Draw a Cross-section of Earth's Atmosphere

Overview:

Students graph data as a means to visualize the locations of atmospheric layers, items in the atmosphere (e.g., satellites, clouds, Mt. Everest), and auroral layers.

Objectives:

The student will:

- hypothesize the distance from the summit of Mt. Everest to magenta auroras;
- graph atmospheric layers, items in the atmosphere, and auroral layers; and
- compare locations of atmospheric layers, items in the atmosphere, and auroral layers.

Materials:

- Calculator
- Colored pencils
- STUDENT WORKSHEETS: "Draw a Cross-section of Earth's Atmosphere"

Activity Procedure:

1. Explain that students will examine the relationship between atmospheric layers, items in the atmosphere (e.g., satellites, clouds, Mt. Everest) and auroral layers.
2. Distribute and review the information and procedures on STUDENT WORKSHEET: "Draw a Cross-section of Earth's Atmosphere."
3. When students have finished the worksheet, discuss students' conclusions.

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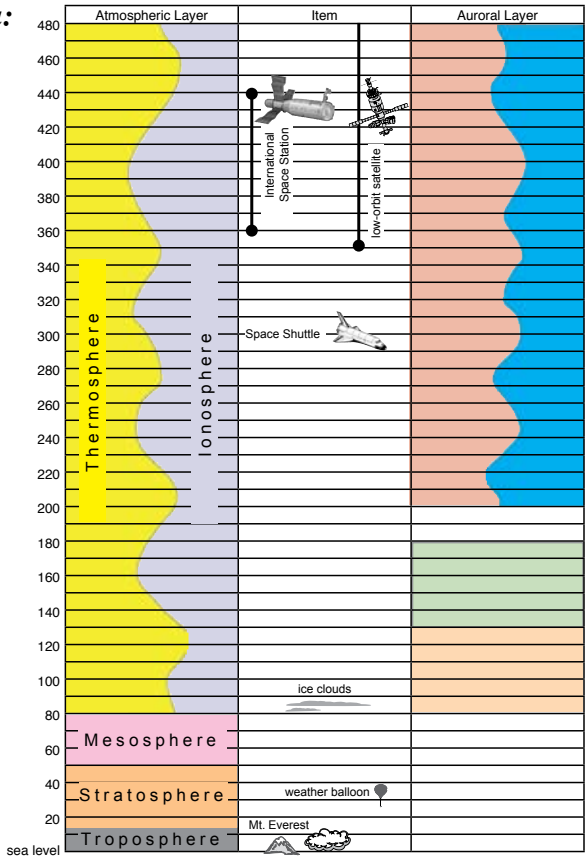
Answers to Student Worksheet:

Data:



Analysis of Data:

1. troposphere
2. troposphere
3. Space Shuttle, International Space Station, and low-orbit satellite

Conclusion:

1. 71.2 kilometers
2. Answers will vary.

Further Questions:

tropo- = change or turn	*temp = -25˚ C to -60˚ C (-13˚F to -76˚F)*
strato- = layer	*temp = -60˚ C to 0˚ C (-76˚F to 32˚F)*
meso- = middle	*temp = -80˚ C to 0˚ C (32˚F to -112˚F)*
thermo- = heat	*temp = -80˚ C to 30˚ C (-112˚F to 5,432˚F)*

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Testable Question:

How close can a person get to the aurora while still standing on Earth?

Background Information:

Modeling something by making a smaller scale version often can be helpful in gaining a better understanding about it, while ensuring the proportions of its various parts stay intact. Drawing to scale a cross-section of Earth's atmosphere will help answer how close a person can get to the aurora while standing atop Mount Everest, Earth's highest point, if it was below the aurora oval.

Hypothesis:

A person standing on Mount Everest, Earth's highest point, can get within _____ kilometers of the aurora, if it was below the aurora oval.

Experiment:

Materials:

- Calculator
- Colored pencils
- STUDENT WORKSHEET: "Draw a Cross-section of Earth's Atmosphere"

Procedure:

1. Draw a heavy line along the bottom of the graph to represent Earth's surface. Label the line "sea level."
2. Each line on the graph measures ½ centimeter. To fit a cross-section of the atmosphere on the paper, each line will represent a height of 10 kilometers. Mark the side of the graph paper in 20 kilometer increments; start with 0 kilometers at "sea level" on the bottom line.
3. Use the information from the "Data" section to complete the graph.

Data:

Enter the data on the following sheet in the appropriate column on the graph found on page 3.

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Atmospheric Layers:

Earth's atmosphere is classified into four layers, which are defined according to temperature changes in the atmosphere: troposphere, stratosphere, mesosphere and thermosphere. The ionosphere is actually part of the thermosphere and is located in the lower elevation of the thermosphere, where energy from solar particles causes molecules to become charged, forming ions (and the ionosphere). In this activity, both the ionosphere and the thermosphere will reach the top of the paper. (NOTE: In reality, the thermosphere extends beyond where the ionosphere ends.) Use the color noted in the table to signify each layer.

Atmospheric Layer	Color	Approximate Altitude in kilometers
Troposphere	gray	0-12 kilometers
Stratosphere	orange	12-50 kilometers
Mesosphere	red	50-80 kilometers
Thermosphere	yellow	80 kilometers and above
Ionosphere	blue	80-550 kilometers

Items in the Atmosphere:

Draw and label the following items within the second column of the graph. (NOTE: Low-orbit satellites can exist in the atmosphere far beyond what is included in the scale drawing.)

Item in the Atmosphere	Altitude in kilometers
Mount Everest	8.8
Cumulus, stratus & cirrus clouds	3 - 12
Ice clouds	82
Commercial airliner	10
Weather balloons	30
Space shuttle	300
International Space Station	361 - 437
Low-orbit satellites	350 - 800

Auroral Layers:

Draw and label the aurora on your cross-section of the atmosphere, making sure to use red, magenta, green and blue to signify the different auroras.

Auroral Layer	Approximate Altitude in kilometers
Magenta auroras	80-120
Green auroras	120-180
Red auroras	200-600
Blue auroras	200-600

Atmospheric Layer	Items	Auroral Layer

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Analysis of Data:

1. In which atmospheric layer do we live? _____

2. In which atmospheric layer is Mt. Everest located? _____

3. Which items are located in the ionosphere/thermosphere?

   _____

   _____

   _____

Conclusion:

1. If the aurora oval were hovering over Mt. Everest, and if you were on top of Mt. Everest, how close could you be to a magenta aurora? _____

2. Explain how you know? _____

   _____

   _____

Further Questions:

1. Find the root meaning of each layer (tropo-, strato-, meso-, thermo-) and the temperature range of each layer. Add this information to your scale drawing.

Root Word	Meaning of Root Word	Temperature Range of Layer
tropo-		
strato-		
meso-		
thermo-		

2. The space shuttle flies about 200-250 miles above Earth. Think of a place 250 miles from your current location. Using the scale on a globe, mark off 250 miles on a small piece of paper or toothpick. Stand the paper or toothpick up so it is perpendicular to the globe to visualize the height that the shuttle orbits Earth. Using a new piece of paper and your globe, demonstrate the altitude of Earth's layers like you did with the space shuttle.

