

Layers of the Atmosphere

Name _____
Date _____ Per _____

Objective: To graph and learn how the atmosphere can be divided into layers based on temperature changes at different heights.

Background:

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

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

The temperature increases with altitude in the stratosphere. This warming is caused by a form of oxygen called ozone (O_3) 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. Some scientists are concerned human activity may lead to a decrease in stratospheric ozone. Nitric oxide, which is the exhaust from high flying jets, and CFC's (chlorofluorocarbons), which are used as refrigerants, may contribute to ozone depletion.

At the stratopause, the temperature stops increasing with altitude. Above the stratosphere, the temperature decreases with altitude because the mesosphere does not absorb solar radiation. At the mesopause, the temperature begins to increase again with altitude, and this trend continues in the thermosphere. The thermosphere is heated as the sun's solar energy first hits the Earth's atmosphere. Here, the atmosphere is so thin a thermometer cannot measure the temperature accurately and special instruments are needed.

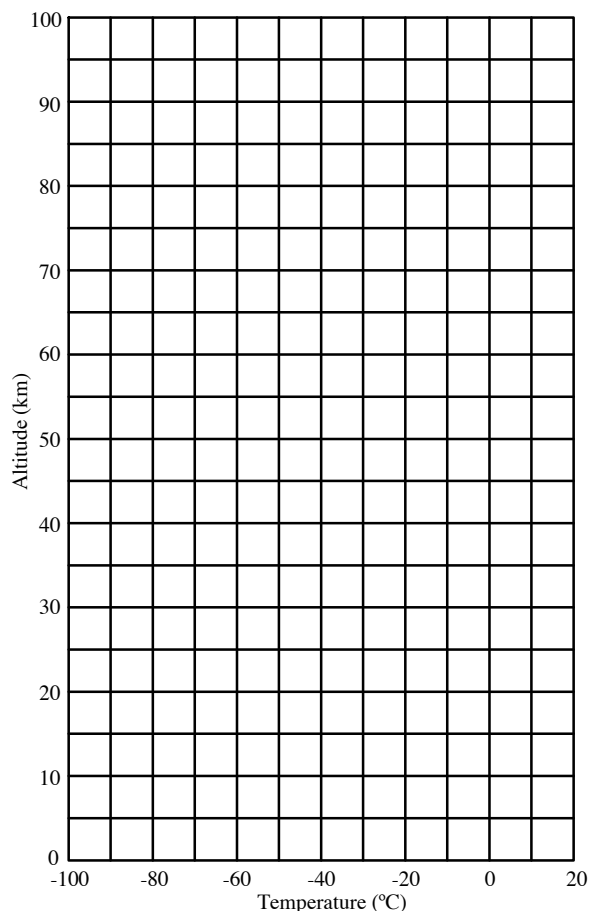
Directions:

1. Table 1 contains the average temperature readings at various altitudes in the Earth's atmosphere. Plot this data on the graph and connect adjacent points with a smooth curve. Be careful to plot the negative temperature numbers correctly. This profile provides a general picture of temperature at any given time and place; however, actual temperatures may deviate from the average values, especially in the lower atmosphere.

2. Label the layers of the atmosphere (troposphere, stratosphere, mesosphere, and thermosphere) and the separating boundaries (tropopause, stratopause, and mesopause) between each layer.

3. Mark the general location of the ozone layer.

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



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Questions:

1. What is the basis for dividing the atmosphere into four layers?
2. Does the temperature increase or decrease with altitude in the:
troposphere _____ stratosphere _____
mesosphere _____ thermosphere _____
3. What is the approximate height and temperature of the:
tropopause _____
stratopause _____
mesopause _____
4. What causes the temperature to increase with height through the stratosphere?
5. What causes the temperature to decrease with height through the mesosphere?
6. What causes the temperatures in the lower troposphere to be warmer?
7. Which layer of the atmosphere is the closest to the Earth?
8. Which layer is the farthest away?
9. Which atmospheric layer contains the coldest temperatures?
10. Which atmospheric layer has the highest temperatures?
11. Approximately how thick is the Earth's atmosphere?
12. Which layer(s) contains the ozone layer?
13. What happens to the temperature at the tropopause?
14. Which layer contains clouds, wind, rain, snow and most weather patterns?
15. Which layer is the densest?
16. Draw the examples given below in the graph to show where each of them would be located
Mount Everest: (8 km) Meteors:
Weather balloon: (47.6 km) A flock of geese:
Spacecraft orbiting: (243 km) Jet airplane:
Altostratus clouds: (1.8 km)