

Using symbols and the periodic table

Grade 8 science (Year 9 · Class 8) · Lesson

Quick answer: An element is a pure substance made of only one kind of atom, written with a symbol such as Na or Fe. A compound joins different elements in a fixed ratio and has new properties. The periodic table orders elements by atomic number, with similar elements in the same group.

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What is an element?

Look at a gold ring, a copper wire and a balloon of helium. Each is made of only one type of atom. That makes it an element. About 118 elements are known; 90 or so occur naturally, and everything around you is built from different combinations of them.

Definition

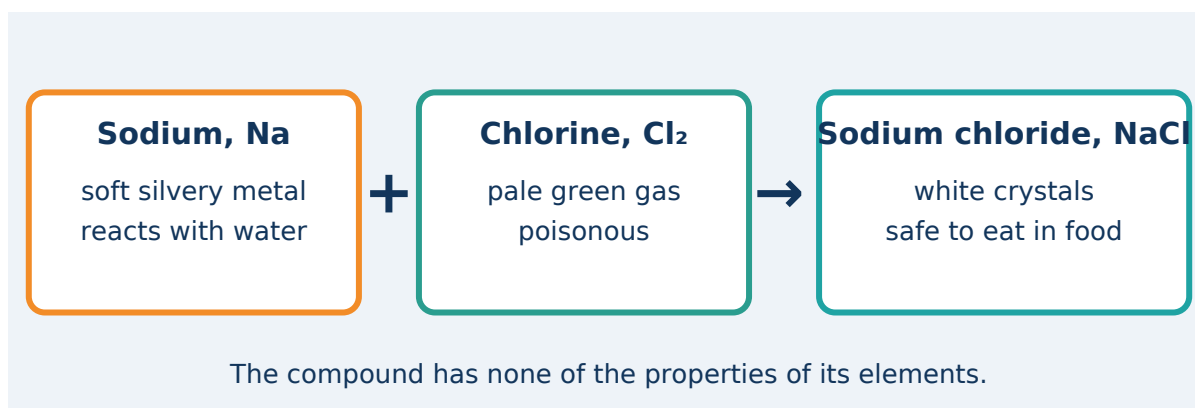
An **element** is a pure substance made of only one kind of atom. Each element has a chemical **symbol** of one or two letters; the first letter is a capital and the second, if there is one, is lowercase.

Many symbols come from English names (O for oxygen, C for carbon), but some come from older Latin names. That is why iron is Fe, from *ferrum*.

Element	Symbol	Origin of the symbol
Sodium	Na	Latin natrium
Potassium	K	Latin kalium
Iron	Fe	Latin ferrum
Copper	Cu	Latin cuprum
Silver	Ag	Latin argentum
Gold	Au	Latin aurum
Lead	Pb	Latin plumbum

What is a compound, and how is it different from a mixture?

A **compound** contains two or more different elements chemically joined in a fixed ratio. Its properties are completely different from those of the elements that made it. A **mixture** is only physically mixed, can have any proportions, and each substance keeps its own properties.



A compound has new properties. Table salt is nothing like the two elements it is made from.

Feature	Compound	Mixture
Joined by chemical bonds	Yes	No
Composition	Fixed ratio	Any proportions
Properties	New, different from the elements	Same as the parts
Separation	Needs a chemical reaction	Physical methods such as a magnet or filter

Worked example 1

Kwame in Kumasi sees a bottle of baking soda labelled NaHCO₃. Is it an element or a compound, and which elements does it contain?

The formula has four different symbols: Na, H, C and O.

It is a **compound of four elements**: sodium, hydrogen, carbon and oxygen.

How is the periodic table organised?

The **periodic table** arranges all the elements in order of increasing atomic number. The **atomic number** is the number of protons in the nucleus of each atom. Rows are called **periods** and columns are called **groups**. Elements in the same group have similar chemical properties.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr

metal
 metalloid
 non-metal
 noble gas

The first four periods. Rows are periods (1 to 4); columns are groups (1 to 18). Transition metals sit in groups 3 to 12.

The diagram shows a single element box for Iron (Fe) from the periodic table. The box is orange and contains the following information: the atomic number '26' in the top left, the symbol 'Fe' in the center, the name 'iron' below the symbol, and the average atomic mass '55.8' at the bottom. Four colored lines point from text labels to specific parts of the box: an orange line from 'atomic number = 26 (protons in the nucleus)' to the number 26; a teal line from 'symbol Fe (from Latin ferrum)' to the symbol Fe; a purple line from 'name of the element' to the word iron; and a red line from 'average atomic mass (about 55.8)' to the number 55.8.

How to read one box of the periodic table (the example is iron).

Key rule

Same group = similar properties. Group 1 holds the alkali metals (soft and very reactive), group 17 the halogens (reactive non-metals) and group 18 the noble gases (almost completely unreactive).

Worked example 2

Sofia in Madrid wants to locate chlorine, Cl. Where is it in the table and what can she predict?

It is in the third row, so **period 3**, and in the column numbered 17, so **group 17** (the halogens). Because fluorine and bromine are in the same group, chlorine is a reactive non-metal.

How do metals and non-metals differ?

Most elements are metals and they lie on the left and middle of the table. Non-metals are on the right, and a staircase line separates them. Elements next to the line, such as silicon, are **metalloids** with in-between properties.

Property	Metals	Non-metals
Appearance	Shiny when polished	Dull (solids)
Conduct electricity	Yes, well	Poorly (graphite is an exception)
Strength	Malleable and ductile	Brittle if solid
State at room temperature	Nearly all solid (mercury is liquid)	Solid, liquid or gas

Common mistake

Hydrogen sits at the top of group 1, but it is a non-metal gas, not an alkali metal. Never decide metal or non-metal from the group number alone; check the colour code of the table.

Lina's tip

To find an element quickly, locate its period first (the row) and then count along to its group. Say the pair "period 3, group 17" out loud and it sticks.

Key points to remember

- An element has one kind of atom; a compound has two or more elements chemically joined in a fixed ratio.
- Symbols have a capital first letter and a lowercase second letter (Co is an element, CO is a compound).
- The periodic table is arranged by atomic number; rows are periods and columns are groups.
- Elements in the same group have similar properties (group 1 alkali metals, group 17 halogens, group 18 noble gases).
- Metals are shiny and conduct well; non-metals are mostly dull and poor conductors.

Using symbols and the periodic table: frequently asked questions

How is an element different from a compound?

An element contains only one kind of atom, such as copper or oxygen. A compound is made of two or more elements chemically joined, such as sodium chloride, and its properties are new.

Why do some symbols not match the English name?

They come from Latin names. Iron is Fe from ferrum, gold is Au from aurum and sodium is Na from natrium. Scientists worldwide use the same symbols, so everyone understands them.

What is the difference between a group and a period?

A group is a vertical column and a period is a horizontal row. Elements in one group have similar chemical properties, while a period shows a gradual change from metals to non-metals.

What does the atomic number tell you?

It is the number of protons in the nucleus of one atom of the element, and it fixes the element's place in the table. Carbon is 6, so it comes before nitrogen, 7.

Where are metals and non-metals in the periodic table?

Metals fill the left and centre of the table, and non-metals are on the right. A staircase line separates the two, and metalloids such as silicon lie next to it.