

Matter, Elements & Chemical Formulas

NCEA Year 9 Physical Science: An Introduction to the Universal
Building Blocks

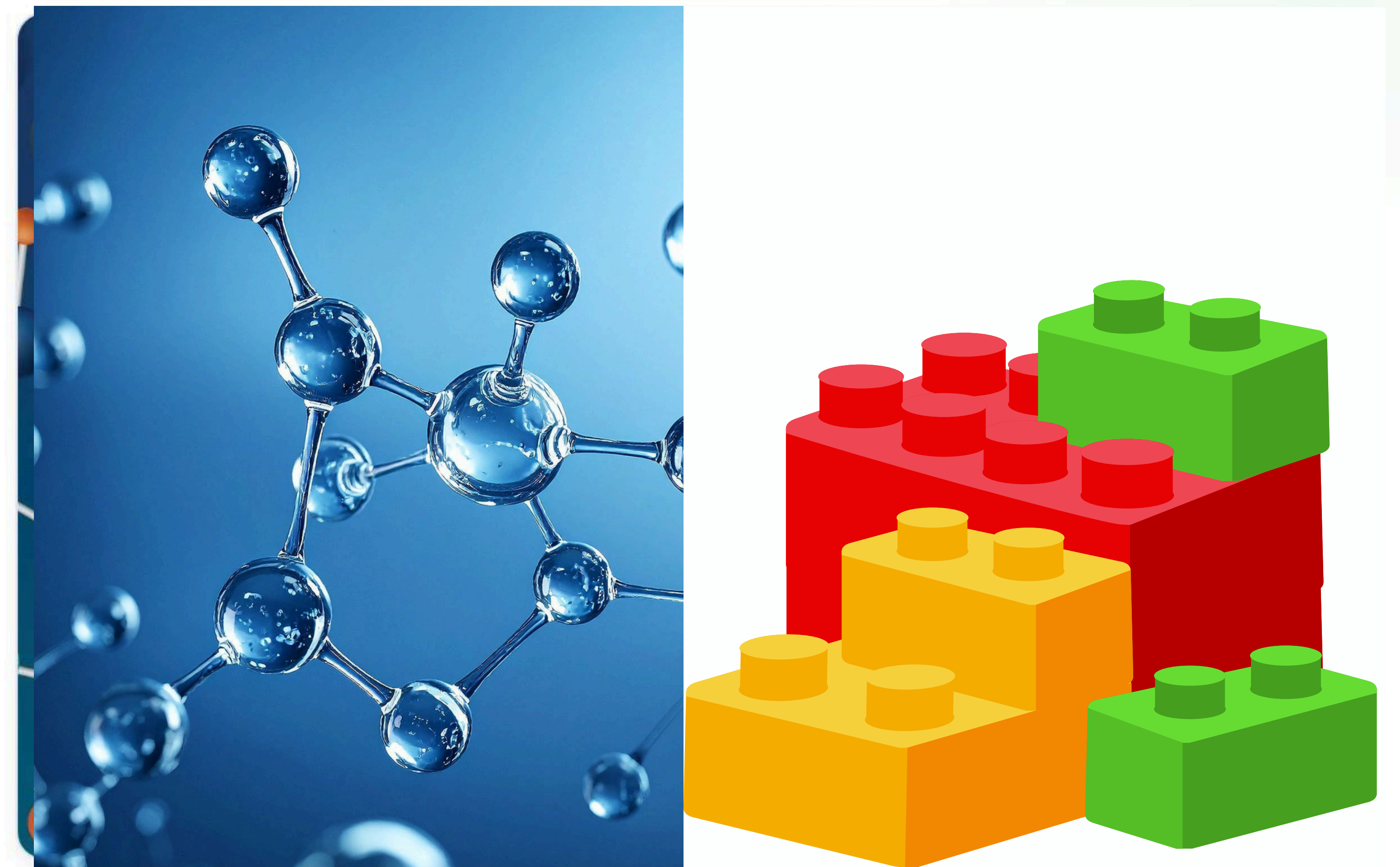
What is Matter?

The Universal Building Blocks

Everything you see, touch, and breathe is matter. At its fundamental level, matter is composed of **atoms**.

Think of elements like **Lego bricks**. With just a few types of bricks, you can build infinite structures—from a simple car to a massive castle.

"The universe builds everything out of these elements."



Categorizing Matter



Pure Substances

Consists of only one type of particle. This includes **Elements** (like pure gold) or **Compounds** (like pure water molecules).



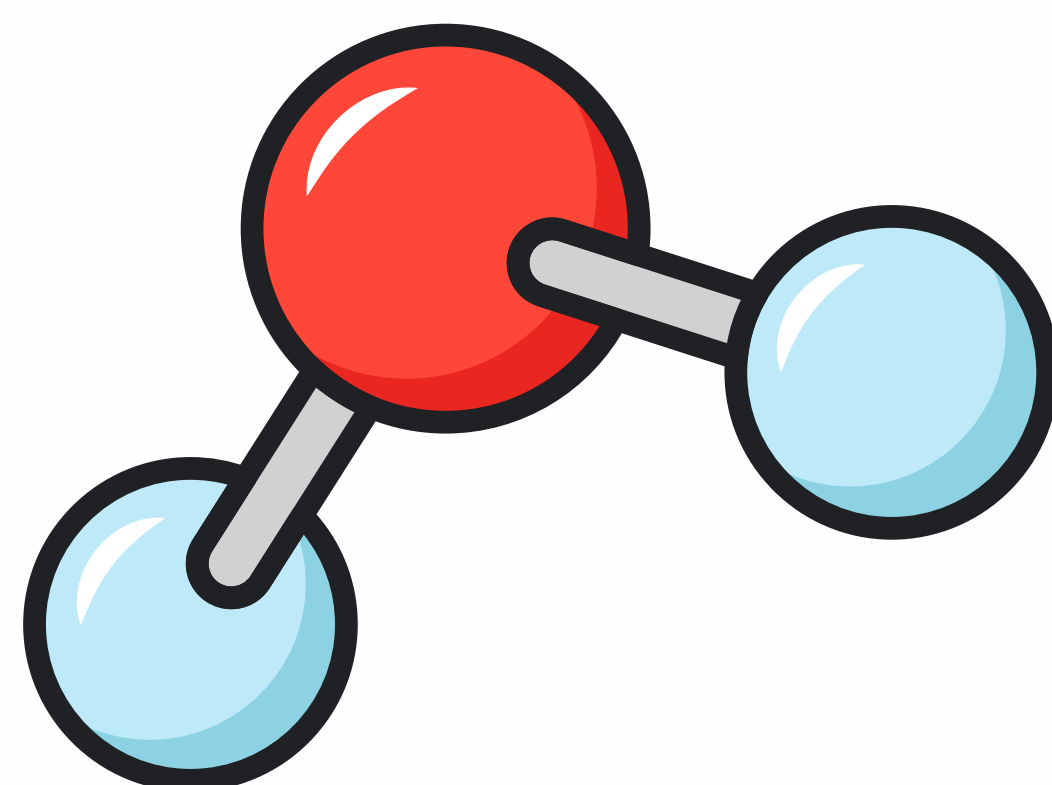
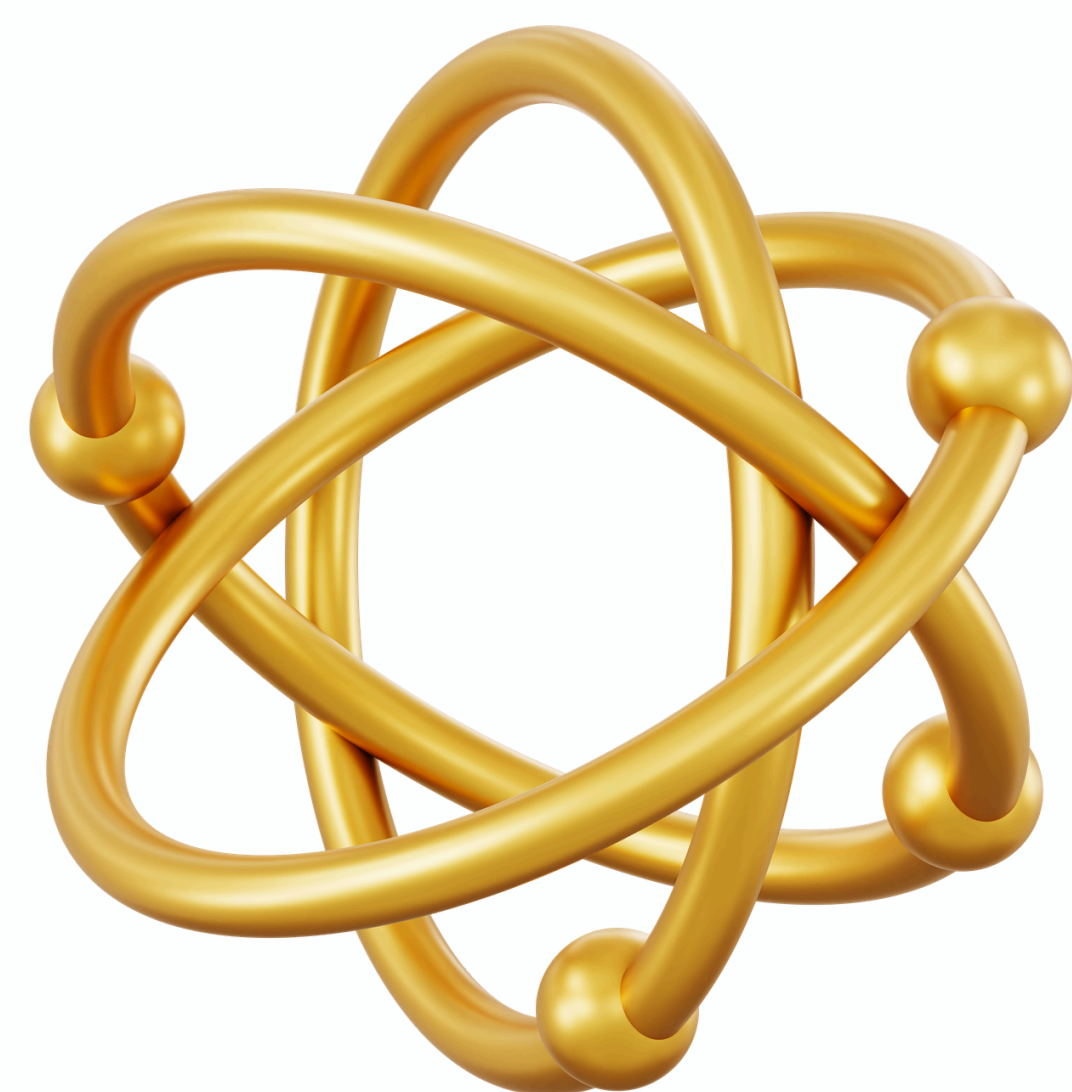
Mixtures

Contains more than one type of substance physically combined. Think of **Salt Water**—it's a mix of salt and water, not a new chemical.



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The Master Guide

Patterns in Properties

The Periodic Table is a highly organized map. Elements are arranged based on their physical and chemical behaviors.

Vertical Groups: Elements in the same column are like family members—they behave similarly in chemical reactions.

A decorative abstract shape in the bottom left corner, composed of overlapping translucent polygons in shades of light blue, green, and yellow.

The Periodic Table of the Elements

	1 IA 11A												13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1	1.00794 H Hydrogen 1312.0 2.20	1 IIA 2A																4.002602 He Helium 2372.3
2	6.941 Li Lithium 520.2 0.98	9.012182 Be Beryllium 899.5 1.57											10.811 B Boron 800.6 2.04	12.0107 C Carbon 1086.5 2.55	14.0067 N Nitrogen 1402.3 3.04	15.9994 O Oxygen 1313.9 3.44	18.998403 F Fluorine 1681 3.98	20.1797 Ne Neon 2080.7
3	22.98976 Na Sodium 495.8 0.93	24.3050 Mg Magnesium 737.7 1.31	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 8	10 VIII 8	11 IB 1B	12 IIB 2B	26.98153 Al Aluminium 577.5 1.61	28.0855 Si Silicon 786.5 1.90	30.97696 P Phosphorus 1011.8 2.19	32.065 S Sulfur 999.6 2.58	35.453 Cl Chlorine 1251.2 3.16	39.948 Ar Argon 1520.6
4	39.0983 K Potassium 418.8 0.82	40.078 Ca Calcium 589.8 1.00	44.95591 Sc Scandium 633.1 1.36	47.867 Ti Titanium 658.8 1.54	50.9415 V Vanadium 650.9 1.63	51.9962 Cr Chromium 652.9 1.66	54.93804 Mn Manganese 717.3 1.55	55.845 Fe Iron 762.5 1.83	58.93319 Co Cobalt 700.4 1.91	58.6934 Ni Nickel 737.1 1.88	63.546 Cu Copper 745.5 1.90	65.38 Zn Zinc 906.4 1.65	69.723 Ga Gallium 578.8 1.81	72.64 Ge Germanium 762 2.01	74.92160 As Arsenic 947 2.18	78.96 Se Selenium 941 2.55	79.904 Br Bromine 1139.9 2.96	83.798 Kr Krypton 1350.8
5	85.4678 Rb Rubidium 403 0.82	87.62 Sr Strontium 549.5 0.95	88.90585 Y Yttrium 600 1.22	91.224 Zr Zirconium 640.1 1.33	92.90638 Nb Niobium 652.1 1.60	95.96 Mo Molybdenum 684.3 2.16	(98) Tc Technetium 702 1.90	101.07 Ru Ruthenium 710.2 2.20	102.9055 Rh Rhodium 719.7 2.28	106.42 Pd Palladium 804.4 2.20	107.8682 Ag Silver 731 1.93	112.441 Cd Cadmium 867.8 1.69	114.818 In Indium 558.3 1.78	118.710 Sn Tin 708.6 1.96	121.760 Sb Antimony 834 2.05	127.60 Te Tellurium 869.3 2.10	126.9044 I Iodine 1008.4 2.66	131.293 Xe Xenon 1170.4 2.60
6	132.9054 Cs Caesium 375.7 0.79	137.327 Ba Barium 502.9 0.89	174.9668 Lu Lutetium 523.5 1.27	178.49 Hf Hafnium 658.5 1.30	180.9478 Ta Tantalum 761 1.50	183.84 W Tungsten 770 2.36	186.207 Re Rhenium 700 1.90	190.23 Os Osmium 840.0 2.20	192.217 Ir Iridium 880 2.20	195.084 Pt Platinum 870 2.28	196.9665 Au Gold 890.1 2.54	200.59 Hg Mercury 1007.1 2.00	204.3833 Tl Thallium 589.4 1.62	207.2 Pb Lead 715.6 2.33	208.9804 Bi Bismuth 703 2.02	(210) Po Polonium 812.1 2.00	(210) At Astatine 890 2.20	(220) Rn Radon 1037
7	(223) Fr Francium 380.0 0.7	(226) Ra Radium 509.3 0.90	(262) Lr Lawrencium 470	(261) Rf Rutherfordium 580	(262) Db Dubnium	(266) Sg Seaborgium	(264) Bh Bohrium	(277) Hs Hassium	(268) Mt Meitnerium	(271) Ds Darmstadtium	(272) Rg Roentgenium	(285) Cn Copernicium	(284) Uut Ununtrium	(289) Fl Flerovium	(228) Uup Ununpentium	(292) Lv Livermorium	117 Uus Ununseptium	(294) Uuo Ununoctium

Atomic mass

1.00794

1

Atomic number

Chemical symbol

H

Name

Hydrogen

1312.0

2.20

Electronegativity

First ionization energy

138.9054 La Lanthanum 538.1 1.10	140.116 Ce Cerium 534.4 1.12	140.9076 Pr Praseodymium 527 1.13	144.242 Nd Neodymium 533.1 1.14	(145) Pm Promethium 540	150.36 Sm Samarium 544.5 1.17	151.964 Eu Europium 547.1	157.25 Gd Gadolinium 593.4 1.20	158.9253 Tb Terbium 565.8	162.500 Dy Dysprosium 573 1.22	164.9303 Ho Holmium 581 1.23	167.259 Er Erbium 589.3 1.24	168.9342 Tm Thulium 596.7 1.25	173.054 Yb Ytterbium 603.4
(227) Ac Actinium 499 1.10	232.0380 Th Thorium 587 1.30	231.0358 Pa Protactinium 508 1.50	238.0289 U Uranium 597.6 1.38	(237) Np Neptunium 604.5 1.36	(244) Pu Plutonium 584.7 1.28	(243) Am Americium 578 1.30	(247) Cm Curium 581 1.30	(247) Bk Berkelium 601 1.30	(251) Cf Californium 608 1.30	(252) Es Einsteinium 619 1.30	(257) Fm Fermium 627 1.30	(258) Md Mendelevium 635 1.30	(259) No Nobelium 642 1.30

Alkali metals

Alkaline metals

Other metals

Transition metals

Lanthanoids

Actinoids

Metalloids

Nonmetals

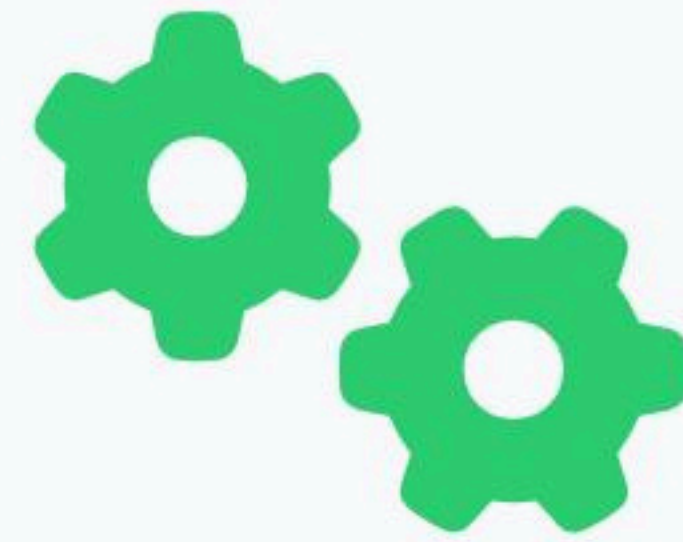
Halogens

Noble gases

Scientific Shorthand

Element Name	Atomic Symbol	Key Application
Carbon	C	Basis of all life on Earth
Oxygen	O	Essential for respiration
Sodium	Na	Highly reactive metal; in table salt
Gold	Au	Valuable, non-reactive metal

By the end of the year, you'll match symbols to names automatically!



Metals vs. Non-Metals

Territories of the Periodic Table and their Physical Properties

Location Predicts Behavior



The Left Side: Metals

Metals occupy the vast majority of the table's left and center regions.

Common Examples: Iron, Copper, Aluminum, Silver.



The Right Side: Non-Metals

Non-metals are found tucked away on the far right-hand side.

Common Examples: Helium, Nitrogen, Sulfur, Carbon.

Predicting Metal Properties



Malleable & Conductive

-  **Malleable:** Can be hammered into shapes or bent without shattering.
-  **Conductive:** Excellent at letting heat and electricity flow through them.
-  **Utility:** This is why we use copper for wiring and aluminum for foil.

Non-Metal Characteristics



-  **Brittle Structure:** Unlike metals, if you hit a solid non-metal with a hammer, it will shatter into pieces rather than bend.
-  **Insulators:** They do not let heat or electricity flow easily. This makes them perfect for handles on cooking pots or coating on wires.
-  **Physical State:** Many non-metals are gases at room temperature (like the Oxygen and Nitrogen in our air).

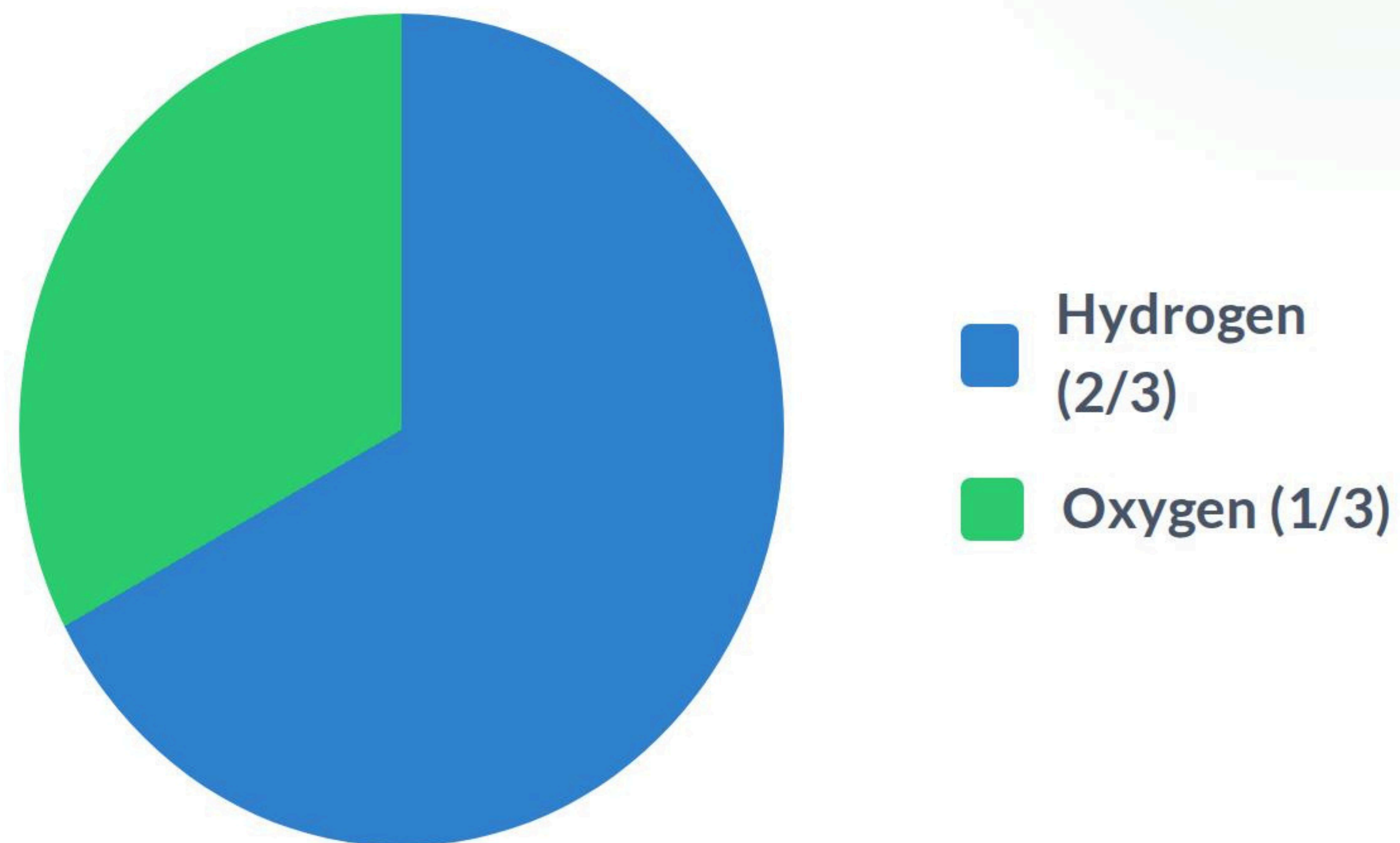
Decoding Formulas

Understanding Proportions

A chemical formula shows the exact "recipe" for a compound. The **subscript** (little number) tells you the count of atoms.



In Water (H_2O), there are **2 Hydrogen** atoms and **1 Oxygen** atom. Total = 3 atoms.



The most common mistake students make is freezing up when there is no subscript number. Use these to teach the rule: "If there is no number, there is a hidden 1."

Table Salt (Sodium Chloride) – NaCl

Elements: Sodium (Na) and Chlorine (Cl)

Decoding: No numbers are present, meaning there is 1 Sodium atom and 1 Chlorine atom.

Total Atoms: 2

Ammonia (Cleaning Product) – NH₃

Elements: Nitrogen (N) and Hydrogen (H)

Decoding: 1 Nitrogen atom and 3 Hydrogen atoms.

Total Atoms: 4

Carbon Monoxide – CO

Elements: Carbon (C) and Oxygen (O)

Decoding: 1 Carbon atom and 1 Oxygen atom. (Great time to remind them that a capital letter means a new element!)

Total Atoms: 2

Carbon Dioxide – CO₂

Elements: Carbon (C) and Oxygen (O)

Decoding: The invisible '1' means 1 Carbon atom. The '2' is attached to the Oxygen, meaning 2 Oxygen atoms.

Total Atoms: 3

Methane (Natural Gas) — CH₄

Elements: Carbon (C) and Hydrogen (H)

Decoding: 1 Carbon atom and 4 Hydrogen atoms.

Total Atoms: 5

Baking Soda (Sodium Bicarbonate) — NaHCO₃

Elements: Sodium (Na), Hydrogen (H), Carbon (C), and Oxygen (O)

Decoding: 1 Sodium, 1 Hydrogen, 1 Carbon, and 3 Oxygen atoms.

Total Atoms: 6

Sulfuric Acid — H₂SO₄

Elements: Hydrogen (H), Sulfur (S), and Oxygen (O)

Decoding: 2 Hydrogen atoms, 1 Sulfur atom, and 4 Oxygen atoms.

Total Atoms: 7

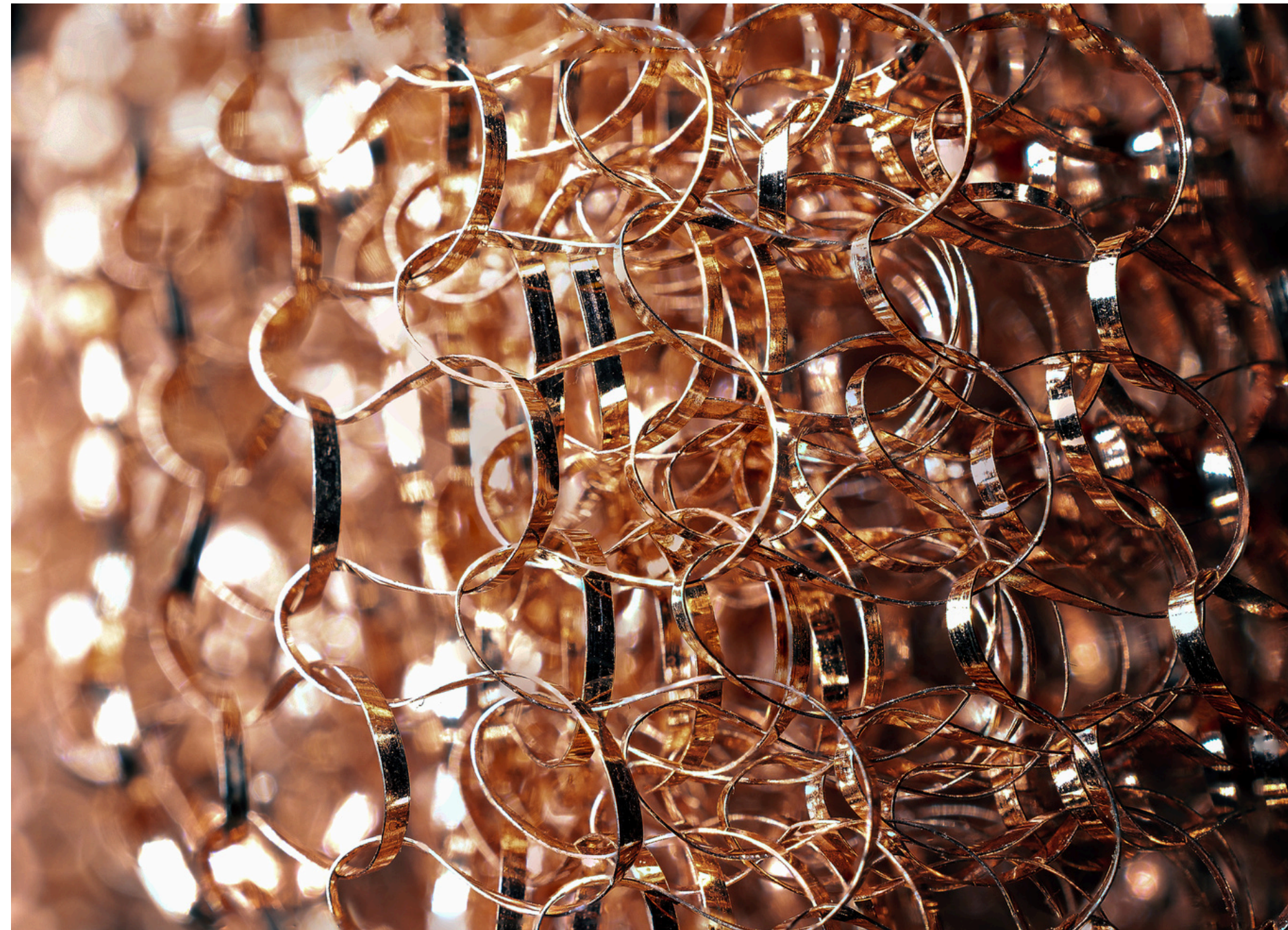
Glucose (Sugar) — C₆H_{12}O₆

Elements: Carbon (C), Hydrogen (H), and Oxygen (O)

Decoding: 6 Carbon atoms, 12 Hydrogen atoms, and 6 Oxygen atoms.

Total Atoms: 24

Supermarket Scientist



Application at Home

Read the labels on your toothpaste or cereal box this week. Look for:

- 🔍 Sodium (Na)
- 🔍 Fluoride (F)
- 🔍 Iron (Fe)

Why are wires made of copper? Why are pots made of metal but their handles of plastic (non-metal)?

Nutrition Facts	
Serving Size 2 pieces (3g)	Amount/Serving % DV
Servings 6	Total Fat 0g 0%
Calories 5	Sodium 0mg 0%
	Total Carb. 2g 1%
	Sugars 0g
	Sugar Alcohol 2g
	Protein 0g
Percent Daily Values (DV) are based on a 2,000 calorie diet.	
Not a significant source of other nutrients.	

Calories / Calories	Total Fat / Lipides
Saturated / saturés	+ Trans / trans 0 g
Polyunsaturated / polyinsaturés	Omega-6 / oméga-6 2 g
Omega-3 / oméga-3 0.6 g	Monounsaturated / monoinsaturés
Cholesterol / Cholestérol 0 mg	Sodium / Sodium 70 mg
Total Carbohydrate / Glucides	Sugars / Sucres 1 g
Fiber / Fibre 1 g	Protein / Protéine 1 g

Questions & Application

Your Mission:

Find **10 metal objects** at home. Explain why that metal is the perfect building block for its job.

NCEA Year 9 Science | Module 1: Introduction to Matter