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AIR AND WATER PROPERTIES

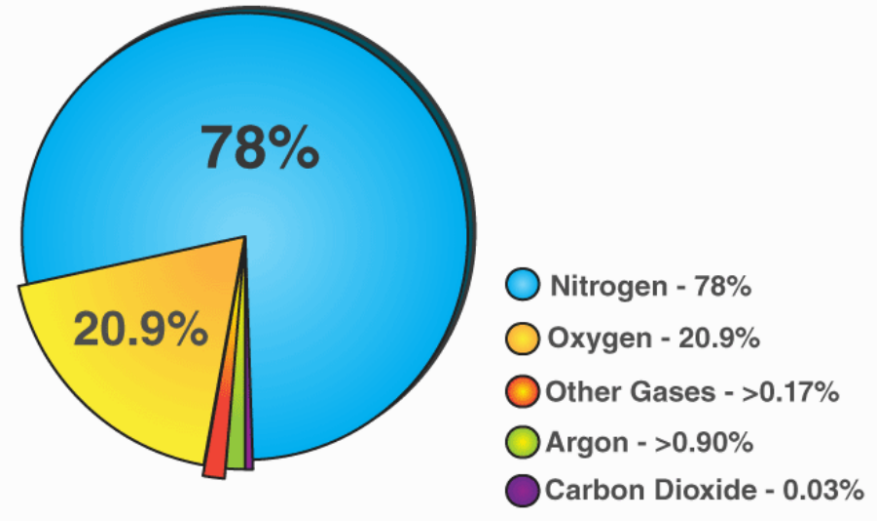
The matter is anything that occupies space. Air is a matter which is inevitable in our lives. The earth is covered with a blanket of air called the atmosphere. Among the few fundamental elements, it is the most important because no life can exist for a pulse of time without it.

In addition to breathing, air has an influential role in abiotic components of the environment like wind, rain, climate, etc.

Air: Composition and Its Properties

Chemical Composition of Air

- Air is a mixture of gases which makes up the Earth's atmosphere. These gases are colorless and odorless and hence, we can't see them but only feel them.
- The atmosphere is an ocean of these gases. It consists of 78% nitrogen, 21% oxygen and 1 % other gases and water vapour.
- The composition of air does not change as you travel through the layers of the atmosphere. What changes is the number of molecules. The air molecules decrease and become less.
- The moisture content varies from place to place. Arid regions have less moisture content as compared to wetlands.
- The water vapour or moisture content of air varies. The maximum moisture carrying capacity of air depends primarily on temperature.
- The composition of air is unchanged until the elevation of approximately *10.000 m.*
- The average air temperature diminishes at the rate of *0.6°C* for each *100 m* vertical height.
- "One Standard Atmosphere" is defined as the pressure which is equal to that exerted by a *760 mm* column of mercury at *0°C* sea level and at standard gravity (*32.174 ft/sec2*).



Composition of Air					
Element	**Volume by %**	**Weight by %**	**PPM (Parts per Million) by Volume**	**Symbol of the Element**	**Molecular Weight of the element**
Nitrogen	78.08	75.47	780790	N2	28.01
Oxygen	20.95	23.20	209445	O2	32.00
Argon	0.93	1.28	9339	Ar	39.95
Carbon Dioxide	0.040	0.062	404	CO2	44.01
Neon	0.0018	0.0012	18.21	Ne	20.18
Helium	0.0005	0.00007	5.24	He	4.00
Krypton	0.0001	0.0003	1.14	Kr	83.80
Hydrogen	0.00005	Negligible	0.50	H2	2.02
Xenon	8.7 x 10-6	0.00004	0.087	Xe	131.30

Other Components of Air

Some other components of air are mentioned below:

- Sulfur dioxide *(SO_2) – 1.0 ppm*
- Methane *(CH_4)2.0 ppm*
- Nitrous oxide *(N_2O) – 0.5 ppm*
- Ozone *(O_3) 0 to 0.07 ppm*
- Nitrogen dioxide *(NO_2) – 0.02 ppm*
- Iodine *(I_2) 0.01 ppm*
- Carbon monoxide *(CO) – 0 to trace ppm*
- Ammonia *(NH_3) 0 to trace ppm*

Properties of Air

- **Colourless and Odourless:** Air generally has no colour or odour. It is an invisible matter that can only be felt. All living things breathe air for their survival. Moving air is called wind.
- **Occupy Space:** It is a mixture of different gases. Hence, like every other matter, they also occupy space. On blowing, a balloon expands because the air being blown into it fills up the empty space.
- **Air Exerts Pressure:** It has weight, and the pressure exerted by the weight of air is known as air pressure. Due to gravity, this mixture of gases near the surface is denser than at high altitudes. This is why the gaseous atmosphere in the mountains is thinner than that at the surface.

- **Expansion:** Another property is its expanding property. On heating, it expands and occupies more space. The more it expands, the thinner it becomes. Hence, the pressure of the warm wind is lower than that of cold wind.

Properties of Water

What is water?

- Water is the chemical substance with chemical formula **H_2O**, one molecule of water has two hydrogen atoms covalently bonded to a single oxygen atom.
- A glance of earth taken from space will depict it blue. This blue colour is actually water, the major part of the earth is covered with water.
- We need water for almost everything, for example- drinking, bathing, cooking etc and therefore we should know about the properties of water.
- 65% human body is composed of water. Water is essential for the survival of life on earth.
- Water is distributed unevenly on the earth's surface. It forms a major solvent and dissolves almost every polar solute.

Physical properties of water

- Water is a colourless and tasteless liquid.
- The molecules of water have extensive hydrogen bonds resulting in unusual properties in the condensed form. This also leads to high melting and boiling points.
- As compared to other liquids, water has a higher specific heat, thermal conductivity, surface tension, dipole moment, etc. These properties form the reason for its significance in the biosphere.
- Water is an excellent solvent and therefore it helps in the transportation of ions and molecules required for metabolism.
- It has a high latent heat of vaporization which helps in the regulation of body temperature.

Chemical properties of water

Water reacts with a lot of substances to form different compounds. Some significant reactions are as follows:

Amphoteric Nature

- Water can act as both acid and base, which means that it is amphoteric in nature.
  Example:

Acidic Behaviour: $H2O(l)+NH3(aq)H2O(l)+NH3(aq) \rightleftharpoons NH+4(aq)+OH-(aq)NH4+(aq)+OH-(aq)$

Basic Behavior: $H2O(l)+H2S(aq)H2O(l)+H2S(aq) \rightleftharpoons H3O+(aq)+HS-(aq)H3O+(aq)+HS-(aq)$

Redox Reactions

- Electropositive elements reduce water to hydrogen molecule. Thus, water is a great source of hydrogen. Let us see an example in this case:

  $2H2O(l)+2Na(s) \rightarrow 2NaOH(aq)+H2(g)2H2O(l)+2Na(s) \rightarrow 2NaOH(aq)+H2(g)$

- During the process of photosynthesis, water is oxidized to O_2. As water can be oxidized and reduced, it is very useful in redox reactions.

Hydrolysis reaction

- Water has a very strong hydrating tendency due to its dielectric constant. It dissolves many ionic compounds. Some covalent and ionic compounds can be hydrolyzed in water.

Properties	
Chemical formula	H2O
Molar mass	18.01528(33) g/mol
Odour	None
Density	**Solid:** 0.9167 g/ml at 0 °C **Liquid:** 0.961893 g/mL at 95 °C 0.9970474 g/mL at 25 °C 0.9998396 g/mL at 0 °C
Boiling Point	99.98 °C (211.96 °F; 373.13 K)
Melting Point	0.00 °C (32.00 °F; 273.15 K)
Solubility	Poorly soluble in aliphatic and aromatic hydrocarbons, ethers and ethers. Improved solubility in amines, ketones, alcohols, carboxylates. Miscible with acetonitrile, dimethyl sulfoxide, dimethoxyethane, dimethylformamide, acetaldehyde, sulfolane, tetrahydrofuran, 1,4-dioxane, glycerol, acetone, isopropanol, propanol, ethanol, methanol. Partially miscible with Bromine, Ethyl Acetate, Diethyl ether, Dichloromethane.
Acidity (pKa)	13.995
Vapour pressure	3.1690 kilopascals or 0.031276 atm
Basicity (pKb)	13.995
Refractive index(nD)	1.3330 (20°C)
Thermal conductivity	0.6065 W/m·K
Viscosity	0.890 cP
Structure	
Crystal structure	Hexagonal
Molecular shape	Bent
Point group	C_{2v}
Dipole moment	1.8546 D

Thermochemistry	
Specific heat capacity *(C)*	75.375 ± 0.05 J/mol·K
Std enthalpy of formation ($\Delta_f H^\circ_{298}$)	-285.83 ± 0.040 kJ/mol
Std molar entropy (S°_{298})	69.95 ± 0.03 J/mol·K
Gibbs free energy ($\Delta_f G^\circ$)	-237.24 kJ/mol