

2nd edition

Edco

The background is a dark blue gradient. It features several faint, light blue icons: a computer monitor, a microscope, a rocket, a magnifying glass, a DNA helix, a telescope on a tripod, a planet with a ring, and a chemical flask. Two thick, wavy yellow lines curve across the page, one above and one below the main title.

Unit 3 Chemical World

Chapter 16 **Building blocks**

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What are atoms?

Atoms are the basic building blocks of all materials. The word 'atom' comes from a Greek word describing something that cannot be divided. When atoms were discovered, scientists thought of them as solid balls, like snooker balls, which could not be split into anything smaller.



Element

An **element** is a substance made up of only one type of atom.

If you burn a piece of wood, you will get a black solid. That solid is called carbon. Carbon is an element because it is made up of only carbon atoms and cannot be broken down into anything simpler.



Element

The periodic table shows a list of all the elements.

1 H Hydrogen																	2 He Helium		
3 Li Lithium	4 Be Beryllium													5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium													13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton		
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon		
55 Cs Cesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon		
87 Fr Francium	88 Ra Radium	89 Ac Actinium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Uut Ununtrium	114 Uuq Ununquadium	115 Uup Ununpentium	116 Uuh Ununhexium	117 Uus Ununseptium	118 Uuo Ununoctium		

* 58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
** 90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

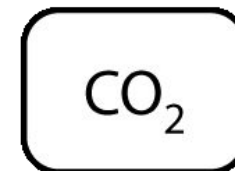
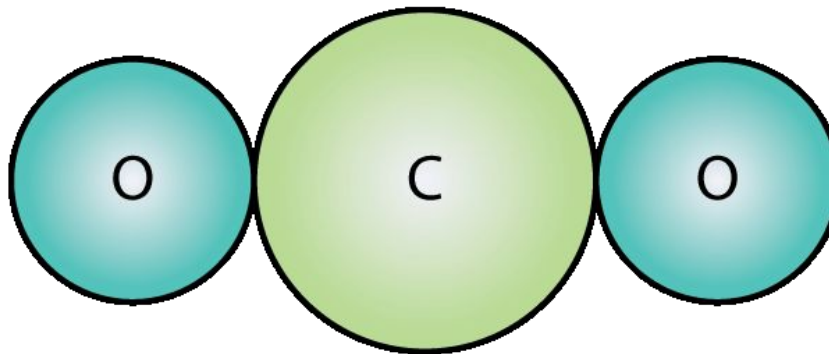
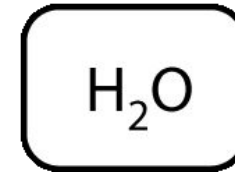
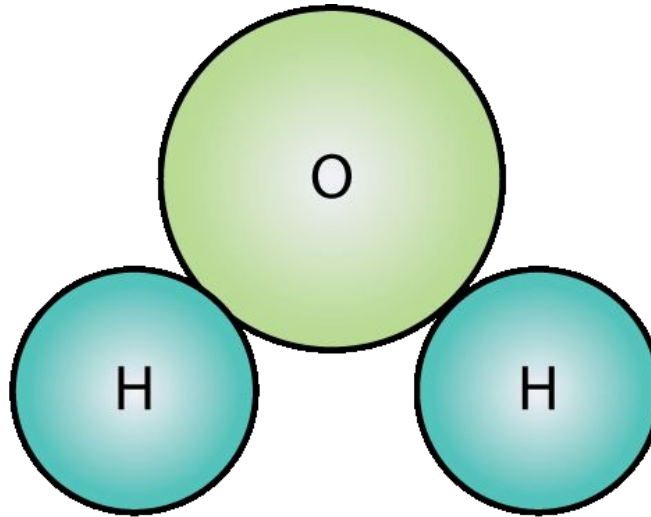
Symbol

Each element has a **symbol** (see some examples below). H is the symbol for hydrogen. Fe is the symbol for iron, which comes from the Latin name *ferrum*.

Element	Symbol
Oxygen	O
Carbon	C
Potassium	K
Nitrogen	N

Molecules

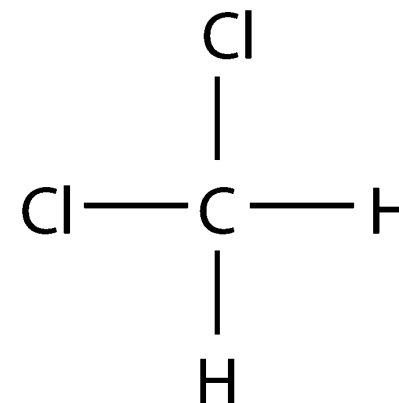
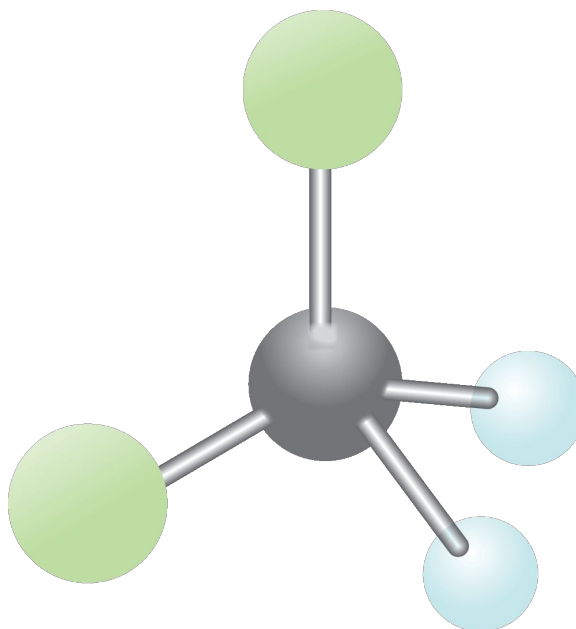
A **molecule** is formed when two or more atoms join (bond) together chemically.



Compounds

When a molecule is made up of two or more different types of elements **chemically combined**, we call it a **compound**. All compounds are molecules, but not all molecules are compounds.

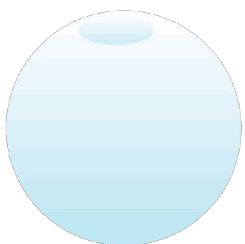
Hydrogen gas (H₂) and oxygen gas (O₂) are not compounds because each is composed of one element. Water (H₂O) and carbon dioxide (CO₂) are compounds because each is made up of more than one type of element. **All compounds are non-elements.**



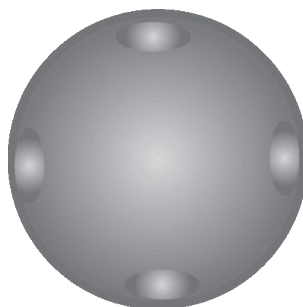
Dichloromethane

Making models

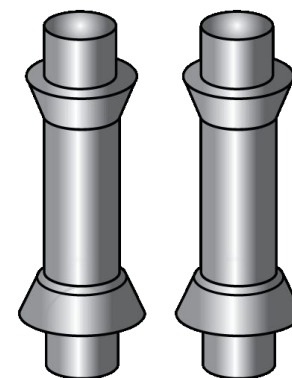
You can use models to show how atoms bond (join) to each other. Model kits have different coloured balls for each element and sticks to join one ball to another.



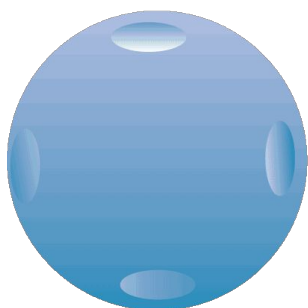
Hydrogen



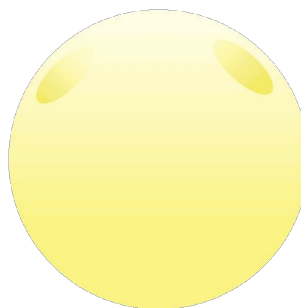
Carbon



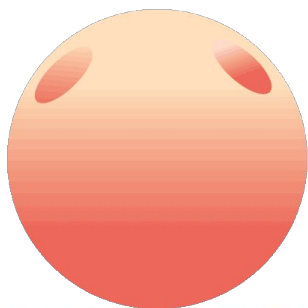
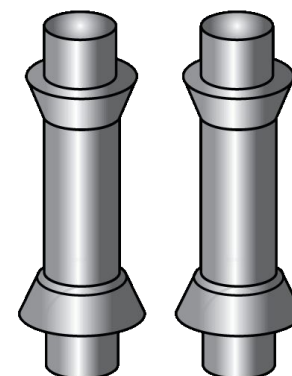
Bonds



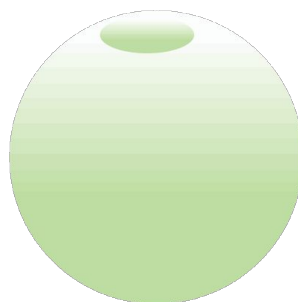
Nitrogen



Sulfur



Oxygen



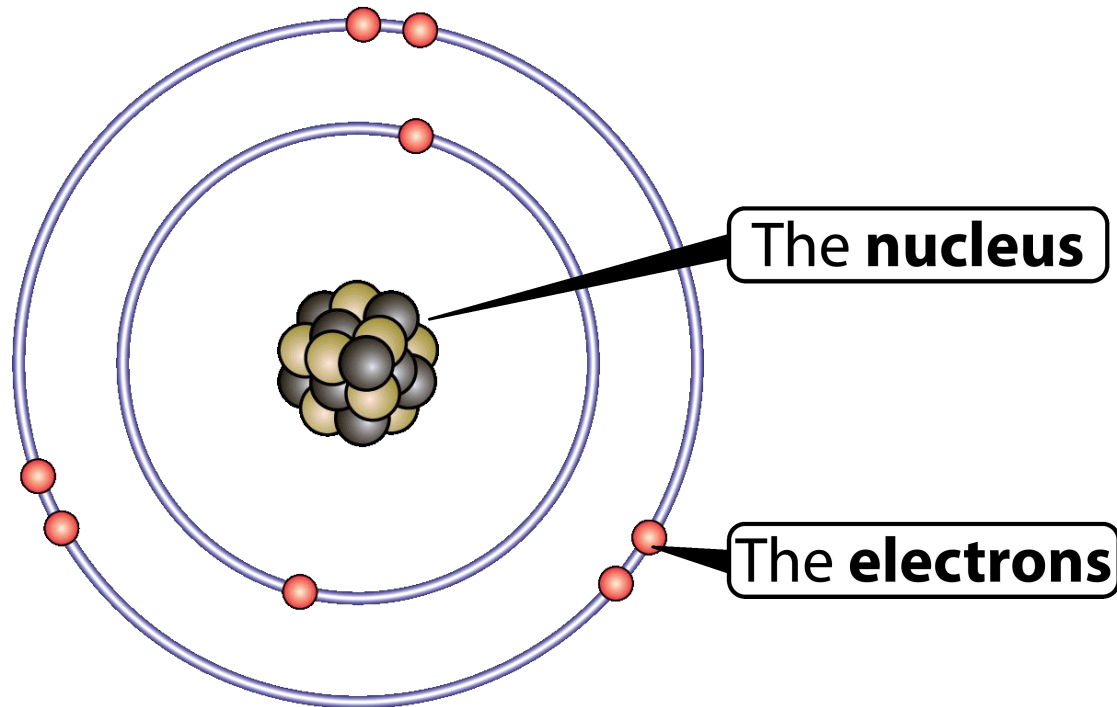
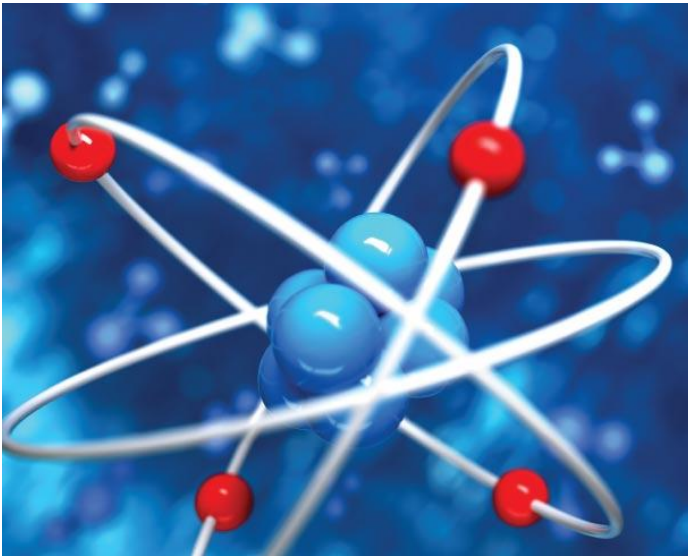
Chlorine

Structure of the atom

The atom is made up of smaller particles called sub-atomic particles. These are:

- Protons
- Neutrons
- Electrons.

The three particles in the atom are quite different from each other



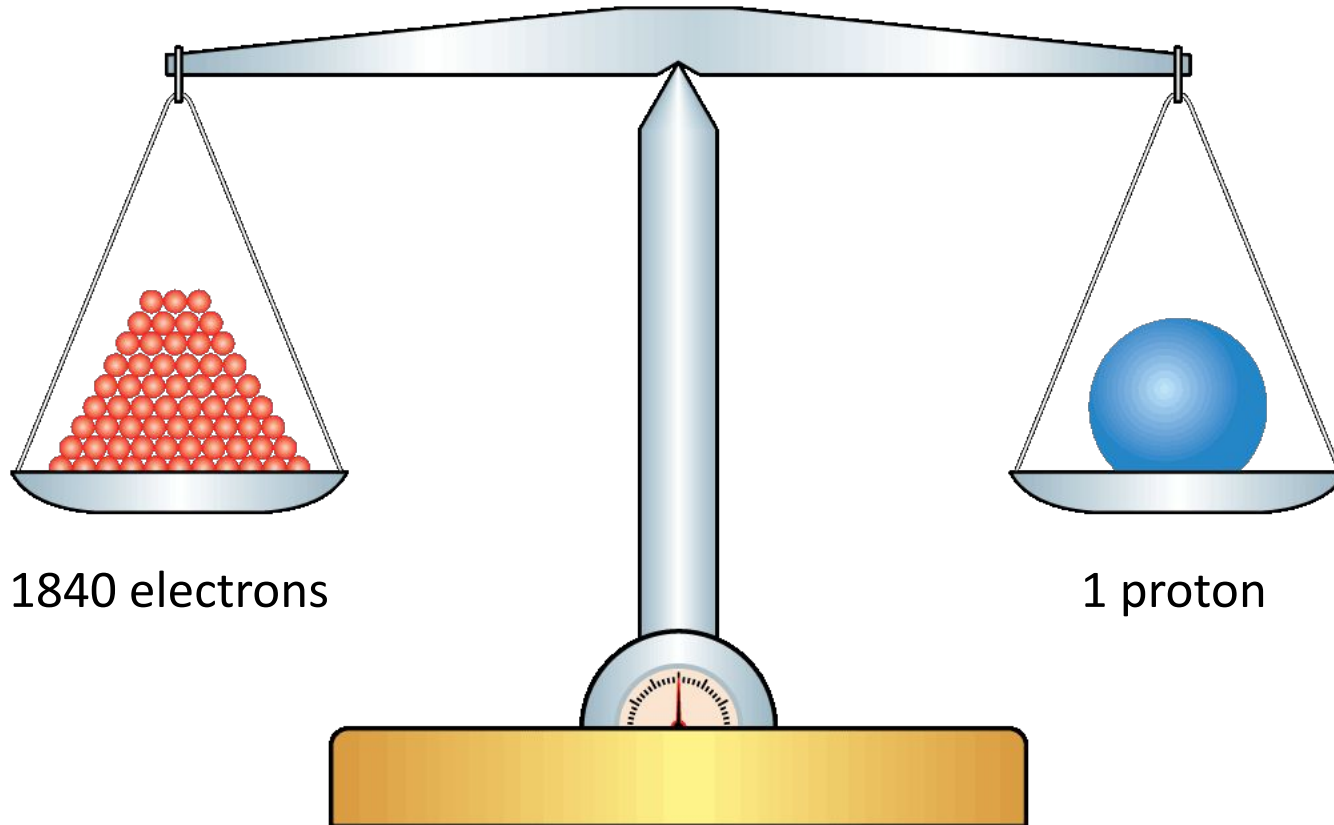
Structure of the atom

The properties of **protons**, **neutrons** and **electrons**

Particle	Charge	Mass	Location
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus
Electron	-1	Negligible	Shells

Structure of the atom

All the particles are extremely small. Electrons are so small it would take almost 2000 of them to have the same mass as a single proton or neutron.

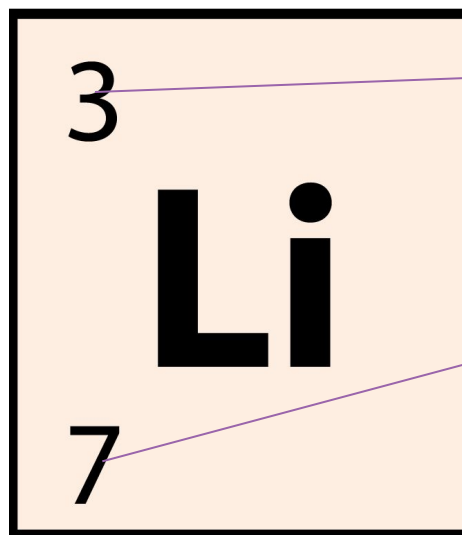
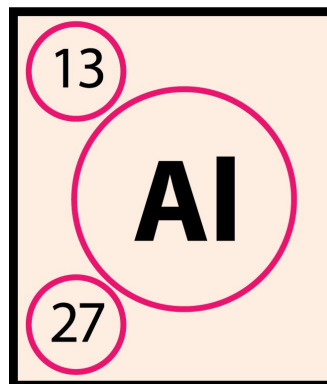


Atomic and mass numbers

Atoms of different elements differ from each other by the number of protons, neutrons and electrons they have.

Every element has its own atomic number. **The atomic number tells you how many protons (which is the same as the number of electrons) there are in one atom of the element.**

There is also the mass number. **The mass number tells you how many protons and neutrons there are in the atom.**



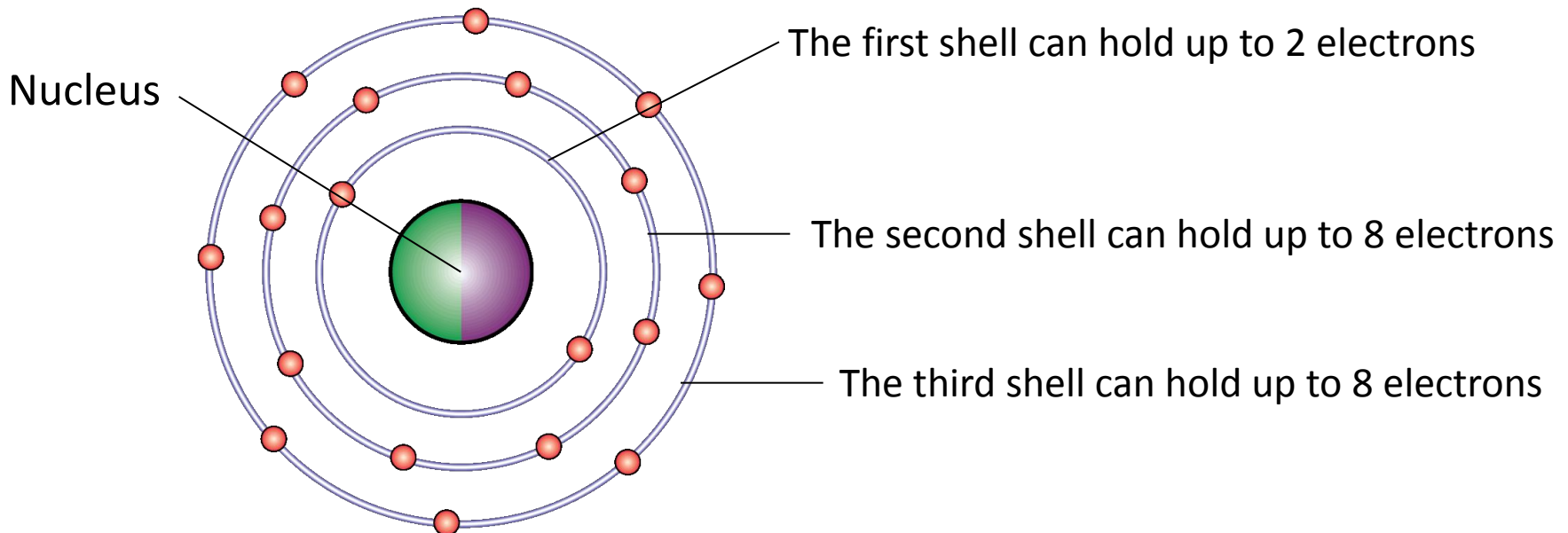
Atomic number
3 protons
3 electrons

Mass number
 $7 - 3 = 4$ neutrons

How electrons are arranged

Electrons whizz around the nucleus in energy levels called shells, or orbits. The first shell can hold only two electrons; the second and third shells can each hold up to eight electrons.

Electrons fill up the shells one by one, starting with the first shell. When a shell is full, they start a new one. All atoms would 'like' to have full electron shells, but in most atoms the outer shell is not full, and this makes the atom 'want' to react to fill it.



Bohr model

A Danish scientist called Niels Bohr was the first person to suggest the idea of electron shells containing electrons orbiting the nucleus. The way these electrons are arranged is called the electron configuration. The way they are explained is called the Bohr model.

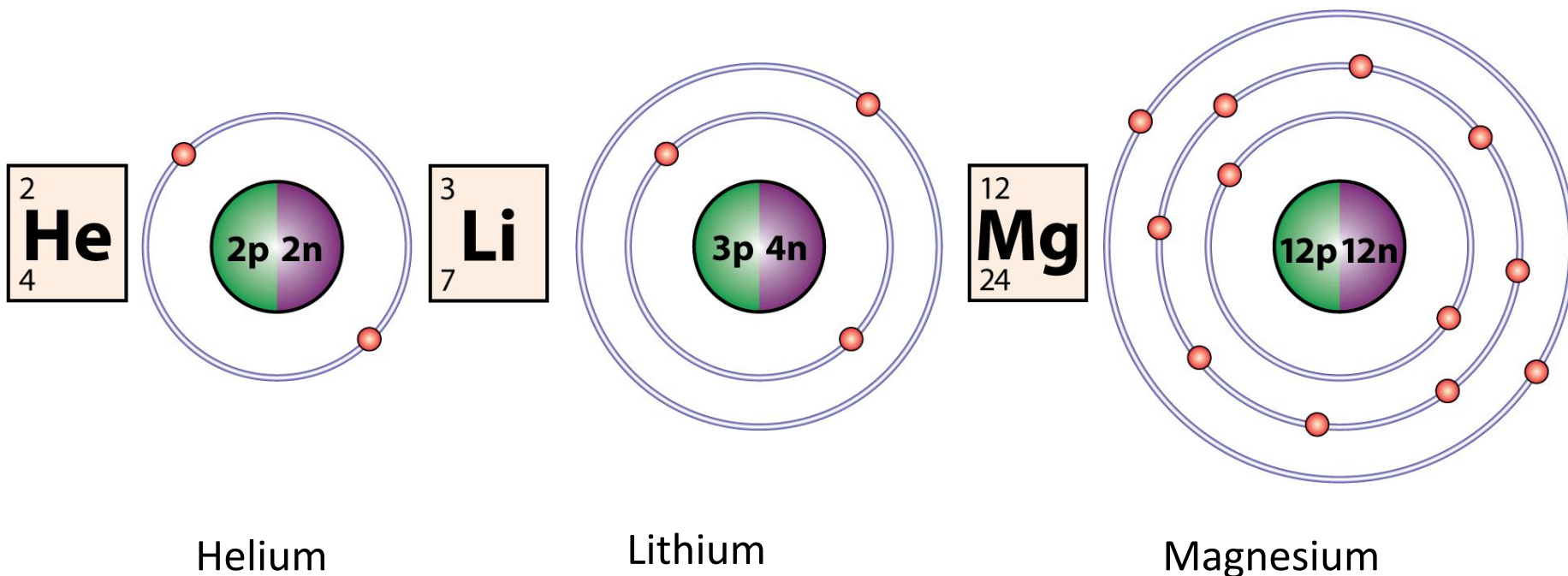


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