Layers of the Atmosphere

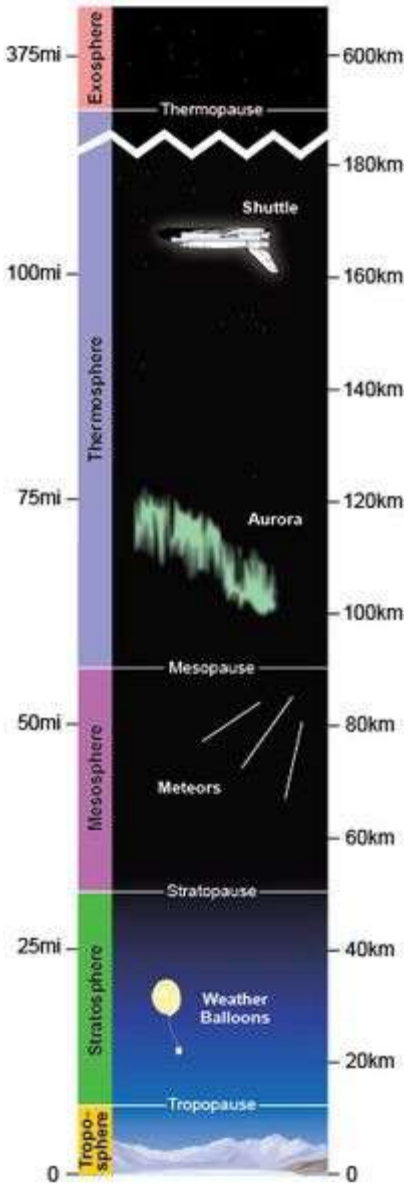
This text is adapted from the U.S. National Oceanic and Atmospheric Administration: National Weather Service.

Earth's atmosphere is a cloud of gas and suspended solids that surrounds the planet.

The envelope of gas surrounding the earth changes from the ground up. Five distinct layers have been identified using. . .

- thermal characteristics (temperature changes),
- chemical composition,
- movement, and
- density.

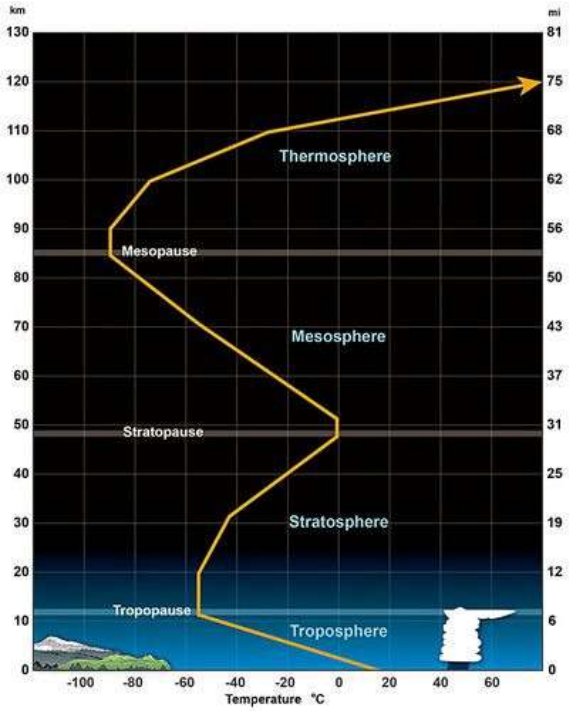
Each of the layers are bounded by "pauses" where the greatest changes in thermal characteristics, chemical composition, movement, and density occur.



The five basic layers of the atmosphere

Exosphere

This is the outermost layer of the atmosphere. It extends from the top of the thermosphere to 6,200 miles (10,000 km) above the earth. In this layer, atoms and molecules escape into space and satellites orbit the earth. At the bottom of the exosphere is the thermopause located around 375 miles (600 km) above the earth.



Thermosphere

Between about 53 miles (85 km) and 375 miles (600 km)

Average temperature profile for the lower layers of the atmosphere

lies the thermosphere. This layer is known as the upper atmosphere. While still extremely thin, the gases of the thermosphere become increasingly more dense as one descends toward the earth.

As such, incoming high energy ultraviolet and x-ray radiation from the sun begins to be absorbed by the molecules in this layer and causes a large temperature increase.

Because of this absorption, the temperature increases with height. From as low as -184°F (-120°C) at the bottom of this layer, temperatures can reach as high as 3,600°F (2,000°C) near the top.

However, despite the high temperature, this layer of the atmosphere would still feel very cold to our skin due to the very thin atmosphere. The high temperature indicates the amount of the energy absorbed by the molecules but with so few in this layer, the total number of molecules is not enough to heat our skin.

Mesosphere

This layer extends from around 31 miles (50 km) above the earth's surface to 53 miles (85 km). The gases, including the oxygen molecules, continue to become more dense as one descends. As such, temperatures increase as one descends rising to about 5°F (-15°C) near the bottom of this layer.

The gases in the mesosphere are now thick enough to slow down meteors hurtling into the atmosphere, where they burn up, leaving fiery trails in the night sky. Both the stratosphere (next layer down) and the mesosphere are considered the middle atmosphere. The transition boundary, which separates the mesosphere from the stratosphere, is called the stratopause.

Stratosphere

The Stratosphere extends around 31 miles (50 km) down to anywhere from 4 to 12 miles (6 to 20 km) above the earth's surface. This layer holds 19 percent of the atmosphere's gases but very little water vapor.

In this region the temperature increases with height. Heat is produced in the process of the formation of Ozone and this heat is responsible for temperature increases from an average -60°F (-51°C) at tropopause to a maximum of about 5°F (-15°C) at the top of the stratosphere.

This increase in temperature with height means warmer air is located above cooler air. This prevents "convection" as there is no upward vertical movement of the gases. As such the location of the bottom of this layer is readily seen by the 'anvil-shaped' tops of cumulonimbus clouds.

Troposphere

Known as the lower atmosphere almost all weather occurs in this region. The troposphere begins at the earth's surface and extends from 4 to 12 miles (6 to 20 km) high.

The height of the troposphere varies from the equator to the poles. At the equator it is around 11-12 miles (18-20 km) high, at 50°N and 50°S, 5½ miles and at the poles just under four miles high.

As the density of the gases in this layer decrease with height, the air becomes thinner. Therefore, the temperature in the troposphere also decreases with height in response. As one climbs higher, the temperature drops from an average around 62°F (17°C) to -60°F (-51°C) at the tropopause.