FAMILY VALUES: 
THE PERIODIC CHART

KEY CONCEPT

The present day periodic chart illustrates, within its format, relationships that allow chemists to predict the properties of the elements.

SKILLS . . . . . . . . . . observing, analyzing
TIME . . . . . . . . . . . . 30 minutes
AUDIENCE . . . . . . . students in grades 5 – 8
NATIONAL SCIENCE CONTENT STANDARDS......
U-1. Systems, Order, and Organization
U-2. Evidence, Models, and Explanations
G-3. History of Science

SAFETY: There are no special safety considerations for this activity.

Background for Teachers

CONTENT FOCUS

The arrangement of the elements in the periodic table can be likened to the arrangement of the days of the month on a calendar. The days of the month on a calendar start with 1 and increase one at a time up to 30 or 31 (or 28 or 29 for February). The elements are arranged in order of increasing atomic number (a measure of how many positive particles [protons] an atom has in its nucleus). The atomic numbers of the elements start with 1 for hydrogen (H on the periodic table) and increase by one with each additional element (up to element #110 presently) just as the days of the month increase successively by one number on the calendar.

The calendar is based on a cycle of seven with each day of the week occurring at a regular interval. (A Friday occurs once every seven days. When Friday is over, we have to wait six days until there is another Friday.) For most people, each day of the week has particular activities associated with it. For example, some people reserve Sunday for religious activities, Monday might be the day to do the laundry, Friday might be set aside for shopping, and Saturday might be reserved for going out for dinner and a movie or similar entertainment. On the calendar, all of the days which are similar (all of the Sundays, all of the Mondays, etc.) line up in a vertical column.
The periodic table of elements, is based on a cycle of eight. Just as the days of the week and their associated activities (grocery shopping, going to church, etc.) occur at regular intervals, the properties of the elements (reactivity, luster, melting point, density, etc.) occur at regular intervals. (Every eighth element has similar properties.) The vertical columns on the periodic table, like the days of the week on the calendar, contain elements with similar properties. These columns are called groups or families. Even though all Sundays in a month may involve similar activities, no two Sundays are exactly alike. Likewise, even though elements listed in the same vertical column on the periodic table are similar, no two elements are exactly alike.

A horizontal row on a calendar is called a week; horizontal rows on a periodic table are called periods. For the elements on the periodic table, there are also certain trends within periods. Atomic radius, for example, tends to decrease as you go from left to right in a period.

Suppose a friend asks you to go to a movie 4 days from now. If you keep a weekly calendar, you can predict whether or not you can go. Chemists can predict the properties of an element by referring to the periodic table since the properties of the element should be similar to the properties of the other elements in the family. In fact, these “periodic” relationships between the elements allowed early scientists to leave “spaces” in the periodic chart for elements that had not yet been discovered.

### ADVANCE PREPARATION

The patterns should be prepared by the teacher from colored overhead transparency sheets using the patterns found in the appendix.

Use the ‘family figures’ for younger students. Each family could be colored a different color with permanent transparency pens, rather than using colored overhead sheets.

For the geometric patterns, divide the set into the subsets as indicated below and put them into numbered envelopes to be distributed to the groups of students. An overhead transparency should be made of the periodic chart showing atomic sizes.

**ENVELOPE #1**

All yellow figures except . . .
- 4-sided
- 7-sided
- 10-sided

**ENVELOPE #2**

All red figures except . . .
- 4-sided
- 6-sided
- 7-sided

**ENVELOPE #3**

All green figures except . . .
- 3-sided
- 7-sided
- 9-sided

**ENVELOPE #4**

All blue figures except . . .
- 5-sided
- 6-sided
- 10-sided
The Activity

MATERIALS
(per class)
4 envelopes containing shapes cut from transparency film
4 sheets of typing paper
4 sheets of clear, colorless transparency film and colored transparency pens
Overhead projector

PROCEDURE (for family shapes)

1. Prepare an envelope with 8-10 family members missing (several different ones should be missing from each family).

2. Inform the students that you were in a hurry this morning and you grabbed this envelope and stuck it in one of your books. On your way from the car to the building, you dropped your books and spilled the contents of the envelope. The wind blew some of the pieces away and you will need to see what is missing so that you might replace the pieces.

3. Pour the contents of the envelope on the overhead projector stage. Begin spreading the pieces apart so students can see the shapes. Ask for suggestions as to how you might determine what pieces are missing.

4. Follow suggestions from several students, noting the patterns they derive and their method for organizing the pieces. Students will eventually discover that they must leave spaces for pieces not present for the pattern to flow from one color (or family) to the other.

5. Ask the students if they can think of a tool they use every week/month that has a pattern with repeating similarities (the calendar).

6. Expound on how different Sundays are not the same day, but that there are similarities (i.e., go to church, watch football games, etc.) [See content section]

7. Relate the story of Mendeleev and his attempt to order the elements. Then show the overhead of the periodic chart.

8. Distribute the Prediction Sheet.

PROCEDURE (for geometric shapes)

1. Divide the students into 4 groups and give each group an envelope along with a clean overhead transparency sheet and a sheet of typing paper.
2. Have the group place the typing paper on a level surface and cover it with the transparency sheet. Inform them that they have a puzzle before them and that they are to make some sense of their objects and try to find a pattern. Ask the students to place their pieces in some kind of order on the transparency sheet and write down the explanation for their pattern. Scientists often try to “make sense” of what they see in the world around them. Sometimes it is not easy to see what might be right in front of our eyes.

3. Allow the students a few minutes to produce a pattern and write a sentence explaining their idea.

4. Have a group come to the overhead projector and arrange their pieces for the rest of the class to see. Ask them to explain their pattern. The students will probably explain their pattern in terms of size, having arranged their pieces in order of size either from largest to smallest or from smallest to largest.

5. Ask the other groups if they followed a similar pattern and had a similar explanation. The other pattern the students might notice involves the number of sides on the pieces. When the pieces are arranged in increasing order of size, the number of sides is in decreasing order. (Because the pieces have irregular shapes, students probably will not notice this pattern.)

6. Have a second group come to the overhead projector and arrange their pieces beneath those of the first group following the same basic pattern. When they do this, they will discover that they are missing some pieces that the first group had. Also, they have some pieces in their set that the first group did not have.

7. Instruct the students in the second group to move the first group’s pieces (without changing the order) so that there are blank spaces where they think pieces are missing. Now have them place their pieces in the appropriate spots beneath the first group’s pieces being sure that pieces that are the same shape line up in the same column. They will have some blank spaces in their pattern, also.

8. Call the third group to the overhead projector and have them arrange their pieces beneath those of the second group. Once again, they may have to move the pieces of the first and second groups if they have pieces that neither of the other two groups had.

9. Finally, have the last group come to the overhead projector and place their pieces beneath those of the third group. They can move the pieces of the first three groups if necessary.

10. When all of the groups have finished, have the students look at the entire pattern that is displayed on the overhead projector. Ask them if they can see another pattern in the rows aside from size. Now that they can see the pieces from the other groups (some of which fill the gaps in their own pattern), they should be able to see the pattern involving the number of sides.
11. Pick one of the blank spaces and ask students to predict what the missing piece should look like in terms of color and shape. Repeat this for as many spaces as you feel is necessary to insure student understanding.

12. Now place the transparency of atomic sizes on the overhead projector. Explain that this is a special representation of the elements on the periodic chart. This chart shows the sizes of the atoms of each element. Note that there are some elements missing. Following the same procedure as in step 11, have students try to determine the approximate atomic sizes for the missing elements.

13. For closure, distribute the “PREDICTION SHEET” for students, if desired. The Russian scientist, Dmitri Mendeleev, developed the periodic table and left spaces in his chart for elements that had not yet been discovered. One of these missing elements was located just beneath silicon on the periodic table. Using information about the elements around this space, Mendeleev predicted its properties. On the prediction sheet, students are asked to determine some properties of this missing element which Mendeleev called eka-silicon (now known as germanium).

The properties of eka-silicon (germanium) are: atomic weight = 72.6, color = gray-white, density = 5.3 g/mL. The density falls about halfway between the vertical data, but horizontally there is no such mathematical relationship. Students should, however, predict the density as being in the 5.3-5.9 g/mL range.