**Definition:** atmosphere from *Dictionary of Energy* Earth Science. 1. the envelope of gases surrounding the earth and held to it by the force of gravity. It consists of four distinct layers, whose boundaries are not precise: the troposphere (extending from sea level to about 5-10 miles above the earth), the stratosphere (up to about 30 miles), the mesosphere (up to about 60 miles), and the thermosphere (up to about 300 miles or more). The upper region of the troposphere is often regarded as a separate region, the exosphere. 2. the pressure of the earth’s atmosphere at sea level; see atmospheric pressure.

**Summary Article:** atmosphere From *The Hutchinson Unabridged Encyclopedia with Atlas and Weather Guide*

Mixture of gases surrounding a planet. Planetary atmospheres are prevented from escaping by the pull of gravity. On Earth, atmospheric pressure decreases with altitude. In its lowest layer, the atmosphere consists of nitrogen (78%) and oxygen (21%), both in molecular form (two atoms bonded together) and argon (1%). Small quantities of other gases are important to the chemistry and physics of the Earth's atmosphere, including water, carbon dioxide, and traces of other noble gases (rare gases), as well as ozone. The atmosphere plays a major part in the various cycles of nature (the water cycle, the carbon cycle, and the nitrogen cycle). It is the principal industrial source of nitrogen, oxygen, and argon, which are obtained by the fractional distillation of liquid air.

The Earth's atmosphere is divided into four regions of atmosphere classified by temperature.

**Troposphere** This is the lowest level of the atmosphere (altitudes from 0 to 10 km/6 mi) and it is heated to an average temperature of 15°C/59°F by the Earth, which in turn is warmed by infrared and visible radiation from the Sun. Warm air cools as it rises in the troposphere and this rising of warm air causes rain and most other weather phenomena. The temperature at the top of the troposphere is approximately −60°C/−76°F.

**Stratosphere** Temperature increases with altitude in this next layer (from 10 km/6 mi to 50 km/31 mi), from −60°C/−76°F to near 0°C/32°F.

**Mesosphere** Temperature again decreases with altitude through the mesosphere (50 km/31 mi to 80 km/50 mi), from 0°C/32°F to below −100°C/−148°F.

**Thermosphere** In the highest layer (80 km/50mi to about 700 km/450 mi), temperature rises with altitude to extreme values of thousands of degrees. The meaning of these extreme temperatures can be misleading. High thermosphere temperatures represent little heat because they are defined by motions among so few atoms and molecules spaced widely apart from one another.

The thermal structure of the Earth's atmosphere is the result of a complex interaction between the electromagnetic radiation from the Sun, radiation reflected from the Earth's surface, and molecules and atoms in the atmosphere. High in the thermosphere temperatures are high because of collisions.

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between ultraviolet (UV) photons and atoms of the atmosphere. Temperature decreases at lower levels because there are fewer UV photons available, having been absorbed by collisions higher up. The thermal minimum that results at the base of the thermosphere is called the mesopause. The temperature maximum near the top of the stratosphere is called the stratopause. Here, temperatures rise as UV photons are absorbed by heavier molecules to form new gases. An important example is the production of ozone molecules (oxygen atom triplets, O₃) from oxygen molecules. Ozone is a better absorber of ultraviolet radiation than ordinary (two-atom) oxygen, and it is the ozone layer within the stratosphere that prevents lethal amounts of ultraviolet from reaching the Earth's surface. The temperature minimum between the stratosphere and troposphere marks the influence of the Earth's warming effects and is called the tropopause.

Ionosphere At altitudes above the ozone layer and above the base of the mesosphere (50 km/31 mi), ultraviolet photons collide with atoms, knocking out electrons to create a plasma of electrons and positively charged ions. The resulting ionosphere acts as a reflector of radio waves, enabling radio transmissions to ‘hop’ between widely separated points on the Earth's surface.

Solar activity Far above the atmosphere lie the Van Allen radiation belts. These are regions in which high-energy charged particles travelling outwards from the Sun (the solar wind) have been captured by the Earth's magnetic field. The outer belt (about 1,600 km/1,000 mi) contains mainly protons, the inner belt (about 2,000 km/1,250 mi) contains mainly electrons. Sometimes electrons spiral down towards the Earth, noticeably at polar latitudes, where the magnetic field is strongest. When such particles collide with atoms and ions in the thermosphere, light is emitted. This is the origin of the glows visible in the sky as the aurora borealis (northern lights) and the aurora australis (southern lights).

During periods of intense solar activity, the atmosphere swells outwards; there is a 10–20% variation in atmosphere density. One result is to increase drag on satellites. This effect makes it impossible to predict exactly the time of re-entry of satellites.

Atmospheric chemistry The chemistry of atmospheres is related to the geology of the planets they envelop. Unlike Earth, Venus’s dense atmosphere is dominantly carbon dioxide (CO₂). The carbon dioxide-rich atmosphere of Venus absorbs infrared radiation emanating from the planet’s surface, causing the very high surface temperatures capable of melting lead (see greenhouse effect). If all of the carbon dioxide that has gone to form carbonate rock (see limestone) on Earth were liberated into the troposphere, our atmosphere would be similar to that of Venus. It is the existence of liquid water, which enables carbonate rock to form on Earth, that has caused the Earth's atmosphere to differ substantially from the Venusian atmosphere.

Other atmospheric ingredients are found in particular localities: gaseous compounds of sulphur and nitrogen in towns, salt over the oceans; and everywhere dust composed of inorganic particles, decaying organic matter, tiny seeds and pollen from plants, and bacteria. Of particular importance are the human-made chlorofluorocarbons (CFCs) that destroy stratospheric ozone.

Development of the atmosphere It is thought that the Earth was formed about 4,600 million years ago. The inside of the Earth was very hot and full of chemical activity, causing hot gases to burst out through volcanoes on the Earth's surface. Slowly, over millions of years, the Earth's atmosphere developed from these gases. The most common gases produced by volcanoes are water vapour, nitrogen, and carbon dioxide. The water vapour cooled and condensed to form the seas and oceans.

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Much of the carbon dioxide dissolved in rainwater and sea water, leaving nitrogen as the major component of the atmosphere. Following the evolution of green plants 2,200 million years ago and the start of photosynthesis, more carbon dioxide was used up and oxygen was produced. The result was the development of the Earth's unique atmosphere, mainly oxygen and nitrogen with small amounts of carbon dioxide. The composition of gases in dry air has been about the same for 200 million years.

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The Earth: Structure and Atmosphere

Ozone: Thinning of the Ozone Layer

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barometer
carbon cycle
greenhouse effect

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