Science 11 Resource Package

Physical Science: Chemical Reactions

Suggested Lessons and Activities

The following lessons and activities meet some of the foundational and learning objectives as outlined for Science 11 – Physical Science: Chemical Reactions. Teachers should be reminded that these are only suggested activities and that they can and should be adapted to meet individual learning needs. The order that the lessons appear in is only a suggested order. Teachers can and should integrate their own lessons and ideas within the suggested lessons outlined in this unit.

The lessons outlined in this document consist of four sections. "Foundational and Learning Objectives" provides the numbers that correspond to the objectives that are identified in *Guidelines for Developing Modified Courses: Science 11 (Basic)*. "Lesson Overview" provides a brief description of the suggested lesson or activity. "Instructional Documents" lists Teacher Support Material or Student Handout documents that are directly related to the lesson. "Supporting Resources" lists resources from various sources that may be directly related to the lesson, that may support instructional content within the lesson or that may be alternate ways of meeting all or some of the foundational and learning objectives outlined in the lesson.

The guidelines and objectives for Science 11 have been chosen to reflect the units of the renewed Science 10 (2005) curriculum. Therefore, in addition to the *Guidelines for Developing Modified Courses: Science 11 (Basic),* teachers should use the document *Science 10: Curriculum Guide* to assist with unit planning and instruction for Science 11. *Science 10: Curriculum Guide* provides sections on key questions, key concepts, pre-instructional questions as well as suggested teaching strategies and activities for each of the foundational objectives within each unit. Curriculum documents are available on-line at http://www.learning.gov.sk.ca/.

List of Lessons for Chemical Reactions

Lesson #	Name of Lesson
1	Chemistry in Everyday Life
2	Laboratory Equipment and Safety
3	Workplace Hazardous Materials Information System
4	Observing Evidence of Chemical Interaction
5	Building Compound Models
6	Naming and Writing Formulas for Compounds
7	Conservation of Mass Models
8	Alternative Energy Project
9	Chemical Reaction Rates
10	Acids and Bases
11	Neutralization of Vinegar

Foundational and Learning Objectives

CR1 Observe common chemical reactions in your world

1. Provide examples of how science and technology are an integral part of our lives and community. (TL)
2. Observe and describe chemical reactions that are important in everyday life.
3. Perform activities to investigate exothermic and endothermic chemical reactions.
4. Identify indicators that provide evidence that a chemical reaction has likely taken place.
5. Show concern for safety and accept the need for rules and regulations when conducting scientific investigations.
6. Demonstrate knowledge of Workplace Hazardous Materials Information System (WHMIS) standards by selecting and applying proper techniques for handling and disposing of lab materials.

CR2 Represent chemical reactions symbolically using models, word equations, and balanced chemical equations

1. Represent common chemical compounds using models.
2. Name and write formulas for common ionic compounds using the periodic table and a list of ions. (COM)
3. Name and write formulas for common molecular compounds using the periodic table and a list of numerical prefixes.
7. Represent chemical reactions using word equations.
9. Represent chemical reactions and conservation of mass using models.

CR3 Identify characteristics of chemical reactions involving organic compounds

1. Observe and describe the combustion process.
4. Propose alternative solutions to society's reliance on fossil fuels, identify the potential strengths and weaknesses of each solution, and select one as the basis for a plan. (CCT, PSD)

CR4 Identify factors that affect the rates of chemical reactions

1. Identify how factors such as temperature, concentration, and surface area can affect the rate of a chemical reaction.
3. Design and perform an experiment to determine how various factors affect chemical reaction rates, identifying and controlling major variables. (CCT)
4. Carry out procedures controlling the major variables and adapting or extending procedures where required.
5. Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data. (COM, NUM)

CR5 Investigate chemical reactions involving acids and bases

1. Perform activities to investigate the characteristics of acids and bases. (IL)
2. Work co-operatively with team members to develop and carry out a plan, and troubleshoot problems as they arise. (CD 2.3)
4. Classify substances as acids, bases, or salts, based on observable characteristics, name, and chemical formula.
6. Describe the process of neutralization and identify practical examples.

Lesson 1 – Chemistry in Everyday Life

Foundational and Learning Objectives: CR1: 1, 2

Lesson Overview:

In this lesson students will brainstorm to create a list of products and categories of products used during any given day. Examples of categories of products and products within might include: automobile products (brake fluid, washer fluid), household cleaners (bleach, glass cleaner, furniture polish), personal care products (make up, shampoo, hair colouring). Students will then choose a product, or category of products, and research it to collect information on manufacturing process, paying particular attention to chemical reactions that occur during the process.

Prior to, or following this lesson, the teacher could direct discussions and/or demonstrations that allow students to observe and describe some chemical reactions that are important in everyday life. Examples of such reactions to discuss and/or demonstrate could include: Alka-Seltzer tablet added to water, combustion of wax, vinegar added to milk, vinegar added to baking soda, a match burning, leaves changing colour in the fall, the process of tanning hides.

Instructional Document(s):

1. Chemistry in Everyday Life - Research Assignment (Student Handout).

Supporting Resource(s):

1. Case Study – Household Chemicals, pp. 72-75 *Nelson Science 10: Concepts and Connections*.

2. Examples of Chemical Changes: http://www.chemtutor.com/react.htm

Lesson 2 – Laboratory Equipment and Safety

Foundational and Learning Objectives**:** CR1: 5

Lesson Overview:

In this lesson students will be introduced to basic lab equipment, its function, use and safety. To meet these objectives the students could rotate through a series of teacher designed stations. At each station the students could be asked to identify the piece of equipment and follow a set of instructions to use the equipment properly (where appropriate). For example, name a graduated cylinder and then use the proper technique to measure out 50mL of water. This lesson could easily be extended to include information on lab safety.

Supporting Resource(s):

1. Common Laboratory Equipment, p. 675 *Nelson Science 10*.

2. Conducting an Experiment, pp. 677-681 *Nelson Science 10*.

3. Choosing Materials, pp.262-263 *Nelson Science 10: Concepts and Connections*.

Lesson 3 – Workplace Hazardous Material Information System

Foundational and Learning Objectives: CR1: 6

Lesson Overview:

In this lesson students should have the opportunity to review the common WHMIS symbols. As a visual aid, use some common substance we encounter everyday. Students should be able to analyze the information given on a chemical and from there discuss what precautions must be taken and what safety instruments might have to be used.

Supporting Resource(s):

1. Household Chemicals, pp. 72-73 *Nelson Science 10: Concepts and Connections*.

2. Case Study – Hazardous Household Chemicals, pp. 176-178 *Nelson Science*.

3. Safety Symbols, p. 608 *Sciencepower 10*.

4. Health Canada website: http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/symbol/index_e.html

Lesson 4 – Observing Evidence of Chemical Interaction

Foundational and Learning Objectives: CR1: 3, 4, 5

Lesson Overview:

In this lesson students will complete a lab investigation that allows them to observe evidence of chemical change as well as a simple exothermic reaction. As a follow up the students could complete (or the teacher could demonstrate) a simple endothermic reaction and then have the students compare exothermic and endothermic reactions through a discussion.

Prior to, or during this lab investigation, students should be able to identify indicators that provide evidence that a chemical reaction has taken place. This lab investigation could also be used as an opportunity to complete instruction and evaluation on lab safety.

Instructional Document(s):

1. Observing Evidence of Chemical Interaction (Student Handout).

2. Observing Evidence of Chemical Interaction – Lab Write Up (Student Handout).

Supporting Resource(s):

1. Investigation - Exothermic and Endothermic Reactions, pp. 281-283 *Nelson Science 10*.

2. Try This Activity - Introducing Chemical Reactions, p. 71 *Nelson Science 10: Concepts and Connections*.

3. Energy Changes, p. 179 *Sciencepower 10*.

4. Energy Changes and Chemical Reactions, pp. 180-182 *Sciencepower 10*.

Lesson 5 – Building Compound Models

Foundational and Learning Objectives: CR2: 1

Lesson Overview:

In this lesson students will represent common chemical compounds using models. They will work with molecular model kits to assemble models of several chemical compounds. Candy jujubes and toothpicks can be used if model kits are not available. On the activity worksheet students are instructed to draw their models and record the chemical formula for each of them. As an extension students could be asked to name the compounds.

Instructional Document(s):

1. Building Compound Models (Student Handout).

Supporting Resource(s):

1. Ionic or Covalent: Track Those Electrons, pp. 148-150 *Sciencepower 10*.

Lesson 6 – Naming and Writing Formulas for Compounds

Foundational and Learning Objectives: CR2: 2, 3

Lesson Overview:

In this lesson students will learn how to write formulas for common ionic compounds using the periodic table and a list of ions. They will also learn how to name and write formulas for common molecular compounds using the periodic table and a list of numerical prefixes.

Note: There is only one student worksheet included for this lesson. The text book pages listed are great resources to help guide students through the processes of naming and writing formulas for both ionic and covalent compounds. Appropriate questions are also included within the text book pages.

Instructional Document(s):

1. Ionic Compounds (Student Handout).

Supporting Resource(s):

1. How Atoms Form Ions, pp. 78-81 *Nelson Science 10: Concepts and Connections* or Ionic Compounds, pp. 192-195 *Nelson Science 10*.

2. Molecular Compounds, pp. 201-204 *Nelson Science 10*.

3. Writing Names and Formulas of Binary Ionic Compounds, pp. 156-158 *Sciencepower 10*.

4. Names and Formulas for Binary Molecular Compounds, pp. 162 *Sciencepower 10*.

Lesson 7 – Conservation of Mass Models

Foundational and Learning Objectives**:** CR2: 7, 9

Lesson Overview:

In this lesson students will build jujube models of compounds to represent chemical reactions. They will use the models to help them recognize and explain the Law of Conservation of Mass. They will be given reactants (in model form) and told what products to make. This will encourage students to make and break bonds as they transition from reactants to products. Students will also be encouraged to weigh the reactants before making the products and then weigh the products.

Instructional Document(s):

1. Conservation of Mass Models (Student Handout).

Supporting Resource(s):

1. Measuring Masses in Chemical Changes, pp. 88-89 *Nelson Science 10: Concepts and Connections* or Measuring Masses in Chemical Changes, pp. 220-221 *Nelson Science 10*.

2. Comparing the Masses of Reactants and Products, pp. 168-169 *Sciencepower 10*.

Lesson 8 – Alternative Energy Project

Foundational and Learning Objectives: CR3: 1, 4

Lesson Overview:

In this lesson students will research one type of alternative energy solution in order to identify the possible strengths and weaknesses of the energy source. Students could be asked to debate their energy sources, develop an action plan or design a model to represent their source.

As an introduction to this project the teacher should present information on combustion reactions and the burning of fossil fuels.

Instructional Document(s):

1. Alternative Energy Project (Teacher Support Material).

Supporting Resource(s):

Background information on combustion reactions:

1. Describing Chemical Reactions, pp. 86- 87 *Nelson Science 10: Concepts and Connections*.

2. Combustion, pp. 230-232 *Nelson Science 10*.

3. Reactions Involving Carbon Compounds, pp. 203-205 *Sciencepower 10*.

Lesson 9 – Chemical Reaction Rates

Foundational and Learning Objectives: CR4: 1, 3, 4, 5

Lesson Overview:

In this lesson students will complete the *Chemical Reaction Rates Investigation* to discover how factors such as temperature, concentration, and surface area can affect the reaction rate of a particular chemical reaction. This lab investigation uses Alka-Seltzer tablets, water, magnesium and hydrochloric acid to study the affects of temperature, concentration and surface area on reaction rates.

The investigation *Chemical Reaction Rates* could be used in addition to or as a replacement for the investigation described above. However, because this investigation is more complex than the one above it is important that the teacher be comfortable with the chemistry background involved if choosing to use this investigation.

Instructional Document(s):

1. Chemical Reaction Rates Investigation (Student Handout).

2. Chemical Reaction Rates (Student Handout).

Supporting Resource(s):

1. Factors That Affect Rates of Reactions pp. 92-95 *Nelson Science 10: Concepts and Connections* or Factors That Affect Rates of Reaction pp. 260-264 *Nelson Science 10*.

2. Investigation - Blast Off, pp. 96-98 *Nelson Science 10: Concepts and Connection* or Investigation - Blast Off, pp. 276-277 *Nelson Science 10*.

3. Factors Affecting Chemical Reaction Rate, pp. 243-244 *Sciencepower 10*.

Lesson 10 – Acids and Bases

Foundational and Learning Objectives**:** CR5: 1, 2, 4

Lesson Overview:

In this lesson students will complete a lab investigation to distinguish between acidic, basic and neutral solutions using a universal indicator. They will also identify the level of acidity or alkalinity in a variety of household products.

Prior to performing this investigation it is suggested that the teacher present information on what acids, bases and neutral substances are and properties of each type of substance. Information could also be included on the role of indicators and a few simple demonstrations of some indicators could be shown. Information on preparing and using cabbage juice as an indicator can be found online. A link has been provided in the supporting resources section below.

Instructional Document(s):

1. Acids and Bases (Student Handout).

Supporting Resource(s):

1. Properties of Acids and Bases, pp. 106-107 *Nelson Science 10: Concepts and Connection* or Properties of Acids and Bases pp. 293-295 *Nelson Science 10*.

2. Recognizing Acids and Bases pp. 104-105 *Nelson Science10: Concepts and Connections*, or Recognizing Acids and Bases pp. 290-292 *Nelson Science 10*.

3. Acid or Base?, pp. 214-216 *Sciencepower 10*.

4. Instructions for preparing and using cabbage juice as an indicator can be found at: Cabbage Juice - pH indicator

Lesson 11 - Neutralization of Vinegar

Foundational and Learning Objectives: CR5: 6

Lesson Overview:

In this lesson students will perform a lab investigation in order to observe and describe the process of neutralization and determine what volume of base is required to neutralize vinegar.

Prior to starting this investigation it is suggested that the teacher present background information on the process of neutralization and provide some practical examples.

Instructional Document(s):

1. Neutralization of Vinegar (Student Handout).

Supporting Resource(s):

1. Neutralization Reactions, pp. 317-319 *Nelson Science 10*.

2. Neutralizing Acids and Bases, pp. 112-113 *Nelson Science 10: Concepts and Connections*.

3. Drop-by-Drop Neutralization, pp. 232-233 *Sciencepower 10*.

SH
Student Handout

CHEMISTRY IN EVERYDAY LIFE
RESEARCH ASSIGNMENT

1. With a partner brainstorm a list (10–15) of products you use in any given day (example categories of products include auto products, household cleaners, pesticides, personal care products, home construction products, etc.)

2. Using the list that you have generated above choose one product (or category of product) and research the manufacturing process.

   a) List any chemical names and/or chemical formulas that are used in the product.

   b) Record information you can find on chemical reactions that occur during the manufacturing processes.

SH

Student Handout

OBSERVING EVIDENCE OF CHEMICAL INTERACTION

This investigation provides an opportunity to make some careful observations on chemical and physical change. Be alert and pay attention to all the details of the interaction(s) (before, during, and after). A data tables will allow you make both qualitative and quantitative observations.

During this investigation, you will be working with 3 substances which will interact with each other to produce two changes – one chemical, the other physical.

CAUTION: Wear your safety glasses at all times. Hair must be in a ponytail. No loose clothing.

Materials:

safety glasses	aluminum foil	mass scale
distilled water	copper II chloride	glass stir stick
100 mL beaker	thermometer	

Procedure:

1. Obtain a clean 100 mL beaker. Place it on a mass scale. Tare the scale. Carefully add 2.0 g of copper II chloride to the beaker. **Record** the mass of the copper II chloride on the data table 1.

2. **Look** at the colour of copper II chloride ($CuCl_2$) crystals. **Record** the colour of the crystals on the data table 2.

3. Obtain a 50 mL graduated cylinder. Place 25 mL of distilled water into the graduated cylinder. Carefully add the water to the beaker. **Record** the volume of water used on the data table 1.

4. Allow the system of water and crystals to stand for 2 minutes. **Record** your observations in the data table 2.

5. Then gently stir the crystals and water. This change results in a solution being formed. **Record** the observations of the solution on data table 2.

6. Using a thermometer find the temperature of the copper II chloride solution. **Record** the temperature on the data table 1.

7. Obtain a piece of aluminum (Al) foil from the teacher. **Find** the mass of the foil. **Record** the mass of the aluminum foil on the data table 1.

8. Place the loosely rolled aluminum foil into the solution. **Record** what happens between the aluminum foil and copper II chloride solution on data table 2.

9. Using the thermometer as a stirring stick, gently stir the mixture. Measure the temperature of the mixture when it reaches the highest value. **Record** the final temperature on the data table 1.

10. After the investigation is completed, depose of the end products as directed by the teacher. Return all the clean equipment and materials back to the appropriate places.

Student Handout

OBSERVING EVIDENCE OF CHEMICAL INTERACTION
LAB WRITE UP

Purpose: Write out a purpose for this investigation.

____

____

Data Table:

Table 1 – Quantitative Observations

Mass of copper II chloride	
Volume of distilled water	
Mass of aluminum foil	
Temperature before mixing	
Temperature after mixing	
Change in temperature	

Table 2 – Qualitative Observations

The colour of copper II chloride is
The colour of water and copper II chloride is
The colour of copper II chloride solution is
The colour of mixture of Al foil and $CuCl_2$ is

Discussion: Answer the questions in a complete sentence.

1. When water and copper II chloride were mixed, how many phases did the resulting solution have?
____
____

2. Was the mixture of water and copper II chloride a chemical or physical change? Why?
____
____
____

3. Does the temperature increase or decrease as result of mixing the Al foil with the copper II chloride solution?
____
____

4. Was the mixture of aluminum foil and $CuCl_2$ solution a chemical or physical change? Why?
____
____

5. What evidence could you use to indicate there was an interaction between the Al and $CuCl_2$ solution in question 4?
____
____

6. $Al + CuCl_2 \rightarrow AlCl_3 + Cu$ is the chemical equation for this reaction. What are the reactants? ____________________________________ What are the products? ____________________________

7. Balance the chemical equation for this reaction.

$$\_\_\_\_Al + \_\_\_\_CuCl_2 \rightarrow \_\_\_\_AlCl_3 + \_\_\_\_Cu$$

Conclusion:
____
____
____
____
____
____
____

Student Handout

BUILDING COMPOUND MODELS

In this activity you will have the opportunity to build some simple molecular models and write the chemical formulas for each of them.

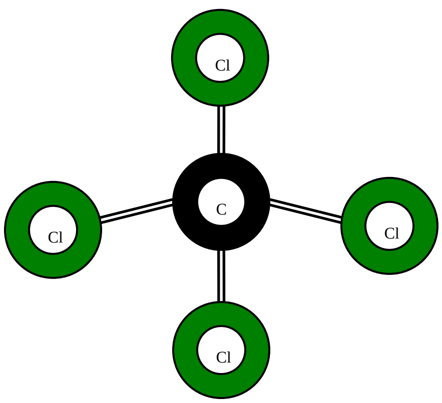
Introduction:

Most molecular model kits have the following colour codes:

Black (4 holes)	= carbon atom
Red (2 holes)	= oxygen atom
Yellow (1 hole)	= hydrogen atom
Orange (1 hole)	= sodium atom
Green (1 hole)	= chlorine atom
Blue (3 holes)	= nitrogen atom

In the world of atoms, chemical bonds allow atoms to join forming bigger particles called molecules. In our molecular model kit, the sticks or springs represent the chemical bonds.

For example, carbon atom joins with chlorine atoms and the resulting compound is called carbon tetrachloride. Building a model of this molecule results in the following drawing:



Note the central carbon atom is surrounded by 4 chlorine atoms.

From this model, one can conclude that the formula for carbon tetrachloride is CCl_4.

Note how the formula is written:

a) There is not any number after C, this means that the molecule contains one carbon atom.
b) There is a subscript 4 after Cl, this means that the molecule contains 4 chlorine atoms.

Summary: A carbon tetrachloride molecule is a compound consisting of 5 smaller atoms, joined together.

Now it is your turn. Build the following compounds, draw diagrams (coloured) for each, and determine the formula of each.

(1) water molecule (one oxygen atom and 2 hydrogen atoms)

Drawing:	Formula:

(2) hydrogen chloride or hydrochloric acid (one hydrogen and chlorine atom)

Drawing:	Formula:

(3) hydrogen gas molecule (2 hydrogen atoms)

Drawing:	Formula:

(4) oxygen gas molecule (2 oxygen atoms with 2 springs)

Drawing:	Formula:

(5) sodium chloride (sodium and chlorine)

Drawing:	Formula:

(6) sodium fluoride (sodium and fluorine)

Drawing:	Formula:

(7) ammonia molecule (nitrogen with 3 hydrogen)

Drawing:	Formula:

(8) natural gas or methane molecule (carbon and 4 hydrogen)

Drawing:	Formula:

(9) ethane molecule (2 carbon and 6 hydrogen; a bond between the 2 carbons atoms)

Drawing:	Formula:

(10) carbon dioxide molecule (1 carbon and 2 oxygen and 4 springs)

Drawing:	Formula:

Complete the following table:

Chemical Formula	Number of elements per molecule	Total number of atoms in one molecule
NaOH		
$MgCl_2$		
$AlBr_3$		
Fe_2O_3		
$C_6H_{12}O_6$		
PCl_3		
KNO_3		
Na_2SO_4		
$Zn(OH)_2$		

SH
Student Handout

IONIC COMPOUNDS

Complete the table below by following steps a-c for each pair of elements on the table. The first one has been completed as an example for you.

a) Indicate the correct symbol and charge for each element.
b) Write the correct chemical formula for the ionic compound most likely to be produced from a reaction between the pair of elements.
c) Write the name for the ionic compound (remember the metal is first and the ending of nonmetal changes to ide).

Elements	Symbol / Charge	Chemical Formula	Name of Compound
beryllium, fluorine	Be^{2+} F^{1-}	BeF_2	beryllium fluoride
potassium, sulfur			
lithium, oxygen			
magnesium, sulfur			
aluminum, chlorine			
barium, sulfur			
calcium, nitrogen			
aluminum, sulfur			

SH

Student Handout

CONSERVATION OF MASS MODELS

In this activity you demonstrate simple chemical reactions and compare the mass before the reaction with the mass after the reaction.

Introduction:

The molecular model (candy) kits have the following colour codes:

Orange candy – one hole	= sodium atom
Yellow candy – one hole	= hydrogen atom
Green candy – one hole	= chlorine atom
Red candy – two holes	= oxygen atoms
Tooth picks	= chemical bonds

Recall that chemical bonds allow atoms to join to form a molecule or compound. In a chemical equation, the reactant(s) have a mixture of molecules or atoms. Like wise, the product(s) can also have a mixture of molecules or atoms. In a chemical reaction, atoms change the way they are joined together.

For example, in the following equation, hydrogen molecules are reacting with an oxygen molecule to create water molecules

hydrogen + oxygen → water

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

1. Which 2 substances are the reactants? ___________________________
2. What substance is the product? ________________________________
3. 2 yellow atoms are joined by one toothpick. Repeat this step again.
4. 2 red atoms are joined by 2 toothpicks.
5. Now weigh all 3 molecules to find its mass. ___________ g
6. Remove the toothpicks from all the atoms. Every 2 hydrogen atoms is joined to 1 oxygen atom. Repeat this step again.
7. Now weigh the 2 water molecules. _____________ g
8. The mass of the reactants before the change is the __________ as the mass of the product after the change.

Now it is your turn. You will receive a baggie with sufficient atoms and toothpicks.
First, you must read the first half of the chemical equation to see if you need to make any compounds for the reactants.
Secondly, you will take all your reactants and weigh them. RECORD THE MASS IN THE PROVIDED BOX.
Thirdly, you will read the second half of the chemical equation to reassemble the atoms to form the products.
Fourthly, you will take all your products and weigh them. RECORD THE MASS IN THE PROVIDED BOX.
Fifthly, you will compare your masses and fill in the blanks.

1. sodium + chloride → sodium chloride
   $2\ Na + Cl_2 \rightarrow 2\ NaCl$

Mass before the change (g)	Mass after the change (g)

- The mass before the change is __________ as the mass after the change.

2. hydrogen + chlorine → hydrogen chloride
   $H_2 + Cl_2 \rightarrow 2\ HCl$

Mass before the change (g)	Mass after the change (g)

- The mass before the change is __________ as the mass after the change.

3. sodium oxide + heat → sodium and oxygen gas
   $2\ Na_20 + heat \rightarrow 4\ Na + O_2$

Mass before the change (g)	Mass after the change (g)

- The mass before the change is __________ as the mass after the change.

Conclusion:

In any chemical reaction, there is __________ loss in mass. The mass of the products is the __________ as the mass of the reactions. This means that __________ matter was destroyed during a chemical change.

[Now, you can consume your lab.]

ALTERNATIVE ENERGY PROJECT

Overview:

Each student or small group will research an alternative energy source and produce a poster to present their findings. Student research should include finding information that describes what each power source is, how it works, the pros and cons of the source, where and if it is currently used, and where it could be used in the future.

Method:

1. Introduce the idea of alternative energy.
2. Discuss how to make a proper poster as well as any other project expectations.
3. Create groups if necessary
4. Begin research, using the Internet, text sources, databases, etc.
5. Allow sufficient time for completion.

Possible topics:

- Solar power
- Wind power
- Nuclear power
- Geothermal power
- Hydrogen Fuel Cells

Extension:

Students could be asked to debate their energy sources, develop an action plan, or design a model to represent students' source.

Student Handout

CHEMICAL REACTION RATES INVESTIGATION

Background Information:

The conditions under which a chemical reaction occurs have great effect on the speed or rate at which the reaction occurs. These conditions are often termed the factors that affect a reaction rate. The key factors that affect a chemical reactions rate are:

1. Temperature under which the reaction occurs
2. Surface area
3. Concentration of reacting substances
4. Nature of the reactants (state and type of reactants)
5. Presence of catalysts

Perform the following chemical reactions. Each reaction shows how one of the factors affects the speed of a chemical reaction. Record your answers in the spaces provided.

Investigation:

Procedure - Reaction One

1. Put approximately 150 mL of cold (about 10^{o}C) water in beaker A.
2. Put the same amount of hot (about 80^{o}C) water in beaker B.
3. Add one Alka-Seltzer tablet to beaker A and time how long it takes the Alka-Seltzer tablet to completely react with the water (when the tablet has completely disappeared).
4. Repeat step 3 with beaker B.

Observations - Reaction One

1. How long did it take for the reaction to complete in beaker A? ______________________________.
   In beaker B? ____________________________
2. What variable was different between the two reactions? ______________________
3. What conclusion can you make from your observations regarding the speed of a chemical reaction and temperature?
   ____
   ____

Procedure - Reaction Two

1. Grind one Alka-Seltzer tablet into powder using a mortar and pestle.
2. Put approximately 150 mL of water at 20^{o}C in a beaker.
3. Add the powder. Observe what happens.
4. In a second beaker put the same amount of water at the same temperature.
5. Add a whole Alka-Seltzer tablet and observe what happens.

Observations - Reaction Two

1. In which beaker did the Alka-Seltzer tablet react the fastest (disappear completely)? ____
2. Why is it important to keep the temperature and the amount of water the same in both beakers? ____ ____
3. What variable was different between the two beakers ______________________________
4. What conclusion can you make from your observations regarding the speed of a chemical reaction and surface area? ____ ____

Procedure - Reaction Three

1. Cut two pieces of magnesium to an equal length. Place each into separate test tubes, labeled A and B.
2. In test tube A add 10mL of dilute hydrochloric acid.
3. In test tube B add 10mL of concentrated hydrochloric acid.
4. Observe the reaction.

Observations – Reaction Three

1. In which test tube was the reaction the fastest? ______________________________________
2. What variables had to be controlled (kept the same) in order to make a comparison? ____
3. What variable was different between the two reactions? ________________________________
4. What conclusion can you make from your observations regarding the speed of a chemical reaction and surface area? ____ ____

Student Handout

CHEMICAL REACTION RATES

In this investigation we will discover what variables will affect the reaction rate of a particular chemical reaction. The two variables we will look at is the effect of different concentrations and surface area in a chemical reaction.

Your class will measure how fast carbon dioxide gas bubbles will form. The faster the gas bubbles appear, the faster the reaction. The quantity of gas bubbles is important as well. You will use word descriptors like “very slow”, “slow”, “faster”, or “fastest”.

Materials:

- 10 mL graduated cylinders
- 4 stop watches (optional)
- 4 test tubes
- test tube holder
- $CaCO_3$ fine powder
- $CaCO_3$ crystals
- diluted hydrochloric acid (0.25 mol/L solution)

Procedure:

1. Obtain 2 test tubes, a 10 mL graduated cylinder, and test tube holder.

2. Label the 2 test tubes #1 and #2.

3. In test tube #1, add 10 mL of hydrochloric acid.

4. In test tube #2, add 10 mL of hydrochloric acid.

5. At the same time add 2 crystals of $CaCO_3$ into test tube 1 and a small sample $CaCO_3$ powder in test tube 2. Watch to see which test tube produces carbon dioxide bubbles first and how many bubbles are produced. Analyze the rate of your bubble production with the words like “very slow”, “slow”, “faster”, or “fastest”.

6. Record your speed on the Data Table.

7. Obtain 2 more test tubes. Label these test tubes #3 and #4.

8. In test tube #3, add 5 mL of hydrochloric acid and 5 mL of water. Do the same for test tube #4.

9. Repeat step 5 and 6

Observations:

Data Table

Trial	Hydrochloric Acid (mL)	Calcium carbonate	Water (mL)	Temperature	Actual Speed
1	10	Chips	0	Room	
2	10	Powder	0	Room	
3	5	Chips	5	Room	
4	5	Powder	5	Room	

Questions:

1. Compare the time for trial 1 and 2. Which trial had the fastest speed? Which trial had the slowest speed? How come?

2. Compare the time for trial 3 and 4. Which trial had the fastest speed? Which trial had the slowest speed? How come?

3. If you were to compare trial 2 and 4, which trial had the fastest speed? How come?

4. What 2 variables will determine how fast a chemical reaction take place?

SH Student Handout

ACIDS AND BASES

Objectives:

- To distinguish between acidic, basic, and neutral solutions using an universal indicator.
- To distinguish the level of acidity or alkalinity in a variety of household products.

Materials:

safety glasses	0.10 mol/L HCl
micro-tray	0.010 mol/L HCl
medicine droppers	0.10 mol/L NaOH
universal indicator or red cabbage juice	0.010 mol/L NaOH
various household substances	0.10 mol/L NaCl
table illustrating the colours and pH range	0.10 mol/L KI
	0.10 mol/L vinegar
	0.10 mol/L ammonia

Procedure:

1. Obtain a micro-tray. On a piece of paper, label the tray for the various acids and bases to be tested. DO 4 SUBSTANCES AT ONE TIME. Also, obtain a dropping bottle containing universal indicator (red cabbage juice).
2. Record the number and name of each substance in the first column of the data table.
3. Put 5 to 6 drops of each substance in appropriate places on the micro-tray. (Remember to read your labeled paper before adding the drops of acids or bases.)
4. At your work station add 1 drop of universal indicator (red cabbage juice) to each substance in the micro-tray.
5. Record your resulting colours on the provided data table. (Recall reds, oranges or yellows are acids and greens, blues and purples are bases.)
6. Obtain the corresponding pH values that are associated with the colours from the chart. Record the appropriate number in the pH column on your data table.
7. Repeat steps 2, 3, 4, 5, and 6 with the other 4 substances after cleaning the micro-tray as directed by the teacher. Record your results on the data table as you did before.
8. Repeat steps 2, 3, 4, 5, and 6 with 4 household substances after again cleaning the micro-tray as directed by the teacher. First, record the names of the household substances used on the data table.
9. Return the universal indicator (cabbage juice) dropping bottle back to the front. Clean the micro-tray, beaker, etc.

Observations:

Data Table

Substances Tested	Acid	Base	Neutral	pH Values

Analysis:

1. What was the range in pH values being tested?

2. How can you explain this range in the pH?

3. Are the majority of household products – acidic or basic? Explain your answer.

SH
Student Handout

NEUTRALIZATION OF VINEGAR

Purpose:

What volume of base is required to neutralize vinegar?

Materials:

- safety glasses
- test tube
- 50 mL beaker
- 2 medicine droppers (or plastic pipettes)
- bromothymol blue
- household vinegar
- 0.10 mol/L NaOH

Procedure:

1. Using a medicine dropper (or plastic pipette), place 10 drops of vinegar into a test tube. (Make sure the volume of each drop is the same.)
2. Add 1 drop of bromothymol blue indicator into the test tube. What is the colour of indicator and vinegar? Record your answer.
3. Fill a clean beaker with 20 mL of 0.10 mol/L NaOH.
4. Carefully add NaOH to the test tube, using a medicine dropper, drop by drop, until a color change is noted. Record the colour change. Then, record the number of drops of base used to neutralize the acid in data table.
5. Repeat the procedure again but first clean the test tube as instructed by the teacher. Make sure you record your second number of drops of base added to the vinegar in the table.
6. Repeat the procedure again but first clean the test tube as instructed by the teacher. Make sure you record your third number of drops of base added to the vinegar in the table.

Observations:

Initial color of vinegar and bromothymol blue:
____

Final color of bromothymol blue and neutralized solution:
____

	Trial 1	Trial 2	Trial 3
Drops of vinegar			
Drops of NaOH			

Questions:

1. Find the average number of drops of NaOH used to neutralize vinegar.

2. How many drops of base is needed to neutralize an acid? From your observations, how many drops are needed to neutralize 10 drops of vinegar?

3. The acid found in vinegar is acetic acid (HCH_3CO_2). Acetic acid reacts with NaOH to formulate this equation: HCH_3CO_2 + NaOH -------> $NaCH_3CO_2$ + H_2O

   a) Circle which product is water.
   b) Put a square around which product is the neutral salt produced.

4. Would you need the same number of drops of base to neutralize the acid (carbonic acid) found in 10 drops of Coke/Pepsi? Explain.

Conclusion: