

Virtual Ballooning Student Activity Sheet

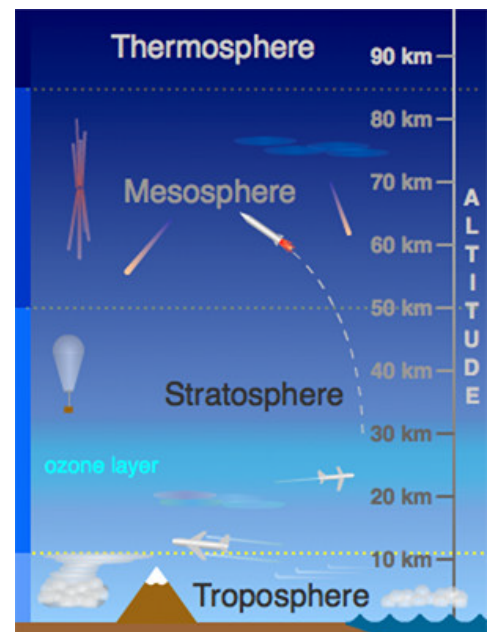
Virtual Ballooning to Explore the Atmosphere

Mission: You are the leader of a team of atmospheric scientists. Your mission is to explore Earth's atmosphere using instruments carried into the sky by a balloon. *Your instruments will measure altitude, air pressure, and temperature.*

The lightweight batteries in your instrument package are not very strong. They only have enough charge to power the balloon's radio transmitter a few times. On each balloon flight, you will only be able to collect data at four different altitudes. However, you will be able to launch a total of four balloons.

You will be able to plan where the balloon's instruments start and stop collecting data (the low sample and high sample altitudes) on each flight. Use your first flight to look for patterns in how the pressure and temperature changes with altitude. This information can help you decide what settings to use in later flights.

Background: It may seem odd to think of Earth's atmosphere as having layers, but scientists know that it does. The layer closest to the ground is called the troposphere. The layer above that is called the stratosphere. Above the stratosphere is the mesosphere, and above that is the thermosphere. At certain altitudes, the pressure or temperature (or both!) changes suddenly. Those altitudes are the boundaries or borders between layers. Keep an eye on your data, looking for sudden changes that indicate a boundary between atmospheric layers. Keep in mind that there is a limit to how high balloons can fly; your balloon may not be able to reach all of the layers of the atmosphere. Now you are ready to launch balloons!



Step-by-step Instructions

- Go to the Virtual Ballooning website: scied.ucar.edu/interactive/virtual-ballooning
- Select "Layers of the Atmosphere" (not "Explore the Troposphere").
- Set your data collection points.** Move the red "low sample" arrow to the altitude where you want to start recording data. Move the red "high sample" arrow to the altitude where you want to stop recording data. By moving the arrows you can control the distance (altitude) between data points. The dotted lines indicate where data will be recorded during each balloon flight - a total of four data points per flight.
- Launch a balloon.** When you are happy with your sample settings, click the "Launch Balloon" button. The balloon will rise, collecting and graphing data along the way.
- Launch another balloon.** You can launch a total of four balloons. Click "New flight" to load another balloon. Adjust the data collection points (the low and high sample locations) between each flight to collect data from different altitudes. When you are ready, click the "Launch balloon" button. New data will appear as the balloon rises.
- Select which data to view.** Temperature and air pressure is measured for each flight. You can switch between viewing a graph of temperature vs. altitude and a graph of pressure (in millibars) versus height by clicking the "Temperature" button or the "Air Pressure" button.
- Repeat these steps for flights 3 and 4. Remember, you only get 4 flights!
- To reset the program, select the circular arrow button next to the home button below your graph. You might want to take a few test flights to help you plan your data collection.

Use the Virtual Ballooning program to fill in the tables below.

Air Pressure

Notice how air pressure changes as altitude increases. The top of Mt. Everest is about 10 km above sea level. Air pressure at sea level (0 km) is about 1,013 millibars.

What is the air pressure (in millibars) at the top of Mt Everest?	
Write the air pressure at the top of Everest as a percentage of air pressure at sea level.	
At what altitude has the air pressure dropped to 50% (half) of air pressure at sea level (1,013 millibars)?	

Layers of the Atmosphere

Look for sudden changes in pressure and/or temperature as you rise through the atmosphere. These changes often indicate a transition, or pause, from one layer to the next. These areas are given a special name. For example, the boundary between the troposphere and the stratosphere is called the *tropopause*. The boundary between the stratosphere and the mesosphere is called the *stratopause*. And the boundary between the thermosphere and space is called the *thermopause*.

Collect data from your virtual balloon launches to fill in the table below. Remember that your balloon may not reach all of the layers of Earth's atmosphere. You may need to leave some boxes blank.

Boundary	Altitude (km)	Temperature (°C)	Pressure (millibars)
Tropopause (top of the troposphere)			
Stratopause (top of the stratosphere)			
Mesopause (top of the mesosphere)			
Thermopause (top of the thermosphere)			

Summarize your data

Use the space below to write a sentence that describes how **air pressure** changes as **altitude** increases. Write another sentence that describes how **temperature** changes as **altitude** increases for each layer that you detected.