Our Atmosphere

Our atmosphere is a complex and beautiful envelope of gasses that support life, protect us from radiation, allows for a vital hydrologic cycle, and makes for some beautiful colors.

The atmosphere is divided into 5 main layers. Starting from the ground level, they are as follows:

Troposphere: 0 to 12 km (0 to 7 miles)

Containing about 80% of the Earth's atmosphere by mass, the troposphere extends from the surface to about 7 miles above the surface. This value is smaller at the poles and larger at the equator and also varies somewhat with local weather. Nearly all of the moisture in the air is contained in this layer. As a result, most weather takes place in this layer. Because of its density, it is the only region of the atmosphere where propeller driven aircraft can operate and it is the realm of commercial flights as well. In general, the temperature lowers as you go higher into the troposphere. The separation between the troposphere and the next layer can be seen by the fact that the temperature stops falling and in some cases, actually starts to go up.

Stratosphere: 12 to 50 km (7 to 31 miles)

The stratosphere sits on top of the troposphere. It is marked by rising temperature with rising altitude. The stratosphere contains the ozone layer. Ultra Violet radiation from the sun is absorbed by the ozone causing this layer to warm up. This causes the stratosphere to be relatively stable with little mixing and turbulence. Because of this, there are usually no clouds or other forms of weather here. The temperature rise can be substantial. The temperature may be about -75 °F at the transition from troposphere to stratosphere, but may be +32 °F at the transition to the next level. This is the highest layer for jet engines to operate.

Mesosphere: 50 to 80 km (31 to 50 miles)

The temperature profile returns to dropping with an increase in altitude. At the top of this layer (considered by some to be the coldest place on the Earth) the temperature can average -120 °F. Here, any moisture available can turn directly from vapor to ice and form noctilucent clouds. These are the highest clouds in our atmosphere. The air is too thin to allow engines to burn fuel so aircraft in this zone must bring their own oxidizer or use rockets for propulsion. Most meteors entering our atmosphere burn up here. Satellites cannot use this area because the air is still dense enough to create too much drag on spacecraft.

Thermosphere: 80 to 700 km (50 to 440 miles)

The thermosphere is again marked by a temperature inversion. The temperature starts to go up with altitude again. And the temperatures can get very high. But there is so little material that these hot molecules rarely interact with material enough to transfer significant heat. This thin air has little enough drag that spacecraft can operate in this region. There is some debate about where space starts. Many people say 50 miles. Others use 100 km. Many international treaties use this 100 km (62 miles) as their value. This is known as the Kármán Line. Whatever you want to believe, it is clear that space starts in the Thermosphere. This is where the International Space Station (ISS) operates. There is still enough matter in this layer that the ISS needs to boost itself up into a higher orbit every once in a while due to the loss of altitude due to friction. This drag can get worse depending on atmospheric heating. There is no moisture here. But this is the region that the Southern and Northern lights can be found.

Exosphere: 700 to 10,000 km (440 to 6,200 miles)

This is the upper most part of the atmosphere. The air is so thin that the molecules may need to travel hundreds of kilometers to hit another molecule. There is no moisture or weather. Most of the satellites orbiting the Earth orbit in this layer. The molecules here are also loosely bound to the Earth and can get pulled around by the Earth's magnetic field, drawn into the solar wind, or just ejected from the Earth.

Each region between the layers is a transition layer with the name ending in -pause (tropopause, stratopause, mesopause, thermopause). Since the layers are not defined by a ridged requirement on material or pressure, these areas are used to identify the regions where the atmosphere is moving from one layer to the next.

