biosphere, and lithosphere.

Scenario: *Over the past 100 years, the global average temperature has risen by 1° C. Strong evidence shows that this change in the earth's thermal energy is having an effect on weather patterns, ecosystems, and global water systems. You and your teammates have been requested to look into this situation, investigate whether this is a new phenomenon or a part of a natural cycle, and determine if its effects are positive or negative on the rest of the earth.*

Objectives:

TSWBAT design and conduct an experiment (lab activity)
TSWBAT make a hypothesis and evaluate it in terms of class results (lab activity)
TSWBAT work with their peers to complete a project (board game)
TSWBAT clearly communicate an understanding of the earth's current climate and the changes it is going through (scavenger hunt)
TSWBAT demonstrate through the creation of questions and answers for a board game the role of the atmosphere (board game)
TSWBAT explain the history of global warming, and utilize that information to hypothesize on the current global climate change
(TSWBAT = The Student Will Be Able To)

Materials:
Lab: seawater, beakers, thermometers, O2 meters, hot plates, hot gloves, goggles
Scavenger Hunt: access to computer lab and materials for the scavenger hunt and writing of questions for the board games
Board Games: construction paper, markers, glue, poster board and various other art supplies for the creation of their games

Instruction:

Day 1 – ***Experiment measuring dissolved O2 concentrations*** in test tubes of seawater at variable temperatures. Class fills out "data sheet" on dry erase board. Class discussion of results. Homework: Find one article (newspaper, magazine, internet) on one aspect of global warming.

Day 2 – Introduce the project, ***talk about the students' ideas of global warming***, what is causing it, and if they believe that the globe has ever changed temperature before. Go over the schedule, assign research groups and begin lecture on background information.

Day 3 – Continue the in ***class introductory lectures and discussions*** on:

- the atmosphere, its composition and role in the earth's climate
- global wind patterns and ocean currents
- geologic time and the fossil record's role in interpreting changes in the earth

Days 4 – 5 – ***Complete Scavenger Hunt Questions*** on the History of Global Climate Change

1. What is climate and how does it differ from weather?
2. Has the global temperature ever been at the same levels as it is now? If so, when?
3. What are the warmest and coolest global temperature time periods? Describe at least two ways that scientist study paleoclimatology.
4. What are the current theories on global warming? Include at least two anthropogenic and at least two natural sources that scientists believe are contributing to the change in the global climate.
5. Describe at least three effects that global warming can have on the different spheres of the earth, such as changing weather patterns, ecological changes, etc…

Day 6 – As a research group, have the ***students share their answers to the scavenger hunt*** questions and begin conceptual design of board games.

Days 7 – 8 – The students will work in their groups to ***design and make a Global Climate Change Board Game***. This game will be used to teach the rest of the class about the findings of each research group.

- make sure the students have access to a computer lab or library at least one day during this period
- make sure that there are a variety of art supplies available for the students so that they can utilize their time wisely
- have as many additional reference books and resources available for your students in class so that they can continue to gather information as they need for their games

Requirements for the board game: The students will need to create a board game that can be utilized to teach or review information on global climate change, both past and present. The games must have the following components:

1. a clear set of rules
2. ability to be played by 2 or more people

3. a theme
4. cards or questions that will be used to teach or review
5. a logical start and finish
6. a neat, eye-catching layout

Days 9 – 10 – Allow ***the students to play the games*** that the other research groups have created.

Resources:

http://www.ngdc.noaa.gov/paleo/globalwarming/what.html
Information on weather, climate, global warming and paleoclimatology background and data.
http://www.envirolink.org/
Multitude of links to information on weather patterns, global warming, climate changes, ecosystem effects
http://www.studyworksonline.com/cda/content/explorations/0,,NAV2-79_SEP630,00.shtml
Information on past climates – activities, references
http://www.studyworksonline.com/cda/content/explorations/0,,NAV2-79_SEP689,00.shtml
Information on the effects of global climate change on birds, weather, hibernation, etc.
http://users.pandora.be/educypedia/education/climatetopics.htm
multitude of links to information on weather, climate,
Glick, D. GeoSigns. *National Geographic Magazine*. Vol. 206(3) pp. 12-34. Sept., 2004.
Miller, K.R. and J.L. Levine. *Biology*, Sixth Edition. Prentice Hall. Needham, Massachusetts 2004
Morell, V. TimeSigns. *National Geographic Magazine*. Vol. 206(3) pp. 56-76. Sept., 2004.
http://earthobservatory.gov/study/volcano
http://www.exploratorium.edu/climate/primer/atmos-p.html
Campbell, N.A., J.B. Reece, and L.G. Mitchell. *Biology*, Fifth Edition. Benjamin Cummings. Menlo Park, California 1999.

Global Climate Change Lab Activity Task #1

Experiment measuring dissolved O2 concentrations **in test tubes of seawater at variable temperatures**

Materials:

Lab: seawater, beakers, thermometers, O2 meters, hot plates, ice, hot gloves, goggles

Procedure:

1. Collect seawater
2. Pour 100ml water into 250ml Erlenmeyer beakers (ideally 1 per student)
3. Place 1/3 of beakers into ice bath, 1/3 leave at room temp, 1/3 warm on hot plates to 90 deg C
4. After beakers equilibrate to temperatures, measure 02 concentration and temperature with 02 meters
5. Collect all student data on board in one data table.
6. Have students find the mean of the temperatures and dissolved 02 concentration for each of the three treatments
7. Ask the students to interpret the data (i.e. what temp of water has greatest dissolved 02, etc.?)
8. Have discussion on what the implications of this data are for a warming planet.

Global Climate Change Scavenger Hunt Task #2

Individually, please answer the following questions on a separate piece of paper. You may use the internet, books, class notes or magazines in order to find this information. These questions will help you further understand global climate change and will help you contribute to your group's project in Task #3.

1. **Define –**
    a. Anthropogenic
    b. Paleoclimatology
    c. Lithosphere
    d. Hydrosphere
    e. Atmosphere
    f. Bioshpere
    g. Geologic Time
    h. Ecology
2. What is **climate** and how does it differ from **weather**?
3. Has the global temperature ever been at the same level as it is now? If so, when?
4. What are the **warmest** and **coolest** global temperature geologic time periods?
5. Describe at least two ways that scientist study **paleoclimatology**.
6. What are the current theories on what is causing global warming? Include at least two **anthropogenic** and at least two natural sources that scientists believe are contributing to the change in the global climate.
7. Describe at least two effects that global warming can have on the **lithosphere, hydrosphere, atmosphere** or **biosphere**, such as changing weather patterns, changes to the types of plants and animals found in an area, etc…

Global Climate Change Scavenger Hunt ANSWER KEY

1. **Define –**
    a. Anthropogenic - caused or produced by humans: anthropogenic air pollution.
    b. Paleoclimatology - The study of climatic conditions, and their causes and effects, in the geologic past, using evidence found in glacial deposits, fossils, and sediments.
    c. Lithosphere - the solid part of the earth consisting of the crust and outer mantle
    d. Hydrosphere - the water on or surrounding the surface of the globe, including the water of the oceans and the water in the atmosphere.
    e. Atmosphere - The gaseous mass or envelope surrounding a celestial body, especially the one surrounding the earth, and retained by the celestial body's gravitational field.
    f. Biosphere - The part of the earth and its atmosphere in which living organisms exist or that is capable of supporting life.
    g. Geologic Time - The period of time covering the physical formation and development of Earth, especially the period prior to human history.
    h. Ecology - the branch of biology dealing with the relations and interactions between organisms and their environment, including other organisms.

2. What is **climate** and how does it differ from **weather**? Climate is the meteorological conditions, including temperature, precipitation, and wind, that characteristically prevail in a particular region. Weather is the state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity, and barometric pressure.

3. Has the global temperature ever been at the same level as it is now? If so, when? Yes, many times it has been as hot or much hotter on Earth is the geologic past. For example, global average temperatures in the early Carboniferous were 68 deg F (20 deg C) compared to global average temperatures today of 54 deg F (12 deg C).

4. What are the **warmest** and **coolest** global temperature geologic time periods? The warmest recorded temperatures occurred in the late Triassic and early Jurassic periods. The kids may also find the **Paleocene-Eocene Thermal Maximum** which would be fine too. The coolest global temperatures occurred in the Ordovician and late Carboniferous periods.

5. Describe at least two ways that scientist study **paleoclimatology**. Ice cores, tree rings, pollen deposits, fossil deposits, isotope ratios, layered sediments, etc.

6. What are the current theories on what is causing global warming? Include at least two **anthropogenic** and at least two natural sources that scientists believe are contributing to the change in the global climate.
   Anthropogenic – Increased production of greenhouse gases (CO2, CH4, CFC's). Deforestation is resulting in decrease of CO2 draw down by photosynthesis.
   Natural – The warming is a consequence of coming out of a prior cool period called the Little Ice Age. The warming is primarily a result of variances in solar irradiance.

Many other possible answers for this one. A pretty well balanced treatment of the issues at Wikipedia:

http://en.wikipedia.org/wiki/Global_warming_controversy

7. Describe at least two effects that global warming can have on the **lithosphere, hydrosphere, atmosphere** or **biosphere**, such as changing weather patterns, changes to the types of plants and animals found in an area, etc…

There are lots of possible answers for this one too. A pretty good list is at:

http://en.wikipedia.org/wiki/Global_warming#Alternative_theories

Resources:

http://www.ngdc.noaa.gov/paleo/globalwarming/what.html
Information on weather, climate, global warming and paleoclimatology background and data.
http://www.envirolink.org/
Multitude of links to information on weather patterns, global warming, climate changes, ecosystem effects
http://www.studyworksonline.com/cda/content/explorations/0,,NAV2-79_SEP630,00.shtml
Information on past climates – activities, references
http://www.studyworksonline.com/cda/content/explorations/0,,NAV2-79_SEP689,00.shtml
Information on the effects of global climate change on birds, weather, hibernation, etc.
http://users.pandora.be/educypedia/education/climatetopics.htm
multitude of links to information on weather, climate,
Glick, D. GeoSigns. *National Geographic Magazine*. Vol. 206(3) pp. 12-34. Sept., 2004.
Miller, K.R. and J.L. Levine. *Biology*, Sixth Edition. Prentice Hall. Needham, Massachusetts 2004

Morell, V. TimeSigns. *National Geographic Magazine*. Vol. 206(3) pp. 56-76. Sept., 2004.
http://earthobservatory.gov/study/volcano
http://www.exploratorium.edu/climate/primer/atmos-p.html
Campbell, N.A., J.B. Reece, and L.G. Mitchell. *Biology*, Fifth Edition. Benjamin Cummings. Menlo Park, California 1999.

Global Climate Change TASK #3

As a research group, share your answers to the scavenger hunt questions and discuss possible areas of research focus within the issue of global warming. Your research task force may choose one of the following, or pick another issue related to global warming that is particularly interesting to your group:

Hurricanes
El Nino Events
Rise in Sea Level
Loss of Glaciers
Change in Where Species are Found
Deforestation
Activity of Sunspots
Change in the Orientation of the Earth's Poles to the Sun

Individually, describe **at least five** cause and effect relationships between global warming and your chosen issue.

As a research group, combine your cause and effect relationship charts to create one with at least 15 examples**.** Make sure that there is no redundancy in your relationships.

Global Warming Board Game TASK #4

In this activity you will be working with your Research team to create a board game. You will need to use your notes, your research materials, your answers to the scavenger hunt questions, your creativity, and your teamwork to complete this assignment. This game will be utilized for two reasons:

1. **to show what you have learned about global warming and its impact on the earth's spheres**

2. **to use as a review game**

Your research team's board game will need to meet the following requirements:

7. **a clear set of rules** – written down so that people can easily play your game
8. ability to be **played by 2 or more people**
9. **a theme** – such as "the Muppets end global warming"
10. cards or questions that will be **used to teach or review the information learned** about global warming
11. a logical and clear **start and finish**
12. **a neat, eye-catching layout**

Step 1: As a team, decide on **the theme** for your game.

Record it here. _____

Step 2: As a team write **the rules** for your game.

Step 3**: as a team,** write the questions/cards for the game.

Step 4: **as a team**, Design and make the board.