



Box 1: Keywords

Atom	the smallest part of an element that exist
Atomic number	the number of protons (which equals the number of electrons) in an atom.
Element	a substance made up of only one type of atom
Isotope	atoms that have the same number of protons but different number of neutrons
Mass number	the number of protons plus neutrons in the nucleus of an atom
Compound	a substance made when two or more different elements are chemically bonded together
Nucleus	the very small and dense central part of an atom that contains protons and neutrons
Electronic structure	a set of numbers to show the arrangement of electrons in their shells
Shell	an area in an atom, around its nucleus, where electrons are found
Relative atomic mass	the average mass of all the atoms of an element

Box 2: Key skills

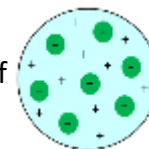
Use models as a way of understanding things that are very small
Understand that models have limitations
Understand the relationship between standard prefixes and powers of 10

Box 3: Changing models of the atom

John Dalton's model: atoms were solid spheres that could not be divided into smaller parts

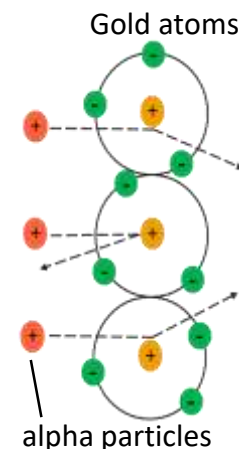


Plum pudding model: the discovery of the electron led to the plum pudding model of the atom. A ball of positive charge with electrons embedded into it

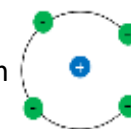


Rutherford's alpha particle scattering experiment (Gold foil experiment)

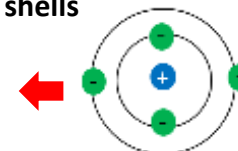
1. Positively charged alpha particles were fired at a piece of gold foil
2. Rutherford thought the alpha particles would pass straight through the gold, but some of the particles bounced back or were deflected
3. To explain this, Rutherford suggested that the positive charge and mass of an atom must be in the centre of the atom. They called this area the **nucleus**



Nuclear model: The results from the alpha particle scattering experiment led to the conclusion that the mass of an atom was concentrated at the centre (nucleus) and that the nucleus was charged. This nuclear model replaced the plum pudding model.



Bohr model: Niels Bohr calculated that electrons were at fixed distances around the nucleus in **shells**



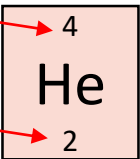
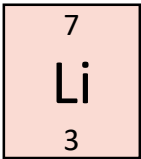
The neutron: James Chadwick discovered the neutron was in the nucleus in 1932



Box 4: Sub-atomic particles

	Relative charge	Relative mass	
Proton	+1	1	= atomic number
Neutron	0	1	= mass number – atomic number
Electron	-1	1/2000	= same as the number of protons

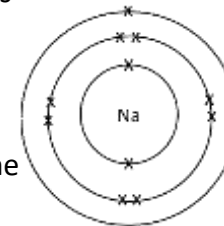
Atoms have no overall charge as they have equal number of protons and electrons.

Mass number		Protons <u> 2 </u>		Protons <u> 3 </u>
		Neutrons <u> 2 </u>		Neutrons <u> 4 </u>
Atomic number		Electrons <u> 2 </u>		Electrons <u> 3 </u>

Box 5: Drawing atoms and electronic structure

Electrons are in fixed shells around the nucleus

- Up to 2 electrons go in the 1st shell
- Up to 8 electrons go in the 2nd, 3rd and 4th shells



Electrons must fill up a shell before going to the next shell.

Electronic structure for sodium would be 2,8,1

Box 6: Size and mass of the atom

Atoms are very small, having a radius of about 0.1 nm (1×10^{-10} m)

The radius of a nucleus is less than 1/10 000 of that of the atom (about 1×10^{-14} m).

Almost all of the mass of an atom is in the nucleus

Box 7: Isotopes

Atoms with the same number of protons but a different number of neutrons is called an **isotope**. Isotopes have different mass numbers
The **relative atomic mass** is the average mass of all the atoms of an element. Abundance means the percentage of an atom with a certain mass

$$\text{Relative atomic mass} = \frac{(\text{abundance of isotope 1} \times \text{mass of isotope 1}) + (\text{abundance of isotope 2} \times \text{mass of isotope 2})}{100}$$

Box 8: Pathway

Previous knowledge: Particle model, Periodic Table

Future links: Bonding, structure and properties, nanotechnology

Careers: nanotechnologists, material scientists, researchers, engineers
electricians, radiologist

Box 9: Cross curricular links

Physics: atomic structure and nuclear physics

Maths: using standard form and converting units