

What is hydrogen?

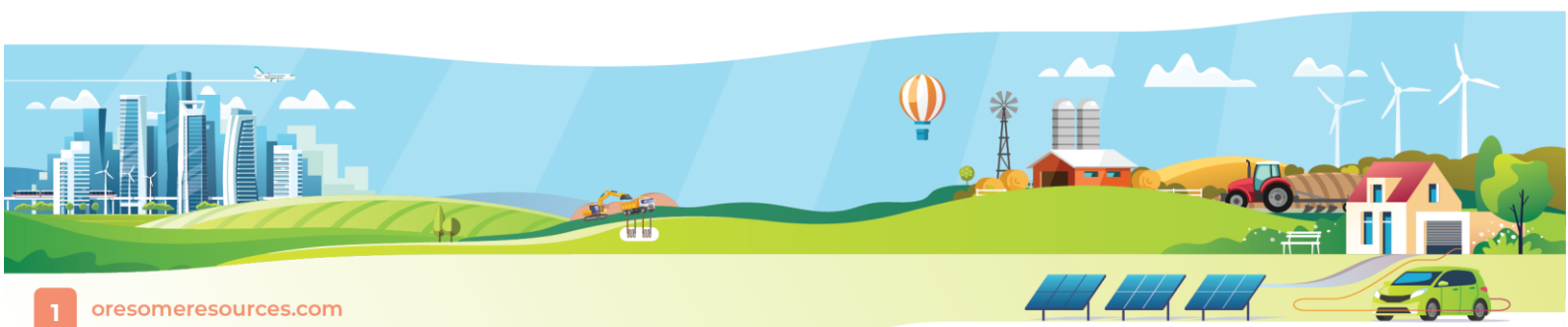
Hydrogen is a chemical element with symbol H and atomic number 1. It is classified as a nonmetal and sits above the alkali metals in the periodic table.

Hydrogen is the simplest, most abundant element in the universe. It is estimated to make up more than 90% of all the atoms and three quarters of the mass of the universe.

Under ambient conditions it is a non-toxic, colourless, odourless and highly flammable. It is diatomic gas, composed of only two hydrogen atoms and has the molecular formula H₂. Hydrogen burns readily with oxygen to produce considerable heat energy and water.

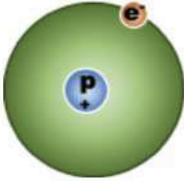
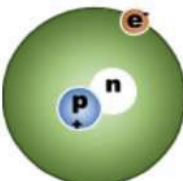
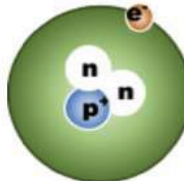
It is possible to make liquid hydrogen at atmospheric pressure by cooling it to below -252.87 °C. Liquid hydrogen can be stored in insulated containers under pressure.

¹ H Hydrogen 1.0079	
Atomic Number	1
Melting Point	-259.16°C
Boiling Point	-252.88°C
Density	0.000082 g/cm ³



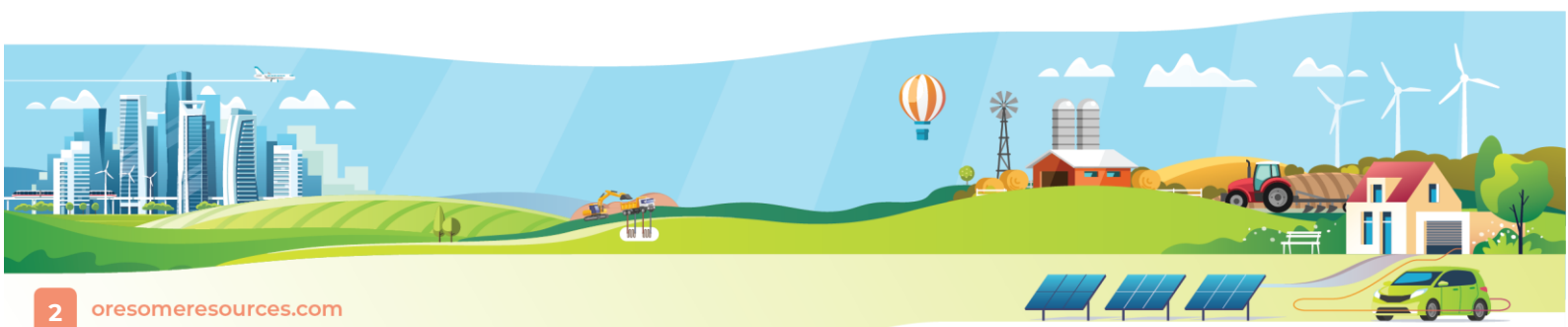
Isotopes

There are three isotopes of hydrogen: protium, deuterium and tritium. Hydrogen is the only element with isotopes that have different names. Protium has one proton and zero neutrons and deuterium has one proton and one neutron. Tritium has one proton and two neutrons and is radioactive in nature as it emits low energy beta particles.

Name	Protium (Hydrogen-1)	Deuterium (Hydrogen-2)	Tritium (Hydrogen-3)
Image			
Symbol	${}^1\text{H}$	${}^2\text{H}$	${}^3\text{H}$
Atomic number	1	1	1
Atomic Mass	1.008 amu	2.014 amu	3.016 amu
Natural abundance	99.985%	0.015%	$\gg 10^{-18}\%$
Stability	Stable	Stable	Unstable
Half Life			12.32 years
Specific importance or use	<ul style="list-style-type: none"> forms the natural water molecule with oxygen 	<ul style="list-style-type: none"> moderator in nuclear reactors production of neutron rich medical and industrial isotopes 	<ul style="list-style-type: none"> production of the hydrogen bomb radioactive agent in luminous paints tracer for biochemical drug research, geological prospecting and hydrology.

Compounds

Pure hydrogen gas has the lowest density of all gases. It is only found in trace amounts in our atmosphere, making up with approximately 0.000055% of the air. Hydrogen combines with other elements to form numerous compounds but predominantly occurs with oxygen in water (H_2O). Some of the other common compounds formed with hydrogen are ammonia (NH_3), methane (CH_4), table sugar ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$), hydrogen peroxide (H_2O_2), methanol (CH_3OH) and hydrochloric acid (HCl). Hydrogen also forms part of the innumerable carbon compounds present in all organic matter, animal and vegetable tissue, petroleum and coal.



Uses

Hydrogen is a commercially important element used for a wide range of industrial processes. Large quantities of hydrogen are required for the Haber process to produce ammonia, which is used to make fertilizer, as a refrigerant gas, and for various manufacturing processes. Hydrogen is also added to liquid oils, such as peanut oil, through a process called hydrogenation, to convert them to solid fats. Methanol, which is primarily used for organic synthesis and as fuel, solvent, and antifreeze, is produced from hydrogen and carbon monoxide. Hydrogen is also used in the manufacturing of semiconductors to be used in electronic devices.

Hydrogen can also be used as a clean fuel and is becoming more important in the move to decarbonise energy production. Hydrogen fuel cells have been used for many years on-board space shuttles to provide electricity and drinking water for the astronauts. Progressively, hydrogen fuel cells are being used for cars, portable power systems, and electric power generation with technology that converts a source of hydrogen gas into large amounts of electrical current. The only by-products from the use of hydrogen as a fuel are water and heat. This pollution-free electricity generation using hydrogen could replace natural gas, gasoline and coal in the near future.

Liquid hydrogen, when combined with liquid oxygen, makes an excellent rocket fuel. It is important in

Production Methods

It is possible to produce hydrogen by a variety of processes, including:

- Electrolysis of water, from renewable or non-renewable energy sources
- Steam methane reforming from natural gas or biomass
- Gasification of coal or biomass
- Methane pyrolysis
- Nuclear High Temperature Electrolysis of water
- High Temperature Thermochemical Water splitting
- Biomass Fermentation
- Photoelectrochemical (PEC) Water splitting
- Photobiological processes

