

THE EXTRAORDINARY ELEMENTS

THE PERIODIC TABLE PERSONIFIED

COLIN STUART

XIMO ABADÍA

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How do we Discover the Elements?

There was a time when we thought that the Universe was made up of just four elements: air, water, earth and fire. Yet as we learned more we realised there was a better way to classify the ingredients that make up the world around us.



PREHISTORIC

The story starts thousands of years ago when our ancestors made use of new materials to build themselves a better world. The Iron Age started about 3,200 years ago and lasted for six hundred years. We learnt how to build tools out of the element with the atomic number 26. Iron is one of thirteen elements known to humans since ancient times. Others include gold, lead, tin and zinc.



ALCHEMY

It was from the 1600s when the list really started to get bigger as scientists began to experiment with new **substances**. The element phosphorus was discovered in urine by an alchemist – a person trying to turn everyday **chemicals** into gold. By boiling chemicals and turning gases into liquids, alchemists identified a host of new elements including oxygen, nitrogen and hydrogen.



SPECTROSCOPY

The mid-1800s saw the rise of a technique called **spectroscopy**. Electrons moving between shells (see page XII) inside an atom give out light that is unique to that particular element. Scientists including Robert Bunsen – who gives his name to the Bunsen burner – used this light to discover elements caesium and rubidium.

During the 19th century there was a real explosion in the number of new elements discovered – a total of 49.



SYNTHETIC

A further 35 have been found since 1900. During and after World War Two, scientists were experimenting with **nuclear** weapons, such as atomic bombs. They discovered new elements including curium and americium while testing them. New elements were also found by firing small elements at bigger ones at really high speeds inside enormous machines – a method called **bombardment**. Mendelevium – named after the inventor of the **periodic table** (see p101) – was discovered in 1955 by firing helium at an element named after another famous scientist: einsteinium.

CHLORINE



STATE AT 20°C
A yellowy-green dense gas with a distinctive smell.



WHERE ON EARTH?
Largely produced from the compound sodium chloride.



DANGER TO LIFE
Essential to all living things but can be highly toxic.



SPECIAL USES
Disinfectant, paper, paints, textiles, insecticides, PVC.

GERM KILLER

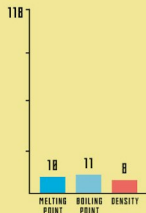
DISCOVERED IN 1774

Widely associated with the smell of swimming pools, chlorine is often used as a cleaning product to kill bacteria. In its standard state, the yellow-coloured chlorine gas is highly toxic to humans. Yet you'll still find it in your stomach combined with hydrogen to form hydrochloric acid (HCl). This acid helps to break down the food that you eat. Chlorine gas is very poisonous, and was used as a chemical weapon during World War I.

ELECTRON CONFIGURATION



ELEMENT RANKINGS



ATOMIC MASS
35.45

ARGON



STATE AT 20°C
A colourless, odourless gas.



WHERE ON EARTH?
Found in 0.94% of the Earth's atmosphere.



DANGER TO LIFE
No known biological role. It is non-toxic.



SPECIAL USES
Low-energy light bulbs, tyres, food and drink containers.

THE LAZY ONE

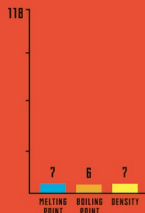
DISCOVERED IN 1894

The first noble gas to be discovered, argon is named the 'lazy one' due to its incredibly unreactive nature. This property means that it is often used to replace oxygen inside food and drink containers so that the contents last longer. Despite this lack of reactivity, argon produces a beautiful blue-purple hue when stimulated by electricity and is widely used for both incandescent and fluorescent lighting. It is the third most abundant gas in the Earth's atmosphere after nitrogen and oxygen.

ELECTRON CONFIGURATION



ELEMENT RANKINGS



ATOMIC MASS
39.95

ASTATINE



STATE AT 20°C
A radioactive element, not seen by the naked eye.



WHERE ON EARTH?
The rarest naturally occurring element in the Earth's crust.



DANGER TO LIFE
No known biological role. It is radioactive and highly toxic.



SPECIAL USES
No uses outside of scientific research.

DEADLY OGRE

 DISCOVERED IN 1940

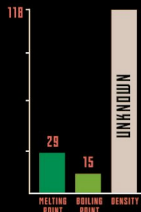
Dangerously radioactive, astatine has no uses outside of scientific research and to this day very little is known about it. It is the rarest naturally-occurring element in the Earth's crust. Even the most stable of its 39 isotopes has a half-life of just eight hours. Mendeleev speculated about its existence when he began creating his version of the periodic table and it's only from its position in the table that we can guess at its properties.

ELECTRON CONFIGURATION



ATOMIC MASS
210

ELEMENT RANKINGS



RADON



STATE AT 20°C
A colourless and odourless gas.



WHERE ON EARTH?
Naturally produced from the decay of elements in the Earth's crust.



DANGER TO LIFE
No known biological role. It is highly toxic.



SPECIAL USES
Limited use due to its radioactivity.

HOT WATER

 DISCOVERED IN 1900

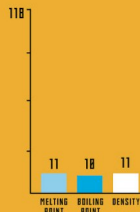
Radon is a naturally occurring, highly toxic and radioactive gas produced as a by-product of decaying elements in the Earth's crust, including radium, uranium and thorium. It has even been found in groundwater and hot springs. Radon is considered a major health hazard – in the USA alone 21,000 deaths per year are attributed to lung cancer brought on by exposure to radon. That said, used in the right way, it can also be an effective cancer treatment as radiotherapy.

ELECTRON CONFIGURATION



ATOMIC MASS
222

ELEMENT RANKINGS



ACTINIUM



STATE AT 20°C

A soft, silvery-white metal which glows blue in the dark.



WHERE ON EARTH?

Found in uranium ores.



DANGER TO LIFE

No known biological role. It is radioactive and highly toxic.



SPECIAL USES

Limited use outside of research.

ALPHA-GLOW



DISCOVERED IN 1899

Another extremely rare element, actinium is hardly used outside of research. It glows pale blue in the dark and its name comes from the Greek word *aktinos*, meaning 'beam' or 'ray', because it is a powerful source of alpha radiation. In turn, it gives its name to the actinides series of elements and is the first member of that group. It has a potential use in cancer treatment and is also used in a probe that can measure the water content of soil.

ELECTRON CONFIGURATION



ATOMIC MASS
227

ELEMENT RANKINGS



THORIUM



STATE AT 20°C

A silvery, radioactive metal.



WHERE ON EARTH?

Found in the minerals thorite, thorianite and monazite.



DANGER TO LIFE

No known biological role. It is radioactive and highly toxic.



SPECIAL USES

Nuclear power, high-quality camera lenses.

GREAT GODS



DISCOVERED IN 1829

Named after Thor, the Norse god of war and thunder, thorium is used as a nuclear power source as it is slightly radioactive. The half-life of its most common form is about the same as the age of the Universe. When used as an alloying agent, thorium gives other metals great strength and increased resistance to high temperatures. It can be found in trace amounts in most rocks and soils.

ELECTRON CONFIGURATION



ATOMIC MASS
232.038

ELEMENT RANKINGS

