GENESIS SEARCH FOR ORIGINS — Education

Cosmic Chemistry: Understanding Elements

A Historic Overview: Mendeleev and the Periodic Table

TEACHER GUIDE SUPPLEMENT

IT'S ALL IN THE FAMILY (choose one)

Present the two options to the students.

1. Draw a family tree for your immediate and extended family. Include photographs if available.

   Model this process by drawing an example of your family tree. Once this is done students may work on a rough draft. Ask students to complete as much of their family trees at school as possible, based upon their own knowledge of family history. Students can then take their family trees home and elicit help from family members.

2. Conduct an oral history interview of a friend or family member. Steps on how to do this are located at http://www.kbyu.org/capturingpast/. Follow the procedure entitled "Capturing the Past: How to Prepare and Conduct an Oral History Interview."

   This option was written for students who may have trouble finding information about their history. For students who are completing question two, ask them to find (on a computer) the location listed in the question. Students should read the four steps required to conduct an oral history and complete the steps.

   For both questions, students should prepare a presentation for the class that communicates what they learned from this process.

THE TRIAD MODEL

Use an example of ordering soft drinks at a fast food restaurant. Normally soft drinks come in three sizes: small, medium, and large. Relate this to Dobereiner's Triad model of classifying elements. Ask students the different sizes of soft drinks. Most will say 12, 16 and 20 oz. Show that the arithmetic mean of the volume of the small and the large drinks is the volume of the medium drink. $12 + 20 = 32/2 = 16$. Explain that in the Triad model elements were classified in groups of three. The atomic weight of the middle element was the average of the other two.

1. Explain how Johan Dobereiner classified elements.

   He classified elements in small groups of elements that had similar physical properties. Elements were found in groups of three. Therefore, Dobereiner called them triads. The intermediate element in this threesome had the average atomic weight and density of the other two.

2. Why was the Triad model eventually not useful?
   Newly discovered elements did not follow this rule.

THE LAW OF OCTAVES

Relate the Law of Octaves to colorful beads on a necklace. Using colored chalk or colored overhead pens, draw circles to represent a necklace. Use eight colors that repeat. Explain that in the Law of Octaves properties of elements were similar in every eighth element and not the same as in the necklace example. Ask students to think of other examples of recurring numbers of eight. One example is the octave of notes in music.

1. What did John Newlands use to arrange the elements?

Newland arranged elements according to the increasing order of atomic weights.

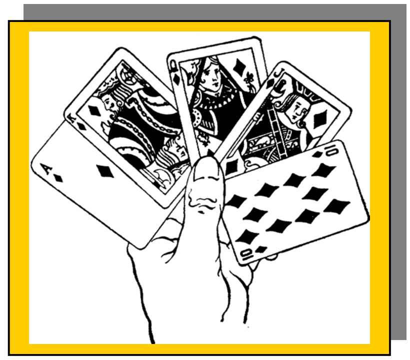
2. Why was his model called the Law of Octaves?

   He noted that chemically similar elements occurred in every eighth element.

3. Give two reasons why Newlands' law was not a good model?

   Some known elements did not fit into his model and his model did not allow for the possibility of the discovery of additional elements at a later date.

MENDELEEV



Atoms of various elements differ in how many atoms of another element they combine with. Use the following example with playing cards to illustrate this point. In groups of four, have each student match the king and queen of each suit and keep one pair.

The dealer should then shuffle the cards and deal them out giving each student the card from their suit. Once a student has at least four cards total, they should not receive any more cards. Ask students to match up the King with one of the cards they were dealt. Tell them to do the same with the Queen. Explain that the King or Queen represents an element that can combine with a card from that suit. Relate this to elements that can combine with chlorine. Such as iron, sodium, copper, potassium and cesium. Using the representation ECl, ask students what the E represents. Ask students to relate this to the card demonstration. (E stands for the cards in the same suit, Cl is the King or Queen)

3. What question did Mendeleev ask that formed the basis of today's periodic table?

   What is the relationship of the elements to one another and to the chemical families to which they belong?

4. State Mendeleev's periodic law.

   The properties of the elements are a periodic function of their atomic weights.

5. Why did Mendeleev leave out hydrogen from his game of cards?

   Its properties were not like any other element.

6. Describe how Mendeleev placed his element cards for the first seven elements.

   In vertical columns from lowest (top) to highest (bottom) atomic mass.

7. If Mendeleev found an element with physical or chemical properties that were similar to another element, he placed it ____________ to it.

   Next

8. What was the first problem that Mendeleev encountered?

   Titanium did not fit next to aluminum because it had different properties; titanium had closer properties to silicon.

9. How did he solve this problem?

   He did not make it fit. Rather, he put it next to silicon where he thought it belonged and left a gap next to aluminum.

Mendeleev predicted there was an element with properties similar to boron and aluminum with atomic mass between that of calcium and titanium. Mendeleev in fact predicted the properties of scandium which was not discovered until 1878. Mendeleev also predicted properties he called "ekasilicon," which was eventually discovered in 1886.

10. Which of the examples from above was an extrapolated prediction. Which was an interpolated prediction?

    Extrapolated: "ekasilicon" because its properties were found beyond known data points.
    Interpolated: scandium because its atomic weight was between two known data points.

11. Give another example of an interpolated and extrapolated prediction made by Mendeleev.

    Interpolated: Sc, Ga, Ge, and Po
    Extrapolated: Ga

12. Find Mendelevium on the Periodic Table of Elements. How is this element classified? Where can it be found?

    Atomic Number 101
    Mass Number 258
    Rare Earth Element
    Synthetically produced