What is the structure of Earth’s atmosphere?

The atmosphere is the air surrounding Earth, from the surface of the planet to outer space. It is a mixture of gases with some suspended liquids and solids. The atmosphere is composed of several layers, each with unique characteristics.

The layer of the atmosphere closest to Earth is called the troposphere. It extends from the surface of Earth to an altitude of 10-16 kilometers above sea level. The troposphere is the only layer of the atmosphere that contains a mixture of gases that supports life on Earth. Temperature in the troposphere are warmest at low altitudes, in part because Earth’s surface absorbs solar radiation and transfers it to the surrounding air.

Beyond the troposphere is the stratosphere. The stratosphere extends from approximately 11 kilometers above sea level to approximately 50 kilometers above sea level. Temperatures in the lower part of the stratosphere are extremely cold, due to the presence of jet streams – curving paths of strong wind with speeds ranging from 97-185 kilometers per hour. Commercial airliners and some hot air balloons travel in the lower stratosphere, often making use of jet streams to save time and fuel. Temperatures increase with altitude in the stratosphere. Scientists attribute these temperature changes to the presence of the ozone layer. When ozone molecules absorb solar radiation, they begin to move faster heating the air around them.

Beyond the stratosphere is the mesosphere, extending from approximately 51-80 kilometers above sea level. The mesosphere is characterized by a drastic decrease in temperature. Temperatures as low as -1430C have been recorded in the mesosphere.

Beyond the mesosphere is the thermosphere, the widest layer of Earth’s atmosphere. The thermosphere extends from approximately 81-to 500 kilometers above sea level. Temperatures increase with altitude in the thermosphere. At the top of the thermosphere, temperatures can reach 19820C. These extreme temperatures result when oxygen molecules near the top of the thermosphere absorb short-wave ultraviolet radiation from the sun.

The uppermost layer of Earth’s atmosphere is called the exosphere. It extends from approximately 500 kilometers above sea level to outer space. If you traveled upward through the exosphere, you would encounter fewer and fewer molecules and ions until you would be out of Earth’s atmosphere and in space. There is no exact boundary between the atmosphere and space.

In this Virtual Lab you will investigate the structure of Earth’s atmosphere. You will collect atmospheric pressure, density, and temperature data for various altitudes and observe the types of meteorological astronomical phenomena that occur in the layers of Earth’s atmosphere.

Objectives:

* Describe the structure of Earth’s atmosphere
* Investigate temperature, density, and pressure changes in layers of Earth’s atmosphere.
* Identify meteorological and astronomical phenomena that occur in layers o Earth’s atmosphere.

Procedure: Prepare a Data Table … See below

1. Record in the Table the Atmospheric Data – Density, Pressure, and Temperature at sea level (at 0 km)
2. Drag the red slider along the altitude measurement bar and select another altitude.
   1. If you select an altitude less than 30km above sea level, a balloon will appear.
   2. If you select an altitude greater than 30 km above sea level, a rocket will appear. (Rockets are used to collect atmospheric data at altitudes greater than 30 km above sea level because the low atmospheric pressure at high altitudes causes balloons to burst.)
3. Click the Launch button to launch the balloon or rocket.
4. Observe the balloon or rocket being launched into Earth’s atmosphere, peaking at the selected altitude, and then returning to Earth by parachute.
   1. Record the Atmospheric Data in the Table.
5. If the Show Phenomenon button is enabled, click it to learn about a meteorological or astronomical phenomenon that occurs at or near the selected altitude.
   1. To see the phenomenon again, click its label.
6. REPEAT the Virtual Lab until you have collected data for each of the eleven (11) altitudes. As you collect data, watch for trends in atmospheric pressure, density, and temperature within the four layers of Earth’s atmosphere.
7. Click the Reset button to start over.
8. Answer the Journal Questions.

Data Collection: Prepare a Data Table like the one shown below……

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Altitude (km) | Density (% of Sea Level) | Pressure (Pa) | Temperature (0C) | Phenomenon |
| 0 |  |  |  |  |
| 5 |  |  |  |  |
| 10 |  |  |  |  |
| 25 |  |  |  |  |
| 50 |  |  |  |  |
| 60 |  |  |  |  |
| 75 |  |  |  |  |
| 100 |  |  |  |  |
| 150 |  |  |  |  |
| 200 |  |  |  |  |
| 400 |  |  |  |  |

Journal Questions:

1. Which layer of the atmosphere do you live in?
   1. What kinds of meteorological phenomena can be found in this layer?
2. If a rocket were launched to a height of 210 kilometers above sea level, which layer of the atmosphere would it rise to?
   1. What kinds of meteorological and astronomical phenomena might the rocket encounter in that layer?
3. What is the ozone layer?
   1. In which layer of the atmosphere is it found
   2. What is the importance of the ozone layer to life on Earth?
4. Describe the pattern of air density changes within layers of the atmosphere.
   1. Describe the pattern of air pressure changes within layers of the atmosphere.
   2. What is the relationship between air density and air pressure?
5. Describe the pattern of temperature changes within the layers of the atmosphere.
   1. Why do you think temperature changes follow this unique pattern?