

Atoms & bonding

How do tiny particles make
salt, water and everyday materials?



First thought: what do you think holds atoms together?

Inside a sodium atom

Atomic number 11 Mass number 23

Particle	Where?	Charge	Number
Proton	Nucleus	+1	11
Neutron	Nucleus	0	$23 - 11 = 12$
Electron	Around nucleus	-1	11 (neutral)

Why does a neutral sodium atom have 11 electrons?

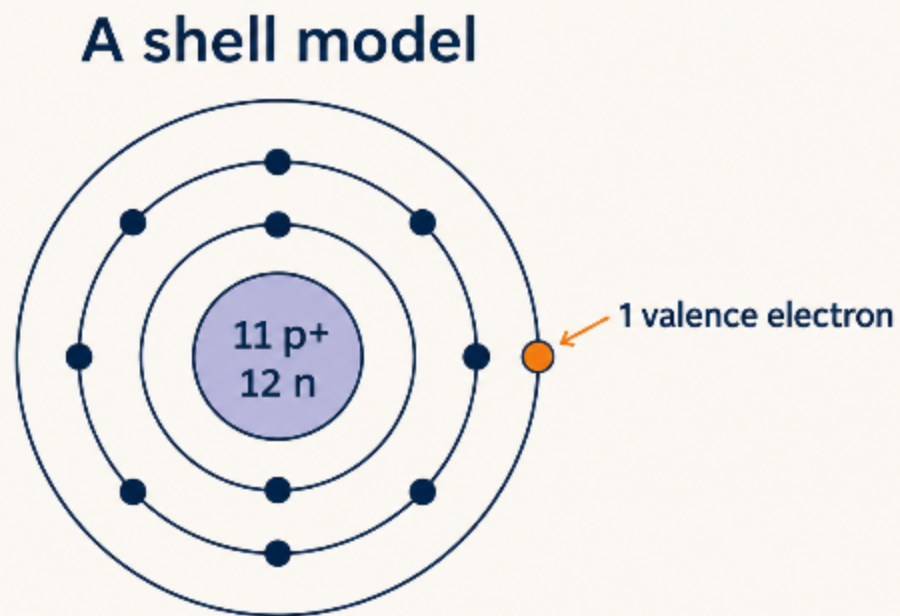
The outer electron matters

11 electrons

2 in the first shell

8 in the second

1 in the outer shell



Sodium: 2, 8, 1

Simplified model, not to scale

Point to sodium's valence electron.

Valence electrons and valency

Atom	Valence electrons	Usual valency here
Hydrogen	1	1
Oxygen	6	2
Sodium	1	1
Chlorine	7	1

Oxygen has 6 outer electrons. Why do we say its valency is 2?

Why bonds form

Attraction between electric charges can hold particles together.

A stable bonded arrangement has lower energy than the same atoms separated.

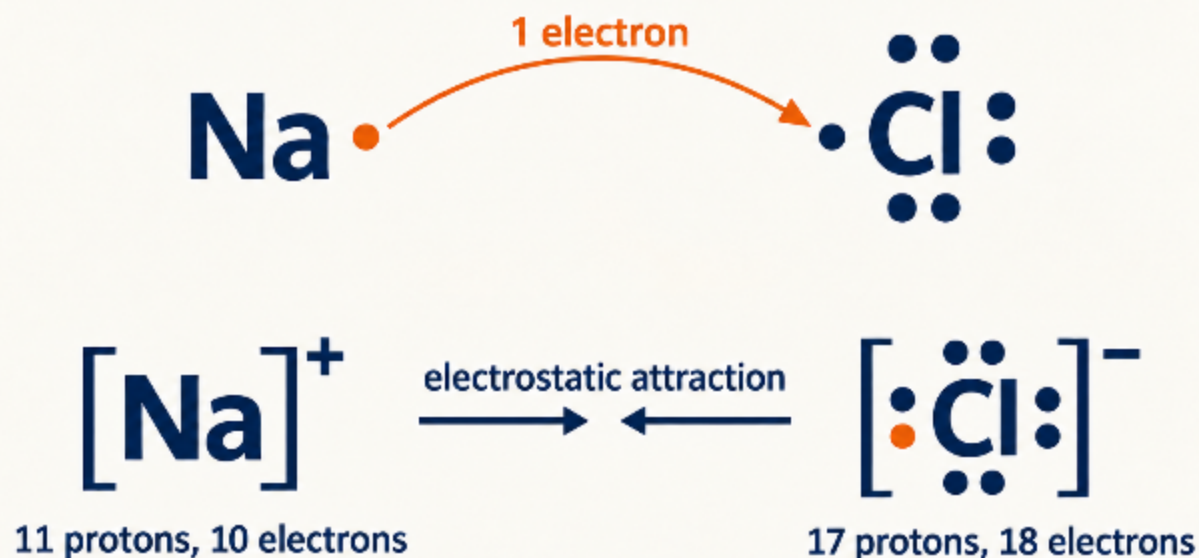
Full outer shells are a useful pattern, with exceptions.

Which particles carry positive and negative charge?

Ionic bonding

- 1 Transfer an electron
- 2 Form charged ions
- 3 Opposite charges attract

Electron transfer forms ions



Opposite charges attract

What is the bond: the transfer, or the attraction afterwards?

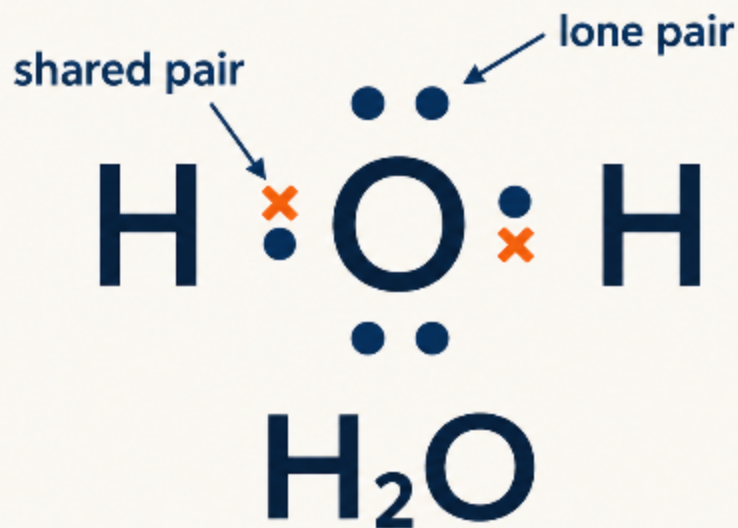
Covalent bonding

A shared electron pair holds two atoms together.

Water has two O–H bonds.

Each bond = 2 electrons

Water shares two pairs



● oxygen electron X hydrogen electron

Electron diagram only. A real water molecule is bent.

How many shared electron pairs are in H_2O ?

Sorting and naming the compounds

Formula	Name	Worksheet classification
KCl	Potassium chloride	Ionic
H ₂ O	Water	Covalent
NO ₂	Nitrogen dioxide	Covalent
FeCl ₃	Iron(III) chloride	Ionic
CaCl ₂	Calcium chloride	Ionic
CO	Carbon monoxide	Covalent

What does the III in iron(III) chloride tell you?

A formula must balance the charges



$$(+2) + (-1) + (-1) = 0$$



Your turn: what formula balances Mg^{2+} and Cl^- ?

Structure explains properties

Property	Ionic substance	Simple molecular substance
Particles	Ions in a lattice	Separate molecules
Melting point	Usually high	Often low
In water	Many dissolve	Varies with substance
Conductivity	When ions can move	Usually poor

The worksheet's covalent column is a simplified pattern.

Why can molten salt conduct, but solid salt cannot?

Properties explain uses

Battery electrolyte

Mobile ions carry charge through the electrolyte.

Wire coating

Insulating plastic has very few mobile charge carriers, so it resists electric current.

Finish: “Plastic suits wire coatings because...”

A fair flame test

Question	A useful answer
What changes?	The metal salt tested
What is observed?	The flame colour
What stays the same?	Sample amount and flame conditions
More valid?	Prevent contamination between samples
More reliable?	Repeat and check for consistent colours

Eye protection: splashes. Tied-back hair: ignition risk.

Does repeating a contaminated test make it valid?

An extended answer needs “because”

Sodium chloride: ions in a lattice

Paraffin wax: covalent molecules in a mixture

Compare	Salt	Wax
Melting	High melting point	Melts easily: moulding
Water	Dissolves: brine	Insoluble: water barrier
Electricity	Dissolved ions: electrolyte	Poor conductor: insulation

Explain a property, give its particle reason, then link a use.

Can you teach it back?

- 1 Count the particles in sodium-23.
- 2 Explain valence electrons and valency.
- 3 Say what holds an ionic compound together.
- 4 Count the shared pairs in water.
- 5 Explain the 2 in CaCl_2 .
- 6 Explain when salt can conduct electricity.

If you can explain it in your own words, try the worksheet.