

Matter and Atoms

Part 1 - Substances and Mixtures

What is matter?

Anything that has a mass and takes up space
(has a volume)



Air



Sound



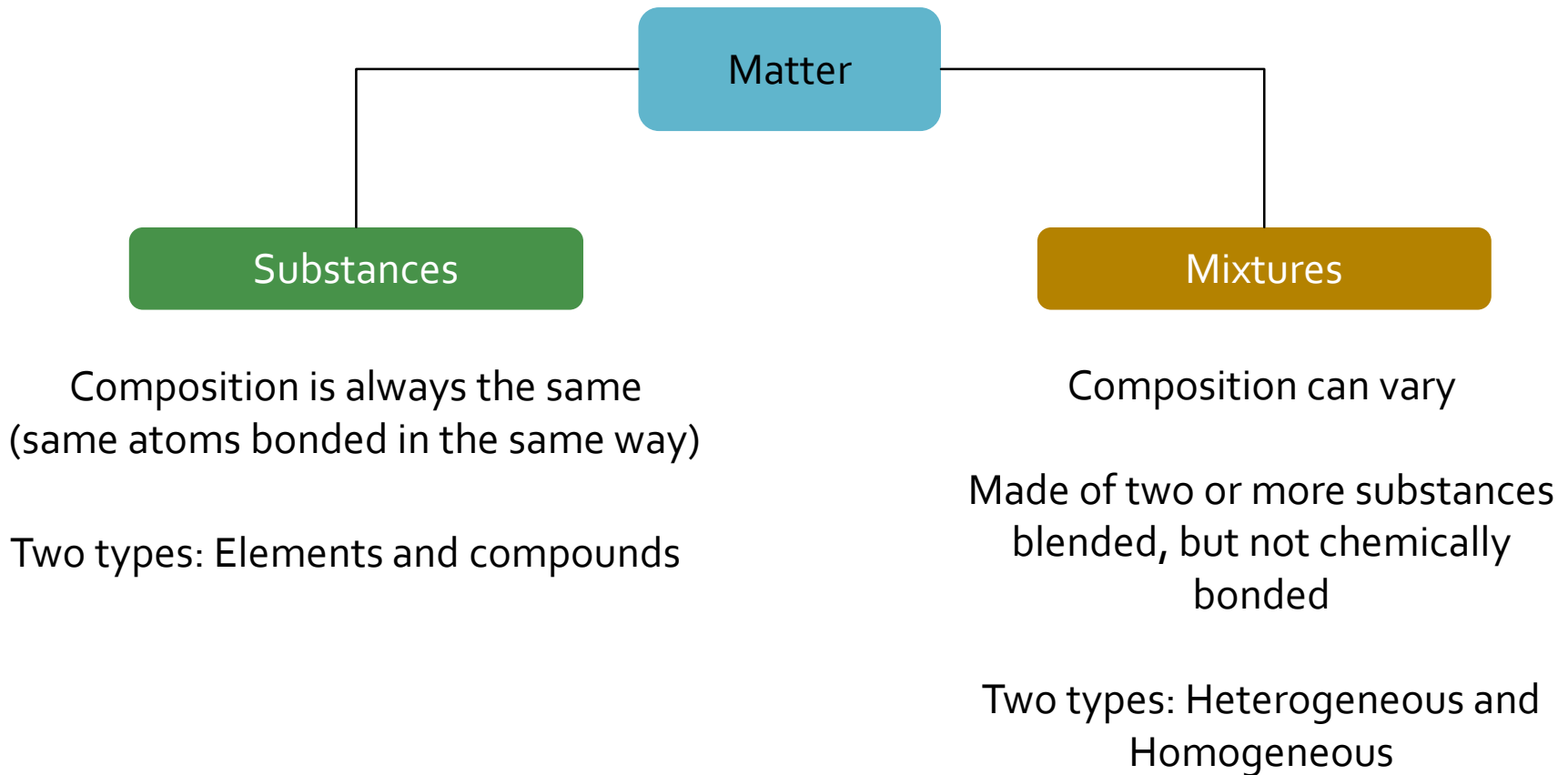
Water



Light/Heat



Classifying Matter



Substances

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graph TD; Substances[Substances] --- Elements[Elements]; Substances --- Compounds[Compounds];
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Elements

Substances composed of only one type of atom

The smallest part of an element is an atom

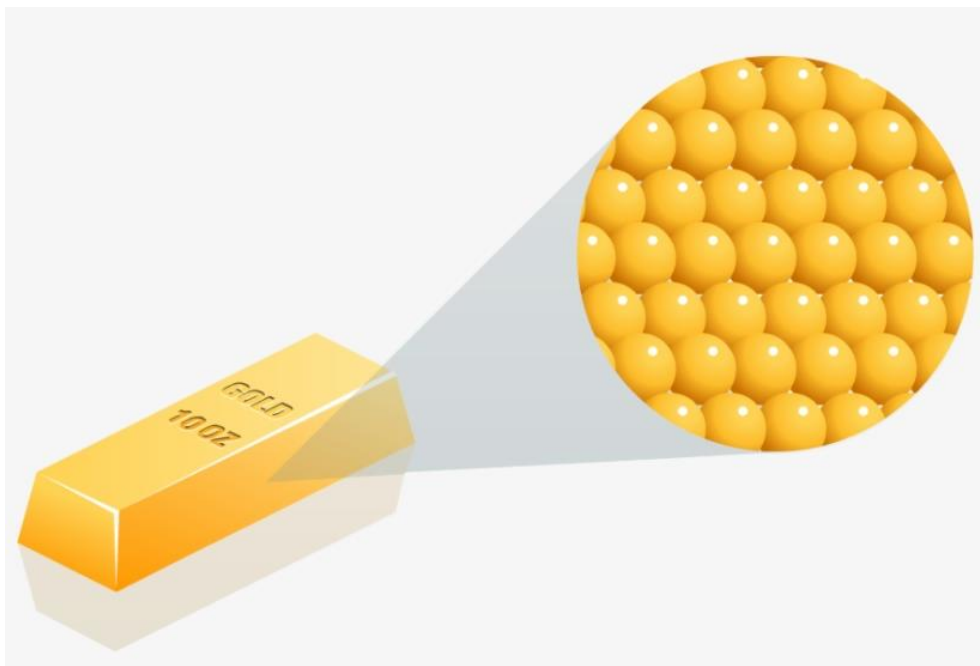
Some elements exist as molecules

Compounds

A substance made of two or elements chemically bonded together

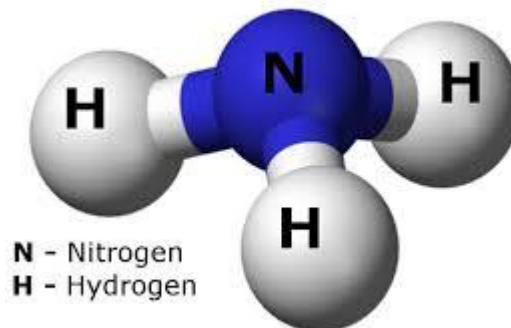
All compounds are molecules

Elements, molecules, compounds



Only one type of atom (gold atoms) = Element

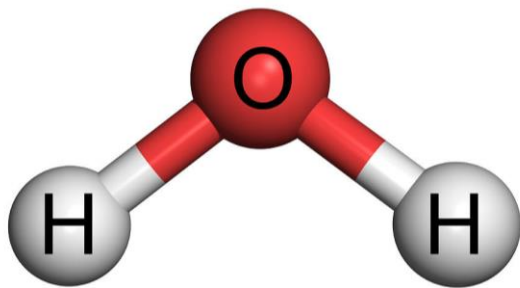
Two or more atoms bonded together = Molecule



Two or more types of elements
(nitrogen and hydrogen) =
Compound

Two or more atoms bonded
together = Molecule

Examples

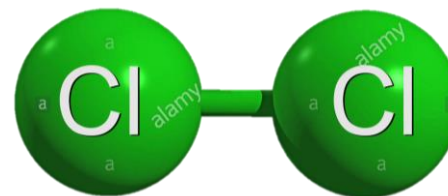


Water (H_2O) contains 3 atoms bonded together.

2 or more atoms bonded together = **molecule**

Water contains 2 types of atoms (elements): Hydrogen (H) and Oxygen (O)

2 or more elements bonded together = **compound**



Chlorine gas (Cl_2) contains 2 atoms bonded together.

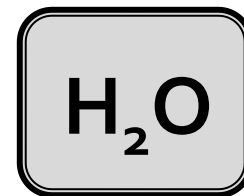
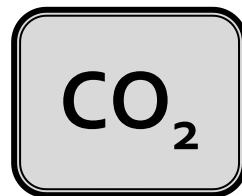
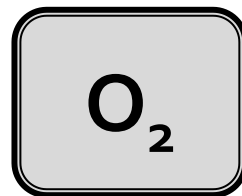
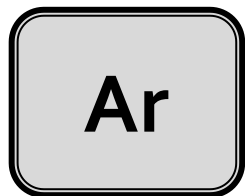
2 or more atoms bonded together = **molecule**

Chlorine gas contains only 1 type of atom (element): Chlorine (Cl)

Only 1 type of atom = **element**

Identify the elements, molecules and compounds

What gases make up the air we breath?

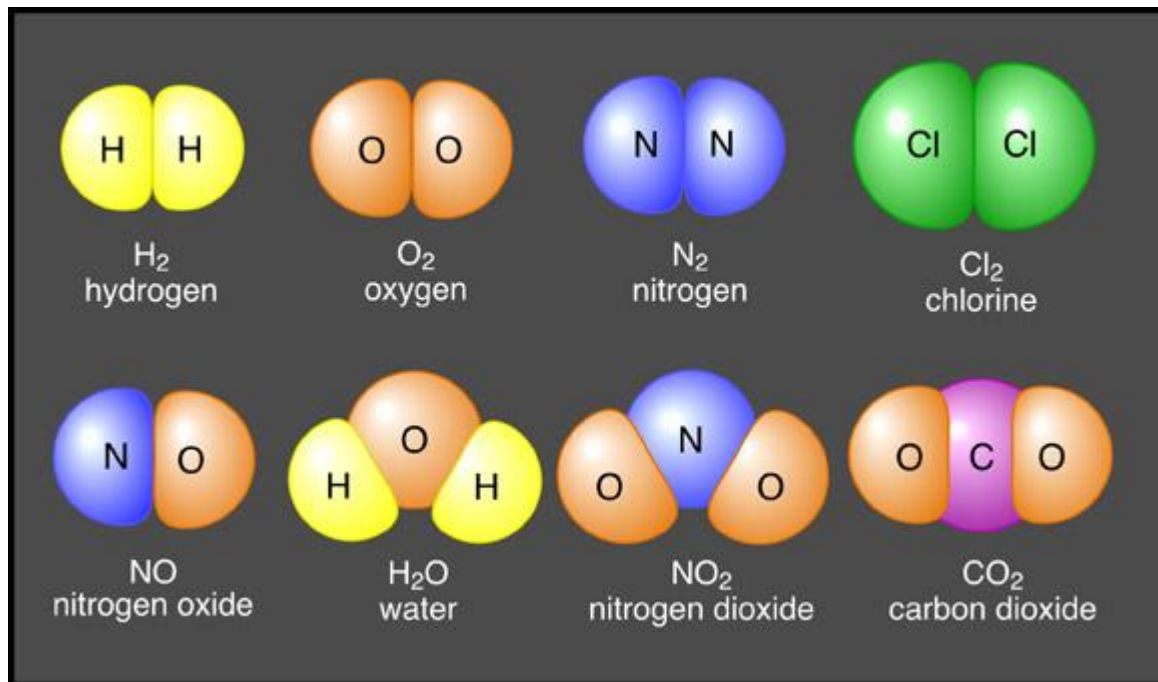


Elements: Argon (Ar), Neon (Ne), Nitrogen (N₂), Oxygen (O₂)
Each of these only contain one type of atom

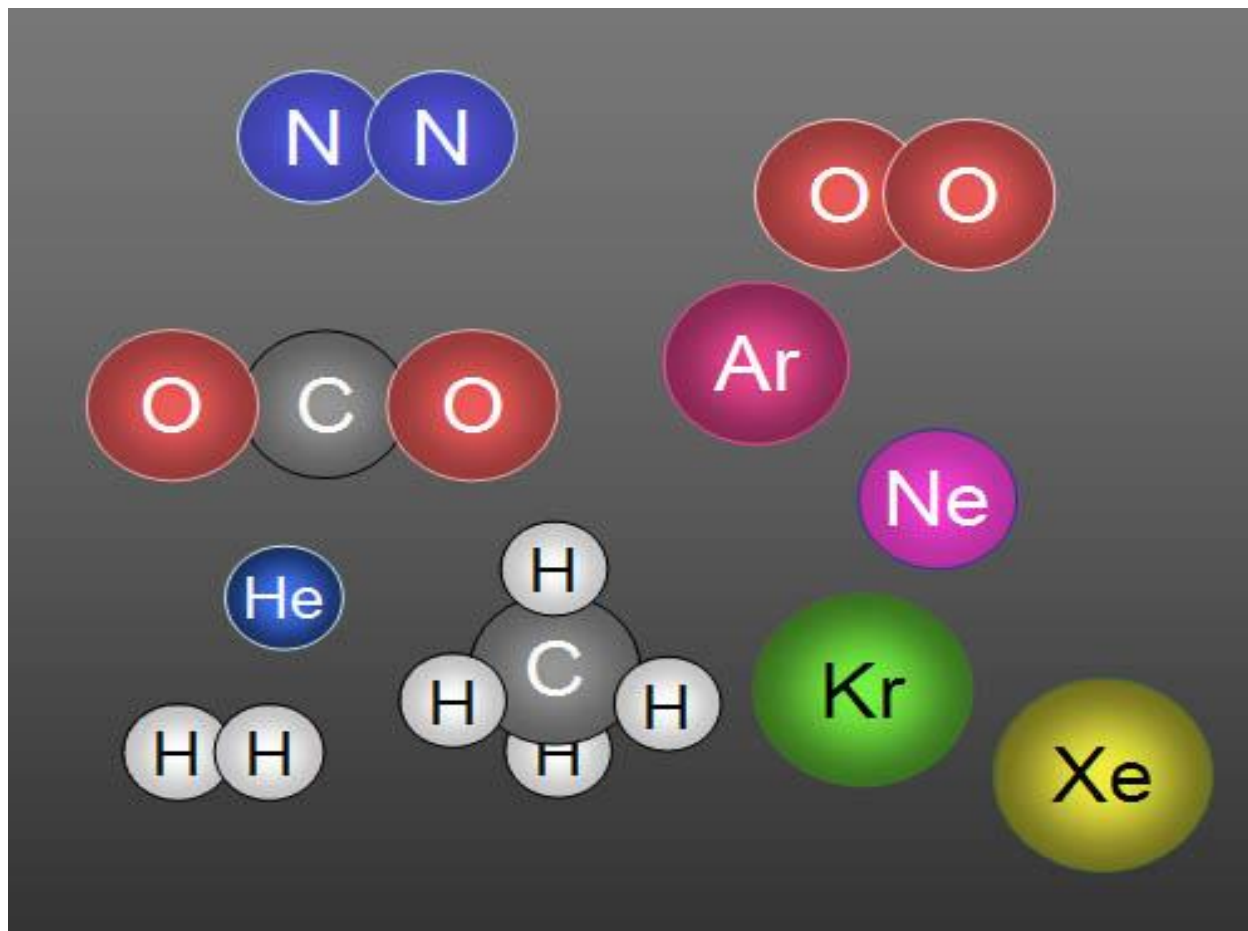
Molecules: Nitrogen (N₂), Oxygen (O₂), Carbon dioxide (CO₂) and Water (H₂O)
Each of these contain 2 or more atoms bonded together

Compounds: Carbon dioxide (CO₂) and Water (H₂O)
Each of these contain 2 or more elements bonded together

Identify the molecules and the compounds



Practice



How many elements?

How many molecules?

How many compounds?

Mixtures

- Most matter exists as a mixture



Pure Water



Ocean Water



Tap Water

- There are two types of mixtures
 - Heterogeneous
 - Homogeneous

Heterogeneous Mixtures

A mixture in which the substances are not evenly mixed



Remember that the substances within a mixture are not bonded together

Homogeneous Mixtures

A mixture in which two or more substances are evenly mixed, but not bonded together.



Homogeneous Mixtures

Another name for a homogeneous mixture is a solution.

A solution is made up of two parts – a solvent and one or more solutes.

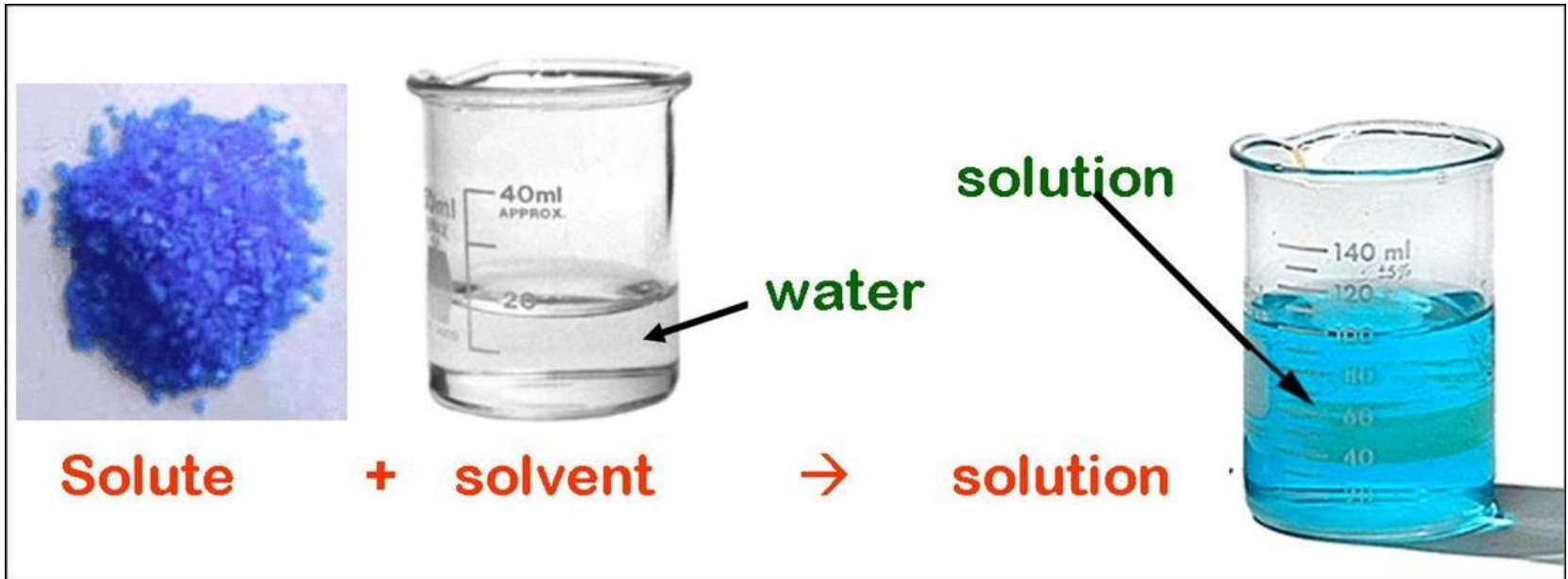


Solute



Solvent

Solutions

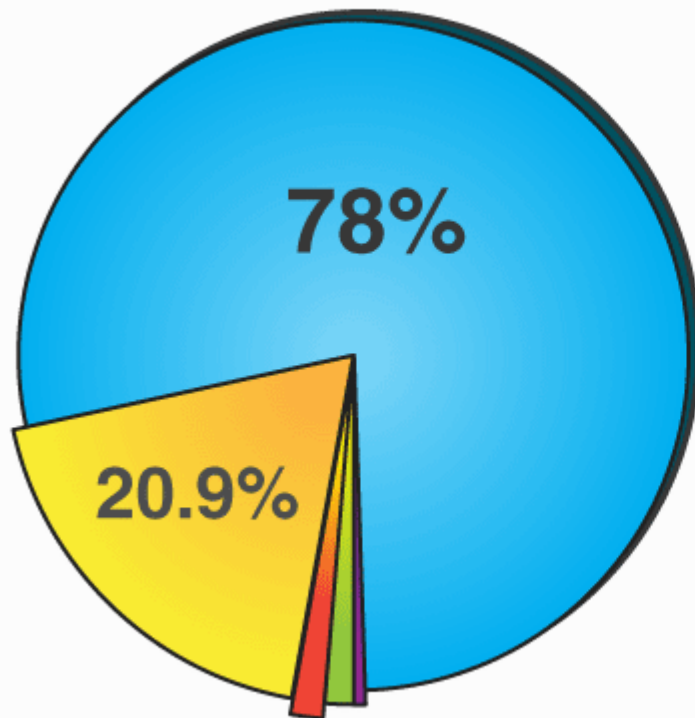


The state of the solution = The state of the solvent

In this case as water is a liquid the solution is a liquid

Solutions

COMPOSITION OF AIR



Nitrogen is the solvent as its present in the largest amount

All the other gases in this mixture are solutes

- Nitrogen - 78%
- Oxygen - 20.9%
- Other Gases - >0.17%
- Argon - >0.90%
- Carbon Dioxide - 0.03%

Separating Mixtures

- Because the substances within a mixture are not chemically bonded they can be separated by physical processes.



Separating Mixtures

It is more difficult to separate a homogeneous mixture as the components are evenly mixed. One way to do this is by boiling or evaporation.



Summary

Matter

- Anything that has mass and takes up space
- Most matter on Earth is made up of atoms.
- Two classifications of matter: substances and mixtures

Substances

- Matter with a composition that is always the same
- Two types of substances: elements and compounds

Element

- Consists of just one type of atom
- Organized on the periodic table
- Each element has a chemical symbol.

Compound

- Two or more types of atoms bonded together
- Properties are different from the properties of the elements that make it up
- Each compound has a chemical formula.

Substances physically combine to form mixtures.

Mixtures can be separated into substances by physical methods.

Mixtures

- Matter that can vary in composition
- Substances are not bonded together.
- Two types of mixtures: heterogeneous and homogeneous

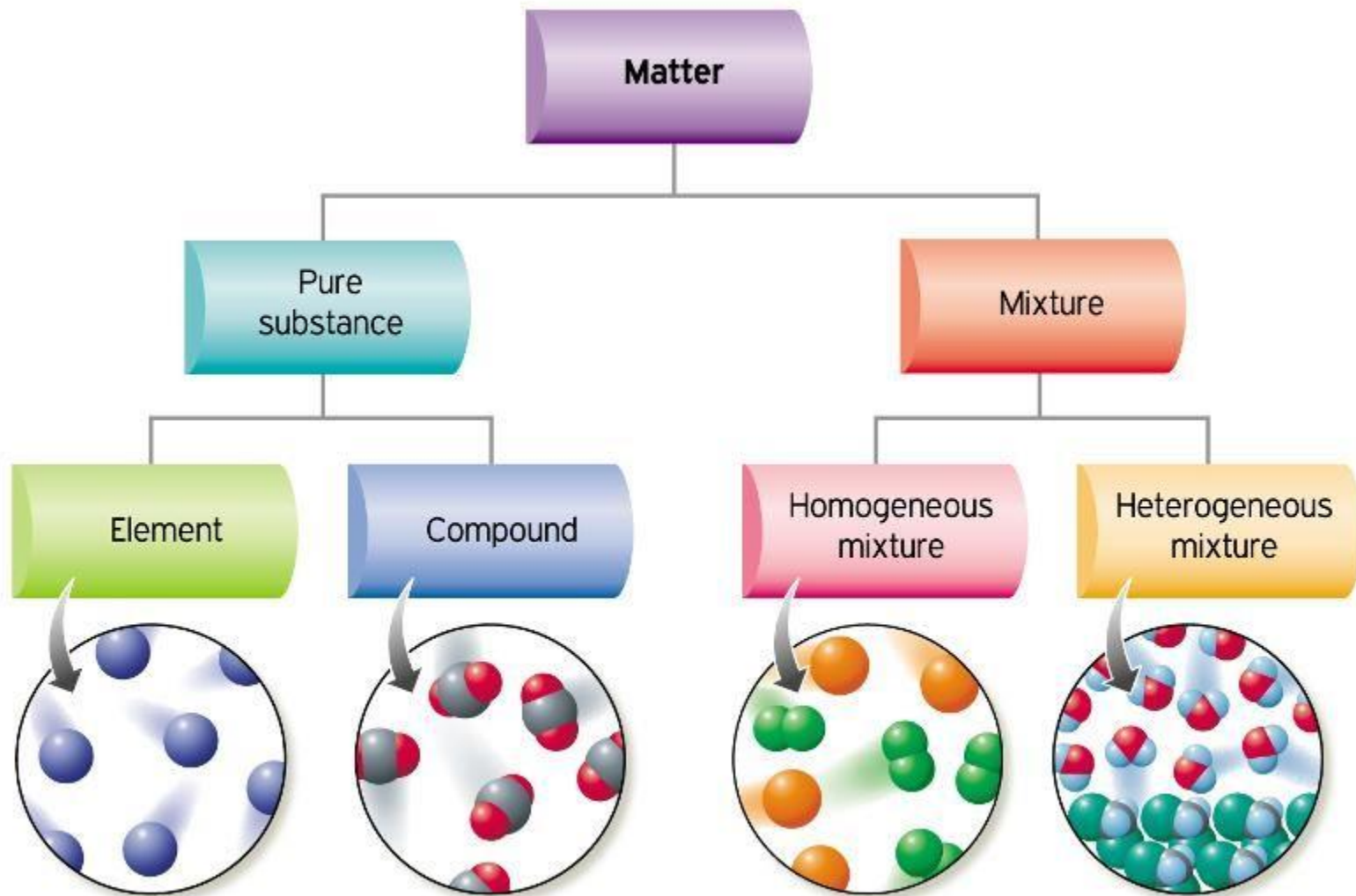
Heterogeneous Mixture

- Two or more substances unevenly mixed
- Different substances are visible by an unaided eye or a microscope.

Homogeneous Mixture—Solution

- Two or more substances evenly mixed
- Different substances cannot be seen even by a microscope.

Summary

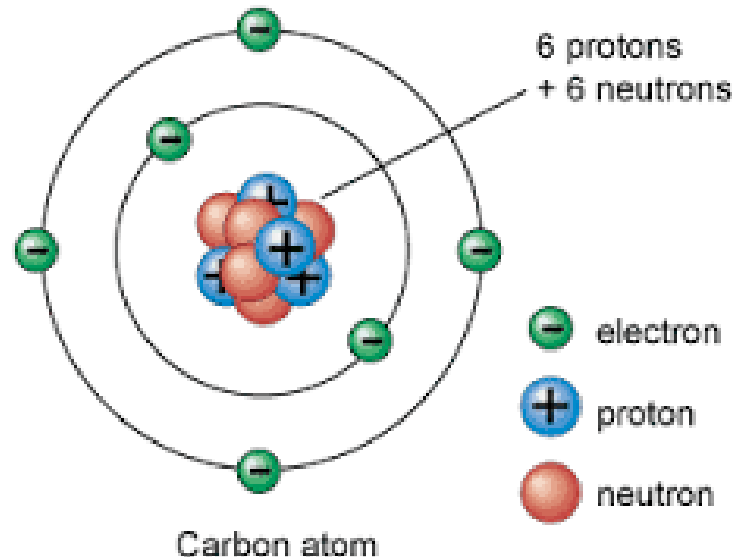


Matter and Atoms

Part 2 – The Structure of Atoms

Protons, neutrons and electrons

There are 3 different particles that make up atoms. Although the number of these particles changes with each atom the structure is always the same.



The Nucleus

The nucleus is at the centre of an atom and contains the **protons** and **neutrons**.

- Protons – positively charged particles
- Neutrons – uncharged particles

The nucleus contains most of an atoms mass

Electrons

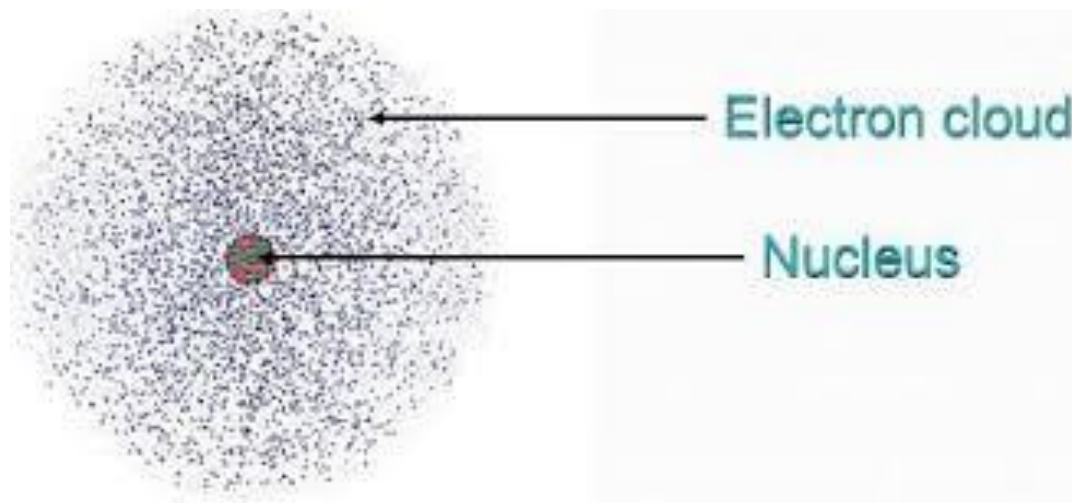
An electron is a negatively charged particle located outside of the nucleus.

Electrons are so small and move so quickly that we cannot tell exactly where they are.

Therefore the area outside of the nucleus is known as an **electron cloud**.

Electron clouds

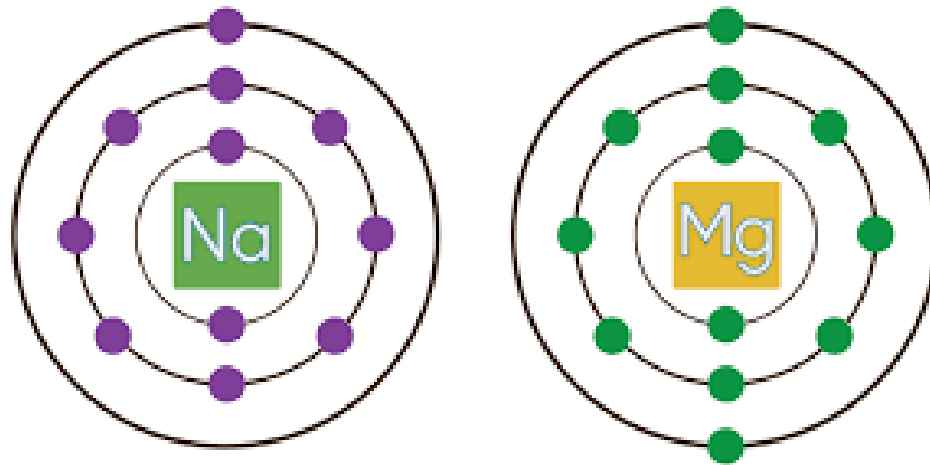
The region surrounding an atoms nucleus where one or more electrons are most likely to be found.



Differences in Atoms

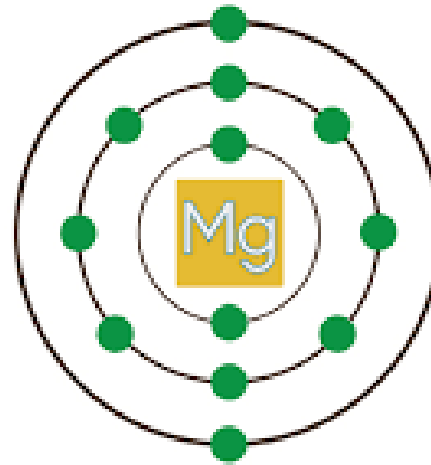
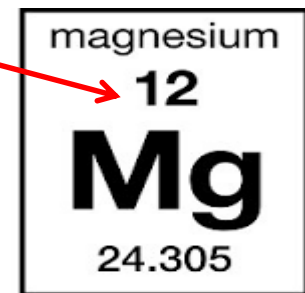
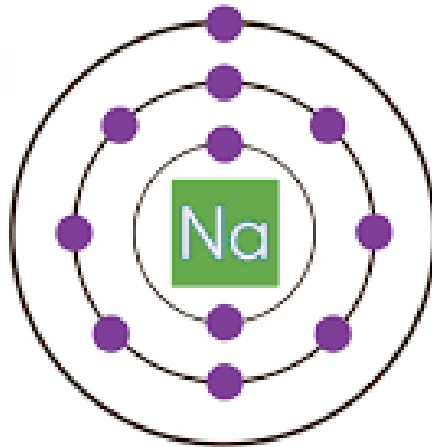
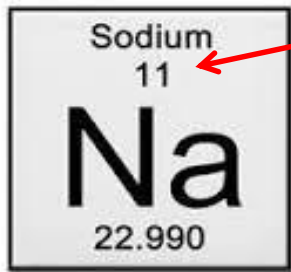
All the atoms/elements in the periodic table are different.

How are they different?



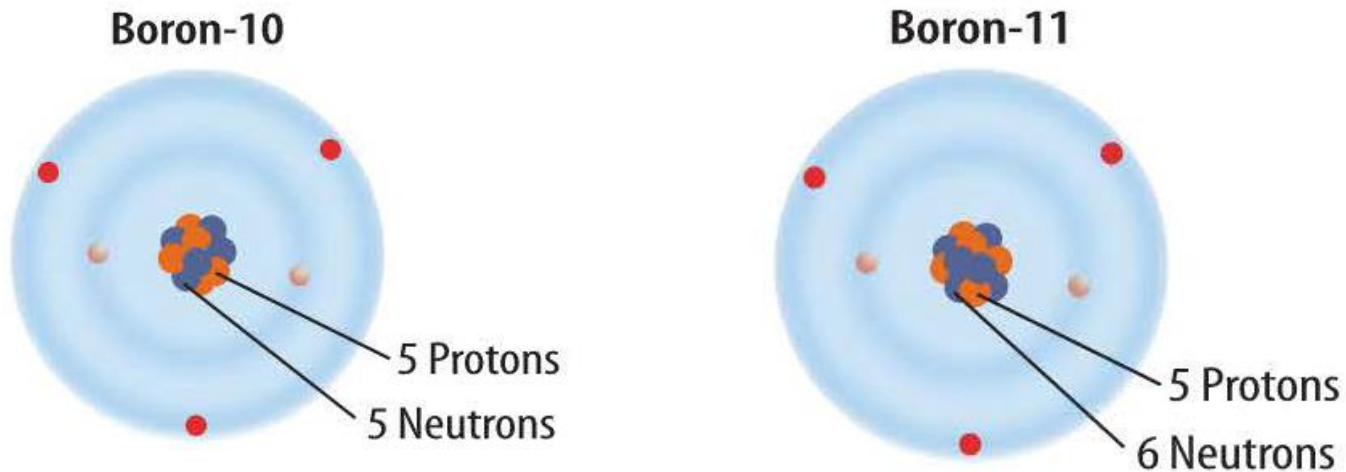
Differences in Atoms

Atomic number – the number of protons in the nucleus of an atom of an element.



Isotopes

How do these two boron atoms vary?



Isotope – one of two or more atoms of an element having the same number of protons, but a different number of neutrons.

Ions

What charge does an atom have? **Neutral**

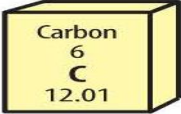
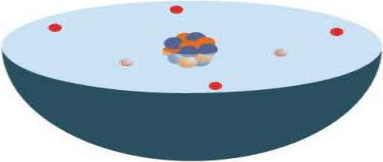
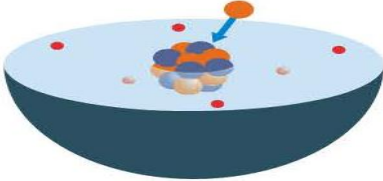

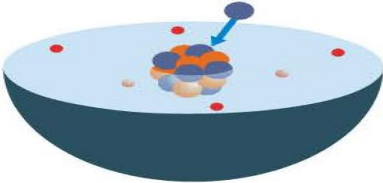
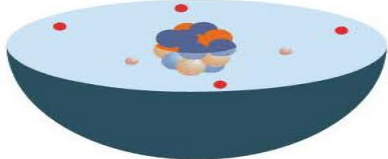
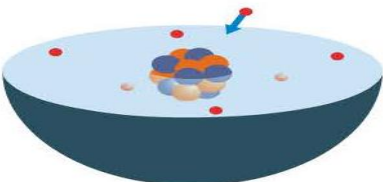
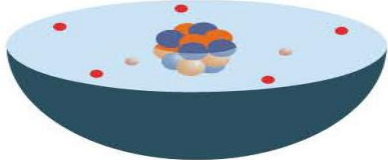
What would happen if an atom gained or lost an electron? **Becomes an Ion (positive or negative)**

If the number of electrons changes does the type of atom change? **No, because the number of protons has not changed**

What are ions? **An atom that has a charge because it has gained or lost electrons**

Changes in Atoms

Table 3 Possible Changes in Atoms 

Neutral Atom	Change	Results
 <ul style="list-style-type: none">• 6 protons• 6 neutrons• 6 electrons 	<p>Protons add one proton</p> 	<p>New element—nitrogen</p>  <ul style="list-style-type: none">• 7 protons• 7 neutrons• 7 electrons
	<p>Neutrons add one neutron</p> 	<p>Isotope</p>  <ul style="list-style-type: none">• 6 protons• 7 neutrons• 6 electrons
	<p>Electrons add one electron</p> 	<p>Ion</p>  <ul style="list-style-type: none">• 6 protons• 6 neutrons• 7 electrons

Summary

Atomic Structure

- **ATOMS**
 - Differ by number of *protons*
- **IONS**
 - Differ by number of *electrons*
- **ISOTOPES**
 - Differ by number of *neutrons*

Review Questions

Which term describes two or more atoms that are held together by chemical bonds and act as a unit?

- A. Atom
- B. Compound
- C. Molecule
- D. Substance

Review Questions

Which term refers to two or more substances that are blended but are not chemically bonded?

- A. element
- B. Compound
- C. Molecule
- D. Mixture

Review Questions

Which term describes the substance in a solution that is present in the largest amount?

- A. Solute
- B. Solvent
- C. Element
- D. Mixture

Review Questions

Which term refers to the region surrounding an atom's nucleus where one or more electrons are most likely to be found?

- A. Isotope
- B. Ion
- C. Electron cloud
- D. Proton

Review Questions

Which term describes one of two or more atoms of an element having the same number of protons but a different number of neutrons?

- A. Atomic number
- B. Ion
- C. Molecule
- D. Isotope

Review Questions

What charge would a neutral atom have if it lost an electron?

- A. Positive
- B. Negative
- C. Neutral
- D. Atomic

Review Questions

Which term refers to matter that can vary in composition?

- A. Compound
- B. Element
- C. Mixture
- D. Solvent

Review Questions

Which type of mixture has two or more substances that are evenly mixed but not chemically bonded together?

- A. Molecular
- B. Homogeneous
- C. Heterogeneous
- D. Atomic

Review Questions

What is the region at the centre of an atom that contains most of the mass?

- A. Proton
- B. Nucleus
- C. Neutron
- D. Electron

Review Questions

Which is an atom that has a charge because it has gained or lost electrons?

- A. Ion
- B. Isotope
- C. Molecule
- D. Compound