

Reading a Slice of the Periodic Table

Learning target: I can read an element's position, symbol and atomic mass from the periodic table and build a model that shows what the elements in one group have in common.

Diagrams and models

About 35 min

Individual

MS-PS1-1 · practice

visual modeling

independent practice

Standards connections

MS-PS1-1 (practice): Students practice the modeling skill the PE depends on (representing atoms by symbol and reading them from the table) but with single elements rather than molecules, so this builds toward the PE without assessing it.

Purpose: build · **Time:** about 35 minutes · **Format:** individual

Answers with reasoning

The first twenty elements (rows = periods, columns = groups)

H 1							He 4
Li 7	Be 9	B 11	C 12	N 14	O 16	F 19	Ne 20
Na 23	Mg 24	Al 27	Si 28	P 31	S 32	Cl 35.5	Ar 40
K 39	Ca 40						

Each tile shows the chemical symbol and the rounded atomic mass in daltons. Blank tiles in rows 1 and 4 are real empty spaces in this slice: row 1 has only two elements, and row 4 continues to the right beyond this sheet.

Data table for the twenty elements

Element	Symbol	Atomic mass (Da)	Row (period)	Column	State at room temperature	A behavior
Hydrogen	H	1	1	1	gas	burns in air
Helium	He	4	1	8	gas	does not react with anything
Lithium	Li	7	2	1	solid metal	fizzes in water
Beryllium	Be	9	2	2	solid metal	does not react with water
Boron	B	11	2	3	solid	very hard, poor conductor

Element	Symbol	Atomic mass (Da)	Row (period)	Column	State at room temperature	A behavior
Carbon	C	12	2	4	solid	forms diamond and graphite
Nitrogen	N	14	2	5	gas	most of the air; unreactive
Oxygen	O	16	2	6	gas	needed for burning
Fluorine	F	19	2	7	gas	most reactive nonmetal
Neon	Ne	20	2	8	gas	does not react; glows red in lamps
Sodium	Na	23	3	1	solid metal	reacts strongly with water
Magnesium	Mg	24	3	2	solid metal	burns with a bright white light
Aluminum	Al	27	3	3	solid metal	light, used in foil and cans
Silicon	Si	28	3	4	solid	used in computer chips
Phosphorus	P	31	3	5	solid	one form catches fire in air
Sulfur	S	32	3	6	solid	yellow; smells when burned
Chlorine	Cl	35.5	3	7	gas	reactive; used to treat water
Argon	Ar	40	3	8	gas	does not react; fills light bulbs
Potassium	K	39	4	1	solid metal	reacts violently with water
Calcium	Ca	40	4	2	solid metal	reacts steadily with water

Part A: Read the diagram

- Which element sits in row 3, column 7? Give its name, symbol and atomic mass.

Answer: Chlorine, Cl, 35.5 Da.

Why: Row 3, column 7 is the tile marked Cl 35.5; the data table confirms the name.

Also acceptable: None.

2. Reading across row 2 from lithium to neon, by how many daltons does the atomic mass increase in total? Then find the average increase per step (there are seven steps). Show your work.

Answer: Total increase: 20 Da – 7 Da = 13 Da. Average per step: 13 Da ÷ 7 steps ≈ 1.9 Da per step (about 2 Da).

Why: Students should subtract the first mass from the last, then divide by the number of steps (seven moves between eight tiles).

Also acceptable: Accept 1.86 or 'about 2 Da'. If a student divides by 8, note that there are only seven steps between eight elements.

3. Name the three elements in column 1 below hydrogen. Using the data table, state one behavior they share and describe how that behavior changes as you move down the column.

Answer: Lithium, sodium and potassium. All three are solid metals that react with water. The reaction gets stronger down the column: lithium fizzes, sodium reacts strongly, potassium reacts violently.

Why: The pattern (shared property, with strength changing in order) is the core idea of a group.

Also acceptable: Accept 'they get more reactive as the mass goes up.'

- Three correct names
- Shared behavior: react with water (or solid metals)
- Trend: reaction becomes more vigorous going down

4. Hydrogen is placed at the top of column 1, yet it is not a metal. Using the data table, give one way hydrogen is **unlike** the other column 1 elements.

Answer: Hydrogen is a gas at room temperature (the others are solid metals), or it burns in air instead of reacting with water the way they do.

Why: Hydrogen's placement is a known oddity; the student needs one accurate difference from the table.

Also acceptable: Either difference earns full credit.

5. Pretend magnesium's atomic mass has been lost. Use the halfway idea from Döbereiner and Mendeleev with the elements directly above and below it (beryllium and calcium) to predict it. Then compare your prediction with the real value in the table.

Answer: Prediction: (9 Da + 40 Da) ÷ 2 = 49 ÷ 2 = 24.5 Da. Real value: 24 Da. The prediction is off by only 0.5 Da.

Why: This repeats Mendeleev's method for a gap. The small difference shows the halfway idea is a useful pattern, not an exact rule.

Also acceptable: Accept 24.5 Da with a difference of 0.5 Da, or 'about 24 Da' if the division is shown.

6. Find the one place on this slice where moving to the next element does **not** increase the atomic mass. Name the two elements. Then explain, using column behavior, why scientists keep them in that order anyway.

Answer: Argon (40 Da) is followed by potassium (39 Da), so the mass goes down by 1 Da. Scientists keep argon under neon because, like neon and helium, it is an unreactive gas, and they keep potassium under sodium because, like sodium and lithium, it is a metal that reacts with water. Position in the table follows behavior, not just mass.

Why: This is the textbook's 'few exceptions.' The deeper reason, that the modern table is ordered by atomic number (proton count), can be mentioned to students who ask; argon has 18 protons and potassium 19.

Also acceptable: A student who cites the atomic number as the real ordering rule is correct.

- Identifies argon and potassium
- Explains the order by matching column behavior

7. A newly discovered element is placed in column 8, directly below argon. Which description is the best prediction of its behavior?

Answer: B. It is a gas that does not react.

Why: Column 8 holds helium, neon and argon, all unreactive gases; the real element below argon is krypton, which fits.

Also acceptable: None.

Part B: Build a model of a group

-  Choose column 1 (Li, Na, K) or column 8 (He, Ne, Ar). Draw the column as a vertical strip of three tiles. In each tile write the symbol, the atomic mass, the state at room temperature and the shared behavior. Draw an arrow beside the strip showing the direction in which atomic mass increases. Add a fourth, dashed tile at the bottom for the next element in that column, and write inside it two things you predict about that element (its state and its behavior) plus a rough mass range, 'more than ___ Da'. Title your model.

Answer: A titled vertical strip of three tiles. Column 1 version: Li 7 Da, solid metal, reacts with water; Na 23 Da, solid metal, reacts strongly; K 39 Da, solid metal, reacts violently; arrow pointing down labeled 'atomic mass increases'; dashed tile predicting a solid metal that reacts with water (even more violently) with mass more than 39 Da (the real element, rubidium, is 85.5 Da and does react more violently). Column 8 version: He 4, Ne 20, Ar 40, all gases that do not react; arrow down; dashed tile predicting an unreactive gas of mass more than 40 Da (krypton, 84 Da).

Why: The model must make the shared property visible (same words repeated in each tile, or a shared color) and make the trend visible (the arrow and the increasing numbers). The dashed tile is the predictive part of the model.

Also acceptable: Students may draw the strip horizontally if the arrow and order are clear. Extra accurate details (for example, 'glows in lamps' for neon) are welcome.

- Three tiles with correct symbol, mass and state
- Shared behavior written or color-coded in every tile
- Arrow showing mass increasing downward
- Dashed tile with a state prediction, a behavior prediction and a mass range
- A title

8. Label your model: which feature of your drawing shows 'what the group has in common,' and which feature shows 'what changes down the group'?

Answer: The repeated behavior and state written in every tile (or the shared color) show what the group has in common. The arrow and the increasing mass numbers (and, for column 1, the increasing violence of the reaction) show what changes down the group.

Why: The student must point to a specific feature for each of the two ideas.

Also acceptable: Accept any clear pairing of drawing feature to idea.

- Names a feature for the shared property
- Names a feature for the trend

9. Explain why a scientist would trust the predictions in your dashed tile more than a random guess.

Answer: Because the prediction follows a pattern that already holds for three elements in the column, and the same kind of prediction worked for Mendeleev when gallium, scandium and germanium were found. A random guess uses no pattern at all.

Why: Students should connect trust to a pattern that has been confirmed before.

Also acceptable: Mentioning Mendeleev's successful predictions is strong but not required.

- Refers to the observed pattern in the column
- Contrasts with a guess that uses no evidence

Teacher notes

All twenty atomic masses are rounded real values (chlorine kept at 35.5 because rounding it to 35 or 36 misleads later work). The eight-column slice is a teaching layout; from period 4 on, the real table inserts the ten transition-metal columns between calcium and gallium, which is why the extension asks students to sketch that gap. Watch q5: some students average lithium and sodium (the neighbors in a different column); the question says above and below, that is, beryllium and calcium. The argon-potassium exception in q6 is the honest answer to the textbook's 'with only a few exceptions'; the modern table orders by atomic number.

Scaffold offered to students: Finger-tracing the grid

For every Part A question, put one finger on the row number and another on the column number, then slide them until they meet; that tile is the element. Check the symbol against the data table before you copy the mass. For q6, run your finger along row 3 to argon, then jump to the start of row 4, and compare the two masses you just passed.

Extension: The missing block

The real periodic table does not put potassium directly under sodium with calcium beside it and then stop. From row 4 on, ten extra columns of metals (such as iron and copper) are inserted between column 2 and column 3. Sketch how this slice would look if row 4 were drawn at full width with ten blank tiles inserted, and explain why keeping aluminum above gallium (the element that was discovered in 1875 to fill a Mendeleev gap) matters more than keeping the rows the same length.