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Wikijunior:The Elements

About the book

Welcome to Wikijunior The Elements.

The target age of this title is 8–12 years old. Section titles will include elements children may have heard of or are particularly interesting. The print version will focus only on answering a specific series of questions about the elements plus an explanation of what an element is. There will be an introduction and a glossary. Other articles of general interest about the Elements as a group may also be included.

When working on this project, remember that it is aimed at children. Being understood is just as important as being accurate. Authors should concentrate on the most important concepts rather than getting wrapped up in every detail. Use technical vocabulary when you need to, but don't use big words where simpler language would work.

If you have made contributions to this Wikibook and would like to have formal credit for being an author, please add your name to the list of authors.

Special Pages

- Introduction
- Introduction to The Elements
- The Periodic Table
  - List of the Elements
- Glossary of basic terms

Matter

- Matter Is The Stuff Around You
- States Of Matter
  - Solids
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Atom

- Overview
- Structure

Molecules

- What's a molecule?
- Forming Bonds

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Please use the Stub Template when creating a new article.

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- Gold
- Hydrogen

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- Aluminum
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- Carbon
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- Iron
- Magnesium
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- Lithium
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Introduction

Introduction

Graphite. Pencil lead is made of graphite. Graphite is made up of the element carbon.

To know what "Elements" are, you need to know about chemistry. So, what is chemistry? Chemistry is the study of matter and the changes that take place within that matter. Unfortunately, this does not tell you very much about chemistry, and it is also a very long way from telling you EVERYTHING about chemistry.

Everything on Earth, everything in our solar system, everything in our galaxy, and everything in the universe is made up of matter. Matter is the name that scientists have given to everything you can touch, or see, or feel, or smell. Matter takes up space, and matter has weight. To be really correct, we should say that **matter has volume and mass**. In other words matter has substance, and **"Elements"** (about 118 of them) are what gives matter its substance, even what makes it exist at all.

Most of the matter around you will have more than one element in it. But there are bits of matter that you have certainly seen and touched that are made up of just one element. If you have ever held a diamond, for example, it has been formed from just one element, the element Carbon. Surprisingly, the graphite in a pencil that you use for drawing or writing is also Carbon, just arranged differently.

Some other examples of matter you may have seen which have just one element are: an aluminium drink can; 24 carat gold jewelry; the helium gas in a balloon that floats upwards; cast iron garden railings; lead sheeting used by builders on the roofs of houses; a powder called "Flowers of Sulphur" that you can buy in a pharmacy.

In actual fact these are not perfectly true examples of elements, because an element, like gold or aluminium, will always have tiny amounts of other elements present as impurities.

Not many elements occur "naturally;" that is to say as pieces of nearly pure substance that you can pick from the ground. The elements Gold and Sulphur do occur naturally, as does Carbon when it is a diamond.

To purify them, most elements have to be pried apart from one another, because in most matter they are fixed together by strong "chemical bonds." Sometimes this can be done quite easily by using heat or electricity.

Ancient people knew how to make the element Iron. They did it by heating iron ore dug from the ground with charcoal they got from burning wood. The matter containing the iron was originally a "compound" of two elements, iron and oxygen; by heating with charcoal the oxygen was removed as a gas called carbon dioxide, leaving iron behind.

The elements Sodium and Chlorine can be separated from common salt by passing an electric current into salt that is melted at a very high temperature. The salt we started with is said to be a "compound" of sodium and chlorine. It is given the scientific name of sodium chloride.

One interesting source of elements is the air around us. It contains a mixture of elements that are all gases, such as Oxygen which you will have heard of already, as well as many gases which are not elements but are compounds — a bit like salt, only different!.

To get the elements from the air we need to cool it down to a very low temperature, much lower than even Siberia in winter! At around −190°C it forms a liquid. It's a bit like cooling down steam to make water. Afterwards, by boiling this liquid, the gases are released one at a time. As well as elements Oxygen and Nitrogen, we can get what are called the "Noble Gas" elements Argon, Xenon and Krypton. Two other noble gases, Helium and Neon, are in the air and can be taken out by cooling to an even lower temperature.

You have probably wondered how we have got this far without using some words that you probably know, and which are very much part of the subject of chemistry: atom, molecule, electron, nuclear and so forth. In fact, up until about 150 years ago chemists didn't really know very much about any of these things, even though they did understand the difference between elements and compounds.

Today we can "see" atoms by using a special electron microscope, which magnifies things that are millions of times smaller than those things we look at with an ordinary microscope. Under a scanning electron microscope, which shows things in 3-D, atoms appear as fuzzy balls.

Atoms are the key to describing why there exists different elements and why these elements form just those **compounds** that they do.

Atoms also explain why the Periodic Table of Elements is the way it is, even though much of it was worked out by the old-time chemists like Dobereiner and Medeleev (see Chapter 4). Understanding atoms can explain, for example, why there are just 81 elements that have atoms which can exist for ever.

Periodic Table

What is the Periodic Table of Elements?

Although scientists know of many elements, the properties of many of them are similar. Thus if they are grouped on the basis of their properties, it becomes easy to study and compare their properties. The periodic table of elements is a way of organising all the known elements. In the early days, elements were classified into only two groups: metals and non-metals. But some elements showed the properties of both metals and non-metals. They were called as metalloids.

History of the Periodic Table

Early History

People have known about basic chemical elements such as gold, silver, and copper from antiquity, as these can all be discovered in nature in native form and are relatively simple to mine with primitive tools. Aristotle, a philosopher, theorised that everything is made up of a mixture of one or more of four elements. They were earth, water, air, and fire. This was more like the four states of matter (in the same order): solid, liquid, gas, and plasma, though he also theorised that they change into new substances to form what we see.

Hennig Brand was the first person to discover a new element. Brand was a bankrupt German merchant who was trying to discover the Philosopher's Stone — a mythical object that was supposed to turn inexpensive base metals into gold. He experimented with distilling human urine until in 1669 he finally obtained a glowing white substance which he named phosphorus. He kept his discovery secret, until 1680 when Robert Boyle rediscovered it and it became public.

By 1809, a total of 47 elements had been discovered. As the number of known elements grew, scientists began to recognize patterns in the way chemicals reacted and began to devise ways to classify the elements.

Antoine-Laurent de Lavoisier

Antoine Lavoisier's *Traité Élémentaire de Chimie (Elementary Treatise of Chemistry*, 1789, translated into English by Robert Kerr) is considered to be the first modern chemical textbook. It contained a list of elements, or substances that could not be broken down further, which included oxygen, nitrogen, hydrogen, phosphorus, mercury, zinc, and sulfur. It also forms the basis for the modern list of elements. His list, however, also included light and caloric, which he believed to be material substances. While many leading chemists of the time refused to believe Lavoisier's new revelations, the *Elementary Treatise* was written well enough to convince the younger generation.

This model only classified elements into metals and non-metals and thus was not accepted.

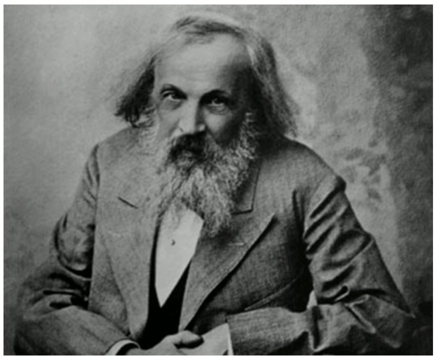
Alexandre-Emile Béguyer de Chancourtois

Alexandre-Emile Béguyer de Chancourtois, a French geologist, was the first person to notice the *periodicity*, the **periodic** or repetitive nature, of the elements — similar elements seem to occur at regular intervals when they are ordered by their atomic weights. He devised an early form of periodic table, which he called the **telluric helix**. With the elements arranged in a spiral on a cylinder by order of increasing atomic weight, de Chancourtois saw that elements with similar properties lined up vertically. His chart included some ions and compounds in addition to elements. His paper was published in 1862, but used geological rather than chemical terms and did not include a diagram; as a result, it received little attention until the work of Dmitri Mendeleev.[1]

John Newlands

John Newlands was an English chemist who in 1863 classified [2] the 56 elements that had been discovered at the time into 11 groups which were based on similar physical properties. He noted that many pairs of similar elements existed which differed by some multiple of eight in atomic weight.

The first periodic table


Dmitri Mendeleev

Dmitri Mendeleev, also spelt Dmitry Mendeleyev, middle name (patronymic) Ivanovich, a Siberian-born Russian chemist, was the first scientist to make a periodic table much like the one we use today. Mendeleev arranged the elements in a table ordered by atomic mass. It is sometimes said that he played "chemical solitaire" on long train rides using cards with various facts of known elements.[3] On March 6, 1869, a formal presentation was made to the Russian Chemical Society, entitled *The Dependence Between the Properties of the Atomic Weights of the Elements*. His table was published in an obscure Russian journal but quickly republished in a German journal, *Zeitschrift für Chemie*, in 1869. It stated

1. The elements, if arranged according to their atomic weights, exhibit an apparent periodicity of properties.
2. Elements which are similar as regards to their chemical properties have atomic weights which are either of nearly the same value (e.g., Pt, Ir, Os) or which increase regularly (e.g., K, Rb, Cs).
3. The arrangement of the elements, or of groups of elements in the order of their atomic weights, corresponds to their so-called valencies, as well as, to some extent, to their distinctive chemical properties; as is apparent among other series in that of Li, Be, Ba, C, N, O, and Sn (probably an error for Li, Be, B, C, N, O and F, since the symbols for the elements weren't completely standard yet at that time).
4. The elements which are the most widely diffused have small atomic weights.
5. The magnitude of the atomic weight determines the character of the element, just as the magnitude of the molecule determines the character of a compound body.
6. We must expect the discovery of many yet unknown elements–for example, elements analogous to aluminum and silicon–whose atomic weight would be between 65 and 75.
7. The atomic weight of an element may sometimes be amended by a knowledge of those of its contiguous elements. Thus the atomic weight of tellurium must lie between 123 and 126, and cannot be 128.
8. Certain characteristic properties of elements can be foretold from their atomic weights.

Advantages

- Mendeleev predicted the discovery of other elements and left space for these new elements, namely eka-silicon (germanium), eka-aluminium (gallium), and eka-boron (scandium). Thus, there was no disturbance in the periodic table.
- He predicted (often accurately as it turned out) properties of some of these then missing elements as well as properties of some of their compounds.
- He pointed out that some of the then current atomic weights were incorrect.
- He provided for variance from atomic weight order

Drawbacks

- There was no place for the isotopes of the various elements.
- His table did not include any of the noble gases, which hadn't been discovered. But these were added by Sir William Ramsay as Group 0, without any disturbance to the basic concept of the periodic table.

Unknown to Mendeleev, Lothar Meyer was also working on a periodic table. In his work published in 1864, Meyer presented only 28 elements, classified not by atomic weight but by valence alone. Also, Meyer never came to the idea of predicting new elements and correcting atomic weights. Only a few months after Mendeleev published his periodic table of all known elements (and predicted several new elements to complete the table, plus some corrected atomic weights), Meyer published a virtually identical table. Some people consider Meyer and Mendeleev the co-creators of the periodic table, although most agree that Mendeleev's accurate prediction of the qualities of the undiscovered elements lands him the larger share of credit. In any case, at the time Mendeleev's predictions greatly impressed his contemporaries and were eventually found to be correct. An English chemist, William Odling, also drew up a table that is remarkably similar to that of Mendeleev in 1864.

Henry Moseley

In 1914, Henry Moseley found a relationship between an element's X-ray wavelength and its atomic number and therefore resequenced the table by electronic charge rather than atomic weight. Before this discovery, atomic numbers were just sequential numbers based on an element's atomic weight. Moseley's discovery showed that atomic numbers had an experimentally measurable basis.

Moseley's research also showed that there were gaps in his table at atomic numbers 43 and 61 which are now known to be radioactive and not naturally occurring. Following in the footsteps of Dmitri Mendeleyev, Henry Moseley also predicted new elements.

Glenn T. Seaborg

During his Manhattan Project research in 1944, Glenn T. Seaborg experienced unexpected difficulty isolating Americium (95) and Curium (96). He began wondering if these elements more properly belonged to a different series which would explain why the expected chemical properties of the new elements were different. In 1945, he went against the advice of colleagues and proposed a significant change to Mendelev's table: the actinide series.

Seaborg's actinide concept of heavy element electronic structure, predicting that the actinides form a transition series analogous to the rare earth series of lanthanide elements, is now well accepted in the scientific community and included in all standard configurations of the periodic table. The actinide series are the second row of the f-block (5f series) and comprise the elements from Actinium to Lawrencium. Seaborg's subsequent elaborations of the actinide concept theorized a series of superheavy elements in a transactinide series comprising elements 104 through 121 and a superactinide series inclusive of elements 122 through 153.

References

[1] Annales des Mines history page (http://www.annales.org/archives/x/chancourtois.html).
[2] in a letter published in the Chemical News in February 1863, according to the Notable Names Data Base (http://www.nndb.com/people/480/000103171/)
[3] *Physical Science*, Holt Rinehart & Winston (January 2004), page 302 ISBN 0-03-073168-2

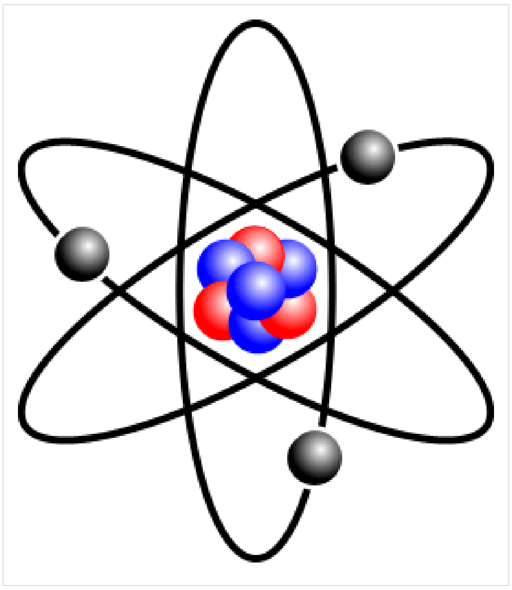
Glossary

- **alchemy**: a science that attempts to change one element into another.
- **alloy**: a substance that is a compound of two or more metals.
- **amalgam**: any metallic alloy which has mercury in it.
- **atom**: any one of the smallest particles of an element, that combine with similar particles of other elements to form compounds.
- **chemistry**: the science of the properties, composition, and transformation of substances.
- **compound**: a mixture of two or more elements or ingredients.
- **condensation**: changing a gas to a liquid.
- **conductive**: able to pass heat or electricity from one side to the other.
- **corrosion**: the act of eating away at gradually, as by rust or chemical action.
- **covalent bond**: a bond between atoms formed by sharing of **electrons**.
- **ductile**: capable of being drawn out into threads, as some metals.
- **electron**: a negatively charged particle that is a component of all atoms.
- **element**: a natural substance which cannot be broken down any further.
- **emulsion**: a liquid, as milk, in which minute particles remain in suspension.
- **evaporation**: the opposite of condensation, in which a liquid becomes a gas.
- **fusibility**: the ability to join separate parts together as one.
- **gas**: a fluid and elastic form of matter tending to expand indefinitely.
- **halogens**: A group of elements, all of which are very reactive.
- **ion**: An ion is an electrically charged particle. Some atoms can bond with each other ionically to form **molecules**. Certain **atoms** are allowed to have certain ionic charges so that they may bond with other atoms having opposite ionic charges.
- **ionic bond**: a bond between **ions**.
- **liquid**: a compressed mass of particles that flow freely.
- **luster**: how a material shines.
- **malleable**: capable of being hammered or shaped without breaking.
- **matter**: any particular substance.
- **melting**: to change from a solid to a liquid state, usually by heat.
- **metal**: one of the elements with the characteristics of **luster**, **ductility**, **malleability**, **fusibility**, and **conductivity** of heat and electricity.
- **mixture**: when two or more **elements** are put together but still retain their own properties.
- **molecule**: two or more atoms bonded together.
- **neutron**: an uncharged particle having nearly the mass of a **proton**.
- **nucleus**: the center of an **atom**.
- **ore**: a mineral in its natural state.
- **oxidation**: the operation of converting into an oxide, such as rust (iron-oxide).
- **particle**: a very tiny piece, bit.
- **proton**: a positively charged particle in the nucleus of an atom.
- **radioactive**: When an atom has to many protons it cannot hold themselves together anymore, when this happens protons emit radiation until they are balanced.
- **solid**: a hard object that is not a liquid or a gas.
- **solution**: a mixture of solids, liquids, or gases that joins together evenly.
- **sublimation**: to change from a **solid** directly to a **gas**.

Overview

Overview

Atoms Around Us



Everything in the Universe is made of matter. All matter is made of tiny particles called atoms. Atoms are so incredibly tiny that trillions of them could fit into the period at the end of this sentence.

If you want to have a language, you will need an alphabet. Chemistry is no different. If you want to build molecules, you will need elements. Each element is a little bit different from the rest. Those elements are the alphabet to the language of molecules.

Let's stretch the idea a bit. If you read a book, you will read a language. Letters make up that language. But you need ink to create the letters on the page, and for each letter, it is the same type of ink.

Elements are like those letters — and atoms are like the ink they're written in. Each element is a particular kind of atom (a particular shape for the ink), and each atom is always an element (the ink is always in the shape of a letter).

While the atoms may have different weights and organization, they are all built in the same way. Electrons, protons, and neutrons make the universe go.

If you want to do a little more thinking, start with particles of matter. Matter, the stuff around us, is used to create atoms. Atoms are used to create the elements. Elements are used to create molecules. It just goes on. Everything you see is built using something else.

You could start really small...

-Particles of matter

-Atoms

-Elements

-Molecules

-Macromolecules

-Cell organelles

-Cells

-Tissues

-Organs

-Systems

-Organisms

-Populations

-Communities

-Ecosystems

-Biomes

-Biospheres

-Planets

-Planetary Systems with Stars

-Galaxies

-Galaxy Clusters

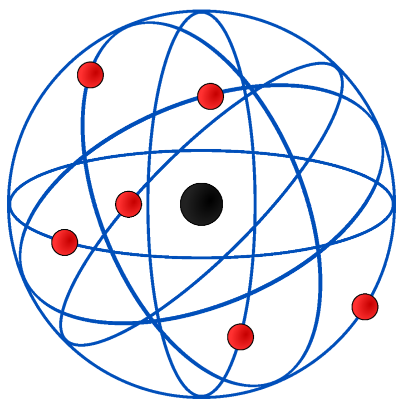
-The Universe

... And finish really big.

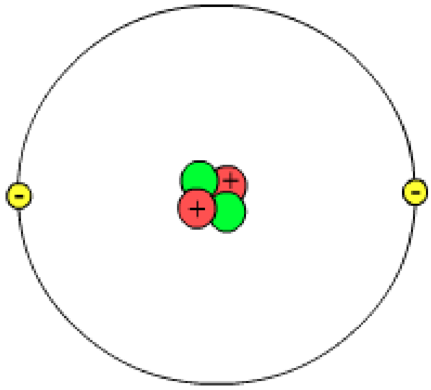
All of that is possible because of atoms.

Structure

Structure



Rutherford Atom



Helium has a simple atom

Protons, **Neutrons** and **Electrons** make up atoms. Because of this, they are called subatomic particles. Each type of atom can differ in the number of protons, neutrons, and electrons. According to the current electron-cloud theory of atoms, there are 2 parts to the atom, the **nucleus** and the **electron cloud**. The nucleus is made up of protons & neutrons, and in turn each of these nucleons is made up of triples of even smaller particles called "quarks".

The *nucleus* is the center of the atom and contains the protons and neutrons. The nucleus is very small compared to the size of the electron cloud. This means there is empty space around the nucleus. The protons and neutrons of an atom are in specific locations.

The protons have a positive charge. The number of protons decides what element an atom becomes. For example, if an atom has one proton, that means it is a Hydrogen element; only Hydrogen can have one proton. On the periodic table, the atomic number of the element is the same as its number of protons.

The neutrons have no charge, but they help to stabilize the nucleus; if the positive charges of the protons were by themselves in the nucleus, they would repel each other and make the nucleus less stable. Elements with differing numbers of neutrons but the same number of protons are called isotopes of each other. For example, Hydrogen has three isotopes, one with one neutron, one with two neutrons, and one with three neutrons. They all have one proton and so they are all Hydrogen, but because they differ in the number of neutrons they are different isotopes. Some isotopes are radioactive, which means that they decay, or lose their extra neutrons over time. A certain radioactive isotope of Carbon, called Carbon-14 is used by paleontologists to discover the age of fossils. They can do this because they know the rate at which Carbon-14 decays.

The outer part of the atom, or the **electron cloud** surrounds the nucleus. Now, according to a theory called Quantum Mechanics, we never know the exact location or speed of a specific electron; we can only say the probability of it being anywhere. If we know exactly where the electron is, than we don't know how fast it is going. If we know how fast it is going, likewise, we cannot determine where exactly it is located. The electrons have a negative charge. Some scientists used to think that electrons orbited the nucleus like planets around the sun, but we now know this isn't true. The electrons move randomly around the nucleus and are attracted to the positive charge of the protons in the nucleus. They let the atoms bond together to make molecules.

Atoms = Building Blocks

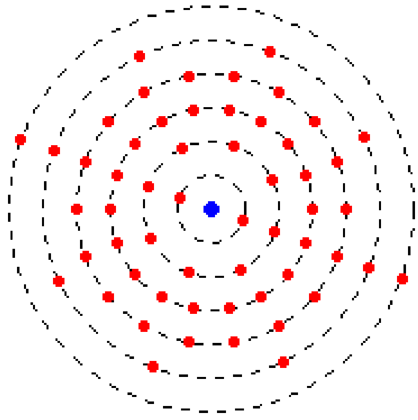
Atoms are the basis of chemistry. They are the basis for everything in the Universe. You should start by remembering that matter is composed of atoms. Atoms and the study of atoms are a world unto themselves. We're going to cover basics like atomic structure and bonding between atoms. As you learn more, you can move to the biochemistry tutorials and see how atoms form compounds that help the biological world survive.

Electron Arrangement

What keeps all the electrons in place? The answer is *energy levels*. These energy levels have little compartments inside which the electrons are kept. These are called **orbitals**. Each orbital can hold two electrons.

- In the first energy level, there is a maximum of one orbital, so two electrons can be kept in the first energy level.
- In the second energy level, there is a maximum of four orbitals, so eight electrons can be kept in the second energy level.
- Eighteen electrons are found in the third energy level.
- The fourth energy level contains up to thirty-two electrons.
- Less is known about the fifth level and so on.

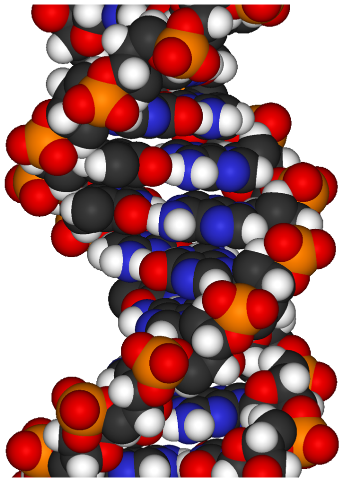
As explained before, some atoms only have a certain amount of electrons, so some elements don't have as many orbitals or energy levels as others.



Bohr Atom showing energy levels

What's a molecule?

What is a molecule?



DNA is a very complicated molecule and essential for all known life.

A molecule is made up of two or more atoms held together by chemical bonding. These atoms can be the same kind, or different kinds.

Where do we find molecules?

Almost everything is made up of molecules, including the air you breathe, the food you eat, and even the water you drink! In the air, oxygen atoms usually travel with a partner (2 x O = O_2), as does Hydrogen (2 x H = H_2) and Nitrogen (N_2). Water (H_2O) is made of two Hydrogen atoms (H_2) and one Oxygen atom (O). Even regular table salt that you eat is a combination of molecules! Would it surprise you to know that the molecules in table salt are made up of dangerous atoms? You may eat salt every day, but it is made up of an explosive atom (sodium) and a toxic one (chlorine)! The reason salt is safe to eat is because molecules are very different from the atoms that make them up.

How do the atoms join together?

Atoms come together to form molecules because of their electrons. Electrons can join (or *bond*) atoms together in two main ways. When two atoms share electrons between them, they are locked together (bonded) by that sharing. These are called *covalent* bonds. Bonds like this are in oxygen gas, nitrogen gas, and hydrogen gas. But when on atom gives one of its electrons to another atom, they are held together by magnetic forces, like the ones you see in a compass. These sorts of bonds are called *ionic*, because once an atom loses an electron, it becomes something called an ion. These sorts of bonds are in acids, like vinegar, and bases, like ammonia. Salt is also made of an ionic bond. The sodium, usually explosive, loses and electron to the chlorine, which is also dangerous in its natural state, but when this reaction happens, both become harmless and even tasty!

Bonding

Bonding

Atoms are able to bond to each other to make molecules and compounds. A compound is a molecule with more than one kind of element in it. How do they do it? It has to do with their electrons.

Ionic Bonds

When an atom is by itself before it has reacted with anything, it has the same number of protons as it has electrons. With an equal number of protons and electrons, the charges cancel each other out and the atom has no charge.

Sometimes, atoms do not have an equal number of protons and electrons. If an atom loses an electron, that means it has more protons than electrons, and so the atom has a positive charge. If an atom gains an electron, that means it has more electrons than protons, and so the atom has a negative charge. Atoms with a charge are called ions.

To form an ionic bond, some atoms will take an electron from another atom; this will make both of them ions, one positive and one negative. Because one is positive and one is negative, the ions will attract to each other and form an ionic bond. An ionic bond is a bond formed when one atom takes the electron or electrons of another atom.

Covalent Bonds

Not all bonds are formed by taking electrons away. Atoms can share electrons instead. By sharing electrons, atoms can bond together, but they do not form ions because none of the atoms lost or gained electrons.

Pure Covalent Bonding

This is when the two atoms that form the bond share the electrons equally.

All atoms can attract electrons in a pure covalent bond. Some have high attracting powers, like oxygen, nitrogen, chlorine, and fluorine. Some have low attracting powers like *metals*, carbon, and hydrogen. Elements with identical or similar attraction are considered to form pure covalent bonds.

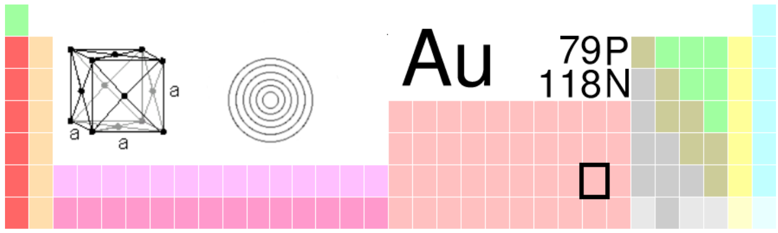
Polar Covalent Bonding

This involves unequal sharing. The further right and up the Periodic Table, the greater the attracting powers of the element. The exceptions to this are the noble gases. If two elements have significant differences in attracting powers, the result is a Polar Covalent Bond.

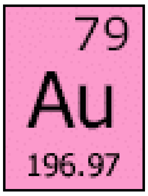
Metallic bonds

A slightly different form of sharing that can be thought of in terms of atoms sitting in a sea of shared electrons. Metallic bonds exist only in metals, such as aluminum, gold, copper, etc.

Gold



Shows the position of gold on the periodic chart.



Gold's symbol on the Periodic Table

Gold is a yellow precious metal that is valued for its beauty and shine. Not only does gold shine, it can also be formed into different shapes with simple tools and without fire or other heat. Because it is so soft, and can be found in clumps, it is believed to be the first metal that was worked by humans. It has been used for coins and jewelry for thousands of years. Today it is still used in jewelry and as a symbol of wealth. It is also used in electronic devices such as computers.

Where did its name come from?

Gold gets its English name from the Germanic word *gulþa* (meaning gold). The Old English word *geolu* means yellow. In Latin, gold was called *aurum*. That is why the chemical symbol for gold is **Au**.

Did You Know?

- Gold may have been one of the first metals used by humans.
- Gold is so soft that people used to bite gold coins to make sure they were real.
- A single gram of gold can be pounded into a sheet of gold leaf covering a square meter.

Where is it found?

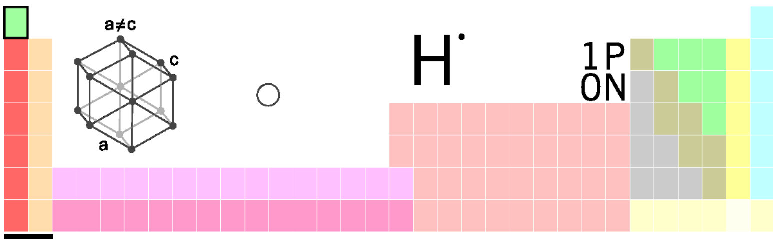
Gold is rare, which means it is difficult to find. Gold is usually found underground, where it is dug out of *mines* that can tunnel deep into the earth. Above ground, it can sometimes be found in sand and gravel bars in streams. Flakes and grains of gold trapped in rock come loose as the rock is broken up by the force of the water. Then the water carries the gold downstream and it settles out along with sand and gravel when the current slows down. A person called a *prospector* looks for loose gold above ground. A prospector often carries a wide pan, to scoop up the sand and gravel from the bottom of a stream and swish it around, looking for dust and nuggets of gold. This is called "panning for gold".

Gold is used to coat the visor of space suits in order to protect the astronaut's eyes from infrared radiation.

Is it dangerous?

Gold is not very dangerous and does not react very much chemically. Impurities in gold can be poisonous, but very pure gold leaf (sometimes called "edible gold") is safe to eat and is sometimes used to decorate food. In fact, gold is so safe to put in your mouth that even today many people have false teeth and fillings made out of gold.

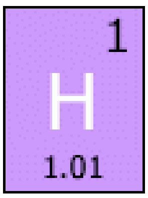
Hydrogen



Shows the position of Hydrogen on the periodic chart.

Hydrogen is an atom that contains an electron and a single proton. It is found at the very upper left of the periodic chart. The symbol for Hydrogen is the letter H. Hydrogen is both the lightest and most abundant element in the universe. Here are some data:

- **Name**: Hydrogen
- **Symbol**: H
- **Atomic Number**: 1
- **Atomic Mass**: 1.00794 amu
- **Melting Point**: -259.14 °C (14.009985 K, -434.45203 °F)
- **Boiling Point**: -252.87 °C (20.280005 K, -423.166 °F)
- **Number of Protons/Electrons**: 1



Hydrogen's symbol on the Periodic Table

- **Number of Neutrons**: 0
- **Classification**: Non-metal

- **Color**: colorless

What does it look, feel, taste, or smell like?

A close up of the Rosette Nebula. Stars are forming in this region of space. The red color comes from clouds of hydrogen.

Hydrogen is the absolute smallest of all elements, so small that four thousand million, laid end to end, could fit on the head of one pin! At room temperature hydrogen is a clear gas. Hydrogen gas (H_2) is a molecule made of two hydrogen atoms bonded together. It has no taste or odor and is not toxic. It takes a very, very low temperature and/or very high pressure to turn hydrogen into a liquid or a solid. One common molecule formed by hydrogen is water or H_2O. It has two hydrogen atoms and one oxygen atom. At room temperature, water is a clear liquid.

How was it discovered?

Henry Cavendish was the first to understand that hydrogen was a unique substance. In 1776 he produced hydrogen by mixing mercury with an acid. Hydrogen had actually been produced much earlier by the Swiss alchemist Paracelsus. He also added mixes of water samples in it to make water!

Where did its name come from?

Hydrogen comes from Hydrogenium, which comes from Ancient Greek meaning "water-forming". The element was named by Antoine Lavoisier in 1783. When hydrogen burns, it produces water.

Did You Know?

- Hydrogen is the smallest element.
- Hydrogen is the most abundant element in the universe.
- Hydrogen isn't common in a pure form on Earth, but is mostly found as part of water.
- Hydrogen is the main fuel of stars and the only fuel for red dwarfs.
- The whole universe is thought to have been formed by a Hydrogen nucleus.
- Hydrogen makes a squeaking noise when it is set on fire.

Where is it found?

Hydrogen in its atomic form is found commonly in space and stars. There are vast clouds of hydrogen in outer space. However much of the hydrogen in space is missing an electron, which means it is an ion. On Earth, hydrogen is commonly found as part of water molecules. Many other molecules also contain hydrogen. Some bacteria produce pure hydrogen gas as waste.


The Sun setting into the sea. The Sun is mostly hydrogen. Most of the hydrogen on Earth is in the form of water.

Hydrogen is very important for all living creatures including people to exist. It is found in every living thing on Earth, and also forms the oceans, rivers, lakes and clouds.

Hydrogen gas is most of the atmosphere of the gas-giant planets Jupiter, Saturn, Uranus, and Neptune, planets with much stronger gravity and lower temperatures than Earth.

What are its uses?

The largest application of hydrogen is for the processing ("upgrading") of fossil fuels, and in the production of ammonia. Hydrogen can be used as a fuel source. A fuel cell is a device that produces electricity by safely combining hydrogen and oxygen.

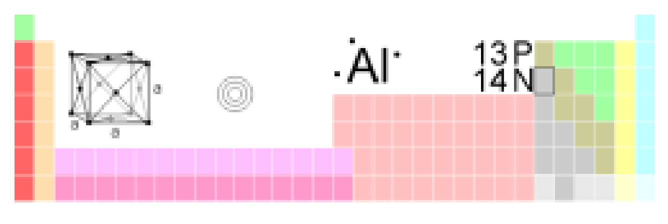
In the future, non-polluting cars may be fueled by hydrogen. The technology to make a hydrogen car already exists, but there are reasons you don't see them on the road. Separating hydrogen from water takes energy. The energy needed to produce enough hydrogen to power a car can cause pollution. Also, it's hard to carry enough hydrogen to power a vehicle for a long trip.

Stars give off light and heat because of the energy made when hydrogen atoms are merged (or fused) together to form heavier elements. Scientists are working to create a reactor that can make energy in the same way. This, however, is a very hard problem to solve and will take many years before we see useful fusion reactors built.

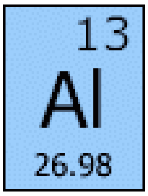
Is it dangerous?

Elemental hydrogen is highly flammable, and when it is mixed with oxygen gas or with air it can explode.

Aluminum



Aluminum, also known as *aluminium*, is a metal that is known for its resistance to corrosion and its light weight. Aluminum is used in many industries to manufacture a large variety of products and is very important to the world economy.



Aluminum's symbol on the Periodic Table

What does it look, feel, taste, or smell like?

A piece of aluminum metal.

Aluminum is a soft, lightweight metal which usually has a dull silvery appearance. This dull appearance is caused by a thin layer of oxidation that forms quickly when the metal is exposed to air. Without this layer of oxidation, aluminum has a bright and clear silvery appearance.

How was it discovered?

Friedrich Wöhler is credited with isolating aluminum in 1827 by mixing anhydrous aluminum chloride with potassium. The metal, however, had indeed been produced for the first time two years earlier — but in an impure form — by the Danish physicist and chemist Hans Christian Ørsted. Therefore, Ørsted can also be listed as the discoverer of the metal.

Where did its name come from?

In 1807, Sir Humphrey Davy was trying to isolate aluminum from a mineral called *alumina*. He first called the metal *alumium*, but decided to call it *aluminum* in 1812.

Did You Know?

- Recycling aluminum requires one twentieth as much energy as producing aluminum from raw ore.
- Aluminum is the most common metal in the earth's crust.
- Aluminum and Aluminium are two different names for this metal.

Where is it found?

Aluminum is the most abundant metal in the Earth's crust, and the third most abundant element overall, after oxygen and silicon. But it is not found free in nature. The Bayer process is used to refine aluminum from bauxite (aluminum oxide,) an aluminum ore.

What are its uses?

147,000 pounds of aluminum are used in building a single Boeing 747 airplane.

Aluminum has many uses. It is light and strong. Aluminum helps us get from place to place since it's a part of cars, trucks, airplanes, bicycles, rockets, and more.

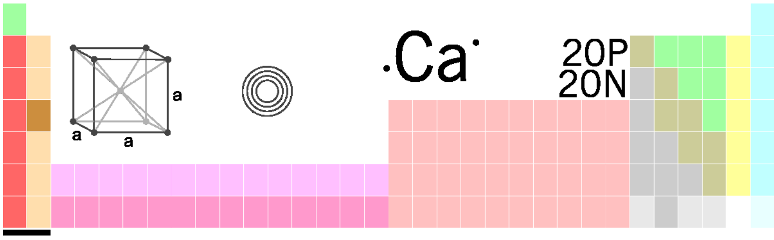
Every morning you wake up and look in a mirror, the reflective backing is likely made from aluminum. The pots and pans your family uses to cook dinner may be made with aluminum. The utensils you eat your dinner with could be made with aluminum, along with the kitchen aluminum foil used to wrap up leftover food. Soda cans are also made from aluminum.

When aluminum is combined with Fe_2O_3 in the right quantity thermite can be made. Thermite burns very quickly and with extreme heat. Aluminum is one of the primary components of the fuel that propels rockets into space.

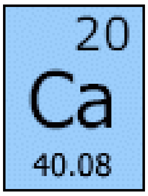
Is it dangerous?

Aluminum isn't dangerous. The metal is protected by a surface layer of aluminum oxide. This surface layer forms at once when the metal is exposed to air, and is very stable. So dishes, pots, and pans can be made of aluminum, and aluminum foil can be used for packing sensitive foods. However, acidic foods, such as tomatoes, can dissolve the surface oxide layer and some of the aluminum underneath. This isn't dangerous and doesn't compromise the strength of the aluminum object, but can lead to off tastes in the food, which is why it is usually not recommended to cook acidic foods in aluminum cookware.

Calcium



Shows the position of Calcium on the periodic chart.



Calcium's symbol on the Periodic Table

What does it look and feel like?

Calcium is a soft, gray metal. When it burns, it burns with a yellow-red flame. When it is exposed to air, it develops a gray-white coating because it reacts with the oxygen in the air to form a coating of calcium oxide (lime.)

How was it discovered?

Calcium has been known since Ancient Roman times. The Romans discovered a way to make calcium oxide by heating limestone in a furnace. However, it wasn't until 1808 that pure calcium was isolated by Sir Humphrey Davy.

Where did its name come from?

Calcium gets its name from *calcis*, which is a Latin word that means lime.

Did You Know?

- As wet calcium hydroxide combines with air it becomes hard calcium carbonate. This chemical reaction is what causes cement to harden.
- Calcium is the most common metal in animals.
- Stalactites and stalagmites are made primarily of calcium carbonate.

Where is it found?

Calcium is not found pure as an element due to its great tendency to react with other elements to form compounds, but it is commonly found in the compound calcium carbonate ($CaCO_3$). Many rocks such as limestone, marble, chalk, and calcite contain this substance. Limestone caves are a great example of where calcium can be found. Seashells and snail shells are primarily of calcium carbonate. Eggshells are mostly made from this compound too.

Calcium is also found in significant amounts in many foods. Dairy products like milk, yogurt and cheese contain calcium. Green vegetables also often have calcium. Broccoli, collard greens, almonds, sesame seeds, and beans all contain significant amounts of calcium.

The Hoover Dam is made of cement. Calcium is the element that causes cement to harden.

What are its uses?

Calcium is important for our body to run. It helps build strong bones and teeth, and it allows our muscles and brain cells work.

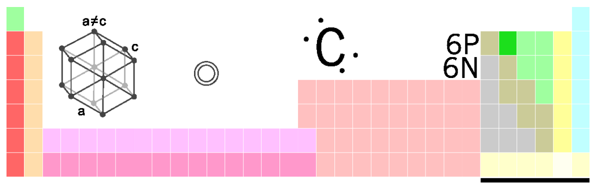
Calcium is an important substance in the building industry, because calcium hydroxide ($Ca(OH)_2$ is used in cement and mortar. Calcium carbonate is also used in plastics and adhesives as a filler. Because calcium oxide (CaO) neutralizes acid it can be used to decrease the effects of acid rain in rivers and lakes. Calcium is also commonly used in heartburn and antacid tablets.

Is it dangerous?

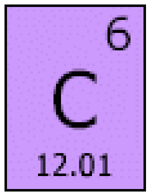
No, most calcium compounds aren't dangerous. In fact, calcium is an essential nutrient that is needed by the human body to help build strong bones and teeth.

Calcium metal burns easily and hot, so it is a fire hazard.

Carbon



Shows the position of Carbon on the periodic chart.



Carbon's symbol on the Periodic Table

Diamonds and graphite (the stuff that pencil leads are made of) are both made of carbon.

Did You Know?

- Carbon has the highest melting point of all of the elements at 3652 °C(6605 °F).
- Most molecules known to science contain carbon.
- Carbon is one of the four main elements in most or all living things (the others are hydrogen, oxygen, and nitrogen.)
- When carbon is heated to a very high temperature it sublimates (changes directly from a solid to a gas).

How carbon looks depends on the molecule shape carbon makes. Carbon has many allotropes (see Wikipedia article). The most famous type of carbon shape is diamond. Diamond is clear but very shiny. It is very valuable and the hardest substance from nature. It is number 10 on the Mohs scale of hardness. Low quality diamonds can be made from other forms of carbon. Diamond is also notable for being one of the few substances which conducts heat very well but does not conduct electricity.

Another well known type of carbon is graphite, which is used in pencils. Graphite is grey instead of clear, and very soft, registering about 1 on the Mohs scale of hardness.

How was it discovered and how did it get its name?

Carbon was known prehistorically by ancient people who produced it in the form of charcoal. The name is based off of the Latin name *carbo*, which means charcoal.

Where is it found?

Carbon is found in many places. Diamonds, graphite, and oil all contain carbon and can all be found underground. Carbon is also present in all living things, in organic molecules such as fat and sugar. Carbon is also found in the atmosphere as part of carbon dioxide and other compounds. Organic chemistry is a branch of chemistry that is dedicated to studying carbon-containing compounds. Some scientists speculate that without carbon, life couldn't exist at all. Others suggest that life based on silicon is possible.

A racing car. The body of the car is made from steel, it burns petroleum, and it drives on asphalt. All of these substances contain carbon. The car also releases carbon dioxide (the air you breathe out) into the atmosphere as it burns petroleum.

What are its uses?

Diamonds are often used as decorations and in jewelry. Because diamonds are so hard, they are sometimes used to make blades to cut things, but these blades are very expensive. Graphite is very soft. Because of this, it is often used in pencils. "Lead" pencils are actually carbon.

Carbon separates the oxygen from iron in iron ore in furnaces and allows the useful metal iron to be made. Much carbon is used in making iron. When carbon is heated with iron in a furnace, steel is made.

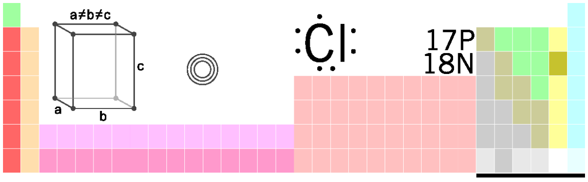
When carbon is combined with hydrogen it forms a molecule called a 'hydrocarbon'. Hydrocarbons are very important because they are used for energy and fuel. Petroleum, such as the gas in your car, is a hydrocarbon and it is used to power vehicles and to make lubricants, among other things.

Carbon is sometimes used in filtration as "activated carbon", and helps to clean some unwanted materials from water.

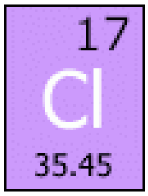
Is it dangerous?

Carbon is relatively safe by itself. However, inhaled soot or smoke, which contain carbon, are bad for your lungs. Carbon is part of carbon dioxide which is linked to global warming. Incomplete burning of hydrocarbons releases carbon monoxide, which is very dangerous because it keeps the hemoglobin in your blood from picking up oxygen and basically suffocates your cells, so try not to breathe in the exhausts from your car.

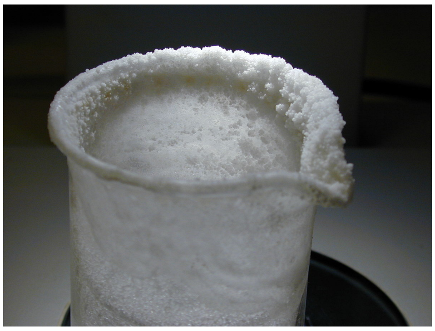
Chlorine



Shows the position of Chlorine on the periodic chart.



Chlorine's symbol on the Periodic Table


This Beaker Contains Table Salt which is made from Sodium and Chlorine

Chlorine as an element is a pale green, poisonous gas with a suffocating odor. Chlorine as a chemical cleaner (in a solution with water) is a liquid, which is colorless with little odor, and a distinctly chemical taste.

How was it discovered?

Chlorine was discovered in 1774 by the Swedish chemist Carl Wilhelm Scheele.

Where did its name come from?

Chlorine gets its name from the Greek word *chloros*, which means "pale green".

Did You Know?

- Chloride, the ionic form of Chlorine, is the most abundant dissolved substance in seawater.

Where is it found?

In nature, chlorine is mostly found as chloride, the ionic form of chlorine. Chloride is very common in seawater as part of sodium chloride, the scientific name for salt. In a laboratory, chlorine gas can be generated by the rapid combination of a strong base and a strong acid, or by running electricity through a solution of table salt (which is NaCl, the most common salt in seawater and the best-known, and probably the most common, chlorine compound n the world.)

Chlorine is used in swimming pools to kill bacteria.

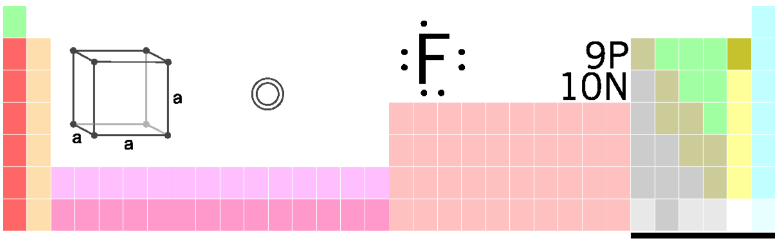
What are its uses?

Chlorine is commonly used to purify water so it is clean enough to bath in. Almost all public pools use chlorine as a cleaning chemical for water. Chlorinated water can be toxic at high concentrations. Chlorine as a gas is incredibly dangerous, and has been used as a chemical weapon. Chlorine is also used in bleaches.

Is it dangerous?

Yes, when chlorine is concentrated in a gaseous form, it is extremely toxic to humans, killing within minutes of exposure. The gas burns lungs when it is inhaled, and victims of inhalation most often die of a combination of axphyxiation and internal bleeding from damage to the airways.

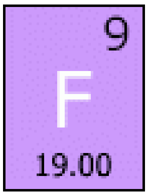
Fluorine



Shows the position of Fluorine on the periodic chart.

What does it look, feel, taste, or smell like?

Fluorine is usually a pale, yellowish brown gas. It has a pungent odor.



Fluorine's symbol on the Periodic Table

How was it discovered?

Henri Moissan

Henri Moissan isolated pure fluorine in 1886. Many other scientists had unsuccessfully tried to isolate fluorine from hydrogen fluoride. In some cases they accidentally killed themselves by exposure to dangerous compounds. Moissan's successful method relied on electrolysis — using an electric voltage to convert fluoride ions to fluorine gas. He won the Nobel Prize in 1906 and died the next year at the age of 54.

Where did its name come from?

Fluorine gets its name from the Latin word *fluere*, which means "to flow". Fluorspar ores were used as fluxes, which help ores to flow during smelting. Fluorine was later found to be a present in fluorspar.

Did You Know?

- Fluorine is the most reactive element.
- Fluorine is the 13th most abundant element in the earth's crust.
- Fluorspar ores can look either like emeralds or amethyst. Fluorine's atomic number is 9

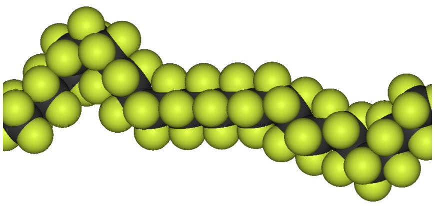
Where is it found?

Fluorine is so reactive that it is not found in its elemental state. It is always found bonded to a different element. Some common minerals from which fluorine can be extracted include fluoroapatite, cryolite, and hornblende. There are currently no working mines in the US that produce fluoride ores. The last one closed in 1995, so fluorine is imported into the US.

What are its uses?

Fluorine is not used much in the elemental form because it is so reactive. One use is in rocket fuel, where elemental fluorine is used in place of oxygen to help fuels burn.

Fluoride, the ionic form of Fluorine, is put in toothpaste and sometimes in water to help prevent cavities in the teeth.



3D model of Teflon

Teflon, the non stick material found in frying pans, is a polymer that is 75% fluorine by weight. The scientific name for Teflon is polytetrafluoroethene, or PTFE. This is a chain of carbon atoms with two fluorine atoms attached to each carbon atom.

Fluorine is used in hydrofluoric acid in industry. The acid is able to dissolve silicate-containing compounds such as glass and computer chips. Because of this it cannot be stored for a long time in glass containers. The acid is used for cleaning, purification, and etching.

Fluorine can react with uranium to produce uranium hexafluoride. This compound is then centrifuged to separate out the different isotopes of uranium. This is how enriched uranium is obtained.

A major use of fluorine was in the production of CFCs, the chemicals that lead to the ozone hole. These were once common in aerosols and cooling fluids, but have been banned in developed countries in accordance with the Montreal Protocol.

Is it dangerous?


Fluorine and some of its compounds are highly toxic

Fluorine gas is extremely poisonous. It can cause chemical burns on the skin. Hydrofluoric acid is very dangerous. It causes burns to the skin like sulfuric acid and other acids do, and is also easily absorbed into the skin. Once inside the body it causes damage to tissues and organs. Exposure of less than 2% of the body to concentrated hydrofluoric acid can be fatal. The small levels of fluoride ions in toothpaste and treated water are not dangerous, although slightly higher levels can cause unsightly (and permanent) mottling of the teeth.

References

Web Links

Webelements [1]

The Discovery of Fluorine and Fluoride [2]

Within Wikipedia

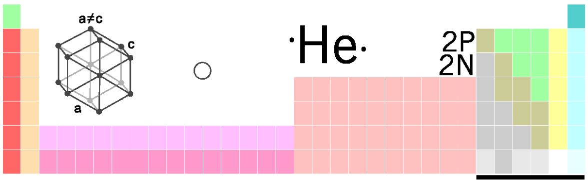
Fluorine [3]

Henri Moissan [4]

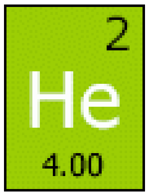
References

[1] http://www.webelements.com
[2] http://www.fluoride-history.de/fluorine.htm
[3] http://en.wikipedia.org/wiki/Fluorine
[4] http://en.wikipedia.org/wiki/Henri_Moissan

Helium

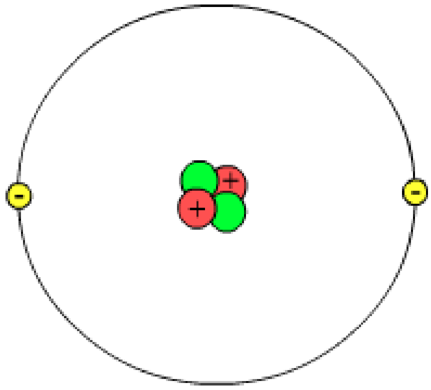


Shows the position of Helium on the periodic chart.



Helium's symbol on the Periodic Table

Helium is seen on earth as a colorless and odorless gas. It is the clearest element, and even in a liquid state (which can only be achieved by either applying great pressure or extreme cold) it is almost completely transparent. However, in a plasma state (see below,) it emits a pinkish glow.


Helium's Atom is very simple


Helium in a plasma state.

How was it discovered?

Helium was discovered in the Sun in 1868 by an astronomer, Sir Norman Lockyer. He was using a technique (then new) called spectrography, which breaks light into its separate colors. Each element produces a different spectral pattern of bright lines. Lockyer noticed a line in sunlight that didn't match any known element and realized it belonged to a new element not found on Earth.

About 27 years later, in 1895, Sir William Ramsay discovered helium on Earth in a uranium mineral, cleveite. It was discovered independently about the same time by P.T. Cleve and Nils Langlet.

Where did its name come from?

Helium gets its name from *Helios*, the Greek god of the sun.

Did You Know?

- Helium is the second most common element in the universe.
- Helium is a noble gas, so it doesn't react very easily.
- Helium was used to learn that the structure of the atom had a dense nucleus and an electron cloud.

A monument to helium doubles as a time capsule including thousands of items packed in helium in Amarillo, Texas. Much of the world's helium is mined in the area.

- Even at absolute zero, helium is still a liquid. It can only be solidified by applying extreme pressure to liquid helium.
- Near absolute zero, liquid helium will crawl along any surface; this is called *superfluidity*. Superfluid helium has zero viscosity (thickness.)

Where is it found?

Helium is found very commonly in the universe, but not very common on Earth. Today, most helium comes from Texas and Kansas in the United States. It is extracted along with natural gas from wells drilled into the ground.

A Zeppelin blimp filled with helium.

What are its uses?

Helium is used to inflate balloons and blimps because it is the second lightest element (after Hydrogen), but doesn't burn like Hydrogen can.

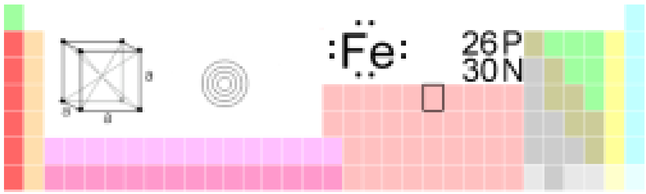
Helium is often used (along with oxygen and sometimes nitrogen) in breathing gas for divers that go very deep, where high pressure is needed. (Normal air at this pressure causes *nitrogen narcosis*, a state similar to being drunk.)

Liquid helium is the coldest liquid known (even at absolute zero, it remains a liquid) and is often used in cryogenic applications such as Magnetic Resonance Imaging (MRI), where the extreme cold makes it possible to create extreme magnetic fields.

Is it dangerous?

Though helium is nontoxic, if you breathe in too much helium you can suffocate through lack of oxygen.

Iron



Shows the position of Iron on the periodic chart.

Introduction

Iron is created in massive stars before they explode in a supernova.

Iron's symbol on the Periodic Table

What does it look, feel, taste, or smell like?


Casting iron. People pour melted iron into a mold.

Iron is shiny and metallic with a gray tinge. It is solid and heavy. As it oxidizes (rusts) it becomes a distinctive reddish brown.

Iron is usually a solid, and it neads to be extremely hot to melt. In fact, it melts at one and a half thousand degrees. This temperature is even hotter than the hottest part of a candle flame! To melt it, engineers and scientists have to use a torch called a welding torch. This torch melts iron, and it can be used to stick two pieces of iron together. When iron is melted, it glows red. It is literally 'red hot'.

How was it discovered?

Iron has been known to people since ancient times. It is believed that people have been using iron for at least 5,000 years.

Where did its name come from?

The modern English word *iron* comes from the old English word *isærn*, which comes from Indo-European roots meaning "strong metal" or "holy metal". (In ancient times, anything strong was considered holy, and they used the same word.) Some linguists like the "holy metal" origin since the first iron used came from meteorites that fell from the sky so were thought to have been provided by the gods. But others suggest it comes from "strong metal" since iron is much stronger than the bronze which was used before the Iron Age.

Iron's chemical symbol, Fe, comes from "ferrum", the Latin word for iron. To this day, metals that contain iron are known as 'Ferrous' metals.

Did You Know?

- Iron is the second-most abundant metal in the Earth's crust, behind only aluminum.
- The ion Fe2+, inside a heme group in a molecule of hemoglobin, allows blood to carry oxygen.
- The Earth's magnetic field is generated by the movement of molten iron in the outer core.

Where is it found?

Iron makes up about 5% of the Earth's crust and a large part of the Earth's core. Iron also comes from meteorites.

On earth Iron is found mainly inside the minerals hematite (Fe_2O_3) and magnetite (Fe_3O_4.) Removing the iron from these minerals is a reasonably long process involving many large industrial factories. During this process many other elements are used in order to remove the iron, including limestone and carbon.

What are its uses?

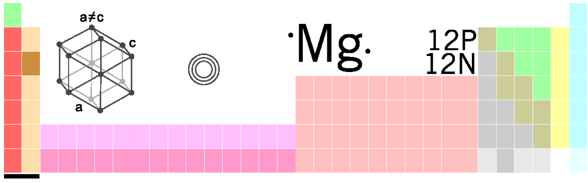
The Golden Gate Bridge with traffic. The bridge is made of more than 83,000 tons of steel and supported by huge steel cables. The cars on the bridge are made from steel too.

Iron is used in a lot of alloys such as cast iron, wrought iron, steel, and carbon steel. There are many useful things made of steel including cars, trucks, ships, trains, rails, cutlery, bridges, and all kinds of different machines . In fact, there are few machines that do not use steel. Steel beams are used to reinforce large cement structures like skyscrapers and make them stronger. Iron is an essential part of hemoglobin, which carries oxygen in red blood cells. Iron also aids with the production of chlorophyll in plants. Iron is also used in iron sulfate (FeSO4), a treatment for the blood disease anemia.

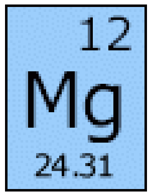
Is it dangerous?

Some types of iron are dangerous to the body in large amounts. However, the intestines do not absorb that much iron, so iron poisoning only happens if there is so much iron that the intestines are damaged, or if the iron is injected.

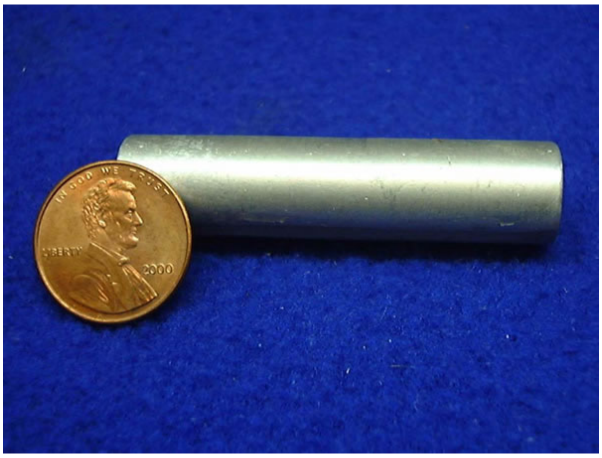
Magnesium



Shows the position of Magnesium on the periodic chart.



Magnesium's symbol on the Periodic Table


A small piece of magnesium.

Magnesium as a metal is silver-white and lightweight. It is pictured here in a stick, but it also comes in powder form. Surprisingly, it can be bought by the average person, usually for medical reasons.

How was it discovered?

Sir Humphry Davy electrolytically isolated pure magnesium metal in 1808. Before Davy isolated magnesium, it was recognized as an element by Black in 1755.

Where did its name come from?

Magnesium gets its name from the Greek word for a district in the Greek region of Thessaly called *Magnesia*.

Did You Know?

- Magnesium is the eighth most abundant element.
- 1.3 kilograms of magnesium can be found in every cubic kilometer of sea water.
- Magnesium is used in marine flares and fireworks to produce a brilliant white light.

Where is it found?

Magnesium as a pure metal is not found in nature, but it is very common as an ion in various compounds.

Magnesium is very common on earth and in seawater.

Magnesium can be found in green vegetables, especially darker green ones. This is because chlorophyll, the green pigment in plants, contains magnesium.

What are its uses?

Magnesium is necessary for all living cells. It is used to help our body make molecules like DNA. Plants also use magnesium as a part of chlorophyll for photosynthesis.

Magnesium burns very bright white. In the old days, magnesium could be used as a light source and was used to create the flash for cameras. Now, it is used in some fireworks. It is also used to make incendiary bombs.

Since magnesium is a third lighter than aluminum, it is combined with other metals to make missiles and aircraft.

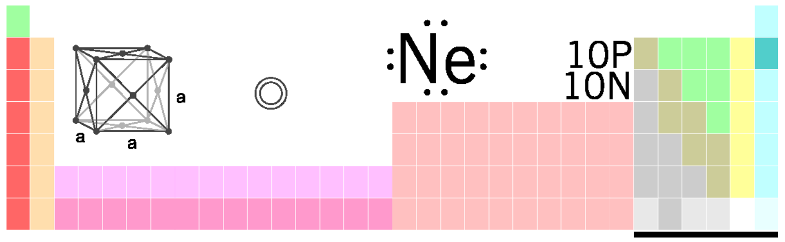
Magnesium oxide (MgO), also called magnesia, is used in some stomach antacids. Magnesium is also used to make epsom salts, which is used to treat minor skin abrasions.

Magnesium is also used for construction. It is known as one of the lightest metals that can be used for construction.

Is it dangerous?

Magnesium is flammable, and the bright light it gives off can damage the eyes. Never place it in fire, as it burns at an *EXTREMELY* high temperature, and never throw it into an acid which might cause the release of flammable hydrogen gas. Keep away from children.

Neon



Shows the position of Neon on the periodic chart.

Neon's symbol on the Periodic Table

What does it look, feel, taste, or smell like?

Neon is a colorless, odorless gas at room temperature.

How was it discovered?

It was discovered by Scottish chemist William Ramsay and English chemist Morris Travers in 1898.

Where did its name come from?

Neon gets its name from Greek *neos*, meaning "new".

Did You Know?

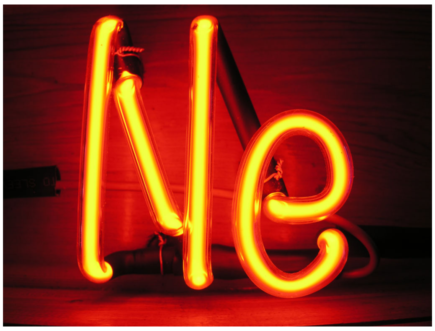
- Neon is used in lighting.
- Neon, when in a plasma state, emits a reddish-orange glow.

Where is it found?

Neon is a gas that is common in the universe but rare on Earth itself. Neon can be found in the earth's atmosphere, in small amounts. It is the fourth most common element in the atmosphere behind nitrogen, oxygen and argon. Because it is a noble, inert gas, it forms no compounds.

What are its uses?

Neon is used in lighting and some lasers. Below is an example of the characteristic reddish-orange glow emitted by Neon plasma.

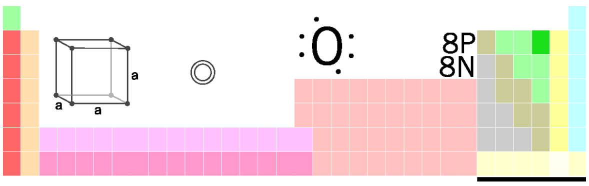


A lighted sign containing neon

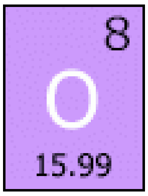
Is it dangerous?

No. Neon is an inert gas. It is odorless, and has no effects. Neon lights do get hot, though, so you can burn yourself by touching them. Also, breathing in pure neon gas can cause suffocation because it contains no oxygen, which is what your cells need to produce energy.

Oxygen



Shows the position of Oxygen on the periodic chart.



Oxygen's symbol on the Periodic Table


Liquid oxygen is blue.

Oxygen comes in two common forms, diatomic oxygen (O_2) and ozone (O_3), although larger molecules such as O_4 and O_8 can occur under very rare conditions. O_2 is a colorless gas in most conditions, but when it is liquid it is blue. O_3 is a blue, toxic gas with a sharp odor.

How was it discovered?

In 1772, Carl Wilhelm Scheele discovered that heating mineral oxides generated a gas that supported combustion (burning) better than air. He was able to collect a pure form of this gas for his experiments, but waited several years to publish his results.

In the meantime, in 1774, Joseph Priestley independently performed similar experiments to generate and collect oxygen gas. Like Scheele, he demonstrated oxygen's ability to support combustion better than air. In addition, he showed oxygen was able to support life in mice up to four times as long as in air. He promptly published his results and is generally credited as the discoverer of oxygen.

Where did its name come from?

Oxygen comes from Greek and means "acid forming." When oxygen was named, scientists thought all acids contain oxygen, but now we know that's not true, although most of them do (acetic acid, CH_3COOH, which is the acid in vinegar, and sulfuric acid, H_2SO_4 or oil of vitriol, do contain oxygen, but hydrochloric acid, HCl, does not.)

Did You Know?

- Oxygen is the most common element in the Earth's crust.
- Most of the oxygen in our atmosphere comes from photosynthesis in plants or biosynthesis in bacteria.
- Oxygen is the third most common element in the universe.
- Oxygen is responsible for 61% of your body weight.

Where is it found?

Oxygen is found all over the Earth, in the crust and in the atmosphere. Oxygen is also found in the water that covers most of the earth's surface.

What are its uses?

Scuba divers use tanks filled with a mixture of oxygen and nitrogen to breathe under water. Water itself is made from oxygen and hydrogen atoms.

Without oxygen, life as we know it would not exist. There are only a few microbes known that do not require oxygen to live. Every other life form including tiny bacteria, fungus, trees, animals and people needs oxygen. Oxygen is crucial to our bodies — we need oxygen from the air to survive.

Ozone in the atmosphere helps shield the Earth from harmful UV rays given off by the sun.

Oxygen is used along with another gas called acetylene to power metal welding or cutting torches. Rockets carry oxygen in tanks to mix with fuel. The combustion of the fuel and the oxygen is what propels the rocket.

Scuba divers carry tanks of oxygen mixed with nitrogen that allow them to breathe under water.

It is also used in respirators in hospitals for people who can't get enough oxygen themselves (for instance, if they can't breathe on their own.)

Is it dangerous?

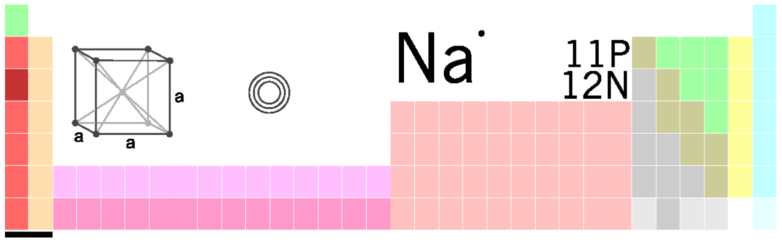
O_2 can actually be toxic, even though we rely on it to survive. This is only true at very high concentrations of oxygen.

Ozone can be toxic because it oxidizes things even more easily then O_2.

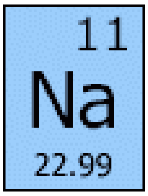
Oxygen can also help the spread of fire, so it can be dangerous for that reason.

Oxygen is very reactive, and, as a result, can combine with other elements very easily.

Sodium



Shows the position of Sodium on the periodic chart.



Sodium's symbol on the Periodic Table

What does it look, feel, taste, or smell like?

Pure sodium is a soft and silvery metal. Sodium is prevented from contact with the air and water by immersion in oil. It is so soft that you could cut it with a knife.

How was it discovered?

Sodium was isolated by Sir Humphrey Davy in 1807 from sodium hydroxide.

Where did its name come from?

Sodium gets its name from the English *soda*. In Latin it was called *natrium*.

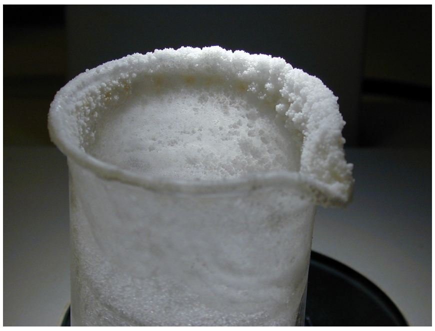
Did You Know?

- Sodium is the sixth most abundant element overall.
- Sodium is the most abundant alkali metal, in the first column of the periodic table.
- Sodium ions taste salty in flavor.

Where is it found?

The most common compound of sodium is sodium chloride, better known as salt, which can be found in seawater and in the mineral halite. Sodium is relatively common in stars. Because sodium is highly reactive, it is never found in its pure state in nature.

What are its uses?



This Beaker Contains Table Salt which is made from Sodium and Chlorine

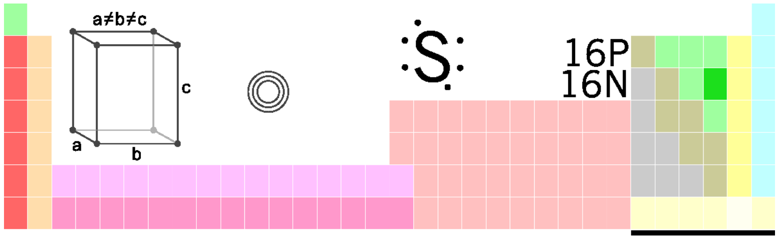
We use sodium everyday. Sodium chloride is used to help flavor food in the form of table salt. Sodium is also found in sodium bicarbonate, also called baking soda. Sodium is also used in most soaps and detergents (although some, such as those in shaving cream, use potassium instead.)

Sodium is also required by the body for proper blood, brain cell action, heart activity, and more. It is so important that animals and people are adapted to tasting sodium. Sodium is salty.

Is it dangerous?

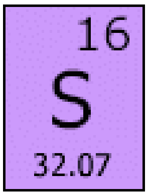
Sodium is highly reactive and may ignite on contact with water. It can even cause an explosion. The strong alkali sodium hydroxide — also called *lye* — is very corrosive and should never be touched, as it can cause severe chemical burns; neither should solutions of it.

Sulfur



Shows the position of Sulfur on the periodic chart.

Sulfur is a common non metallic element with the chemical symbol S and atomic number 16.



Sulfur's symbol on the Periodic Table

What does it look, feel, taste, or smell like?

It is bright yellow and forms large crystals. In its native (pure) form it is both odorless and tasteless, but many substances containing sulfur have a distinct odor. The scent of rotten eggs, burnt matches, and skunks are all caused by sulfurous compounds.

A sulfur crystal is bright yellow.

How was it discovered?

Sulfur was discovered early in human history. References in the Bible associated the element with the devil and hell. The Bible refers to it as brimstone.

Where did its name come from?

The word *sulfur* has old roots. It comes from the ancient Latin word for sulfur, *sulpur*, which later changed to *sulphur*, perhaps under the influence of the Arabic word for yellow, *sufra*; and the ancient Latin name came from the word *Sulvere* in Sanskrit!

Where is it found?

In nature, it can be found as the pure element or combined with other elements as different minerals. Sulfur can be found in areas where there are volcanoes. It is also found in meteorites and hot springs. Sulfur is mined from the ground and can be found throughout the world. A form of sulfur (hydrogen sulfide, or H_2S,) is also a common component of oil and natural gas, especially now that most sulfur-free oil and gas has been used up. A large amount of the element is made from H_2S by oil refineries.

Sulfur melts to a bloodred liquid and burns with a faint blue flame which you can see if you look very closely.

Sulfur ready to be loaded on ships.

Did You Know?

- Sulfur burns with a blue flame.
- The name sulfur is also sometimes spelled sulphur.
- Sulfur boils at 832°F and melts at 239°F.
- Although solid sulfur is bright yellow, molten sulfur is blood red.

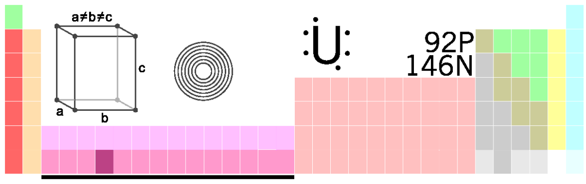
What are its uses?

Sulfur is used to make matches and gunpowder. It is also used to make fertilizers to help plants grow, and to make sulfur dioxide (SO_2,) which is used to keep dried fruit from discoloring. It is an essential element for life.

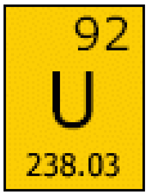
Is it dangerous?

When mixed together with other elements, like hydrogen or oxygen, it can cause lung scarring and breathing problems. Sulfuric acid is a strong acid that can cause burns on unprotected skin. Hydrogen sulfide is a very dangerous gas. Sulfur is an important part of gunpowder. Gunpowder is explosive and is very dangerous if handled incorrectly.

Uranium



Shows the position of Uranium on the periodic chart.



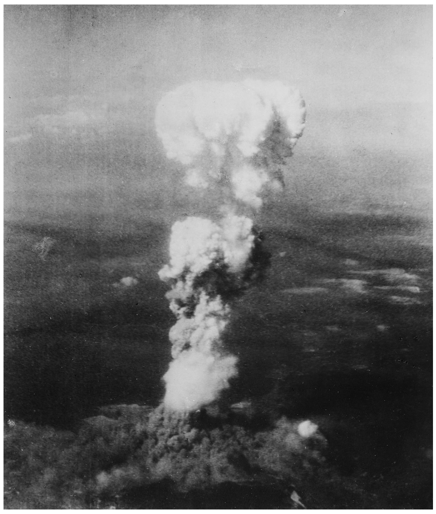
Uranium's symbol on the Periodic Table

Uranium is silvery-white and metallic. Uranium can appear to be slightly blue.

Uranium ore

How was it discovered?

Uranium was discovered in 1798 by Martin Klaproth, a German chemist. Klaproth found uranium while he was analyzing samples of pitchblende, a variety of the mineral uranite, from the Joachimsal silver mines in the Kingdom of Bohemia (now located in the present-day Czech Republic). It was discovered to be radioactive by Henri Becquerel in 1896, and until the discovery that thorium was radioactive two years later, in 1898, it was thought to be the only radioactive element.



Uranium was used in the "Little Boy": the first nuclear bomb used in warfare

Where did its name come from?

Uranium is named after the planet Uranus, which had been discovered some years before, in 1781, by William Herschel.

Did You Know?

- Uranium is the highest-numbered element, with a number of 92, to be found naturally in significant quantities on Earth.
- One ton of natural uranium can create over 40 million kilowatt hours of electricity. This is the same amount of energy that would be created by burning 16,000 tons of coal or the contents of 80,000 barrels of oil.
- Native Americans living on the Colorado Plateau used the uranium-bearing mineral carnotite to make bright yellow war paint.

Where is it found?

Uranium is found worldwide in soil and rocks. Australia has the largest known reserves.

What are its uses?


A nuclear power plant.

Uranium is commonly used in nuclear reactors to make electricity, as well as in nuclear weapons.

Uranium is also used to test the age of very old rocks.

Uranium was used to color paints and glazes, although such use is rare today.

Uranium can also be used to color glass yellow; such uranium glass, or "vaseline glass," glows green under ultraviolet light (also known as a black light.)

Because it is so heavy, uranium is used in armor-piercing artillery bullets.

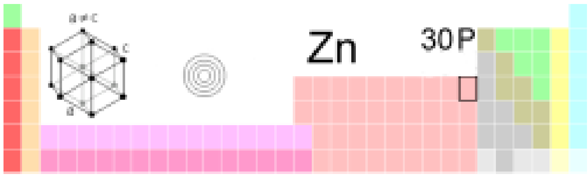
Is it dangerous?

Pure uranium can burst into flames.

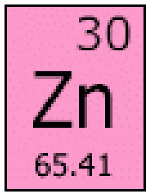
Compounds with uranium in them are toxic.

Uranium is radioactive, and can lead to cancer.

Zinc



Shows the position of Zinc on the periodic chart.



Zinc's symbol on the Periodic Table

Zinc is a hard solid that is bluish in color.

How was it discovered?

Zinc was known to the ancients, but it wasn't until 1746 that zinc was isolated by Andreas Marggraf. Marggraf showed people that zinc could be isolated by reducing calamine with charcoal.

Centuries before the metallic form of zinc was discovered, zinc ores were used for making brass and zinc compounds. An alloy containing 87% zinc has been found in prehistoric ruins in Transylvania. Zinc ores were used for healing wounds and sore eyes. It is estimated that during the rule of Augustus (20 BC to 14 AD), the Romans were the first people to make brass. In the 13th century explorer Marco Polo was cited as describing the production of zinc oxide in Persia. India recognized zinc as a new metal by 1374; at the time, it was the eight metal known to man. Zinc oxide had been produced in Zawar, India from the 12th to 16th centuries. This zinc was produced by reducing calamine using organic substances like wool.

Where did its name come from?

The name zinc comes from "zinn", the German word for tin.

Did You Know?

- A human body contains around 2.3g Zinc.
- Another interesting fact.
- Yet another interesting fact.

Where is it found?


Foods and spices that contain the essential mineral zinc

Zinc is hard to find, because it is very reactive in its pure form, and makes up less than 1% of the earth's crust. It's found mostly in compounds like the mineral Zinc Sulfide, also known as sphalerite or zincblende.

What are its uses?

Zinc has many common and not-so-common uses: Zinc is used in many coins. Zinc is used to make brass and bronze. It is also used in metal coating and rust protection, called galvanization. It is also used in the batteries that power everything from flashlights to radio-controlled toys. This type of battery was invented by the French chemist George Leclanche more than 100 years ago. Zinc oxide is a common sunscreen because it can block harmful ultraviolet (UV) rays that damage skin. This same compound is also used to make white paints and to make photocopies. Zinc sulfide, another zinc compound, is used in electronic devices as a phosphor (pronounced "*fos-four*"). Phosphor gives off light when struck by electrons. Zinc sulfide has been used on the inside of computer and television screens to produce images from your favorite TV show to computer games.

Is it dangerous?

No, it is not dangerous, unless you drop a large enough chunk of it on your head. Zinc is necessary for the human body and helps boost your immune system. Zinc oxide can also be used as a sunblock to protect your skin from the damaging effects of ultraviolet light.

Other details about ZINC

Zinc has a boiling point of 907 degree Celsius and melting point of 419.53 degree Celsius.

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