Layers of the Atmosphere

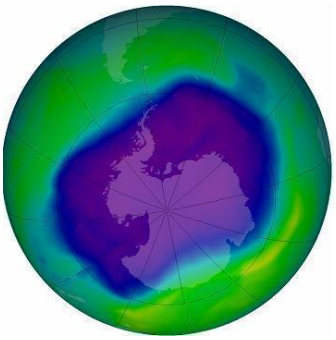
Troposphere

Study Tip

To memorize the five atmospheres in order, try a mnemonic sentence. For example: **T**roubled **S**uper **M**an **T**hanked **E**llie.

- The **troposphere** is the lowest layer of the atmosphere.
- Temperature decreases with altitude.
  - Heat source: Earth absorbs sunlight and radiates it back as heat, and gravity pulls in more gases at the surface of the Earth (higher density of gases raises temperature).
  - Warm air is under cool air, but will want to rise since it has a lower density. A frequent rising and sinking of air in the troposphere creates weather.
- A temperature **inversion** occurs when warm air sits over cold air.
  - This happens usually when the ground below is cold (night or winter), or when the seawater below is cold.
  - Inversions are stable and can last for days or weeks; they often trap unhealthy pollutants in cities.
- At the top of the troposphere is a layer in which temperature does not change with height. As a result, air from the troposphere and stratosphere rarely mix.

Stratosphere



The purple region is the Earth's ozone hole at Antarctica.

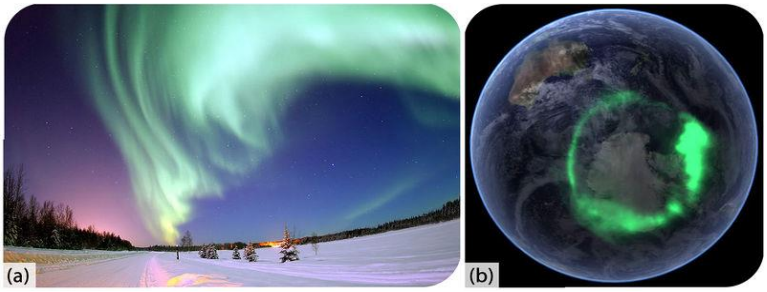
- The **stratosphere** is above the troposphere.
- Temperature increases with altitude.
  - Heat source: The Sun.
  - Warm air sits above cool air; therefore, the stratosphere is very stable with little turbulence. This makes it ideal for planes to fly through.
- The ozone layer is found from 15 to 30 km, and the thickness varies by season and latitude.
  - The ozone layer has a higher concentration of ozone than other spots in the atmosphere.
  - UV radiation splits an O_2 molecule into two. Each atom combines with another oxygen molecule to create ozone, O_3.
  - Ozone reflects harmful UV light—radiation that has the ability to penetrate cells and DNA.

Mesosphere

- The **mesosphere** is above the stratosphere.
- Temperature decreases with altitude.
  - Heat source: The stratosphere. (The mesosphere has too few gas molecules to absorb radiation.)
- **Noctilucent clouds** are rarely seen, and are the highest clouds in the atmosphere.

Thermosphere

- The **thermosphere** is above the mesosphere.
- The **ionosphere** is within the thermosphere.
    - Solar radiation ionizes gas to create positively and negatively charged ions, which form electric currents here.



(a) An aurora seen at the Northern Hemisphere.
(b) The aurora australis, also called "southern lights", is seen encircling Antarctica.

- The **magnetosphere** is above the thermosphere.
    - Particles from solar flares are trapped in the Earth's magnetic fields.
    - An overload of particles can ionize oxygen and nitrogen, causing them to light up and form auroras.

Exosphere

- The **exosphere** is above the thermosphere, and it is the outermost layer of our atmosphere.
- Beyond the atmosphere is **solar wind**, consisting of high-speed particles traveling outward from the Sun.

Concept Check

- What are the five layers of the atmosphere?
- What are the two layers with charged particles?
- What is the ozone layer? How do they help protect Earth?
- Where and how are auroras formed?