**Balloon Ride through the Atmosphere Online Lab**

**Names: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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 pressure and temperature data at **four** different altitudes. However, you will be able to launch four balloons; so you will be able to take as many as 16 temperature, pressure, and altitude readings.

Before each balloon flight, you will set: 1) the altitude at which the balloon's instruments will start collecting data, and 2) the distance (altitude) between readings. For example: you might choose to start collecting data at an altitude of 5 km, and take readings every 2 km. Since you get four readings per flight, these settings would cause the balloon's instruments to measure temperature and pressure at altitudes of 5 km, 7 km, 9 km, and 11 km above sea level.

**You will need to plan carefully to collect the data you need to see how pressure and temperature change with altitude. You should also take a look at patterns you see in your first flight to help you decide where you need more data. That information can help you decide what settings to use in later flights.**

Are you ready to start launching balloons?

**Step-by-step Instructions**

|  |  |  |
| --- | --- | --- |
| **Flight #** | **Start Recording Altitude** | **Altitude Interval** |
| **1** |  |  |
| **2** |  |  |
| **3** |  |  |
| **4** |  |  |
| **5** |  |  |
| **6** |  |  |

Start up the software. Go to the following web page: www.windows.ucar.edu/earth/Atmosphere/balloon\_atmostrata.html

1. Click the "Play Game" button.
2. About halfway down on the left side is a popup menu for setting the "Start Recording Altitude". This is the height at which your balloon will **begin to record** data. Choose a value from the popup menu.
3. Just below that is the "Altitude Recording Interval" popup menu. That sets the distance (altitude) **between** data points. Choose a value from the menu.
4. When you are happy with your settings, click the "Launch Balloon" button near the top of the screen.
5. The balloon will rise, collecting and graphing data along the way.
6. Click the "Show Pressure" and "Show Temperature" buttons (along the bottom) to switch between graphs.
7. To plan a second flight, click the "New Flight" button. Take a look at your graphs. Where do you need more data?
8. Select new values for the "Start Recording Altitude" and "Altitude Recording Interval". When you're ready, click the "Launch Balloon" button to start your second flight.
9. Repeat these steps for flights 3 and 4. Remember, you only get 4 flights!
10. Answer the questions and fill in the tables below.

**Questions:**

1. The top of Mt. Everest is about 10 km above sea level. Air pressure at sea level is about 1,013 millibars.

|  |  |
| --- | --- |
| What is the air pressure (in millibars) at the top of Everest? |  |
| What % of sea level air pressure is that? |  |
| What is the temperature at the top of Everest? |  |

|  |  |
| --- | --- |
| 1. At what altitude has the air pressure dropped to 50% (half) of air pressure at sea level (1,013 millibars)? | \_\_\_\_\_\_\_\_\_\_\_\_\_ |

1. Can you see any sudden changes in the way pressure and/or temperature change with altitude? \_\_\_\_\_\_\_\_\_ Those altitudes could be the boundaries between layers of the atmosphere. The boundaries between layers have names:
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (the boundary between the top of the troposphere and the bottom of the stratosphere)
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (the boundary between the top of the stratosphere and the bottom of the mesosphere)
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (the boundary between the top of the mesosphere and the bottom of the thermosphere)
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (the boundary between the top of the thermosphere and the bottom of the exosphere)
6. Remember, your balloon may not reach all of the layers of Earth's atmosphere. Fill in as much of the table below as you can.

|  |  |  |  |
| --- | --- | --- | --- |
| **Boundary** | **Altitude (km)** | **Temperature (° C)** | **Pressure (mbars)** |
| Tropopause (top of troposphere) |  |  |  |
| Stratopause (top of stratosphere) |  |  |  |
| Mesopause (top of mesosphere) |  |  |  |
| Thermopause (top of thermosphere) |  |  |  |

1. Fill in the table below for each layer you detected:

|  |  |  |
| --- | --- | --- |
| **Atmosphere Layer** | How does pressure change as altitude increases? | How does temperature change  as altitude increases? |
| **Troposphere** (lowest layer, starting at sea level) |  |  |
| **Stratosphere** (layer above the troposphere) |  |  |
| **Mesosphere** (layer above the stratosphere) |  |  |
| **Thermosphere** (layer above the mesosphere) |  |  |