Teaching Activity: Researching the Earth's Atmospheric Gases

Introduction: The atmosphere that surrounds the Earth today contains the gases necessary for the survival of living things. These atmospheric gases include nitrogen, oxygen, and several trace gases. Nitrogen and oxygen are by far the most abundant, representing 99 percent of the mass of the atmosphere. All the trace gases together make up the remaining 1 percent.

These gases are held close to the Earth's surface by the force of gravity and their density in the atmosphere varies as the distance from the Earth's surface increases. Two crucial atmospheric properties are temperature and pressure. Pressure is highest at the Earth's surface and decreases rapidly with increasing altitude. The temperature variation with height is much more complex. Atmospheric scientists use the inflection points in the temperature profile of the atmosphere to distinguish the different regions for study and reference. The troposphere and the stratosphere are the two most important regions for weather and climate studies and for life on Earth. Both are strongly affected by anthropogenic and natural emissions at the Earth's surface (volcanic explosions, nuclear explosions, solar eruptions, etc.,) The higher levels of the atmosphere are much less affected by influences from below.

Important Terms: Chemical and physical property, pressure, gravity, density, trace gases, troposphere, stratosphere, altitude, spreadsheet, pie chart, greenhouse gas, chemical symbol / formula, boiling / melting point, triatomic, hypothesis;

Materials: Protractor, compass, paper / pencil, colored pencils, ruler, calculator, research materials, computer access;

Objective:

- To research the Earth's atmospheric gases and illustrate that information in spreadsheet format;
- To compute the approximate percentage of the Earth's atmospheric gases by volume;

Procedure:

1. Students should research the 12 main gases found in the Earth's atmosphere using materials available in your classroom or the library.
    a. Include the following information about each gas: Name, chemical symbol or formula, percentage of the atmosphere, boiling point, melting point, atomic mass, atomic number, description and any other pertinent information.

2. Students should create a *spreadsheet format on the computer.
    a. Label each column with the correct title, and fill in the information that they researched on each of the gases.

Spreadsheet: Composition of the Earth's Atmosphere

Name of Substance	Symbol/ Formula	% in Atmos.	Boiling Point	Melting Point	Mass No.	Atomic No.	Description	Additional Information
1)								
2)								
3)								
4)								
5)								
6)								
7)								
8)								
9)								
10)								
11)								
12)								

* If computer access is unavailable, students can create their own spreadsheets or use the blank spreadsheet included with this activity.

3. Using the percentage of each gas in the atmosphere, students should create a pie chart of the main gases.
   a. Calculate the number of degrees required by multiplying the percent of the gas in decimal form by 360 degrees.
      Example: 25% x 360 = .25 x 360 = 90 degrees
   b. Use the protractor to measure the correct number of degrees in the circle.
   c. Label each section of the pie chart with the chemical symbol / formula of the gas and the percent in the atmosphere.
   d. Color each section of the chart a different color.

4. Students should then answer the questions in the **Analysis and Comprehension** section.]

Student Activity Sheet: Researching the Earth's Atmospheric Gases

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These gases are held close to the Earth's surface by the force of gravity and their density in the atmosphere varies as the distance from the Earth's surface increases. Two crucial atmospheric properties are temperature and pressure. Pressure is highest at the Earth's surface and decreases rapidly with increasing altitude. The temperature variation with height is much more complex. Atmospheric scientists use the inflection points in the temperature profile of the atmosphere to distinguish the different regions for study and reference. The troposphere and the stratosphere are the two most important regions for weather and climate studies and for life on Earth. Both are strongly affected by anthropgenic and natural emissions at the Earth's surface (volcanic eruptions, nuclear explosions, solar eruptions, etc.,) The higher levels of the atmosphere are much less affected by influences from below.

Objective:

- To research the Earth's atmospheric gases and illustrate that information in spread sheet format;
- To compute the approximate percentages of the Earth's atmospheric gases by volume;

Procedure:

1. Using the research materials available in your classroom or in the library, research the 12 main gases in the Earth's atmosphere.
   a. Include the following relevant information about each gas: Name, chemical symbol / formula, percentage of the atmosphere, boiling point, melting point, atomic mass, atomic number, description and any other pertinent information.

2. Create a spreadsheet format on the computer.
   a. Label each column and fill in the columns with the information that you researched on each gas.

3. Using the percentages of each gas inn the atmosphere, create a pie chart of the main gases.
   a. Calculate the number of degrees required by multiplying the percent of the gas in decimal form by 360 degrees.
      Example: 25% x 360 = .25 x 360 = 90 degrees
   b. Use your protractor to measure the correct number of degrees.
   c. Color each section of the chart a different color.

4. Answer the questions in the **Analysis and Comprehension** section.

Spreadsheet: Composition of the Earth's Atmosphere

Name of Substance	Symbol/ Formula	% in Atmos.	Boiling Point	Melting Point	Mass No.	Atomic No.	Description	Additional Information
1)								
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7)								
8)								
9)								
10)								
11)								
12)								

Analysis and Comprehension Section:

1. Which gas is found in greatest abundance in the Earth's atmosphere? The least abundance? _____

2. Which of the gases is the result of plant respiration? Why is it so important?

   _____

   _____

3. Which of the trace gases is added to the atmosphere by animal respiration?

   _____

4. Hypothesize about what would eventually happen to the amounts of gases in the atmosphere is the energy from the Sun were blocked by increased cloud cover. (List the sequence in which these events would occur.) _____

   _____

   _____

   _____

   _____

5. How would life on Earth be affected by the event you predicted in your response to #4 above? _____

   _____

   _____

   _____

6. Why is the triatomic form of oxygen so important to life on Earth?

   _____

   _____

   _____

7. Some scientists think that complex life forms on Earth did not develop until the formation of the ozone layer. Why is this a logical assumption to make?

   _____

   _____

   _____

8. Which of the trace gases are considered to be "greenhouse gases"? Why?

   _____

   _____

9. What physical or chemical property of carbon dioxide makes it such an important greenhouse gas?_____

   _____