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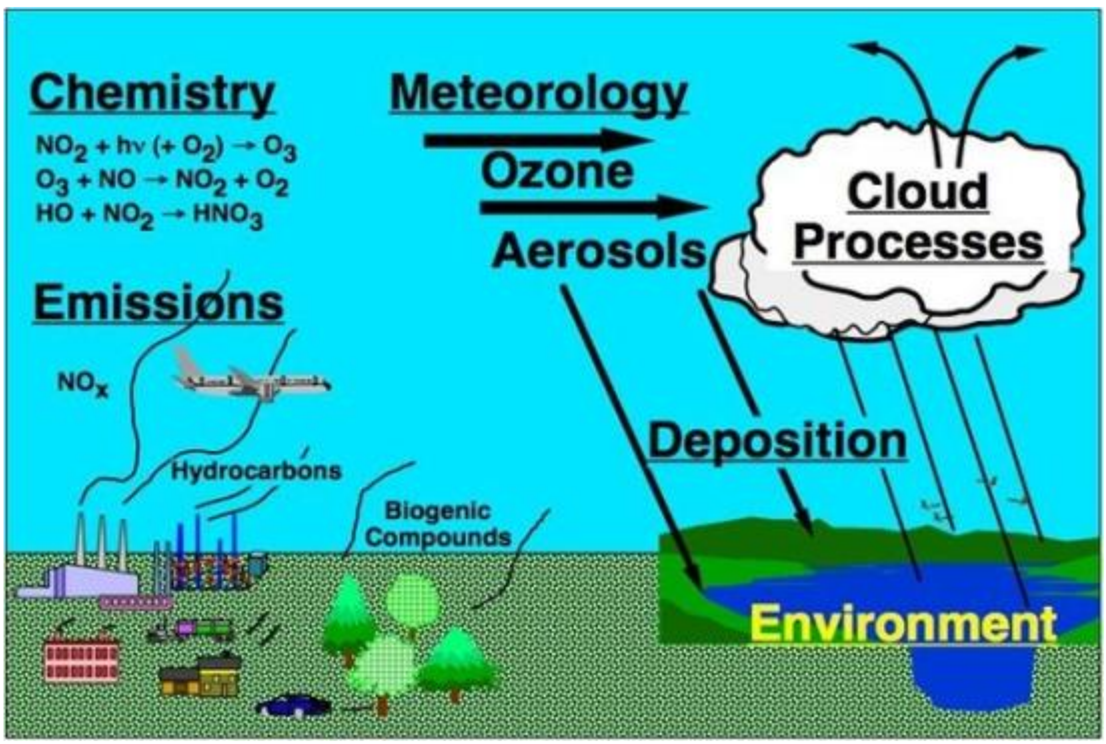
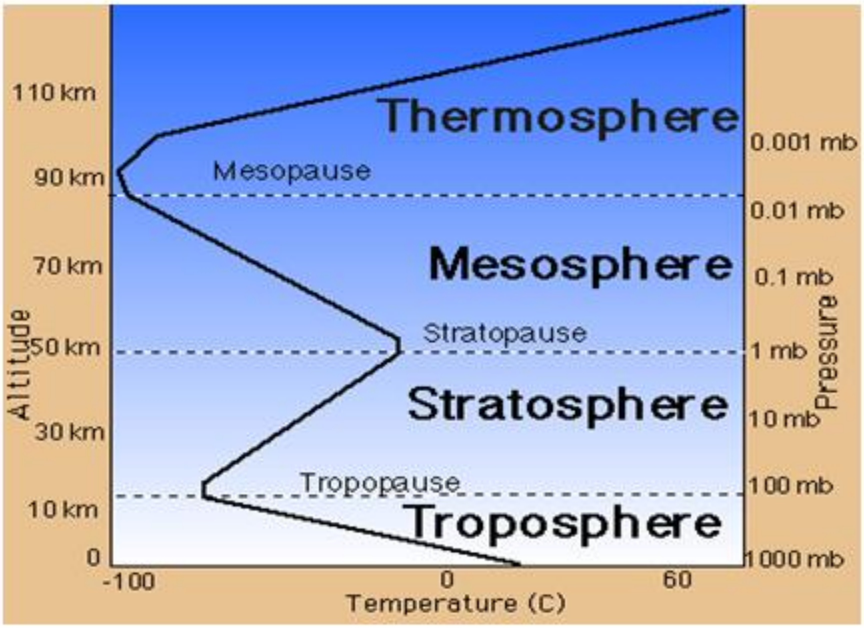
Atmospheric chemistry

Atmospheric chemistry: involves study of the chemistry of the atmospheres of Earth and other planets. It is a branch of atmospheric science and is a multidisciplinary field of research, drawing on environmental chemistry, meteorology, physics, computer modeling, oceanography, geology, volcanology, and other disciplines. In addition, it is being increasingly associated with the field known as climatology.



Stricture of the atmosphere

Atmospheric layers are characterized by variations in temperature resulting primarily from the absorption of solar radiation; visible light at the surface, near ultraviolet radiation in the middle atmosphere, and far ultraviolet radiation in the upper atmosphere.



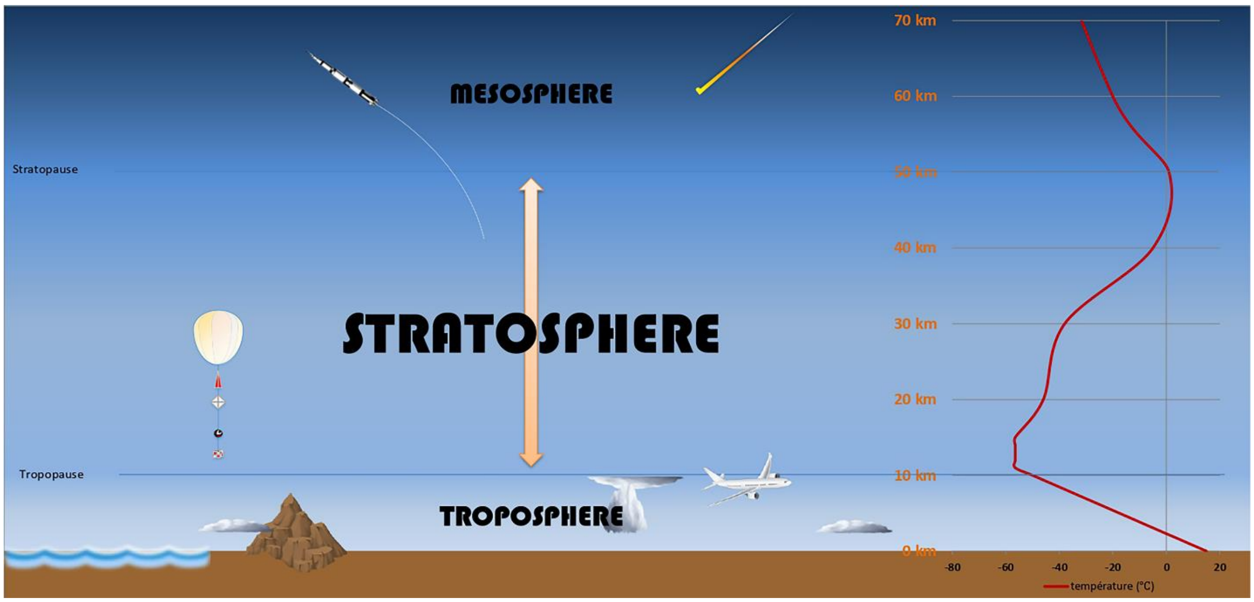
Troposphere

The troposphere is the atmospheric layer closest to the planet and contains the largest percentage (around 80%) of the mass of the total atmosphere. Temperature and water vapor content in the troposphere decrease rapidly with altitude. Water vapor plays a major role in regulating air temperature because it absorbs solar energy and thermal radiation from the planet's surface. The troposphere contains 99 % of the water vapor in the atmosphere. Water vapor concentrations vary with latitude. They are greatest above the tropics, where they may be as high as 3 %, and decrease toward the polar regions. All weather phenomena occur within the troposphere, although turbulence may extend into the lower portion of the stratosphere. Troposphere means "region of mixing" and is so named because of vigorous convective air currents within the layer. The upper boundary of the layer, known as the tropopause, ranges in height from 5 miles (8 km) near the poles up to 11 miles (18 km) above the equator. Its height also varies with the seasons; highest in the summer and lowest in the winter.

Stratosphere

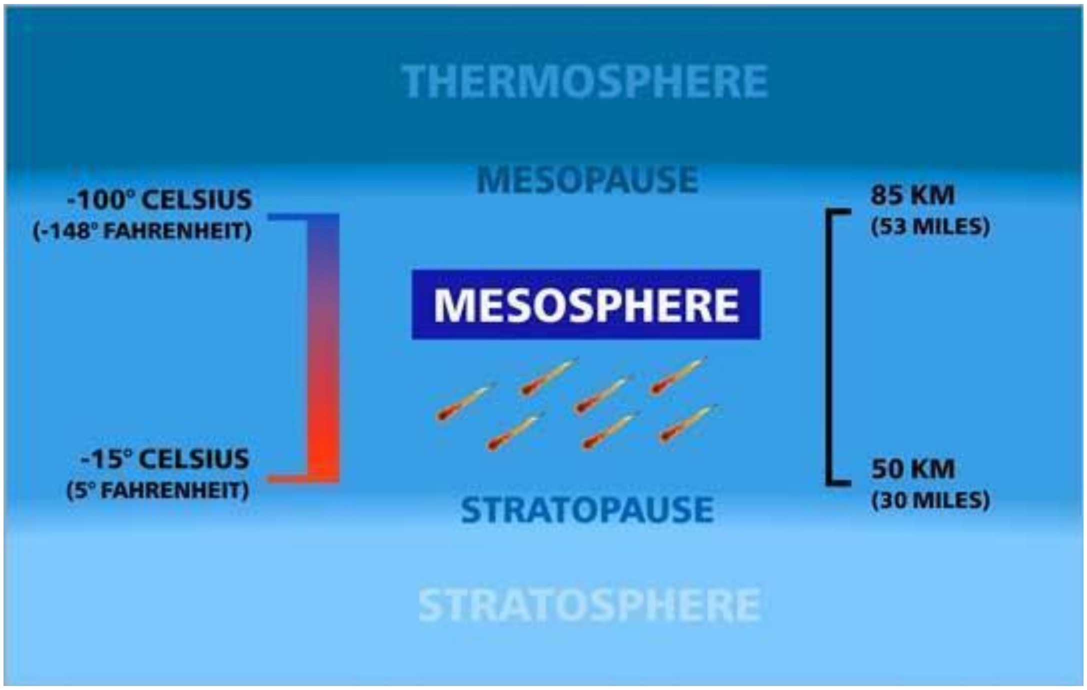
The stratosphere is the second major strata of air in the atmosphere. It extends above the tropopause to an altitude of about 30 miles (50 km) above the planet's surface. The air temperature in the stratosphere remains relatively constant up to an altitude of 15 miles (25 km). Then it increases gradually to up to the stratopause. Because the air temperature in the stratosphere increases with altitude, it does not cause convection and has a stabilizing effect on atmospheric conditions in the region. Ozone plays the major role in regulating the thermal regime of the stratosphere, as water vapor content within the layer is very low. Temperature increases with ozone concentration. Solar energy is converted to kinetic energy when ozone molecules absorb ultraviolet radiation, resulting in heating of the stratosphere. The ozone layer is centered at an altitude between 10-15 miles

(15-25 km). Approximately 90 % of the ozone in the atmosphere resides in the stratosphere. Ozone concentration in this region is about 10 parts per million by volume (ppmv) as compared to approximately 0.04 ppmv in the troposphere. Ozone absorbs the bulk of solar ultraviolet radiation in wavelengths from 290 nm - 320 nm (UV-B radiation). These wavelengths are harmful to life because they can be absorbed by the nucleic acid in cells. Increased penetration of ultraviolet radiation to the planet's surface would damage plant life and have harmful environmental consequences. Appreciably large amounts of solar ultraviolet radiation would result in a host of biological effects, such as a dramatic increase in cancers.



Mesosphere

The mesosphere a layer extending from approximately 30 to 50 miles (50 to 85 km) above the surface, is characterized by decreasing temperatures. The coldest temperatures in Earth's atmosphere occur at the top of this layer, the mesopause, especially in the summer near the pole. The mesosphere has sometimes jocularly been referred to as the "ignorosphere" because it had been probably the least studied of the atmospheric layers. The stratosphere and mesosphere together are sometimes referred to as the middle atmosphere.



Thermosphere

The thermosphere is located above the mesosphere. The temperature in the thermosphere generally increases with altitude reaching 600 to 3000 F (600-2000 K) depending on solar activity. This increase in temperature is due to the absorption of intense solar radiation by the limited amount of remaining molecular oxygen. At this extreme altitude gas molecules are widely separated. Above 60 miles (100 km) from Earth's surface the chemical composition of air becomes strongly dependent on altitude and the atmosphere becomes enriched with lighter gases (atomic oxygen, helium and hydrogen). Also at 60 miles (100 km) altitude, Earth's atmosphere becomes too thin to support aircraft and vehicles need to travel at orbital velocities to stay aloft. This demarcation between aeronautics and astronautics is known as the Karman Line. Above about 100 miles (160 km) altitude the major atmospheric component becomes atomic oxygen. At very high altitudes, the residual gases begin to stratify according to molecular mass, because of gravitational separation.

Exosphere

The exosphere is the most distant atmospheric region from Earth's surface. In the exosphere, an upward travelling molecule can escape to space (if it is moving fast enough) or be pulled back to Earth by gravity (if it isn't) with little probability of colliding with another molecule. The altitude of its lower boundary, known as the thermopause or exobase, ranges from about 150 to 300 miles (250-500 km) depending on solar activity. The upper boundary can be defined theoretically by the altitude (about 120,000 miles, half the distance to the Moon) at which the influence of solar radiation pressure on atomic hydrogen velocities exceeds that of the Earth's gravitational pull. The exosphere observable from space as the geocorona is seen to extend to at least 60,000 miles from the surface of the Earth. The exosphere is a transitional zone between Earth's.

Earth's atmosphere is composed of about 78 percent nitrogen, 21 percent oxygen, and small amounts of water vapor, carbon dioxide, argon, and other gases. This mixture of gases, commonly called air, protects and sustains life on Earth in a variety of ways. It provides oxygen for respiration, carbon dioxide for photosynthesis, and water vapor for the precipitation that replenishes moisture in the soil. In addition, carbon dioxide and water vapor act as "greenhouse gases" that keep the Earth sufficiently warm to maintain life. Nitrogen is used by "nitrogen-fixing" bacteria to produce compounds that are useful for plant growth. Water vapor prevents exposed living tissue from drying up. Ozone in the stratosphere absorbs ultraviolet solar radiation that could damage living tissue. In addition, higher layers of the atmosphere protect the Earth from bombardment by meteorites and charged particles in the solar wind.

The residence time

The residence time (or lifetime) is defined as the amount of the chemical in the atmosphere divided by the rate at which the chemical is removed from the atmosphere. This time scale characterizes the rate of adjustment of the atmospheric concentration of the chemical if the emission rate is changed suddenly.

Oxidation

Oxidation is defined as a process in which an electron is removed from a molecule during a chemical reaction. What happens in oxidation? During oxidation, there is a transfer of electrons. In other words, during oxidation, there is a loss of electrons. When oxygen combines with an element or compound, an oxidation reaction occurs. Oxidation can also be defined as the process of the removal of hydrogen from the reactant species. Oxidation is the process of losing electrons by a molecule, atom, or ion.

Blackbody radiation

Blackbody radiation is a term used to describe the relationship between an object's temperature, and the wavelength of electromagnetic radiation it emits. A black body is an idealized object that absorbs all electromagnetic radiation it comes in contact with.