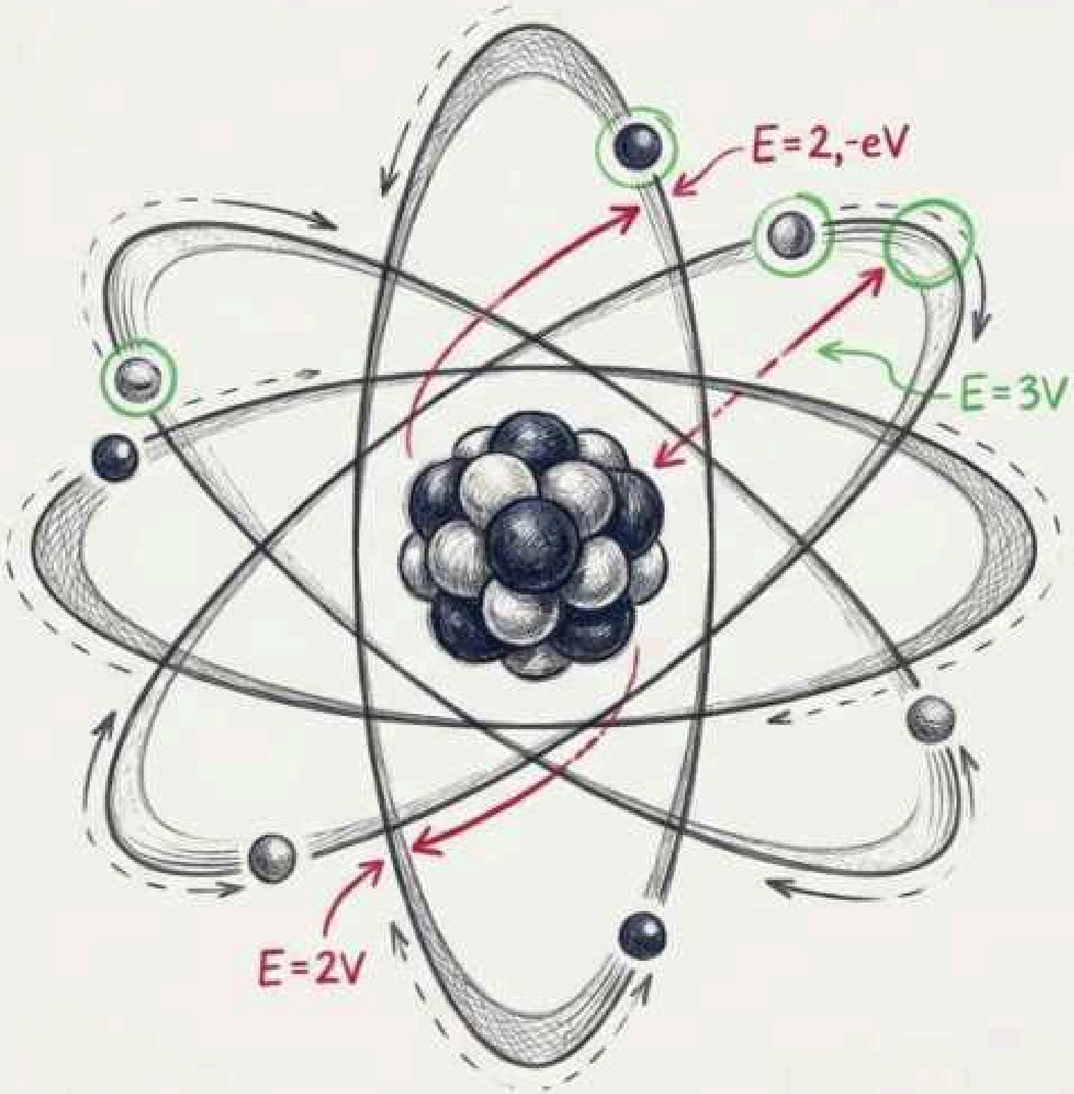
¶ 2.1

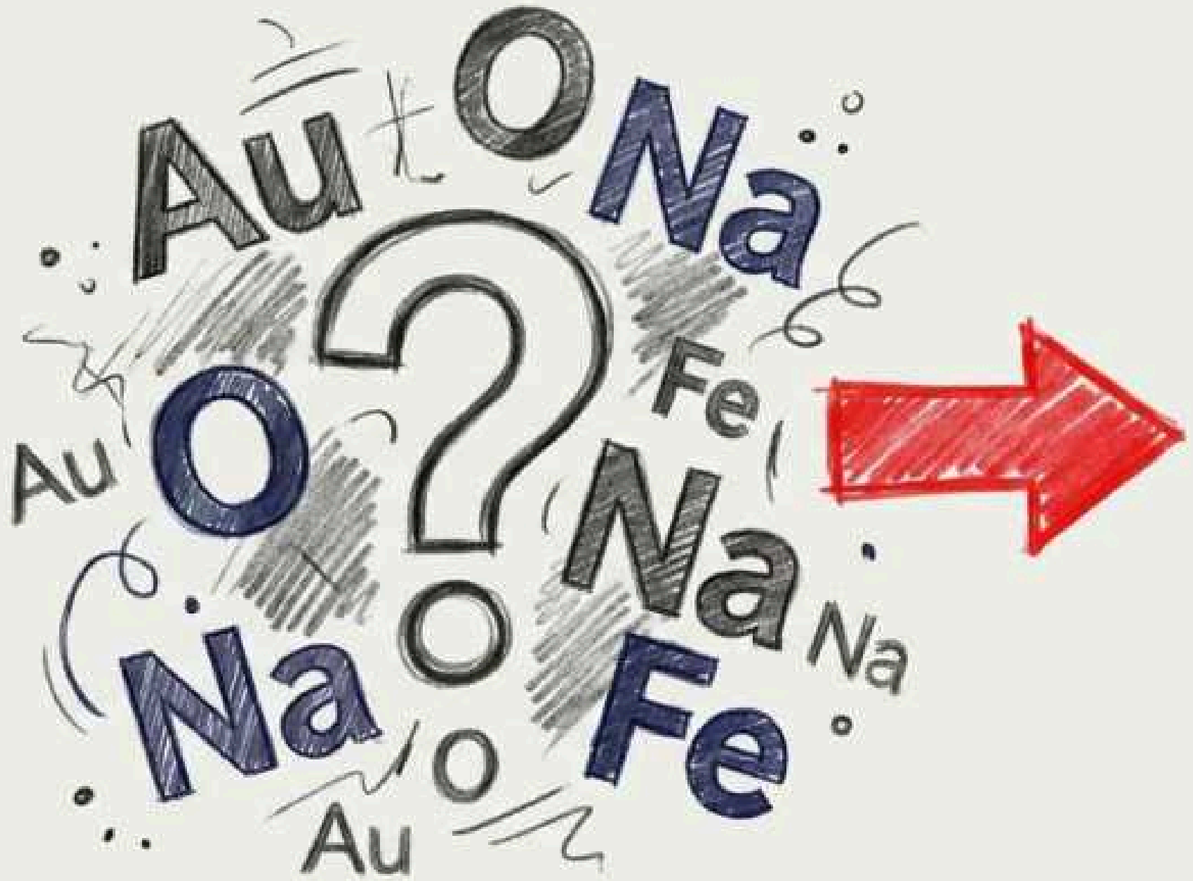


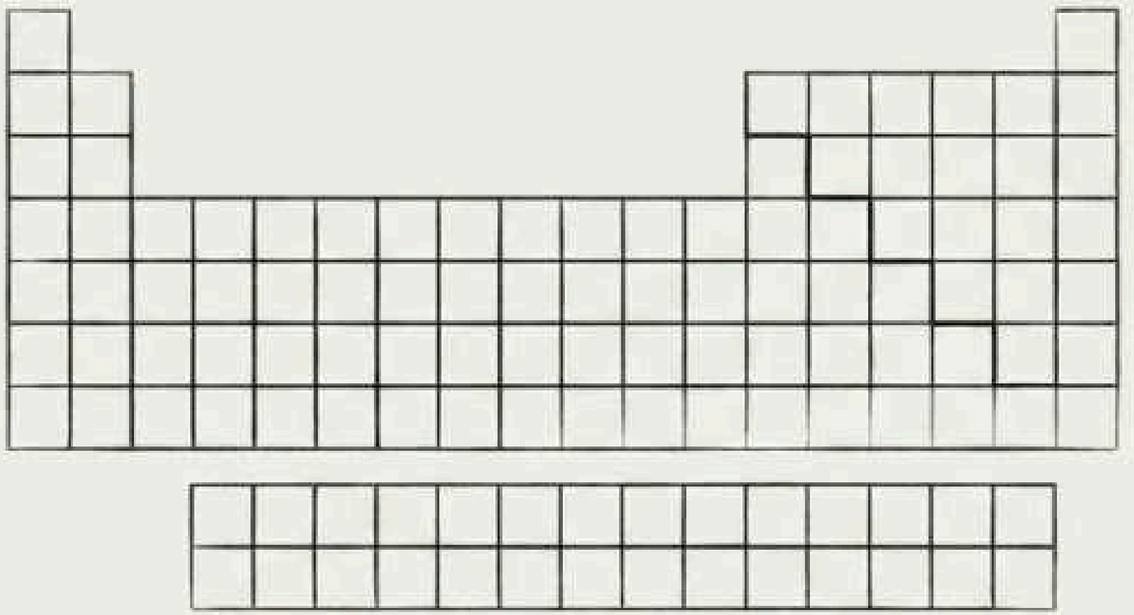
Lecture 2: The Pleridodic Table and Electron Arrangement.

At a glance: Mendeleev, periods & groups, electron shells, the octet rule, quantum orbitals, and periodic trends.

The Big Question: Why do the 118 known elements behave the way they do?

¶ 2.2

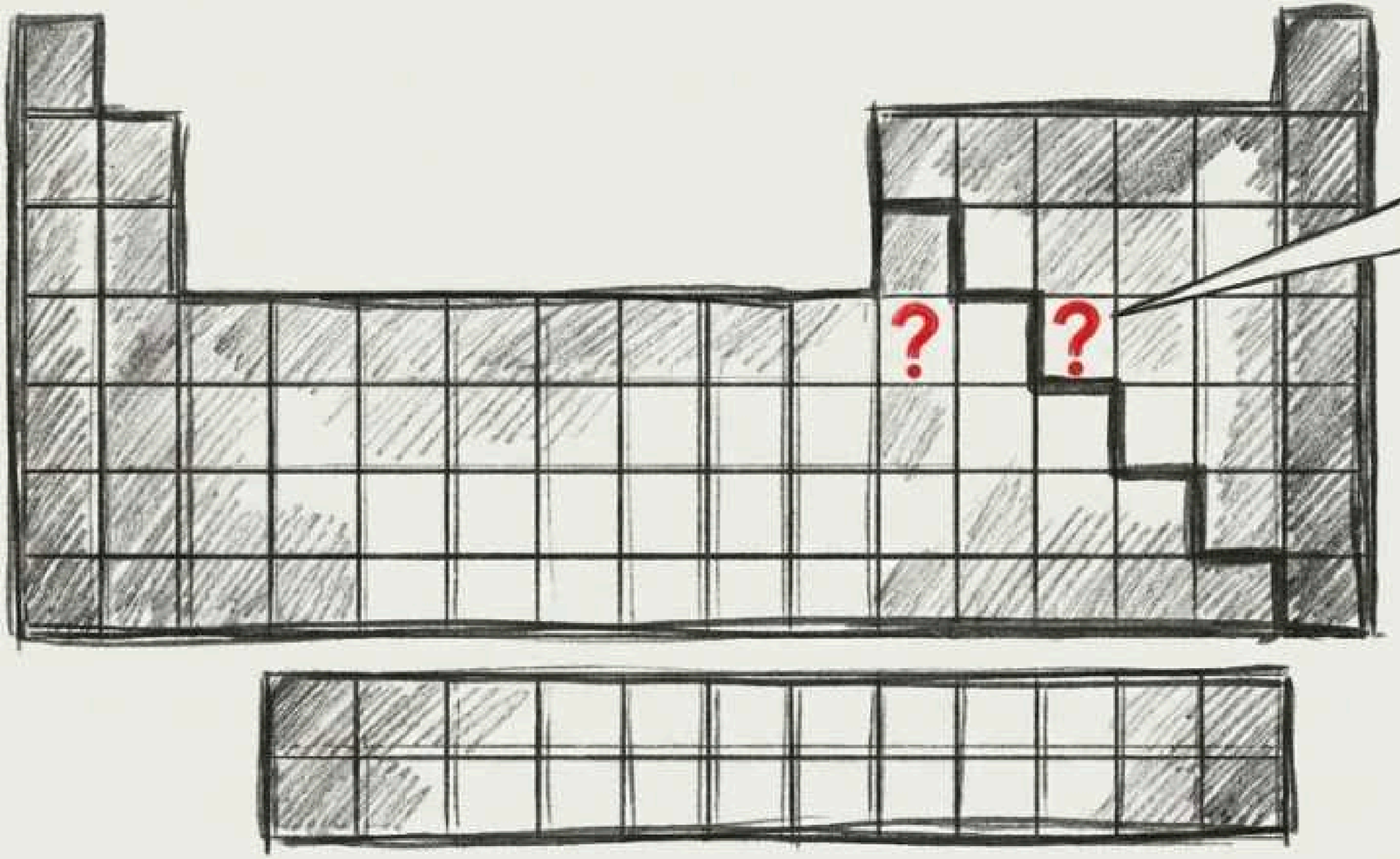




1) Read the layout
2) See how electrons explain it
3) Predict trends

Mendeleev's Bold Gaps (1869)

¶ 2.3



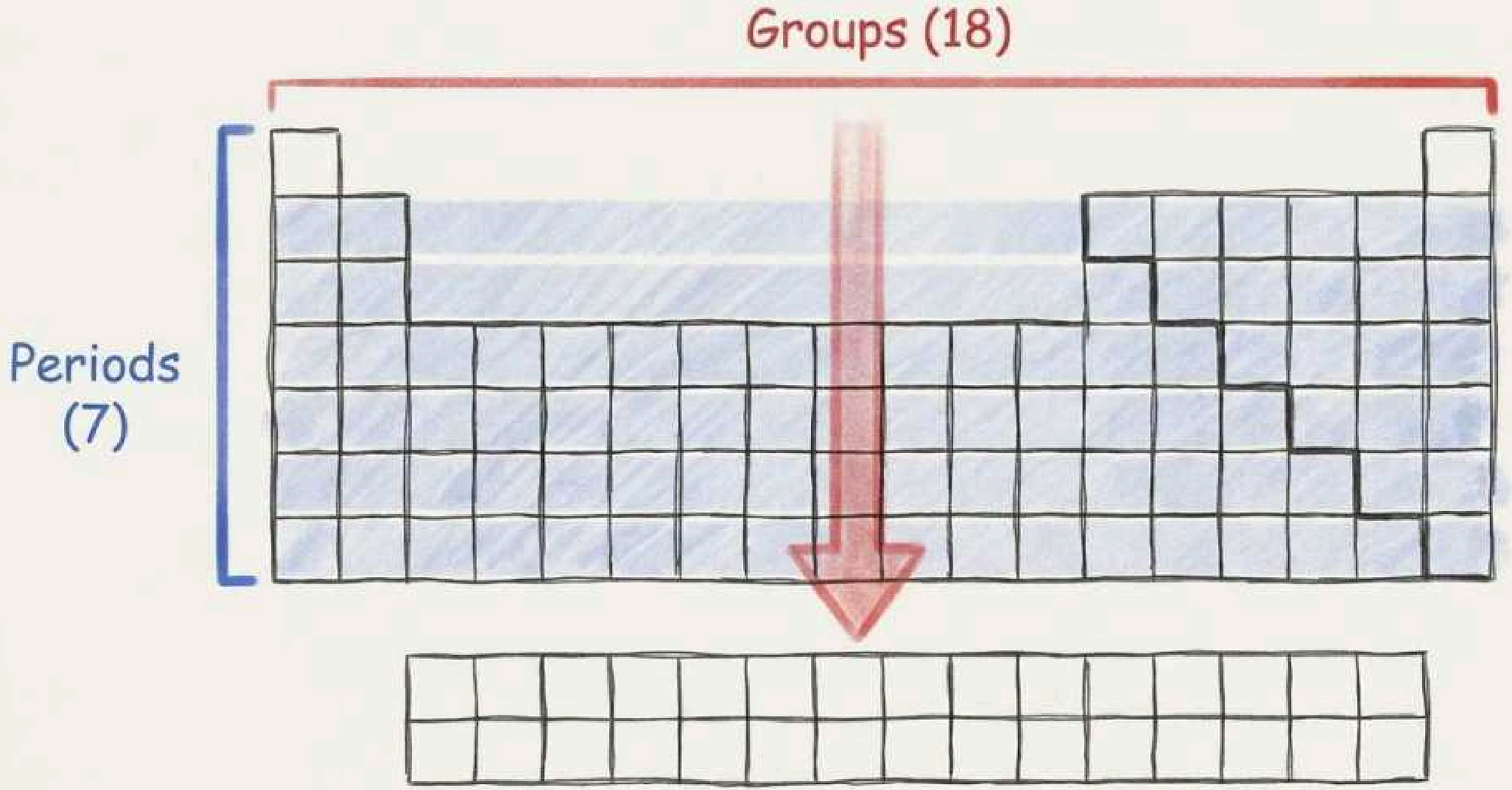
Predicted properties of undiscovered elements (Gallium & Germanium matched perfectly).

Atomic Number ✓

~~Atomic Mass~~

Fixed the few places where mass gave the wrong order.

¶ 2.4

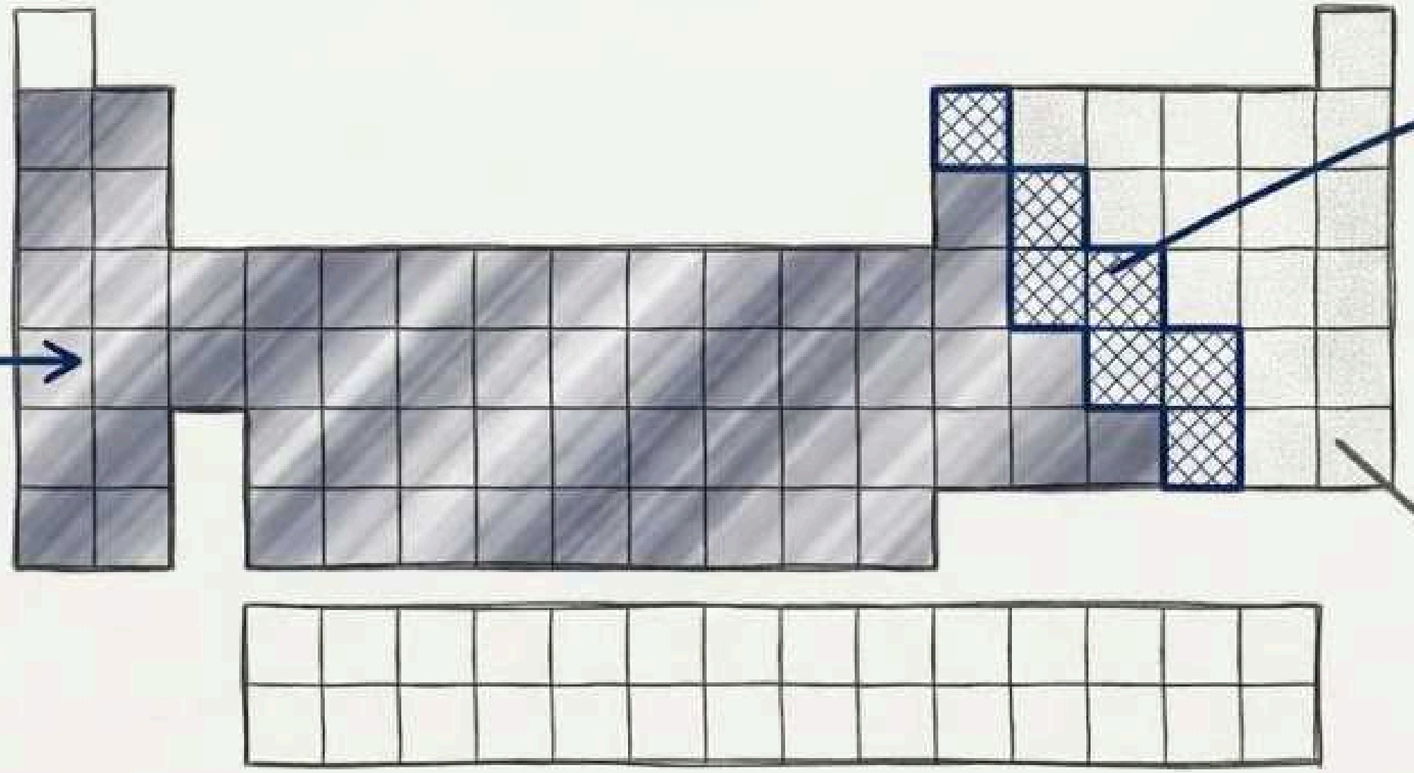


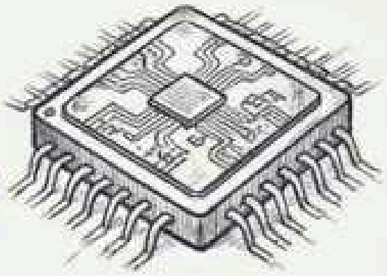
KEY RULE: Elements in the same group share the same number of outer-shell electrons → Similar Behavior.

¶ 2.5



Metals: Shiny, conduct heat/electricity, can be hammered into sheets.



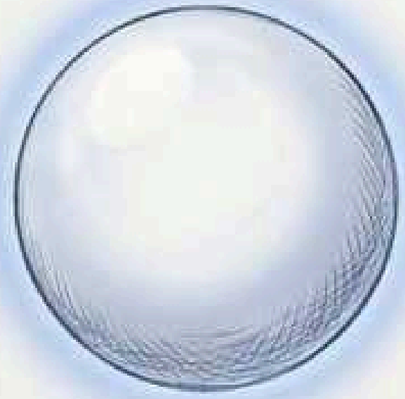


Metalloids: Properties in between; power the electronics industry.



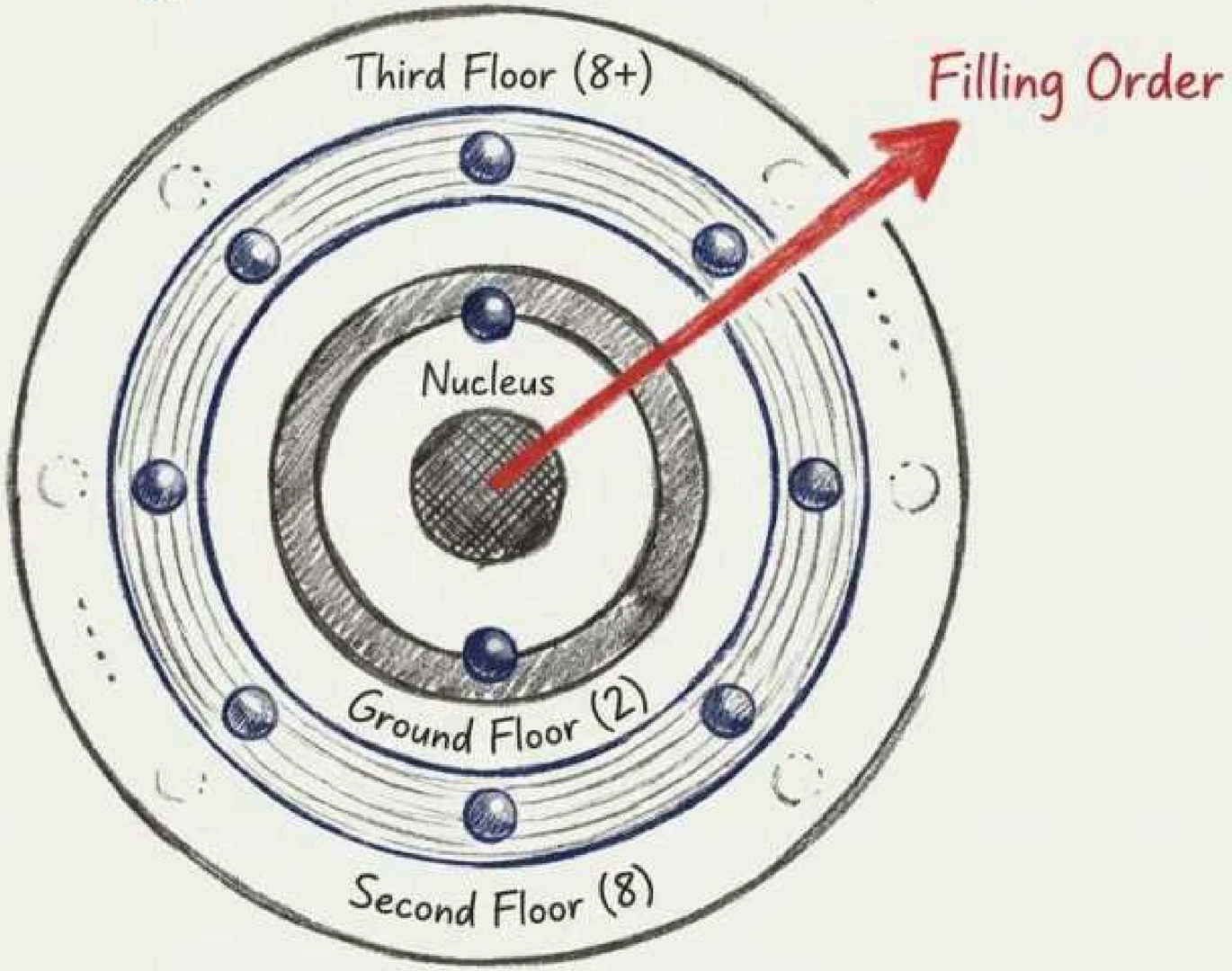
Nonmetals: Dull, poor conductors, brittle as solids.

¶ 2.6

Alkali Metals (Group 1)	Halogens (Group 17)	Noble Gases (Group 18)
		
Soft, shiny metals. React violently with water.	Reactive nonmetals (e.g., Chlorine, Fluorine).	Helium, Neon, Argon. Calm, almost never react.

Electron Shells: Filling from the Ground Up

¶ 2.7

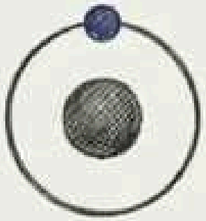


Electrons fill the lowest, innermost shell first, then the next.

Count the electrons yourself and check each total.

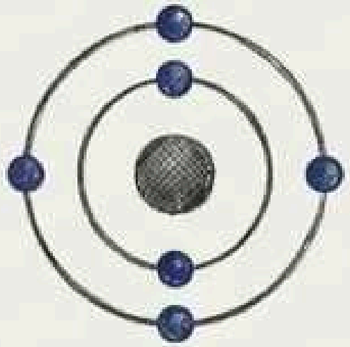
¶ 2.8

Hydrogen (H)



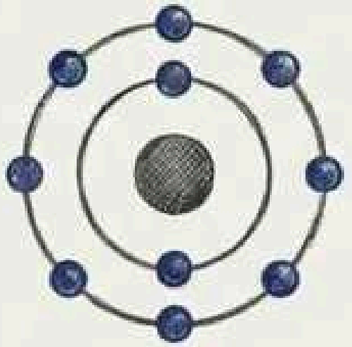
H: 1

Carbon (C)



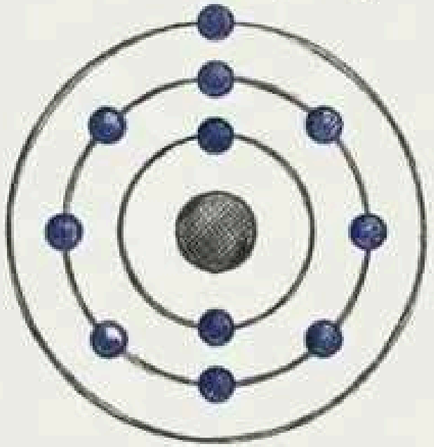
C: 2, 4

Neon (Ne)



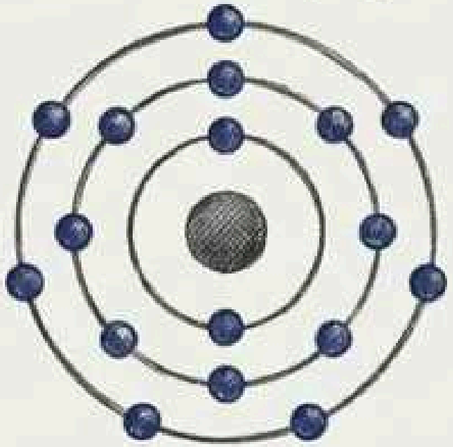
Ne: 2, 8

Sodium (Na)



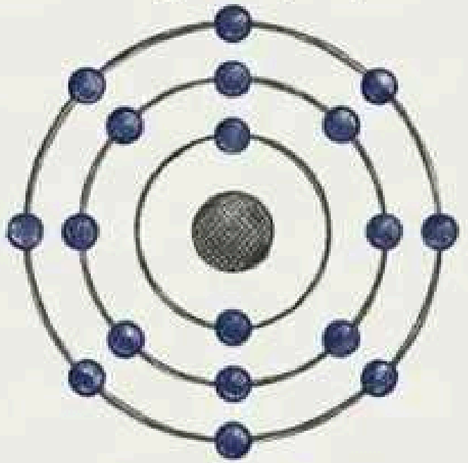
Na: 2, 8, 1

Chlorine (Cl)



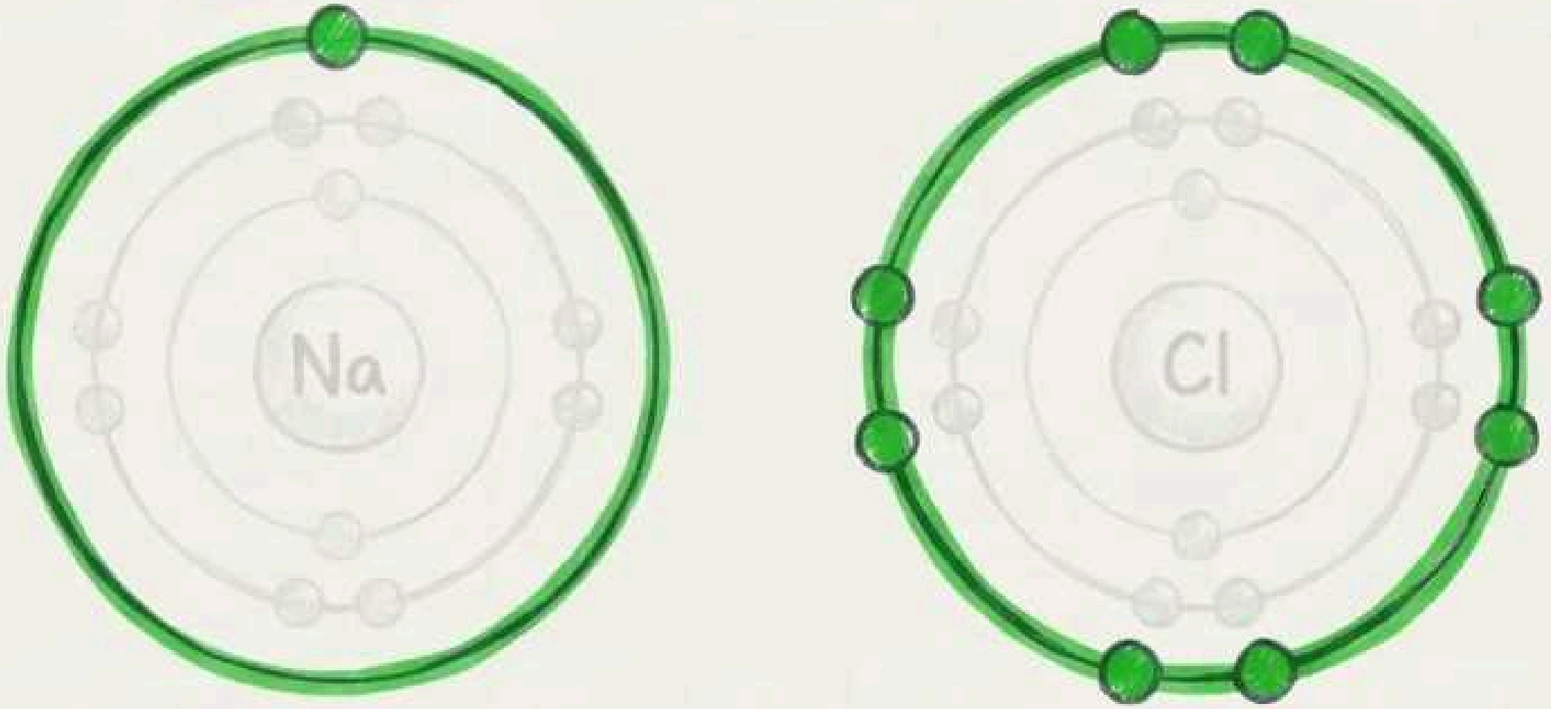
Cl: 2, 8, 7

Argon (Ar)



Ar: 2, 8, 8

VALENCE ELECTRONS = The Outermost Shell



They do the chemistry. Elements in one column act alike because they share this outer arrangement.

Group 1 (Na) = 1 valence e- Group 14 (C) = 4 valence e- Group 17 (Cl) = 7 valence e-

Element	Valence Electrons	Action (Needs/Gives)
Oxygen (Group 16)	6	Needs 2
Nitrogen (Group 15)	5	Needs 3
Fluorine (Group 17)	7	Needs 1
Calcium (Group 2)	2	Gives away 2

Fierce appetite for electrons

Read this way, the table becomes a quick guide to bonding.

The Octet Rule

¶ 2.11

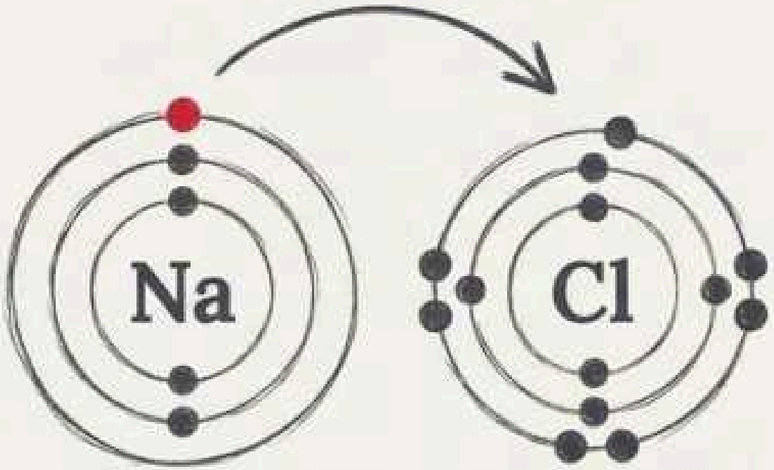


Atoms tend to gain, lose, or share electrons until they have eight in their outer shell.

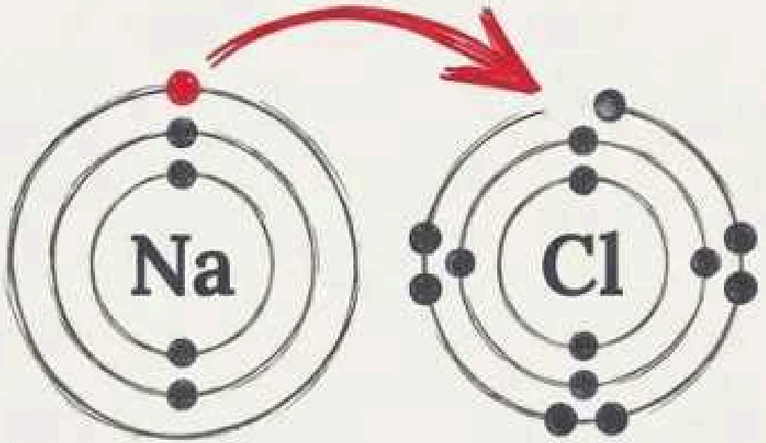
Noble gases already have full outer shells, which is why they are unreactive. Other atoms behave as if they want the same stability.

Group 2 loses 2. Group 16 gains 2.

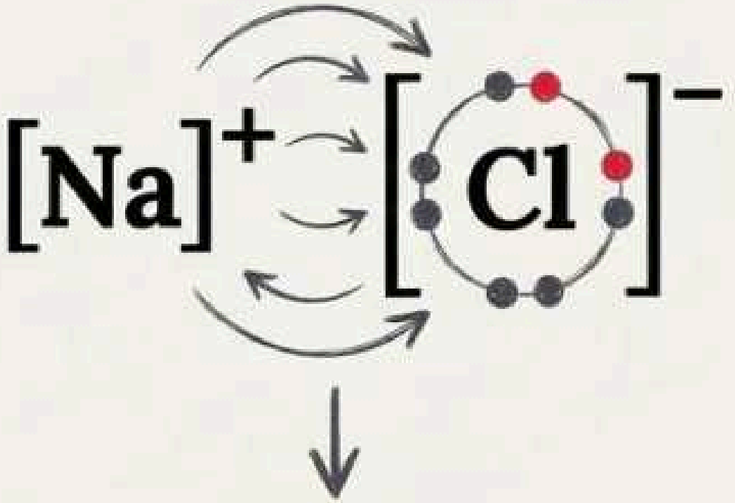
¶ 2.12

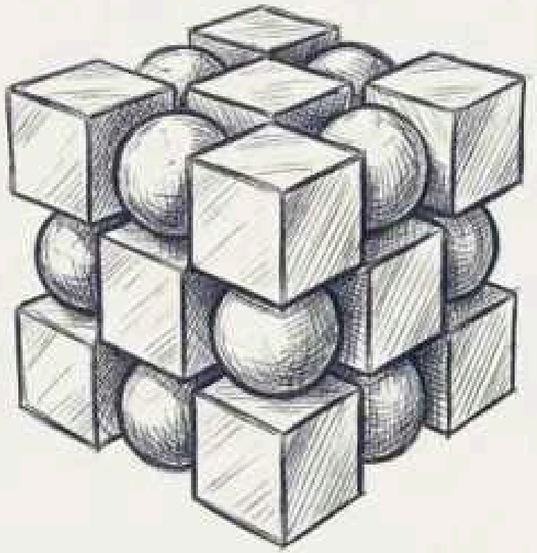


Step 1



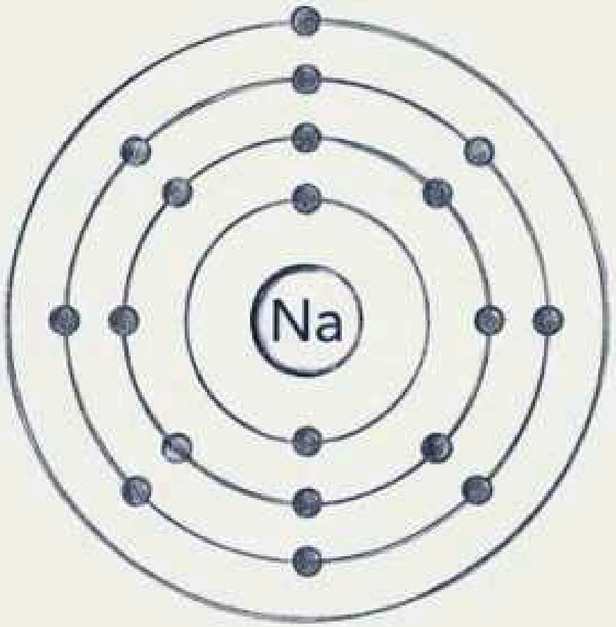
Step 2



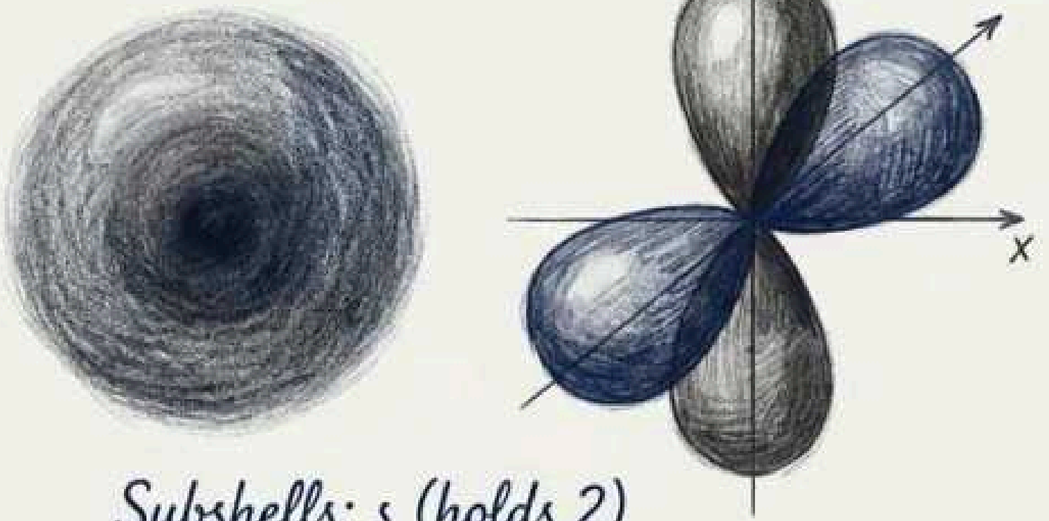


When sodium hands an electron to chlorine,
the two opposite ions attract → ordinary table salt.

Electrons are not tiny planets. They live in orbitals—regions of probability.



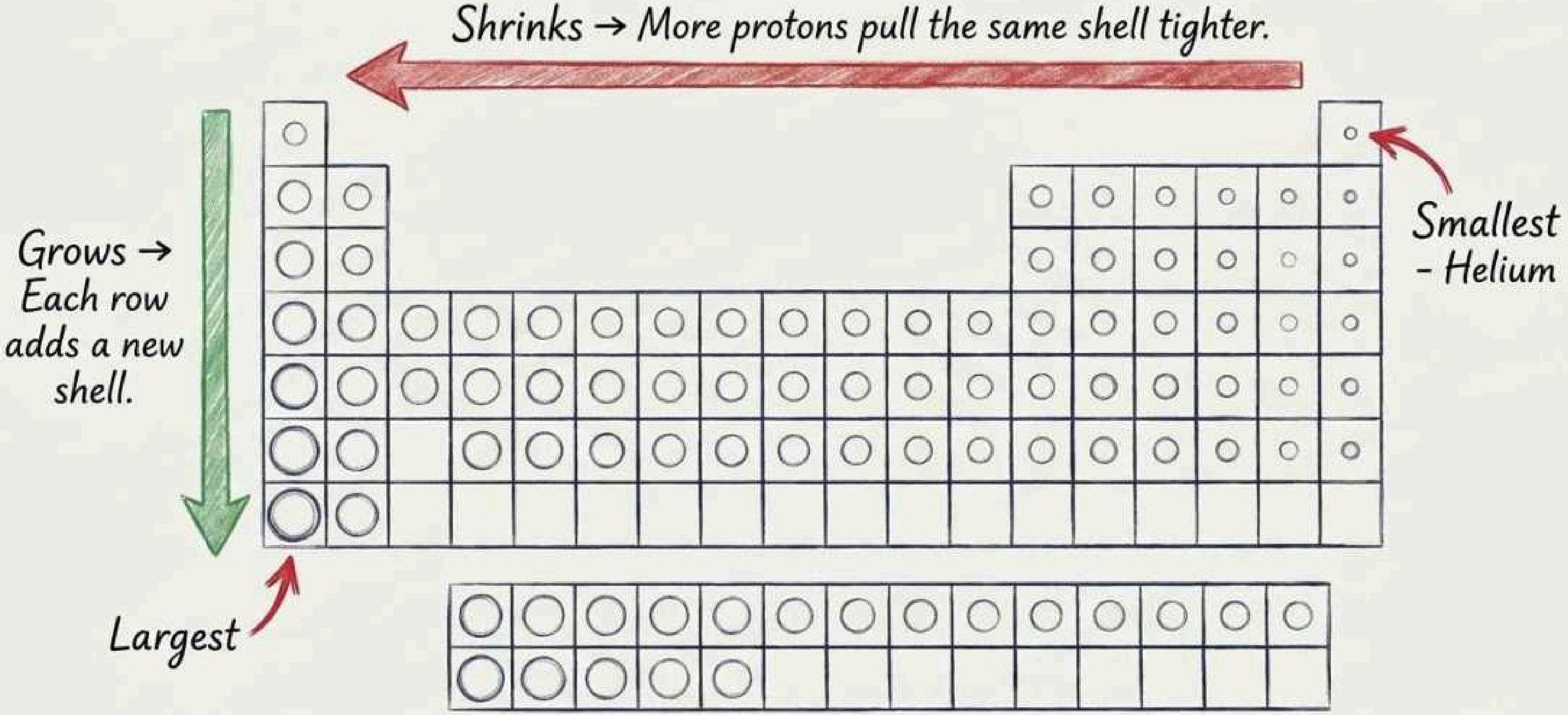
Quantum Reality



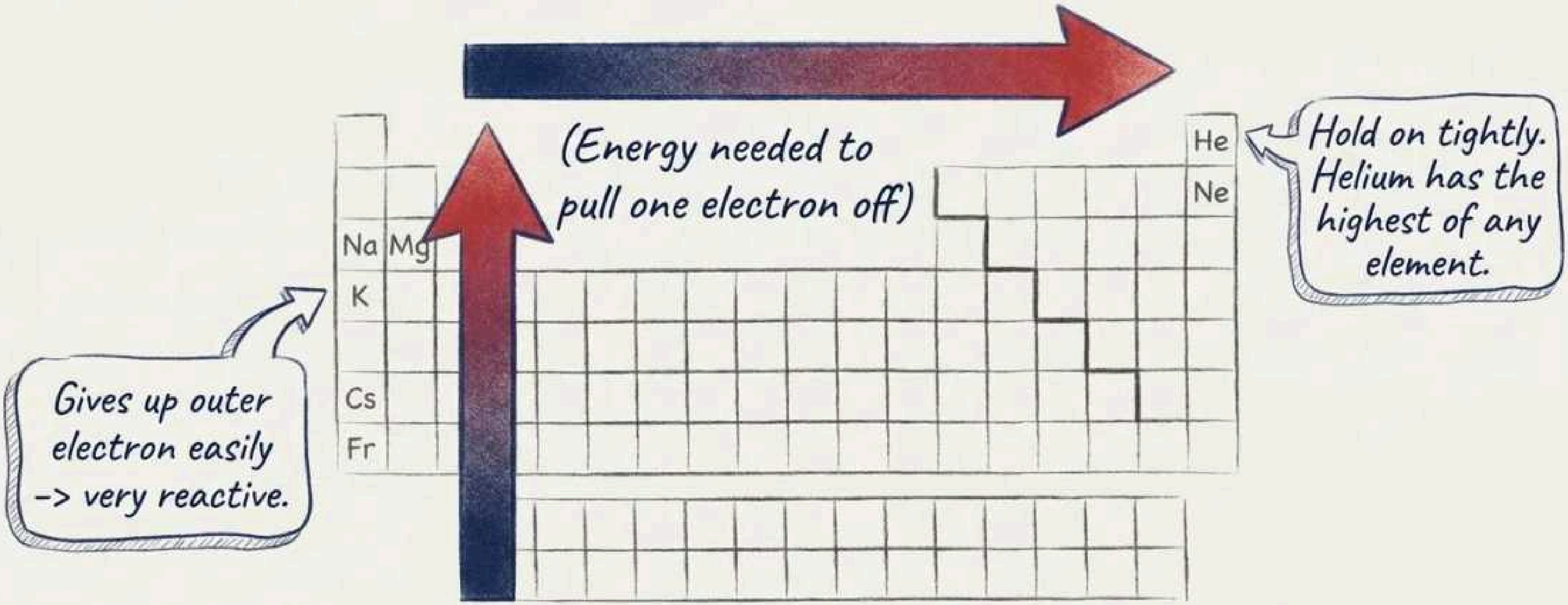
Subshells: s (holds 2)
p (6)
d (10)
f (14).

Sodium: $1s^2\ 2s^2\ 2p^6\ 3s^1$

Trend 1: Atomic Radius



Trend 2: Ionization Energy

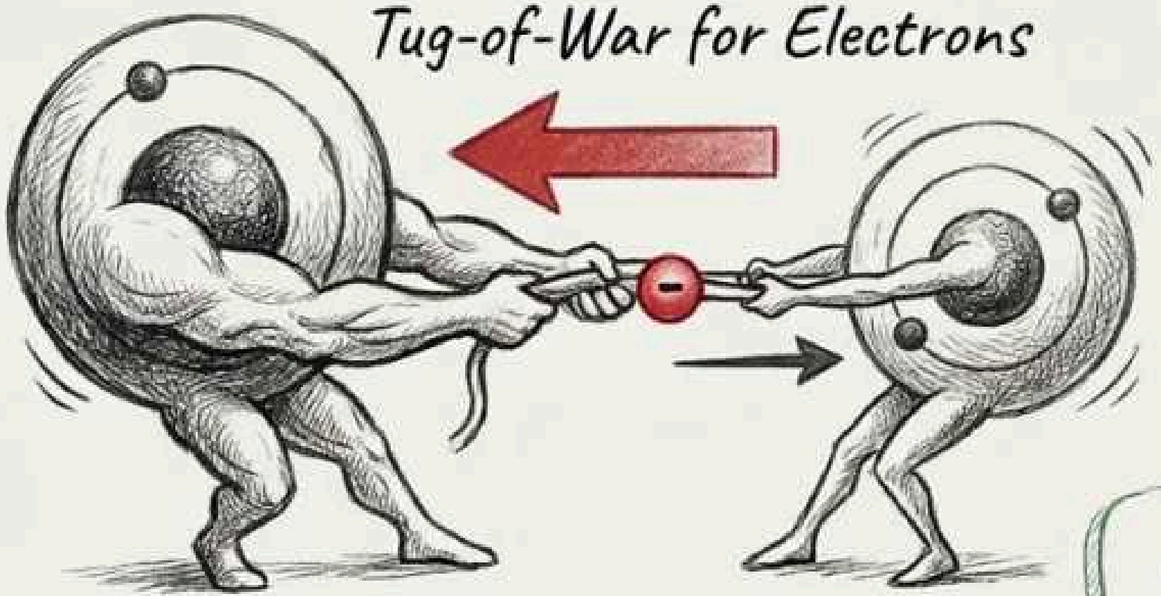


Explains why metals form positive ions, and noble gases stay aloof.

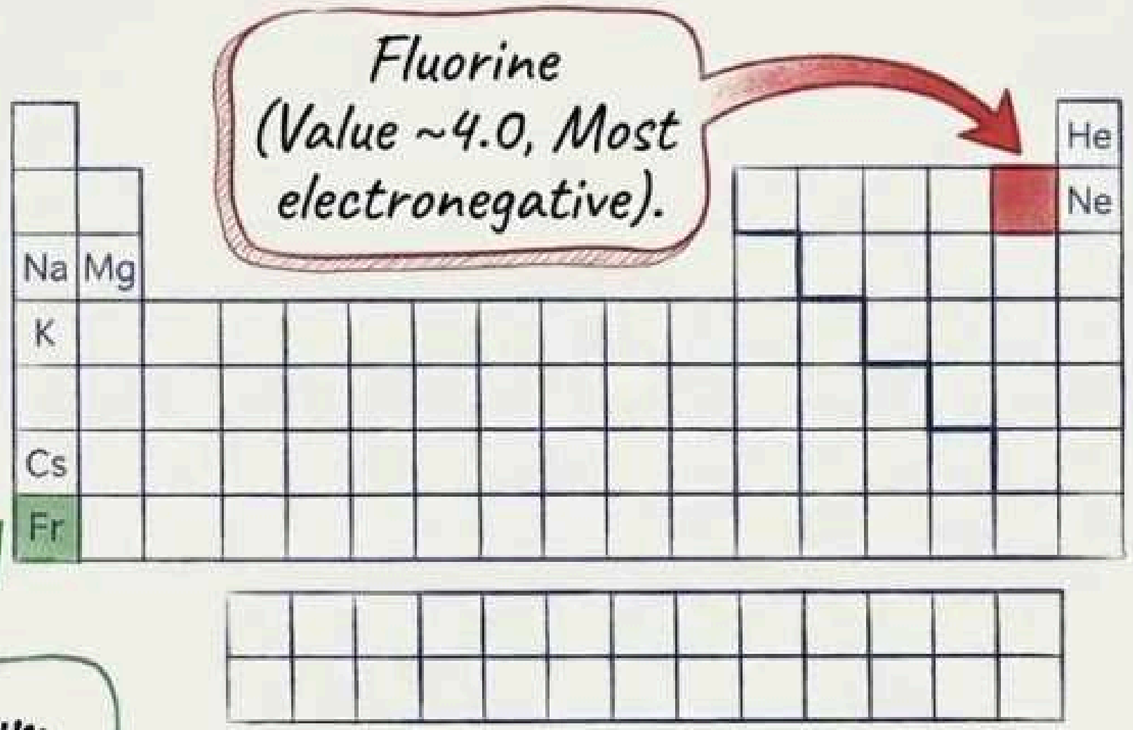
Trend 3: Electronegativity

How strongly an atom attracts electrons when bonded to another.

Electronegativity:
Tug-of-War for Electrons



Electronegativity:
Tug-of-War for Electrons



Follows the same pattern as Ionization Energy.

Trend 4: Reactivity

Alkali Metals



Li (fizzes)

↓

Na (skates & burns)

↓

K (bursts into flame)

Reactivity INCREASES down the group (outer electron held more loosely).

Halogens



F (attacks everything)

↓

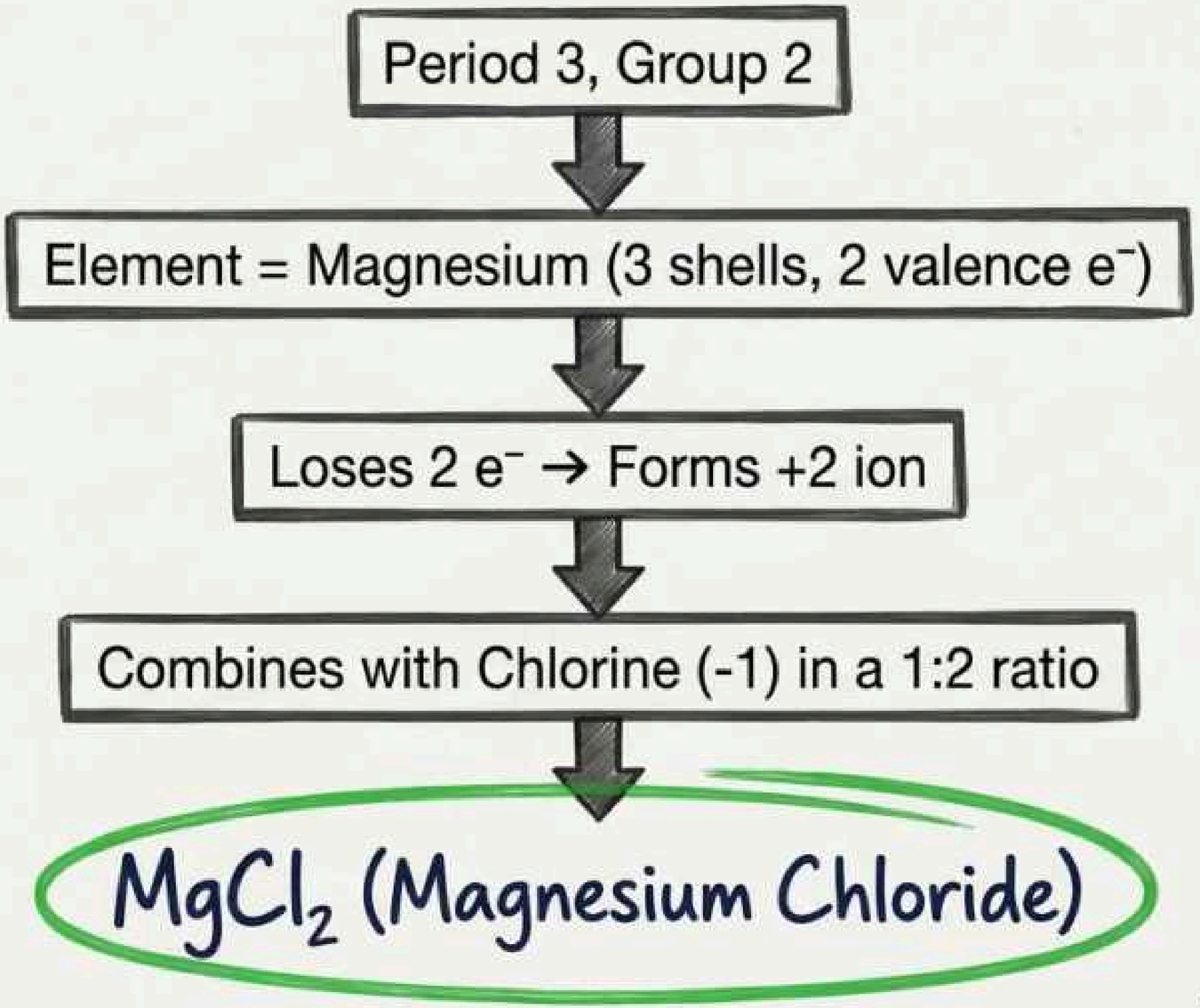
I (mild solid)

Reactivity DECREASES down the group.

The table lets you rank them without memorising anything.

The Table at Work

¶ 2.18



Prediction, without a single memorised fact.

¶ 2.19

Lecture Challenge

1) Choose an element you know (e.g., Calcium, Sulfur, or Lithium) and find it on the table.

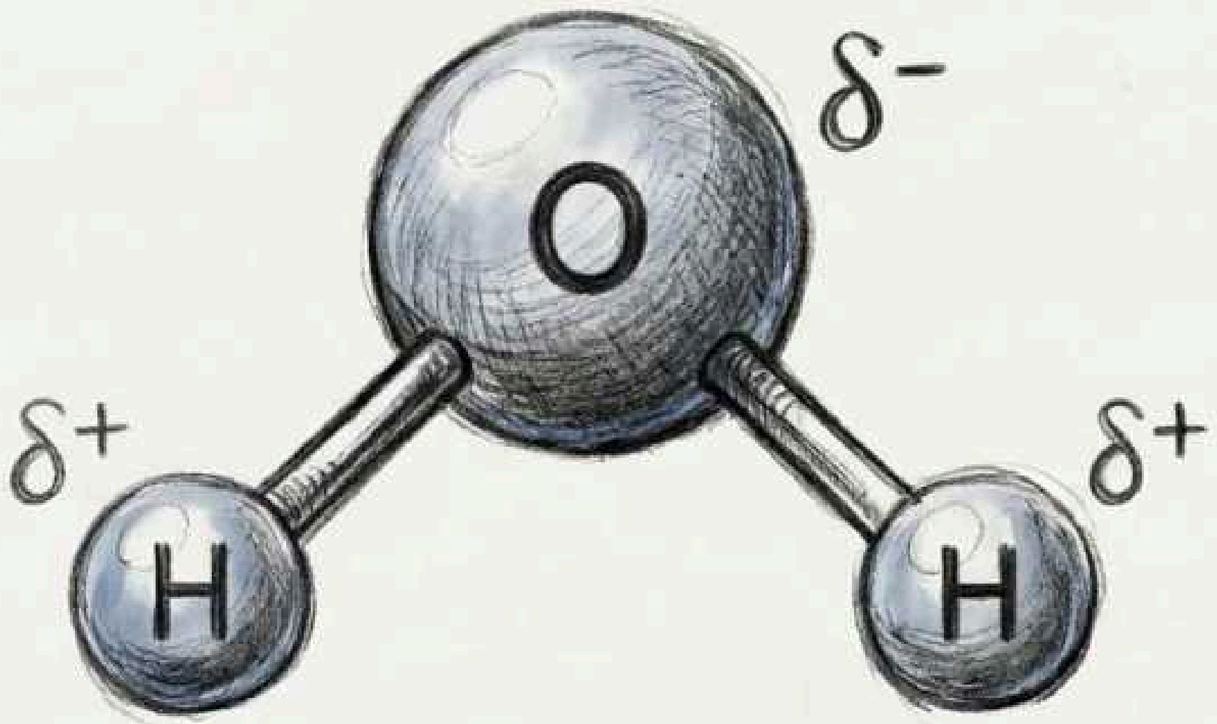
2) How many valence electrons does it have? [___]

3) What ion will it likely form? [____]

4) Which noble gas will it then resemble? [____]

Looking Ahead to Lecture 3

¶ 2.20



Next: How atoms join, the shapes of molecules, and the strangeness of water.