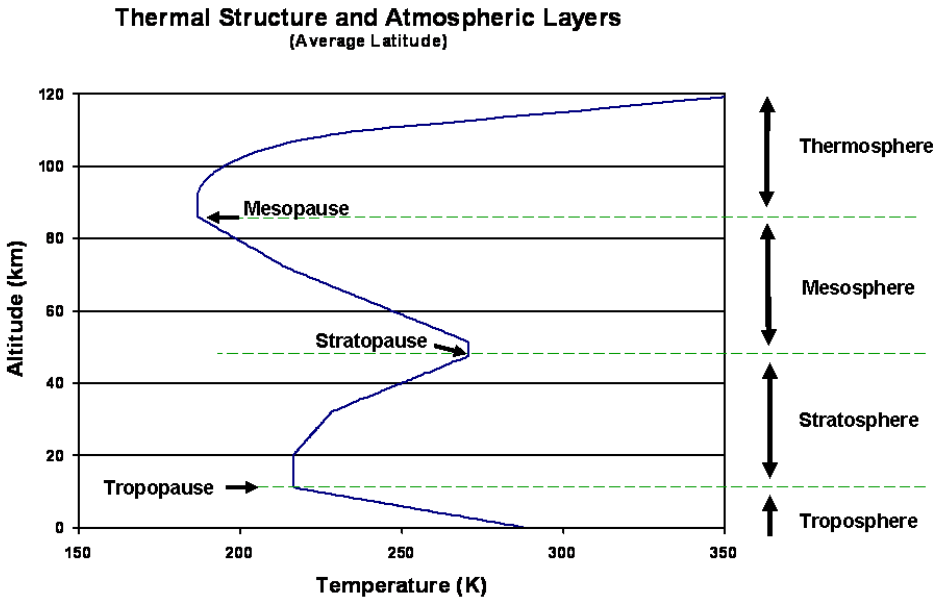
LAYER OF THE ATMOSPHERE

https://vortex.plymouth.edu/atmosphere/layers

Our planet's unique atmosphere contains four distinct layers. These layers are divided vertically on the basis of temperature. The different layers alternate between regions of increasing temperature and decreasing temperature with height.

The figure below shows how temperature varies with altitude in the atmosphere. The x-axis represents temperature in degrees Celsius and the y-axis represents altitude. Note the alternating regions of decreasing and increasing temperature with height. An *inversion* exists when temperature increases with altitude. The figure below shows the four layers : the Troposphere, the Stratosphere, the Mesosphere, and the Thermosphere. Between each layer exists a "pause" in which the temperature remains constant with height.

THERMAL STRUCTURE OF THE ATMOSPHERE



The Troposphere

Meteorologists spend most of their time studying the processes in the troposphere. It is often thought of as the "zone of weather". All of the precipitation, winds, storms, and clouds (except a few observed in the stratosphere and mesosphere) we observe occur in this bottom-most layer. The troposphere is characterized by turbulent mixing and overturning. This turbulence results from uneven heating of the surface and the atmosphere. Temperature decreases with height in this layer. This temperature decrease is known as the environmental lapse rate and averages 6.5 ºC/km. This layer extends from the surface up to an average altitude of 11 km. This altitude can range as high as 16 km in the tropics to less than 9 km over the poles. This range is due to the temperature differences between the tropics and poles. The warm surface temperatures and turbulent mixing over the tropics help to push the troposphere's boundary upward.

The tropopause extends above the troposphere. Temperature remains constant with height in this layer. Jet streams flow through the tropopause where the latitudinal variations in temperature are great.

The Stratosphere

The stratosphere lies above the tropopause, extending to a height of about 50 km. The stratosphere is characterized by a strong temperature inversion, as shown by the above figure. This is a stable layer with little mixing. As a result, pollutants and other particles may reside in the stratosphere for many years. A large concentration of ozone (O_3) is found in the stratosphere, with a maximum concentration at about 25 km. This "ozone layer" absorbs much of the ultraviolet radiation emitted by the sun. Heat is

released as the UV is absorbed, which then heats the atmosphere. This explains why temperature increases with height in this layer.

It is interesting to note that the inversion continues beyond the maximum density of ozone. The reason for this is that much of the available UV radiation is already absorbed by ozone above the level of maximum density. Therefore, there is less potential UV that can be absorbed, resulting in lower temperatures near the bottom of the stratosphere.

The stratopause lies above the stratosphere, and like the tropopause, temperature remains constant with height. At the stratopause, the pressure is only 1 mb! This means 99.9% of the atmosphere is contained in the stratosphere and troposphere. Yet the atmosphere continues upward: 99% of the remaining mass is found in the mesosphere and 1% in the thermosphere.

The Mesosphere

The mesosphere lies above the stratosphere and extends to an altitude of about 85 km. This is layer is often referred to as the cold layer, as the lowest readings in the atmosphere are found here. Temperature decreases with height, reaching a minimum average value of -90 ºC at the top of the layer. The upper part of the mesosphere contains part of the ionosphere, an electrified region. Occasionally in the polar regions, noctilucent clouds in the mesosphere can be seen. These are seen in the summer when there is sufficient lifting. The existence of these clouds proves that even at this altitude, there is still a trace amount of moisture. The mesopause lies above the mesosphere, separating it from the thermosphere.

The Thermosphere

The thermosphere is often considered the "hot layer" because it contains the warmest temperatures in the atmosphere. Temperature increases with height

until the estimated top of the thermosphere at 500 km. Temperatures can reach as high as 2000 K or 1727 ºC in this layer. However, because the air is so thin, our bodies would not be able to detect this heat. Our bodies rely on the constant bombardment of air molecules to detect temperature. The air is so thin that a molecule will travel 1 kilometer before striking another molecule (Compare that with less than a millionth of a centimeter at the earth's surface). At the top of the thermosphere, molecules will move 10 km before striking another molecule. At this height, many lighter molecules have attained enough velocity to escape earth's gravity into outer space. The region where air molecules escape is known as the exosphere.