Name: _____ Date: _____

Completing the Periodic Table

Notice in the Periodic Table on page 24 that the elements fall into seven numbered rows (going from left to right) and 18 numbered columns (going from top to bottom). The rows are called **periods**, and the columns are called **families**. Like human families, the various families of elements "look alike" in appearance and chemical behavior.

Mendeleev's version of the Periodic Table was not perfect. In a few cases, an element's atomic mass seemed to place it in the wrong family. The insight that would explain this problem and give the Periodic Table its final form was provided by a brilliant scientist named **Henry Moseley** (1887–1915).

Recall on page 15, that atoms, the smallest particle of an element, can be broken down into smaller parts. Moseley, working with X-rays, was able to show that an element's properties were more dependent on the number of positively charged particles in an atom of that element than its mass. Those positively charged particles were later named **protons**. The number of protons in the atom of a given element defines its **atomic number**, which is listed just above the element's chemical symbol in the table. When elements are listed by their atomic number, they all fall within the proper families.

Moseley's work in the early 1900s led to the following statement of the **Periodic Law: The physical and chemical properties of the elements are periodic functions of their atomic numbers.** Moseley successfully predicted the discovery of seven new elements whose atomic numbers were not represented in the table in 1914.

1. Give the atomic numbers of the following elements:
   A. Carbon _____ B. Helium _____ C. Polonium _____ D. Lanthanum _____
   E. Thallium _____ F. Calcium _____ G. Francium _____ H. Copper _____
2. Name five elements in the fourth period of the Periodic Table.
   _____ _____ _____ _____ _____
3. Name five elements in Family 17 of the Periodic Table.
   _____ _____ _____ _____ _____
4. Which of the following groups of chemical elements would you expect to be most alike in their physical and chemical properties?
   A. Chromium, rhodium, zinc, silicon
   B. Magnesium, strontium, radium, barium
   C. Lithium, beryllium, boron, oxygen
   D. Sulfur, selenium, chlorine, krypton
5. What happens to atomic numbers going from left to right along a period in the Periodic Table? _____
6. What happens to atomic mass going from top to bottom in a family in the Periodic Table?
   _____

Name: _____ Date: _____

Family Fun: A Tour of the Periodic Table Neighborhood

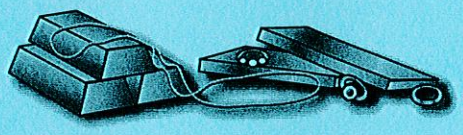
Let's tour the 18 families of the Periodic Table to get an overview. Then we'll come back to visit some neighborhoods in more detail. The first thing to notice is that the table is divided into **metals**, **nonmetals**, and long strings (in Periods 6 and 7) of something called **rare earth elements**. Most elements—90 out of 111—are metals or metal-like substances.

The "first family," called **alkali metals**, contains metals that are soft enough to cut with a knife, white and shiny, and so reactive with other substances that they are never found uncombined in nature. They're party elements! Scientists keep pure samples submerged in oil. Sodium, for example will burst into flame when placed in water.

Family 17, the **halogens**, contains nonmetals like fluorine, chlorine, and bromine that are also very reactive—mostly with the metals at the left of the table. Members of families 1 and 2 react with members of family 17 to form **salts** like sodium chloride.

Family 18 at the extreme right of the Periodic Table consists of elemental hermits. These are gases like helium, neon, and argon that almost never react with anything else. They are sometimes called the "**noble gases**" because, like royalty, they don't associate with "common" elements.

Families 13 through 16 are "blended" families with some members showing metallic properties and others the characteristics of nonmetals.



1. A. In what family do you find gold and silver? _____
   B. What family contains the metal platinum? _____
   C. What are the metals in families 3 to 12 called? _____
2. With which of the following elements would potassium (K) be most likely to react?
   A. Molybdenum B. Magnesium C. Zinc D. Bromine
3. Name three elements that would probably show similar physical and chemical properties with cobalt. _____ _____ _____
4. What is the "Mystery Element?" Here's how to find out: Take the atomic number of rhenium and subtract the atomic number of the third element in family 2. Divide that number by the atomic number of sodium. Multiply that number by the atomic number of the first element in family 17. Your answer is the atomic number of the mystery element which is _____.
5. Magnesium burns quickly in flashbulbs when an electric current passes through it, providing a bright light for exposing film. Why do you suppose the inside of the bulb containing the magnesium is filled with a "noble" gas instead of air?

   _____

Name: _____ Date: _____

"Rowing" Across the Periodic Table

Unlike the vertical families in the Periodic Table, the horizontal rows, or **periods**, contain elements that display those periodic changes that Mendeleev noticed. Think of each period as a grade level in school. Each grade level will have a math whiz, a star athlete, and a hall monitor. Each period in the Periodic Table has "hot shot" reactive metals on the left, transition metals and rare earth elements in the middle, then nonmetals and "snooty" noble gases on the far right.

And although each grade level has members with similar "jobs," the jobs are not identical because older students can do more and different things than younger students. In the Periodic Table, each row is filled with increasingly heavier elements, as you can see by looking at atomic weights. The weight and size of atoms affects both physical and chemical properties.

In the end, just like people, each element is special—one of a kind. The key to describing the basic identity of each element is provided in the squares, or **element keys**, making up the table. Remember, each element key (reading from top to bottom) gives the **atomic number** of the element, the element's **chemical symbol**, its **name**, and its **atomic weight**.

One more thing to note is that long strings of rare earth elements in periods 6 and 7 have been "lifted out" of the main part of the table and placed below it to make the table easier to read. You'll learn more about rare earth elements on page 26.

1. Using Period 3 of the Periodic Table, list
   - A. 1 other metal: _____
   - B. 2 nonmetals: _____ _____
   - C. 1 noble gas: _____
2. Using Period 5 of the Periodic Table, list
   - A. 2 other metals: _____ _____
   - B. 3 transition metals: _____ _____ _____
   - C. 1 [redacted] nonmetal: _____
   - D. 1 noble gas: _____
3. What's unusual about Period 1 of the Periodic Table? _____
   _____
4. Create an "identity key" for yourself similar to an element key box in the Periodic Table. List your age in place of atomic number, list your initials in place of the chemical symbol, write your name in place of the element's name, and list your weight in place of atomic mass. Assume you now find someone else's identity key, and it reads like this: 32, MKS, Marvin K. Sedbetter, 251

   Do you think you would be in the same "Period" as Marvin? Explain: _____
   _____

Name: _____ Date: _____

Metals, Nonmetals, and Metalloids

Metals have useful and attractive physical properties including **luster** (shininess). They **conduct heat and electricity**, and are **dense** substances with fairly **high melting points.** Metals can be stretched into wires (are **ductile**) and are **malleable**—can be pounded into all kinds of shapes without much trouble.

Chemically, metals **corrode** or react with other compounds in air and water. Iron combines with oxygen and rusts to form the compound iron oxide. Silver corrodes or tarnishes when it combines with sulfur compounds in the air.

We've seen that the **alkali metals** of family 1 are very reactive. Calcium, part of the **alkaline earth metal** family, adds strength to bones. Magnesium-aluminum alloys make strong and lightweight parts for planes, ladders, and other products.

Gold and other **transition metals** make beautiful jewelry. Cadmium and chromium are used in artists' paints. Transition metals tend to form a great variety of compounds.

Nonmetals are dull in appearance, bad conductors, brittle, and have low densities and melting points. But nonmetals are some of the most important elements on Earth. **Carbon** forms over five million organic compounds in living tissues. **Oxygen** is the most abundant element in the Earth's crust and is critical for life. **Nitrogen** makes up 70% of Earth's atmosphere. (Oxygen accounts for 20%.)

Metalloids share characteristics of both metals and nonmetals. **Silicon** and **germanium** are important **semiconductors** used in making computer chips.

1. A tube of "Brilliant Yellow" acrylic paint contains titanium dioxide. What transition metal is in this compound? _____
   What important nonmetal element is in this compound? _____
2. How would you expect a metalloid like arsenic to conduct electricity, compared to a metal?
   _____
3. The melting point of sodium is 97.8°C. Would you expect the melting point of iodine to be higher or lower? _____
4. In an old "Star Trek®" episode, Captain Kirk and Spock come across a life form called the Horta made mostly of silicon compounds. Based on silicon's place in the Periodic Table, do you think silicon compounds are a reasonable choice for an alien life form? Why or why not? _____
   _____
5. Pure gold can be fashioned into elaborate masks and thin plates that can be incorporated into clothing. What physical trait of metals does this demonstrate? _____
6. Copper wires are a great example of the fact that metals are very _____.

Name _____ Date _____

Setting the Table

The periodic table is a chart of the chemical elements arranged to show patterns of chemical or physical properties. The elements are arranged on the table based on properties they have in common. Match each term to its definition. You can use the periodic table on page 20 as a reference.

alkali metals	transition	metals
atomic number	alkaline earth metals	naturally
families	noble	periods
rare earth metals		

1. _____ Elements in the middle of the periodic table are known as these kinds of metals.
2. _____ These gases are considered inactive. They do not react with other elements.
3. _____ Most of the elements are considered to be these.
4. _____ These refer to Group I metals.
5. _____ Horizontal rows are called this.
6. _____ The elements are arranged by this.
7. _____ Vertical columns are called groups or this.
8. _____ These refer to Group II metals.
9. _____ For convenience, these are placed at the bottom so the periodic table does not become too wide to be represented in chart form.
10. _____ There are 92 elements, from hydrogen to uranium that occur in this manner.

Name _____ Date _____

Properties of Metals and Nonmetals

The elements on the periodic table are grouped by metals and nonmetals. Each group has distinct physical and chemical properties. Classify the phrases in the word box to complete the chart.

malleable	lustrous	thallium
gaseous at room temperature	ductile	brittle
[redacted]	conductor	nonconductor
[redacted]	helium	titanium
[redacted]	[redacted]	[redacted]
phosphorus	zinc	
selenium	nickel	gold
[redacted]	argon	

Properties of Metal Elements	Properties of Nonmetal Elements
Examples	**Examples**

Name _____

Date _____ Hour _____

SAMPLING THE PERIODIC TABLE

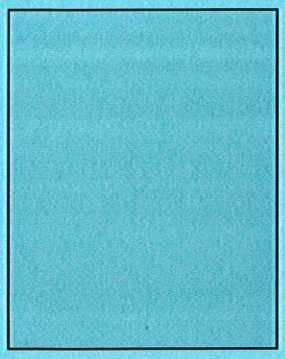
Atomic Number	Symbol	Element Name	Atomic Mass	Protons	Electrons	Neutrons	Group Number	Period Number	Metal, Non-Metal, or Metalloid
	H								
		potassium							
47									
	As								
			16						
				18					
92									

DENSITY: **The chart contains the densities of several common substances. Use the information about the densities to answer the questions that follow.**

Substance	Density (g/cm³ or g/mL)
Air	0.0013
Rubbing Alcohol	0.8
Wood	0.85
Oil	.9
Water (liquid)	1.0
Aluminum	2.7
Iron Pyrite	4.9
Copper	8.96
Silver	10.5
Lead	11.3
Gold	19.3

1. Draw a diagram that shows what would happen (based on densities) if the following items/substances were placed in a beaker: (3 pts)

   - rubbing alcohol
   - water
   - oil
   - A piece of silver
   - A piece of wood



2. Explain your diagram, in 1 sentence. Why did the substances/objects end up the way you drew them?

   _____

   _____

3. You are given a substance that has a mass of 8.1g and a volume of 3cm³.
   a. What is the density of the substance? _____
   b. What is the substance? _____

4. You are given a substance that has a mass of 45.2g and a volume of 4cm³.
   a. What is the density of the substance? _____
   b. What is the substance? _____