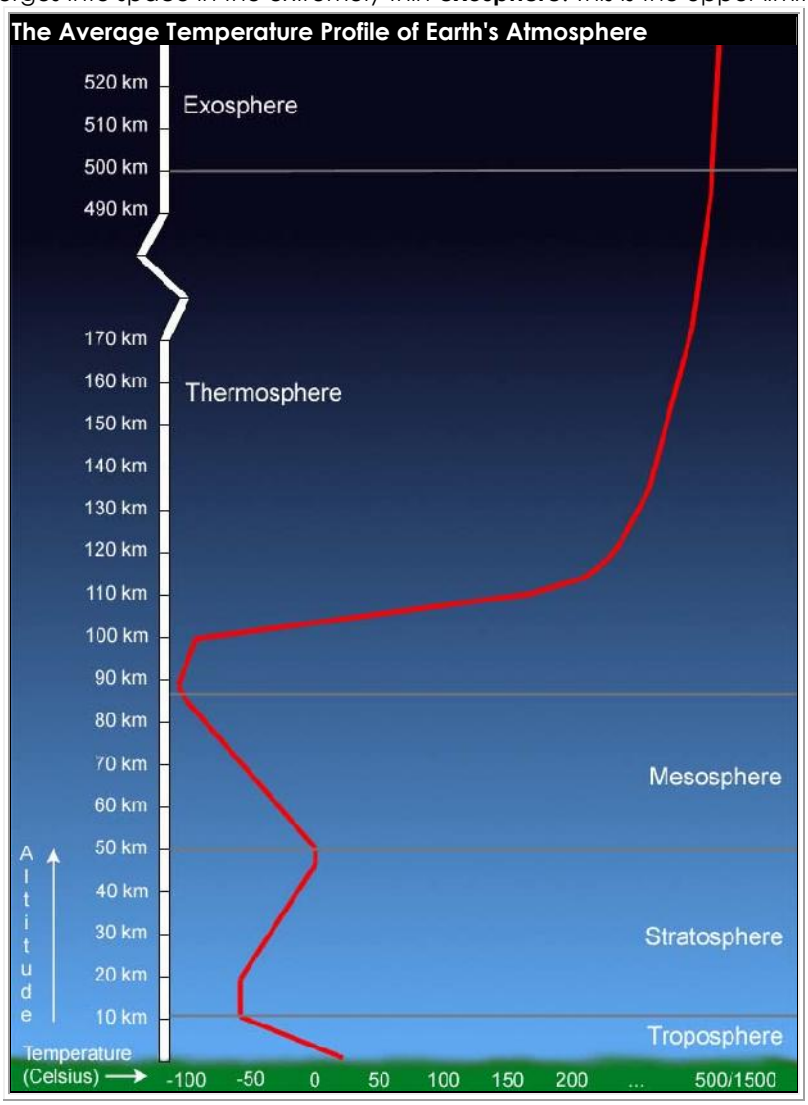
Layers of the Earth's Atmosphere

The atmosphere is divided into five layers. It is thickest near the surface and thins out with height until it eventually merges with space.

1. The **troposphere** is the first layer above the surface and contains half of the Earth's atmosphere. Weather occurs in this layer.
2. Many jet aircrafts fly in the **stratosphere** because it is very stable. Also, the ozone layer absorbs harmful rays from the Sun.
3. Meteors or rock fragments burn up in the **mesosphere**.
4. The **thermosphere** is a layer with auroras. It is also where the space shuttle orbits.
5. The atmosphere merges into space in the extremely thin **exosphere**. This is the upper limit of our atmosphere.



The Troposphere

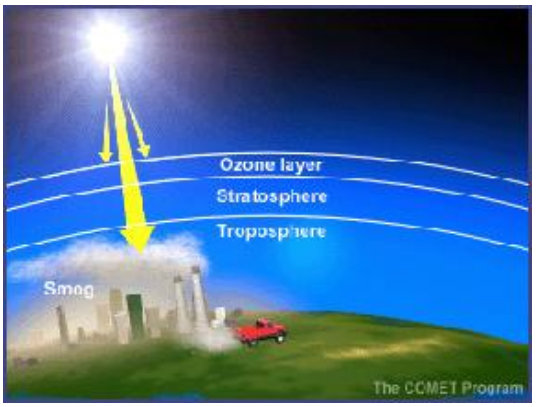
The troposphere is the lowest layer of the Earth's atmosphere. The air is very well mixed and the temperature decreases with altitude.

Air in the troposphere is heated from the ground up. The surface of the Earth absorbs energy and heats up faster than the air does. The heat is spread through the troposphere because the air is slightly unstable.

Weather occurs in the Earth's troposphere.

The Stratosphere

In the Earth's stratosphere, the temperature increases with altitude. On Earth, ozone causes the increasing temperature in the stratosphere. Ozone is concentrated around an altitude of 25 kilometers. The ozone molecules absorb dangerous kinds of sunlight, which heats the air around them. The stratosphere is located above the top of the troposphere.



Ozone in the Stratosphere
About 90% of the ozone in the Earth's atmosphere is found in the region called the stratosphere. This is the atmospheric layer between 16 and 48 kilometers (10 and 30 miles) above the Earth's surface. Ozone forms a kind of layer in the stratosphere, where it is more concentrated than anywhere else.
Ozone and oxygen molecules in the stratosphere absorb ultraviolet light from the Sun, providing a shield that prevents this radiation from passing to the Earth's surface. While both oxygen and ozone together absorb 95 to 99.9% of the Sun's ultraviolet radiation, only ozone effectively absorbs the most energetic ultraviolet light, known as UV-C and UV-B. This ultraviolet light can cause biological damage like skin cancer, tissue damage to eyes and plant tissue damage. The protective role of the ozone layer in the upper atmosphere is so vital that scientists believe life on land probably would not have evolved - and could not exist today - without it.

The ozone layer would be quite good at its job of protecting Earth from too much ultraviolet radiation - that is, it would if humans did not contribute to the process. It's now known that ozone is destroyed in the stratosphere and that some human-released chemicals such as CFC's are speeding up the breakdown of ozone, so that there are "holes" now in our protective shield.

While the stratospheric ozone issue is a serious one, in many ways it can be thought of as an environmental success story. Scientists detected the developing problem, and collected the evidence that convinced governments around the world to take action. Although the elimination of ozone-depleting chemicals from the atmosphere will take decades yet, we have made a strong and positive beginning. For the first time in our species' history, we have tackled a global environmental issue on a global scale.

The Mesosphere
In the Earth's mesosphere, the air is relatively mixed together and the temperature decreases with altitude. The atmosphere reaches its coldest temperature of around -90°C in the mesosphere. This is also the layer in which a lot of meteors burn up while entering the Earth's atmosphere.
The mesosphere is on top of the stratosphere The upper parts of the atmosphere, such as the mesosphere, can sometimes be seen by looking at the very edge of a planet.

The Thermosphere
The thermosphere is the fourth layer of the Earth's atmosphere and is located above the mesosphere. The air is really thin in the thermosphere. A small change in energy can cause a large change in temperature. That's why the temperature is very sensitive to solar activity. When the sun is active, the thermosphere can heat up to 1,500° C or higher!
The Earth's thermosphere also includes the region of the atmosphere called the ionosphere. The ionosphere is a region of the atmosphere that is filled with charged particles. The high temperatures in the thermosphere can cause molecules to ionize. This is why an ionosphere and thermosphere can overlap.

The Ionosphere
Scientists call the ionosphere an extension of the thermosphere. So technically, the ionosphere is not another atmospheric layer. The ionosphere represents less than 0.1% of the total mass of the Earth's atmosphere. Even though it is such a small part, it is extremely important!
The upper atmosphere is ionized by solar radiation. That means the Sun's energy is so strong at this level, that it breaks apart molecules. So there ends up being electrons floating around and molecules which have lost or gained electrons. When the Sun is active, more and more ionization happens!
Different regions of the ionosphere make long distance radio communication possible by reflecting the radio waves back to Earth. It is also home to auroras. Temperatures in the ionosphere just keep getting hotter as you go up!

The Exosphere
Very high up, the Earth's atmosphere becomes very thin. The region where atoms and molecules escape into space is referred to as the exosphere. The exosphere is on top of the thermosphere.

Layers of the Earth's Atmosphere

Name: _____

Name: _____

Directions: Use the information provided & your notes to organize the data in table format.

Atmospheric Layer	Based on the background information, identify important characteristics of each layer (be sure to include the temperature ranges for each layer).
Exosphere	5th layer on top of thermosphere b/w 500km-530km until it merges with space; extremely thin upper limit of our atmosphere; region where atoms & molecules escape into space.
Thermosphere	4th layer occurs b/w 86km-500km from the surface b/w the mesosphere & exosphere; temperatures range from -100°C to 1500°C; air is very thin; a small change in energy can cause a large change in temp. so very sensitive to solar activity; includes ionosphere (filled with charged particles-high temps cause molecules to ionize) which is home to auroras; different regions of ionosphere make long distance radio communication possible by reflecting radio waves back to earth; where the space shuttle orbits.
Mesosphere	This layer occurs b/w 50km-86km from the surface on top of the stratosphere; temperatures range from 0°C to -90°C; temperature decreases with altitude; meteors or rock fragments burn up here;
Stratosphere	Occurs b/w 10km-50km from the earth's surface just above the troposphere; temperatures range from -50°C to 0°C; temperature increases w/altitude; ozone occurs naturally here around 25km (10-30 miles up) which absorbs the dangerous UV rays from the sun—it provides a shield that prevents this radiation from passing to the earth's surface; jet aircraft fly here because it is very stable.
Troposphere	The first layer just above the earth's surface from zero to 10km (the lowest layer); temperatures range from 20°C to -50°C; contains half of the earth's atmosphere (the densest layer); weather occurs in this layer (very unstable); temperature decreases with altitude; air is heated from the ground up because the earth's surface absorbs energy & heats up faster than the air does.

Directions: Refer to the graph "The Average Temperature Profile of Earth's Atmosphere" & complete the table. The first one is done for you. * Don't forget to include the units!!!

Atmospheric Layer	Exists between which altitudes (km)	Thickness (km) (Hint: subtract)	Maximum Temperature (°C)
Exosphere	500km to 530km	30 km	1700°C
Thermosphere	86km to 500km	414 km	1500°C
Mesosphere	50km to 86km	36 km	0°C
Stratosphere	10km to 50km	40 km	0°C
Troposphere	zero to 10km	10 km	20°C

Layers of the Earth's Atmosphere

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Exosphere	
Thermosphere	
Mesosphere	
Stratosphere	
Troposphere	

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Atmospheric Layer	Exists between which altitudes (km)	Thickness (km) (Hint: subtract)	Maximum Temperature (°C)
Exosphere	500 km to 530 km	30 km	1700°C
Thermosphere			
Mesosphere			
Stratosphere			
Troposphere			

Layers of the Earth's Atmosphere

Use the following conversions when given °C and looking for °F and when given kilometers and looking for miles; remember to include the units with your answers in the table!!!

$$F = (C \times 9/5) + 32$$

$$1 \text{ km} = 0.62 \text{ mi}$$

Atmospheric Layer	Thickness (km) (Use your numbers from previous chart!)	Thickness (mi) [Show work below!]	Maximum Temperature (°C) (Use your numbers from previous chart!)	Maximum Temperature (°F) [Show work below!]
Exosphere				
Thermosphere				
Mesosphere				
Stratosphere				
Troposphere				

***Show your work in the bare space below (plug the variable into the formula)!!!**

<u>Steps</u> for converting using dimensional analysis:

1. Write given information with unit
2. Draw a "X" for multiplication
3. Draw a bar (------) for division
4. Place given unit on bottom & desired unit on top of bar.
5. Plug in conversion factor
6. Cross out units that are alike
7. Calculate answer
8. REMEMBER UNITS on the answer!

Example: Convert 9040 seconds to hours

$$9040\ \cancel{s} \times \frac{1\ \cancel{min}}{60\ \cancel{s}} \times \frac{1\ hr}{60\ \cancel{min}} = \frac{9040\ hr}{3600} = \boxed{2.5\ hrs}$$

Layers of the Earth's Atmosphere

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Atmospheric Layer	Thickness (km) (Use your numbers from previous chart!)	Thickness (mi) [Show work below!]	Maximum Temperature (°C) (Use your numbers from previous chart!)	Maximum Temperature (°F) [Show work below!]
Exosphere	30 km	18.6 mi	1700°C	3,092°F
Thermosphere	414 km	256.68 mi	1500°C	2,732°F
Mesosphere	36 km	22.32 mi	0°C	32°F
Stratosphere	40 km	24.8 mi	0°C	32°F
Troposphere	10 km	6.2 mi	20°C	68°F

***Show your work in the bare space below (plug the variable into the formula)!!!**

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