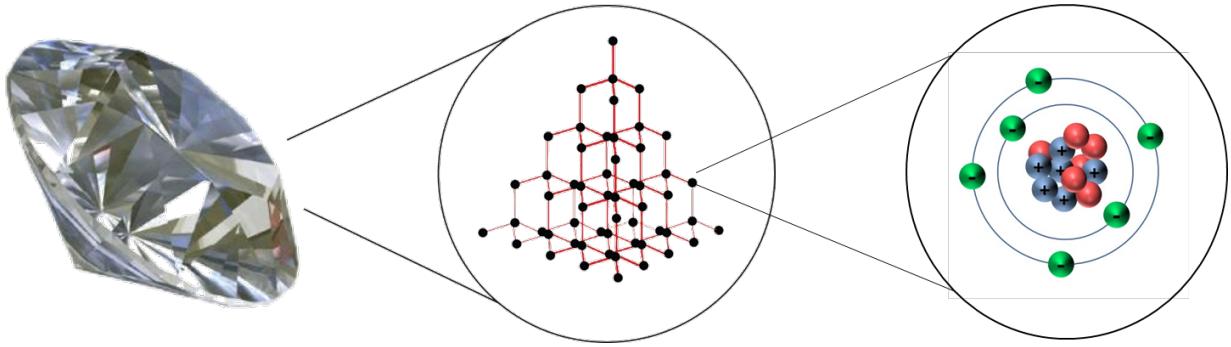
All Matter is made up of particles

Matter exists in different types as **elements**, **compounds** or **mixtures**.

Particles make up all matter in the Universe. The three particles that make up these types of matter are **atoms**, **molecules** and **ions.**

Different types of matter can have different types of particles. The type of particles and the way these are arranged and connected to each other determines the type of matter, and therefore the **physical** and **chemical** properties of the matter.

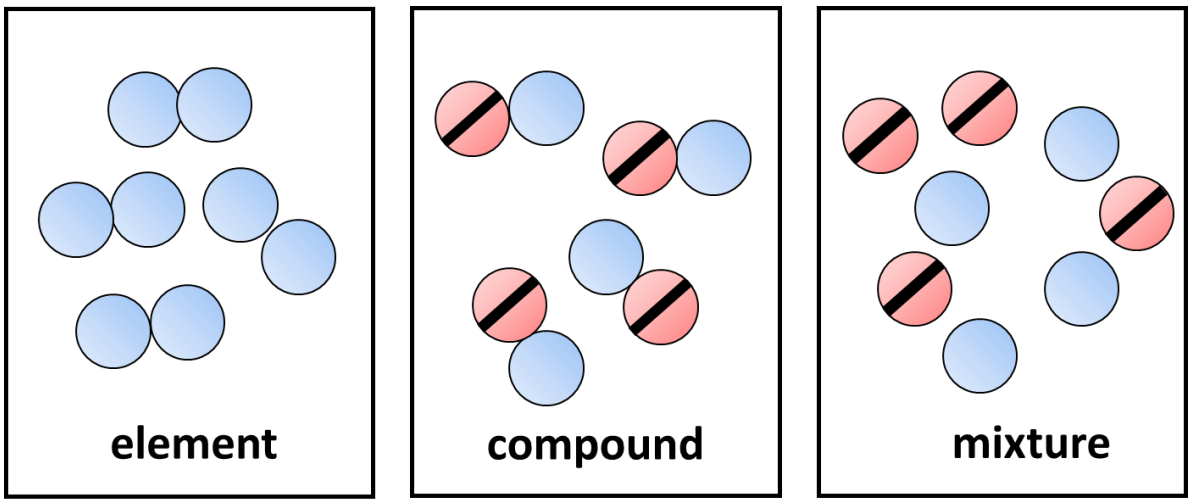


Matter can exist in different arrangements (configurations)

Elements are substances made up of only one type of atom/particle (in the same space), and can be a solid, liquid or gas. There are approximately 130 different elements but many millions of substances. Most matter around us is made up of combinations of elements.
If two or more different elements have chemically reacted together and joined, then they form a **compound**.
If different elements and/or compounds are in the same physical space and not chemically joined, then they form a **mixture**.

Particle diagrams

Different types of matter can be drawn using **particle diagrams**. Each different colour represents a different type of particle. **Elements** only have one type of particle. **Compounds** have more than one type of particle joined together. **Mixtures** have more than one type of particle, but they are not joined and can be separated physically.



Everyday examples of Elements, Compounds and Mixtures

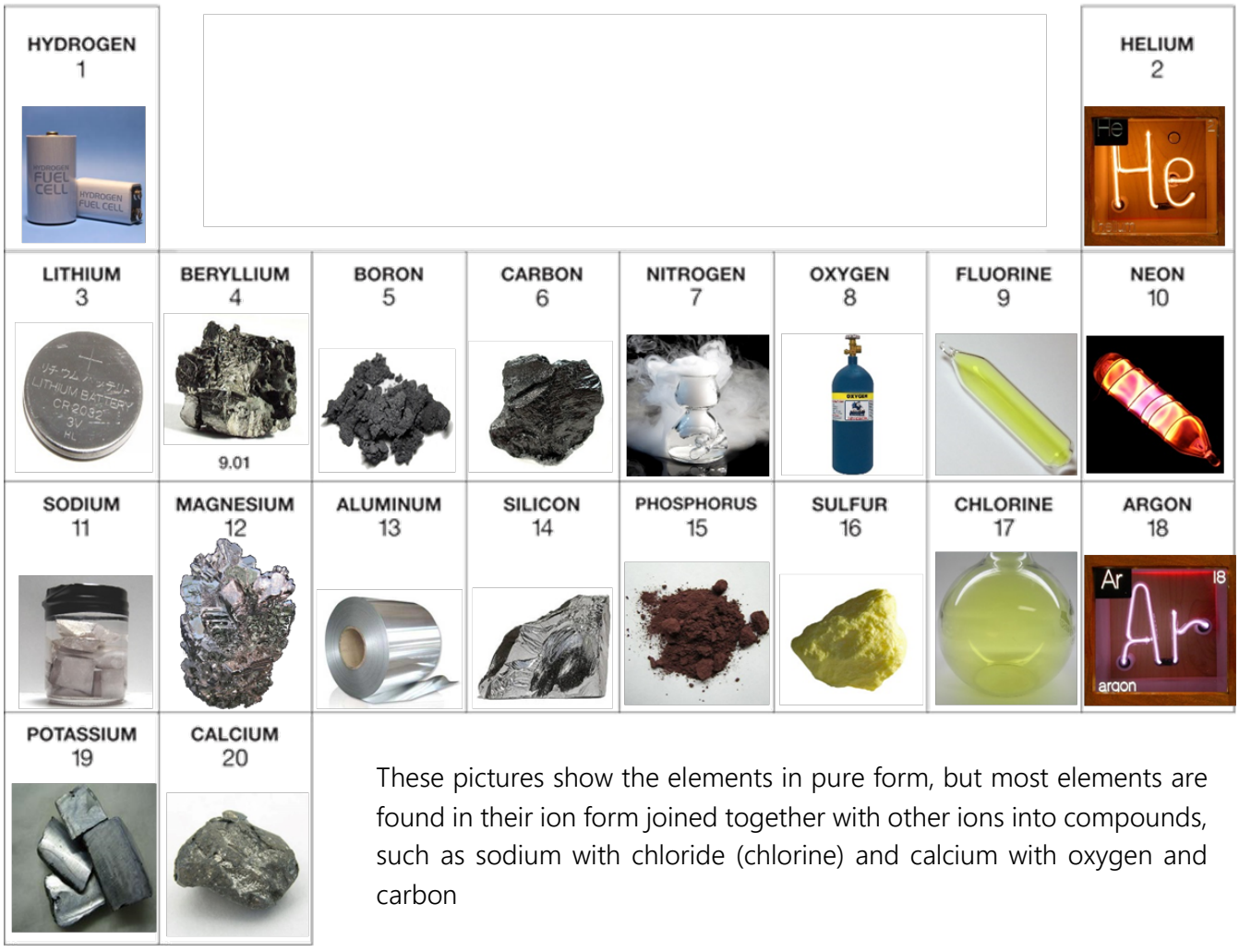
All around us are examples of elements, compounds and mixtures. Few pure elements are found in nature because they react with chemicals around them so instead, we have chemical processes to **extract** and **purify** them.

Many of the everyday items that we use are compounds that have been manufactured by chemical processes as well. We find mixtures in nature, such as iron sand, that we can separate by physical processes. We can also create mixtures to use.

Elements are everywhere

Over 130 Elements make up all the matter in the universe but only about 20 types are commonly found on Earth. Each type of element has a unique type of atom/particle (being the only one of its kind). The Earth, as well as all living things on it, is made up of a combination of the elements in different forms.

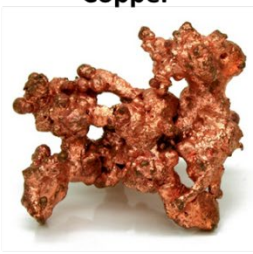
Many of the common types of elements are grouped in the first 20 elements out of 130+ elements. These elements can either be gas, liquid or solid at room temperature.



These pictures show the elements in pure form, but most elements are found in their ion form joined together with other ions into compounds, such as sodium with chloride (chlorine) and calcium with oxygen and carbon

Other important elements

Other elements that are common can be found further down the list of elements – many of these tend to be metals.

Gold	Iron	Copper	Silver
			
Lead	**Bromine**	**Iodine**	**Zinc**
			

Each element is named and has its own symbol.

Elements consist of only one type of atom. (particle) Each element can be represented by a chemical symbol, which is made up of one or two letters.

The element symbols are **one or two letters**, formed from the name of the element. Such as **H**ydrogen H, or **He**lium He. The first letter of the symbol is always a **capital letter**. Any other letters are **lower case**. E.g. Helium is He (not HE or he)

If the symbols are not based on an element's English name then it is most likely to be based on its Latin name, the original language of Science.

Name	Symbol	Name	Symbol	Name	Symbol	Name	Symbol
hydrogen	**H**	oxygen	**O**	phosphorus	**P**	silver	**Ag**
helium	**He**	fluorine	**F**	sulfur	**S**	lead	**Pb**
lithium	**Li**	neon	**Ne**	chlorine	**Cl**	zinc	**Zn**
beryllium	**Be**	sodium	**Na**	argon	**Ar**	copper	**Cu**
boron	**B**	magnesium	**Mg**	potassium	**K**	bromine	**Br**
carbon	**C**	aluminium	**Al**	calcium	**Ca**	iodine	**I**
nitrogen	**N**	silicon	**Si**	gold	**Au**	iron	**Fe**

Elements are everywhere - Carbon

Carbon is one of the most important elements for living organisms and it also is present in many non-living substances as well including fuels, types of rocks and as part of carbon dioxide in the air.

There is a fixed amount of carbon on Earth and it gets recycled from living organisms when they die by decomposers and added to the atmosphere as carbon dioxide when they respire.

Some substances are pure carbon, such as diamonds, coal and graphite.

Elements are everywhere - Oxygen

Oxygen is essential for living organisms and is required to break down the food into energy during respiration. Pure oxygen is found as a gas on Earth.

Most of our oxygen in our atmosphere came from organisms, bacteria at first then plankton and plants, which broke apart water and released the oxygen during **photosynthesis**.

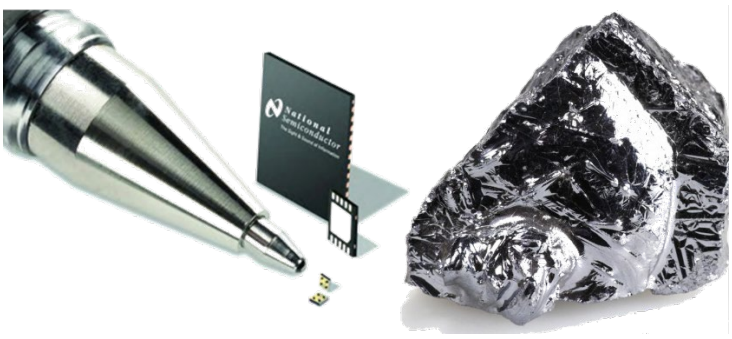
Oxygen is a very reactive gas and causes many metals to corrode and rust, chemically combining with the metal to form a compound.

Elements are everywhere - Hydrogen

Hydrogen is the most common element in the universe and is the main component (ingredient) in stars, including our Sun. Nuclear reactions inside the Sun and stars change the hydrogen into helium, another common element, and release large amounts of energy. Life on Earth is **dependent** on this energy source and planets too far away, are too cold for living organisms to survive.

Hydrogen was also used for bombs that were far more destructive than traditional chemical weapons.

Elements are everywhere - Silicon



Silicon is a similar element to carbon and is one of the most common elements on Earth. In combination with other elements it forms most of the rocks present both above ground and below ground as molten magma (liquid rock).

Sand is made from a combination of silicon and oxygen and when heated it can turn into glass.

Silicon is also very important in computer parts.

Periodic table

Dmitri Mendeleev was a Chemist who created a periodic table and placed the elements in groups based on the element's similar properties. Not all the elements had been discovered at the time he created the table, so he left gaps that have now mostly been filled.

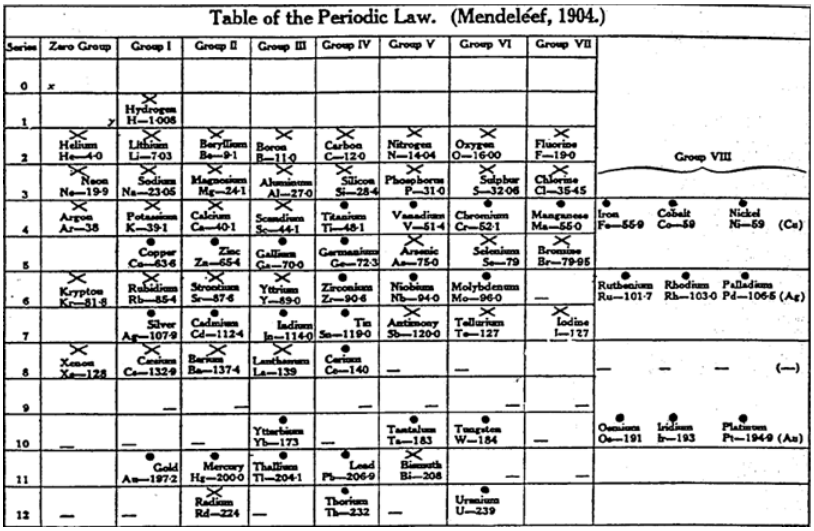
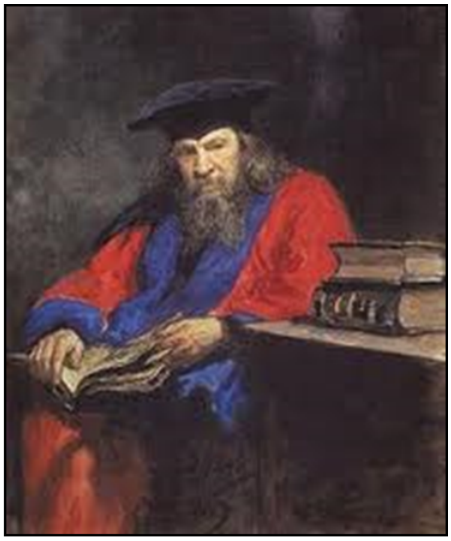


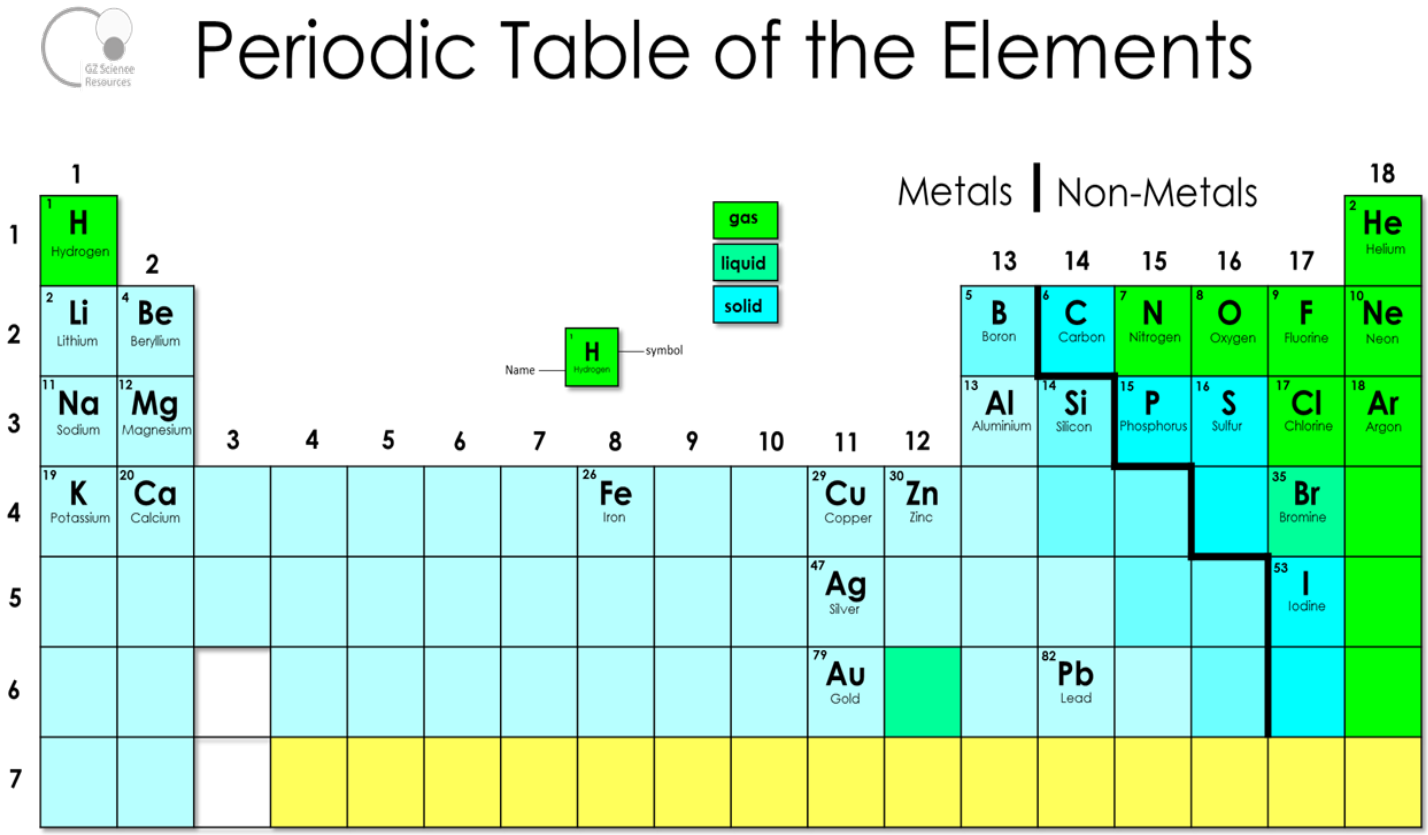
Table of the Periodic Law. (Mendeléef, 1904.)

Series	Zero Group	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII
0	x								
1		Hydrogen H—1·008							
2	Helium He—4·0	Lithium Li—7·03	Beryllium Be—9·1	Boron B—11·0	Carbon C—12·0	Nitrogen N—14·04	Oxygen O—16·00	Fluorine F—19·0	
3	Neon Ne—19·9	Sodium Na—23·05	Magnesium Mg—24·1	Aluminium Al—27·0	Silicon Si—28·4	Phosphorus P—31·0	Sulphur S—32·06	Chlorine Cl—35·45	
4	Argon A—38	Potassium K—39·1	Calcium Ca—40·1	Scandium Sc—44·1	Titanium Ti—48·1	Vanadium V—51·4	Chromium Cr—52·1	Manganese Ma—55·0	Iron Fe—55·9 Cobalt Co—59 Nickel Ni—59 (Cu)
5		Copper Cu—63·6	Zinc Zn—65·4	Gallium Ga—70·0	Germanium Ge—72·3	Arsenic As—75·0	Selenium Se—79	Bromine Br—79·95	
6	Krypton Kr—81·8	Rubidium Rb—85·4	Strontium Sr—87·6	Yttrium Y—89·0	Zirconium Zr—90·6	Niobium Nb—94·0	Molybdenum Mo—96·0	—	Ruthenium Ru—101·7 Rhodium Rh—103·0 Palladium Pd—106·5 (Ag)
7		Silver Ag—107·9	Cadmium Cd—112·4	Indium In—114·0	Tin Sn—119·0	Antimony Sb—120·0	Tellurium Te—127	Iodine I—127	
8	Xenon Xe—128	Caesium Cs—132·9	Barium Ba—137·4	Lanthanum La—139	Cerium Ce—140	—	—		— — — (—)
9		—	—		—	—	—	—	
10	—	—	—	Ytterbium Yb—173	—	Tantalum Ta—183	Tungsten W—184	—	Osmium Os—191 Iridium Ir—193 Platinum Pt—194·9 (Au)
11		Gold Au—197·2	Mercury Hg—200·0	Thallium Tl—204·1	Lead Pb—206·9	Bismuth Bi—208	—	—	
12	—	—	Radium Rd—224	—	Thorium Th—232	—	Uranium U—239		



Metals and non-metals can be identified from their position on the periodic table

Elements can be classified as metals or non-metals. Metals are placed on the left-hand side and non-metals are placed on the right-hand side of the periodic table. Nearly 2/3 of all elements are metals.

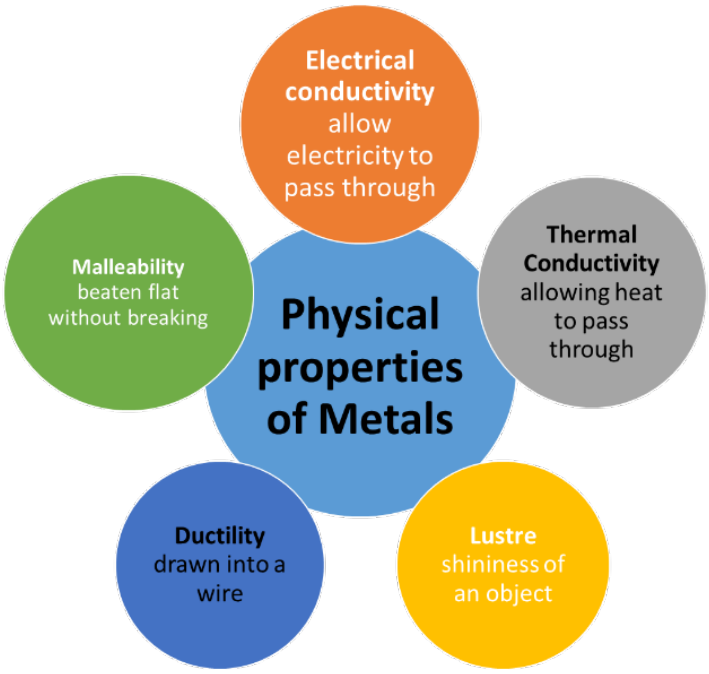


Metals

Metals can be distinguished from non-metals by their physical properties; they are strong, dense, shiny solids that can be worked into different shapes. They are good conductors of heat and electricity.

The Physical Properties of Metals

Many of these physical properties are unique to metals and because of that, metals are used for many situations that other non-metals could not be used.



Metal physical properties

Copper

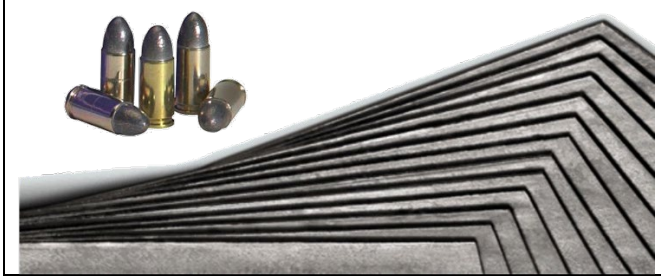
• Reddish-brown in colour • **Malleable** • **Ductile** • **Good heat and electrical conductivity** •Electrical wires •Heating pipes •Roofing

Iron

•**Ductile**, **malleable** & tough. •Shrinks on cooling •Making water pipes, gas pipes and sewers •Making ornamental castings such as brackets, gates, lamp posts, spiral staircases etc. •Making parts of machinery. •Can be used to form temporary magnets. •Used where a tough material is required.

Lead

•Can be cut with a knife. •**Lustrous** (shiny) & heavy metal •Bluish-grey colour •Very soft & plastic (**malleable**) at room temperature •Toilet fittings, water-proof and acid proof chambers •Gas pipes, roof gutters •Damp-proof courses of buildings, cable coverings •Plates for storage batteries, covering for electrical cables



Aluminium

•Silver in colour •Very strong but light in weight •**Very good conductor of heat and electricity** •Non-magnetic substance •Soft & **malleable** •**Ductile** •Making automobile bodies, engine parts •**Conductive of heat and electricity** • Manufacture of electrical conductors •Making drink cans, high tension wires

Metal physical properties – Gold

•Yellow gold in colour •Very soft and **malleable** and heavy in weight •**Very good conductor of heat and electricity** •Ductile •Jewellery and decorative objects •Manufacture of audio wires and fittings •Gold bullion (bars) and coins

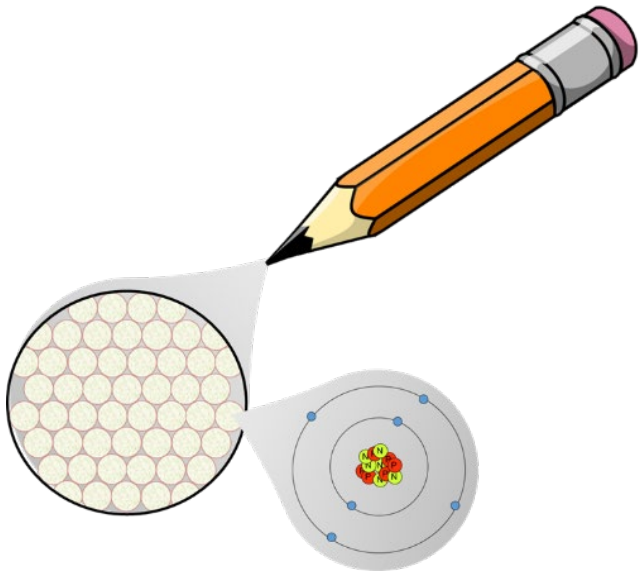
Metal uses Summary

We select appropriate metals, which are the most useful for the task or technology they assist with, because of their particular physical properties.

Metal	*Uses*	*Property involved*
copper	Pipes. Wires. cooking pots	Excellent electrical conductor Good thermal (heat) conductor
aluminium	Aircraft frames wires	Strong and light Good conductor and ductile
Gold (and silver)	Jewellery	Colour, malleable and ductile
lead	Roof flashing	Very malleable
iron	Car bodies Structural steel	Malleable Good heat conductor

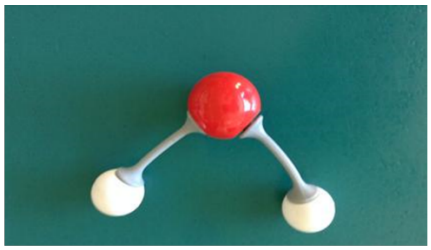
Matter is made up of particles /atoms

Matter (elements, mixtures and compounds) is made up of particles. The smallest neutral particle that matter can be broken down to is called an **atom**. Other particles that matter can be made of are **molecules** and **ions**. The type of particle and the way these particles are arranged and joined to each other makes different types of matter. Each different type of matter has different **physical** and **chemical** properties. These properties mean we use different types of matter for different uses.



Molecules are made from Atoms

Oxygen Molecule



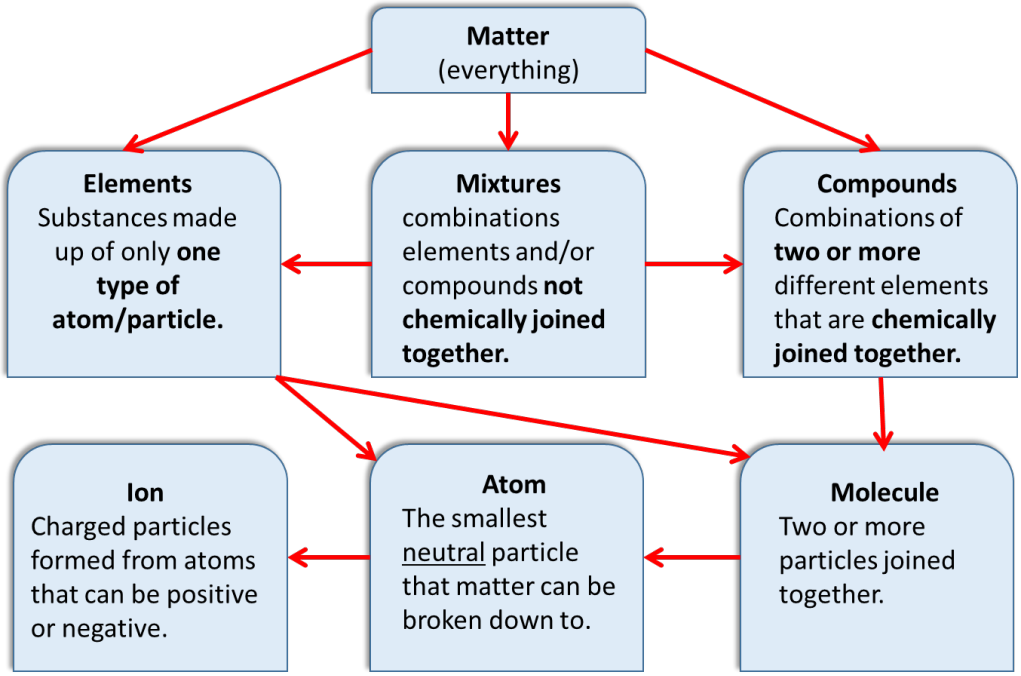
Water Molecule

When two or more particles join, they form a **molecule.** The particles can be either the same type of particle (atoms) such as oxygen gas or different types of particles (atoms) such as water.

A molecule of an **element** (such as oxygen gas – made from 2 oxygen atoms) O_2

A molecule of a **compound** (such as water - made from 2 hydrogen and one oxygen atoms). H_2O

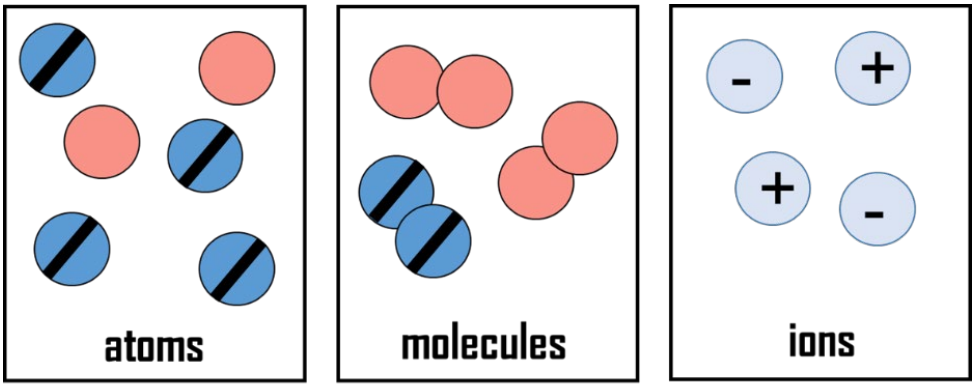
Matter can exist in different arrangements



Particle diagrams

Matter is made up of three main types of particles. They are the **atom**: the smallest neutral particle that matter can be broken down to, the **molecule**: two or more particles joined together and an **ion**: charged particles formed from atoms that can be positive or negative.

Different types of particles can be drawn using **particle diagrams**. Each circle represents an individual particle.

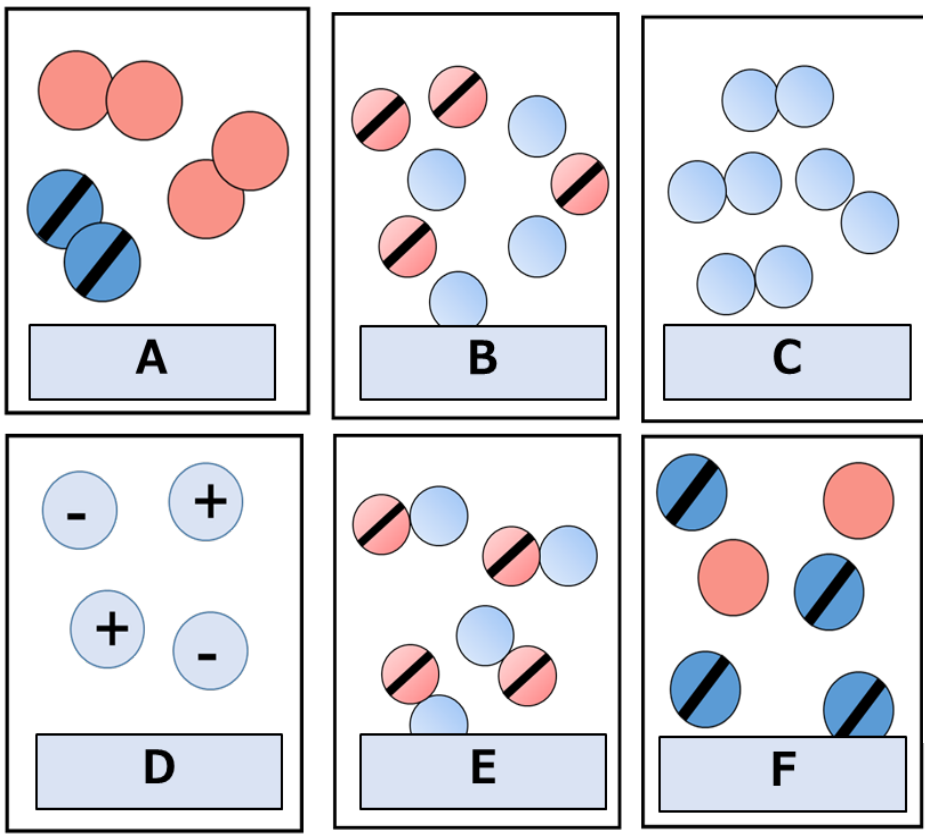


Matter can exist in different arrangements: **mixtures, compounds and elements.** These arrangements can consist of different particles: **atoms, ions or molecules.**

1. Match the following definitions to these bolded terms above

Definition	Term
Two or more particles joined together	
Combinations of two or more different elements that are chemically joined together.	
combinations elements and/or compounds not chemically joined together.	
The smallest neutral particle that matter can be broken down to.	
Charged particles formed from atoms that can be positive or negative.	
Substances made up of only one type of atom/particle.	

2. Match the terms to the correct particle diagram (some terms may require more than one diagram)



Term	Particle diagram (s)
Mixture	
Compound	
element	
atom	
ion	
molecule	

3. Sort the following substances into mixtures compounds or elements

Mixtures	Elements	Compounds

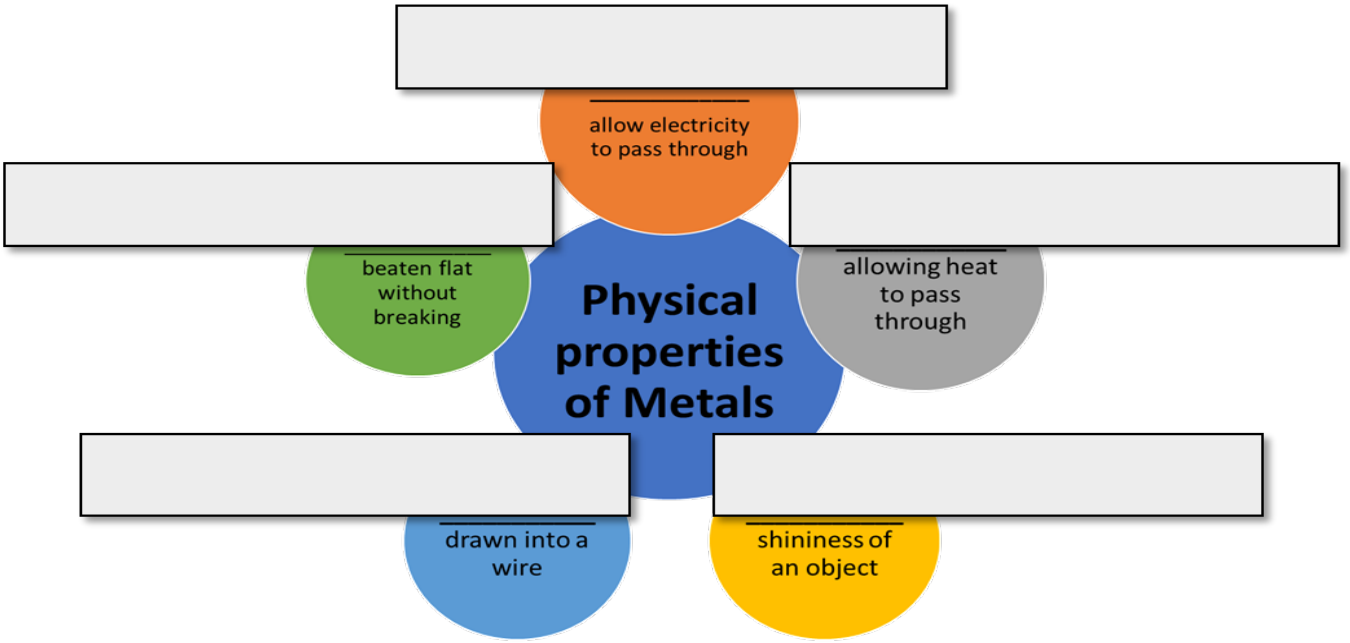
4. Many of the common types of elements are grouped in the first 20 elements out of 130+ elements in a periodic table. Complete the missing **symbols** in the Periodic table above

HYDROGEN 1 **H** 1.01							HELIUM 2
LITHIUM 3	BERYLLIUM 4 **Be** 9.01	BORON 5 **B** 10.81	CARBON 6	NITROGEN 7 **N** 14.01	OXYGEN 8 **O** 16.00	FLUORINE 9	NEON 10
SODIUM 11	MAGNESIUM 12 **Mg** 24.31	ALUMINUM 13	SILICON 14 **Si** 28.09	PHOSPHORUS 15	SULFUR 16	CHLORINE 17 **Cl** 35.45	ARGON 18 **Ar** 39.95
POTASSIUM 19	CALCIUM 20 **Ca** 40.08						

Metals

5. Name any **four elements** from the above table that are considered **metals**

6. Complete the diagram and match the **FIVE physical properties** of metals: Ductility, Electrical conductivity, Lustre, heat conductivity, malleability.



7. Copper can often be used for electrical wiring. List two physical properties that make copper useful for this purpose and give an explanation.

Physical property	Explanation linked to use

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