

Using Clues to Identify Elements

Background Information

Chemical elements can be classified according to their properties as metals, nonmetals, and metalloids. **Metals** are good conductors of heat and electricity. Many metals are malleable and ductile.

Nonmetals are poor conductors of heat and electricity, and solid nonmetals tend to be brittle. **Metalloids** have properties between those of metals and nonmetals.

Elements in the same group on the periodic table have the same number of **valence electrons**, which are electrons in the highest occupied energy level of an atom. The number of an A group matches the number of valence electrons in atoms of each element in the group. For example, the Group 4A elements each have four valence electrons per atom. The exception to this pattern is the element helium, which is in Group 8A but has only two valence electrons.

Because elements in a group have the same number of valence electrons, they tend to have similar properties. The most reactive metals are the **alkali metals** in Group 1A on the far left side of the periodic table. The Group 2A elements are the **alkaline earth metals**, which are somewhat less reactive than the alkali metals. Groups of elements become less metallic in their properties from left to right across the periodic table. The most reactive nonmetals are the **halogens** in Group 7A. Group 8A contains the **noble gases**, which are colorless and odorless, and rarely react with other elements.

In this investigation, you will use a list of clues to identify 34 elements and place them in their correct locations in the periodic table.

Problem

Where do the elements described in the clues fit in the periodic table?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

- Analyzing Data** How will the index cards be useful when you are reading the clues to the elements?

2. **Inferring** Do you have to know a specific, identifying property for each element in order to place all 34 elements in the partial periodic table? Explain your answer.

3. **Classifying** Are elements with similar properties in the same row or the same column of the periodic table?

4. **Analyzing Data** Explain how information about an element's physical state at room temperature will help you fill in the partial periodic table.

5. **Classifying** How would information about number of valence electrons be useful for placing elements in the periodic table?

6. **Analyzing Data** Why is it important to review the clues after you have read all of the clues once?

Materials *(per group)*

25 index cards

copy of the periodic table from the textbook for reference

Procedure

1. Work in pairs. Examine the partial periodic table that follows the list of clues. Note that it contains spaces for the 34 elements in Periods 1 through 5 and Groups 1A through 8A. The locations of the metalloids are shaded.
2. For this investigation, these 34 elements have been randomly assigned a number from 1 to 34. (*Hint:* This number has no relation to the atomic number or mass of the element.) By using the list of clues, you will identify where each element belongs in the partial periodic table.
3. Read the clues in order. You will probably find it useful to summarize the information in each clue by using index cards, to which you can refer later as needed. Fill in the partial periodic table by placing each element's assigned number in the appropriate box. Use a pencil so that you can correct any mistakes.
4. Sometimes a single clue will enable you to identify an element and place its number in the correct box. In most cases, however, you will need to combine information from different clues in order to identify the element.
5. Reread the clues as many times as necessary. When you are certain that you have correctly identified all the elements referred to in a clue, set that index card aside.

List of Clues

1. Elements 2, 5, 18, 29, and 33 are colorless, odorless, unreactive gases. Of these gases, element 29 has the largest atomic mass.
2. Elements 13, 19, 23, and 34 have six valence electrons, and element 13 is a metalloid.
3. Elements 9, 14, 16, and 21 are highly reactive metals in the same group. Of these metals, element 16 is the least reactive.
4. Elements 1, 8, 11, 13, 14, 17, 24, and 29 are in the same period.
5. Elements 11, 26, 27, and 28 have three valence electrons.
6. Elements 1, 4, 6, and 30 are found in the same group. Element 6 is in chlorophyll molecules.
7. Elements 10, 22, 24, and 32 are in the same group. Element 22 is a liquid at room temperature.
8. Elements 2, 10, 15, and 34 are nonmetals in the same period.
9. Elements 7, 15, 17, and 25 are in the same group. Of these, only element 7 is a gas at room temperature.
10. Elements 12, 20, and 26 are metalloids. Elements 20 and 12 are in the same group.

11. Element 30 is important to maintain strong bones and teeth.
12. An atom of element 21 has one more proton than an atom of element 2.
13. Element 3 is a nonmetal with one valence electron.
14. Element 27 is the most abundant metal in Earth's crust.
15. Element 31 is a solid at room temperature. Most of the compounds in your body contain this element.
16. Element 18 has two electrons.
17. Element 33 has a smaller atomic mass than element 5.
18. Element 32 is the most reactive nonmetal.
19. Element 20 and element 19 are combined in a compound found in glass.
20. Glass that contains element 26 does not shatter easily.
21. Element 19 is the most abundant element in Earth's crust.

Observations

Partial Periodic Table

	1A							8A
1		2A						
2			3A	4A	5A	6A	7A	
3				4A				
4				4A	5A			
5					5A	6A		

Analysis and Conclusions

1. **Drawing Conclusions** Identify each element in the list of clues by matching its assigned number to the correct name of the element.

2. **Analyzing Data** Were you able to place some elements in the partial periodic table with just a single clue? Use examples to explain.

3. **Analyzing Data** Provide at least two examples of when you needed to use more than one clue to identify an element.

4. **Applying Concepts** Why were you able to use clues about atomic mass to place elements, even though the periodic table is organized by atomic number?

5. **Comparing and Contrasting** Which elements are not included in the partial periodic table? Compare the number of elements in the partial periodic table to the number of known elements.

Go Further

Now that you have identified the elements from the list of clues, write at least five additional clues based on information from Chapter 5.