

### ***Teaching Activity: Changing Atmospheric Gases***

**Introduction:** Scientists know that the Earth's present atmosphere is quite different from the way it was 4.5 billion years ago. Then data was obtained from oxygen isotope analysis of gases trapped in ice cores, and illustrated the changes in the concentrations of atmospheric gases in the over time. Although the data seems to suggest that some gases decreased to zero per cent, there are actually minute amounts of these gases still present in the modern atmosphere. Also, there were probably small amounts of oxygen present in the air well before oxygen appears in the table. The table presents data from 4.6 billion years ago to the present for four important gases: oxygen, nitrogen, hydrogen and carbon dioxide.

**DATA TABLE: CHANGES IN ATMOSPHERIC GASES-4.6 Byr BP to PRESENT**

<b>GAS</b>	<b>TIME(B yr BP)</b>	<b>% of ATMOSPHERE</b>
OXYGEN	4.6	0
OXYGEN	4	0
OXYGEN	3	0
OXYGEN	2	0.5
OXYGEN	1	12
OXYGEN	P	21
HYDROGEN	4.6	5
HYDROGEN	4	2
HYDROGEN	3	0
HYDROGEN	2	0
HYDROGEN	1	0
HYDROGEN	P	0
NITROGEN	4.6	12
NITROGEN	4	32
NITROGEN	3	60
NITROGEN	2	72
NITROGEN	1	75
NITROGEN	P	78
CARBON DIOXIDE	4.6	75
CARBON DIOXIDE	4	12
CARBON DIOXIDE	3	5
CARBON DIOXIDE	2	1
CARBON DIOXIDE	1	0.005
CARBON DIOXIDE	P	0.0005

**Objective:**

- To create and analyze a line graph of atmospheric gas concentrations over time

**Important Terms:** Oxygen isotope, ice cores, trace amounts, oxygen, nitrogen, hydrogen, carbon dioxide, line graph;

**Materials:** Student Activity Sheet, graph paper, pencil, ruler, colored pencils;

**Procedure:**

1. Read and discuss the Introduction and Data Table on the first page with the class.
  - Be sure that students understand that they are reading from the past to the present.
  - Be sure students understand the numerical forms used in columns 2 and 3 of the table: Ex: 4.6 = 4.6 Billions years before the Present  
0% = none in the atmosphere
2. Tell students that they will be creating a line graph of the information in the Data Table.
  - They should give the graph a title:  
**Changes in Atmospheric Gases- 4.6 B yrs BP to Present**
3. Student should draw and label the axes as follows:
  - X-axis: Billions of Years Ago
  - Y-axis: Percent of the Atmosphere
4. Students should plot the information for each gas by placing a dot with a colored pencil.
  - Use a different colored pencil for each gas.
  - Connect the dots with the same color.
  - Create a key at the bottom indicating the color and the gas it represents.
5. Students should complete the **ANALYSIS/COMPREHENSION** section.

## ***Student Activity Sheet: Changing Atmospheric Gases***

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## Student Activity Sheet

### *Objective:*

- To create and analyze a line graph of atmospheric gas concentrations over time

### *Procedure:*

1. Read and discuss the Introduction and Data Table on the first page with your teacher.
2. You will be creating a line graph of the information in the Data Table.  
Give the graph a title:  
**Changes in Atmospheric Gases -4.6 B yr BP to Present**
3. Draw and label the axes as follows:
  - X-axis: Billions of Years Ago
  - Y-axis: Per cent of the Atmosphere
4. Plot the information for each gas by placing a dot with a colored pencil.
  - Use a different color for each gas.
  - Connect the dots with the same color.
  - Create a key at the bottom of the page indicating the color and the gas it represents.
5. Answer the questions in the **ANALYSIS/ COMPREHENSION** section.

## Student Activity Sheet #1

### ANALYSIS / COMPREHENSION

1. What can be said about the concentrations of the four atmospheric gases you graphed over the past 4.6 B years? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. When did sizable amounts of oxygen appear in the atmosphere? \_\_\_\_\_
3. When did oxygen reach its present level? \_\_\_\_\_
4. What happened to the amount of hydrogen? \_\_\_\_\_
5. What about hydrogen could have caused it to disappear from the atmosphere completely except for very tiny amounts? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. How much nitrogen was probably present in the atmosphere at the time Earth formed? \_\_\_\_\_
7. Would you consider nitrogen a stable element? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
8. What is the present percent of  $CO_2$  in the atmosphere? \_\_\_\_\_
9. For how long was  $CO_2$  a dominant atmospheric gas? \_\_\_\_\_
10. What could you conclude about the Earth's average temperature 4.6 B yrs BP? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
11. If someone told you that living organisms (plants and animals) began to flourish on Earth about 2 B yrs BP, would you be surprised? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Student Activity Sheet #1**

12. Why was there no ozone present in the early atmosphere? Explain. \_\_\_\_\_

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13. Although ozone is not indicated in the graph, when would expect that it level in the atmosphere would have started to increase? Why? \_\_\_\_\_

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14. Why would the formation of ozone have helped living organisms move to the surface from beneath the surface of the ocean? \_\_\_\_\_

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15. If you traveled back in time 3-4 billion years, what type of special equipment would have to take with you? Why? \_\_\_\_\_

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