

Build the Table, Defend the Blank: An Element Jigsaw

Learning target: I can work with a team to arrange elements into columns by shared behavior and rows by atomic mass, identify where an element is missing, and defend a prediction about it.

Collaborative investigation

About 50 min

Jigsaw

MS-PS1-1 · practice

collaboration

discussion

data analysis

Name _____

Date _____

Period _____

Directions

Work in home groups of four. Step 1 (expert round, 10 minutes): each member takes one expert set of three cards (Set A: cards 1-3; Set B: cards 4-6; Set C: cards 7-9; Set D: cards 10-12), reads them, and meets briefly with the other students who hold the same set to agree on what the three cards have in common and how they differ. Step 2 (home round, 20 minutes): return to your home group, teach your cards to the others, and complete the group task. Step 3 (defense, 10 minutes): present your arrangement and your blank-space prediction to a neighboring group, who will challenge it. Step 4 (individual, 10 minutes): answer Part C alone.

You will need: Twelve cards per group, cut from the card sheet, One blank card per group, Group record table, Pencils

Twelve element cards (real rounded atomic masses)

1 Card 1: Lithium (Li), 7 Da

Soft silvery metal, cut with a knife. Fizzes steadily in water, no flame. Stored under oil. Forms a white salt with chlorine in a one-to-one ratio of atoms (LiCl).

2 Card 2: Neon (Ne), 20 Da

Colorless gas. Does not react with any other element under normal conditions. Glows red-orange when electricity passes through it; used in lighted signs.

3 Card 3: Iodine (I), 127 Da

Gray-black solid that turns into a purple vapor when warmed. Reactive non-metal. Forms a white salt with sodium in a one-to-one ratio of atoms (NaI). Used as an antiseptic.

4 Card 4: Sodium (Na), 23 Da

Soft silvery metal, cut with a knife. Reacts fast with water and can catch fire. Stored under oil. Forms table salt with chlorine in a one-to-one ratio of atoms (NaCl).

5 Card 5: Argon (Ar), 40 Da

Colorless gas. Does not react with any other element under normal conditions. Makes up about 1 percent of air; used to fill light bulbs so the hot wire does not burn.

6 Card 6: Fluorine (F), 19 Da

Pale yellow gas. The most reactive non-metal known. Forms a white salt with sodium in a one-to-one ratio of atoms (NaF), which is added to toothpaste.

7 Card 7: Potassium (K), 39 Da

Very soft silvery metal. Bursts into flame immediately in water. Stored under oil. Forms a white salt with chlorine in a one-to-one ratio of atoms (KCl).

8 Card 8: Krypton (Kr), 84 Da

Colorless gas. Does not react with other elements under normal conditions. Used in some bright white lamps.

9 Card 9: Chlorine (Cl), 35.5 Da

Yellow-green gas with a sharp smell. Reactive non-metal. Forms salts with the soft metals in a one-to-one ratio of atoms. Used in small amounts to keep swimming pools clean.

10 Card 10: Rubidium (Rb), 85.5 Da

Very soft silvery metal. Explodes on contact with water. Stored under oil. Forms a white salt with chlorine in a one-to-one ratio of atoms (RbCl).

11 Card 11: Xenon (Xe), 131 Da

Colorless gas. Does not react with other elements under normal conditions. Used in some car headlights and camera flashes.

12 Card 12: Helium (He), 4 Da

Colorless gas, lighter than air. Does not react with any other element. Used in party balloons and to cool scientific magnets.

Part A: Expert round (one set per person)

1. Your expert set: _____. Each set contains three elements that do NOT belong together. For each of your three cards, write the one behavior that will decide which column it goes in.

Part B: Home group task

1. Lay all twelve cards on the desk. Sort them into columns so that every element in a column shares a behavior. You should end with exactly three columns. Name each column by its shared behavior.
2. Inside each column, order the cards from lowest atomic mass at the top to highest at the bottom.
3. Now line the columns up side by side so that each row contains elements with similar masses (the lightest metal beside the lightest reactive non-metal beside the lightest unreactive gas, and so on). Helium starts a row by itself.
4. Look for a row that has a hole. One element that should exist is not in the deck. Mark the hole with a blank card.
5. Using the masses above and below the hole in its column, and the masses on either side of it in its row, predict the missing element's atomic mass. Then predict its state, its behavior with the soft metals, and what it would look like.
6. Prepare a one-minute defense: why the columns are right, why the hole is where it is, and why your prediction is reasonable. Every member must be able to give the defense.

Group record (fill in)

Row	Soft metals that react with water	Reactive non-metals that form 1:1 salts	Unreactive gases
Row 1			
Row 2			
Row 3			
Row 4			
Row 5			

2. Group answer: Which row and column has the hole? What atomic mass does your group predict for the missing element, and how did you calculate it?

3. Group answer: Write the strongest challenge the neighboring group made to your arrangement or prediction, and how you answered it.

Part C: Individual accountability (complete alone)

4. Explain in your own words why your group did not simply put the twelve cards in one long line by mass. What would have been lost?

5. The soft-metal column gets more violent with water as mass increases (fizz, flame, immediate flame, explosion). Does the unreactive-gas column show any trend down the column? Use the cards to answer.

6. The missing element is real; it was discovered in 1826 and is a red-brown liquid. Name the three predictions your group made about it (mass, state and behavior), and say which one the real element matches, which one it does not, and why a prediction can be useful even when one part is wrong.

7. Suppose a thirteenth card arrived: a soft silvery metal, stored under oil, explodes in water, atomic mass 133 Da. Where would it go, and what would that do to the number of rows?

Column-first, then mass

If the sorting feels overwhelming, use the storage clue: cards that say 'stored under oil' go together, cards that say 'does not react' go together, and everything left over is the third column. Only after the three stacks exist should you look at the masses. Then order each stack by mass before you line the stacks up into rows.

Mendeleev's harder problem

Your deck had only three kinds of behavior and one hole. Mendeleev's 1869 table had to handle about 60 elements and eight columns, and he left three major gaps. Find out which three elements filled those gaps and in which years, then write a paragraph comparing your group's prediction process to his: what information did you have that he did not, and what did he have to figure out that your deck handed to you?