

Unit C5

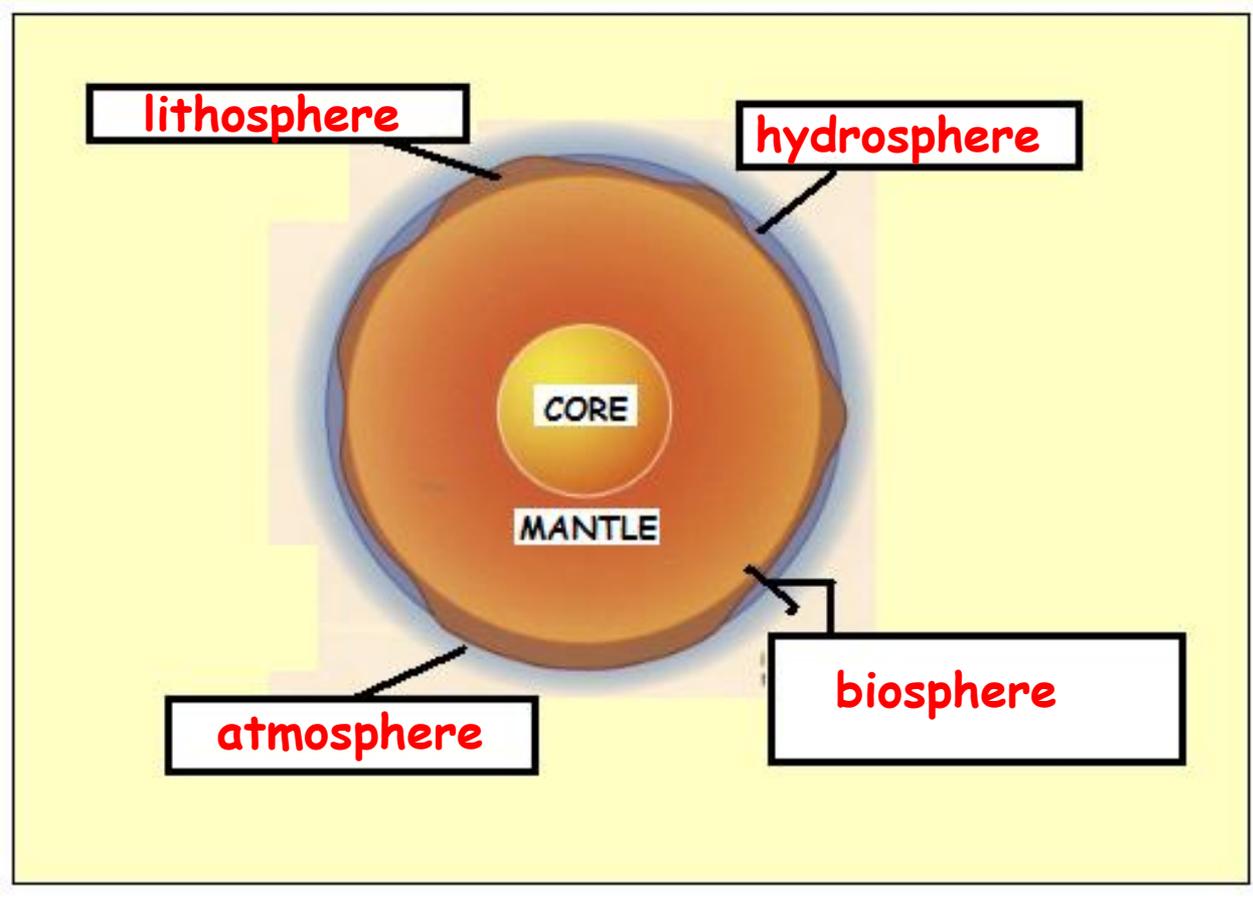
Chemicals of the Natural Environment

The topics in this unit are:

-  1 - Spheres of the earth
-  2 - The atmosphere
-  3 - The atmosphere (molecules)
-  4 - The atmosphere (bonding)
-  5 - The hydrosphere
-  6 - The hydrosphere (the sea)
-  7 - The lithosphere (elements)
-  8 - The lithosphere (silicon dioxide)
-  9 - The lithosphere (silicon dioxide properties)
-  10 - The biosphere
-  11 - Extracting metals
-  12 - Extracting metals (displacement)
-  13 - Extracting metals (electrolysis)
-  14 - Electrolysis of aluminium oxide

Spheres

The Earth is made up of four different spheres.



The Atmosphere

The **atmosphere** is a layer of **gas** surrounding the Earth.

It contains the elements **nitrogen**, **oxygen** and **argon**

It contains some compounds, **carbon dioxide** and **water vapour**

The chemicals that make the atmosphere are **non-metal elements** or **molecular compounds** of non-metals

The Atmosphere 2

The molecules in the atmosphere are **gases** because they have **low boiling points**.

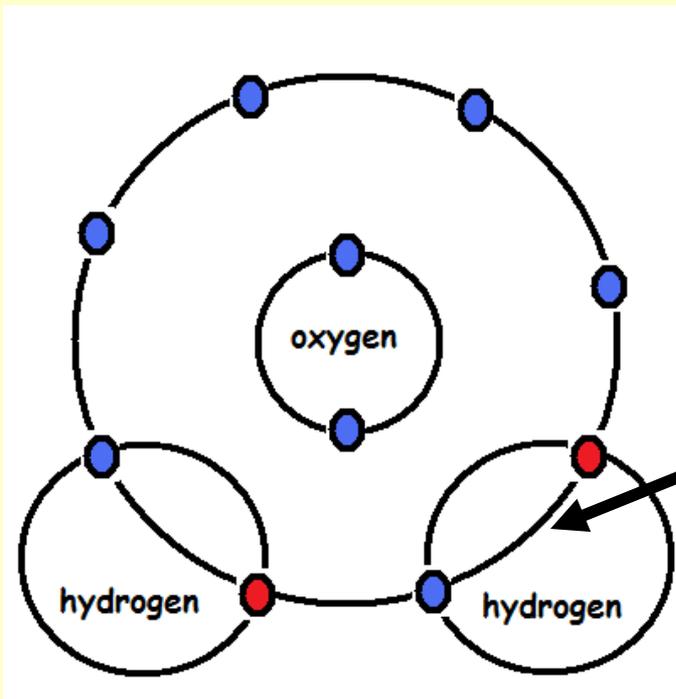
Chemical	Formula	Diagram	Mass	Boiling point
Oxygen	O ₂	O=O	(16x2) 32	-182.9°C
Nitrogen	N ₂	N≡N	(14x2) 28	-195.8°C
Carbon dioxide	CO ₂	O=C=O	(16x2)+12 44	-78°C
Water vapour	H ₂ O	H-O-H	(1x2) +16 18	100°C
Argon	Ar	Ar	40x1 40	-185.8°C

What is the relationship between boiling point and mass?

The Atmosphere - Bonding

The molecules in the atmosphere covalently bonded.

This means that there is a shared pair of electrons between the molecules



Shared pair of electrons

Each atom has a full outer shell

-oxygen has claim to 8 electrons

-Each hydrogen has claim to 2 electrons

The Hydrosphere

The hydrosphere is to do with **water** on the Earth.

Water is an unusual molecule.

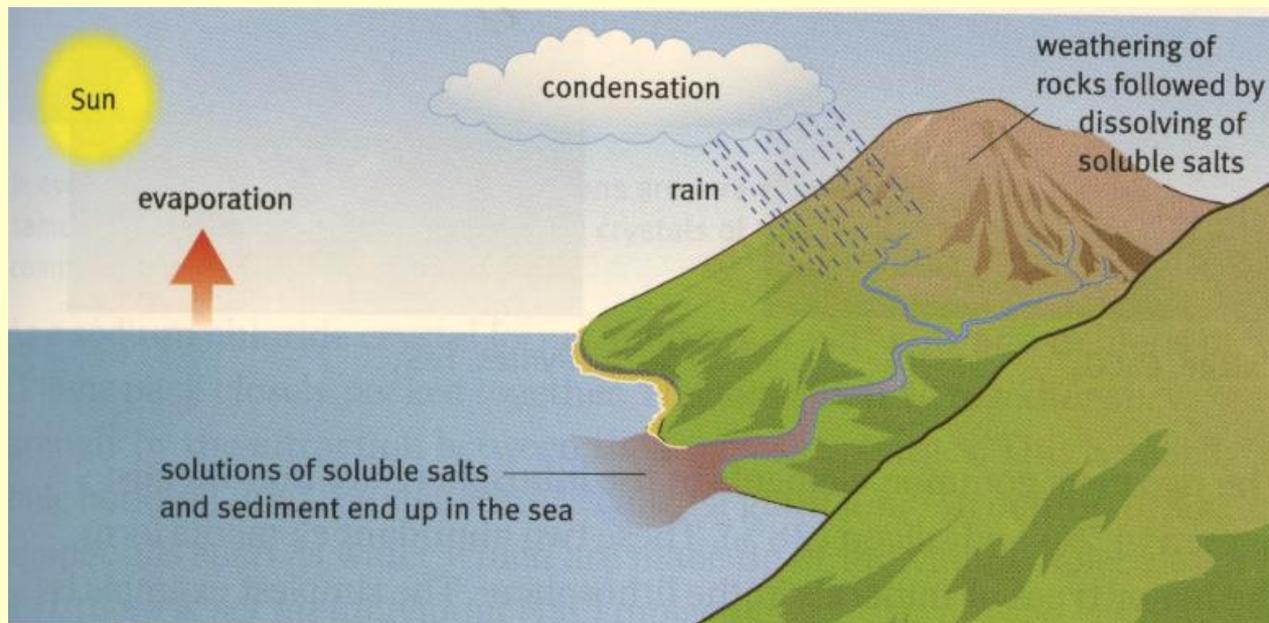
Its special properties are

- It is a liquid. Has a small mass so we would expect it be a gas
- It can dissolve ions in it
- It becomes less dense as it becomes a solid
- Pure water does not conduct

The Hydrosphere

The hydrosphere is mainly made of the **seas**.

Sea water is **salty**. Why?



The main soluble chemical carried into the sea is sodium chloride. Sea water tastes salty because the concentration of salt has built up over millions of years.

The Lithosphere

The lithosphere is the **crust** and **upper mantle**.

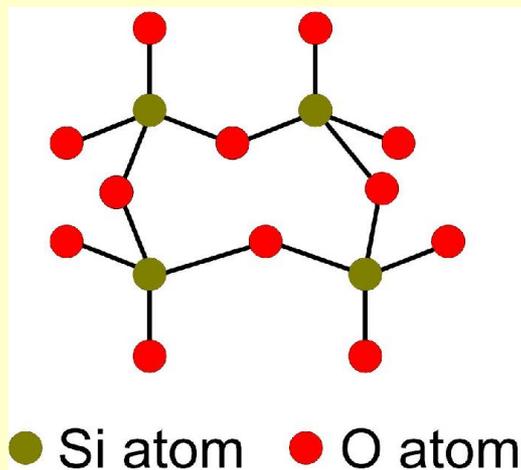
Element	Abundance
Oxygen, O	455000
Silicon, Si	272000
Aluminium, Al	83000
Iron, Fe	62000
Calcium, Ca	46600
Magnesium, Mg	27640
Sodium, Na	22700
Potassium, K	18400
Titanium, Ti	6320
Hydrogen, H	1520

The most common elements are **O, Si and Al**.

Some compounds found in the lithosphere are used as **gemstones** because they are **rare** and have a **shiny appearance**.

The Lithosphere - Silicon Dioxide

A lot of the silicon and oxygen in the crust is present as silicon dioxide.



In silicon dioxide, SiO_2 , each silicon atom forms a **covalent bond** to **four** oxygen atoms and each oxygen atom forms a covalent bond to **two** silicon atoms.

Instead of forming small molecules, they form a **giant structure (lattice)** that goes on and on. The Si-O bond is very **strong** and so the structure is very **strong and rigid**.

The Lithosphere - Silicon Dioxide

Properties of silicon dioxide are:

It has a high melting point and boiling point

This is because of the strong covalent bonds

It is an electrical insulator

This is because there are no free ions

Insoluble in water

This is because there are no charges to attract water molecules

The Biosphere

The biosphere contains three groups of molecules

-carbohydrates, proteins and DNA

Chemicals in the biosphere are mainly made of **carbon, hydrogen and oxygen.**

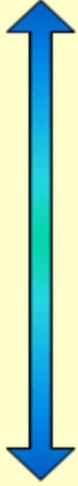
Extracting Metals

Metals are found in the ground as **ORES**. The metal combined with another element (commonly oxygen).

The metal must be separated from the other element.

There are **two methods** to extract a metal and it depends on the reactivity of the metal. **Displacement with carbon or electrolysis**

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt



Metals **below** carbon are extracted using **displacement**

Metals **above** carbon are extracted using **electrolysis**

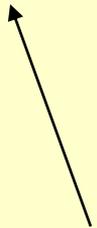
Extracting Metals - Displacement

A more reactive element will **displace** a less reactive element.

For example:



Zinc has
been
reduced



Carbon has
been
oxidised



Extracting Metals - Electrolysis

Metals that are more reactive than carbon will not be displaced by it. **Electrolysis** must be used.



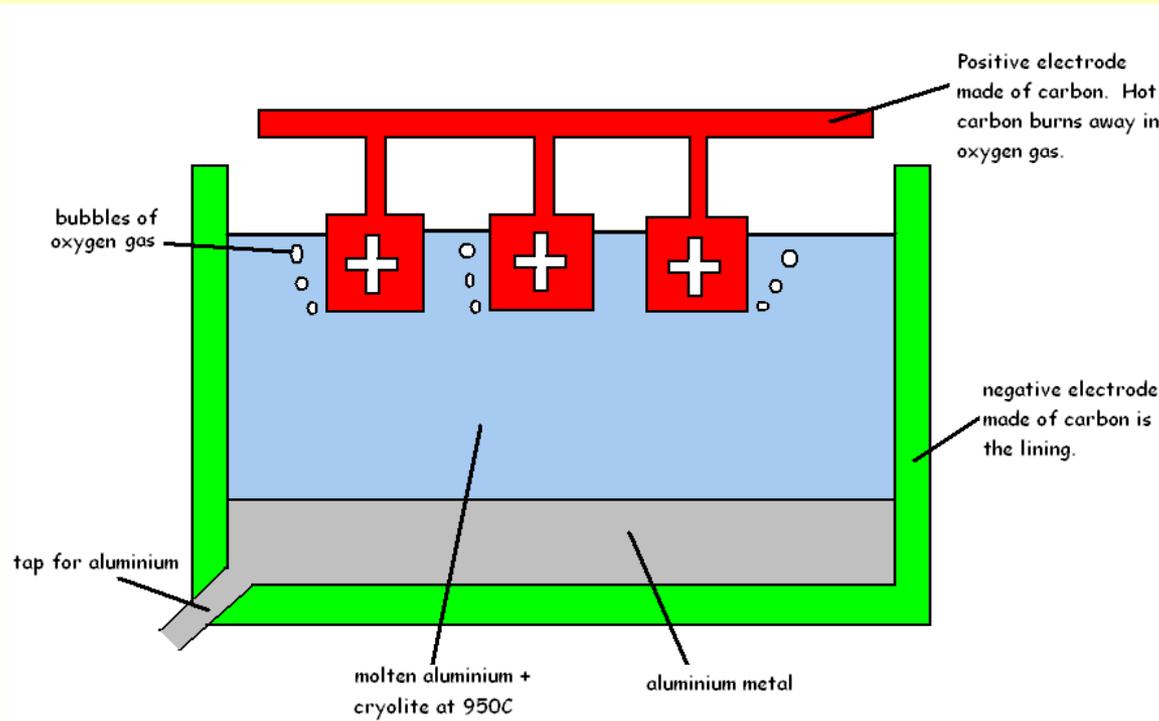
Electrolysis is splitting up **ionic compounds** by passing **electricity** through them.

The solution we are splitting up must be **molten** so that the **ions** are free to **move**.

One electrode is **positively charged** (anode) and one is **negatively charged** (cathode).

When current is passed through, **positive ions** move to the **cathode** and **negative ions** move to the **anode**

Extracting Metals - Electrolysis of Aluminium



Aluminium oxide is dissolved in cryolite to lower the melting point.

Aluminium oxide is made into a liquid so the ions can move

Aluminium ions move to the cathode and form pure aluminium metal

Oxide ions move to the anode and form bubbles of oxygen gas.