Mr. Mayorga’ Presentation:
“Exploring the Earth’s Weather: An Introduction”

THE ATMOSPHERE

Section 3-1
An Introduction to Meteorology

Meteorology

- The study of the Earth’s atmosphere and its weather.
- Meteor- “high in the air” + -logy “study of”
- Weather vs. Climate

The Atmosphere

An atmosphere is a mixture of gases and particles that surrounds a planet.

Functions of the atmosphere:
- Supports life
- Protects against harmful radiation (e.g., gamma rays, x-rays, and ultraviolet rays) and meteors
- Traps heat and distributes it to keep the planet warm
- Holds moisture

Atmospheric Composition

The atmosphere is made up of nitrogen, oxygen, carbon dioxide, water vapor, and many other gases, as well as particles of liquids and solids.

<table>
<thead>
<tr>
<th>Gas in Dry Air</th>
<th>Percentage by Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Other Gases</td>
<td>32%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>78%</td>
</tr>
<tr>
<td>Oxygen</td>
<td>21%</td>
</tr>
</tbody>
</table>

Atmospheric Structure

Scientists divide the atmosphere into six different layers based on their...
- Temperature Changes
- Chemical Composition
- Movement
- Density

Troposphere
- Stratosphere
- Ozonosphere
- Mesosphere
- Thermosphere
- Ionosphere
- Exosphere
- Magnetosphere

The Troposphere

- 8-20 km above the surface
- The densest layer (75% of the total mass) of the atmosphere
- Has all the factors that make up our daily weather: heat energy, air pressure, winds, and moisture

10-mile troposphere
**The Troposphere (2)**
- Coldest at the top, about −50°C, (−55°C at the poles), but warmer as you get near the surface
  - An average of 6.5°C per kilometer—This is known as the “Environmental Lapse Rate”
- The «tropopause» marks the end of the troposphere.
  - Isothermal region or boundary between the troposphere and the next layer

**The Stratosphere**
- From the tropopause (top of troposphere) to about 50 km
- Is clear, dry and less dense
- Has strong, steady winds and few weather changes
- Is where jet airplanes fly
- Holds 19% of the atmosphere

**The Ozonosphere**
- A separate layer within the stratosphere; the ozonosphere
- Absorbs some of the Sun’s ultraviolet rays (UV), which heat up the layer
- Has various concentrations between the altitudes of 10 to 50 kilometers

**The Mesosphere**
- Up to about 80-85 km (50-53 miles)
- Contains extremely thin air (0.1% of the atmosphere)
  - Most meteors burn up here
- Becomes colder as you increase in altitude
  - It is the coldest at the top; ranging between −93°C and −100°C. This region is called the mesopause

**The Thermosphere**
- Extends to about 600 km (372 mi) high
- Contains gases such as N₂ and O₂; atoms that absorb UV and X-ray solar radiation, and so heat up this layer
- Increases in temperature as you increase in altitude (1700°C-2000°C at the top)
- Is the hottest layer of the atmosphere
The Ionosphere
- The area of the atmosphere between 65 km (40 mi) and 500 km (310 mi) above the Earth
- Stretches from the upper mesosphere to the middle-upper of the thermosphere
- Has ions that are formed when UV rays from the sun knock electrons (e⁻) off oxygen atoms.

The Ionosphere Also...
- Each of its four layers reflect and absorb radio waves, allowing us to receive shortwave radio broadcasts in New Zealand from other parts of the world.

The Aurora Borealis

The Exosphere
- Contains extremely thin air as well as very few gases
- Has its top layer at about 900 km (560 miles) above the ground
- Contains some polar orbiting weather satellites

The Magnetosphere
- The uppermost layer of the atmosphere
- Contains no gases, but forms a barrier which stops many space particles from entering the Earth's atmosphere
- Traps electrons (e⁻) and protons (p⁺) and concentrates them into two bands known as “the Van Allen radiation belts” (about 3,000 and 16,000 km above the globe)
- Most weather satellites are found way up beyond it.
Altitude vs. Temperature in the Troposphere

- What is the Environmental Lapse Rate?
- What would be the temperature at a height of 18 km if the temperature at the surface of the earth is 25°C?
- Using the laptops, show how you arrive at your answer.

What would be the temperature at a height of 18 km if the temperature at the surface of the earth is 25°C?

Using the laptops, show how you arrive at your answer.

What two variables are being graphed? In what unit is each measured?

What is the temperature at the bottom of stratosphere?

Atmospheric Altitude vs. Temperature

- What happens to the temperature and the pressure as you go up through the different layers of the atmosphere?

Atmospheric Comparison

http://www.ucar.edu/learn/1_1_2_1t.htm