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Periodic Chart Lab

Student Laboratory Kit

Introduction

Have you ever gone to the video store and looked for a specific movie? The videos are arranged, or classified, according to type as well as alphabetically. This arrangement is an example of *two-dimensional classification*. All the videos in a particular section have something in common and arranged A to Z. When you come to a different section, the alphabetical arrangement is repeated. Experience for yourself how a method of two-dimensional classification led to the modern-day arrangement of the elements known as the *periodic table*.

Concepts

- Periodic table
- Period vs. family
- Two-dimensional classification

Background

In the years 1868–1870, Dmitri Mendeleev (1834–1907), a professor of chemistry at the University of St. Petersburg in Russia, was writing a new textbook called *Principles of Chemistry*. More than 60 individual elements were known, along with a great many facts about their properties. Mendeleev knew the atomic masses of the elements, their densities, boiling points, and melting points. What was missing was a way to organize these facts, a way to understand how individual facts related to each other—in short, a way to classify the elements. The following quote from Mendeleev reveals his thoughts at the time:

"I wished to establish some sort of system of elements in which their distribution is not guided by chance . . . but by some sort of definite and exact principle."

Mendeleev decided to arrange the elements according to atomic mass. He wrote out the exact atomic masses (as they were known at the time) in the margin of a list of the elements, and then wrote out separate cards for each of the elements with the atomic mass and other chemical and physical properties. Using these cards, Mendeleev played "chemical solitaire" for several hours, finally copying to a sheet of paper the arrangement he had worked out with the cards. With slight modification, this became *Mendeleev's first Periodic Table of the Elements*.

Periodic refers to the repeating pattern of certain properties of the elements when properly arranged. A horizontal row of elements on the periodic table is known as a period. Family is a concept of "same." Families are present in vertical columns; so that each element has the same value. Scientists originally thought that weight was a family concept, even though the weights were not the same for every element. They found if you added the top and bottom element weight in a family and divided it by two, it always gave the weight of the element in the middle of that column. This organization of the elements into a logical table is perhaps one of the greatest achievements in the history of science. Other chemists had developed tables of the elements, but Mendeleev's table was different because he left gaps for several elements yet to be found based on the patterns and trends he discovered. He even accurately predicted the properties of these missing elements!

Experiment Overview

The purpose of this activity is to arrange nine elements from the periodic table without their name or atomic number.

Pre-Lab Questions *(optional but strongly recommended)*

1. Identify the meaning of every letter or number in the potassium box located below. Use a chemical handbook for help if necessary.

The diagram shows a rectangular box representing an element's data. The text inside the box is as follows:

- Top: Potassium
- Left: K
- Right: 19
- Below K: 39.0983
- Below 39.0983: 0.86
- Below 0.86: [Ar]4s
- Below [Ar]4s: 760°
- Below 760°: 63.25°
- Below 63.25°: β^-
- Below β^- : 1.28×10^0 y

Numbered callouts (1-13) point to the following elements:

- 1. Potassium
- 2. K
- 3. 19
- 4. 39.0983
- 5. 0.86
- 6. [Ar]4s
- 7. 760°
- 8. 63.25°
- 9. β^-
- 10. 1.28×10^0 y
- 11. 19
- 12. 39.0983
- 13. 0.86

Materials

- Periodic table sheet
- Scissors

Safety Precautions

This laboratory activity is considered nonhazardous. Please follow all laboratory safety guidelines.

Procedure

1. Your instructor will give each lab group a sheet containing nine elements from the periodic table without their name or atomic number.
2. Using scissors, cut along the dotted lines resulting in nine element cards.
3. Arrange these nine elements into three rows and three columns according to the definition of periodic and family found in the background section.
4. Each element lists characteristics of weight, density, boiling point, melting point, valences, number of isotopes and number of radioactive isotopes. Determine which characteristics are periodic and which are constant. *Note:* Constant changes may occur if you add the characteristics in the top and bottom element of a family and divide by to yield the property of the middle element.