

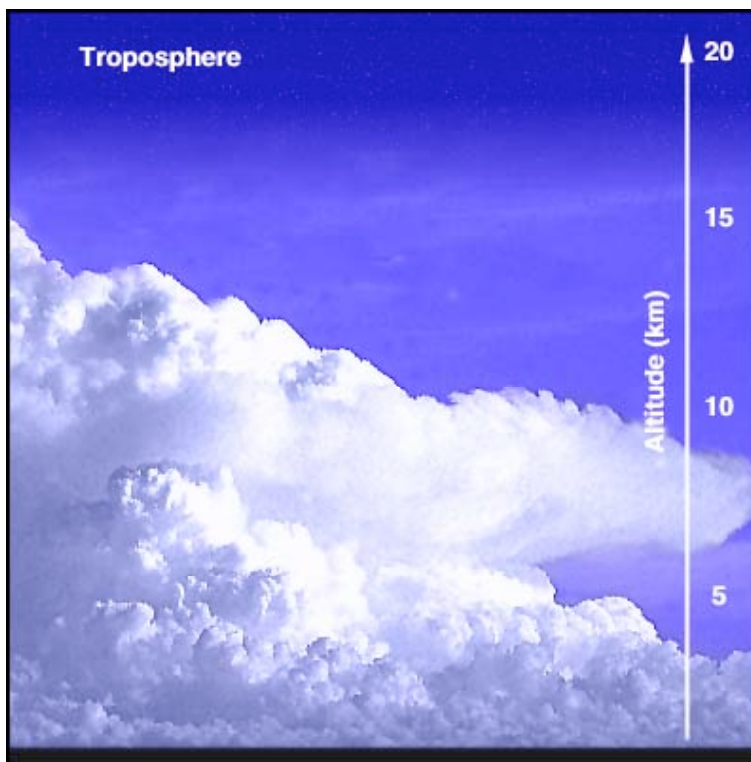
## The Layers of Earth's Atmosphere

### Dividing up the Atmosphere

The Earth's atmosphere can be divided into several layers. How the layers are defined can vary depending upon what properties are taken into consideration. We can define these layers based on many different properties of the atmosphere. Layers defined by different types of properties can overlap.

Temperature is one important property that varies in our atmosphere. Based on temperature changes, the atmosphere can be broken into four major layers, and another three small intermediate layers that serve as transition regions from one layer to the next. There is the troposphere and tropopause, the stratosphere and stratopause, the mesosphere and mesopause, and the thermosphere.

The troposphere is the layer of the atmosphere that is closest to the ground. This is the layer that we live in. As light from the Sun reaches the ground, some of it is absorbed and converted into **thermal energy** (the energy associated with heat). This thermal energy spreads through the atmosphere by **conduction** and **convection**. The result is that the troposphere is warmest near the ground, and it gets cooler as we go to higher **altitudes** (distance up from the surface of the Earth). The mixing of air also leads to weather! Air continues to cool with altitude for an average of 12 km above the Earth's surface, but actual heights can vary with weather and time of day to between 8 and 18 km. Above the troposphere the temperature stops changing at an average value of about 220 K. This region is called the tropopause.



The troposphere is the home of the everyday weather we are used to.

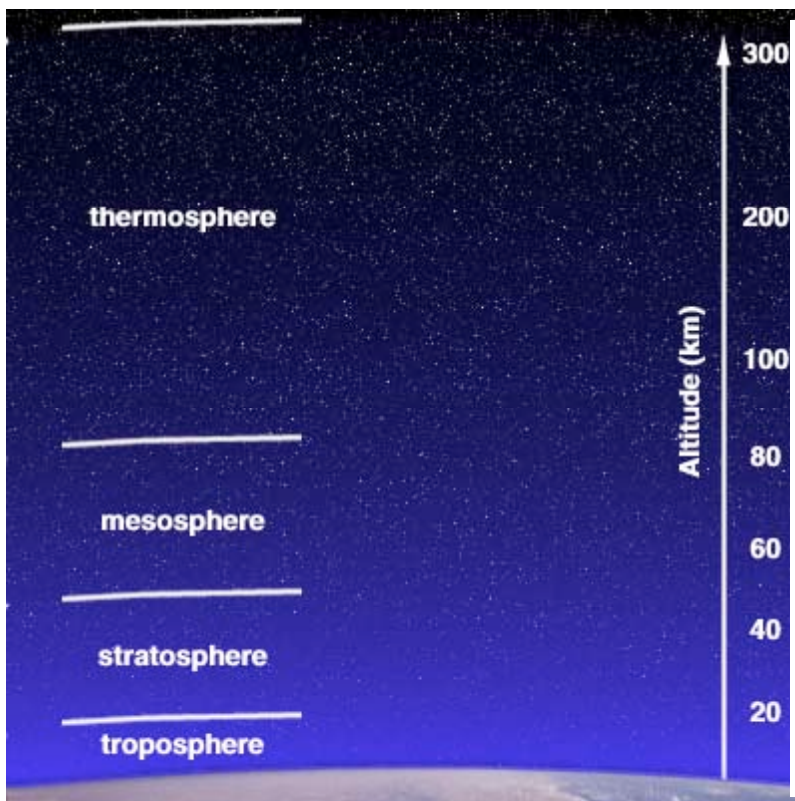
*Image Credit: NASA*

Source:

[http://daac.gsfc.nasa.gov/CAMPAIGN\\_DOCS/ATM\\_CHEM/atmospheric\\_structure.html](http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/ATM_CHEM/atmospheric_structure.html)

Temperature changes differently with altitude in the next layer, the stratosphere. Past the tropopause, temperature actually increases with height! The stratosphere continues up to an altitude of about 50 km. Temperatures rise in the stratosphere because it contains most of what is known as the **ozone layer** in a different layering system. Ozone absorbs most of the dangerous ultraviolet light that comes from the Sun to the Earth. This protects us, on the surface, from this harmful radiation, but it also serves another purpose. The ozone converts the energy of the ultraviolet light into thermal energy, heating the stratosphere. The stratopause is the transition region between the stratosphere and the mesosphere. The stratopause takes over from the stratosphere at about 45 km. In this thin region, the temperature stops changing again. With the ozone layer heating it from below, the mesosphere is warmer at lower altitudes and cools at higher altitudes. This decreasing temperature with height continues throughout the mesosphere up to an altitude of about 80 km.

The mesopause separates the mesosphere from the thermosphere, and it again has roughly the same temperature throughout the layer. The mesopause is the coldest layer of the atmosphere with an average temperature of about 180 K. Above the mesopause, the thermosphere starts at about 90 km. The thermosphere is heated mostly by absorbing radiation from the Sun. The thermosphere is hotter at higher altitudes where it is closer to the Sun, and it absorbs more ultraviolet radiation. This layer reaches an altitude of about 750 km. At this altitude, the temperature stops changing as we go higher, and the remaining atmosphere above this altitude is called the thermopause. The thermopause has a very high temperature, often over 1000 K. At extreme altitudes of hundreds of km or more, gas molecules are few and far between. With so little gas, it is hard to say where the thermopause ends. Scientists usually adopt 2000 km for the top of the atmosphere.



The layers of the atmosphere, as defined by temperature, are shown with the edge of the Earth.

Notice how the darkness of space and the brightness of the stars quickly become more apparent as the gases of the atmosphere become thinner with increasing altitude.

*Image is courtesy of NASA.*

Source:

[http://daac.gsfc.nasa.gov/CA\\_MPAIGN\\_DOCS/ATM\\_CH\\_EM/layers.html](http://daac.gsfc.nasa.gov/CA_MPAIGN_DOCS/ATM_CH_EM/layers.html)