History of Earth's Atmosphere

Challenge Question: Has the earth's atmosphere always been the same as it is today?

Objective:
With hands-on activity, discussion and notes, students will demonstration the history of our atmosphere in the form of a timeline.

GLCE:
E.ES.07.11: Describe the atmosphere as a mixture of gases.
E.ES.07.42: Describe the origins of pollution in the atmosphere, geosphere and hydrosphere and how pollution impacts habitats, climatic change and weather.

Activity Overview (from SEPUP):
Students place in chronological order eight cards describing the history of the earth's atmosphere. With these cards they examine the relative amounts of carbon dioxide and oxygen gases at different times in earth's history, and the role of living organisms in determining the composition of the atmosphere.

Background (from SEPUP):
Documenting earth's atmosphere over its geological history is an area of active research. When earth was first formed, its atmosphere (the primordial atmosphere) consisted primarily of hydrogen and helium gas. Because of earth's size and proximity to the sun these gases could not be retained in earth's atmosphere and they escaped into space. Scientists have determined this by comparing the ratio of nitrogen gas to an isotope of neon gas with cosmic ratios. These values indicate that much of the nitrogen in earth's atmosphere was not originally present, and its appearance marked the development of what scientists refer to as earth's "secondary" atmosphere.

The secondary atmosphere began to develop as a result of volcanic activity, and such gases as water vapor and carbon dioxide were predominant. There was no free oxygen. The free oxygen that makes up the modern atmosphere is probably a result of two processes: 1) solar ultraviolet radiation broke water vapor into hydrogen and free oxygen; and 2) photosynthesis by organisms such as cyanobacteria produced free oxygen. It likely took at least 1 billion years for there to be enough oxygen in the atmosphere to cause oxidation of iron sandstones, and more than 2 billion years for high levels of free oxygen to collect in the atmosphere. Earth's present atmosphere continues to depend heavily on the biological processes that replenish free oxygen.

http://teachertech.rice.edu/Participants/louviere/atmos.html

Vocabulary:
Atmosphere: what meteorologists call the air that surrounds the earth

Atmospheric Scientist: scientists who study the atmosphere, from the surface of the earth to several kilometers above
Climatologist: scientists who study earth's climates
Organism: a living thing

Materials:
Atmosphere Cards – 1 set per pair of students (SEPUP kit)
Transparency 64.2, "Composition of Earth's Atmosphere" (SEPUP teacher's manual)
Student handout (see attached)
Student directions for timeline (see attached)
Metric Rulers – 1 per group
Rope (adding machine/cash register paper) – 1 per group
Clips (tape or clothes pins) – 8 per group

Before Lesson:
Make sure there are enough Atmosphere Cards from the SEPUP kit for your class. If not, make copies and laminate. Also, if the timeline is being done in small groups, assemble bags of rope and clips.

Procedure:
See 5-E Lesson Plan attached
Teaching Strategies from SEPUP

Hands-on Connections:
Timeline – Use a rope/register paper 3 meters long. Every billion years = 67 cm and every 500 million years = 33 cm. Atmosphere cards will be clipped/taped along the rope in order and at the correct length. Cards B, H, G, D, A, F can be placed by year and cards E and C place between 4.5 bya and 3.5 bya.

History of Earth's Atmosphere

Challenge:

Activity:

1. Carefully read the information on the Atmosphere Cards.

2. Work with your partner to put the cards in order from oldest to most recent. ***Record your order***:

3. Compare your order with another group. Explain 2 differences you had. Why did you have those differences?

_____

_____

_____

_____

_____

4. Earth's Atmosphere Through Time (correct order)

Card	Gases Present in the Atmosphere (and percentage, if listed)	Important Date and Event

Analysis:

1. Look carefully at your completed table. Use evidence from the table to support your answer.
    a. How has the amount of carbon dioxide gas in the atmosphere changed over the earth's history?

    _____

    _____

    _____

    b. How has the amount of oxygen gas in the atmosphere changed over the earth's history?

    _____

    _____

    _____

2. What effect have living organisms (including people) had on the composition of the earth's atmosphere? Support your answer with examples from this activity?

    _____

    _____

    _____

    _____

3. Reflection: Do you think that the atmosphere will have different amounts of oxygen and carbon dioxide in the future? Explain your reasoning.

    _____

    _____

    _____

    _____

    _____

Atmosphere Cards

A – The modern atmosphere is 78% nitrogen gas, 21% oxygen gas, and less than 1% carbon dioxide gas.	E – The earth was very hot, and there were many erupting volcanoes releasing gases. These gases – water vapor, carbon dioxide, nitrogen, and sulfur dioxide – created the atmosphere. There was no oxygen gas in this atmosphere.
B – The earth is more than 4.5 billion years old. At first, it contained large amounts of hydrogen and helium gases. Most of these gases escaped into space.	F – The amount of carbon dioxide gas in the modern atmosphere is less than 1%, but recent measurements taken at a Hawaiian laboratory show that it is slowly increasing. In 1959, the percentage of carbon dioxide in the atmosphere was 0.0316%. In 2004, it was 0.0377%. This is a 19% increase in the amount of carbon dioxide in the atmosphere. The increased burning of fossil fuels by greater numbers of people is one reason for this change.
C – The earth began to cool down and water vapor condensed into liquid water. Liquid water began to collect on the earth's surface in lakes and oceans. The amount of water vapor in the atmosphere decreased. The atmosphere was about 70% carbon dioxide gas and 30% nitrogen gas	G – About 2-3 billion years ago, some living organisms began to use energy from sunlight to turn carbon dioxide gas and water into sugar and oxygen gas (a process called photosynthesis). The amount of carbon dioxide gas was about 15%, but it began to decrease. The amount of oxygen gas was less than 1%, but it began to grown because of the oxygen produced by living organisms.
D – The first land plants appeared on the earth about 400-500 million years ago. The plants took in carbon dioxide and produced oxygen gas through photosynthesis. The amount of oxygen gas in the atmosphere continued to increase, approaching 21%.	H – A lot of carbon dioxide gas was absorbed by the oceans by about 3.5 billion years ago. This reduced the amount of carbon dioxide in the atmosphere to about 20%.

Assessment Rubric

	Excellent	Satisfactory	Needs Improvement
Analysis Questions Pg. E-75: #1-3	All questions answered correctly and in complete sentences. Each answer provides evidence from activity.	All questions answered correctly and in complete sentences. No evidence from activity supports answer.	All questions answered but not in complete sentences.
Timeline	All cards are placed in the correct order and at correct centimeter marks. Drawings or other descriptions of events included.	All cards are placed in the correct order and at correct centimeter marks.	All cards are placed in the correct order but not at correct centimeter marks.
Challenge Question (CER)	Claim – clearly provides a correct answer that can be supported with evidence from activity Evidence – provides 3-5 pieces of valid evidence from activity or previous activities that relates to claim Reasoning – provides clear explanation linking all pieces of evidence to claim	Claim – provides an answer that can be supported Evidence – provides 1-2 pieces of valid evidence from activity or previous activities that relates to claim Reasoning – provides clear explanation linking some evidence to claim	Claim – provides an answer that is vague and cannot be supported Evidence – provides 1-2 pieces of evidence from activity or previous activities but does not relate to claim Reasoning – provides explanation for some evidence but not linking to claim

History of Earth's Atmosphere Timeline

In your bag you have 3 meters of rope and 8 clips. Your task is to clip the Atmosphere Cards in the correct order at correct centimeter marks, according to dates on the cards. One end of your rope represents 4.5 billion years ago and the other end is present day. In order to get all points possible, each card must have a drawing or further description taped to it.

1 billion years = 67 centimeters and 500 million years = 33 centimeters.

Card	Centimeter Placement
A	_____
B	_____
C	_____
D	_____
E	_____
F	_____
G	_____
H	_____

Aquifer in a Cup

Beth Diekema

I. Standards
   a. E.ES.M.8 Water Cycle – water circulates through the four spheres of the Earth in what is known as the "water cycle."
      i. E.ES.07.41 - Explain how human activities (surface mining, deforestation, overpopulation, construction and urban development, farming, dams, landfills, and restoring natural areas) change the surface of the Earth and affect the survival of organisms.
      ii. E.ES.07.81 – Explain the water cycle and describe how evaporation, transpiration, condensation, could formation, precipitation, infiltration, surface runoff, ground water, and absorption occur within the cycle.
      iii. E.ES.07.82 – Analyze the flow of water between the components of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater.

II. Objective/Benchmark
   a. Through teaching a lesson on aquifers students will participate in discussions and complete the activity with 90% accuracy.
   b. To illustrate how water is stored in an aquifer, how groundwater can become contaminated, and how this contamination ends up in a drinking source. Ultimately, students should get a clear understanding of how careless use and disposal of harmful contaminates above the ground can potentially end up in the drinking water below the ground. This particular experiment can be done by each student at their work station. (taken from objective, http://www.epa.gov/ogwdw000/kids/teachers_4-8.html)
   c. IEP Goal: The students will maintain self control in activities.
   d. Objective: The student will refrain from reacting impulsively 3/5 times.

III. Knowledge Needed / Vocabulary
   a. Knowledge Needed
      i. Students should know the different parts of the water cycle. This will be reviewed by watching the video clip: (http://www.youtube.com/watch?v=0_c0ZzZfC8c&feature=PlayList&p=E6A7CA6A937B9E95&playnext=1&index=4)
      ii. Students will need to fill in the water cycle picture with the correct labels. (see attached worksheet)
      iii. Students will need to be familiar with forming a claim, evidence and reasoning.
   b. Vocabulary
      i. Aquifer – An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.
      ii. Aquitard - Is a bed of low permeability along an aquifer.
      iii. Aquiclude - Is a solid, impermeable area underlying or overlying an aquifer. (also known as a confined aquifer)
      iv. Water Table – the surface of saturated material in an aquifer
      v. Ground water – water supply found under the surface of the ground.
      vi. Surface water – water supply found on the surface of the ground.
      vii. Runoff – the amount of liquid surface substances that move dependent on gravity.

IV. Procedure
   a. Anticipatory Set (Engage)

i. Review the previous lesson on the water cycle. Watch the video on the water cycle, watch the red water molecule travel through the cycle : http://www.youtube.com/watch?v=0_c0ZzZfC8c&feature=fvw
ii. Have student's label the parts of the water cycle while watching the video, the labels will be provided in a word bank.
iii. Teacher Move: "Knowing what we know about the water cycle we have a scenario that we will be examining through evaluation and observation, our first step is identifying the question, then we can move on to making a claim."
iv. Watch the YouTube video: http://www.youtube.com/watch?v=Dh5r8K8CEjk
v. Have students discuss what they think the question should be using accountable talk. ("I agree with_____…" "I'd like to add to what _____ said…" etc.)
vi. As a class, decide upon a question, most likely something like: Is it possible that the contamination in the water in Grand Haven will disappear over time? This is a great example of a misconception that students will be able to explore further. (Explore)
vii. Have students discuss in small groups the evidence that was seen in the video clip in relation to water contamination. (accountable talk discussion)
viii. Have the small groups share with the class to make a list on the board of all of the pieces of evidence seen in the video clip. The following are examples:
    1. Rusty colored sidewalks
    2. Test the water for contamination
    3. State warning was given to residents of Grand Haven
    4. Identified in private irrigation wells, not in the water that is treated for drinking water
    5. Vapors may be in the basements of homes with irrigation wells
    6. Contamination chemical causes cancer

b. Task Analysis: (Explore) This is a student activity that all students will participate in; the goal of the activity is to aid students in making a claim regarding the question of the water contamination found in Grand Haven. (taken from, http://www.epa.gov/ogwdw000/kids/teachers_4-8.html)
c. Method and Materials
    i. Materials – per student
        1. Clear plastic cup
        2. Piece of modeling clay or floral clay
        3. Sand
        4. Aquarium gravel
        5. Red food coloring
        6. Bucket of clean water and small cup
    ii. Go to http://www.epa.gov/ogwdw000/kids/teachers_4-8.html for a diagram and a video segment of step by step instructions.
d. Procedure for Students: (Explore)
    i. Teacher move: "Now that we know some background knowledge of this situation we are going to create an aquifer in a cup, this activity will give you more evidence to include in your claim, evidence and reasoning paper. Listen carefully, you will have specific instructions to follow, and you are being graded on this activity."
    ii. Pass out materials and procedures paper, then student may begin to make their aquifer with teacher assistance.
    iii. Pour ¼" of sand in the bottom of each cup completely covering the bottom of the container. Pour water into the sand, wetting it completely (there should be no

standing water on top of the sand). Let students see how the water is absorbed in the sand, but remains around the sand particles as it is stored in the ground and ultimately forming part of the aquifer.

iv. Have each student flatten the modeling clay (like a pancake) and cover ½ of the sand with the clay (have each student press the clay to one side of the container to seal off that side). The clay represents a "confining layer" that keeps water from padding through it. Pour a small amount of water onto the clay. Let the students see how the water remains on top of the clay, only flowing into the sand below in areas not covered by the clay.

v. Use the aquarium rocks to form the next layer of earth. Place the rocks over the sand and clay, covering the entire container. To one side of your cup, have students slope the rocks, forming a high hill and a valley. Explain to students that these layers represent some of the many layers contained in the earth's surface. Now pour water into your aquifer until the water in the valley is even with your hill. Students will see the water stored around the rocks. Explain that these rocks are porous, allowing storage of water within the pours and openings between them. They will also notice a "surface" supply of water (a small lake) had formed. This will give them a view of both the ground and surface water supplies which can be used for drinking purposes.

vi. Use the food coloring and put a few drops on top of the rock hill as close to the inside wall of the cup as possible. Explain to students that often old wells are used to dispose of farm chemicals, trash and used motor oils and other activities about their aquifer can end up in their drinking water. They will see that the color spreads not only through the rocks, but also to the surface water and into the sand at the bottom of their cup. This is one way pollution can spread throughout the aquifer over time.

vii. Students will need to label the following on their diagram of an aquifer:
   1. Aquifer
   2. Aquiclude
   3. Aquitard
   4. Water table
   5. Lake

e. Assignment (Explain)
   i. Students will need to complete their Claim, Evidence and Reasoning. There should be three – four pieces of evidence explained. This assignment and their diagram of an aquifer will be there grade for the unit.

V. Methods
   a. Discussion (accountable talk)
   b. Modeling / demonstration (teacher moves)
   c. Elmo projector with internet hook-up

VI. Modeling
   a. Students will be shown an example throughout the lesson to ensure correct understanding of the activity.
   b. There will be a teacher demonstration of a larger model to insure full understanding of an aquifer.

VII. Checking for Understanding
   a. How do we contaminate our drinking water?

b. What are some things that we can do to help eliminate contamination of ground water?

VIII. Closure (Expand)

a. Watch the follow up video: http://www.youtube.com/watch?v=O3UAPknYAjM&feature=channel then ask students what they would do if they lived in Grand Haven and had their own ground water well, would they continue to pump the water knowing that it is contaminated or would they stop? (accountable talk discussion)
b. Students will be assigned to write a short paragraph about what they would do if they lived in Grand Haven and had an irrigation well and knew about the contamination of the water.
c. Just for fun: watch the Groundwater video –http://www.youtube.com/watch?v=Wao-8zcRiTA&feature=related students should see a complete recap of the topics that were taught today.

IX. Assessment/Reflection (Evaluation)

a. Student's will be graded by the following rubric:

	Excellent (4)	**Good (3)**	**Satisfactory (2)**	**Needs Improvement (1)**
Water Cycle Worksheet	All parts of the water cycle are correctly labeled with correct spelling	All parts of the water cycle are correctly labeled	Most parts of the water cycle are correctly labeled	None of the parts of the water cycle are correctly labeled
Aquifer in a Cup	the aquifer diagram is correctly made with all parts correctly labeled and spelled correctly	The aquifer diagram is correctly made with all parts correctly labeled	Most parts of the aquifer diagram are made correctly and labeled correctly	The aquifer diagram was not made correctly and is not labeled correctly
Question	The question is written correctly			The question is not written
Claim	Proposes a valid answer to the scientific question	Proposes an answer to the scientific question	The claim is vaguely connected to the scientific question	The claim is not at all connected to the scientific question
	The claim is stated clearly while focusing on one idea	The claim focuses on one idea but the statement could be clearer	The claim is confusing and complicated by including multiple ideas	The claim is not focused on an idea that is relevant to the question
Evidence	All of the evidence presented is directly related to the claim	Most of the evidence presented is closely related to the claim	There is more evidence that is not closely related to the claim than that which is	The evidence is not able to support the claim that was made
	Includes 3-4 pieces of evidence from multiple sources	Includes 2-3 pieces of evidence	Includes 1-2 pieces of evidence	Includes no evidence that can support the claim
Reasoning	Clearly shows a connection between the claim and every piece of evidence	Includes a few connections between the claim and most of the evidence	Did not show the connections between the claim and the evidence	The reasoning didn't connect with the question, the claim or the evidence
	Provides a final statement of conclusion that is clear and convincing	The final statement is present and convincing	The final statement is weak and not convincing	The final statement is not present
Paragraph on Response to Grand Haven	Paragraph includes a clear stance with correct explanation	Paragraph includes a clear stance but isn't supported	Paragraph includes a stance with little support	Paragraph has no clear stance and no support
Totals:				
Final Total:				