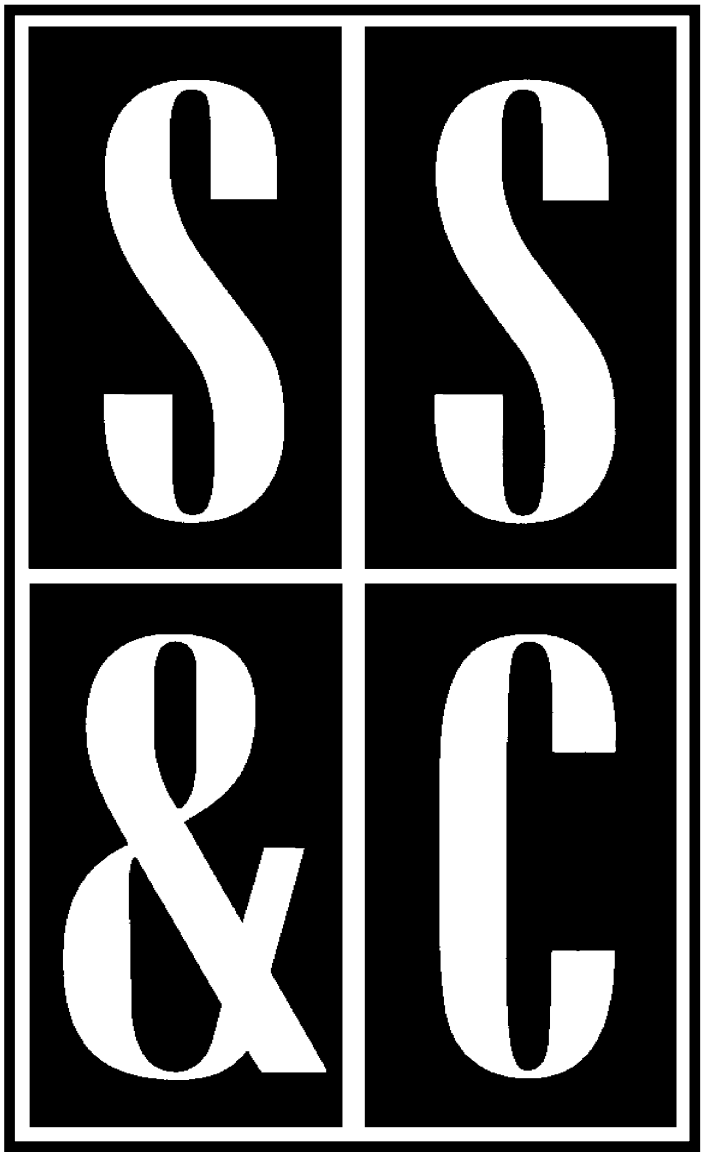
Scope, Sequence & Coordination

A National Curriculum Development and Evaluation Project for High School Science Education



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Scope, Sequence & Coordination

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National Science Education Standard—Physical Science

Structure and Properties of Matter

An element is composed of a single type of atom. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties. This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies.

Teacher Materials

Learning Sequence Item:

961

Patterns Using Metals, Nonmetals and Metalloids

March 1996
Adapted by: Glenda Burris, Sandra McCann, Ghassem Mozaffari and Dorothy Gabel

Elements, Atoms, and the Periodic Table. Students should learn that early chemists grouped elements with similar properties into families. These families could be arranged into a pattern called the periodic table. Students should classify or group elements according to their physical and chemical characteristics (metals, nonmetals, metalloids) and learn the names of common elements and their symbols. This should be done in conjunction with direct observation of samples of the various common elements whose symbols are being learned. Thus students should look at samples, touch them when safe to do so, and consider their appearance, density, and other measurable observable properties, so that the symbol for the element represents something common to their experience. (*Chemistry, A Framework for High School Science Education, p. 53.)*

Contents

This micro-unit was adapted by **Glenda Burris** and **Sandra McCann** (Northside H.S., Pinetown, N.C.), **Ghassem Mozaffari** (Jack Yates H.S., Houston, Texas), and **Dorothy Gabel** (Indiana Univ., Bloomington, Ind.)

961
Learning Sequence

Elements, Atoms, and the Periodic Table. Students should learn that early chemists grouped elements with similar properties into families. These families could be arranged into a pattern called the periodic table. Students should classify or group elements according to their physical and chemical characteristics (metals, nonmetals, metalloids) and learn the names of common elements and their symbols. This should be done in conjunction with direct observation of samples of the various common elements whose symbols are being learned. Thus students should look at samples, touch them when safe to do so, and consider their appearance, density, and other measurable observable properties, so that the symbol for the element represents something common to their experience. (*Chemistry, A Framework for High School Science Education, p. 53.)*

Science as Inquiry	Science and Technology	Science in Personal and Social Perspectives	History and Nature of Science
A Physical Challenge **Activity 1**	Elements in the Human Body **Activity 5**	Lead Poisoning **Reading 1**	The Significance of Phlogiston **Reading 2**
Elemental Classification **Activity 2**	Metalloids and Their Many Uses **Activity 6**	Elements in the Earth **Reading 3**	Tabling the Matter **Reading 4**
Name that Metal **Activity 3**	Hydrogen and Helium **Reading 6**		Element X **Reading 5**
Sulfur: A Typical Nonmetal? **Activity 4**			
Patterns of Classification **Activity 7**			
Metal Properties **Assessment 1**			
Card Tricks **Assessmen5t 2**			
Periodic Table **Assessment 3**			
Testing for Metals **Assessment 4**			

Suggested Sequence of Events

Event # 1*

Lab Activity

1. A Physical Challenge (50 minutes)

Event #2*

Lab Activity

2. Elemental Classification (50 minutes)

Alternative or Additional Activities

3. Name that Metal (50 minutes)
4. Sulfur: A Typical Nonmetal? (50 minutes)
5. Elements in the Human Body (50 minutes)
6. Metalloids and Their Many Uses (50 minutes)

Event #3

Lab Activity

7. Patterns of Classification (50 minutes)

Event #4

Readings from Inquiry, Science and Technology, Personal and Social Perspectives, and History of Science. Students select two or three from list.

Reading 1 Lead Poisoning
Reading 2 The Significance of Phlogiston
Reading 3 Elements in the Earth
Reading 4 Tabling the Matter
Reading 5 Element X
Reading 6 Hydrogen and Helium

The above readings can be found in the student version of this publication.

Assessment items can be found at the back of this volume.

*****These two events and primary lab activities are essential. Please complete them in this order. Substitutions, if needed, must be carefully chosen to avoid the disruption of the sequence.

Assessment Recommendations

This teacher materials packet contains a few items suggested for classroom assessment. Often, three types of items are included. Some have been tested and reviewed, but not all.

1. Multiple choice questions accompanied by short essays, called justification, that allow teachers to find out if students really understand their selections on the multiple choice.

2. Open-ended questions asking for essay responses.

3. Suggestions for performance tasks, usually including laboratory work, questions to be answered, data to be graphed and processed, and inferences to be made. Some tasks include proposals for student design of such tasks. These may sometimes closely resemble a good laboratory task, since the best types of laboratories are assessing student skills and performance at all times. Special assessment tasks will not be needed if measures such as questions, tabulations, graphs, calculations, etc., are incorporated into regular lab activities.

Teachers are encouraged to make changes in these items to suit their own classroom situations and to develop further items of their own, hopefully finding inspiration in the models we have provided. We hope you may consider adding your best items to our pool. We also will be very pleased to hear of proposed revisions to our items when you think they are needed.

Science as Inquiry

A Physical Challenge

Can elements be classified by physical properties?

Overview:

Using some common metallic and nonmetallic elements, students determine their characteric properties.

Materials:

Per lab group:

1 centrigram balance	6-volt battery
1 miniature lamp (flashlight)	25-mL graduated cylinder
sand paper	3 wire leads
hammer	2 alligator clips
screwdriver	1 overflow can (optional)

Sample of materials (two samples of each per group, 3 to 6 g per sample):

iron	magnesium
aluminum	carbon
tin	silicon
copper	sulfur
zinc	

Procedure:

Supply students with element samples of metals and nonmetals, and with a "Table of Densities." Samples should not be identified by name but simply labeled A–G. They can vary in mass from about 3 to 6 grams and should be in solid, non-powdered form so that students can obtain the density quite easily. Samples should include both metals (iron, aluminum, tin, copper, zinc, magnesium) and nonmetals (carbon, silicon, and sulfur). Have students make observations of the following properties: color, luster, malleability hardness and conductivity. They should design a data table and record their observations. Have students tap each sample with a hammer to determine if the element is malleable or brittle. Next, they should gently rub each sample with sand paper to determine its hardness, and also record if it is shiny or dull. Have students construct a conductivity apparatus using the materials provided and test each sample for conductivity—recording whether the element is a conductor or nonconductor. Students can obtain the density by obtaining the mass and volume of the sample (the volume can be determined by water displacement using an overflow can or by noting differences in water levels in the graduated cylinder). After completing all tests, students analyze their observations, determine which samples are metals and which are nonmetals—and, from known densities—the name of each element previously labeled A–G.

Background:

Teachers may use any samples of elements that are available to them and suitable for the activity. The test for malleability consists of tapping the sample with a hammer. If it is malleable it will flatten without shattering. If the sample shatters into a number of pieces, it is considered to be brittle. To test metals and nonmetals for conductivity, connect a six volt battery to one side of a miniature lamp. Then connect another piece of wire to the other side of the battery. Then connect another piece of wire to the other side of the miniature lamp. Test for conductivity by touching each wire lead to either side of the substance being tested. Nonmetals will generally not conduct electricity, however if the carbon is graphite, it will conduct because of the free electrons within the structure.

Sample Results

Element	Appearance	Crushing	Conductivity	Density (g/cm^3)
carbon	dull black-gray	brittle	yes (no)	1.8–2.3
zinc	shiny silver	malleable	yes	7.1
silicon	shiny gray	brittle	yes	1.6
iron	shiny gray	malleable	yes	7.9
tin	shiny silver	malleable	yes	7.3
sulfur	dull yellow	brittle	no	2.1
magnesium	shiny silver	malleable	yes	1.7
aluminum	shiny silver	malleable	yes	2.7
copper	shiny gold	malleable	yes	8.9

Variations:

Students may be asked to search for metal and nonmetal objects in the home and list how they are used. Make a list and state why each item is considered as a metal or nonmetal.

Students may be asked to collect food and other product labels. Use the labels to find common elements, write the name of the elements, its symbol and research to find the purpose of using the element in the product.

Adapted from:
American Chemical Society, *Chemunity News,* Vol. 1(3), (2), 2(3), (5), 1991, 1992, pp. 19–20.

Science as Inquiry

Elemental Classification

Can elements be classified by chemical properties?

Overview:

Using some common metallic and nonmetallic elements, students determine their characteric properties.

Materials:

Per lab group:

8 test tubes
1 test tube rack
1 test tube brush
one 10–25 mL graduated cylinder
1 forceps
1 grease or marking pencil
2 medicine droppers
1 conductivity apparatus
1 ring stand
1 ring clamp
1 wash bottle
one 400-mL beaker
8 petri dishes (or covered beakers)
hammer
sandpaper
safety goggles
apron

Solutions

50-mL 0.5 M HCl (43 mL conc. HCl /liter)
50-mL 0.1 M copper (II) chloride solution (17 g copper chloride • 2 H_2O/liter)

Sample of materials (two samples of each per group):

Sample A. 2 g carbon
Sample B. 3 cm Mg ribbon
Sample C. 2 g lump silicon
Sample D. 2 g mossy or foil Zn
Sample E. 2 g lump or roll S
Sample F. 2 g iron filings or wire
Sample G. 4 g mossy Sn
Sample H. 3 g Al foil
Sample I. 3 g Cu strip

Procedure:

These samples are identical with those used in Activity 1 in which students examined the samples for color, luster, texture , malleability, and determined their density. If students have not done Activity 1, they need to do it before doing this activity. *Caution: students need to use safe laboratory techniques.* In this activity they will be testing 6 or 7 of the above samples (as you specify) with two different solutions. After constructing a data table, students prepare test tubes for the tests. They first label the appropriate number of test tubes (one per sample) A–H, and add 5 mL of water to one of them. They use this as a reference point to mark the other test tubes at the same level as the water in the first test tube. They discard the water in the first tube.

For the first test, students place a sample of each substance in separate test tubes and add hydrochloric acid (HCl) to the marked line of each test tube. They observe and record the results. After discarding the resulting solution in a waste container, and washing remaining samples, they prepare a new set of test tubes with samples of each element as before. This time they add copper (II) chloride ($CuCl_2$) to the marked line. and observe for five minutes. After recording results, they dispose of the liquids and solids as before.

Background:

All kinds of matter exhibit a variety of characteristics or properties. Properties of matter are features or characteristics which matter exhibits. There are two basic categories of these properties, physical properties and chemical properties. Physical properties of metals and nonmetals which are used to identify or group metals and nonmetals include: malleability, ductility, brittleness, hardness, and conductivity. Malleability is the ability of a substance to be rolled or hammered into sheets. Ductility is the ability of a substance to be drawn into wires. Conductivity is the ability of a substance to conduct heat or electricity. Metals are hard, shiny, (have luster), malleable, ductile, and conduct heat and electricity. The property of brittleness is observed in nonmetals—they are not malleable but break when hammered. Nonmetals are not ductile and they often are not very good conductors of heat and electricity.

Chemical properties are properties that are only observed when one substance reacts with another substance and a chemical change occurs . When a chemical change occurs, one or more of the following usually occur: there is a change in temperature (heat released or absorbed); light (burning), color; evolution of gases (bubbles form). The ability of a substance to undergo or resist a chemical change is a chemical property. Teachers should direct students to look for bubbles, heat, light, and color changes as an indicator of a chemical change taking place.

In this experiment, the metals will react with acid if they are more active than hydrogen on the Activity Series. Hence, the copper will not react. In addition, it may take some time for the aluminum to react because it is covered with an oxide coating that is also silvery, but not quite so shiny, in appearance. The copper(II) chloride will also only react with metals more active than itself. Therefore the nonmetals will not react, and the copper will not react with it.

Variations:

Students may choose to investigate the links between metals and history, particularly the bronze and Iron ages. They may also make graphs of the abundance of several nonmetals found and then document the usage of these elements.

Adapted from:
Crow, Linda W., *Gassy Reactions,* Bayer College of Medicine, Houston, 1993, pp 3.10–3.13.

Science as Inquiry

Name that Metal

How can a metal be identified?

Overview:

Students identify metals using density and observable characteristics.

Materials:

Per lab group:

balance
graduated cylinder
overflow cans (optional)

Sample of materials (one sample per student, 40–50 g each):

aluminum
zinc
copper
iron

Procedure:

Obtain samples of the above listed metals in different shapes (regular and irregular) and dimensions. If using sheets, cut the samples into different shapes. Lightly spray the samples with black paint to conceal their identity—"identifying" each sample only as "A," "B," etc. Each team of students is given, or selects, four metals (one per student in each team). They measure mass and volume, calculate the densities of their metals and compare them to known densities (provided). They then identify other students in the class that have the same density as each of theirs, and compare their dimensions. The volumes of the samples can be obtained by measuring the dimensions if they are regularly shaped samples, or by water displacement if irregular.

Background:

The element is the simplest form of matter. Matter can be classified by physical and chemical properties. Physical properties are easily observed and include color, odor, taste, hardness, luster, malleability, ductility, conductivity, density, etc. The density of a substance can be determined if the mass and volume are known. Density does not depend on the size or shape of a substance. Sufficient size samples must be used so that the paint will not affect the density significantly and so that the volume measurement will be sufficiently large to minimize measurement errors. Because different metals have different densities, this property can be used to identify a metal. Because metal sample vary slightly in impurities, and some may also contain pockets of air (e.g., some pellets), slight variations in densities are to be expected. Densities of these four metals are as follows (density g/cm^3):

aluminum: 2.7
zinc: 7.1
copper: 8.9
iron: 7.9

Variation:

Use other metals in the same procedure.

Adapted from:
Borgford, Christie L., and Lee R. Summerlin, *Chemical Activities*, American Chemical Society Washington D.C., pp. 36–37.

Science as Inquiry

Sulfur: A Typical Nonmetal?

Is sulfur a typical nonmetallic element?

Overview:

This activity focuses on a nonmetal, sulfur. Characteristics of nonmetals are detected.

Materials:

Per lab group:

1 large test tube
1 test tube holder
one 250-mL glass beaker
1 plastic funnel
1 burner
1 ring stand with iron ring
1 magnifying lens
filter paper
matches
15–20 g roll sulfur
*safety glasses
*cloth towels

**Caution: Fire hazard. During this activity, the sulfur may catch fire and burn at the lip of the test tube. Have cloth towels readily available to smother the flame.*

Procedure:

Students should wear safety glasses for this activity. They will see six different forms of sulfur in this activity. First, students begin with roll sulfur (rhombic sulfur). They heat it carefully and note the lambda sulfur (pale yellow) which solidifies and forms monoclinic sulfur. Then they heat another sample more strongly, and note the vapor as it boils, forming a blackish liquid, (Mu). *Caution: Fire hazard. T*his changes into the amorphous form when poured into cold water. After several days, the amorphous form will turn brittle and return to the rhombic form. Because sulfur is insoluble in water, the same set of test tubes should be used by each class and can be stored until the activity is repeated.

Students will fill a test tube about 1/2 full of roll sulfur and heat is very slowly by moving it back and forth through the flame at as low a temperature as possible. The liquid will be a pale straw color. They turn off the burner and pour the liquid into a dry filter paper in a funnel. As soon as a crust has formed, they puncture the crust with a pencil or other sharp object and open the filter paper. Students examine the monoclinic crystals using a magnifying lens. They then add additional pieces of sulfur to the same test tube until it is half filled again. Then they heat it as before—but continue to heat it to boiling. They then pour it into a beaker of cold water. After 24 hours, they observe it again.

Background:

Most elements exists in only one form. Different forms of the same element are called allotropes of the element. Oxygen has two allotropes: O_2 and O_3, ozone. The allotropes of sulfur are summarized in the chart below.

ALLOTROPIC FORMS OF SULFUR

Form	**rhombic**	**monoclinic**	**amorphous**	**lambda**	**mu**	**vapor**
Formula	S_8	S_8		S_8	S_n	S_2
Structure	rings	rings	chains & rings	rings	chains	molecules
Appearance	rhombus	needles	tangled robe	thin, yellow	thick, red -black	yellow
Phase	solid	solid	solid-liquid	liquid	liquid	gas

Variations:

Use other nonmetals and repeat the procedure.

Adapted from:
Gabel, D., *Introductory Science Skills,* Prospect Heights, Ill.: Waveland Press.
Gassy Reactions, Bayer College of Medicine, Houston, 1993, pp. 3.10–3.13.

alternative activity for Event 2

Teacher Sheet

Science and Technology

Elements in the Human Body

Which elements are the most common and important in the human body?

Overview:

This reference-based activity focuses on elements in the human body. This activity, along with Activity 6, are best used as homework assignments.

Materials:

Per lab group:

Media resource equipment and reference materials

Procedure:

Students use media resources such a magazines, scientific journals, electronic encyclopedia's, and any other resource available to them through the media/computer center to research the elements found in the human body. They should include in the research the health conditions that result from the lack of or excess amount certain elements in the human diet. Using a computer, if available, students make a table, chart, or graph showing how these elements are used in the body. They should also create diagrams, graphs and pictures to display the percentage of each element found in the body.

Background:

There are more than 20 elements found in the human body. About 95% of the human body mass is made up of only four elements—carbon, oxygen, hydrogen, and nitrogen. Elements like copper, selenium and boron are found in trace amounts but are essential to proper health. If these trace elements are introduced into the body in large quantities they become toxic.

Variations:

Students do research to find the percentage of elements found in the earth's crust/atmosphere rather than the human body.

Adapted from:

Focus on Physical Science, Columbus, Ohio: Charles E. Merrill Publishing Co., p. 85.

alternative activity for Event 2

Teacher Sheet

Science and Technology

Metalloids and Their Many Uses

What are the metalloids and how are they used?

Overview:

This activity uses a variety of references to research metalloids. Activity 6 and Activity 5 are best used as homework assignments.

Materials: (possible homework)

Per lab group:

Media resources

Computer lab

Procedure:

Have students research the properties and uses of metalloids—using the Internet as well as other media resources. Students record the information obtained through their research as a brief paragraph. Next, using one page per metalloid, students list the name, symbol and general use of each metalloid. They should add a picture or sketch representative of a property or the use of each metalloid. All information should be written neatly or typed and placed in a booklet. Students must include a bibliography.

Background:

Students may have limited research skills. Teachers need to be prepared to demonstrate library research skills and to model construction of booklets. Be sure to have students use current resource materials.

Variation:

Combine this activity with Activity 5.

Adapted from:

Focus on Physical Science, Columbus, Ohio: Charles E. Merrill Publishing Co., 1989, p. 23.

Science as Inquiry

Patterns of Classification

How did scientists construct the Periodic Table?

Materials:

Per group:

1 set of cards containing the properties of the elements

Procedure:

Create a set of cards which contain the following descriptive information (not the name of the element) on separate cards for each element: ionization energy, atomic mass (in bold), atomic radius, electro-negativity, melting point, formulas of fluoride, hydroxide, and common oxides. Randomly leave out some information on a few of the cards. Use elements from atomic number 3 through 83, excluding the transition metals and selenium. Remove at least one card per group. Students will place the missing card in their arrangement later in the exercise.

Provide each group of students with a set of cards. Have them organize the cards into a logical pattern of rows and columns based upon the information on the cards, so that the values follow either an increasing or decreasing pattern—both vertically and horizontally. Students do not need to know what the values on the cards represent, except to note that values that are in the same position on all cards represent the same property. Tell students that there are missing cards.

After students have made their arrangements, they should explain why they arranged the cards in a particular order.

Background:

In 1869, Dimitri Mendeleev of Russia and Lothar Meyer of Germany independently published their periodic arrangement of the elements. Both of these periodic arrangements were based on increasing atomic weights. The elements were tabulated so that those with similar chemical properties fit into columns to form family groups. This arrangement left vacant spaces for undiscovered elements.

Several modifications were made to Mendeleev's table over the years. First, a new family of elements—the noble gases—was discovered and added to the table. Then it was observed that discrepancies arose in the table when elements were listed according to increasing atomic weight. In 1887, the British physicist, H. G. J. Moseley resolved the discrepancy by establishing that elements should be arranged in order of increasing number of particles in the nucleus—namely, the atomic number. This correction led to the current statement of the Periodic Law which states that properties of the elements are periodic functions of their atomic numbers.

Values of the various properties of elements 3 through 83 for this activity can be found in any chemistry handbook, in most college chemistry textbooks, as well as in some high school chemistry textbooks.

Variations:

Have students graph one or two of the values of the elements' properties vs. atomic number.

Adapted from:
Walsh, Maria R., "Mini-Mendeleev," NSTA Convention, Indianapolis Ind., 1987.
Hein, Morris, *Foundations of College Chemistry,* 3rd Ed., pp. 92–104.

Science as Inquiry

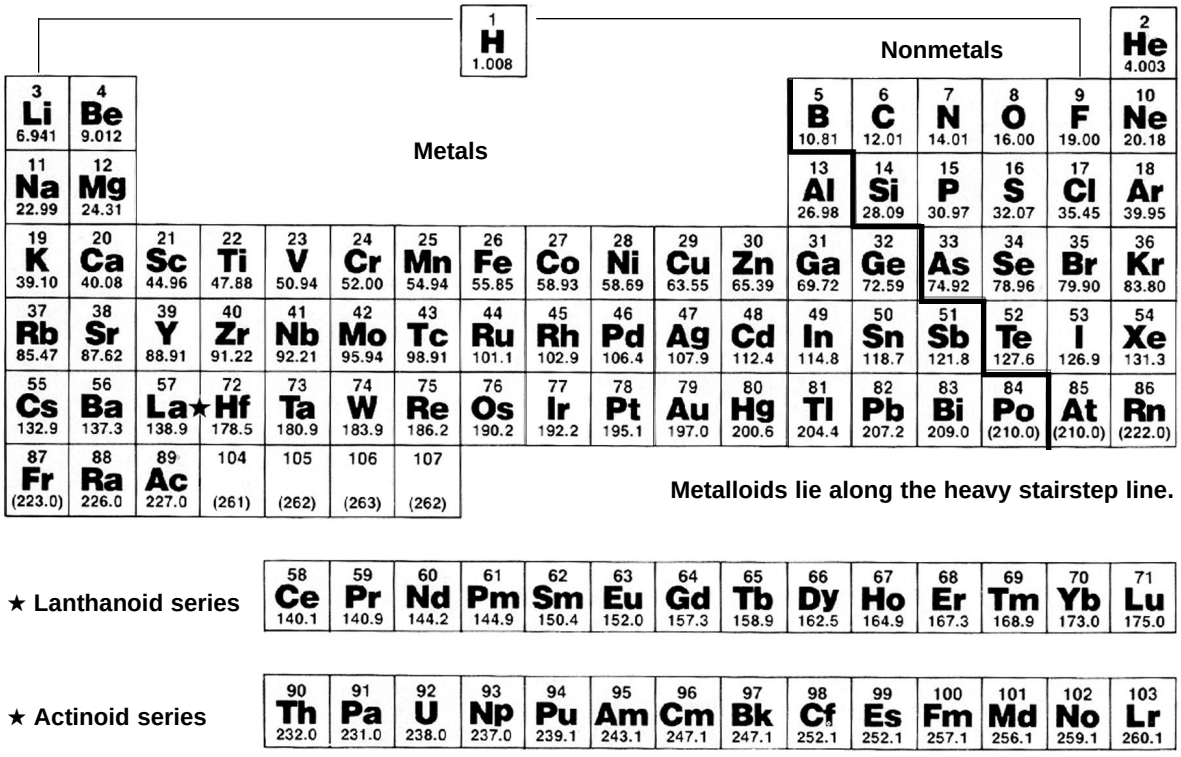
Metal Properties

Item:

The Periodic Table lists elements which can be grouped as either metals, nonmetals, or metalloids. Study the substances described below. Which of the substances is not a metal?

A. Substance A, a copper-colored solid used to make wires.
B. Substance B, a good reflector of heat and light.
C. Substance C, a brittle solid which shatters when hammered.
D. Substance D, a shiny liquid which conducts heat and electricity well.

Periodic Table of the Elements



1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.21	42 Mo 95.94	43 Tc 98.91	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La★ 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (210.0)	85 At (210.0)	86 Rn (222.0)
87 Fr (223.0)	88 Ra 226.0	89 Ac 227.0	104 (261)	105 (262)	106 (263)	107 (262)											

★ Lanthanoid series	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 144.9	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
★ Actinoid series	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu 239.1	95 Am 243.1	96 Cm 247.1	97 Bk 247.1	98 Cf 252.1	99 Es 252.1	100 Fm 257.1	101 Md 256.1	102 No 259.1	103 Lr 260.1

Justification:

Consider your choice above. Describe one way to test the substance to further confirm it is not a metal.

Answer:

C. Nonmetallic elements are usually poor conductors of heat and electricity. As solids, they are brittle and are neither ductile nor malleable. A reasonable test of the substance would be to check its ability to conduct electricity.

Science as Inquiry

Card Tricks

Item:

In the late 1800s, the Russian scientist Demitri Mendeleev was able to arrange an early version of the Periodic Table by placing the name of each known element on a card and grouping the cards by the chemical properties of the elements they represented. Describe the challenges and/or difficulties Mendeleev must have faced in attempting to create an accurate and useful table of elements.

Answer:

Science as Inquiry

Periodic Table

Item:

Researchers are continually working on the development of new elements. These new elements must then be placed on the Periodic Table. What would be the best way to determine where a new element should be listed on the Periodic Table if the atomic number and mass number are unknown? Explain your reasoning.

Answer:

Elements with similar properties are grouped into families, and these families are generally arranged in vertical columns. Therefore, determine the element's chemical properties and place it with the family it most resembles. Since the table already includes consecutive elements of atomic numbers 1 through 106 (at least), the new element would be "heavy" and will need to be placed at the bottom of the associated chemical family.

Science as Inquiry

Testing for Metals

Performance assessment:

Provide students will different samples that were not used in the lab activities. Chromium may be a good one to include for this assessment.

Materials. Along with those samples, supply a balance, miniature lamp, sand paper, hammer, 6 volt battery, 25-mL graduated cylinder, 3 wires, water, overflow can, and CRC or table of physical properties.

Procedure. Using these materials, determine whether the samples are metals, nonmetals or metalloids. Provide a justification for each decision. Provide a justification for each decision.

Justification:

Answer:

Consumables

Item	Quantity (per lab group)	Event
aluminum	2 (3–6 g)	1, 2
carbon	2 (3–6 g)	1, 2
copper	2 (3–6 g)	1, 2
copper II chloride 0.1M	50 mL	2
hydrochloric acid, 0.5M	50 mL	2
iron filings or wire	2 (3–6 g)	1, 2
magnesium, ribbon	2 (3–6 g)	1, 2
silicon, lump	2 (3–6 g)	1, 2
sulfur, lump or roll	2 (3–6 g)	1, 2
tin, mossy or foil	2 (3–6 g)	1, 2
zinc, mossy or foil	2 (3–6 g)	1, 2

Non-Consumables

Item	Quantity (per lab group)	Event
alligator clips	3	1
balance, centigram	1	1
battery, 6 volt	1	1
beaker, 400 mL	1	2
overflow can	1	1
cylinder, 25 mL	1, 1	1, 2
dropper	2	2
conductivity apparatus	1	2
element cards	1 set	7
forceps	1	2
hammer	1 per class	1, 2
lamp, flashlight	1	1
pencil, grease	1	2
petri dishes	8	1
ring clamp	1	2
ring stand	1 per student	2
safety goggles	1	2
sand paper	small piece	1, 2
screwdriver	1 per class	1
test tubes	8	2
test tube rack	8	2
test tube brush	1	2
wash bottle	1	2
wire	3	1

Activity Key
1. A Physical Challenge
2. Element Classification
3. Patterns of Classification