

Layers of the Atmosphere

Objective

To discover how the atmosphere can be divided into layers based on temperature changes at different heights by making a graph.

Background

The atmosphere can be divided into four layers based on temperature variations. The layer closest to Earth is called the troposphere. Above this layer is the stratosphere, followed by the mesosphere, then the thermosphere. The upper boundaries between these layers are known as the tropopause, the stratopause, and the mesopause, respectively.

Temperature variations in the four layers are due to the way solar energy is absorbed as it moves downward through the atmosphere. Earth's surface is the primary absorber of solar energy. Some of this energy is reradiated by Earth as heat, which warms the overlying troposphere. The global average temperature in the troposphere rapidly decreases with altitude until the tropopause, the boundary between the troposphere and the stratosphere.

The temperature begins to increase with altitude in the stratosphere. This warming is caused by a form of oxygen called ozone (O₃) absorbing ultraviolet radiation from the sun. Ozone protects us from most of the sun's ultraviolet radiation, which can cause cancer, genetic mutations, and sunburn. Scientists are concerned that human activity is contributing to a decrease in stratospheric ozone. Nitric oxide, which is the exhaust of high-flying jets, and chlorofluorocarbons (CFCs), which are used as refrigerants, may contribute to ozone depletion.

At the stratopause, the temperature stops increasing with altitude. The overlying mesosphere does not absorb solar radiation, so the temperature decreases with altitude. At the mesopause, the temperature begins to increase with altitude, and this trend continues in the thermosphere. Here solar radiation first hits Earth's atmosphere and heats it. Because the atmosphere is so thin, a thermometer cannot measure the temperature accurately and special instruments are needed.

Questions – Complete the graph on the back of this sheet before answering the questions. Then use the graph below to answer the questions.

1. What is the basis for dividing the atmosphere into four layers?

2. Does the temperature increase or decrease with altitude in each layer?

a. Troposphere _____	c. Mesosphere _____
b. Stratosphere _____	d. Thermosphere _____
3. What is the approximate height and temperature of each atmosphere layer division?

(Height)	(Temperature)
a. Tropopause _____	_____
b. Stratopause _____	_____
c. Mesopause _____	_____
4. What causes the temperature to increase with height through the stratosphere and decrease with height through the mesosphere?
5. What causes the temperature to decrease with height in the troposphere?
6. Determine which layer of the atmosphere has the greatest temperature range.
7. Describe temperature changes in the stratosphere. Why do they do this?
8. Explain how cloud cover can influence temperature in the lower atmosphere.

Directions

1. Table 1 contains the average temperature readings at various altitudes in Earth's atmosphere. Plot this data on the graph on the worksheet, and connect adjacent points with a smooth curve. Be careful to plot the negative numbers correctly. This profile provides a general picture of temperature at any given time and place; however, the actual temperature may deviate from the average values, particularly in the lower atmosphere.
2. Label the different layers of the atmosphere and the separating boundaries between each layer.
3. Mark the general location of the ozone layer. You should place eight words on your graph in the correct locations: troposphere, tropopause, stratosphere, stratopause, mesosphere, mesopause, thermosphere, and ozone layer.

Table 1. Average Temperature Readings at Various Altitudes

Altitude (km)	Temperature (°C)	Altitude (km)	Temperature (°C)	Altitude (km)	Temperature (°C)
0	15	40	-22	75	-65
5	-18	45	-8	80	-79
10	-49	48	-2	84	-86
12	-56	52	-2	92	-86
20	-56	55	-7	95	-81
25	-51	60	-17	100	-72
30	-46	65	-33		
35	-37	70	-54		

Graph of Temperatures at Various Altitudes

