Grade 6
Science
Unit 3: Elements, Compounds, and Reactions

Time Frame: Approximately five weeks

Unit Description

This unit is designed to incorporate tasks that will introduce the student to the basics of chemical reactions and atomic structure.

Student Understandings

An understanding of the structure of the atom, properties of the atom, and various ways that elements react are the foci of this unit. The periodic table should be introduced, and students should learn the basis for placement of an element on the chart, as well as the information about the element that is included on this reference tool. Students should be able to identify an element's atomic mass and know the relationship of atomic number to the number of protons and electrons. Students should recognize that some solutions are better conductors of electricity.

Guiding Questions

1. Can students model atomic structure in chemical reactions?
2. Can students recognize and identify the factors that determine the rate of a chemical reaction?
3. Can students explain how an element's mass is determined from the periodic table?
4. Can the student explain the difference between covalent and ionic bonding?
5. Can students describe how the mass of the products in a chemical reaction compares with the mass of the reactants in that reaction?

Unit 3 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
Note: The following Science as Inquiry GLEs are embedded in the suggested activities for this unit. Other activities incorporated by teachers may result in additional SI GLEs being addressed during instruction.	
1.	Generate testable questions about objects, organisms, and events that can be answered through scientific investigation (SI-M-A1)

GLE #	GLE Text and Benchmarks
2.	Identify problems, factors, and questions that must be considered in a scientific investigation (SI-M-A1)
3.	Use a variety of sources to answer questions (SI-M-A1)
4.	Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2)
5.	Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment (SI-M-A2)
6.	Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
7.	Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)
8.	Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
10.	Identify the difference between description and explanation(SI-M-A4)
11.	Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
12.	Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
14.	Develop models to illustrate or explain conclusions reached through investigation (SI-M-A5)
15.	Identify and explain the limitations of models used to represent the natural world (SI-M-A5)
16.	Use evidence to make inferences and predict trends. (SI-M-A5)
18.	Identify faulty reasoning and statements that misinterpret or are not supported by the evidence (SI-M-A6)
19.	Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
21.	Distinguish between observations and inferences (SI-M-A7)
22.	Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)
23.	Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8)
25.	Compare and critique scientific investigations (SI-M-B1)
28.	Recognize that investigations generally begin with a review of the work of others (SI-M-B2)
29.	Explain how technology can expand the senses and contribute to the increase and/or modification of scientific knowledge (SI-M-B3)
30.	Describe why all questions cannot be answered with present technologies. (SI-M-B3)
31.	Recognize that there is an acceptable range of variation in collected data (SI-M-B3)
33.	Evaluate models, identify problems in design, and make recommendations for improvement (SI-M-B4)

GLE #	GLE Text and Benchmarks
34.	Recognize the importance of communication among scientists about investigations in progress and the work of others (SI-M-B5)
35.	Explain how skepticism about accepted scientific explanations (hypotheses and theories) leads to new understanding (Si-M-B5)
36.	Explain why an experiment must be verified through multiple investigations and yield consistent results before the findings are accepted (SI-M-B5)
37.	Critique and analyze their own inquiries and the inquiries of others (SI-M-B5)
Physical Science	
1.	Measure and record the volume and mass of substances in metric system units (PS-M-A1)
3.	Construct models that replicate atomic structure for selected common elements from the periodic table (PS-M-A2)
4.	Differentiate between the physical and chemical properties of selected substances (PS-M-A3)
5.	Compare physical and chemical changes (PS-M-A3)
9.	Describe the properties of reactants and products of chemical reactions observed in the lab (PS-M-A6)
10.	Identify the average atomic masses of given elements using the periodic table (PS-M-A7)
12.	Determine the effect of particle size of the same reactants on the rate of chemical reactions during a lab activity (e.g., powdered vs. solid forms) (PS-M-A8)
13.	Use a variety of resources to identify elements and compounds in common substances (PS-M-A9)
18.	Explain how the resistance of materials affects the rate of electrical flow (PS-M-B2)
30.	Trace energy transformations in a simple system (e.g. flashlight)(PS-M-C2)
40.	Identify heat energy gains and losses during exothermic and endothermic chemical reactions (PS-M-C7)

Sample Activities

Activity 1: A is for Atom (SI GLEs: 3, 14, 15, 19, 28, 29, 30, 34, 35; PS GLE: 3, 10)

Materials List: textbooks**,** resource books, copies of Internet resource materials to share, teacher-created element cards from which students can select an element name to create as a Bohr model (select atoms from the periodic table that have small atomic mass so that there are less particles to place in the nucleus and on each shell of a Bohr Model), cardstock or construction paper on which models can be created, colored paper or foam shapes to cut and use to represent neutrons, electrons, and protons, glue, markers, pencils, scissors, science learning logs, Periodic Table of Elements from textbook or other teacher resources (poster)

This is a two-part activity. Part One is to research the history and progression of the model of the atom. In Part Two, students re-create a Bohr-type model of one of the elements of the periodic table.

Part One: Provide access to or assign research of the progression of models of the atom through the works of Dalton, Rutherford, Thomson and Bohr. Discuss how one scientist's skepticism about another scientist's theory leads to a new investigation. While this research does not include all scientists who contributed to the development of ideas about the structure of atoms, it does provide an evolving pattern that will allow students to see that ideas are constantly being evaluated and reworked. It is through the investigation of the history of the atom that students will begin to see how science is constantly changing. Technology broadens our awareness of the atom and its parts. While newer theories are available, the Bohr Model offers an easy to understand arrangement of the particles.

Have student groups present their information in an order that reflects the evolution of the model of the atom. Each group will research a different scientist. If there are more groups than four in the class, assign one group to research the latest model of the atom and then double up on any other scientist.

Groups should be prepared to present their research in three parts: a labeled diagram of the atom model proposed by their scientist with the date of that model, professor-know-it-all presentation, and an explanation of the model including the limitations of that model. They can use their science *learning logs* (view literacy strategy descriptions) to record the result of their research.

This activity lends itself very well to a *professor know-it-all* (view literacy strategy descriptions) approach. All students in the group should be familiar with all information regarding their scientist and the model presented. The rest of the class will create reasonable questions to ask of each scientist and the groups presenting act as one *professor know-it-all*, helping each other field the class questions. The teacher should keep the questions focused on the topic and should also ask questions. This presentation should be limited in time and move quickly.

Part Two: Using the model created by Neils Bohr in 1913, demonstrate the arrangement of the nucleus with shells and the placement of the protons, neutrons, and electrons of an atom. Explain the atomic number, symbol, and atomic mass used for elements in the periodic table. Make certain students know the limits of each shell's capacity. Students should be able to discriminate between the atomic number and atomic mass of an element. Introduce the Hydrogen atom and the placement of its electron and proton. The hydrogen atom is one atom that makes a good lead-in to types of bonding, since it can share an electron.

Assign an element to each student or allow them to select or draw for one. Each student must correctly diagram the atom, provide the correct number of shells, and illustrate the placement of electrons and protons for his/her element. Students must add the information from the periodic table (symbol, element name, atomic mass, atomic number) to their diagram. Have students round the atomic mass to a whole number, if necessary.

Point out to the students that they are still using a model created in the early 1900's, but that there is a relatively new Refined Neils Bohr model at the following site that shows how there are even sub-shells in each shell. (http://education.jlab.org/qa/atom_model.html)

Ask students to reflect on why all questions about the structure of an atom may not be able to be answered at this time. Solicit responses as to what advances in technology might mean to future models of the atom. The cloud-charge model may be introduced at this time as an illustration of the changes the model has undergone.

Activity 2: Shell Collecting (SI GLEs: 10, 15, 19; PS GLE: <u>3</u>)

Material List: element models made by students in Activity 1, card stock or sentence strips to make labels for the bonds they make (covalent bonding and ionic bonding, large enough to be seen from across the room).

The teacher will introduce ions, bonding, and the terms *covalent* and *ionic bonding*. Students should be able to connect the "giving up" of electrons to ionic bonds and the "sharing of" electrons to covalent bonds. The illustrations of the elements from the first activity could be used again.

Given an element and knowing how many electrons are in the outer shell, students will physically link up with another student holding the card of an element with which they could form a bond. They must then identify which bond, covalent or ionic, they have formed and make a large card or sign to label their bond. Have students explain their reasoning behind the label they chose (shared or transferred), not just describe the label they have chosen. Students should recognize that their bonding model will have limitations and should be able to identify some of these limitations.

Activity 3: Action / Reaction (SI GLEs: 1, 2, <u>4</u>, 5, 6, 7, 8, 10, 11, 12, 18, 19, 21, <u>22</u>, <u>23</u>, 25, 31, 36, 37; PS GLEs: 5, <u>9</u>, <u>40</u>)

Materials List: safety goggles for each student, disposable gloves for each, science learning logs, pencils, water, 3 clear plastic cups for each group, a materials station or table with calcium chloride (also sold as closet dehumidifier compound), salt, diatomaceous earth powder (pool supply or building supply store), 5 ml scoops or measuring teaspoons, stirrers, graduated cylinder to measure 50 ml of water each time it is added, thermometers for each group's access, gallon size sealable freezer bags

Safety note: Students should be able to identify safety procedures that must be considered when using chemicals. Protective safety goggles should be worn and water available to wash hands in case of contact with calcium chloride. Plan for clean-up and disposal of chemical mixtures that will include a precipitate.

This activity will introduce students to a chemical reaction involving the formation of a gas, the formation of a precipitate, and a temperature change. As the students will actually hold the plastic cups in their hands, they will be able to see and feel the reaction take place. Provide a one-gallon-size sealable freezer bag for each group to use for the final investigation.

Set up a materials station. Challenge student groups to create mixtures using the chemicals provided (calcium chloride, salt, diatomaceous earth powder, and water). They may make three mixtures, but must document each mixture made with the amounts used and the results observed. Can the students identify the results of the combinations as physical or chemical reactions? Remind students that every result is science data or information, even if it seems rather mundane! Each team needs to create a data collecting chart *before* the investigation begins.

Students may combine water and one other material during this part of the investigation but must keep records of all combinations and results. Have students establish procedures that will assure consistent, comparable results. Did they measure and record all amounts used? Did they record which materials they combined? Did they see evidence of a reaction? Did they measure their mixtures again to compare the mass of the combined reactants? Did they record the effects of the mixing of the materials, even if the effects were insignificant in appearance? Can they identify the variables that must be considered? Each team/group should preface each investigation with a recorded prediction.

Water should be added in 50 ml. amounts. All measurements should be completed with precision and accuracy. Students should describe their processes and explain their results from the data they collect. Remind students to keep their observations limited to what they can observe with their own senses and to connect their inferences to their observations and their conclusions. Each group will give an oral presentation of the investigation with their data chart as evidence. Provide a guiding statement so that presentations reflect a description of the process and an explanation of the results, such as, Describe what you did and explain what occurred.

Groups may challenge conclusions of other groups ONLY with supporting data to do so. Have students compare the results presented by each group. They should recognize that there is an acceptable range in the end results for each group. Can they explain why experiments must be verified through multiple investigations?

When each group has presented their findings, have students mix two scoops of each material (salt, powder, calcium chloride) in the sealable bag. They will then add 50ml of water, seal the bag, and pay close attention to the events that follow. They should record all observations.

Students are to respond to the following statements / questions in their science *learning logs* (view literacy strategy descriptions):

- Describe any changes that were observed in the material combinations.
- Can you classify your changes as chemical or physical?

- If a temperature change is noted, at what point did it occur? Identify the change. Is it exothermic (loses heat / baking soda & water) or endothermic (gains heat / calcium chloride and water)?
- What observations did you make that tell you a chemical reaction is taking place?
- Can students compare how the mass of the product of the combined chemicals compares with the original chemicals combined?
- Did the combination produce a physical or chemical reaction or change?
  Have students filter (coffee filter over a strainer) and dry the precipitate they made in the plastic bag and mass the resulting matter to compare with beginning proportions.

Activity 4: Electrical Conductivity (SI GLEs: 1, 2, 4, 7, 11, 12, 16, 19, 21, 22, 23; PS GLEs: <u>18</u>, <u>30</u>)

Materials List: (For each group) D cell, small light bulb, wires with ends stripped and ready to use, bulb holder, battery holder (if available), masking tape, pencils, assorted materials to test for conductivity (plastic, wood, assorted metals, clay, etc.) salt water solution (2TBSP salt to 100 ml water), bowl or graduated cylinder to hold the salt water solution, science learning logs

Have students review safety procedures for the use of batteries and caution students about maintaining an electrical circuit too long during tests (battery will run down). Provide batteries (D), tape or battery holders, bulbs, bulb holders, and wires for each student or student team. Do not give instructions as to HOW to do it, but direct them to light the bulb with the objects provided. Once the students have had success, have them diagram the set-up that worked in their science *learning logs* (view literacy strategy descriptions). They should include all contact points, all parts of the system, and the arrangement of the parts that made the bulb light. They should also label all parts of their system.

Also, watch student trials to make certain for safety reasons that they do not leave one wire connecting both ends of the same battery. Have teams review each other's diagrams, point out to the whole group that there must be visible contact points wherever they are needed. Move throughout the group and check diagrams for details, labeling, and contact points.

The teacher should then have students test various materials within this circuit to illustrate *conductors* and *insulators*. Students can insert plastic, wood, clay, metals, etc. between the contact points to see which will allow the electricity to pass.

Have students predict what other substances might serve as conductors or insulators. Their observations should help them infer which materials will work to carry a current and which materials resist carrying an electrical current. Students should be able to explain how different materials affect the rate of electrical flow. The teacher will help clarify their explanations by using and explaining the word *resistance*. Students will then use their working circuit to test the conductivity of a salt solution.

For the next step, students will need to have two wires long enough to immerse in a salt water solution without making contact. It may be necessary to make additional wire available. The students will use their previous circuit with the addition of the longer wires to submerge in the salt water. The bulb should light again as the electricity travels through the salt water. Students should then be able to conclude through discussion that the path for electricity continues through the salt water as well as through the conductors tested earlier and that the path through the insulators offers more resistance to the flow of electricity.

Summarizing activities should include class discussion led by teacher-guided questioning and direct instruction as needed, enabling students to respond either orally or in written format in the science *learning logs* to summative questions as follows:

- What do the materials that were used in this activity and that conduct electricity have in common?
- How does the material used in the circuit affect the rate of the flow of electricity?
- Is electrical conductivity a physical or chemical property? Explain your answer.
- What makes it possible for an electric current to travel through salt water?

Activity 5: If Salt Works, Will Sugar? (SI GLEs: 1, 2, 4, 6, 7, 8, 16, 19, 22, 23, 33; PS GLEs: 4, 5, 9)

Materials List: Kosher salt, granulated sugar, hand lens (one for each student), dark construction paper to use as a work surface for observing characteristics of the crystals, water, effervescent tablets, stop watches, science learning log, If Salt Works, Will Sugar? BLM, measuring tools for water, salt, sugar

This activity uses the information they acquired in the last activity regarding salt water as a conductor and extends it to compare another familiar crystalline material, sugar. It also has the students create a conductivity tester specifically for the investigation.
Safety must be considered and students should be able to verbalize what concerns this lab may provide and plan for those concerns.

In this activity, students will work individually or in small groups to make observations of salt and sugar crystals using hand lenses (put crystals on the colored paper to see more easily and to limit their workspace). Students should predict if both of the substances, when put into solution, will conduct electricity. Students may choose to vary their salt solutions to either weaker or stronger than the solution used in the last activity. They should identify an appropriate means of measuring the materials and practice precision and accuracy each time they measure.

They will then make a salt water solution and a sugar water solution and use a homemade conductivity tester to determine if the solutions are conductors or nonconductors. Students should record their results in their science *learning log* (view literacy strategy descriptions) by diagramming the path of electricity through the circuit and the liquids.

Instructions for constructing a conductivity tester can be found at http://www.abc.net.au/science/surfingscientist/pdf/lesson_plan11.pdf. Students may also use the bulb, battery, and wires from the previous activity if the systems provided enough success in the previous activity. Students should evaluate which model they feel would work and pursue that design, evaluating the effectiveness as they use it to test the solutions.

The students should next observe the reaction between water and an effervescent tablet and determine if the resulting solution from the reaction is a conductor or nonconductor. Have students identify problems that must be considered in conducting this investigation.

Summarizing activities should include class discussion led by teacher-guided questioning and direct instruction as needed, enabling students to respond either orally or in written format to summative questions as follows:

- How do the crystals of salt and sugar compare? How are they alike and how are they different? (Use hand lens to gather details.)
- Which of the solutions observed were conductors and which were nonconductors (insulators)?
- What property of a material makes it a conductor?
- What evidence of change did you observe in each mixture? What type of change was observed, physical, or chemical?

Use the If Salt Works, Will Sugar? BLM by placing an “x” in the appropriate box OR have students recreate this in their science *learning log.*

Activity 6: We’ve Got Zip (SI GLEs: 1, 2, 4, 5, 6, 7, 8, 10, 12, 16, 19, 22, 23; PS GLEs: 1, 9, 12, 13)

Materials List: two effervescent tablets per group, water source or containers of water, clear plastic cups, graduated cylinders, thermometers, ice and heated water available as requested, stopwatches, balance scales, science learning logs, and Lab Report BLM (2 pages or 2-sided/one for each student) This lab report format can be used for later investigations, also.

Students will work in small groups to observe the reaction between water and an effervescent tablet. Students should begin the investigation with a review of safety concerns. They should construct a chart on which to record their results making certain they use appropriate labels for all measurements.

They will observe and record what factors change the reaction time by manipulating and controlling variables. Each student group will design their own investigation and should receive two effervescent tablets and water with which to work. Measurement tools should be used and consistency in measuring followed. The investigation should also include research into the components of the tablet. Have students generate a question for each investigation they will design. Inform students they must plan for at least 4 tests, using only the two tablets provided and they may break the tablets as needed.

Distribute the Lab Report BLM to each student to use to formalize their investigation. Along with students submitting a laboratory report, summarizing activities should include class discussion led by teacher-guided questioning and direct instruction as needed, enabling students to respond either orally or in science *learning logs* (view literacy strategy descriptions).

- Discuss variables and identify the variables that are involved when determining factors that affect the reaction rate between tablet and water. (Variables include such factors as water temperature, size of the tablet being dissolved, stirring, and amount of water used.)
- Predict which conditions favored the quickest reaction. Allow students to conduct self-designed investigations to answer this question.
- Using complete sentences, students should write an explanation of their answer to the previous question and support their explanation with experimental data.
- What part of the investigation will be described and what part will be explained? (Students should be able to discriminate between describing and explaining.)

Activity 7: Modeling the Periodic Table (SI GLEs: 11, 22; PS GLE: 10)

Materials List: resources for investigating the periodic table of elements (textbooks, charts or posters, student created element cards from activity 1), colored pencils, crayons or markers, Periodic Table of Elements BLM

Given an explanation for the terms used to define the organization of the periodic table of elements (groups or families, periods, metal, nonmetals, and metalloids), students will investigate the organization of the elements on the periodic table. They may use the tools they created in activity 1 to arrange their element cards in logical order according to the periodic table.

The remaining elements not covered in the first activity could be assigned to the students individually to research and would allow the completion of the periodic table model. Use the Periodic Table of Elements BLM for each student to color-code and identify each classification used on the table. This may also be helpful in recognizing the patterns of arrangement of elements on the table.

The website, http://www.uky.edu/Projects/Chemcomics, connects the elements with comic books that reference the elements. Students might enjoy this twist.

Activity 8: What's In A Name? (SI GLEs: 3, 19; PS GLE: 10, 13)

Materials List: resource materials, internet (if available), poster board, Periodic Table of Elements for reference from textbook or teacher resources

This activity has three different components to explore*:* (1) elements found in everyday objects and household chemicals, (2) common elements found in the human body, and (3) the origin of the names of familiar elements. The teacher may let the students select from one of these categories or have them pick from teacher-generated cards to randomly choose their topic. Make certain all three are covered in the class.

Challenge students to research the information to present to the class in an entertaining format (television commercial, poster, interview, etc.). Atomic mass and atomic number of the specific elements researched should be a part of the final product, also.

If students have difficulty identifying household chemicals to research, the teacher may also provide students with a list of at least twenty common names of substances such as vinegar, baking soda, quicksilver, lye, water, table salt, table sugar, milk of magnesia, aspirin, rubbing alcohol, antifreeze, ammonia, bronze, pewter, brass, chalk, stomach acid, laughing gas, carbon dioxide, lime, limestone, plaster of Paris, etc. Have students complete research to determine the correct chemical name, the formulas (including the names of the elements found in the formula), how produced, and the major uses for each substance. The American Chemical Society has a Periodic Table of Elements that shows common uses of all of the elements: www.chemistry.org/ncw

Some suggested formats for student presentations include the following:

- posters on the origin of the element names that would detail the history of the naming of elements, the names and symbols used by the ancient Greeks and Romans, as well as by the alchemists of the Middle Ages
- commercials that would highlight the sale of household products spotlighting their ingredients (elements)
- elements of the body could be introduced by using road maps through the body or other creative means

Sample Assessments

General Guidelines

Assessment will be from teacher observation/checklist notes of student participation in unit activities, the extent of successful accomplishment of tasks, and the degree of accuracy of oral and written descriptions/responses. Learning log entries provide reflective assessment of class discussions and laboratory experiences. Performance-based assessment should be utilized to evaluate inquiry and laboratory technique skills. All student-generated work, such as drawings, data collection charts, models, etc., may be incorporated into a portfolio assessment system.

- Students should be monitored throughout the work on all activities.
- All student-developed products should be evaluated as the unit continues.
- When possible, students should assist in developing any rubrics that will be used, and provided the rubric during task directions.

- Science learning logs should be completed in pencil and should reflect careful attention to detail, science investigations well-documented, and obvious effort

General Assessments

- The student will create a laboratory report for variables affecting the rate of reaction for the effervescent tablet and the water.
- The students will research historical models of the atom and identify the parts of the Bohr model.
- The student will draw illustrations of the atoms of selected elements and explain the relevance of atomic mass and atomic number.
- The student will present a report or poster on common chemicals.
- Students will successfully complete the bonding movement activity without error and with the type of bond identified.
- The students will create a thorough lab report and descriptive science learning log entries for chemical reaction observations and summaries.

Activity-Specific Assessments

- Activity 1: Students will correctly represent the number and placement of electrons and protons in selected elements of the periodic table.

- Activity 2: Teacher will observe student responses to bonding with their peers as they link up to demonstrate ionic and covalent bonding.

- Activity 5: Student charts will reflect organization of observations and awareness of properties of chemical or physical changes and conductivity.

- Activity 6: Students will correctly identify variables of their investigation. They will present thorough documentation of the facets of the investigation, providing a summary that reflects an awareness of the correlation of data to support or disprove a conclusion.

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Resources

- Answers questions about models of atoms and number of electrons on shells http://education.jlab.org/qa/atom_model.html

- *Alka-Seltzer Student Science Experiments*. 8 different activities http://www.alkaseltzer.com/as/experiment/student_experiment.htm

- *Atoms, Elements, and Molecules.* Available online at http://education.jlab.org/qa/atom_idx.html

- *The Formation of Water Simulation*. Available online at http://www.visionlearning.com/library/flash_viewer.php?oid=1858

- *Law of Conservation of Mass*. Available online at http://chemistry.about.com/library/glossary/bldef5660.htm

- *Periodic Table of the Elements*. Available online at http://pearl1.lanl.gov/periodic/default.htm http://environmentalchemistry.com/yogi/periodic

- *Periodic Table of Elements* with common uses of elements and other great chemistry resources for teachers and students http://www.chemistry.org

- Kid-friendly information on chemistry http://www.chem4kids.com

- Electricity, circuits, conductors, insulators with lesson plans and activities http://www.abc.net.au/science/surfingscientist/pdf/lesson_plan11.pdf (easy version) http://www.instructables.com/id/E8X4ZKJCCSETOMLNME/ (harder)

- The Periodic Table http://www-tech.mit.edu/chemicool/

- *What You Need to Know about Chemistry*. Available online at http://chemistry.about.com/bla/016952.htm

- *Chemcomics* available online at *http://www.uky.edu/Projects/Chemcomics/*