كلية العلوم

القسم : **الكيمياء**

السنة : **الثانية**

المادة : لغة تخصصية١

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
			57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm (150.36)	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
			89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

The actinides and the lanthanides *are placed between the alkaline earth metals and the transition metals, but have been moved below to give them more space.*

KEY

- Hydrogen
- Alkali Metals
- Alkaline Earth Metals
- Transition Metals
- Lanthanides
- Actinides
- The Boron Group
- The Carbon Group
- The Nitrogen Group
- The Oxygen Group
- The Halogen Group
- Noble Gases

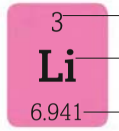
Elements of this group *are semi-metals (elements with the properties of metals and non-metals): they are shiny like metals but crumble easily like non-metals.*

This group *contains the noble gases, which never form bonds with other elements, and are unreactive.*

Reading the table

Element symbol

Every element has a unique symbol of one or two letters. These symbols ensure that scientists who speak different languages do not get confused while describing the same element.



The atomic number is the number of protons in the nucleus of this element's atoms.

The first letter of a symbol is always a capital, but the second is lower case.

The atomic mass number is the average of all the atoms of the element. It is not a whole number because there are different isotopes (forms) of each element, each with a different number of neutrons.

Periods

Elements in the same period, or row, have the same number of electron shells in their atoms. So elements in period one have one electron shell, while those in period six have six electron shells.

Periods run from left to right.

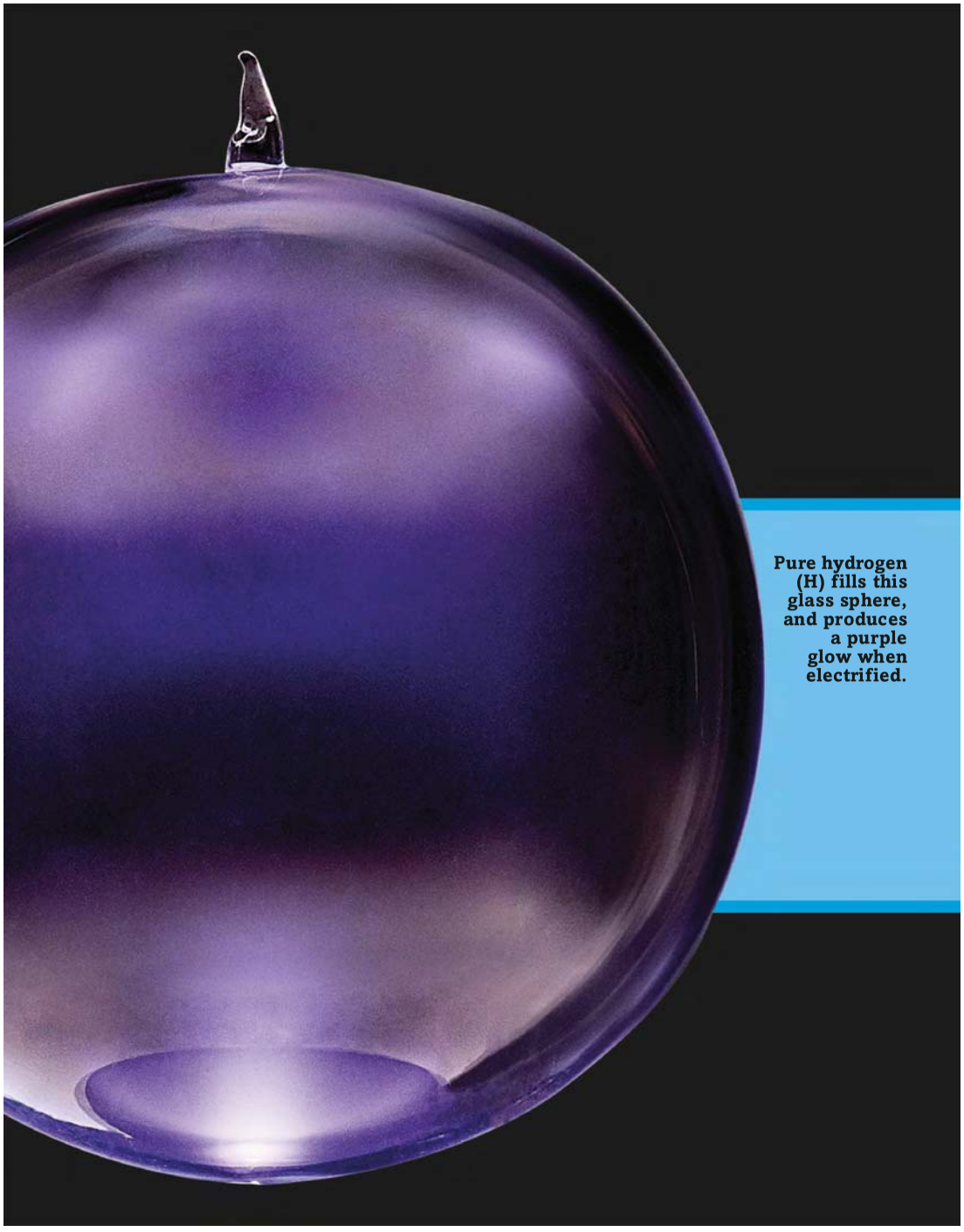
Groups run from top to bottom.

Groups

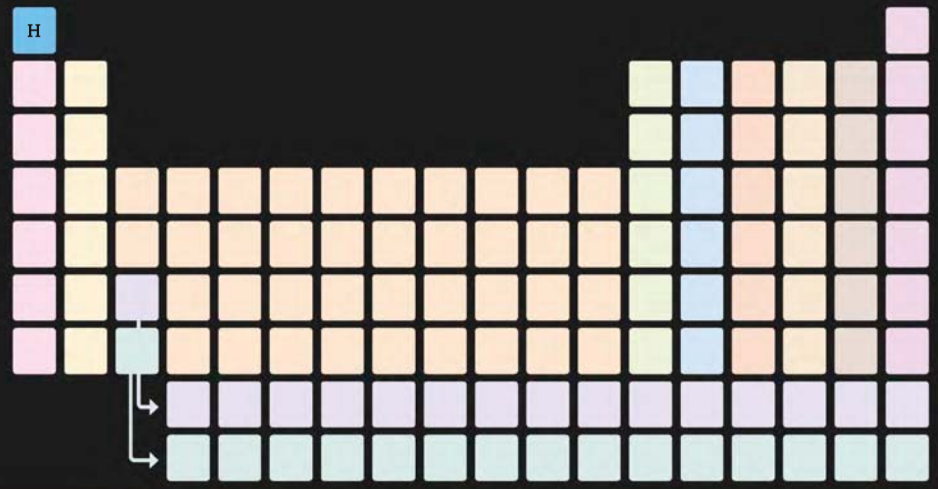
Members of a group, or column, all have the same number of electrons in their outermost shell. For example, group one elements have one outer electron, while group eight elements have eight outer electrons.

DMITRI MENDELEEV

The periodic table was developed by the Russian chemist Dmitri Mendeleev in 1869. Others had tried before, but his table was periodic, or repeating, because the characteristics of elements follow a pattern. The table was incomplete as some elements had not yet been discovered. However, Mendeleev predicted the positions of the missing elements, and was proved right when they were finally isolated many years later.



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.

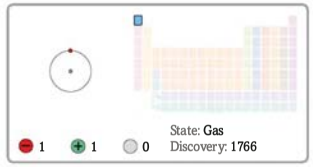
Atomic structure
A hydrogen (H) atom has one electron moving around a nucleus consisting of a single proton.

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.

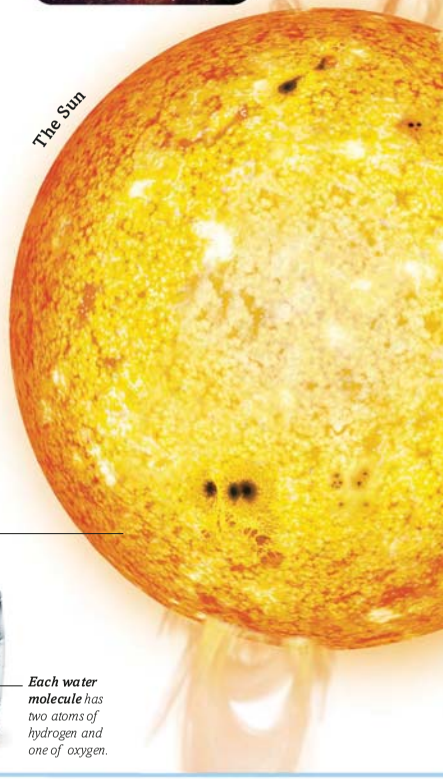
Chemical properties
Hydrogen is highly flammable. It forms compounds with both metals and non-metals.

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

1 H Hydrogen



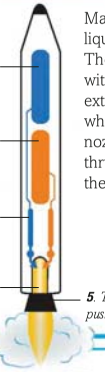
Forms



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 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.

Uses

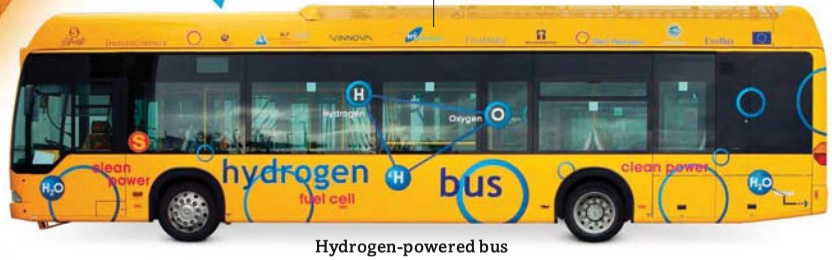
HOW ROCKET FUEL WORKS



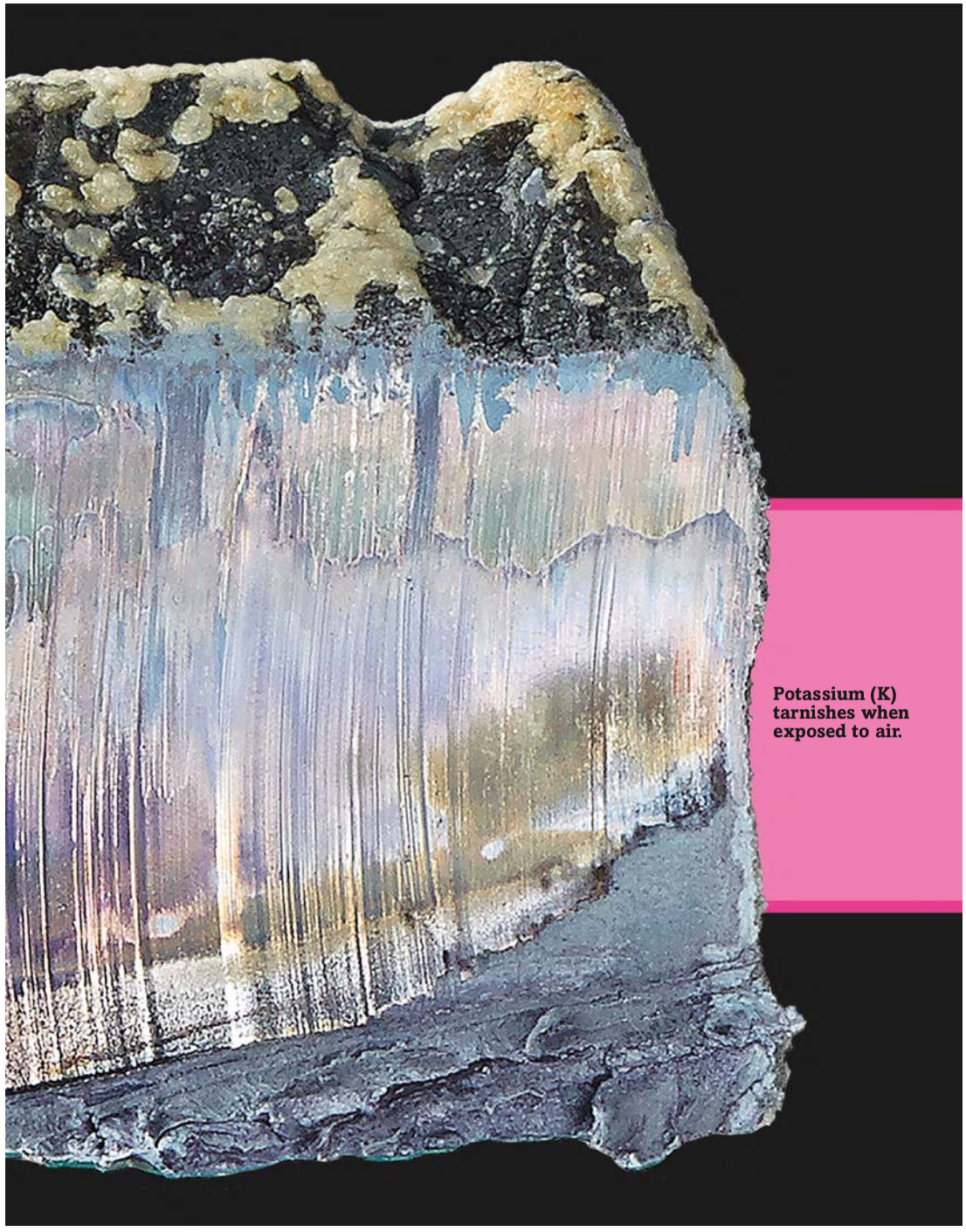
Many space rockets use liquid hydrogen as a fuel. The hydrogen reacts with oxygen to form extremely hot steam, which blasts out of the nozzle. This creates thrust, which pushes the rocket upwards.

The only **waste product** of hydrogen fuel is **steam**.

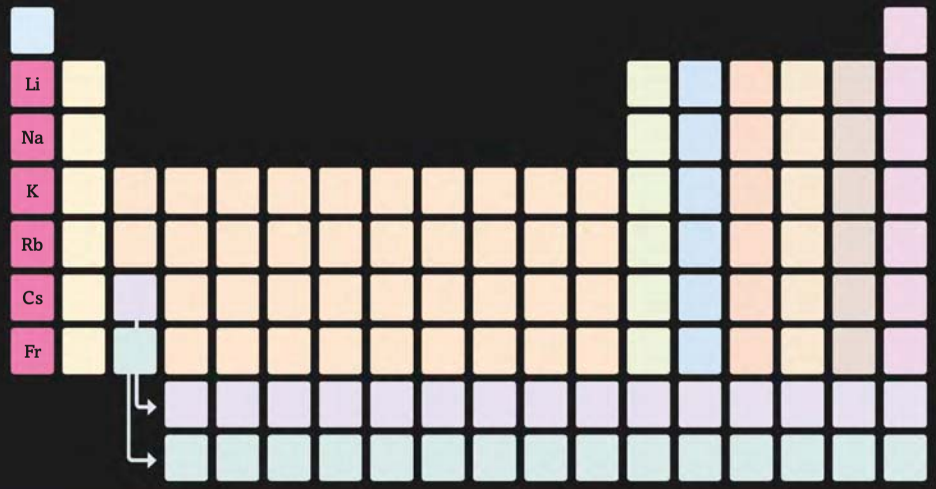
Hydrogen bomb explosion



Hydrogen-powered bus



Potassium (K) tarnishes when exposed to air.



Alkali Metals

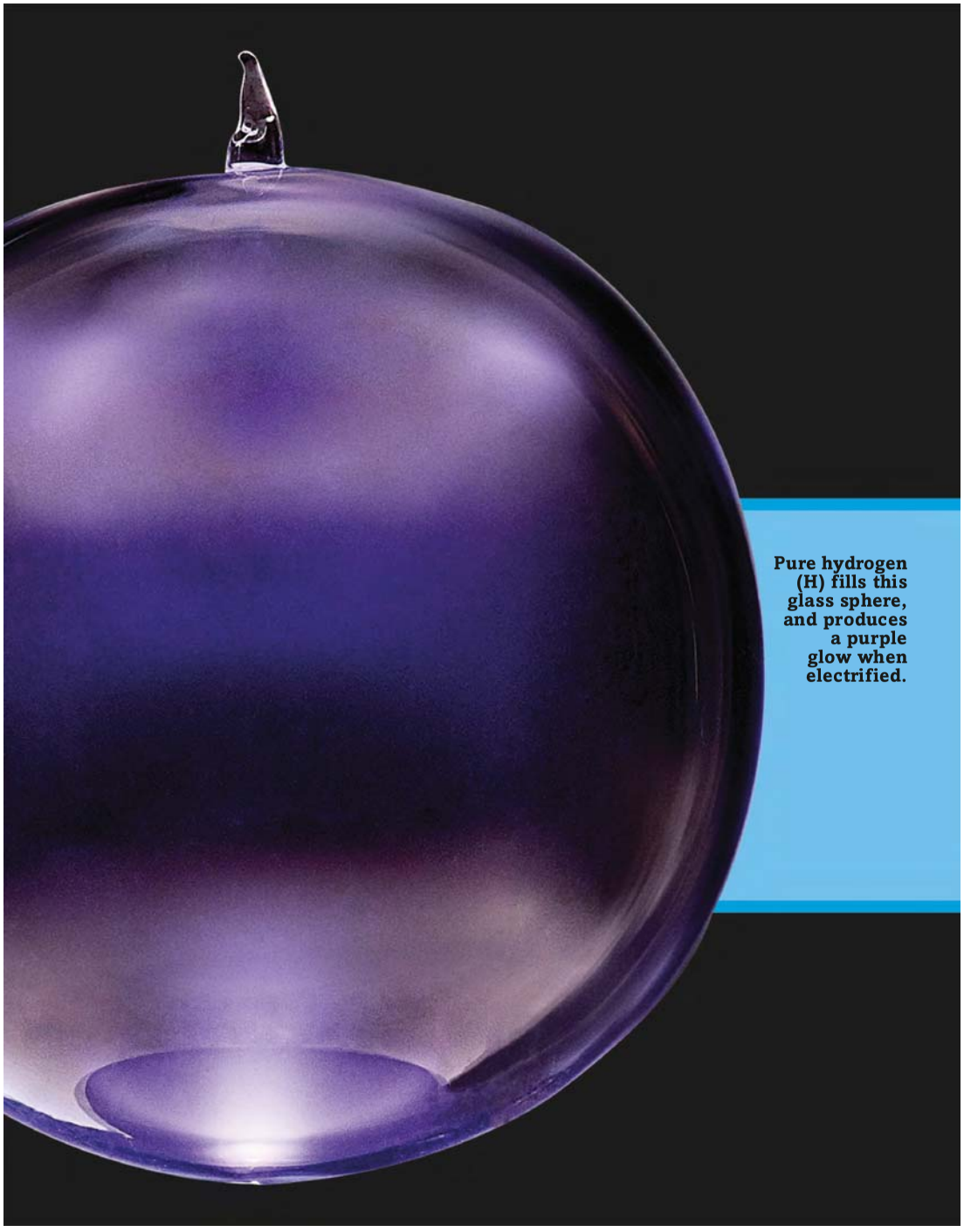
After hydrogen (H) – which is in a group of its own – the first column of the periodic table contains the alkali metals. This group gets its name from the way the elements react with water. These vigorous reactions always produce acid-attacking compounds called alkalis. None of the alkali metals are ever found in a pure form in nature. The first three metals are common in many minerals, while the last three are rarer.

Atomic structure
The atoms of all alkali metals have just one electron in their outer shell. Alkali metal atoms are among the biggest of all atoms.

Physical properties
These metals are soft enough to be cut with a knife. They are all silvery and very shiny when clean.

Chemical properties
Alkali metals are highly reactive. They form bonds with other elements, giving away their single outer electron.

Compounds
These metals react with water to form compounds called hydroxides. They react easily with halogens to form salts, such as sodium chloride.



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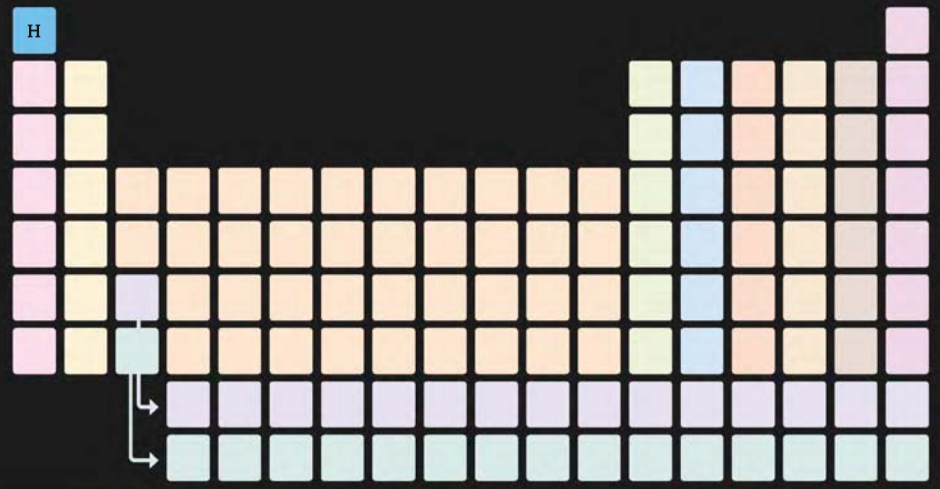

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Compounds
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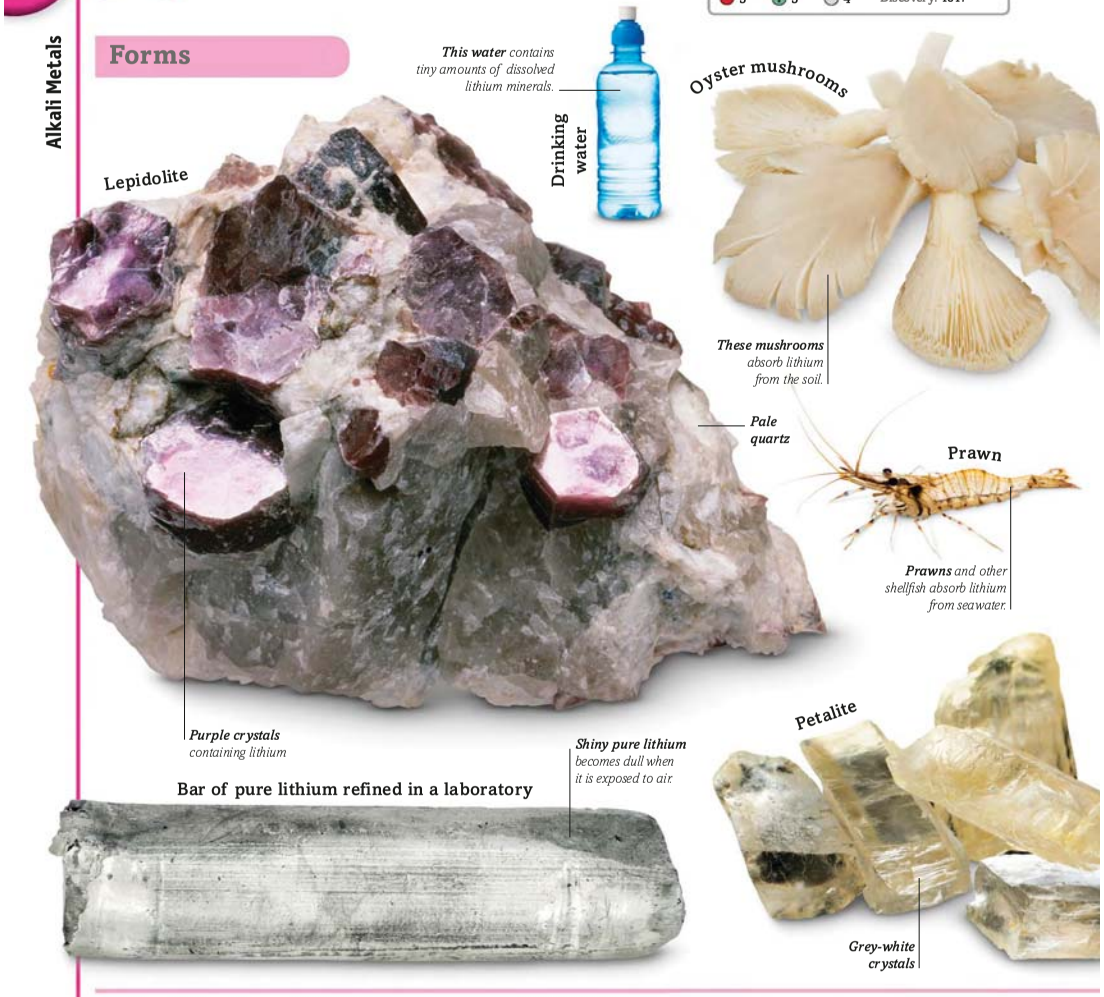
3
Li

Lithium

Forms

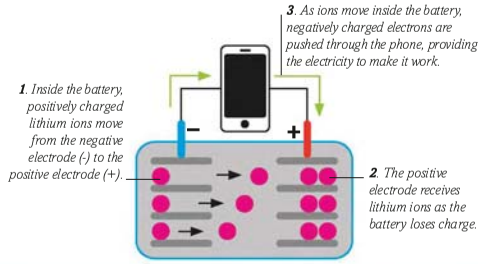


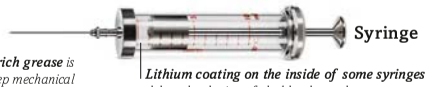
Lithium is the the lightest of all metals: in fact, it can easily float on water. **Pure lithium** is very reactive and exists in nature only in minerals, such as **lepidolite** and **petalite**. Many lithium minerals dissolve well in **water**, and the world's seawater contains millions of tonnes of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

LITHIUM-ION BATTERY

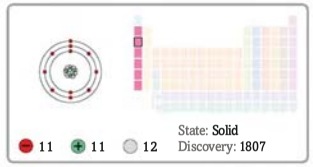
Lithium-ion batteries are widely used in digital devices. They store electrical energy to power gadgets and are rechargeable. This diagram shows a device's battery in use; when it is charging, this process is reversed.





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.

11 Na Sodium



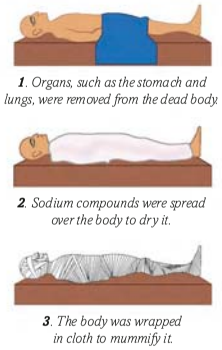
Forms

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.

Uses

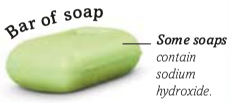
MUMMIFICATION

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.



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

Sodium fireworks

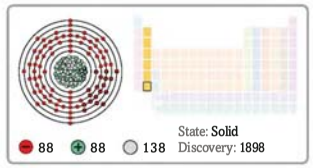


SALT FLATS Hundreds of artificial ponds dot the hillside near the small town of Maras, high in the Andes of Peru. The ponds fill with water from a stream that runs down from the nearby mountains. In the sunshine, the water evaporates, leaving behind a thick salt crust that can be collected. The people 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

Chunk of uraninite

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.

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

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, with most of them quickly decaying into radon, a radioactive noble gas. This element is highly dangerous and is rarely used today. However, in the early 20th century, radium compounds were in common use. Luminous paints, like those used to make **watch dials**

Uses

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 with a luminous dial

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

Radium emanator

Cosmetics

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

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

Tutankhamun's death mask

Royal Crown Derby plate

This glass plate *contains specks of gold.*

Gold bars *stored in banks are a sign of wealth.*

Gold bars

Edible gold flakes

The flakes *decorating this expensive chocolate are edible.*

Gold teeth

These replacement teeth *are made of gold and mercury.*

Wat Phrathat Doi Suthep temple, Thailand

A thin layer of gold *covers this entire temple.*

Gold foil *keeps this car engine at a stable temperature.*

McLaren F1 car engine

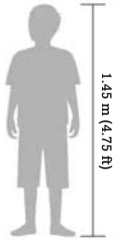
Ancient gold jewellery

This neck ornament *is made from cast gold.*

THE HOLTERMANN NUGGET

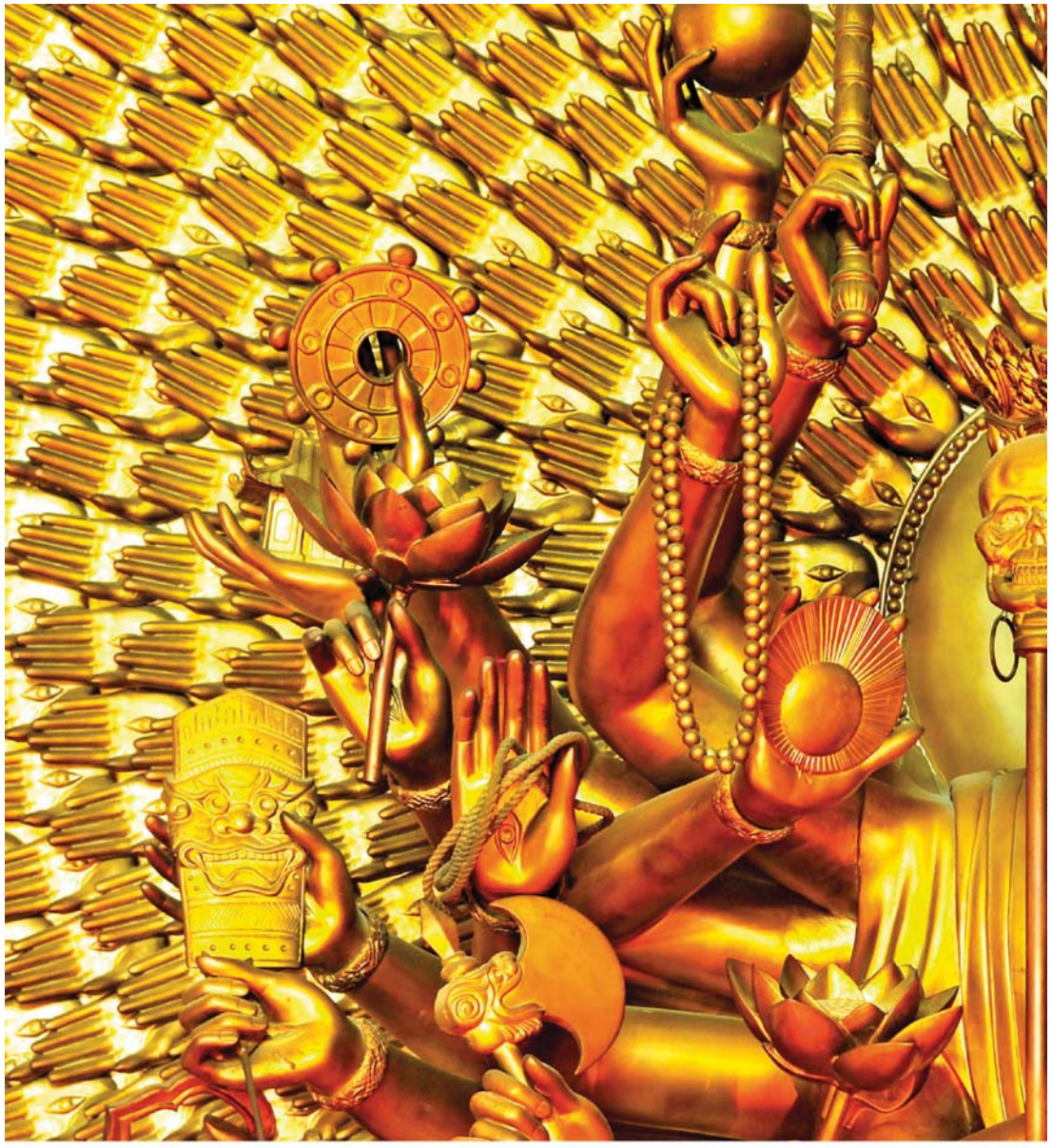
The largest piece of natural gold was found on 19 October, 1872, near the small town of Hill End in Australia. Named after its discoverer, Bernhardt Holtermann, the piece contained moe than 90 kg (198 lb) of pure gold.

Holtermann Nugget

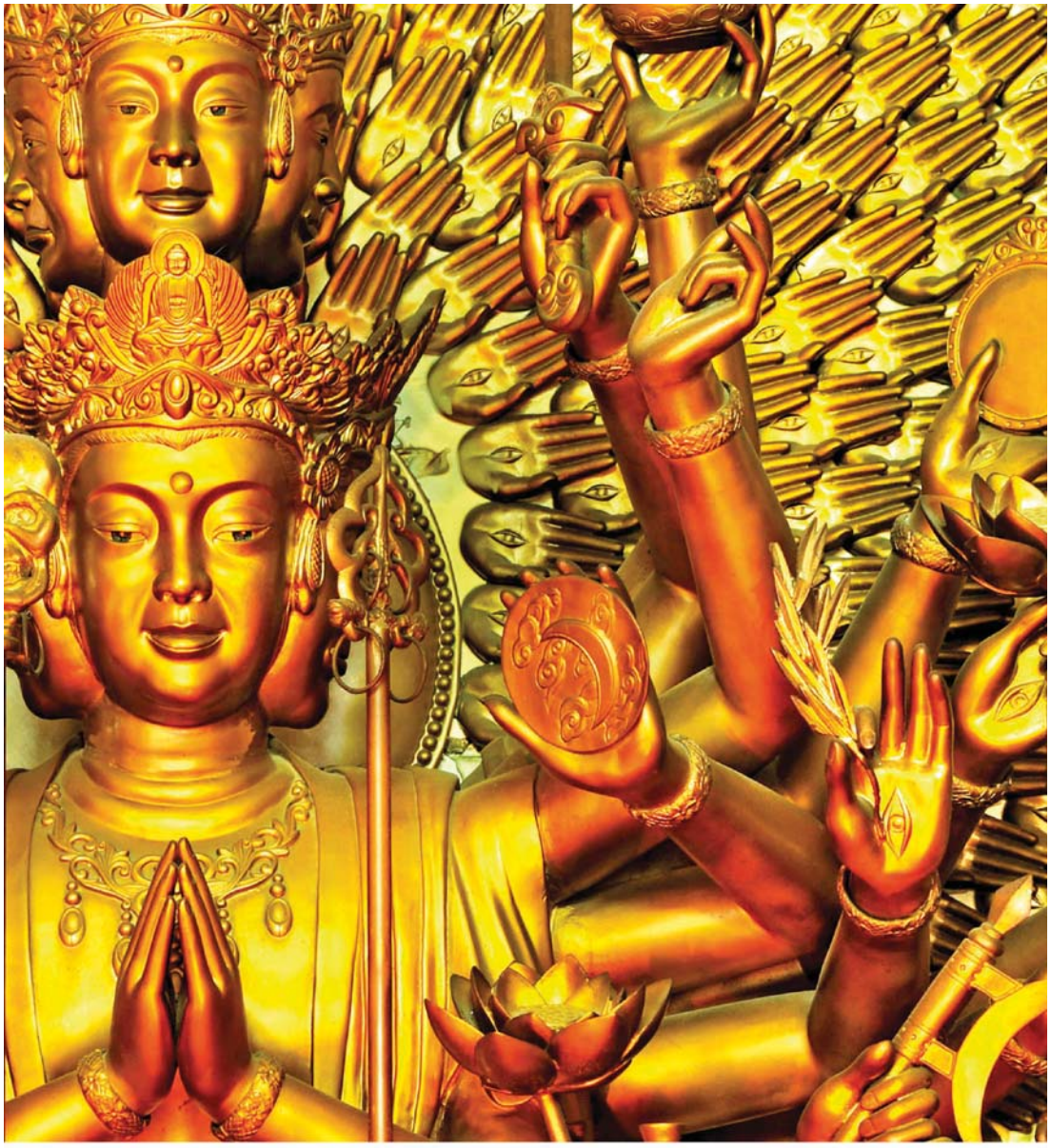


Child aged 10 years old

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 artefacts, 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.



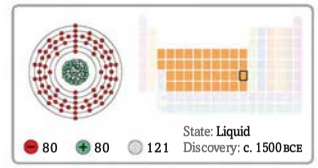
GOLDEN BUDDHA A precious statue of Buddha with one thousand eyes and one thousand hands stands in Long Son Pagoda, a temple in Nha Trang, Vietnam. The Buddha is depicted as holding a range of sacred objects, including scrolls and white lotus flowers. This statue is completely covered in a layer of pure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



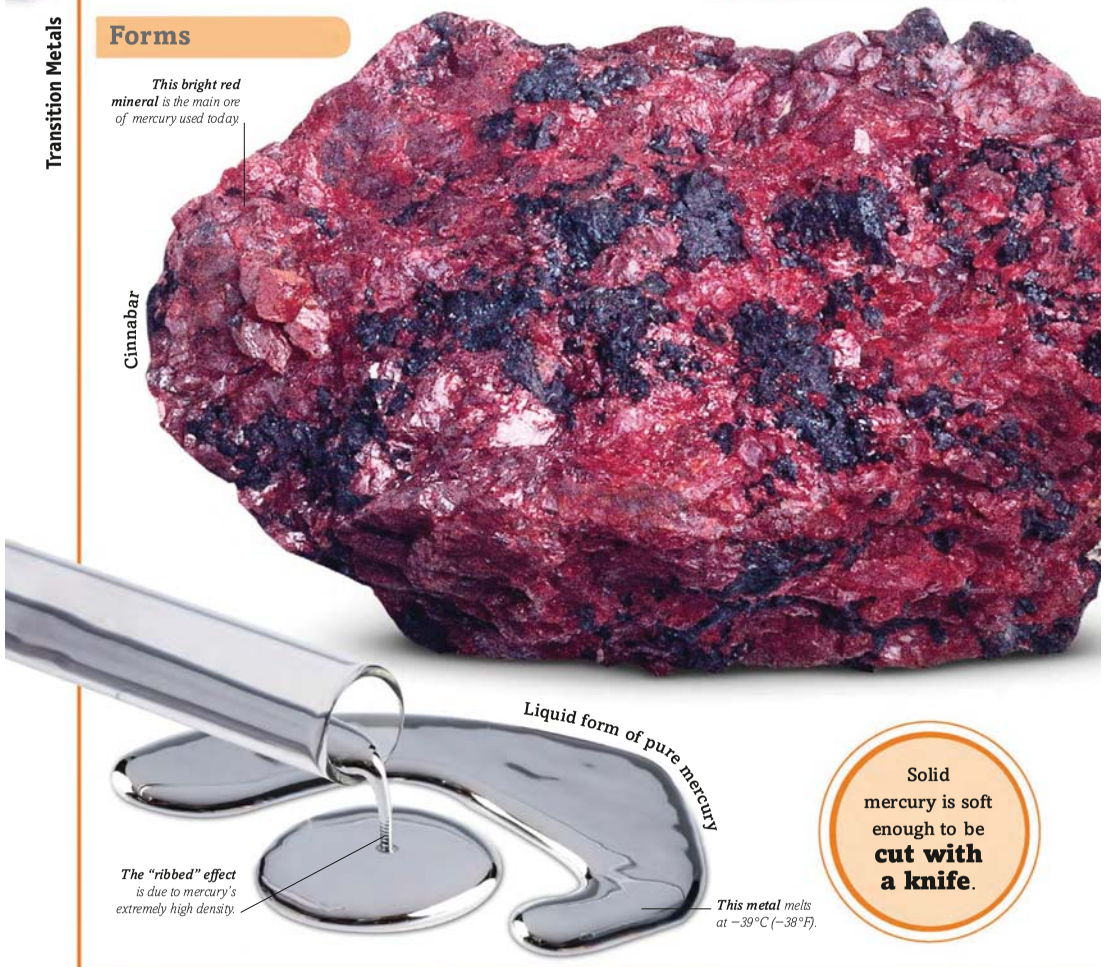
Although humans have discovered many strong metals and useful elements, gold has remained one of the most valuable. Before people knew what it was, they saw glittering gold dust in river beds or dug large gold nuggets out from rocks. They found that gold has many valuable qualities: it is soft enough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

80
Hg

Mercury



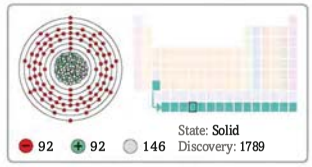
Forms



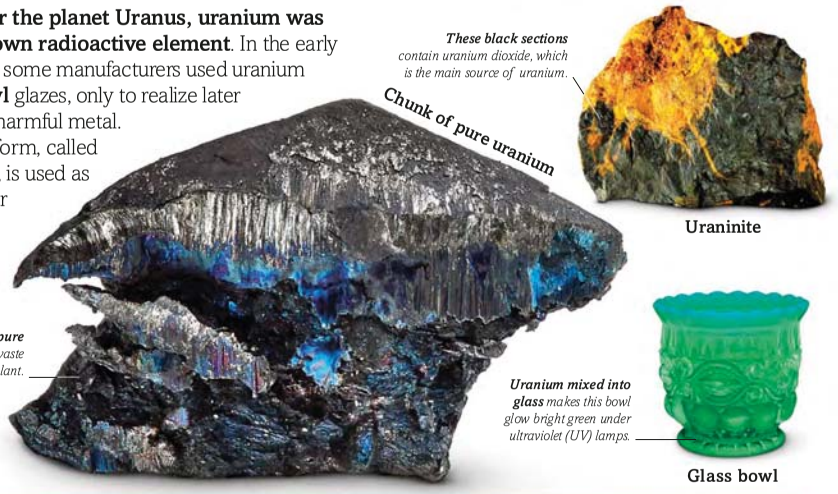
Mercury is the only metal that is liquid at room temperature. Along with water, it is one of the few liquids found naturally on Earth's surface. **Pure mercury** forms around volcanoes where the heat separates it from its minerals, such as **cinnabar**. This red mineral has been used for many centuries: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

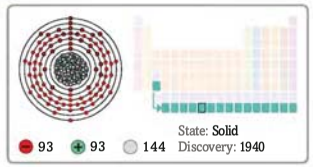


Uraninite

Glass bowl

93
Np

Neptunium

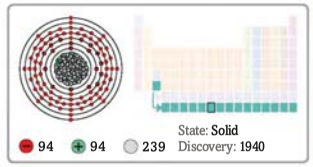


Cyclotron at the University of California, Berkeley, USA

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



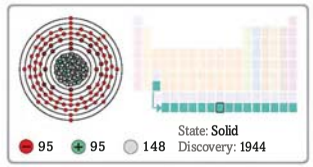
Hardly any plutonium exists in nature: most of it has decayed into other elements over time. It was discovered during the development of nuclear bombs in World War II. Today, plutonium is used mostly as a nuclear fuel.

1970's pacemaker battery

Curiosity Rover

95
Am

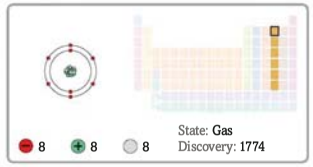
Americium



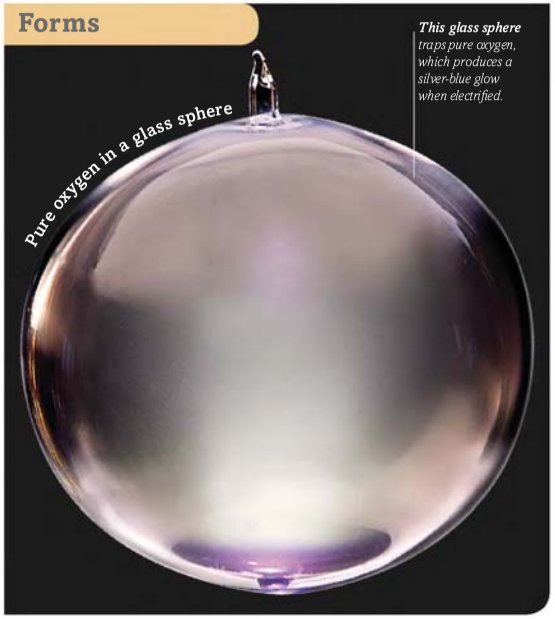
This metallic element is not found in nature. Instead, it is produced inside nuclear reactors when uranium or plutonium atoms are bombarded with neutrons. Remarkably, americium is the most common radioactive element used in the home. Radioactivity emitted by americium atoms causes the air inside **smoke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

8
O

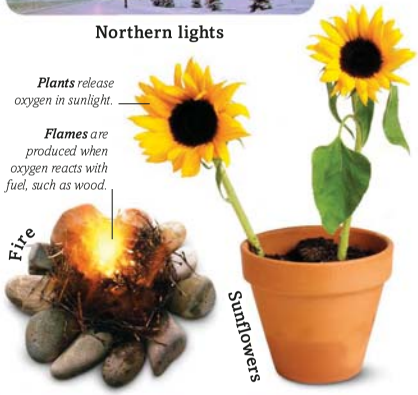
Oxygen

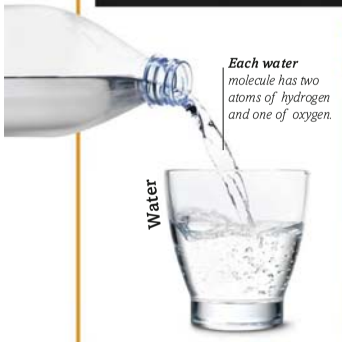


Forms



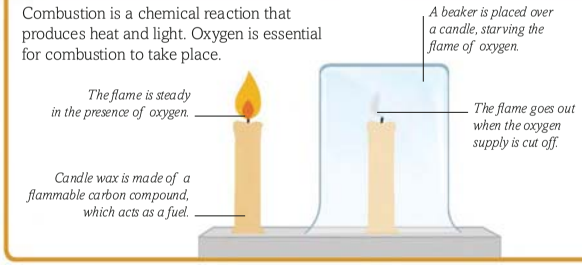
Northern lights





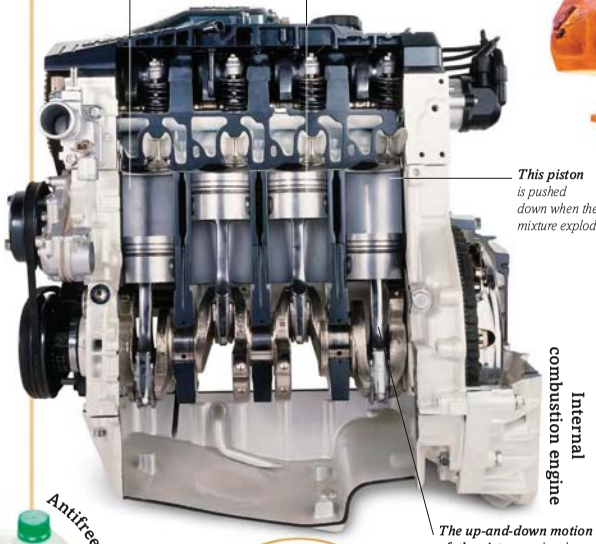
WHAT IS COMBUSTION?

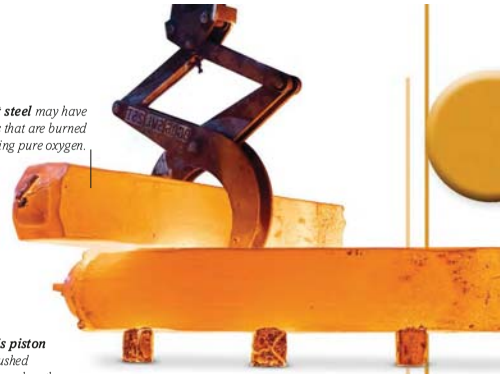
Combustion is a chemical reaction that produces heat and light. Oxygen is essential for combustion to take place.



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



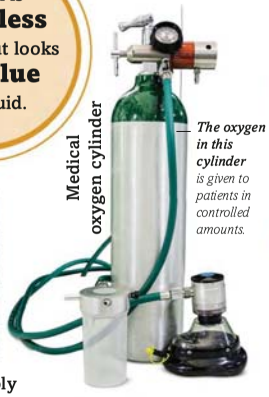


Steelmaking

Scuba diver

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

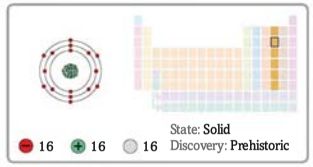
Mountaineer with oxygen supply



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.

16
S

Sulfur



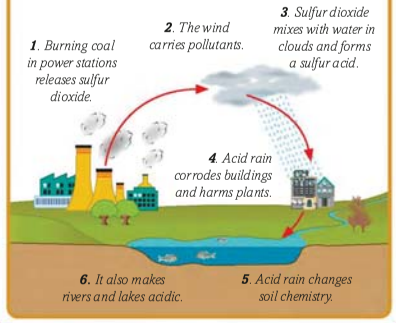
Forms

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

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.



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

minerals, such as **celestine**. Many sulfur compounds smell bad. For example, the rotten-egg smell of volcanic pools is due to hydrogen sulfide gas. Other examples include **skunk** spray, the gaseous substance emitted by chopped **onions**, and the odour of the **titan arum** flower. There are many uses for this non-metal. Its compounds can harden natural rubber for use in **tyres**, preserve **dried fruits**, and make strong **battery** acids. The element has anti-bacterial properties and is used in antibiotic medicine, such as **penicillin**.