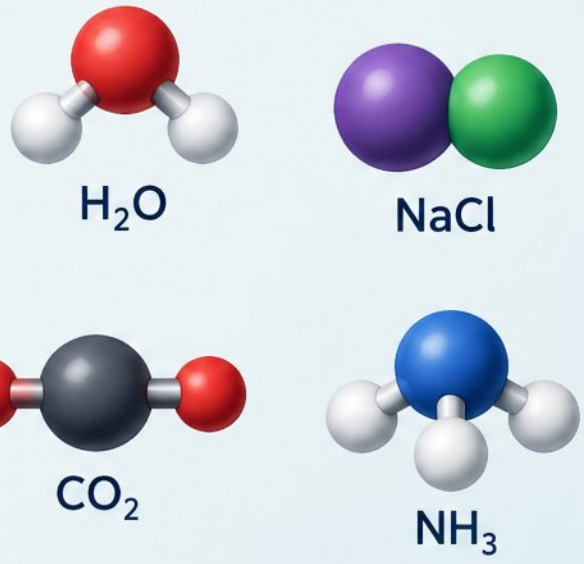
Chemical Formulas and Naming Compounds

- Clear names and formulas prevent dangerous mix-ups in labs and safety documents
- Roadmap: symbols and ions → formulas → ionic, molecular, acid naming → reverse practice → assessment
- Everyday anchors: water (H_2O), table salt (NaCl), carbon dioxide (CO_2), ammonia (NH_3)
- Covers inorganic and simple organic naming; excludes coordination and polymer nomenclature
- Goals for beginners, adult learners, and teachers; IUPAC rules guide the naming throughout

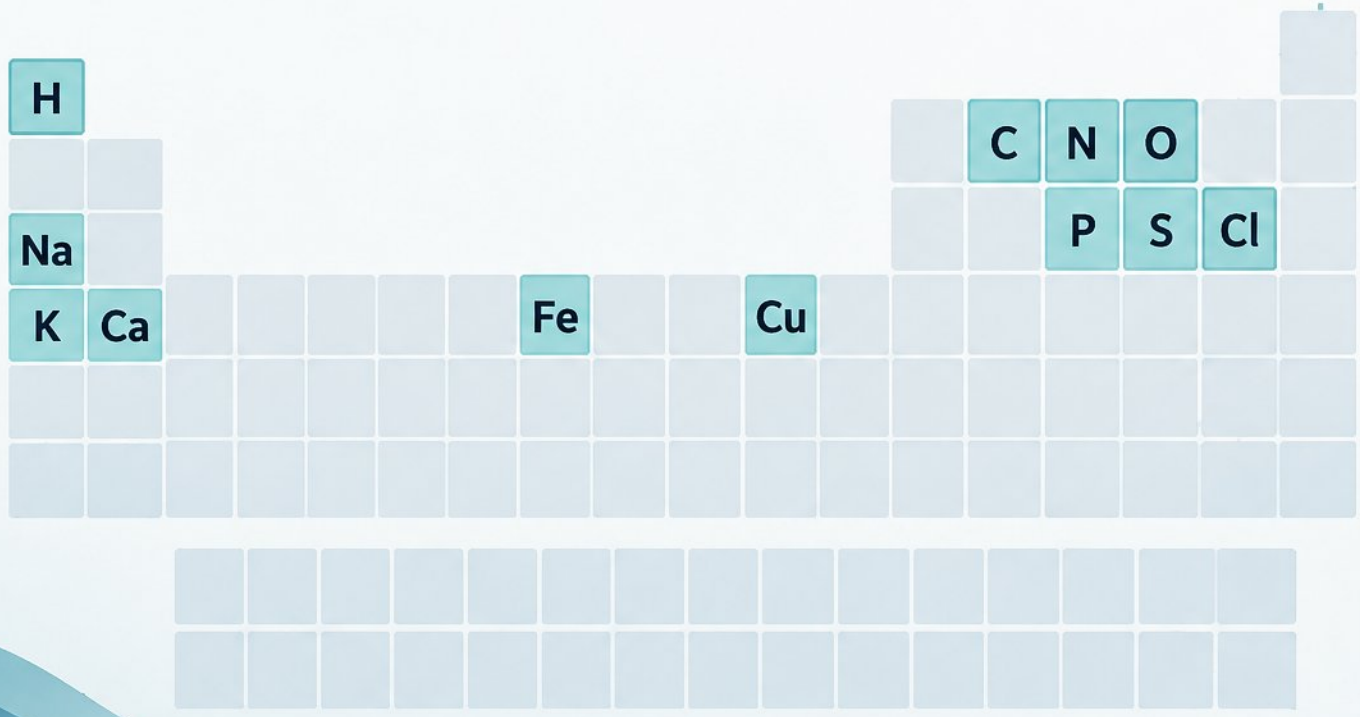




Elements, Symbols, and the Periodic Table

- **Symbols:** one or two letters; first capitalized, second lowercase (Co vs CO)
- **Periodic table:** groups are columns, periods are rows
- **Know these symbols:** H, C, N, O, Na, Cl, K, Ca, Fe, Cu, S, P
- **Some symbols come from Latin:** Na (*natrium*), Fe (*ferrum*), K (*kalium*)
- **Formula grammar:** subscripts, charges, parentheses, hydrate dots
- **Misconception:** Co (cobalt) is not CO (carbon monoxide)

Small symbols. Big meaning.

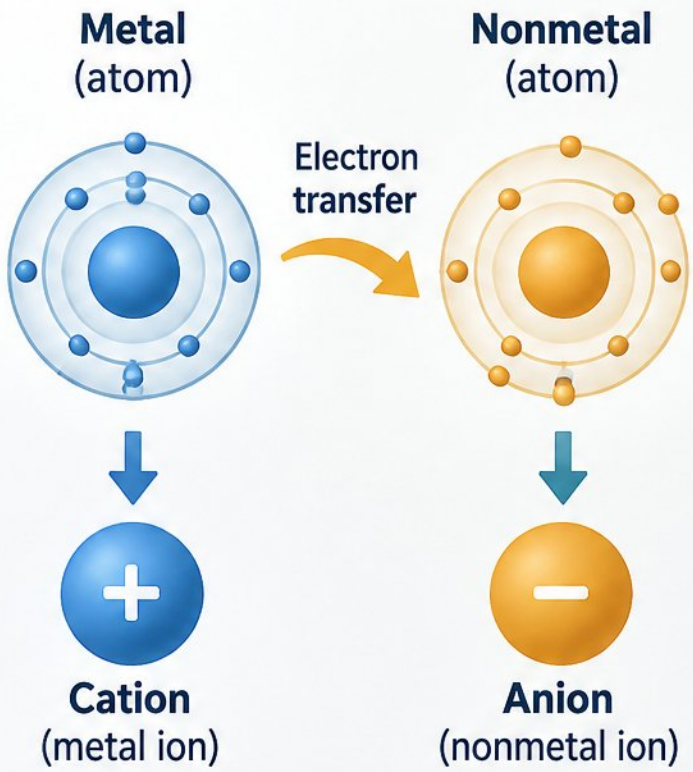


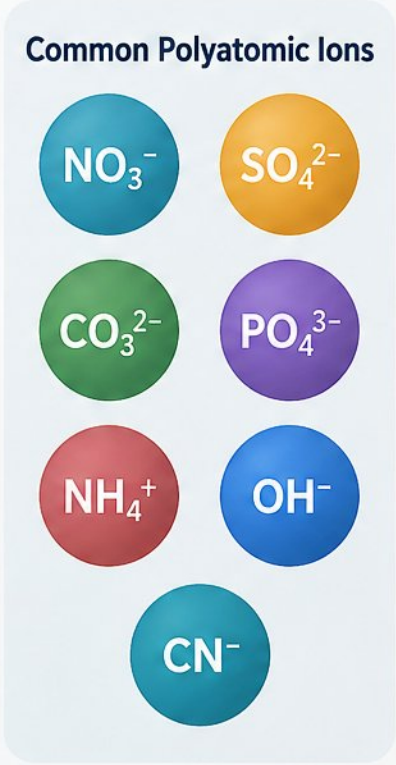
Latin Origins

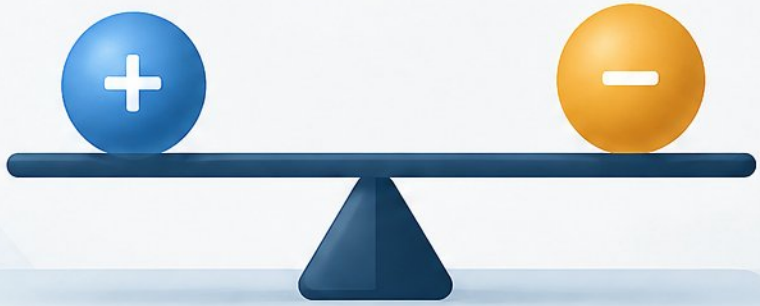
Na	Na (natrium)
Fe	Fe (ferrum)
K	K (kalium)

Ions and Charges: The Building Blocks of Ionic Formulas

- **Monatomic ions:** metals lose electrons (cations); nonmetals gain electrons (anions)
- **Main-group charge pattern:** groups 1, 2, 13 → +1, +2, +3; groups 15, 16, 17 → −3, −2, −1
- **Polyatomic ions to memorize:** NO_3^-, SO_4^{2-}, CO_3^{2-}, PO_4^{3-}, NH_4^+, OH^-, CN^-
- **Variable-charge metals:** Fe^{2+} vs Fe^{3+}, Cu^+ vs Cu^{2+}, shown by Roman numerals
- **Polyatomic ions move as indivisible units** when balancing charge







Balanced charges result in a neutral compound

Writing and Reading Chemical Formulas

- Subscripts count atoms in a unit; coefficients count whole formula units
- Parentheses group polyatomic ions as indivisible units: $Ca(NO_3)_2$
- Empirical vs molecular formulas: CH_2O vs $C_6H_{12}O_6$
- Crisscross charges to build Al_2O_3, $Ca(NO_3)_2$, $Al_2(SO_4)_3$
- Count atoms carefully, including those inside parentheses
- Common errors: misreading subscript multiplication; confusing coefficients and subscripts
- Formulas show composition only, not synthesis or reactivity

$$Al_2(SO_4)_3$$

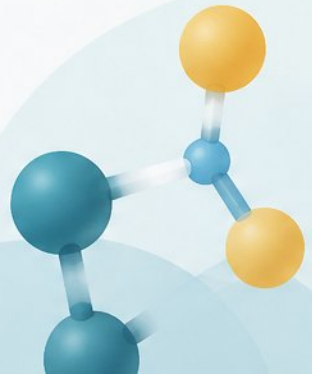
- Subscript 2: 2 Al atoms
- Polyatomic unit (SO_4) counted as a group
- Subscript 3: 3 (SO_4) units

Total atoms in $Al_2(SO_4)_3$:

Al: 2 atoms	S: 3 atoms (1 × 3)	O: 12 atoms (4 × 3)

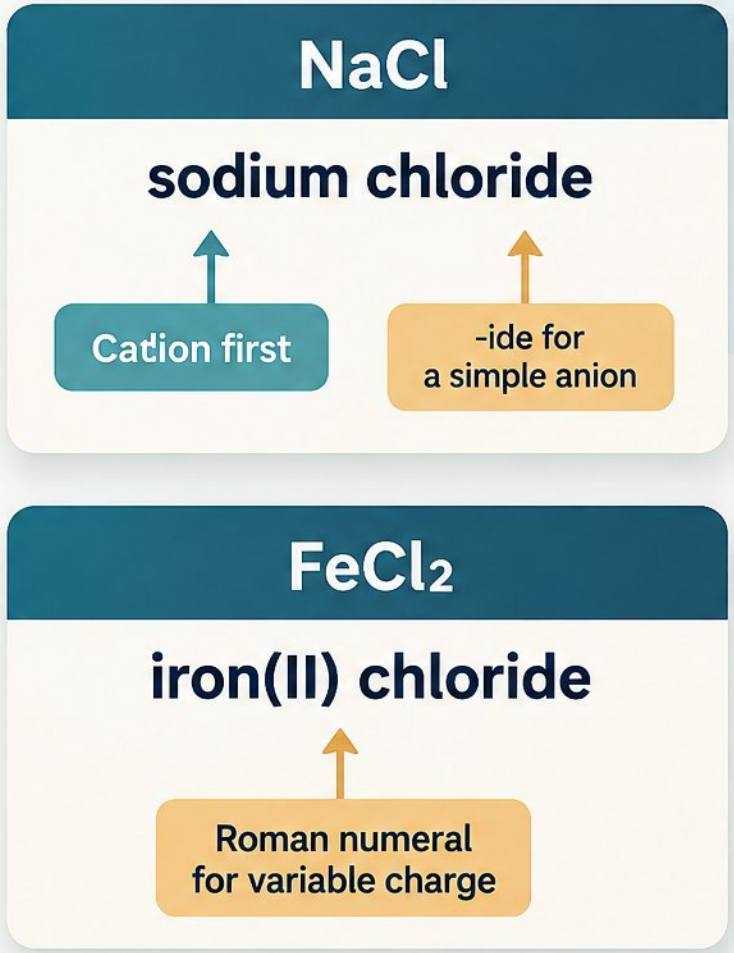
Case matters:

Co	**CO**
Cobalt	Carbon monoxide



Naming Ionic Compounds

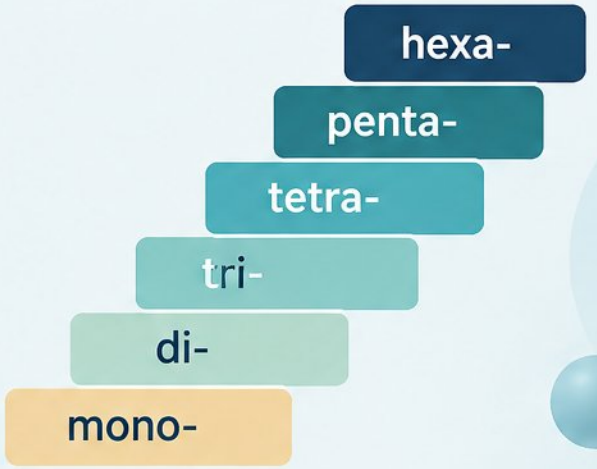
- Cation first, anion second; simple anions take -ide (NaCl = sodium chloride)
- Fixed-charge metals need no Roman numeral; variable-charge metals do (FeCl2 = iron(II) chloride)
- Polyatomic ions keep their names ($NaNO_3$ = sodium nitrate, K_2SO_4 = potassium sulfate)
- Hydrates: Greek prefix + hydrate ($CuSO_4 \cdot 5H_2O$ = copper(II) sulfate pentahydrate)
- Suffix families -ide, -ate, -ite track oxygen content
- Worked cases: main-group, transition-metal, and polyatomic examples



Naming Molecular Compounds

- Binary covalent prefixes: mono-, di-, tri-, tetra-, penta-, hexa-
- Drop “mono-” on the first element: NO = nitrogen monoxide, CO_2 = carbon dioxide
- Check category first: metal–nonmetal = ionic, nonmetal–nonmetal = molecular
- Prefix series: N_2O, NO, NO_2, N_2O_4 each gets a distinct name
- Common names override prefixes: water, ammonia, hydrogen peroxide
- Verify by counting atoms from name back to formula

Binary Covalent Prefixes



Nitrogen Oxide Series



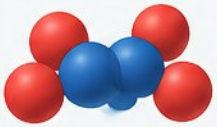
N_2O
dinitrogen monoxide



NO
nitrogen monoxide



NO_2
nitrogen dioxide

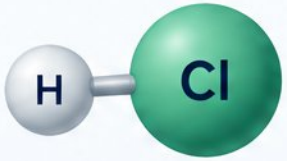


N_2O_4
dinitrogen tetroxide

Acids, Bases, and Special Naming Cases

1 Binary acids

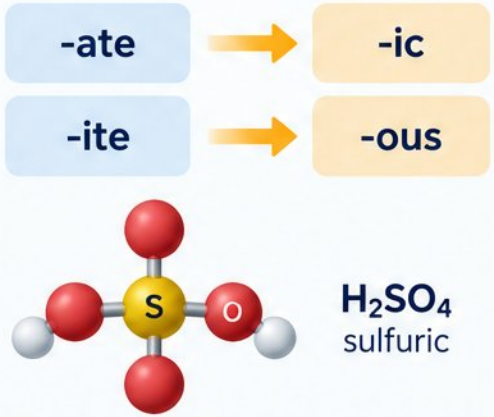
- Binary acids: hydro- ... -ic acid (HCl = hydrochloric acid)



HCl
hydrochloric acid

2 Oxyacids

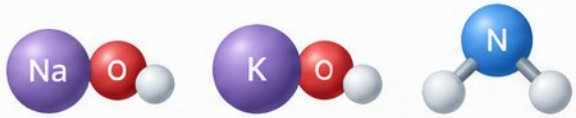
- Oxyacids: -ate becomes -ic, -ite becomes -ous (H_2SO_4 sulfuric)



H_2SO_4
sulfuric

3 Common bases

- Common bases: NaOH sodium hydroxide, KOH potassium hydroxide, NH_3 ammonia



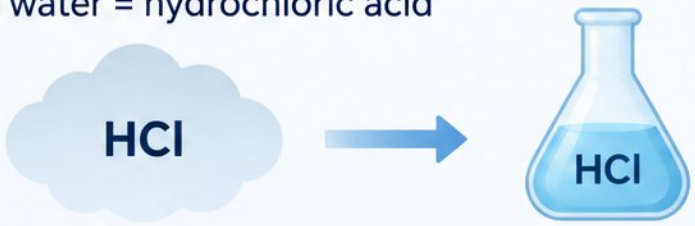
NaOH
sodium hydroxide

KOH
potassium hydroxide

NH_3
ammonia

4 State matters

- State matters: HCl gas = hydrogen chloride; in water = hydrochloric acid



HCl gas = hydrogen chloride

in water = hydrochloric acid

5 Traditional names still fine

- Traditional names still fine: water (H_2O), ammonia (NH_3), hydrogen peroxide (H_2O_2)



H_2O
water

NH_3
ammonia

H_2O_2
hydrogen peroxide

From Name to Formula: Reverse Practice



Identify the category first

ionic, molecular, or acid



Apply the right rule set

- Ionic
- Molecular
- Variable-charge metals
- Acid



Work to get the formula

- Ionic: balance charges, then simplify to lowest whole-number ratio
- Molecular: translate prefixes straight into subscripts
- Variable-charge metals: Roman numeral sets the cation charge

Example (molecular)

dinitrogen tetroxide → N_2O_4



Verify your answer

Re-name your formula and compare with the original.

- Identify the category first: ionic, molecular, or acid
- Ionic: balance charges, then simplify to lowest whole-number ratio
- Molecular: translate prefixes straight into subscripts (dinitrogen tetroxide → N_2O_4)
- Variable-charge metals: Roman numeral sets the cation charge (iron(III) → Fe^{3+})
- Self-check: re-name your formula and compare with the original

Common Pitfalls and Quick Checks

1. **Prefix vs. subscript:** dinitrogen tetroxide = N_2O_4, never N_2O or NO_4
2. **Variable-charge metals need Roman numerals:** iron(II) chloride vs. iron(III) chloride
3. **Formula shows composition only**—not reaction stoichiometry
4. **Case matters:** Co (cobalt) vs. CO (carbon monoxide)
5. **Self-check:** category → charge balance or prefix count → re-name and compare
6. **Tips:** drill polyatomic ions, use decision flowcharts, prompt for misconceptions

Common Mistakes in Context

Dinitrogen tetroxide

✗ N_2O

✓ N_2O_4

Rule violated: Incorrect use of prefixes and subscripts

Iron(II) chloride

✗ $FeCl_2$

✓ iron(II) chloride

Rule violated: Missing Roman numeral for variable-charge metal

Cobalt vs. carbon monoxide

✗ Co

✓ CO

Rule violated: Case matters

Incorrect formula meaning

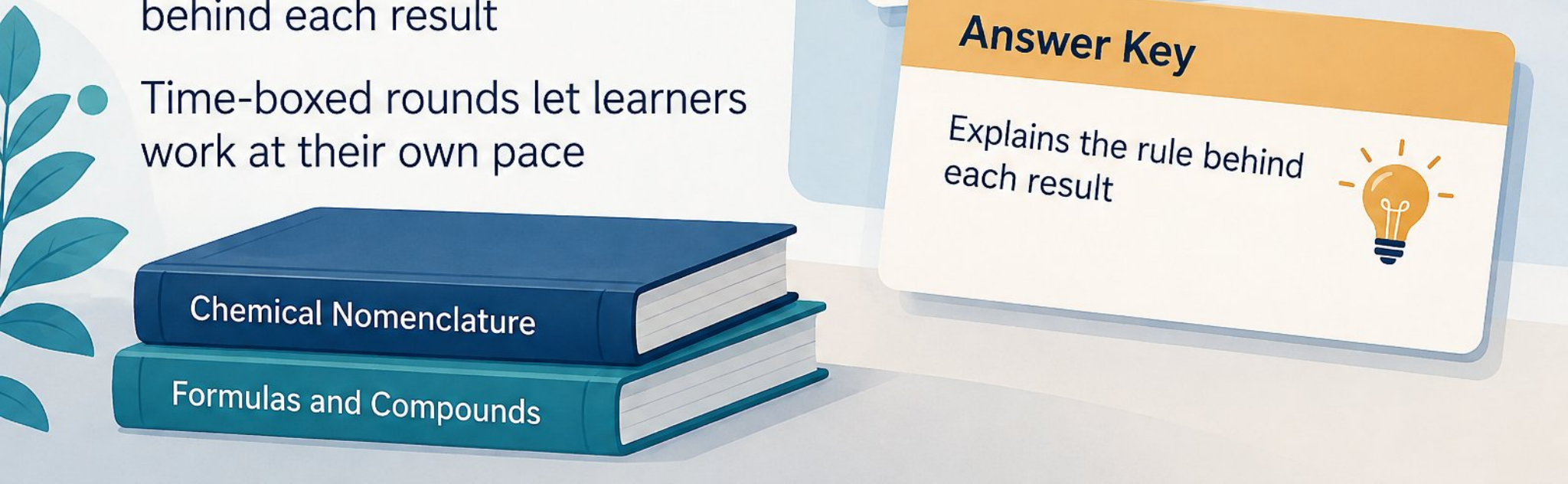
✗ N_2O_4

✓ Composition only

Rule violated: Formula does not show reaction stoichiometry

Practice Set: Mixed Naming and Formula Writing

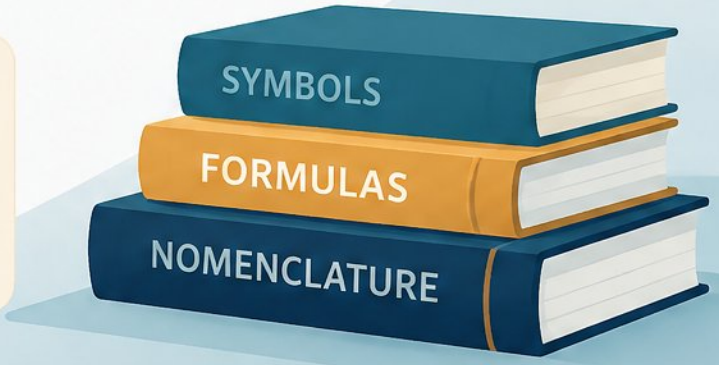
- Four-part drill: ionic, molecular, acid, and reverse naming
- Sample items: name Fe_2O_3; write calcium nitrate
- Also name N_2O_5; write sulfurous acid
- Answer key explains the rule behind each result
- Time-boxed rounds let learners work at their own pace



Assessment Design and Feedback

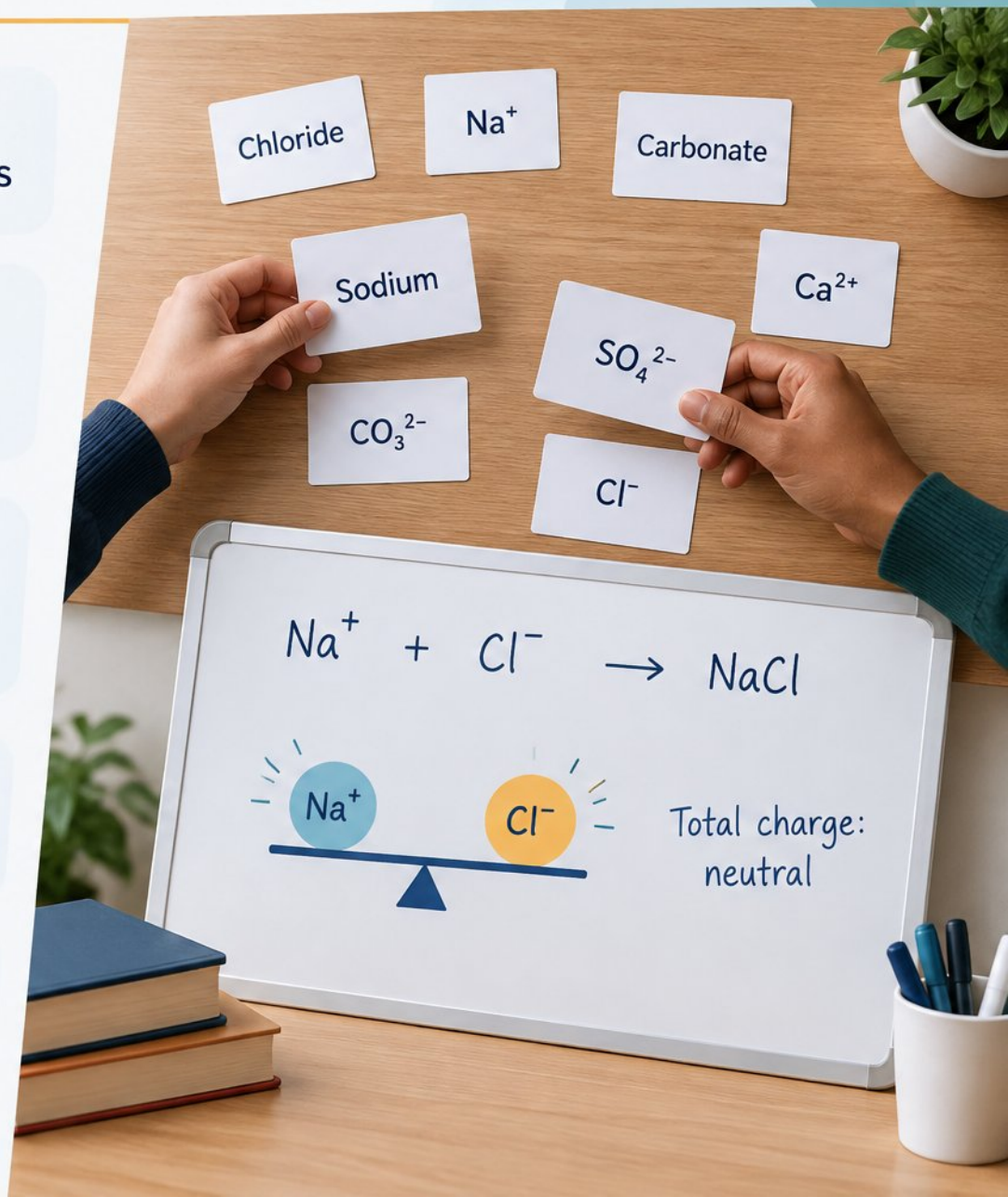
Learning Goal	Item Type	Distractor Design	Feedback Focus
Symbols	Multiple choice for recognition	Prefix vs. subscript	Feedback names the rule violated and points to the relevant reference table
Ion charges	Multiple choice for recognition	Missing Roman numerals	
Formula reading	Multiple choice for recognition	Prefix vs. subscript	
Naming	Short answer for naming	Missing Roman numerals	
Reverse translation	Formula writing for application	Prefix vs. subscript	

Rubric for open-ended naming plus a pass standard for each audience



Classroom Activities and Teaching Strategies

- Card sort: match name cards to formula cards across all categories
- Mnemonics for polyatomic ions and prefix sequences, reusable by teachers
- Think-pair-share prompts that surface misconceptions before correction
- Adaptations for beginners, adult learners, and self-study settings
- Board-work routines that make charge balance visible step by step



Reference Tables and Where to Find Reliable Guidance

- **IUPAC:** recognized authority for chemical nomenclature and terminology
- **Color Books:** Blue Book (organic), Red Book (inorganic); Brief Guides for quick lookups
- Red Book revision started in 2026; use current edition and Brief Guide
- Free IUPAC Standards Online access available through 31 December 2026
- Keep on hand: periodic table, polyatomic ions, prefixes, strong acids and bases



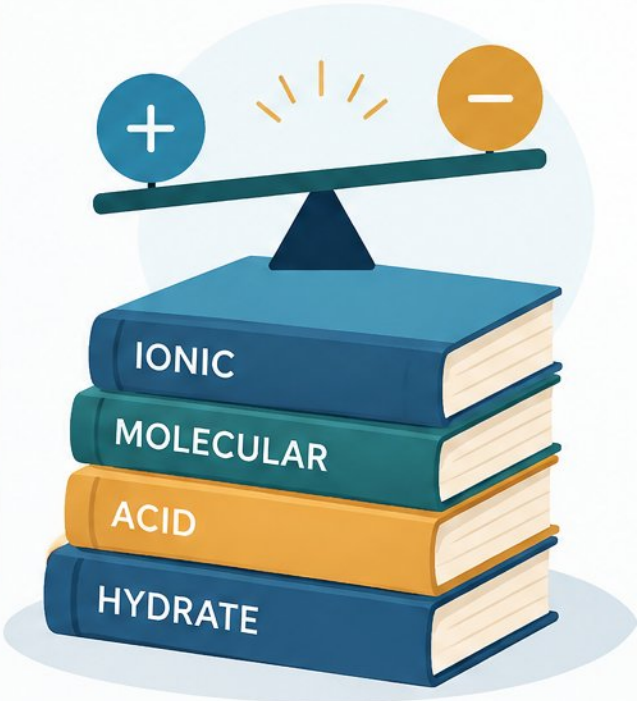
Course Wrap-Up and Next Steps

BUILD
KNOWLEDGE
BRIGHTER
FUTURES

Decision Path

category → rule set → charge balance or prefixes → re-name to verify

- One-page cheat sheet: ionic, molecular, acid, and hydrate rules
- Next topics: moles and molar mass, reaction equations, stoichiometry
- Action plan: 15 minutes of mixed practice daily for one week
- Stay current with IUPAC nomenclature updates and recommendations



SAME PRINCIPLES
BRIGHTER SOLUTIONS

CHEMISTRY TODAY
A BRIGHTER TOMORROW

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