



كلية العلوم

القسم : الكيمياء

السنة : الثانية

المادة : لغة تخصصية ١

المحاضرة : جداول

{{ مكتبة A to Z }}

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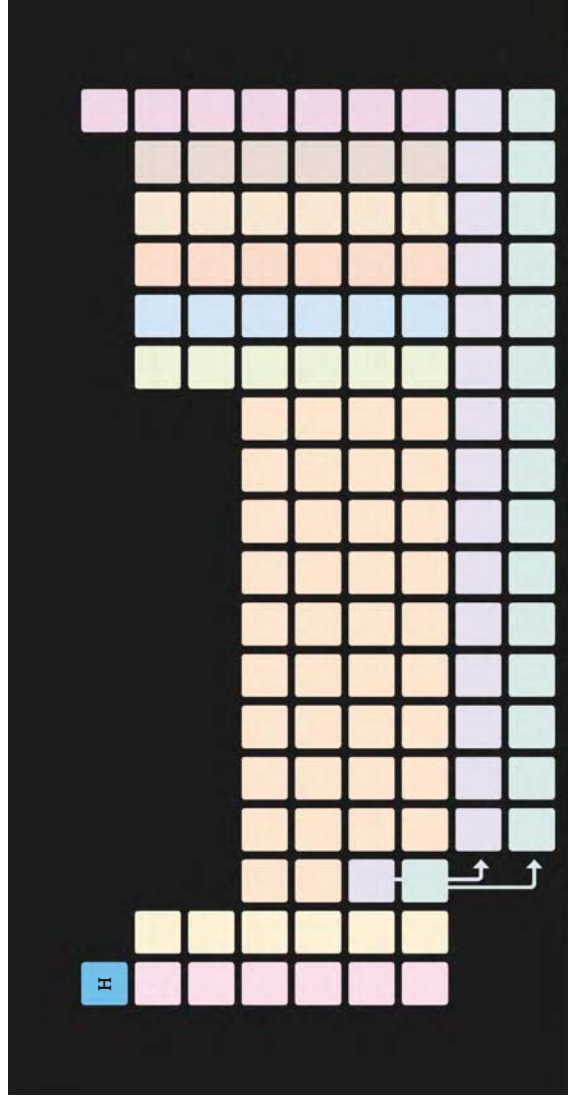
# Periodic table of elements

The periodic table is a useful way of organizing the elements. It arranges the elements in order of their atomic number, which is the number of protons in the nucleus of an atom, and is unique to every element. The table also divides the elements into rows, called “periods”, and columns, called “groups”. Dmitri Mendeleev, the chemist who devised the table, arranged the elements based on the similarity of certain physical and chemical properties.

1 H 1.0079	2 He 4.0026	3 Li 6.941	4 Be 9.0122	5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948	19 K 39.098	20 Ca 40.078
21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39
31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224
41 Nb 92.906	42 Mo 95.94	43 Tc (96)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71
51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29	55 Cs 132.91	56 Ba 137.33	57-71 La-Lu	72 Hf 178.49	73 Ta 180.95	74 W 183.84
75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.96	84 Po (209)
85 At (210)	86 Rn (222)	87 Fr (223)	88 Ra (226)	89-103 Ac-Lr	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)
109 Mt (268)	110 Ds (281)	111 Rg (272)	112 Cn 285	113 Nh 284	114 Fl 289	115 Mc 288	116 Lv 293	117 Ts 294	118 Og 294
119 Uu (295)	120 Uub (296)	121 Uut (297)	122 Uuq (298)	123 Uuq (299)	124 Uuq (300)	125 Uuq (301)	126 Uuq (302)	127 Uuq (303)	128 Uuq (304)
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Pure hydrogen (H) fills this glass sphere, and produces a purple glow when electrified.



# Hydrogen

The first element, hydrogen (H), is located above the alkali metals in the first column of the periodic table. However, because it is so different to the elements below it, hydrogen is not included in their group. This gas has the simplest atoms of any element with one electron and one proton. It is highly reactive and forms compounds with all kinds of other elements.



## Atomic structure

A hydrogen (H) atom has one electron moving around a nucleus consisting of a single proton.



## Physical properties

Hydrogen gas is the lightest material in the Universe. Pure hydrogen is rare on Earth, as it escapes quickly from the atmosphere into space.



## Chemical properties

Hydrogen is highly flammable. It forms compounds with both metals and non-metals.



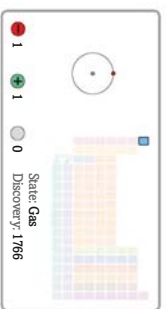
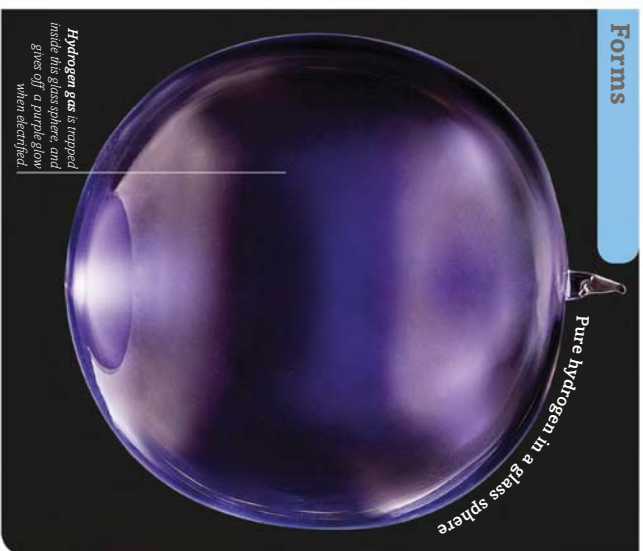
## Compounds

The most common hydrogen compound is water. Acids are compounds that contain hydrogen.



# H Hydrogen

## Forms

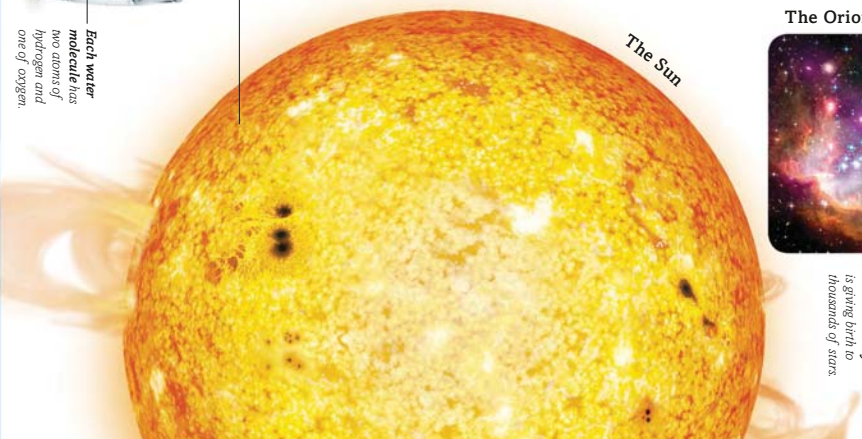


The Orion Nebula



This gaseous stellar nursery is giving birth to thousands of stars

The Sun



The Sun is four-fifths hydrogen.



Each water molecule has two atoms of hydrogen and one of oxygen.

Water

Three quarters of this planet is made up of layers of gaseous and liquid hydrogen.

Jupiter



Hydrogen is the first member of the periodic table because it has the simplest atoms of all elements: they contain just one proton and one electron. Pure hydrogen is a transparent gas. The biggest planets, such as Jupiter, are vast balls of hydrogen mixed with

other gases, such as helium and methane. On Earth, hydrogen is commonly found in water. Although it is rare in Earth's atmosphere, hydrogen is the most common element in the Universe. Stars, such as the Sun, contain large amounts of hydrogen. At the centre of a star, atoms of

## Uses



Hydrogen-filled balloon

This balloon can rise high into the atmosphere where sensors gather information about atmospheric pressure, temperature, and wind speed.

Margarine is made of vegetable oils thickened by adding hydrogen.



Hydrogen peroxide

This powerful rocket uses 45,460 litres (12,000 gallons) of liquid hydrogen as fuel.

This liquid is used as a cleaner

The only waste product of hydrogen fuel is steam.

This powerful explosion was created by fusing hydrogen atoms.



Hydrogen bomb explosion

This energy-efficient bus runs on a fuel cell fed by hydrogen.



Hydrogen-powered bus

this element are fused together, releasing heat and light. New stars form inside **nebulae** – such as the **Orion Nebula**. They are clouds of hydrogen gas that slowly collapse in on themselves. Hydrogen gas is the lightest element of all, and much lighter than air. This is why **hydrogen-filled balloons** can fly higher than air-filled ones. Supercold liquid hydrogen is used as **rocket fuel**. Atoms of hydrogen fuse together to produce a lot of energy in **hydrogen bomb** explosions. Pure hydrogen is also a clean energy source used to power some buses and cars.

## HOW ROCKET FUEL WORKS

- 1 This chamber contains a fuel called liquid hydrogen.
- 2 This chamber contains liquid oxygen, which helps the hydrogen burn.
- 3 Pumps control the flow of the liquids as they enter the combustion chamber.
- 4 The combustion chamber is where the liquids mix together, creating an explosion.
- 5 The nozzle emits hot vapour, pushing the rocket upwards.

Many space rockets use liquid hydrogen as a fuel. The hydrogen reacts with oxygen to form extremely hot steam, which blasts out of the nozzle. This creates thrust, which pushes the rocket upwards.



Delta IV rocket









## Compounds

The most common hydrogen compound is water. Acids are compounds that contain hydrogen.

**Forms**

This water contains tiny amounts of dissolved lithium minerals



Drinking water

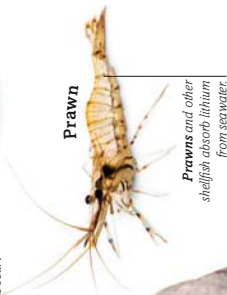
Lepidolite

Oyster mushrooms



These mushrooms absorb lithium from the soil

Pale quartz



Prawns and other shellfish absorb lithium from seawater

Petalite



Shiny pure lithium becomes dull when it is exposed to air

Bar of pure lithium refined in a laboratory



**Lithium is the lightest of all metals: in fact, it can easily float on water. Pure lithium** is very reactive and exists in nature only in minerals, such as **lepidolite** and **petalite**. Many lithium minerals dissolve well in **water**, and the world's seawater

contains millions of tonnes of dissolved lithium. Lithium is found in many foods, such as **mushrooms**, **prawns**, nuts, and seeds. It also has many everyday applications. Glass composed of lithium is resistant to heat and is used in scientific equipment, such as **mirrors inside**

**Uses**

Smartphones run on rechargeable batteries that use lithium to store electricity



Smartphone



Hale telescope mirror

Lithium added to the glass in this mirror stops the disc warping at extreme temperatures

This car runs for at least **64 km (40 miles)** on one charge of its lithium-ion battery



This charging point can recharge an electric car in one hour

Electric car



Grease



Lithium-rich grease is used to keep mechanical parts of engines running smoothly, even when hot



Lithium coating on the inside of some syringes delays the clotting of the blood sample

Some artificial teeth contain lithium disilicate, which makes them strong



Artificial teeth

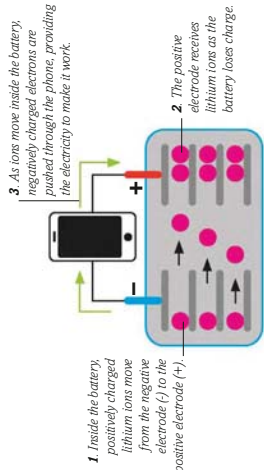
This air scrubber used lithium hydroxide to purify the air inside the Apollo 13 spacecraft



Air scrubber

**LITHIUM-ION BATTERY**

Lithium-ion batteries are widely used in digital devices. They store electrical energy to power gadgets and are rechargeable. This diagram shows a device's battery in use; when it is charging, this process is reversed.



**telescopes**. The main use for lithium is in rechargeable batteries. Lithium-ion batteries are small but powerful, so they are ideal for **smartphones** and tablet computers. Larger lithium batteries can power **electric cars**, which are less polluting than petrol-powered

ones. A soapy compound called lithium stearate is used to make **grease**, which helps automobile engines run smoothly. This element also forms hard ceramics that are used to produce strong **artificial teeth**. Lithium compounds are used in some medicines as well.



# Na<sup>11</sup> Sodium

## Forms

*This sodium-rich mineral is an example of a zeolite, a mineral with tiny holes that can trap gases.*

Clinochloite

Pure halite crystals

Cube-shaped transparent crystals

Soft, shiny metal

Laboratory sample of pure sodium in an airtight vial

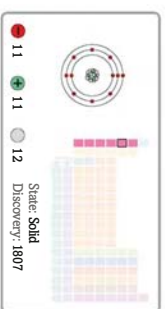
*This glass case holding pure sodium has no air in it, to prevent the metal from reacting with oxygen in air.*

Sodalite catapocoon

Polished gemstone made of the mineral sodalite

*The thick, white crust covering this salt flat contains sodium chloride and other salts.*

Salar de Uyuni, Bolivia



## Uses

*Edible salt is made by refining the mineral halite.*

Common salt

*This mummified body, or mummy, was preserved using sodium compounds.*

Sodium fireworks

*Bright yellow lights in fireworks get their colour from burning sodium compounds.*

*Indigo dyes – often used in blue jeans – contain sodium.*

Indigo dye powder

*Spraying salt keeps roads free from ice and frost.*

## MUMMIFICATION

Ancient Egyptians believed in life after death and so preserved the bodies of their dead. A dead body was washed and the organs removed, then crystals of sodium compounds were used to dry it out. Finally, the body was wrapped, which completed the process of mummification.



**1** Organs, such as the stomach and lungs, were removed from the dead body

**2** Sodium compounds were spread over the body to dry it.

**3** The body was wrapped in cloth to mummify it.

*This tube glows bright yellow-orange when sodium gas is electrified.*

Sodium gas lamp

Bar of soap

*Some soaps contain sodium hydroxide.*

**Cats were sacred in ancient Egypt, so their bodies were mummified.**

Baking soda

*Odourless white powder*

De-icing

**Everyday salt contains lots of sodium.** Although abundant on Earth, sodium is never found in its pure form naturally; it forms compounds with other elements. Sodium chloride, which also contains chlorine, is the most common sodium compound. It is also known as the mineral

**halite**, and it is what makes seawater salty. Other sodium minerals include **sodalite**, a soft blue stone that can be shaped and polished. **Pure sodium** is soft enough to be cut with a knife. It reacts with oxygen in the air, forming a compound called sodium oxide, and bursts

into flames when in contact with water. Sodium compounds in **fireworks** burn with a yellow-orange colour. In ancient Egypt, crystals of sodium compounds were used to preserve dead bodies as **mummies**. Another useful compound is sodium bicarbonate, or **baking soda**, which makes dough

rise by releasing bubbles of carbon dioxide. When refined, sodium chloride, or **common salt**, has several uses. It makes ice melt so it is used in salty grit added to slippery, frozen roads. This helps **de-ice** them to make them safer. It is also an important seasoning for meals.





**SALT FLATS** Hundreds of artificial ponds dot the hillside near the small town of Maras, high in the Andes of Peru. The ponds fill with water from a stream that runs down from the nearby mountains. In the sunshine, the water evaporates, leaving behind a thick salt crust that can be collected. The people of Maras have been gathering salt in this way for at least 500 years.



The salt forms part of rocks deep underground before it is dissolved by the stream and flows into the pools. Evaporation can also be used to collect salt from seawater or other salty water sources (known as brines). Today, however, most of the world's salt comes from underground mines containing thick layers of salt that are a result of

ancient seas drying out. Over millions of years, that dry salt has become buried under dense layers of rocks. This so-called "rock salt" is sometimes unearthed using excavators. At other mines, it is washed out by piping in warm water, which dissolves the salt. The brine is then pumped up to the surface for evaporation.



88

Ra

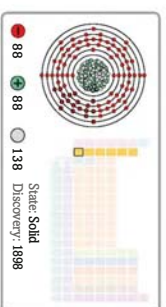
## Radium

## Forms



This ore contains just 0.7 g (0.02 oz) of radium in every 1,000 kg (2,205 lb) of rock.

In 100 years time, only 4% of the radium atoms in this watch would have broken down.



**Radium is the only radioactive member of the alkaline earth metals.** It is also the rarest element in this group, and forms in small amounts when the atoms of more common metals – such as uranium and thorium – break down. Radium atoms do not survive for long.

## Uses



The radium paint in this clock makes the numbers glow green blue in the dark.



## PIERRE AND MARIE CURIE

Radium was discovered in 1898 by Marie and Pierre Curie. They found that uranium ores produced more radioactivity than expected from samples of uranium. They realized another radioactive metal was present and named it radium.



This vial contains a liquid called radium chloride.

Vials for radium treatment

Pocket watch dial with a luminous dial

This machine from the early 20th century mixed radium into water, which was thought to make it healthier to drink.

Cosmetics

Radium emanator



Skin lotions containing radium were common in the 1920s.

Radium face powder was once thought to be good for the skin.

glow in the dark, were created using radium. People working with this paint often became ill, especially with cancer, because the radiation produced by radium damages DNA. Nevertheless, until the 1940s, many people thought radium's radioactivity made them

stronger, not weaker. They injected themselves with **vials containing a radium compound**, believing it gave them an energy boost. They also thought that creams and **cosmetics** with radium in them made the skin healthier, even though they did exactly the opposite.



## Uses

This very thin layer of gold protects the astronaut from the Sun's heat.



Astronaut's visor



Tutankhamun's death mask

This mask was placed over the pharaoh's mummified face.

## THE HOLTERMANN NUGGET

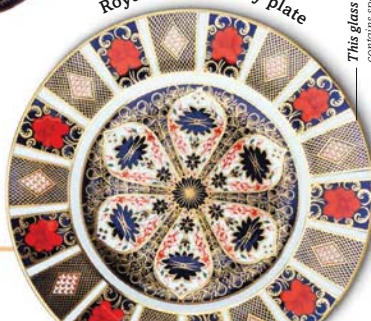
The largest piece of natural gold was found on 19 October, 1872, near the small town of Hill End in Australia. Named after its discoverer, Bernhard Holtermann, the piece contained more than 90 kg (198 lb) of pure gold.



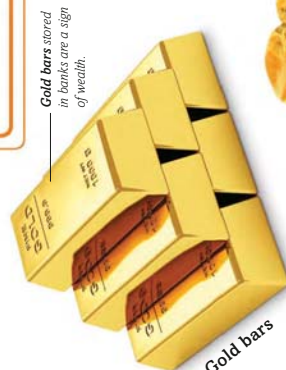
1.45 m (4.75 ft)

Holtermann Nugget Child aged 10 years old

## Royal Crown Derby plate



This glass plate contains specks of gold.



Gold bars stored in banks are a sign of wealth.

Gold bars

The flakes decorating this expensive chocolate are edible.

Edible gold flakes



Gold teeth

These replacement teeth are made of gold and mercury.

Gold foil keeps this car engine at a stable temperature.



McLaren F1 car engine



Ancient gold jewelry

This neck ornament is made from car gold.



Wat Phrathat Doi Suthep temple, Thailand

A thin layer of gold covers this entire temple.

gold dust with water or strong acids. The applications for gold include heat shields in **astronaut's visors**. This metal has always been seen as valuable and many ancient artifacts, such as the **3,300-year-old death mask** of Egyptian pharaoh Tutankhamun, were forged

from it. Some of the earliest coins, found in Turkey, were made of it. Gold is used to cover important buildings, such as Thailand's **Wat Phrathat Doi Suthep** temple. This precious metal is most commonly used today in **jewellery** or decorations.

**GOLDEN BUDDHA** A precious statue of Buddha with one thousand eyes and one thousand hands stands in Long Son Pagoda, a temple in Nha Trang, Vietnam. The Buddha is depicted as holding a range of sacred objects, including scrolls and white lotus flowers. This statue is completely covered in a layer of pure gold, and it draws in hundreds of devotees from across the world.







Although humans have discovered many strong metals and useful elements, gold has remained one of the most valuable. Before people knew what it was, they saw glittering gold dust in river beds or dug large gold nuggets out from rocks. They found that gold has many valuable qualities: it is soft enough to hammer into any shape and can be melted down for moulding

into ornaments. Best of all, its gleaming golden colour never fades away. Ancient cultures prized items made of gold: in ancient Egypt, gold was used to make coins as well as to cap the tops of pyramids. Gold is, however, so rare that if all the world's mined gold were forged into a cube, it would fit inside the penalty area of a soccer pitch.



## Transition Metals

80  
**Hg**

# Mercury

### Forms

This bright red mineral is the main ore of mercury used today.

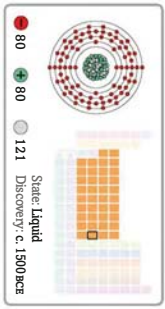
Cinnabar



The "ribbed" effect is due to mercury's extremely high density.

This metal melts at  $-39^{\circ}\text{C}$  ( $-38^{\circ}\text{F}$ ).

Solid mercury is soft enough to be cut with a knife.



**Mercury is the only metal that is liquid at room temperature.** Along with water, it is one of the few liquids found naturally on Earth's surface. **Pure mercury** forms around volcanoes where the heat separates it from its minerals, such as **cinnabar**. This red mineral has been

used for many centuries: ancient Romans roasted cinnabar to release a liquid they called *hydrargyrum*, meaning "silver water." This was the element mercury. It was later known as quicksilver because of how fast it flowed as a stream of liquid. This metal is very poisonous.



92  
U

# Uranium

**Named after the planet Uranus, uranium was the first known radioactive element.** In the early 20th century, some manufacturers used uranium in **glass bowl** glazes, only to realize later that it was a harmful metal. An unstable form, called uranium-235, is used as fuel in nuclear reactors and in atomic bombs.

*This sample of pure uranium is waste from a nuclear plant.*

*These black sections contain uranium dioxide, which is the main source of uranium.*

*Chunk of pure uranium*

Uraninite

*Uranium mixed into glass makes this bowl glow bright green under ultraviolet (UV) lamps.*

Glass bowl

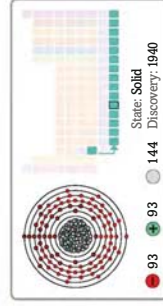


93  
Np

# Neptunium

*The radioactive elements in this mineral decay to form neptunium.*

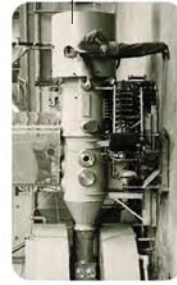
Uraninite



*This cyclotron, built in 1938, was used to discover neptunium.*

Cyclotron at the University of California, Berkeley, USA

**Sitting next to uranium in the periodic table, neptunium was named after the planet Neptune.** It exists in small amounts in radioactive ores, such as aeschynite. It forms during nuclear explosions and was first identified inside a machine called a **cyclotron**. There are no known uses for neptunium.



94  
Pu

# Plutonium

**Hardly any plutonium exists in nature:** most of it has decayed into other elements over time. It was discovered during the development of nuclear bombs in World War II. Today, plutonium is used mostly as a nuclear fuel.

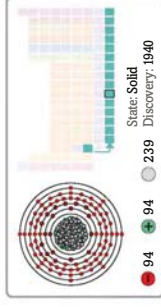
*This ore contains trace amounts of plutonium.*

*This plutonium battery was used in early pacemakers.*

1970's pacemaker battery



Curiosity Rover



*This Martian rover uses the heat given off by a supply of plutonium to generate electrical power.*

Uraninite



95  
Am

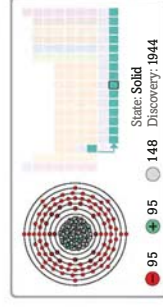
# Americium

*Smoke detector component*



*This smoke detector contains tiny, harmless quantities of americium.*

**This metallic element is not found in nature.** Instead, it is produced inside nuclear reactors when uranium or plutonium atoms are bombarded with neutrons. Remarkably, americium is the most common radioactive element used in the home. Radioactivity emitted by americium atoms causes the air inside **smoke detectors** to conduct electricity. When smoke disrupts the electric current, an alarm goes off.

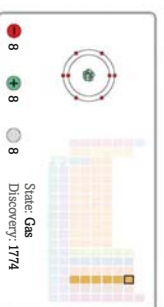




8

# Oxygen

## Forms



Strands of light adorn the sky as streams of oxygen in the air are lit by a stream of particles blasting from the Sun.



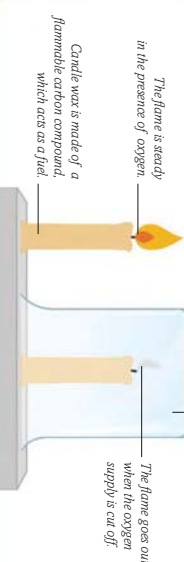
Plants release oxygen in sunlight.

Flames are produced when oxygen reacts with fuel, such as wood.



## WHAT IS COMBUSTION?

Combustion is a chemical reaction that produces heat and light. Oxygen is essential for combustion to take place.



## Oxygen is the most common element in Earth's crust.

Oxygen and its compounds make up half of all rocks and minerals on our planet.

In the atmosphere, **pure oxygen** makes up around one-fifth of the air. This element is a transparent gas. Life on Earth depends on

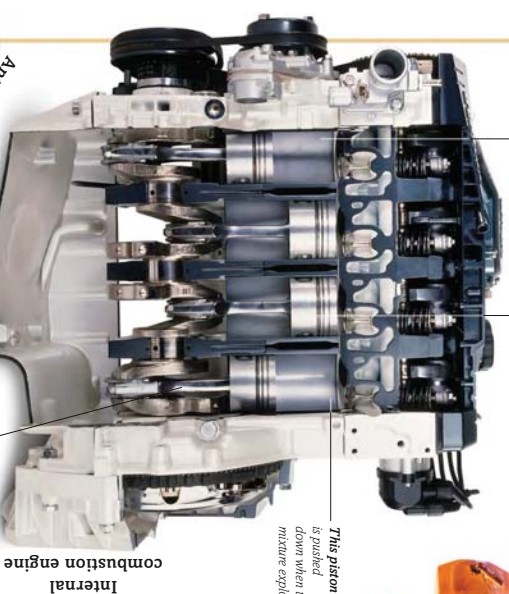
oxygen for survival. Animals breathe in air to collect the oxygen in it. Our bodies' cells then use that oxygen to break apart sugars to release energy, which powers our bodies. Another process that involves oxygen is the burning reaction called combustion, in which oxygen

## Uses

This cylinder takes in oxygen along with the fuel.

The piston then squeezes the mixture of oxygen and fuel.

Hot steel may have impurities that are burned away using pure oxygen.



The oxygen in this cylinder can last for up to 30 minutes.



This rocket carries liquid oxygen that mixes with the fuel to produce hot gases, which help the rocket lift off.



Oxygen is colourless as a gas, but looks pale blue as a liquid.

Mountaineers have to adjust slowly to changing levels of oxygen as they climb higher.



Medical oxygen cylinder



Atlas V rocket



reacts with a fuel and produces **fire**. Oxygen is also used up when it reacts with other elements to form compounds called oxides. However, it is replenished by **plants** through a process called photosynthesis, which releases fresh oxygen. **Car engines** are powered by the combustion

of petrol or other fuels. Oxygen is also useful in the **making of steel**. Tanks of oxygen let **mountaineers** breathe easily in environments that have low levels of this gas. Rockets, such as the **Atlas V**, carry liquid oxygen to burn fuel in the absence of air in space.



# Sulfur

## Forms

These yellow sulfur crystals often attach to volcanic mud.

Neutral sulfur

Liquid sulfur



This gray-blue crystal contains a sulfur compound called strontium sulfate.

Hot liquid sulfur is pumped up from an underground mine.

Celestine

Soft, brittle granules

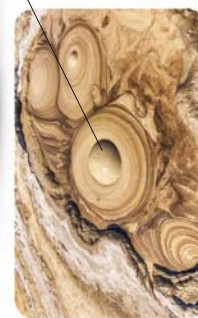
Skunks release a foul spray that contains three kinds of sulfur compounds.

Laboratory sample of pure sulfur

Skunk

Hydrogen sulfide bubbles form in volcanic mud.

Mud volcano



Onions

Cut onions release sulfur compounds that make our eyes water.

**Known since ancient times, sulfur is one of the few non-metals that can be found pure in nature.** This yellow, crystalline element is found in large amounts near volcanic craters. Another name for sulfur is "brimstone," which refers to the way its crystals burn, melting into

a blood-red liquid. In some religions, brimstone is thought to be the fuel that burns in the underworld. **Pure sulfur** is extracted from underground deposits using hot water. The hot **liquid sulfur** is then pumped to the surface. This element is a common ingredient in many

## Uses

Vulcanized rubber – made by heating sulfur with natural rubber – is weather proof.



Vulcanized tyre

Creams that contain sulfur compounds can disinfect skin.



Lead acid battery

This battery contains strong sulfuric acid.

penicillin pills

Acid rain destroys forests by removing nutrients in the soil and in the leaves.

Some antibiotics contain sulfur compounds that kill harmful bacteria.

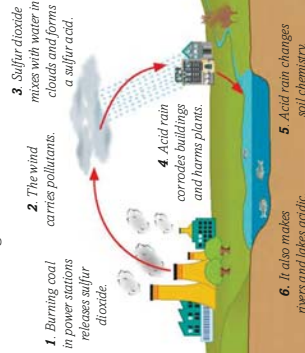
Sulfur acid rain damage

This plant emits a rancid smell to attract meat-eating insects.

Titan arum

## ACID RAIN

Sulfur dioxide gas produced by burning fuel dissolves in rain water, making a sulfur acid. This falls to the ground as acid rain.



This limestone sculpture has been weathered by acid rain.



Preserved dried fruits

When burned, sulfur in this candle drives away pests.



Some dried fruits are preserved using powder containing a sulfur compound.

Sulfur candle





مكتبة  
A to Z