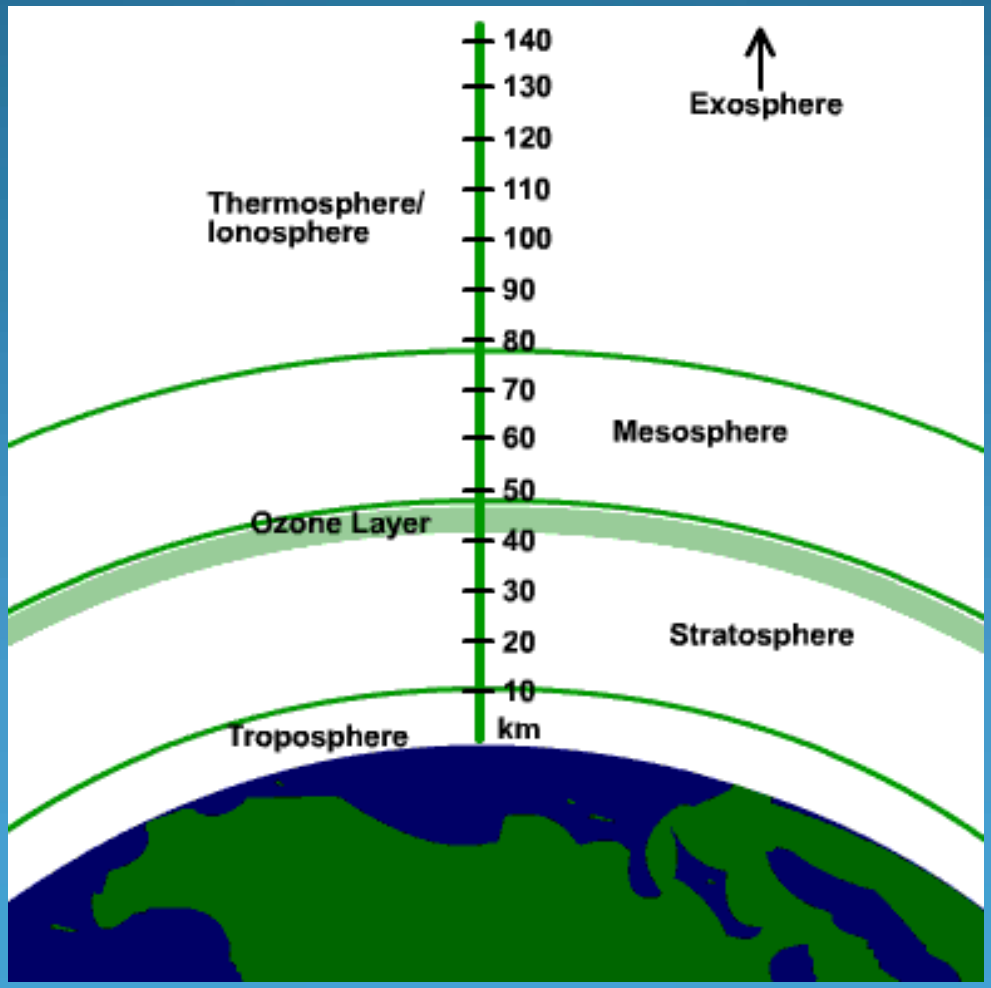
The Atmosphere



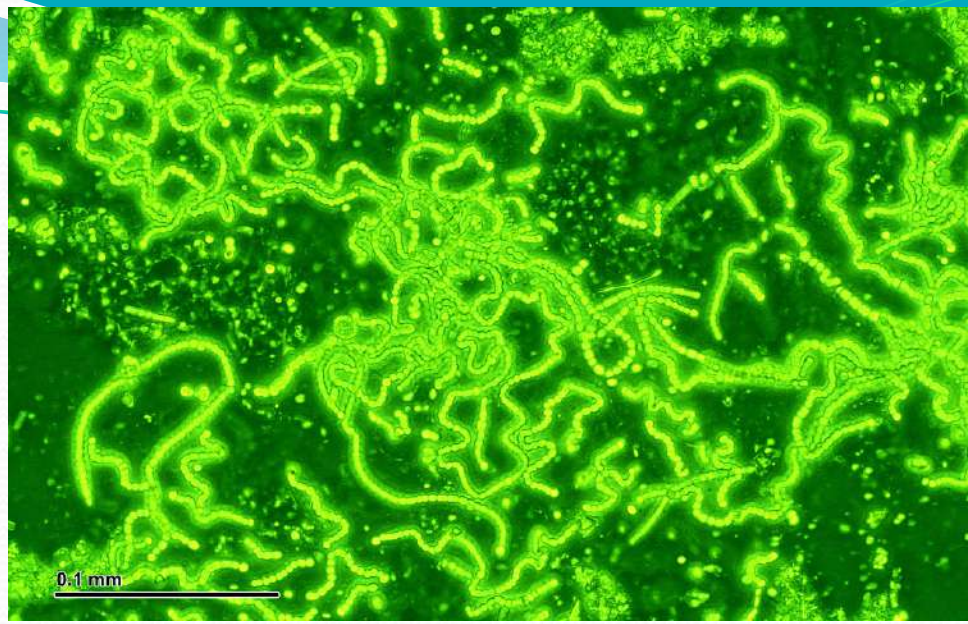
The Composition of the Atmosphere

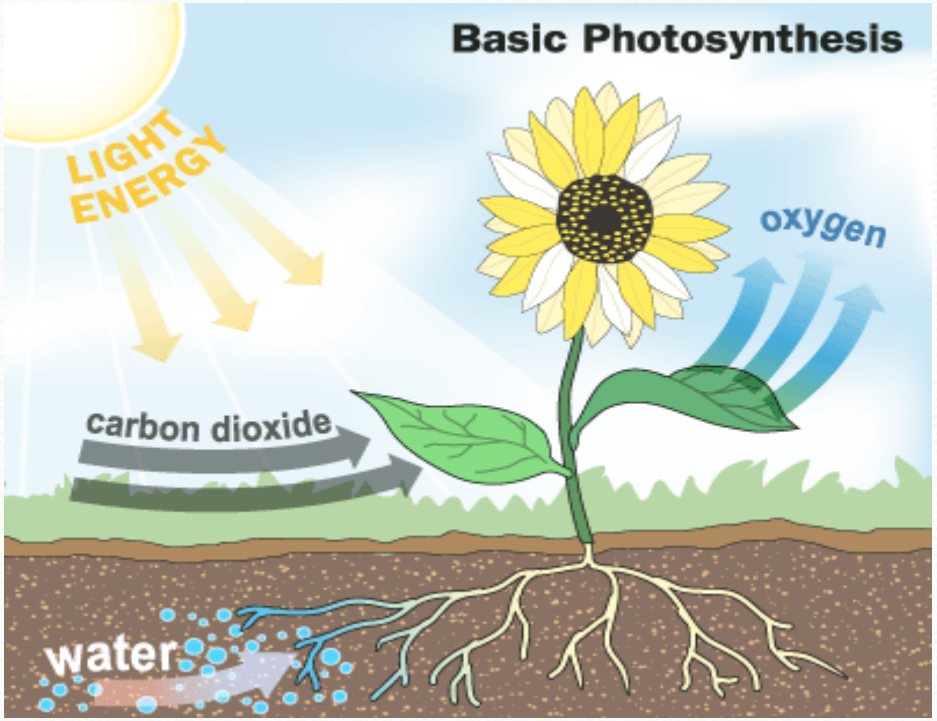
- Scientists hypothesize that volcanic eruptions played the main role in forming Earth's early atmosphere.
- **Gases released from volcanic eruptions** – primarily carbon dioxide, sulfur dioxide, water vapor, and nitrogen – probably made up nearly all of this early atmosphere.
- What is missing?.....

Oxygen Formation

- The first oxygen appearing in the geologic record dates to 2.8 billion years ago as a result of an early form of bacteria known as Cyanobacteria evolving to undergo Photosynthesis.

- Oxygen became abundant in the atmosphere during the **Great Oxidation Event** ~ 2.5 billion years ago.





Oxygen Caused Earth's 1st Mass Extinction!

- Photosynthesis removed massive amounts of CO_2 from the atmosphere which had been keeping the Earth warm.
- As a result a Global Ice Age covered the entire Earth with ice (Snow Ball Earth Theory) which almost killed all life on Earth.

https://www.youtube.com/watch?v=qERdL8uHSgI

Air

- "**Air**" is a mixture of many gases in Earth's lower atmosphere.
- The main **permanent gases** in air are nitrogen (78%) and oxygen (21%), which together form about 99% of dry air by volume.
- The remaining 1% is mostly argon. Also present are tiny amounts of trace gases, such as neon, helium, hydrogen, and xenon.

Nitrogen + Oxygen = 99%

Air

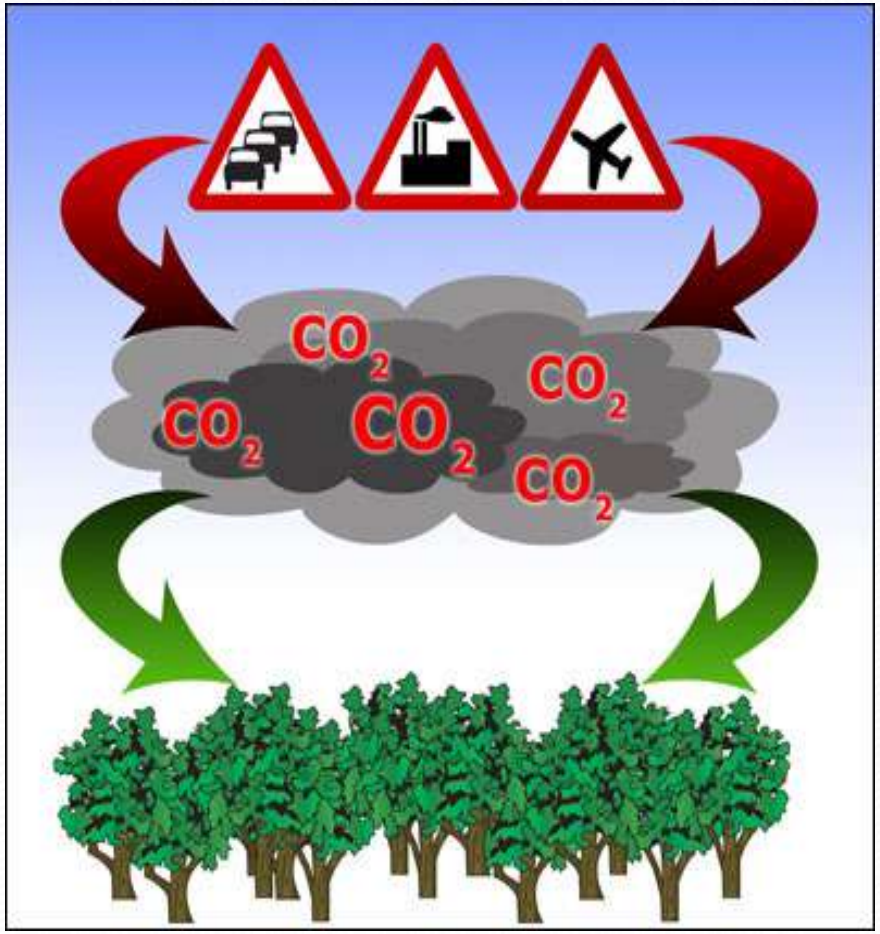
- The **variable gases** that make up the Earth's atmosphere include water vapor, carbon dioxide, methane, ozone, nitrous oxide, and chlorofluorocarbons (CFCs).
- Water vapor can vary from 4% in humid tropical climates near the Earth's equator, to 0.5% in the drier polar regions.
- Why do polar region have less water vapor than desert regions?
- Water vapor content varies with location, season, and time of day. Water vapor concentration is higher near the surface.

Carbon Dioxide

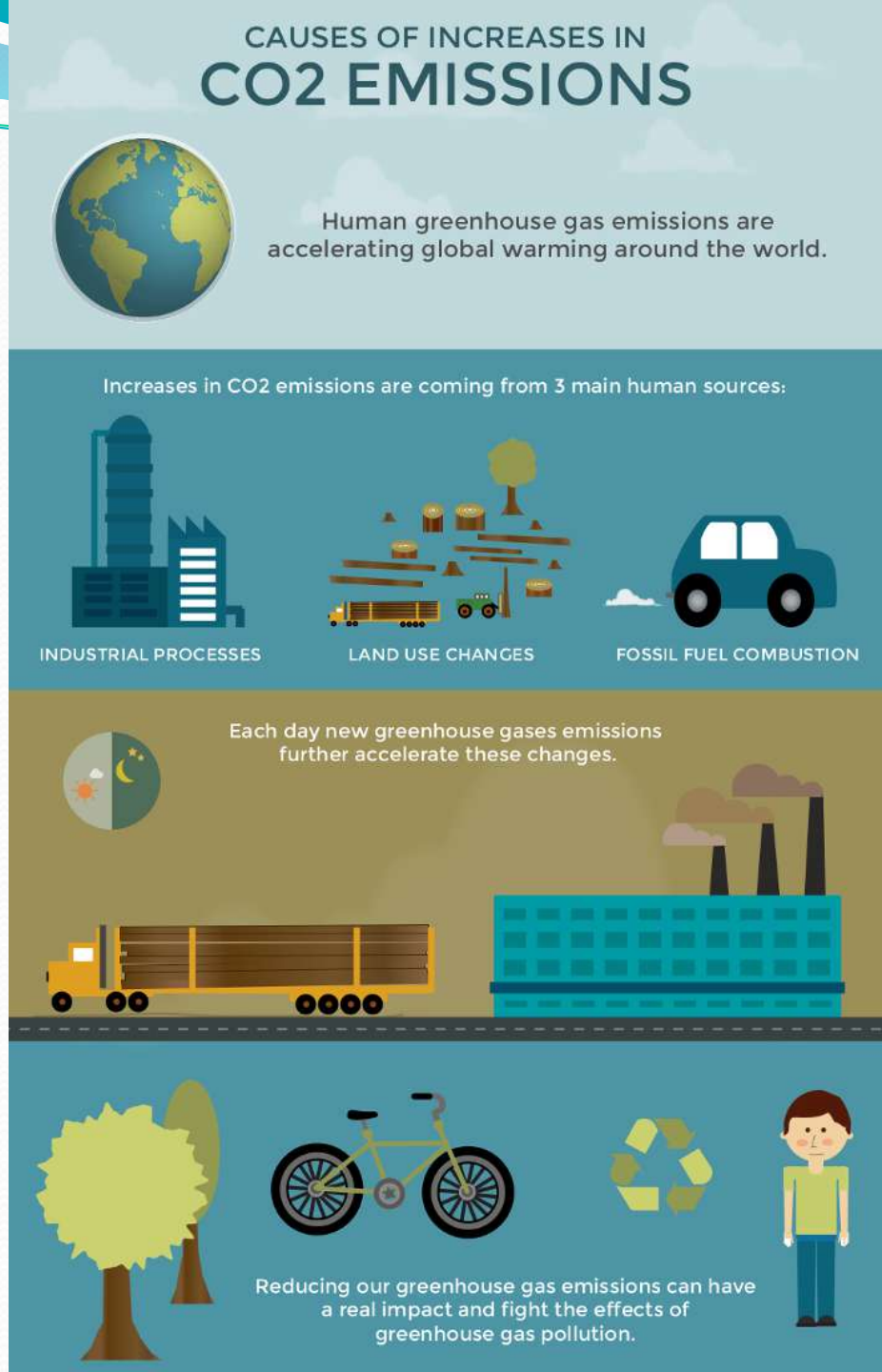
- Carbon dioxide only composes a small portion of the air, about 0.035%. However, levels of this gas are slowly increasing.
- There are both natural and human sources of carbon dioxide emissions. Natural sources include decomposition, volcanoes, wildfires and respiration.

Human Produced Carbon Dioxide

Since the Industrial Revolution, human sources of carbon dioxide emissions have been growing. Human activities such as the burning of oil, coal and gas, as well as deforestation are the primary cause of the increased carbon dioxide concentrations in the atmosphere.

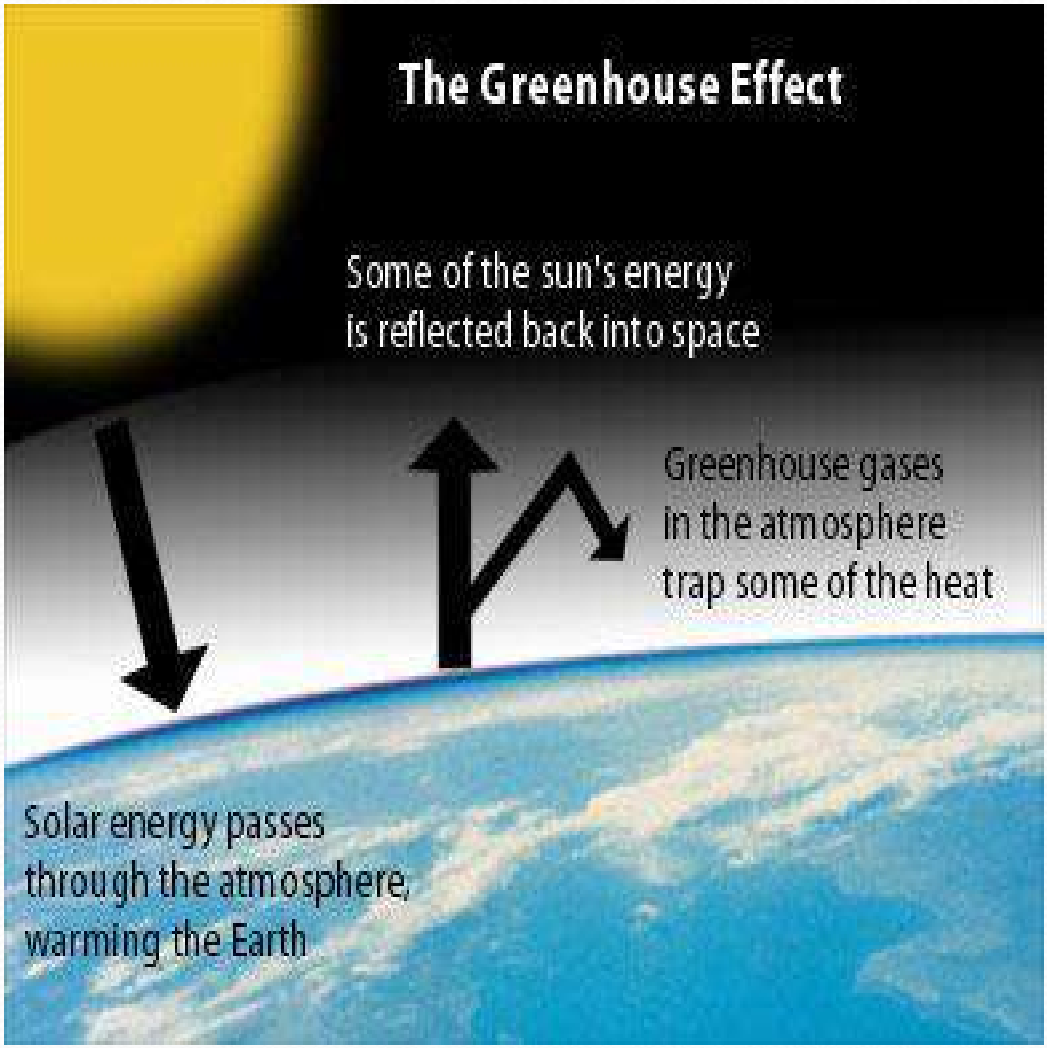


The largest human source of carbon dioxide emissions is from the combustion of fossil fuels. This produces 87% of human carbon dioxide emissions. Burning these fuels releases energy which is most commonly turned into heat, electricity or power for transportation. Some examples of where they are used are in power plants, cars, planes and industrial facilities.



The Greenhouse Effect

The earth's temperature is naturally regulated by a layer of gases in the atmosphere which act like the glass in a greenhouse. This layer of gases—**Greenhouse Gases (GHGs)**—such as carbon dioxide (CO_2), methane , and nitrous oxide, let in sunlight but tend to trap the heat reflected from the earth's surface. Thus, the earth is naturally warmed by the greenhouse effect.



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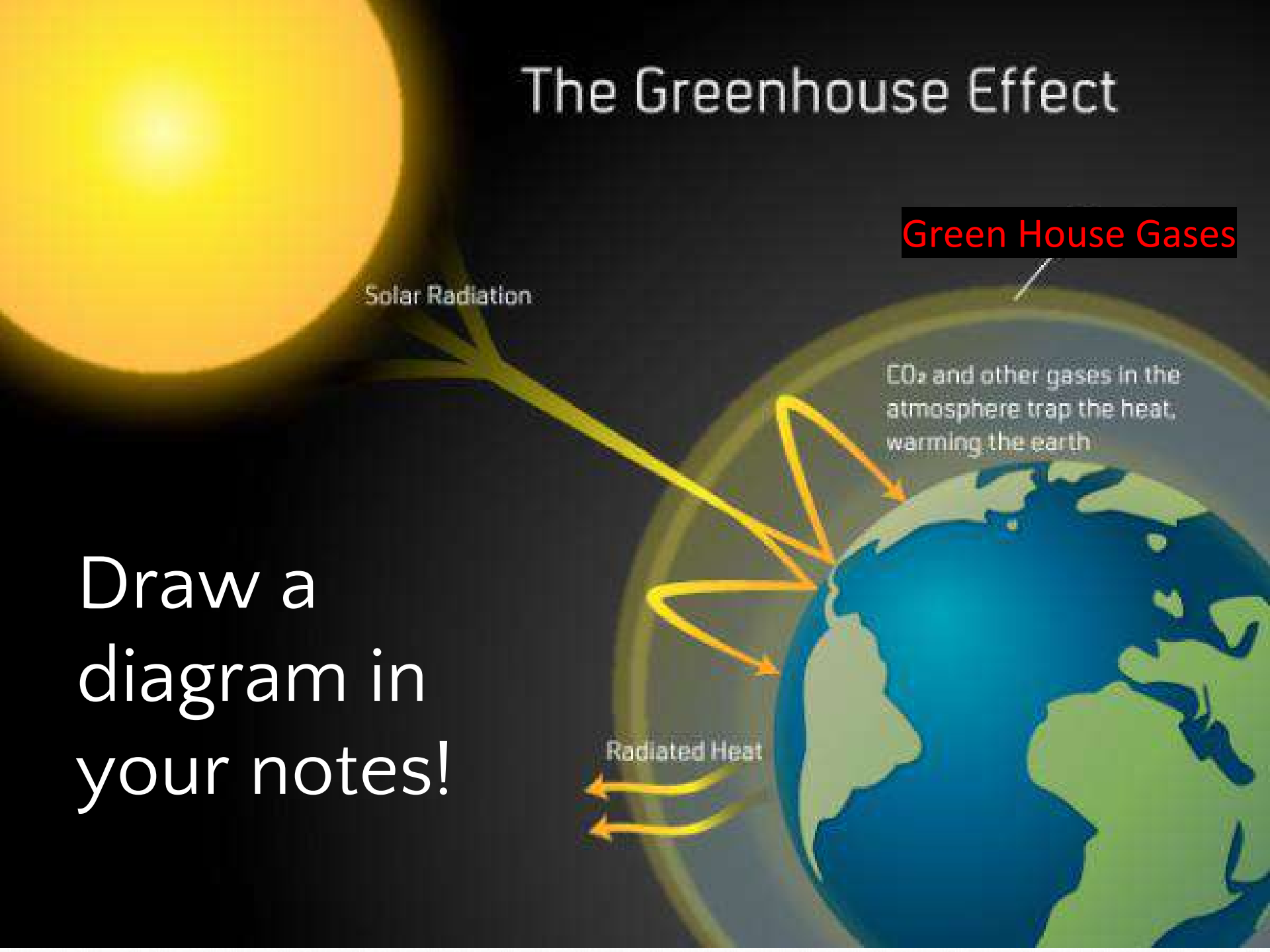
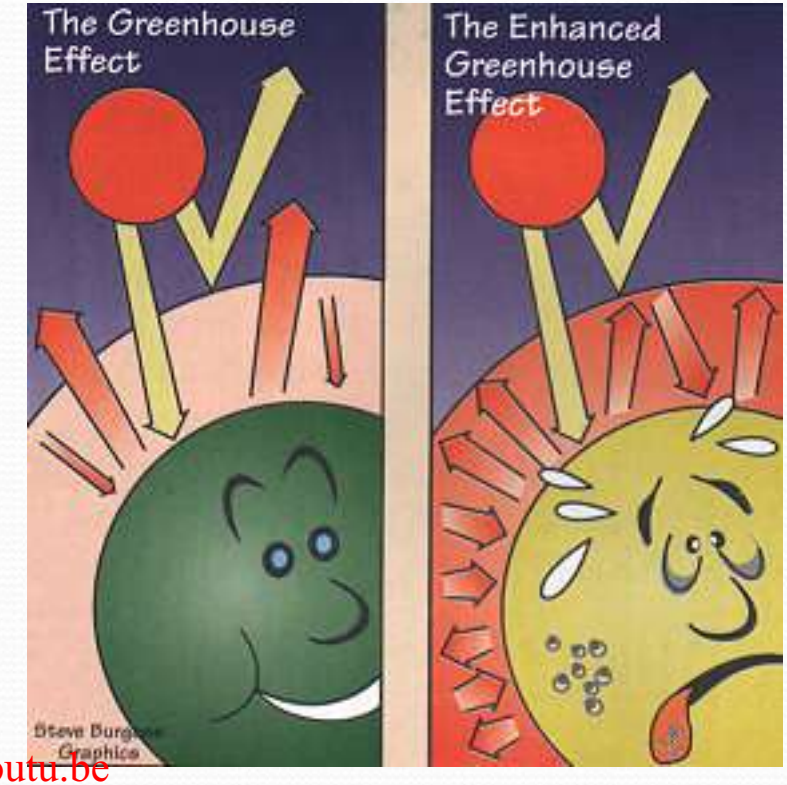


Draw a diagram in your notes!

CO_2 & Global Warming

- Global warming is part of a natural cycle where the Earth goes through a cycle of heating and cooling. However, many human activities cause large amounts of greenhouse gases to build up in the atmosphere, and have sped up this cycle and are causing the Earth to heat up faster than usual.



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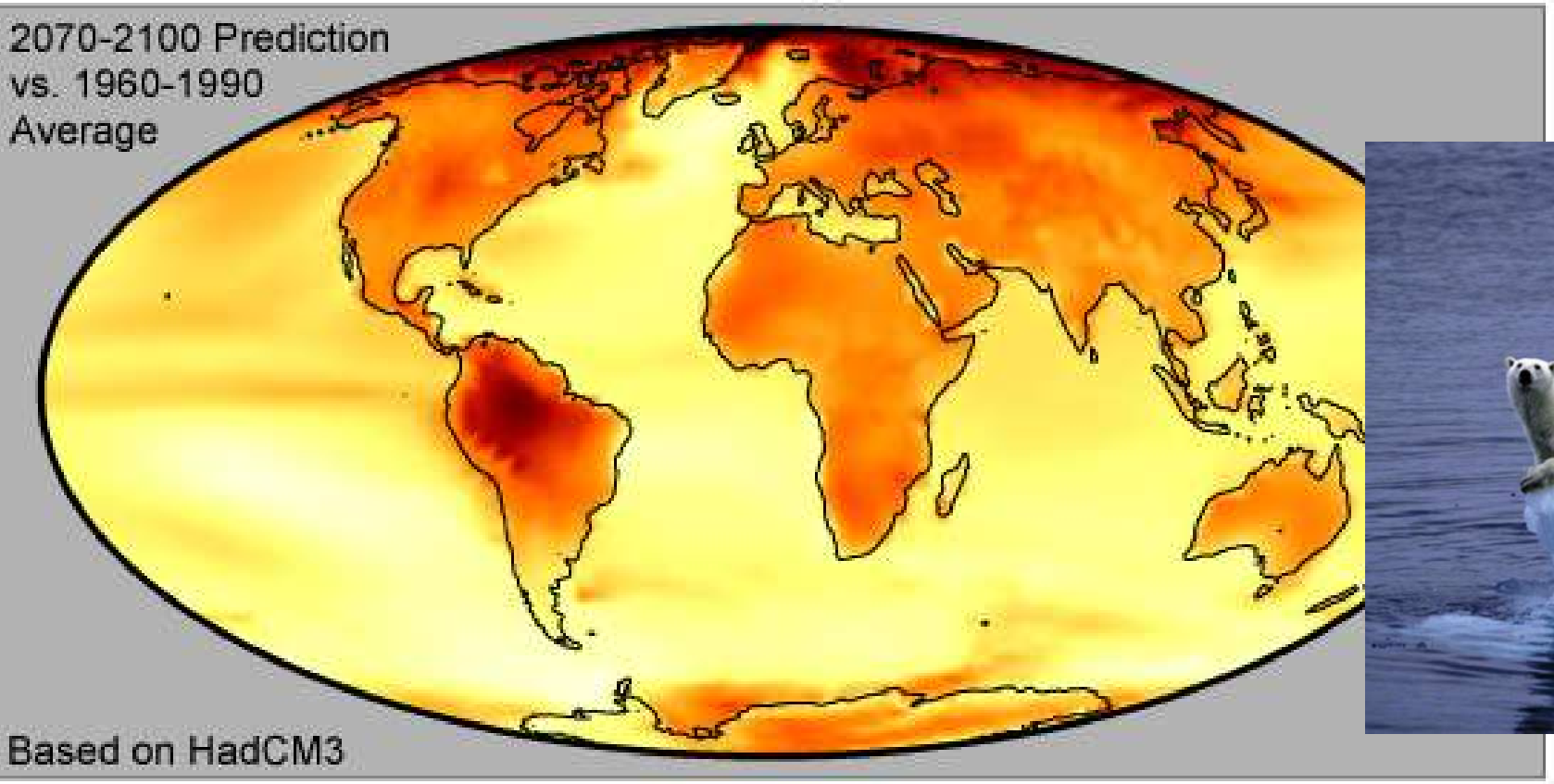
Global Warming Predictions

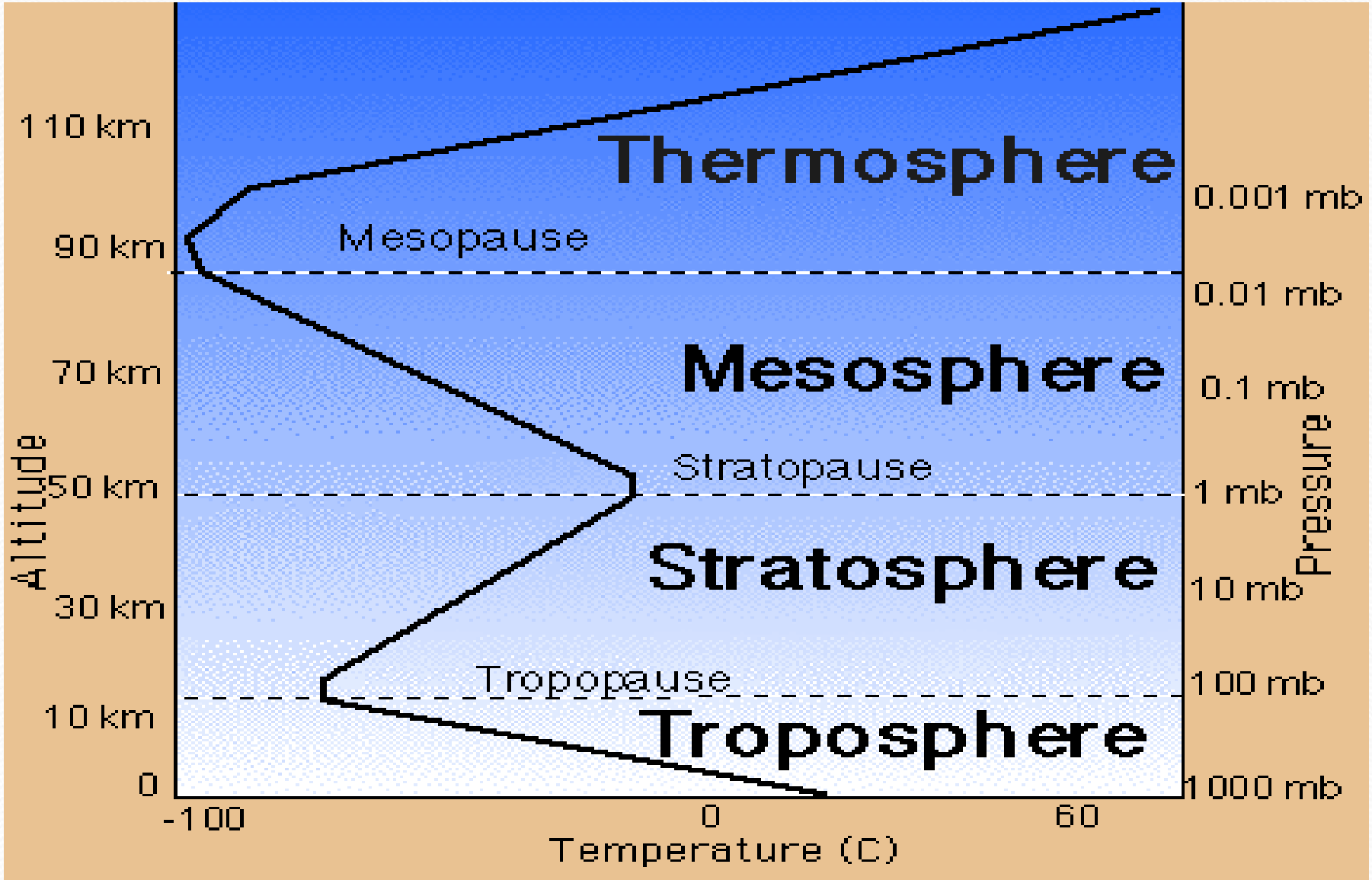


Air's Particulate Matter

- The atmosphere also contains a wide variety of dust particles.
- Dust includes: tiny grains of rocks, dirt, pollen, salt crystals from sea spray, and soot from fires.

Create Your Own Diagram

Structure of the Atmosphere

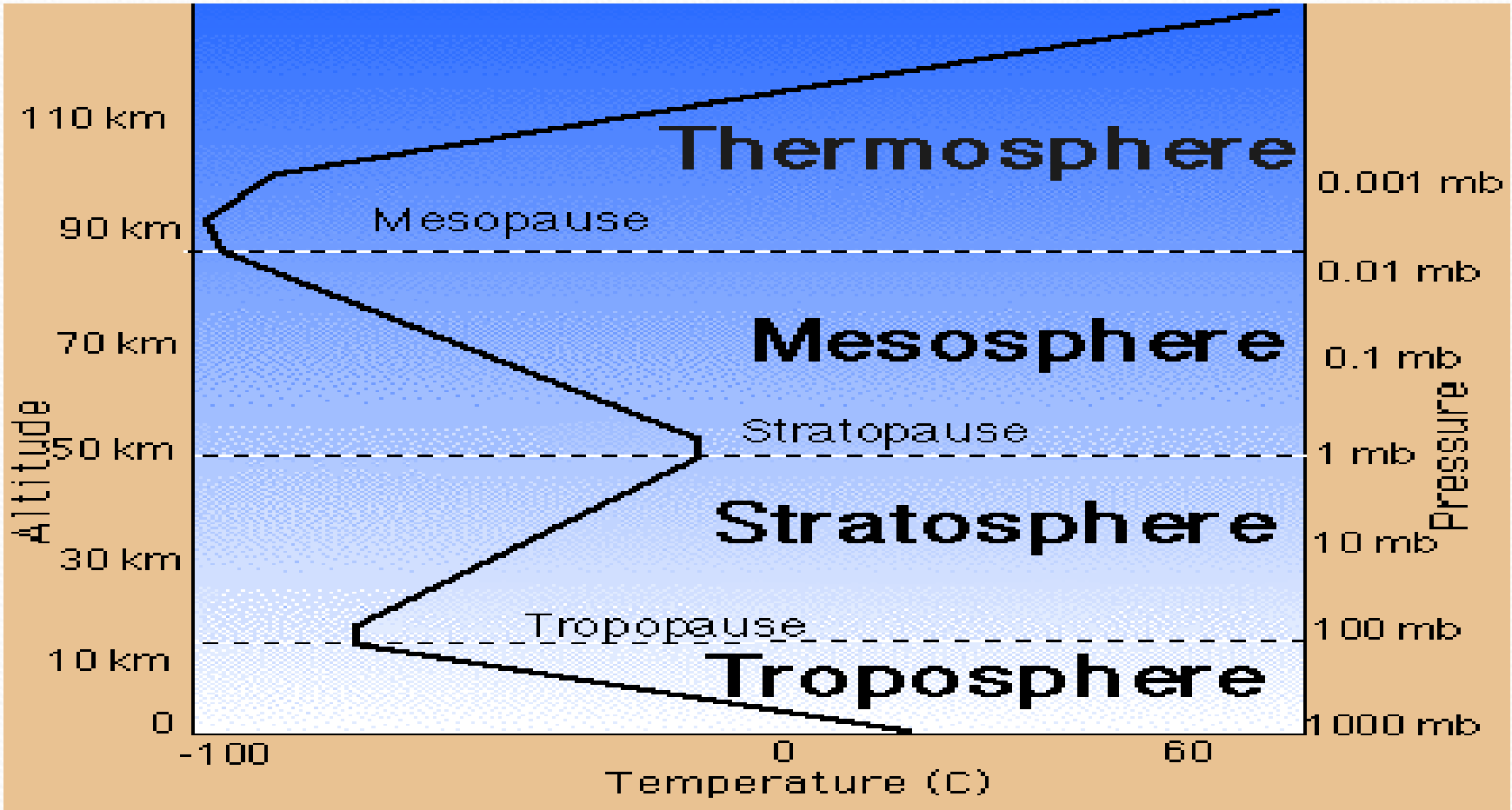


Atmosphere Data Analysis Questions

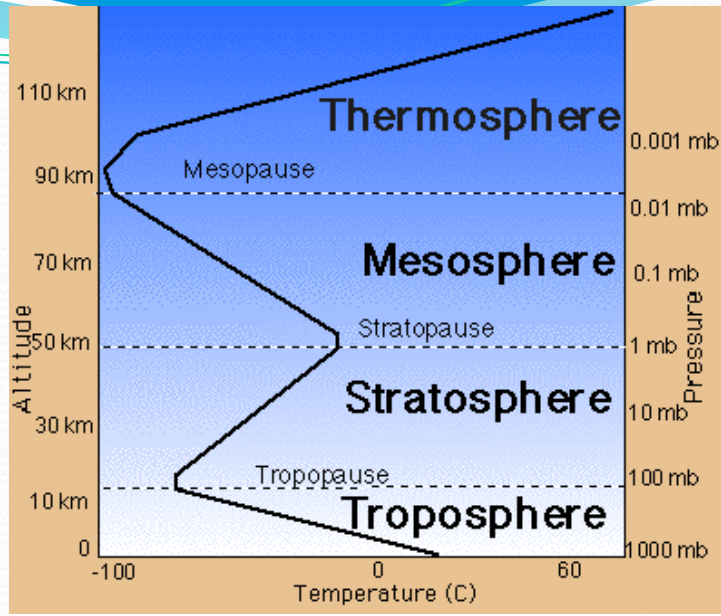
1. What variables are being being graphed? What units are used to measure each?
2. What is the temperature at the bottom of the stratosphere?
3. Which layer of the atmosphere has the lowest temperature?
4. Describe how temperature changes as altitude increases in the troposphere.
5. We have not yet talked about why the temperature changes this way. Write out an explanation for why you think the temperature decreases and increases at different points in the atmosphere. Be very thorough in your explanation.

Points to Notice:

- The temperature of the atmosphere changes dramatically at varying altitudes.
- Temperature differences are used to divide the atmosphere into four layers: troposphere, stratosphere, mesosphere, and thermosphere.



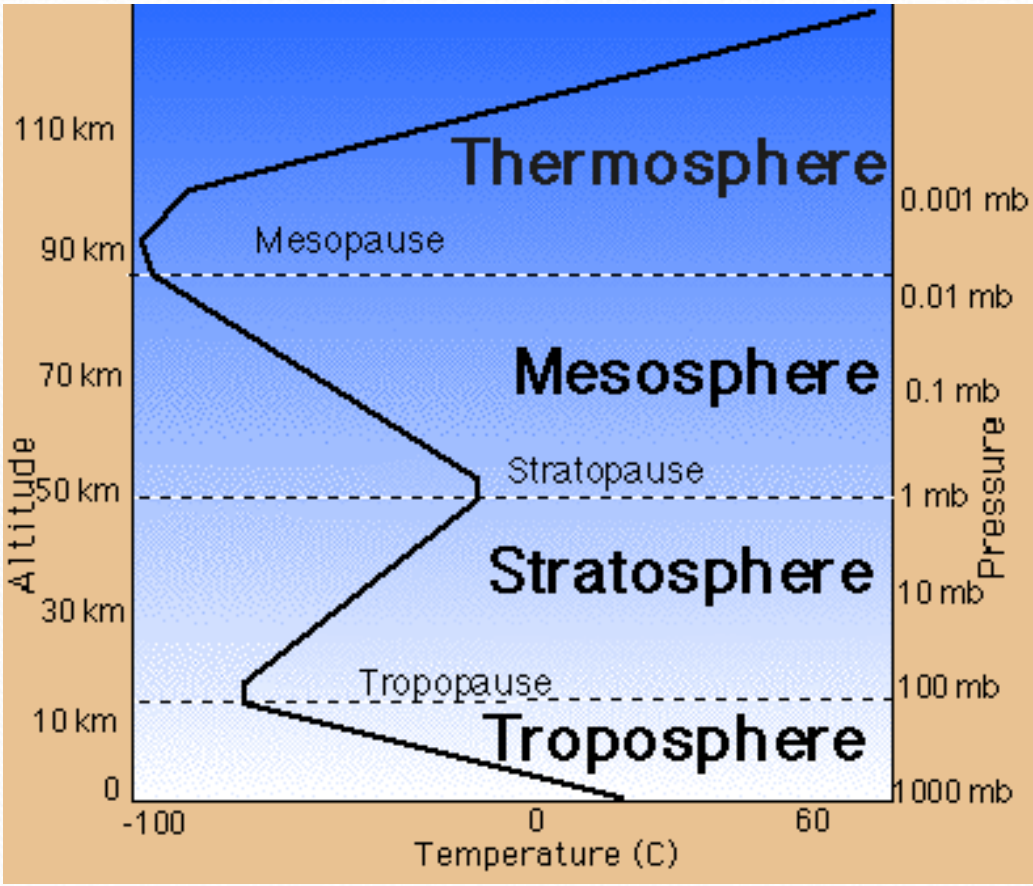
The Troposphere



- The lowest layer of our atmosphere. It is approximately 11 km (7 miles) thick.
- Temperature and pressure decreases with altitude.
- The rate of cooling with altitude is highly variable, but averages about 6.5°C for each kilometer in altitude gain.
- The Troposphere contains more than 90% of the atmosphere's gases.
- All weather on Earth takes place in the Troposphere.

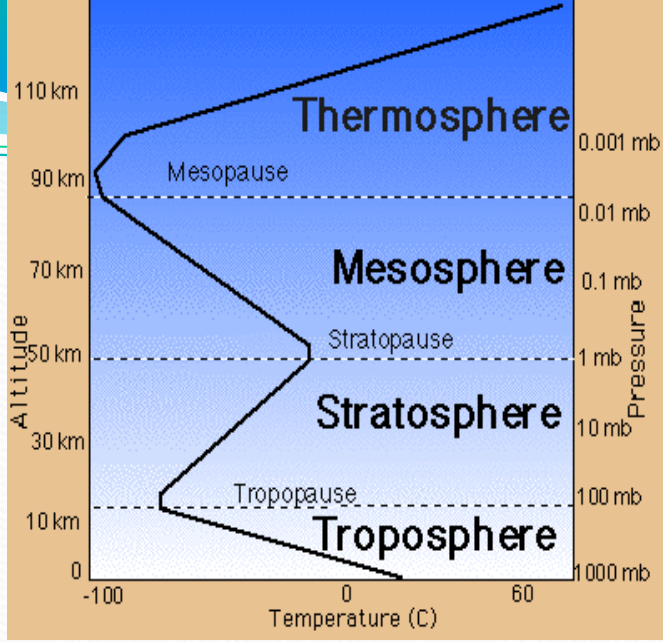
The Tropopause

- The area between the Troposphere and the Stratosphere.
- Temperature remains stable as you increase in height.
- The jet stream is located just below the Tropopause.

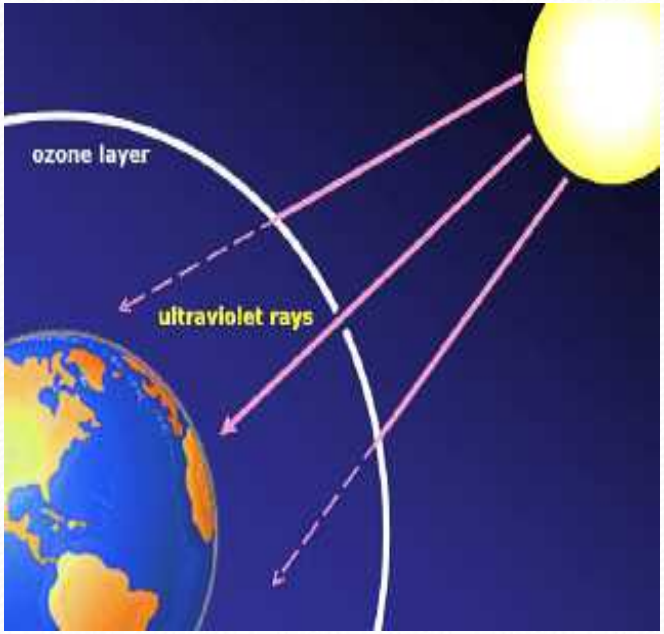


PAUSE = NO TEMP. CHANGE

The Stratosphere

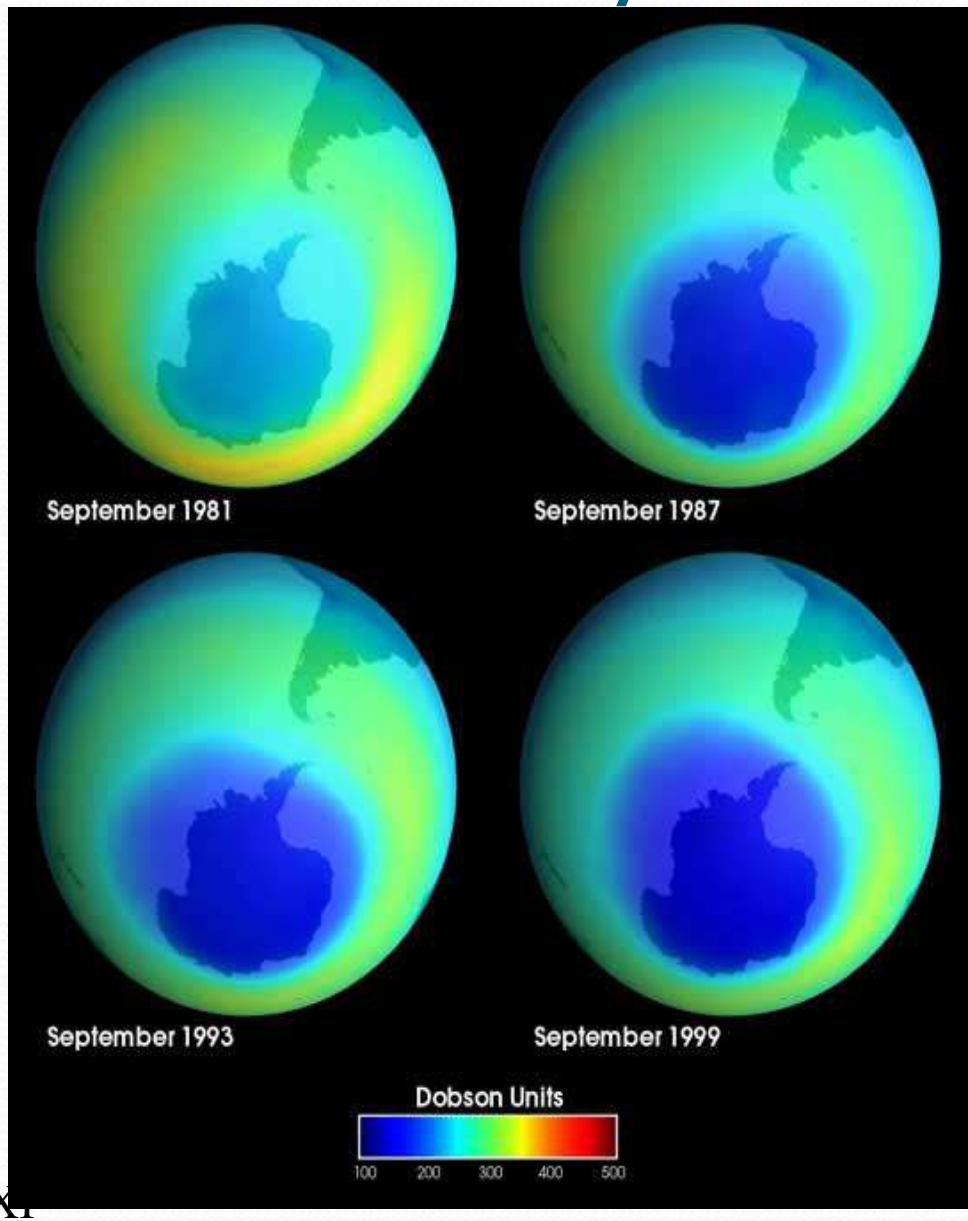


- "Strato" means spreading out.
- A clear, dry layer of the atmosphere.
- Temperature increase in the Stratosphere is caused by the presence of the Ozone Layer.
- Ozone absorbs ultraviolet rays from the sun and then releases some of this energy in the form of heat.



Ozone layer

During the 70's and 80's and large hole was discovered in the ozone layer. This was a big concern because large amounts of very harmful ultraviolet rays were being let into Earths lower atmosphere. It was determined that the cause was the presence of chlorofluorocarbon(CFC) compounds, commonly called freons, which were release into the atmosphere by human activities. Now most countries ban the use of CFC's.



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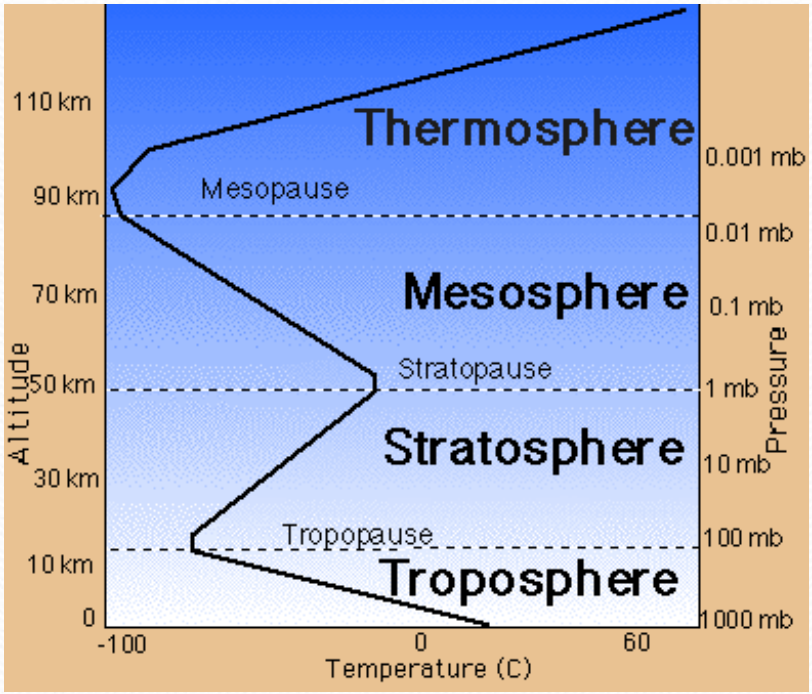
The Stratopause

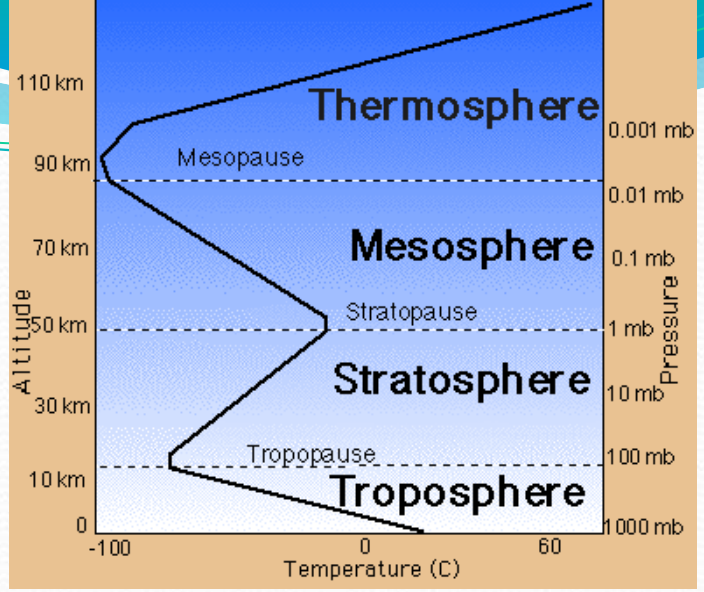
- The area between the Stratosphere and the Mesosphere.
- Located at approximately 50 kilometers above Earth's surface.



PAUSE = NO TEMP. CHANGE

The Mesosphere

- "Meso" means middle.
- Contains very little ozone, so temperatures again drop with increasing altitude.
- It is in this layer that foreign bodies (such as meteors and spacecraft) entering the atmosphere start to warm up. We know them as "shooting stars".



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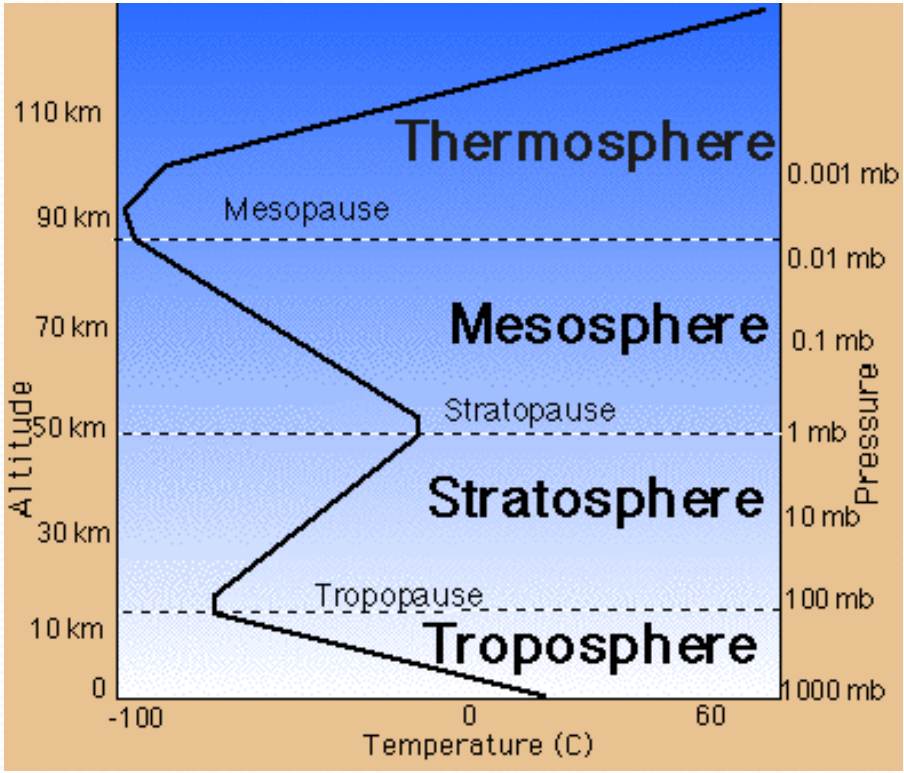
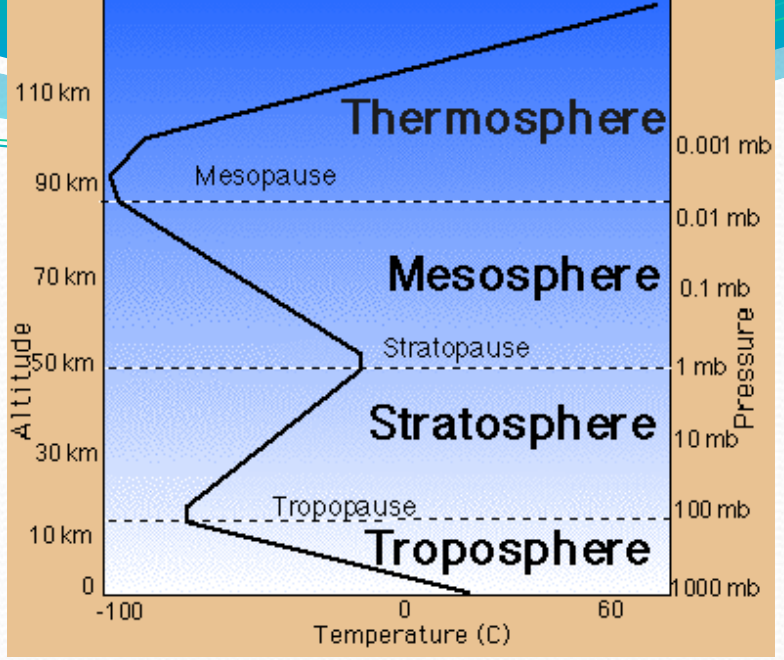
The Mesopause

- The area between the Mesosphere and the Thermosphere.
- Located approximately 90 kilometers above Earth's surface.

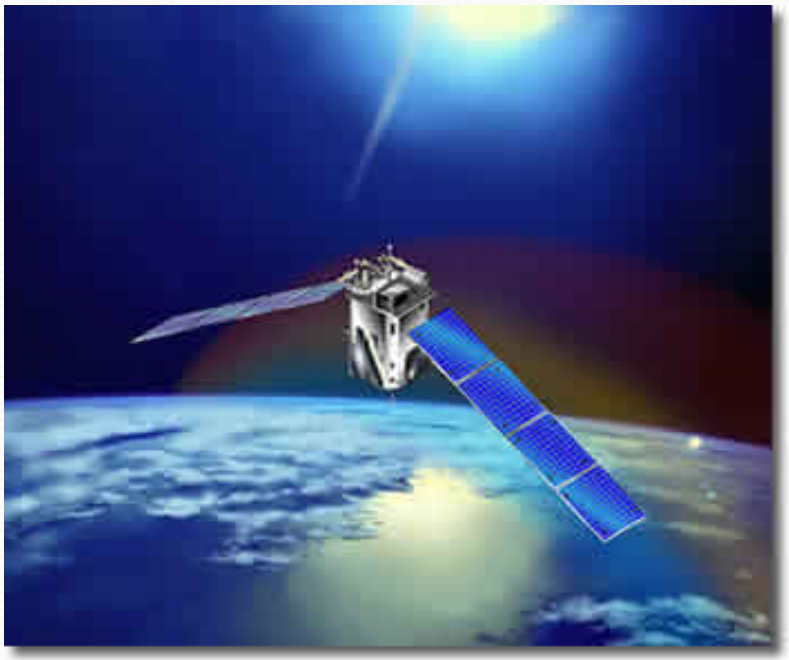


PAUSE = NO TEMP. CHANGE

The Thermosphere



- The outermost layer of Earth's atmosphere.
- Where satellites orbit.
- The atmosphere at this great altitude is extremely thin, but the few molecules and atoms present receive such intense solar radiation that temperatures can rise above 1000°C.
- Contains the "Ionosphere"



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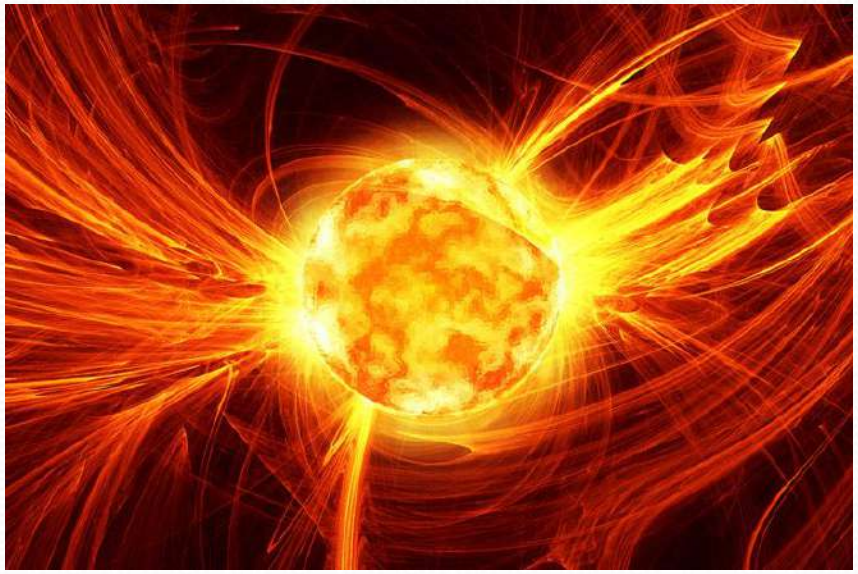
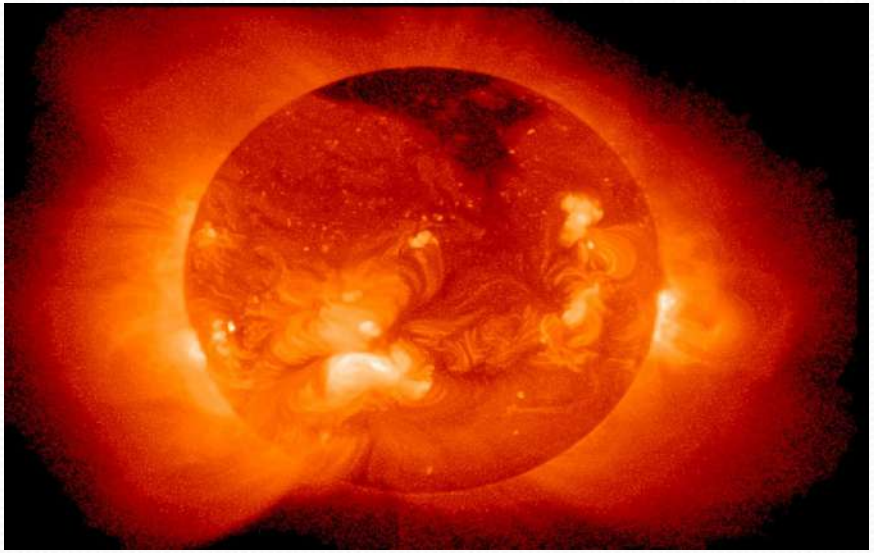
The Ionosphere

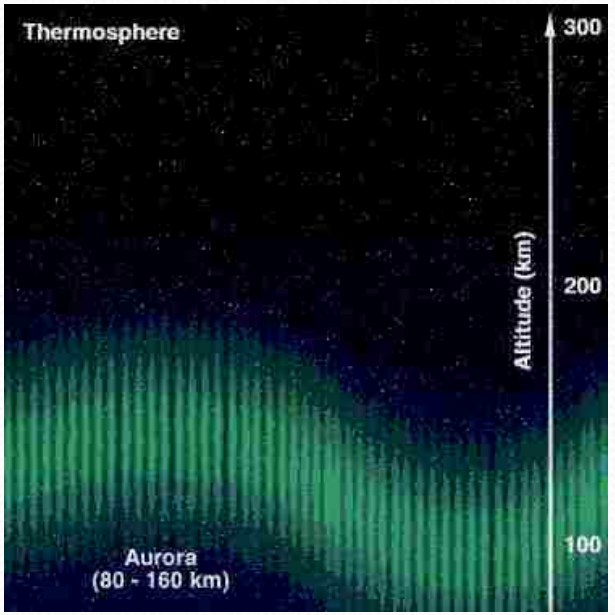
- The Ionosphere is affected by solar events.
- The Sun gives off charged particles called ions. They travel out into space super fast. The cloud or gas of these ions, or charged particles is called a Plasma.
- The stream of plasma coming from the sun is known as solar wind, and the intensity of it depends on storms occuring on the sun, called sunspots.





The Ionosphere

- Huge eruptions associated with sunspots send out large amounts of radiation and ionized particles.
- Because the sun's particles are electrically charged, they are deflected by Earth's magnetic field to the North and South poles.
- The ionized particles sometimes interact with air molecules to form **auroras**, sometimes called "**Northern Lights**"



The Northern Lights

Northern Lights Videos

- https://www.youtube.com/watch?v=1MI3YDGgtN4
- https://www.youtube.com/watch?v=hsMW7zbzsUs