SCOPE, SEQUENCE, and COORDINATION

A National Curriculum Project for High School Science Education

This project was funded in part by the National Science Foundation. Opinions expressed are those of the authors and not necessarily those of the Foundation. The SS&C Project encourages reproduction of these materials for distribution in the classroom. For permission for any other use, please contact SS&C, National Science Teachers Association, 1840 Wilson Blvd., Arlington, VA 22201-3000.

SCOPE, SEQUENCE, and COORDINATION

SS&C Research and Development Center
Gerry Wheeler, *Principal Investigator*
Erma M. Anderson, *Project Director*
Nancy Erwin, *Project Editor*
Rick McGolerick, *Project Coordinator*
Arlington, Va., 703.312.9256

Evaluation Center
Frances Lawrenz, *Center Director*
Doug Huffman, *Associate Director*
Wayne Welch, *Consultant*
University of Minnesota, 612.625.2046

Houston SS&C Materials Development and Coordination Center
Linda W. Crow, *Center Director*
Godrej H. Sethna, *School Coordinator*
University of Houston-Downtown, 713.221.8583

Houston School Sites and Lead Teachers
Jefferson Davis H.S., Lois Range
Lee H.S., Thomas Ivy
Jack Yates H.S., Diane Schranck

California Coordination Center
Tom Hinojosa, *Center Coordinator*
Santa Clara, Calif., 408.244.3080

California School Sites and Lead Teachers
Sherman Indian H.S., Mary Yarger
Sacramento H.S., Brian Jacobs

Iowa Coordination Center
Robert Yager, *Center Director*
University of Iowa, 319.335.1189

Iowa School Sites and Lead Teachers
Pleasant Valley H.S., William Roberts
North Scott H.S., Mike Brown

North Carolina Coordination Center
Charles Coble, *Center Co-Director*
Jessie Jones, *School Coordinator*
East Carolina University, 919.328.6172

North Carolina School Sites and Lead Teachers
Tarboro H.S., Ernestine Smith
Northside H.S., Glenda Burrus

Puerto Rico Coordination Center*
Manuel Gomez, *Center Co-Director*
Acenet Bernacet, *Center Co-Director*
University of Puerto Rico, 809.765.5170

Puerto Rico School Site
UPR Lab H.S.

* * * * * * * * * * * *

Pilot Sites
Site Coordinator and Lead Teacher
Fox Lane H.S., New York, Arthur Eisenkraft
Georgetown Day School, Washington, D.C., William George
Flathead H.S., Montana, Gary Freebury
Clinton H.S., New York, John Laffan*

*not part of the NSF-funded SS&C Project.

Advisory Board

Dr. Rodney L. Doran (Chairperson), University of Buffalo

Dr. Albert V. Baez, Vivamos Mejor/USA

Dr. Shirley M. Malcom, American Association for the Advancement of Science

Dr. Shirley M. McBay, Quality Education for Minorities

Dr. Paul Saltman, University of California-San Diego

Dr. Kendall N. Starkweather, International Technology Education Association

Dr. Kathryn Sullivan, Ohio Center of Science and Industry

Project Associates

Bill G. Aldridge
SciEdSol, Henderson, Nev.

Dorothy L. Gabel
Indiana University

Stephen G. Druger
Northwestern University

George Miller
University of California-Irvine

Student Materials

Learning Sequence Item:

1042

The Periodic Table, Electrons, and Chemical Bonds

January 1997
Adapted by: Gary Freebury, George Miller, and Linda Crow

Chemical Formulas and Chemical Bonds. Using an element's position on the periodic table and the idea of stable octets, students should determine the number of valence electrons the element would transfer or share in forming chemical bonds and the type of bonding that would occur when the element combines with another (*Chemistry, A Framework for High School Science Education, p. 56).*

Contents

This micro-unit was adapted by **Gary Freebury** (Flathead High School, Kalispell, Mont.), **George Miller** (University of California, Irvine), and **Linda W. Crow** (University of Houston-Downtown)

Student Sheet

Science as Inquiry

Table Tales

What can we find out using the periodic table?

Overview:

The periodic table can be a useful reference, but you must know how to use it. This activity will give you some practice.

Procedure:

Examine your periodic table and key. What types of information does the periodic table give you? Using the table, determine the number of valence electrons for the following elements: hydrogen, helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon, sodium, magnesium, aluminum, silicon, phosphorus, sulfur, chlorine, argon, potassium, and calcium. Organize your data in a table.

Now predict whether an element will lose or gain electrons and how many electrons will be involved in this process, recording your predictions on your table.

Questions:

1. What types of information does the periodic table provide?

2. Where on the table is this information located?

3. Why are the valence electrons so important?

4. What is indicated by an element's group in the periodic table?

Science as Inquiry

Predicting a Formula

How can we experimentally determine the formula of a compound?

Overview:

In this activity you will use chemicals as color indicators to determine the formula of a simple compound.

Procedure:

Your teacher will demonstrate use of color indicators. Ater the demonstrations, set up 11 test tubes in the first row of a 96-well plate. Add 24 drops of sodium hydroxide to test tube 1and 24 drops of cobalt chloride to test tube 11. Next add cobalt chloride to test tubes 2 through 10. First add 4 ml to test tube 2. You should then add 2 mL more cobalt chloride to each subsequent test tube (6 mL to test tube 3, 8 mL to test tube 4, etc.).

Now add sodium hydroxide to test tubes 2 through 10. First add 20 drops to test tube 2. Next, add 2 drops *less* to each subsequent test tube (18 drops to test tube 3, 16 drops to test tube 4, etc.)

When you have completed these additions, each test tube should contain the same volume—24 drops. Use a toothpick to stir the solutions. Allow the test tubes to rest for approximately 30 minutes so that the precipitates settle to the bottom.

Construct a table showing the number of drops of cobalt chloride in each tube, the number of drops of sodium hydroxide in each tube, and the ratio of the number to drops of cobalt chloride to the number of drops of sodium hydroxide. After the precipitates have settled, measure the height of the precipitate in each test tube in millimeters and record these heights in your data table.

Next add the indicators:

Ammonium thiocyanate (NH_4SCN). Add 2 drops of NH_4SCN to each test tube, beginning with test tube 11, until there is no color change (2 drops to test tube 11, 2 drops to test tube 10, etc.)

Phenolphthalein. Add 2 drops of phenolphthalein to each test tube, beginning with test tube 1, until there is no color change (2 drops to test tube 1, 2 drops to test tube 2, etc.).

Note any color changes and record these observations in your data table.

Questions:

1. Which ratio of cobalt chloride to sodium hydroxide produced the most precipitate?

2. What is the balanced equation for the reaction between cobalt chloride and sodium hydroxide?

3. Which test tubes contain an excess of cobalt? How do you know?

4. Which test tubes contain an excess of hydroxide? How do you know?

Science as Inquiry

Naming a Binary Compound

What does the name of a compound tell us about the formula?

Overview:

In the previous activity, you experimentally determined the formula of a compound. But is there an easier and quicker way? What does the name of a compound tell us? Here you will examine the relationship between the formulas of simple compounds and their binary names.

Procedure:

Supply the missing names produced by the reactions on the following page.

Questions:

1. When lithium metal reacts with chlorine, hydrogen, or oxygen, what are the names and formulas for the resulting compounds? How do you know this?

2. What are the correct formulas for barium oxide, boron trichloride, and arsenic trihydride?

$Mg(s) + H_2(g)$	$\longrightarrow$	$MgH_2(s)$
$2Mg(s) + O_2(g)$	$\longrightarrow$	$2MgO(s)$
$Mg(s) + Cl_2(g)$	$\longrightarrow$	$MgCl_2$
$2Al(s) + 3H_2(g)$	$\longrightarrow$	$2AlH_3$
$4Al(s) + 3O_2(g)$	$\longrightarrow$	$2Al_2O_3(s)$
$2Al(s) + 3Cl_2$	$\longrightarrow$	$2AlCl_3$
$C(s) + 2H_2(g)$	$\longrightarrow$	$H_4C(g)$
$C(s) + O_2(g)$	$\longrightarrow$	$CO_2(g)$
$C(s) + 2Cl_2(g)$	$\longrightarrow$	CCl_4
$S(s) + H_2(g)$	$\longrightarrow$	$H_2S(g)$
$S(s) + O_2(g)$	$\longrightarrow$	$SO_2(g)$
$S(s) + Cl_2(g)$	$\longrightarrow$	SCl_2
$H_2(g) + Cl_2\ (g)$	$\longrightarrow$	$2HCl$
$2Cl_2(g) + O_2(g)$	$\longrightarrow$	$2Cl_2O$
$N_2(g) + 3H_2(g)$	$\longrightarrow$	$2H_3N(g)$
$2N_2(g) + 3O_2(g)$	$\longrightarrow$	$2N_2O_3$
$N_2(g) + 3Cl_2(g)$	$\longrightarrow$	$2NCl_3$
$F_2(g) + H_2(g)$	$\longrightarrow$	$2HF$

g = gas

s = solid

Student Sheet

Science as Inquiry

Bonding Properties

How do compounds reveal their bonding?

Overview:

Just by looking at a compound, can you tell what type of bonds it has? In this activity you will test the physical properties (melting point, hardness, odor, solubility in water, electrical conductivity) of sodium chloride and silicon dioxide (sand) to compare their similarities and differences.

Procedure:

Place 1-g samples of sodium chloride and silicon dioxide (sand) in separate evaporating dishes. Test their hardness by rubbing each solid with the end of a stirring rod. Next smell each substance (an odor usually indicates volatility).

Next add a small sample of each solid to separate test tubes. Place these tubes in a hot water bath and test for melting point. If the substances do not melt in the hot water bath, transfer the materials from the test tubes to evaporating dishes. Using a burner flame, again try to determine the melting point.

To test for solubility, mix 0.5 g of each sample with 5 mL of water. Stopper and shake the tubes, looking for any signs of the solids dissolving. Save these solutions for the next step.

Test the conductivity of the substances using a simple conductivity tester (battery, small bulb, and wire) to see if the substances will conduct an electrical current in the solid state and/or in a solution (saved from solubility test).

Organize your data in a table and compare it with that of other lab groups.

Questions:

1. How were the two substances different? Similar?

2. How many valence electrons do sodium and chlorine possess? What type of evidence does this provide?

3. How many valence electrons do silicon and oxygen possess? What type of evidence does this provide?