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Air is a mixture of gases. Three elements make up over 99.9 percent of the composition of dry air: these are nitrogen, oxygen, and argon. Composition of Dry Air The DataThe numbers below are averages. In modern times, the percentage of carbon dioxide in air has been rising with the burning of fossil fuels. Methane has also risen significantly.Nitrogen78.08% Oxygen20.95% Argon 0.93% Carbon Dioxide0.04% Neon0.018% Helium0.00052% Methane0.00018% Krypton0.00011% Hydrogen0.000055% Nitrous Oxide0.000032% Carbon Monoxide0.00002% Xenon0.0000087% Solid argonHow Airs Composition was Discovered In 1640, the Flemish chemist Jan Baptist van Helmont burned charcoal to produce the previously unidentified gas carbon dioxide. In 1674, the English physician John Mayow established that air is not a single element, it is made up of different substances. He did this by showing that only a part of air is combustible. Most of it is not.Nitrogen, Oxygen, and Carbon DioxideIn the 1750s, the Scottish chemist Joseph Black discovered that carbon dioxide is present in air.In 1772, the Scottish chemist Daniel Rutherford, who was actually Joseph Blacks student, reported his discovery of noxious air, which we now call nitrogen.In 1774, oxygen was discovered by the English chemist Joseph Priestley, although two years earlier in Sweden Carl Scheele had discovered oxygen, but had not published his results. In 1785, Sir Henry Cavendish was dissatisfied with scientific knowledge about the air around us, which was believed to be entirely composed of oxygen, nitrogen, and carbon dioxide.He knew nitrogen in air could be reacted with oxygen to form, ultimately, nitrous acid. He aimed to find out if ALL of the air that was not oxygen or carbon dioxide could be converted to nitrous acid. If it could, he would have proved that air was entirely oxygen, carbon dioxide and nitrogen.Cavendish sparked air in a jar with electricity to react oxygen and nitrogen to form nitrogen oxides. He then added additional oxygen and sparked the air again until all the nitrogen had reacted.Nitrogen oxides are acidic. Cavendish used aqueous sodium hydroxide to remove them from the apparatus. [This would also, of course, have removed any carbon dioxide that was present.] He removed the remaining oxygen using potassium polysulfides.A small bubble of gas remained. We know now this was mostly argon. Cavendish wrote that this bubble was not more than one hundred and twentieth of the bulk of the phlostigated air [nitrogen]. (1) At Least One More Gas is Present in AirSo, Cavendish had learned that air is at least 99.3 percent nitrogen/oxygen/carbon dioxide with a maximum 0.7 percent of something else. We now know that the something else, argon, is very unreactive; this enabled Cavendish to find it, but it also prevented him finding out more about it. (The giant advances in spectroscopy made by Gustav Kirchhoff and Robert Bunsen lay 85 years in the future.) In hindsight, we can say Cavendish slightly underestimated the part of air that isnt oxygen, nitrogen, or carbon dioxide. Despite this, he was ahead of his time. After his experiment, more than 100 years passed until scientists again began to think that something about air didnt quite add up. In 1892 John William Strutt (better known as Lord Rayleigh) announced that no matter how it was prepared, oxygen was always 15.882 times denser than hydrogen. This very precise work had taken ten years to complete.Continuing to work with great attention to detail, he found that the nitrogen in air was always denser by about 0.5 percent than nitrogen sourced from nitrogen compounds. (2), (3) How could this be explained? In 1893, Rayleigh wrote to Nature, announcing the problem to the world. (Any scientist who responded to that challenge actually had the chance of discovering a new element. None did!)In April 1894, Rayleigh wrote an academic paper about the nitrogen problem. Funnily enough, he viewed pure nitrogen, containing no argon, as abnormally light nitrogen. He stored it for eight months and retested it to see whether its density would increase. (4)Rayleighs paper awakened the serious interest of William Ramsay, who had already been aware of the problem.Rayleigh and Ramsay carried out further experiments, keeping in touch with one another about their progress.Argon and the Noble GasesIn August 1894, Ramsay took air and removed its components oxygen, carbon dioxide and nitrogen. He removed the nitrogen by reacting it with magnesium. After removing all the known gases from air, he found the gas remaining occupied one-eightieth of the original volume. Its spectrum matched no known gas.Rayleigh and Ramsay wrote a joint paper in 1895 notifying the world of their discovery. The new gas wouldnt react with anything, so they named it argon, from the Greek argos, meaning inactive or lazy. (5)In his Nobel Prize winning address, Rayleigh said: Argon must not be deemed rare. A large hall may easily contain a greater weight of it than a man can carry. (6) William Ramsay discovered or codiscovered most of the other noble gases: helium, neon, krypton and xenon.He was responsible for adding an entire new group to the periodic table. Radon was the only noble gas he didnt discover. ReferencesEncyclopaedia Perthensis, or, Universal dictionary of the arts, Sciences, Literature, &c., 1816, vol 1, p231-232, John Brown. John H. Wolfenden, The Noble Gases and the Periodic Table: Telling it like it was., J. Chem. Educ., 1969, 46 (9), p569.Mary Elvira Weeks, The Discovery of the Elements. XVIII. The Inert Gases., J. Chem. Educ., 1932, 9 (12), p2065. Lord Rayleigh, On an Anomaly Encountered in Determinations of the Density of Nitrogen Gas., Proc. Roy. Soc. London, 1894, 55, p340. Vivi Ringnes, Origin of the Names of Chemical Elements, J. Chem. Educ., 1989, 66 (9), p731.Lord Rayleigh, The Density of Gases in the Air and the Discovery of Argon, Nobel Lecture, December 12, 1904. (pdf download.)Robert L. Kelly, David Hurst Thomas, Archaeology., Sixth Edition, 2012, Wadsworth, p137.Image by Deglr6328.To help you plan your year 11 chemistry lesson on: Earth's atmosphere (approximate values), download all teaching resources for free and adapt to suit your pupils' needs.The starter quiz will activate and check your pupils' prior knowledge, with versions available both with and without answers in PDF format.We use learning cycles to break down learning into key concepts or ideas linked to the learning outcome. Each learning cycle features explanations with checks for understanding and practice tasks with feedback. All of this is found in our slide decks, ready for you to download and edit. The practice tasks are also available as printable worksheets and some lessons have additional materials with extra material you might need for teaching the lesson.The assessment exit quiz will test your pupils' understanding of the key learning points.Our video is a tool for planning, showing how other teachers might teach the lesson, offering helpful tips, modelled explanations and inspiration for your own delivery in the classroom. Plus, you can set it as homework or revision for pupils and keep their learning on track by sharing an online pupil version of this lesson.Explore more key stage 4 chemistry lessons from the Atmosphere and changing climate unit, dive into the full secondary chemistry curriculum, or learn more about lesson planning. Some people are surprised to learn that oxygen isnt the most abundant gas in Earths atmosphere composition. Based on the relative volumes of the gases in Earths atmosphere, nitrogen is actually more than 3 times more than oxygen. Because the troposphere is the lowest atmosphere layer, it contains 75 percent of the atmospheres mass. From largest to smallest, Earths atmosphere composition contains nitrogen, oxygen, argon, CO2, and trace gases. Because water vapor is highly variable geographically, its excluded from this total. While nitrogen is the most abundant gas in Earths atmosphere, it only makes up 0.005% of Earths crust in weight (David Darling).Nitrogen is incredibly stable and requires a lot of energy to change forms.Even though its volume in Earths crust is relatively small, nitrogen plays an important role in the nitrogen cycle.As part of this cycle, nitrogen constantly exchanges between the atmosphere and living organisms. Earth has the conditions for life to flourish. Oxygen is essential to human life as our lungs respire oxygen and uses it in metabolism.While nitrogen is an extremely stable gas, its difficult to break up and use for chemical processes. But oxygen will readily take part in chemical reactions because its an electron thief.So even though nitrogen is plentiful, we need oxygen to drive chemical reactions that produce energy. As an inert gas, argon doesnt bond or do much in the atmosphere.This is why theres no argon cycle. But we have nitrogen and carbon because of their ability to bond with other elements.When potassium radioactively decays, argon is one of the possible products. And the lithosphere has lots of potassium.Its not too exciting of a gas. But its up in the atmosphere at 0.93% of air volume. Carbon is the most important element for building molecules essential for living things.As you can see from the long-term carbon cycle, carbon takes up various forms such as carbon dioxide (CO2), methane (CH4), and glucose (C6H12O6).Since 1900, carbon dioxide has increased mostly because of human activity. After extracting fossil fuels, humans burn fossil fuels.In turn, gases like methane and carbon dioxide become air pollution in the atmosphere. In fact, carbon dioxide has nearly doubled since 1900. The remaining portion of the atmosphere belongs to trace gases. For example, neon, helium, methane, and krypton are some of the major trace gases that make up a small part of the atmosphere.But humans can also cause some trace gases. For example, chlorofluorocarbons (CFCs) has damaged the ozone layer in the north and south pole.When chlorine enters the troposphere and eventually the stratosphere, it reacts with ozone (O3) essentially depleting it. Similar to ozone, water vapor is a variable gas. Water vapor has been removed from the 100% total because of its region variability. But it can make up large portions of the atmosphere. For example, it can make up 5% by volume in hot regions but much less in colder regions.Water vapor regulates air temperature because it absorbs solar radiation. It evaporates from lakes and rivers on the surface of Earth. Once its in the atmosphere, water vapor condenses such as in the form of rain. It simply changes form from water vapor to a liquid.As part of the hydrological cycle, water is always in motion. And its all driven by the suns energy.The main focus is how water is stored in the atmosphere, glaciers, oceans, plants, and humans. Most evaporation takes place in oceans. Its the Coriolis effect that moves it away from the equator. In this video, it displays a year in the life of Earths carbon dioxide. As you can see, carbon dioxide is the most important gas affected by human activity.In the northern hemisphere, we see the highest concentrations of carbon dioxide from major emission sources. For example, carbon emissions are mostly focused around North America, Europe, and Asia. But the gas disperses, finding its circulation path with global weather patterns and ocean currents.Even the seasonal patterns on Earth affect the amount of carbon dioxide in the atmosphere. During photosynthesis in spring and summer, plants absorb a substantial amount of carbon dioxide from the atmosphere.As summer transitions to fall, photosynthesis begins to decrease as carbon dioxide accumulates back into the atmosphere. This effect is from the Earths metabolism or net primary productivity. The Earths atmosphere is made up of many different gases. At the lower levels, nitrogen and oxygen are the most abundant gases. One of the most important things to remember about Earths atmosphere is that it is dynamic, meaning what we see today may not be the same as what we see years from now. Do you have any comments or questions? Please let us know in the comment form below.Subscribe to our newsletter:Chat with educators, ask questions, answer live polls, and get your doubts cleared - all while the class is going onLearning isn't just limited to classes with our practice section, mock tests and lecture notes shared as PDFs for your revisionOne subscription gets you access to all our live and recorded classes to watch from the comfort of any of your devicesWritten by: Stewart HirdReviewed by: Lucy KirkhamUpdated on 23 October 2024Did this video help you?The proportion of gases in the air has not changed much in 200 million yearsThe composition of the atmosphere today is:About four-fifths(approximately 80%) nitrogenabout one fifth(approximately 20%) oxygensmall proportions of other gases includingcarbon dioxide, water vapour and trace quantities of the noble gasesThe atmosphere mainly consists of nitrogen and oxygenAlthough the proportion of carbon dioxide is very small, it plays a substantial role in global warming as a greenhouse gas.The percentage of oxygen in air can be found by reacting a metal or non-metal with the oxygen in a fixed volume of airOne way to carry this out is to burn a small amount of phosphorus in a bell jar that is sitting in a trough of waterInitially the water levels are the same inside and outside the jarThe percentage of oxygen in air can be determined by burning phosphorus in air and measuring the volume changeAs the phosphorus burns it uses up the oxygen inside the bell jar and the water level risesBy making careful measurements of water levels before and after the experiment you can determine the percentage of oxygen in the airPhosphorus is very suitable for this experiment as it burns readily until all the available oxygen is used upA disadvantage of this experiment is that phosphorus is toxic, so it is hazardous and great care must be taken to handle it safelyDid this page help you?Expertise: Head of STEMLucy has been a passionate Maths teacher for over 12 years, teaching maths across the UK and abroad helping to engage, interest and develop confidence in the subject at all levels.Working as a Head of Department and then Director of Maths, Lucy has advised schools and academy trusts in both Scotland and the East Midlands, where her role was to support and coach teachers to improve Maths teaching for all. 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The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. AirAir is a mixture of gases and aerosols that composes the atmosphere surrounding Earth. The primary gases of air include nitrogen (78%) and oxygen (21%). Trace gases and aerosols make up the remaining 1% of air. The trace gases include the noble gases argon, neon, helium, krypton and xenon; hydrogen; and the greenhouse gases. The aerosols are solid or liquid particles having diameters in the region of 0.001 to 10 microns (millionth of a metre), and include dust, soot, sea salt crystals, spores, bacteria, viruses and a plethora of other microscopic particles, which may be natural or man-made.Earth maintains an atmosphere through its gravitational pull. Consequently, most air is found in the lowest 10 kilometres of the atmosphere. Experienced mountain climbers are aware of how thin the air becomes, and may carry oxygen tanks to assist breathing at high altitudes. Within the lower atmosphere, however, air remains remarkably uniform in composition, as a result of efficient recycling processes and turbulent mixing in the atmosphere.Atmospheric GasesThere are a number of atmospheric gases which make up air. The main gases are nitrogen and oxygen, which make up 78% and 21% of the volume of air respectively. Oxygen is utilised primarily by animals, including humans, but also to a small degree by plants, in the process of respiration (the metabolism of food products to generate energy).The remaining 1% of the atmospheric gases is made up of trace gases. These include the noble gases, very inert or unreactive gases, of which the most abundant is argon. Other noble gases include neon, helium, krypton and xenon. Hydrogen is also present in trace quantities in the atmosphere, but because it is so light, over time much of it has escaped Earths gravitational pull to space.The remaining trace gases include the greenhouse gases, carbon dioxide, methane, nitrous oxide, water vapour and ozone, so-called because they are involved in the Earth natural greenhouse effect which keeps the planet warmer than it would be without an atmosphere.OxygenThe gas oxygen (O2), composed of molecules of two oxygen atoms, occupies 21% of the Earths atmosphere by volume. It is colorless, odorless, and tasteless. Oxygen also comprises 86% of the oceans and 60% of the human body, and is the third most abundant element found in the Sun. Almost all plants and animals require oxygen for respiration to maintain life.Oxygen is very reactive and oxides of most elements are known. A chemical reaction in which an oxide is formed is known as oxidation. The rate at which oxidation occurs varies with the element with which oxygen is reacting. Rust, or iron oxide, for example forms relatively slowly, over days or weeks. Burning or combustion, however, involves a very rapid oxidation. Carbon in fossil fuels, for example, can be quickly oxidised to carbon monoxide and carbon dioxide, with a considerable amount of heat being given off. We can convert this heat into useful energy for heating, electricity and locomotion.Within the stratosphere, oxygen molecules combine with free oxygen atoms to form ozone (O3). Ozone absorbs ultraviolet (UV) radiation from the Sun, and protects life on Earth from its damaging effect. Although abundant between 19 and 30 km altitude, the air at these levels in the atmosphere is thin. If all the ozone in the stratosphere was compressed to ordinary atmosphere pressure at ground level, it would occupy a layer only 3 mm thick.NitrogenThe gas nitrogen (N2), composed of molecules of two nitrogen atoms, occupies 78% of the Earths atmosphere. It is colorless, odorless, and tasteless. Nitrogen is as important as it is common. Its essential to the nutrition of plants and animals. Nitrogen is a constituent in all proteins and in the genetic material (DNA) in all organisms.The low content of nitrogen in most soils exists in stark contrast to the abundance of nitrogen in air. This is because gaseous nitrogen molecules have very strong bonds linking the atoms together, making the gas chemically stable and unusable by most biological organisms. Some species of bacteria absorb nitrogen from the air and convert it into ammonium, which plants can use. This process, called nitrogen fixation, is the principal natural means by which atmospheric nitrogen is added to the soil. Legumes, such as beans, can fix nitrogen from the atmosphere. This is accomplished by nitrogen-fixing bacteria living in nodules on the plant roots.Nitrogen molecules in the atmosphere can also be broken by the energy generated by lightning strikes and volcanic action. Whenever lightning flashes in the atmosphere, some nitrogen combines with oxygen and forms the gas nitric oxide (NO). This nitric oxide is converted to nitric acid, which is highly soluble in water and falls to the ground in rainwater, to be absorbed by soils. Globally, however, nitrogen-fixing bacteria are a far more significant source of fixed nitrogen.Trace GasesMost of our atmosphere is made up of nitrogen (78% by volume) and oxygen (21% by volume). The remaining 1% of the atmospheric gases are known as trace gases because they are present in such small concentrations. The most abundant of the trace gases is the noble gas argon (approximately 1% by volume). Noble gases, which also include neon, helium, krypton and xenon, are very inert and do not generally engage in any chemical transformation within the atmosphere. Hydrogen is also present in trace quantities in the atmosphere, but because it is so light, over time much of it has escaped Earths gravitational pull to space.Despite their relative scarcity, the most important trace gases in the Earths atmosphere are the greenhouse gases. Most abundant in the troposphere, these gases include carbon dioxide, methane, nitrous oxide, water vapour and ozone, so-called because they are involved in the Earth natural greenhouse effect which keeps the planet warmer than it would be without an atmosphere. Apart from water vapour, the most abundant greenhouse gas (by volume) is carbon dioxide. Despite being present in only about 380 parts per million by volume of air, carbon dioxide and the other greenhouse gases help to keep the Earth 33C warmer than it would otherwise be without an atmosphere. Through emissions of greenhouse gases however, mankind has enhanced with natural greenhouse effect which may now be leading to a warming of the Earth climate.Whilst ozone behaves like a greenhouse gas in the troposphere, in the stratosphere where its abundance is most significant within the ozone layer, it helps to filter out the incoming ultraviolet radiation from the Sun, protecting life on Earth from its harmful effects. Air within the stratosphere is thin however. If all the ozone in the stratosphere was compressed to ordinary atmosphere pressure at ground level, it would occupy a layer only 3 mm thick.Other trace gases in the atmosphere arise from natural phenomena such as volcanic eruptions, lightning strikes and forest fires. Gases from these sources include nitric oxide (NO) and sulphur dioxide (SO2). In addition to natural sources of nitric oxide and sulphur dioxide there are now many man-made sources, including pollutant emissions from cars, agriculture and electricity generation through the burning of fossil fuels. During the 20th century other man-made processes have put completely new trace gases into the atmosphere, for example the chlorofluorocarbons (CFCs) which damage the ozone layer.AerosolsAerosols are solid or liquid particles dispersed in the air, and include dust, soot, sea salt crystals, spores, bacteria, viruses and a plethora of other microscopic particles. Collectively, they are often regarded as air pollution, but many of the aerosols have a natural origin. They are conventionally defined as those particles suspended in air having diameters in the region of 0.001 to 10 microns (millionth of a metre). They are formed by the dispersal of material at the surface (primary aerosols), or by reaction of gases in the atmosphere (secondary aerosols). Primary aerosols include volcanic dust, organic materials from biomass burning, soot from combustion and mineral dust from wind-blown processes. Secondary aerosols include sulphates from the oxidation of sulphur-containing gases during the burning of fossil fuels, nitrates from gaseous nitrogen species, and products from the oxidation of volatile organic compounds (VOCs). Although making up only 1 part in a billion of the mass of the atmosphere, they have the potential to significantly influence the amount of sunlight that reaches the Earths surface, and therefore the Earths climate.Although the abundance of aerosols varies over short time scales, for example after a volcanic eruption, over the long term the atmosphere is naturally cleansed through mixing processes and rainfall. Cleansing is never complete however, and there exists a natural background level of aerosols in the atmosphere. The average time spent in the atmosphere by aerosols is dependent upon their physical and chemical characteristics, and the time and location of their release. Natural sources of aerosols are probably 4 to 5 times larger than man-made ones on a global scale, but regional variations of man-made aerosol emissions may change this ratio significantly in certain areas, particularly in the industrialised Northern Hemisphere. At certain times of the year, the natural background level of aerosols may increase, for example, during the growing season, when large quantities of pollen are released into the atmosphere. There are five atmospheric layers surrounding the Earth, including troposphere, stratosphere, mesosphere, thermosphere and exosphere. The main composition of the atmosphere is the gaseous molecules. The density of the main atmospheric composition is relatively higher in the troposphere than in other atmospheric layers. The main gaseous substances in these layers include nitrogen, oxygen, carbon dioxide and other gases. The density of the gas molecules is higher in the lowest layer from land. Due to the presence of the gaseous substance, all the weather events occurred in this layer. The density of gas decreases gradually with an increase in height. The gaseous composition of the atmosphere is an important component of nature for the survival of living beings.Composition of AtmosphereThe atmosphere of the Earth is commonly known as air. The atmosphere is generally composed of different gas layers, which are retained strongly by the Earth through Earths gravitational force. The pressure of atmospheric compositions allows the water to exist on the surface of the Earth. The gas competitions of the atmosphere are very beneficial for the living hood of entire living beings on the Earth. The composition of the atmosphere, mainly the gaseous components, has a major impact on biodiversity. The gaseous components of the atmosphere are also known as environmental components. There are many gas components in the atmosphere. The atmosphere has a mass due to the presence of gaseous components. The mass of the whole atmosphere is 5.151018 kg. Three-quarters of the total mass of the atmosphere is present within 11 kilometres from the Earths surface. The mass of the atmosphere decreased gradually with altitude. Moreover, the density of air is thinner in high altitudes.The percentage of different gas compositions is different, and those are beneficial for different purposes of living organisms. The main gas composition of the atmosphere includes Nitrogen, oxygen and carbon dioxide. In addition, there is a minute percentage of water vapour present in the atmosphere. Another important gas composition of the atmosphere is ozone, the gaseous molecule of ozone that forms an ozone layer on the upper surface of the stratosphere. The ozone layer protects the Earths surface from entering the ultraviolet rays from the sun. The ozone gas molecule in ozone layers absorbs the ultraviolet rays of sun rays and saves the Earth from overheating. The pressure of the gaseous composition decreased gradually with high due to the lower density of the gas components in the higher surface of the atmosphere. The atmospheric changes due to the change in the gaseous composition may cause many environmental issues like changes in weather, volcanisms etc.Description of atmospheric compositionThe atmospheric composition is mainly made up of gases. The gaseous components of the atmosphere are responsible for the composition of air. The air is built up of a mixture of different gas molecules. The major gas molecules in the air or atmosphere are Nitrogen, oxygen and carbon dioxide. The different gas molecules are present in the atmosphere in different percentages. The gas components have different specific importance for living beings and nature. The different composition of the atmosphere has been described below.NitrogenNitrogen is one of the main compositions of the atmosphere or in the air. Nitrogen is the present highest amount in the atmosphere. The percentage of Nitrogen in the air is approximately 78% among the other gaseous components in the air. This atmospheric Nitrogen is the main source to build up proteins. The nitrogen molecules are an important component for forming proteins in the living body. The nitrogen molecules are combined with oxygen molecules of air and form nitrate compounds which dissolve in rainwater during rains and are mixed with soil. The plants can absorb dissolved Nitrogen from the soil, produce protein, and reserve the protein molecules in fruits and vegetables. The animals get protein from plants.OxygenOxygen is the most important atmospheric composition for the survival of living beings. Oxygen is present by 21% in the air. Moreover, all animals and plants take oxygen for respiration. Therefore, oxygen is an important component for energy generation in the living body and survival. In addition, oxygen is important for combustion; without oxygen, inflammation is impossible as oxygen helps other objects for combustion.Carbon dioxideCarbon dioxide is present in the atmosphere by 0.4 %. Plants produce carbon dioxide during photosynthesis. Carbon dioxide is a toxic gas component. The amount of carbon dioxide in the air increases gradually due to air pollution, which causes global warming.ConclusionThe atmosphere is the surrounding gas layer of the Earth. The layers of the atmosphere remain attached by the Earths gravitational force. The mass of the atmosphere exerts pressure on the surface of the Earth. The atmospheric pressure makes it possible for water on Earths surface. The composition of the atmosphere is mainly the gaseous components. The main gas components are, Nitrogen, oxygen and carbon dioxide. Water vapour and inert gases, mainly argon are present in minute percentages in the air. The density of the atmospheric composition decreases with altitude. Nearly all of Earth's atmosphere (air) is comprised of a mere five gases: nitrogen, oxygen, water vapor, argon, and carbon dioxide. Several other compounds are also present in our air in trace amounts. Below is a summary of the chemical composition of Earth's atmosphere. We also explain how air makeup changes depending on geographic region and time of day.Nitrogen gas is the primary component of air.Nitrogen, oxygen, water vapor, argon, and carbon dioxide account for about 99% of the composition of air.Trace gases in Earth's atmosphere include neon, methane, helium, krypton, hydrogen, xenon, ozone, and many other elements and compounds.The composition of air varies from one place to the next and it depends on whether it is day or night. Below is the composition of air in percent by volume, at sea level at 15 C and 101325 Pa. Nitrogen, oxygen, and argon are the three main components of Earth's atmosphere. Water concentration varies but averages around 0.25% of the atmosphere by mass. Carbon dioxide and all of the other elements and compounds are trace gases. Trace gases include the greenhouse gases carbon dioxide, methane, nitrous oxide, and ozone. Except for argon, other noble gases are trace elements (these include neon, helium, krypton, and xenon). Industrial pollutants include chlorine and its compounds, fluorine and its compounds, elemental mercury vapor, sulfur dioxide, and hydrogen sulfide. Other components of Earth's atmosphere include spores, pollen, volcanic ash, and salt from sea spray. Although this CRC table does not list water vapor (H2O), air can contain as much as 5% water vapor, more commonly ranging from 1-3%. The 1-5% range places water vapor as the third most common gas (which alters the other percentages accordingly). Water content varies according to air temperature. Dry air is denser than humid air. However, sometimes humid air contains actual water droplets, which can make it more dense than humid air that only contains water vapor. Air pollution varies according to geographical location and also where it occurs in the air column. Pollutants include chemicals, particulates like dust and ash, and biological matter, like pollen and bacteria. Ozone (O3) is unevenly distributed throughout Earth's atmosphere. The ozone layer is a portion of the stratosphere from 15 to 35 kilometers (9.3 to 21.7 miles). However, its thickness varies geographically and seasonally. The ozone layer contains about 90% of the atmospheric ozone, with a concentration of 2 to 8 parts per million. Even though this is a much higher concentration of ozone than occurs in the troposphere, ozone is still just a trace gas in the ozone layer. The homosphere is the portion of the atmosphere with a fairly uniform composition due to atmospheric turbulence. In contrast, the heterosphere is the part of the atmosphere where chemical composition varies mainly according to altitude. Earth's homosphere includes the lower layers of the atmosphere: the troposphere, stratosphere, mesosphere, and lower thermosphere. The turbopause, at around 100 kilometers or 62 miles, is the edge of space and roughly the limit of the homosphere. Above this layer, the heterosphere includes the exosphere and thermosphere. The lower portion of the heterosphere contains oxygen and nitrogen, but these heavier elements do not occur higher up. The upper heterosphere consists almost entirely of hydrogen. Barry, R.G.; Chorley, R.J. (1971). Atmosphere, Weather and Climate. London: Menthuen & Co Ltd. ISBN 9780416079401.Lide, David R. (1997). CRC Handbook of Chemistry and Physics. Boca Raton, FL: CRC. 14-17.Lutgens, Frederick K.; Tarbuck, Edward J. (1995). The Atmosphere (6th ed.). Prentice Hall. ISBN 0-13-350612-6.Martin, Daniel; McKenna, Helen; Livina, Valerie (2016). "The human physiological impact of global deoxygenation". The Journal of Physiological Sciences. 67 (1): 97106. doi:10.1007/s12576-016-0501-0Wallace, John M.; Hobbs, Peter V. (2006). Atmospheric Science: An Introductory Survey (2nd ed.). Elsevier. ISBN 978-0-12-732951-2.Skywatching & Cameras EditorThe Earth's atmosphere is composed of about 78% nitrogen, 21% oxygen, and trace amounts of other gases such as argon, carbon dioxide, and water vapor. Collectively, these gases make up about 99.96% of the atmosphere, with the remaining 0.04% consisting of various other gases.AnswerVerifiedHint: You should know that noble gases are the elements present in the 18th group of the periodic table. The most abundant noble gas is the member of the 3rd period of the periodic table.Complete step by step solution: -We know that the air around us is a mixture of several gases like nitrogen, oxygen, carbon dioxide and other noble gases. -Air consists of 78.09 % of nitrogen, 20.95% of oxygen, 0.03% of carbon dioxide. There are other gases too like hydrogen, argon, helium etc.-One of the components of atmospheric air is the noble gases. They do not constitute a huge percentage and they are present in trace but enough for us to test their presence.-Before answering the given question, let us discuss the noble gases.-Noble gases make up a class of chemical elements with similar properties. They are placed in group 18 and are considered as inert elements as they do not react readily due to their stable configuration.-Under the standard conditions, noble gases are odourless, colourless, with very low chemical reactivity.-There are six noble gases in group 18. Those are helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe), and the radioactive radon (Rn).-The noble gases are present in the atmosphere in very small amounts: Percentage of argon is0.934% and that of neon and helium is 0.0018% and 0.00052% respectively.We can show the relative abundance in dry air by volume (ppm) of different noble gases as- Chemical nameChemical symbolAbundance by volume (in ppm)HeliumHe5.24NeonNe18.18ArgonAr93.40KryptonKr1.14XenonXe0.09RadonRntracesWe can understand from the above discussion that argon is present in abundance in the atmosphere.Therefore, the correct answer is argon.Note: You should know that air is the primary industrial source of purified argon products.Argon gas is isolated from air by cryogenic fractional distillation. This is a process that also produces purified nitrogen, oxygen, neon, krypton, and xenon gases.Noble gases have very low boiling and melting points, which makes them useful as cryogenic refrigerantsBlue light is scattered more than other wavelengths by the gases in the atmosphere, surrounding Earth in a visibly blue layer at the stratosphere, above the clouds of the troposphere, when seen from space on board the ISS at an altitude of 335km (208mi) (the Moon is visible as a crescent in the far background).[1]The atmosphere of Earth is composed of a layer of gas mixture that surrounds the Earth's planetary surface (both lands and oceans), known collectively as air, with variable quantities of suspended aerosols and particulates (which create weather features such as clouds and hazes), all retained by Earth's gravity. The atmosphere serves as a protective buffer between the Earth's surface and outer space, shields the surface from most meteoroids and ultraviolet solar radiation, keeps it warm and reduces diurnal temperature variation (temperature extremes between day and night) through heat retention (greenhouse effect), redistributes heat and moisture among different regions via air currents, and provides the chemical and climate conditions allowing life to exist and evolve on Earth.By mole fraction (i.e., by quantity of molecules), dry air contains 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other trace gases (see Composition below for more detail). Air also contains a variable amount of water vapor, on average around 1% at sea level, and 0.4% over the entire atmosphere. Earth's early atmosphere consisted of accreted gases from the solar nebula, but the atmosphere changed significantly over time, affected by many factors such as volcanism, impact events, weathering and the evolution of life (particularly the photoautotrophs). Recently, human activity has also contributed to atmospheric changes, such as climate change (mainly through deforestation and fossil fuel-related global warming), ozone depletion and acid deposition.The atmosphere has a mass of about 5.151018kg,[2] three quarters of which is within about 11km (6.8mi; 36,000ft) of the surface. The atmosphere becomes thinner with increasing altitude, with no definite boundary between the atmosphere and outer space. The Krmn line, at 100km (62mi) or 1.57% of Earth's radius, is often used as the border between the atmosphere and outer space. Atmospheric effects become noticeable during atmospheric reentry of spacecraft at an altitude of around 120km (75mi). Several layers can be distinguished in the atmosphere based on characteristics such as temperature and composition, namely the troposphere, stratosphere, mesosphere, thermosphere (formally the ionosphere) and exosphere. Air composition, temperature and atmospheric pressure vary with altitude. Air suitable for use in photosynthesis by terrestrial plants and respiration of terrestrial animals is found within the troposphere.[3]The study of Earth's atmosphere and its processes is called atmospheric science (aerology), and includes multiple subfields, such as climatology and atmospheric physics. Early pioneers in the field include Lon Teisserenc de Bort and Richard Assmann.[4] The study of historic atmosphere is called paleoclimatology.Main article: Atmospheric chemistryComposition of Earth's atmosphere by molecular count, excluding water vapor. Lower pie represents trace gases that together compose about 0.0434% of the atmosphere.[5][6][7]The three major constituents of Earth's atmosphere are nitrogen, oxygen, and argon. Water vapor accounts for roughly 0.25% of the atmosphere by mass. The concentration of water vapor (a greenhouse gas) varies significantly from around 10 ppm by mole fraction in the coldest portions of the atmosphere to as much as 5% by mole fraction in hot, humid air masses, and concentrations of other atmospheric gases are typically quoted in terms of dry air (without water vapor).[8]:8 The remaining gases are often referred to as trace gases,[9] among which are other greenhouse gases, principally carbon dioxide, methane, nitrous oxide, and ozone. Besides argon, other noble gases, neon, helium, krypton, and xenon are also present. Filtered air includes trace amounts of many other chemical compounds. Many substances of natural origin may be present in locally and seasonally variable small amounts as aerosols in an unfiltered air sample, including dust of mineral and organic composition, pollen and spores, sea spray, and volcanic ash. Various industrial pollutants also may be present as gases or aerosols, such as chlorine (elemental or in compounds), fluorine compounds and elemental mercury vapor. Sulfur compounds such as hydrogen sulfide and sulfur dioxide (SO2) may be derived from natural sources or from industrial air pollution.The volume fraction of the main constituents of the Earth's atmosphere as a function of height, based on the MSIS-E-90 atmospheric model; the model only works above 85kmMajor constituents of air[5]Dry airGasVolume fraction(A)Mass fractionNameFormulain ppm(B)in %in ppmin %NitrogenN2780,08078.08755,20075.52OxygenO2209,50020.95231,40023.14ArgonAr9,3400.934012,9001.29Carbondioxide[6]CO24120.04126260.063NeonNe18.20.0018212.70.00127HeliumHe5.240.0005240.7240.0000724Methane[7]CH41.790.0001790.990.000099KryptonKr1.140.0001143.30.00033If air is not dry:Water vapor(D)H2O030,000(D)03%(E)The total ppm above adds up to more than 1 million (currently 83.43 above it) due to experimental error.Notes(A) In the atmosphere the pressure is low enough for the ideal gas laws to be correct within 1%. Therefore the mole fraction is very close to the volume fraction.[10]:4(B) ppm: parts per million by molecular count(C) The concentration of CO2 has been increasing in recent decades, as has that of CH4.(D) Water vapor is about 0.25% by mass over full atmosphere(E) Water vapor varies significantly locally[8]The average molecular weight of dry air, which can be used to calculate densities or to convert between mole fraction and mass fraction, is about 28.946[11] or 28.964[12][5]g/mol. This is decreased when the air is humid.The relative concentration of gases remains constant until about 10,000m (33,000ft).[13]Earth's atmosphere. Lower four layers of the atmosphere in three dimensions as seen diagonally from above the exobase. Layers drawn to scale, objects within the layers are not to scale. Aurorae shown at the bottom of the thermosphere can form at any altitude within this layer.In general, air pressure and density decrease with altitude in the atmosphere. However, temperature has a more complicated profile with altitude and may remain relatively constant or even increase with altitude in some regions (see the temperature section). Because the general pattern of the temperature/altitude profile, or lapse rate, is constant and measurable by means of instrumented balloon soundings, the temperature behavior provides a useful metric to distinguish atmospheric layers. This atmospheric stratification divides the Earth's atmosphere into five main layers:[14]Exosphere: 70010,000km (4356,214mi)[15]Thermosphere: 80700km (50435mi)[16]Mesosphere: 5080km (3150mi)Stratosphere: 1250km (731mi)Troposphere: 012km (07mi)[17]Main article: ExosphereThe exosphere is the outermost layer of Earth's atmosphere (though it is so tenuous that some scientists consider it to be part of interplanetary space rather than part of the atmosphere). It extends from the thermopause (also known as the "exobase") at the top of the thermosphere to a poorly defined boundary with the solar wind and interplanetary medium. The altitude of the exobase varies from about 500 kilometres (310mi; 1,600,000ft) to about 1,000 kilometres (620mi) in times of higher incoming solar radiation.[18]The upper limit varies depending on the definition. Various authorities consider it to end at about 10,000 kilometres (6,200mi)[19] or about 190,000 kilometres (120,000mi)about halfway to the moon, where the influence of Earth's gravity is about the same as radiation pressure from sunlight.[18] The geocorona visible in the far ultraviolet (caused by neutral hydrogen) extends to at least 100,000 kilometres (62,000mi).[18]This layer is mainly composed of extremely low densities of hydrogen, helium and several heavier molecules including nitrogen, oxygen and carbon dioxide closer to the exobase. The atoms and molecules are so far apart that they can travel hundreds of kilometres without colliding with one another. Thus, the exosphere no longer behaves like a gas, and the particles constantly escape into space. These free-moving particles follow ballistic trajectories and may migrate in and out of the magnetosphere or the solar wind. Every second, the Earth loses about 3kg of hydrogen, 50g of helium, and much smaller amounts of other constituents.[20]The exosphere is too far above Earth for meteorological phenomena to be possible. However, Earth's aurorasthe aurora borealis (northern lights) and aurora australis (southern lights)sometimes occur in the lower part of the exosphere, where they overlap into the thermosphere. The exosphere contains many of the artificial satellites that orbit Earth.Main article: ThermosphereThe thermosphere is the second-highest layer of Earth's atmosphere. It extends from the mesopause (which separates it from the mesosphere) at an altitude of about 80km (50mi; 260,000ft) up to the thermopause at an altitude range of 5001000km (310620mi; 1,600,0003,300,000ft). The height of the thermopause varies considerably due to changes in solar activity.[16] Because the thermopause lies at the lower boundary of the exosphere, it is also referred to as the exobase. The lower part of the thermosphere, from 80 to 550 kilometres (50 to 342mi) above Earth's surface, contains the ionosphere.The temperature of the thermosphere gradually increases with height and can rise as high as 1500C (2700F), though the gas molecules are so far apart that its temperature in the usual sense is not very meaningful. The air is so rarefied that an individual molecule (of oxygen, for example) travels an average of 1 kilometre (0.62mi; 3300ft) between collisions with other molecules.[21] Although the thermosphere has a high proportion of molecules with high energy, it would not feel hot to a human in direct contact, because its density is too low to conduct a significant amount of energy to or from the skin.This layer is completely cloudless and free of water vapor. However, non-hydrometeorological phenomena such as the aurora borealis and aurora australis are occasionally seen in the thermosphere. The International Space Station orbits in this layer, between 350 and 420km (220 and 260mi). It is this layer where many of the satellites orbiting the Earth are present.Main article: MesosphereAfterglow of the troposphere (orange), the stratosphere (blue) and the mesosphere (dark) at which atmospheric entry begins, leaving smoke trails, such as in this case of a spacecraft reentryThe mesosphere is the third highest layer of Earth's atmosphere, occupying the region above the stratosphere and below the thermosphere. It extends from the stratopause at an altitude of about 50km (31mi; 160,000ft) to the mesopause at 8085km (5053mi; 260,000280,000ft) above sea level.Temperatures drop with increasing altitude to the mesopause that marks the top of this middle layer of the atmosphere. It is the coldest place on Earth and has an average temperature around 85C (120F; 190K).[22][23]Just below the mesopause, the air is so cold that even the very scarce water vapor at this altitude can condense into polar-mesospheric noctilucent clouds of ice particles. These are the highest clouds in the atmosphere and may be visible to the naked eye if sunlight reflects off them about an hour or two after sunset or similarly before sunrise. They are most readily visible when the Sun is around 4 to 16 degrees below the horizon. Lightning-induced discharges known as transient luminous events (TLEs) occasionally form in the mesosphere above tropospheric thunderclouds. The mesosphere is also the layer where most meteors burn up upon atmospheric entrance. It is too high above Earth to be accessible to jet-powered aircraft and balloons, and too low to permit orbital spacecraft. The mesosphere is mainly accessed by sounding rockets and rocket-powered aircraft.Main article: StratosphereThe stratosphere is the second-lowest layer of Earth's atmosphere. It lies above the troposphere and is separated from it by the tropopause. This layer extends from the top of the troposphere at roughly 12km (7.5mi; 39,000ft) above Earth's surface to the stratopause at an altitude of about 50 to 55km (31 to 34mi; 164,000 to 180,000ft).The atmospheric pressure at the top of the stratosphere is roughly 1/1000 the pressure at sea level. It contains the ozone layer, which is the part of Earth's atmosphere that contains relatively high concentrations of that gas. The stratosphere defines a layer in which temperatures rise with increasing altitude. This rise in temperature is caused by the absorption of ultraviolet radiation (UV) from the Sun by the ozone layer, which restricts turbulence and mixing. Although the temperature may be 60C (76F; 210K) at the tropopause, the top of the stratosphere is much warmer, and may be near 0C.[24]The stratospheric temperature profile creates very stable atmospheric conditions, so the stratosphere lacks the weather-producing air turbulence that is so prevalent in the troposphere. Consequently, the stratosphere is almost completely free of clouds and other forms of weather. However, polar stratospheric or nacreous clouds are occasionally seen in the lower part of this layer of the atmosphere where the air is coldest. The stratosphere is the highest layer that can be accessed by jet-powered aircraft.Main article: TroposphereA picture of Earth's troposphere, with different cloud types at low and high altitudes casting shadows. Sunlight, filtered into a reddish hue by passing through much of the troposphere at sunset, is reflected off the ocean. The above-lying stratosphere can be seen at the horizon as a band of its characteristic glow of blue scattered sunlight.The troposphere is the lowest layer of Earth's atmosphere. It extends from Earth's surface to an average height of about 12km (7.5mi; 39,000ft), although this altitude varies from about 9km (5.6mi; 30,000ft) at the geographic poles to 17km (11mi; 56,000ft) at the Equator,[17] with some variation due to weather. The troposphere is bounded above by the tropopause, a boundary marked in most places by a temperature inversion (i.e. a layer of relatively warm air above a colder one), and in others by a zone that is isothermal with height.[25][26]Although variations do occur, the temperature usually declines with increasing altitude in the troposphere because the troposphere is mostly heated through energy transfer from the surface. Thus, the lowest part of the troposphere (i.e. Earth's surface) is typically the warmest section of the troposphere. This promotes vertical mixing (hence, the origin of its name in the Greek word , tropos, meaning "turn"). The troposphere contains roughly 80% of the mass of Earth's atmosphere.[27] The troposphere is denser than all its overlying layers because a larger atmospheric weight sits on top of the troposphere and causes it to be most severely compressed. Fifty percent of the total mass of the atmosphere is located in the lower 5.6km (3.5mi; 18,000ft) of the troposphere.Nearly all atmospheric water vapor or moisture is found in the troposphere, so it is the layer where most of Earth's weather takes place. It has basically all the weather-associated cloud genus types generated by active wind circulation, although very tall cumulonimbus thunder clouds can penetrate the tropopause from below and rise into the lower part of the stratosphere. Most conventional aviation activity takes place in the troposphere, and it is the only layer accessible by propeller-driven aircraft.Within the five principal layers above, which are largely determined by temperature, several secondary layers may be distinguished by other properties:The ozone layer is contained within the stratosphere. In this layer ozone concentrations are about 2 to 8 parts per million, which is much higher than in the lower atmosphere but still very small compared to the main components of the atmosphere. It is mainly located in the lower portion of the stratosphere from about 1535km (9.321.7mi; 49,000115,000ft), though the thickness varies seasonally and geographically. About 90% of the ozone in Earth's atmosphere is contained in the stratosphere.The ionosphere is a region of the atmosphere that is ionized by solar radiation. It is responsible for auroras. During daytime hours, it stretches from 50 to 1,000km (31 to 621mi; 160,000 to 3,280,000ft) and includes the mesosphere, thermosphere, and parts of the exosphere. However, ionization in the mesosphere largely ceases during the night, so auroras are normally seen only in the thermosphere and lower exosphere. The ionosphere forms the inner edge of the magnetosphere. It has practical importance because it influences, for example, radio propagation on Earth.The homosphere and heterosphere are defined by whether the atmospheric gases are well mixed. The surface-based homosphere includes the troposphere, stratosphere, mesosphere, and the lowest part of the thermosphere, where the chemical composition of the atmosphere does not depend on molecular weight because the gases are mixed by turbulence.[28] This relatively homogeneous layer ends at the turbopause found at about 100km (62mi; 330,000ft), the very edge of space itself as accepted by the FAI, which places it about 20km (12mi; 66,000ft) above the mesopause.Above this altitude lies the heterosphere, which includes the exosphere and most of the thermosphere. Here, the chemical composition varies with altitude. This is because the distance that particles can move without colliding with one another is large compared with the size of motions that cause mixing. This allows the gases to stratify by molecular weight, with the heavier ones, such as oxygen and nitrogen, present only near the bottom of the heterosphere. The upper part of the heterosphere is composed almost completely of hydrogen, the lightest element.[29]The planetary boundary layer is the part of the troposphere that is closest to Earth's surface and is directly affected by it, mainly through turbulent diffusion. During the day the planetary boundary layer usually is well-mixed, whereas at night it becomes stably stratified with weak or intermittent mixing. The depth of the planetary boundary layer ranges from as little as about 100 metres (330ft) on clear, calm nights to 3,000m (9,800ft) or more during the afternoon in dry regions.The average temperature of the atmosphere at Earth's surface is 14C (57F; 287K)[30] or 15C (59F; 288K),[31] depending on the reference.[32][33][34]Comparison of the 1962 US Standard Atmosphere graph of geometric altitude against air density, pressure, the speed of sound and temperature with approximate altitudes of various objects.[35]Main article: Atmospheric pressureThe average atmospheric pressure at sea level is defined by the International Standard Atmosphere as 101325 pascals (760.00Torr; 14.6959psi; 760.00mmHg). This is sometimes referred to as a unit of standard atmospheres (atm). Total atmospheric mass is 5.14801018kg (1.134941019lb),[36] about 2.5% less than would be inferred from the average sea-level pressure and Earth's area of 51007.2 megahectares, this portion being displaced by Earth's mountainous terrain. Atmospheric pressure is the total weight of the air above unit area at the point where the pressure is measured. Thus air pressure varies with location and weather.If the entire mass of the atmosphere had a uniform density equal to sea-level density (about 1.2kg/m3) from sea level upwards, it would terminate abruptly at an altitude of 8.50km (27,900ft).Air pressure actually decreases exponentially with altitude, for altitudes up to around 70km (43mi; 230,000ft), dropping by half every 5.6km (18,000ft), or by a factor of 1/e 0.368 every 7.64km (25,100ft), which is called the scale height. However, the atmosphere is more accurately modeled with a customized equation for each layer that takes gradients of temperature, molecular composition, solar radiation and gravity into account. At heights over 100km, an atmosphere may no longer be well mixed. Then each chemical species has its own scale height.In summary, the mass of Earth's atmosphere is distributed approximately as follows:[37]50% is below 5.6km (18,000ft)90% is below 16km (52,000ft)99.99997% is below 100km (62mi; 330,000ft), the Krmn line. By international convention, this marks the beginning of space where human travelers are considered astronauts.By comparison, the summit of Mount Everest is at 8,848m (29,029ft); commercial airliners typically cruise between 10 and 13km (33,000 and 43,000ft), where the lower density and temperature of the air improve fuel economy; weather balloons reach 30.4km (100,000ft) and above; and the highest X-15 flight in 1963 reached 108.0km (354,300ft).Even above the Krmn line, significant atmospheric effects such as auroras still occur. Meteors begin to glow in this region, though the larger ones may not burn up until they penetrate more deeply. The various layers of Earth's ionosphere, important to HF radio propagation, begin below 100km and extend beyond 500km. By comparison, the International Space Station and Space Shuttle typically orbit at 350400km, within the F-layer of the ionosphere, where they encounter enough atmospheric drag to require reboosts every few months, otherwise orbital decay will occur, resulting in a return to Earth. Depending on solar activity, satellites can experience noticeable atmospheric drag at altitudes as high as 700800km.Main article: Atmospheric temperatureTemperature trends in two thick layers of the atmosphere as measured between January 1979 and December 2005 by microwave sounding units and advanced microwave sounding units on NOAA weather satellites. The instruments record microwaves emitted from oxygen molecules in the atmosphere. Source:[38]The division of the atmosphere into layers mostly by reference to temperature is discussed above. Temperature decreases with altitude starting at sea level, but variations in this trend begin above 11km, where the temperature stabilizes over a large vertical distance through the rest of the troposphere. In the stratosphere, starting above about 20km, the temperature increases with height, due to heating within the ozone layer caused by the capture of significant ultraviolet radiation from the Sun by the dioxygen and ozone gas in this region. Still another region of increasing temperature with altitude occurs at very high altitudes, in the aptly-named thermosphere above 90km.Main article: Speed of soundBecause in an ideal gas of constant composition the speed of sound depends only on temperature and not on pressure or density, the speed of sound in the atmosphere with altitude takes on the form of the complicated temperature profile (see illustration to the right), and does not mirror altitudinal changes in density or pressure.Main article: Density of airTemperature and mass density against altitude from the NRLMSISE-00 standard atmosphere model (the eight dotted lines in each "decade" are at the eight cubes 8, 27, 64, ..., 729)The density of air at sea level is about 1.2kg/m3 (1.2g/L, 0.0012 g/cm3). Density is not measured directly but is calculated from measurements of temperature, pressure and humidity using the equation of state for air (a form of the ideal gas law). Atmospheric density decreases as the altitude increases. This variation can be approximately modeled using the barometric formula. More sophisticated models are used to predict the orbital decay of satellites.The average mass of the atmosphere is about 5 quadrillion (51015) tonnes or 1/1,200,000 the mass of Earth. According to the American National Center for Atmospheric Research, "The total mean mass of the atmosphere is 5.14801018kg with an annual range due to water vapor of 1.2 or 1.51015kg, depending on whether surface pressure or water vapor data are used; somewhat smaller than the previous estimate. The mean mass of water vapor is estimated as 1.271016kg and the dry air mass as 5.1352 0.00031018kg."Physical and thermal properties of air at atmospheric pressure[39]:602[40]Temperature[K]Density[kg/m3]Specificheat[J/(kgC)]Dynamicviscosity[kg/(ms)]Kinematicviscosity[m2/s]Thermalconductivity[W/(mC)]Thermaldiffusivity[m2/s]Prandtlnumber[1]Bulkmodulus[K1]1003.6011026.66.921061.921060.0009252.501060.770.011502.36751009.91.031054.341060.0137355.751060.7530.0066672001.76841006.11.331057.491060.018091.021050.7380.0052501.41281005.31.601051.131050.022271.571050.7220.0043001.17741005.71.851051.571050.026242.221050.7080.0033333500.99810092.081052.081050.030032 also: SunlightSolar radiation (or sunlight) is the energy Earth receives from the Sun. Earth also emits radiation back into space, but at longer wavelengths that humans cannot see. Part of the incoming and emitted radiation is absorbed or reflected by the atmosphere.[41][42] In May 2017, glints of light, seen as twinkling from an orbiting satellite a million miles away, were found to be reflected light from ice crystals in the atmosphere.[43][44]Main article: Atmospheric scatteringWhen light passes through Earth's atmosphere, photons interact with it through scattering. If the light does not interact with the atmosphere, it is called direct radiation and is what you see if you were to look directly at the Sun. Indirect radiation is light that has been scattered in the atmosphere. For example, on an overcast day when you cannot see your shadow, there is no direct radiation reaching you, it has all been scattered. As another example, due to a phenomenon called Rayleigh scattering, shorter (blue) wavelengths scatter more easily than longer (red) wavelengths. This is why the sky looks blue; you are seeing scattered blue light. This is also why sunsets are red. Because the Sun is close to the horizon, the Sun's rays pass through more atmosphere than normal before reaching your eye. Much of the blue light has been scattered out, leaving the red light in a sunset.Main article: Absorption (electromagnetic radiation)Rough plot of Earth's atmospheric transmittance (or opacity) to various wavelengths of electromagnetic radiation, including visible lightDifferent molecules absorb different wavelengths of radiation. For example, O2 and O3 absorb almost all radiation with wavelengths shorter than 300 nanometres. Water (H2O) absorbs at many wavelengths above 700nm. When a molecule absorbs a photon, it increases the energy of the molecule. This heats the atmosphere, but the atmosphere also cools by emitting radiation, as discussed below.The combined absorption spectra of the gases in the atmosphere leave "windows" of low opacity, allowing the transmission of only certain bands of light. The optical window runs from around 300nm (ultraviolet-C) up into the range humans can see, the visible spectrum (commonly called light), at roughly 400700nm and continues to the infrared to around 1100nm. There are also infrared and radio windows that transmit some infrared and radio waves at longer wavelengths. For example, the radio window runs from about one centimetre to about eleven-metre waves.Further information: Emission spectrumEmission is the opposite of absorption, it is when an object emits radiation. Objects tend to emit amounts and wavelengths of radiation depending on their "black body" emission curves, therefore hotter objects tend to emit more radiation, with shorter wavelengths. Colder objects emit less radiation, with longer wavelengths. For example, the Sun is approximately 6,000K (5,730C; 10,340F), its radiation peaks near 500nm, and is visible to the human eye. Earth is approximately 290K (17C; 62F), so its radiation peaks near 10,000nm, and is much too long to be visible to humans.Because of its temperature, the atmosphere emits infrared radiation. For example, on clear nights Earth's surface cools down faster than on cloudy nights. This is because clouds (H2O) are strong absorbers and emitters of infrared radiation. This is also why it becomes colder at night at higher elevations.The greenhouse effect is directly related to this absorption and emission effect. Some gases in the atmosphere absorb and emit infrared radiation, but do not interact with sunlight in the visible spectrum. Common examples of these are CO2 and H2O.Main article: Atmospheric refractionSee also: Scintillation (astronomy)Distortive effect of atmospheric refraction upon the shape of the sun at the horizonThe refractive index of air is close to, but just greater than, 1. Systematic variations in the refractive index can lead to the bending of light rays over long optical paths. One example is that, under some circumstances, observers on board ships can see other vessels just over the horizon because light is refracted in the same direction as the curvature of Earth's surface.The refractive index of air depends on temperature,[45] giving rise to refraction effects when the temperature gradient is large. An example of such effects is the mirage.Main article: Atmospheric circulationAn idealised view of three pairs of large circulation cellsAtmospheric circulation is the large-scale movement of air through the troposphere, and the means (with ocean circulation) by which heat is distributed around Earth. The large-scale structure of the atmospheric circulation varies from year to year, but the basic structure remains fairly constant because it is determined by Earth's rotation rate and the difference in solar radiation between the equator and poles.See also: History of Earth and PaleoclimatologyThe first atmosphere, during the Early Earth's Hadean eon, consisted of gases in the solar nebula, primarily hydrogen, and probably simple hydrides such as those now found in the gas giants (Jupiter and Saturn), notably water vapor, methane and ammonia. During this earliest era, the Moon-forming collision and numerous impacts with large meteorites heated the atmosphere, driving off the most volatile gases. The collision with Theia, in particular, melted and ejected large portions of Earth's mantle and crust and outgassed significant amounts of steam which eventually cooled and condensed to contribute to ocean water at the end of the Hadean.[46]:10See also: Prebiotic atmosphereThe increasing solidification of Earth's crust at the end of the Hadean closed off most of the advective heat transfer to the surface, causing the atmosphere to cool, which condensed most of the water vapor out of the air precipitating into a superocean. Further outgassing from volcanism, supplemented by gases introduced by huge asteroids during the Late Heavy Bombardment, created the subsequent Archean atmosphere, which consisted largely of nitrogen plus carbon dioxide, methane and inert gases.[46] A major part of carbon dioxide emissions dissolved in water and reacted with metals such as calcium and magnesium during weathering of crustal rocks to form carbonates that were deposited as sediments. Water-related sediments have been found that date from as early as 3.8 billion years ago.[47]About 3.4 billion years ago, nitrogen formed the major component of the then-stable "second atmosphere". The influence of the evolution of life has to be taken into account rather soon in the history of the atmosphere because hints of earliest life forms appeared as early as 3.5 billion years ago.[48] How Earth at that time maintained a climate warm enough for liquid water and life, if the early Sun put out 30% lower solar radiance than today, is a puzzle known as the "faint young Sun paradox".The geological record however shows a continuous relatively warm surface during the complete early temperature record of Earth with the exception of one cold glacial phase about 2.4 billion years ago. In the late Neoarchean, an oxygen-containing atmosphere began to develop, apparently due to a billion years of cyanobacterial photosynthesis (see Great Oxygenation Event), which have been found as stromatolite fossils from 2.7 billion years ago. The early basic carbon isotopy (isotope ratio proportions) strongly suggests conditions similar to the current, and that the fundamental features of the carbon cycle became established as early as 4 billion years ago.Ancient sediments in the Gabon dating from between about 2.15 and 2.08 billion years ago provide a record of Earth's dynamic oxygenation evolution. These fluctuations in oxygenation were likely driven by the Lomagundi carbon isotope excursion.[49]Main article: Geological history of oxygenOxygen content of the atmosphere over the last billion years[50][51]The constant re-arrangement of continents by plate tectonics influences the long-term evolution of the atmosphere by transferring carbon dioxide to and from large continental carbonate stores. Free oxygen did not exist in the atmosphere until about 2.4 billion years ago during the Great Oxygenation Event and its appearance is indicated by the end of banded iron formations (which signals the depletion of substrates that can react with oxygen to produce ferric deposits) during the early Proterozoic eon.Before this time, any oxygen produced by cyanobacterial photosynthesis would be readily removed by the oxidation of reducing substances on the Earth's surface, notably ferrous iron, sulfur and atmospheric methane. Free oxygen molecules did not start to accumulate in the atmosphere until the rate of production of oxygen began to exceed the availability of reductant materials that removed oxygen. This point signifies a shift from a reducing atmosphere to an oxidizing atmosphere. O2 showed major variations during the Proterozoic, including a billion-year period of euxinia, until reaching a steady state of more than 15% by the end of the Precambrian.[52] The rise of the more robust eukaryotic photoautotrophs (green and red algae) injected further oxygenation into the air, especially after the end of the Cryogenian global glaciation, which was followed by an evolutionary radiation event during the Ediacaran period known as the Avalon explosion, where complex metazoan life forms (including the earliest cnidarians, placozoans and bilaterians) first proliferated. The following time span from 539 million years ago to the present day is the Phanerozoic eon, during the earliest period of which, the Cambrian, more actively moving metazoan life began to appear and rapidly diversify in another radiation event called the Cambrian explosion, whose locomotive metabolism was fuelled by the rising oxygen level.The amount of oxygen in the atmosphere has fluctuated over the last 600 million years, reaching a peak of about 30% around 280 million years ago during the Carboniferous period, significantly higher than today's 21%. Two main processes govern changes in the atmosphere: the evolution of plants and their increasing role in carbon fixation, and the consumption of oxygen by rapidly diversifying animal faunae and also by plants for photorespiration and their own metabolic needs at night. Breakdown of pyrite and volcanic eruptions release sulfur into the atmosphere, which reacts and hence reduces oxygen in the atmosphere. However, volcanic eruptions also release carbon dioxide, which can fuel oxygenic photosynthesis by terrestrial and aquatic plants. The cause of the variation of the amount of oxygen in the atmosphere is not precisely understood. Periods with more oxygen in the atmosphere were often associated with more rapid development of animals.Main article: Air pollutionAnimation shows the buildup of tropospheric CO2 in the Northern Hemisphere with a maximum around May. The maximum in the vegetation cycle follows in the late summer. Following the peak in vegetation, the drawdown of atmospheric CO2 due to photosynthesis is apparent, particularly over the boreal forests.Air pollution is the introduction of airborne chemicals, particulate matter or biological materials that cause harm or discomfort to organisms.[53] The population growth, industrialization and motorization of human societies have significantly increased the amount of airborne pollutants in the Earth's atmosphere, causing noticeable problems such as smogs, acid rains and pollution-related diseases. The depletion of stratospheric ozone layer, which shields the surface from harmful ionizing ultraviolet radiations, is also caused by air pollution, chiefly from chlorofluorocarbons and other ozone-depleting substances.Since 1750, human activity, especially after the Industrial Revolution, has increased the concentrations of various greenhouse gases, most importantly carbon dioxide, methane and nitrous oxide. Greenhouse gas emissions, coupled with deforestation and destruction of wetlands via logging and land developments, have caused an observed rise in global temperatures, with the global average surface temperatures being 1.1C higher in the 20112020 decade than they were in 1850.[54] It has raised concerns of man-made climate change, which can have significant environmental impacts such as sea level rise, ocean acidification, glacial retreat (which threatens water security), increasing extreme weather events and wildfires, ecological collapse and mass dying of wildlife.Astronomy portalEarth sciences portalEnvironment portalScience portalSolar System portalSpaceflight portalWeather portalWorld portalAerial perspectiveAir (classical element)Atmospheric scienceBiosphereHydrosphereLithosphereAirglowAirshedAtmospheric dispersion modelingAtmospheric electricityClimate systemCOSPAR international reference atmosphere (CIRA)Environmental effects of aviationGlobal dimmingInstrumental temperature recordReference atmospheric model^ "Gateway to Astronaut Photos of Earth". 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Scotese, Back to Earth History: Summary Chart for the Precambrian, Paleomar Project^ Starting from [1] Pollution Definition from the Merriam-Webster Online Dictionary^ IPCC (2021). "Summary for Policymakers" (PDF). IPCC AR6 WG1. pp.45. Archived from the original (PDF) on 2021-08-11. Retrieved 2021-11-20.Wikimedia Commons has media related to Earth's atmosphere.Wikiquote has quotations related to Air.Buchan, Alexander (1878). "Atmosphere". Encyclopdia Britannica. Vol.III (9thed.). pp.2836.Interactive global map of current atmospheric and ocean surface conditions.Retrieved from " The atmosphere is the mass of air surrounding the earth. Its constitutes a mixture of nitrogen (about 78%), oxygen (about 21%), and other gases (about 1%) such as carbon dioxide (0.039%), argon (0.93%) and the rest are trace gases (krypton, neon, helium , and xenon). The mass of the atmosphere totals to about 5.151018kg. Higher atmospheres are thinner and gradually move towards space. The air in the atmosphere also contains varying water vapor, but on average the water content is about 1% at sea level and 0.4% above the entire atmosphere. The air content and atmospheric pressure also varies at different layers of the atmosphere. Most of the clouds and weather as well as the atmospheric aspects that make life livable on earth originate within the first layer of the atmosphere. The earths atmosphere is divided into five layers. The troposphere is the lowers layer of the atmosphere, nearest to the earths surface. It is where all the aviation activities, weather, wind circulation, and climate take place. The air pressure over the troposphere is only 10% of that at sea level. The troposphere differs in height at different regions of the world and some of variations are as a result of weather. It can range from about 16 kilometers at the equator to about 8 kilometers above the sea level at the poles. The higher the altitude, the cooler the temperature becomes within the troposphere. This is because the troposphere is mainly heated via transfer of energy from the earths surface. Of all the earths atmospheric mass, the troposphere contains 80% of it and it is denser than all the other layers on top. READ: What is an Ocean and What are Different Layers of the Ocean?Also, because it is severely compressed by the overlying layers, most of the weight in the troposphere lies in its lower regions. There exists a thin buffer zone between the troposphere and the next layer known as the tropopause. Beyond the troposphere, the temperature reverses and starts to increase with an increase in altitude. The stratosphere is approximately 18 kilometers above the troposphere right after the tropopause. At the stratosphere, the pressure continues to decline but there is a gradual gain in temperature up to 0 degrees Celsius. The gain in temperature is associated with the absorption of the ultraviolet radiation from the sun by the ozone layer. Similar to the troposphere, the stratosphere also varies in thickness and the air flow is majorly horizontal. It is thinner above the equator and relatively deep above the poles. It also lacks the weather-producing characteristics such as clouds because it has quite stable atmospheric conditions. Still, the lower part of the stratosphere where the air is coldest occasionally witnesses polar-stratospheric clouds. The stratosphere also contains a thin ozone layer which shields the earth from the dangerous ultraviolet rays of the sun. The ozone layer is made up of reactive oxygen. The uppermost layer of the stratosphere is known as the stratopause. At this point, the temperature starts to fall once again. The mesosphere has an altitude as high as 80 kilometers above the earths surface and it is above the startopause. It is the third highest and the coldest of all the layers in the atmosphere with an average temperature of approximately -85 degrees Celsius. The temperature here drops sharply with an increase in altitude. In the highest layer of the mesosphere (the mesopause) the temperature bottoms out at a low of roughly -100 degrees Celsius at 80 kilometers above the earth. READ: 25+ Fascinating Facts About Rainbows That Will Stir Your CuriosityThe air here is so cold that even a single droplet of water vapor can be transformed into polar-mesospheric clouds. These clouds are regarded as the highest whenever they occur. After the mesopause, the temperature starts to rise with higher altitude. This is the layer where the meteorites commonly flare as they move into the atmosphere. Sprites or ELVES lightning are occasionally formed at this layer far above the tropospheric thunderclouds. Above all, the mesosphere is too high to be reachable by balloons or aircrafts. It is mainly reached by rockets. The thermosphere is the fourth layer of the atmosphere and has an altitude of between 80 and 100 kilometers. This makes it the second highest layer in the atmosphere. The thermosphere extends from the mesopause (the thin separating layer between the mesosphere and the thermosphere) to the thermopause (the highest point of the thermosphere). The temperature in the thermosphere rises with altitude, becoming even higher for an indefinite distance into space and the temperatures can rise as high as 1500 degrees Celsius. This is due to extremely low density of molecules and the ionization of many atoms thereby creating a net electrical charge. However, the high temperatures are barely meaningful as the gas molecules are extremely far apart. For instance, an individual oxygen molecule can be as far as an average of 1 kilometer away from other molecules. The lower part of the thermosphere contains the ionosphere. Ionosphere is a thin layer accountable for absorbing the energetic photons from the Sun and creates the possibility of making long-distance radio communications as it can reflect radio waves. The thermosphere is completely free of weather-producing characteristics. The international space station is located in this layer. The exosphere is the very last and the outer limit of all the layers in the atmosphere. The bottom of this layer is about 500 kilometers above the surface of the earth. It extends from the thermopause which is the thin layer above the thermosphere. The exosphere is mostly made up of very low densities of helium, hydrogen and other various heavier molecules including oxygen, carbon dioxide, and nitrogen closer to the thermopause. READ: Where Do Clouds Go When They Disappear?Similar to the thermosphere, the air molecules and atoms at the exosphere are extremely far apart that they can move hundreds of kilometers minus colliding with one another. Accordingly, the exosphere lacks the normal behavior of gases and the molecules constantly escape into space. The movement of the free particles is influenced by the solar wind. Besides, the location of the exosphere is too far from the earths surface to exhibit any form of metrological activity. However, it is at the lower sections of the exosphere that the auroras sometimes form. Most of the satellites orbits in this layer.

**Percentage of other gases in air. What are the percentages of gases in the air. What is the percentage of noble gas in air. Which gas has lowest percentage in air. What is the percentage of noble gases found in air. Find the percentage of carbon dioxide and noble gases in air.**