**Graphing the Atmosphere**

# Atmospheric Composition

The atmosphere is made up of many different gases, and the amount of each type of gas present depends on what layer of the atmosphere you’re talking about. Near the Earth’s surface, the atmosphere is made up of 78% nitrogen, 21% oxygen, and 1% other gases. (These other gases include mostly argon and water vapor, with some carbon dioxide, and trace amounts of others.)

You will be using the above information to construct a pie graph below, but before you start drawing, you will need to calculate how many degrees are represented by each percentage. **Show your factor‐label work for at least one of these calculations in the extra space on this page.** (For factor‐label, just remember that 100 percent = 360 degrees.) Your graph should show percentage nitrogen, oxygen, and other gases. **Make sure that your graph includes a title, labels of gas name and % for each pie piece, and correctly‐sized pie pieces, each colored a**

**different color.** To help you, the template for your pie graph is given below, with 10o pieces already marked.



**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 the 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. The Earth’s surface is the primary absorber of solar energy. Some of this energy is reradiated by the 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 the Earth’s atmosphere and heats it. Because 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 on the worksheet, 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, the actual temperature may deviate from the average values, particularly in the lower atmosphere.

# TABLE 1

Average Temperature Readings at Various Altitudes

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

1. Label the different layers of the atmosphere and the separating boundaries between each layer.
2. 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.

# 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?

1. What is the approximate height and temperature of the: tropopause:

stratopause:

mesopause:

1. What causes the temperature to increase with height through the stratosphere, and decrease with height through the mesosphere?
2. What causes the temperature to decrease with height in the troposphere?

# Graph of Temperature at Various Altitudes

ALTITUDE (km above sea level – Y-axis)

100

95

90

85

80

75

70

65

60

55

50

45

40

35

30

25

20

15

10

5

0

-100 -90 -80 -70 -60 -50 -40 -30 -20 -10 -5 0 10 20

Temperature (oC)