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.

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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	_____