Science 9 Unit B: Matter and Chemical Change

UNIT PLAN

Nature of Science Emphasis:

In these units, student attention is focused on the processes by which scientific knowledge is developed and tested, and on the nature of the scientific knowledge itself. The skills emphasized in these units are the skills of scientific inquiry.

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Big Ideas

- There are many different kinds of materials and each kind has a fixed set of properties.
- A material's fixed set of properties can be used to determine its behavior during a chemical reaction.
- Ideas, theories, and models have been developed over time to help explain observations of chemical change.

Focusing Questions

- What are the properties of materials, and what happens to them during chemical change?
- What evidence do we have of chemical change; and what ideas, theories, or models help us explain that evidence?

Unit Summary

"Different materials have different properties. The ability to distinguish between different substances and make sense of their properties, interactions, and changes requires the development of ideas about chemical substance." -- Alberta Program of Studies

Students will explore and develop ideas about chemical substances through scientific inquiry in the lab.

Unit Rationale

The Alberta Program of Studies has put the "nature of science" emphasis on the grade 9 chemistry unit. As such, students will explore and investigate the topics mainly in the lab. Additionally, students will build on their understanding and skills regarding the scientific method: they will learn to work through the steps of asking a scientific question, doing background research, constructing hypotheses, designing and carrying out experiments to test their hypotheses, analyzing their results, drawing conclusions, and identifying new questions.

Although the chemistry unit is meant to be the second unit, I decided to teach it first for two reasons. One, the emphasis on the nature of science for this unit gives students a solid foundation of understanding what science is, how science happens, and how we as a society come to know the things that we know. Two, my teacher mentors suggested that chemistry is generally the most difficult unit for students, so I wanted to light the metaphorical fire under their butts! I want my students to get used to working hard right away (and while they're still fresh from summer break) in an effort to encourage a strong work ethic.

Learning Outcomes

Skill Outcomes	
1. Investigate materials, and describe them in terms of their physical and chemical properties	1. Investigate and describe properties of materials such as melting point, solubility, and conductivity
	2. Describe and apply different ways of classifying materials based on their composition and properties, including: a. Distinguish between pure substances, solutions, and mechanical mixtures b. Distinguish between metals and non-metals c. Identifying and applying other methods of classification
	3. Identify conditions under which properties of a material are changed, and critically evaluate if a new substance has been produced
2. Describe and interpret patterns in chemical reactions	1. Identify and evaluate dangers of caustic materials and potentially explosive reactions
	2. Describe combustion, corrosion and other reactions involving oxygen
	3. Observe and infer evidence that a chemical reaction has occurred between familiar household materials
	4. Distinguish between materials that react readily and those that do not (e.g., compare reactions of different metals to a dilute corrosive solution)
	5. Observe heat generated or absorbed in chemical reactions, and identify examples of exothermic and endothermic reactions
	6. Identify conditions that affect the rates of reactions
	7. Identify evidence for the conservation of mass in chemical reactions, and demonstrate and describe techniques by which the evidence is gathered
3. Describe ideas used in interpreting the chemical nature of matter, both in the past and present, and identify example evidence that has contributed to the development of these ideas	1. Demonstrate an understanding of the origins of the periodic table, and relate patterns in the physical and chemical properties of elements to their positions in the periodic table (at least up to the first 18 elements)
	2. Distinguish between observation and theory, and provide examples of how models and theoretical ideas are used in explaining observations
	3. Use the periodic table to identify the number of protons, electrons, and other information about each atom; and describe, in general terms, the relationship between the structure of atoms in each group and the properties of elements in that group
	4. Distinguish between ionic and molecular compounds, and describe the properties of some common examples of each
4. Apply simplified chemical nomenclature in describing	1. Read and interpret chemical formulas for compounds of two elements, and give IUPAC name and common name of these compounds

elements, compounds, and chemical reactions	2. Identify and describe chemicals commonly found in the home, and write their chemical symbols
	3. Identify examples of combining ratios/number of atoms per molecule found in some common materials, and use information on ion charges to predict combining ratios in ionic compounds of two elements
	4. Assemble or draw simple models of molecular and ionic compounds
	5. Describe familiar chemical reactions, and represent these reactions by using word equations and chemical formulas, and by constructing models of reactants and products
Skill Outcomes	
1. Ask questions about the relationships between and among observable variables, and plan investigations to address those questions	1. Identify questions to investigate
	2. Define and delimit (set boundaries for) questions and problems to facilitate investigation
	3. State a prediction and a hypothesis based on background information or an observed pattern of events
	4. Select appropriate methods and tools for collecting data and information and for solving problems
2. Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data	1. Carry out procedures, controlling the major variables
	2. Observe and record data, and prepare simple drawings
	3. Demonstrate knowledge of WHMIS standards, by using proper techniques for handling and disposing of lab materials
	4. Research information relevant to a given question
3. Analyze qualitative and quantitative data, and develop and assess possible explanations	1. Compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs, and scatterplots
	2. Calculate the theoretical values of a variable
	3. Identify and suggest explanations for discrepancies in data
	4. State a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea
	5. Identify new questions and problems that arise from what was learned
4. Work collaboratively on problems; and use appropriate language and formats communicate ideas, procedures, and results	1. Receive, understand, and act on the ideas of others
	2. Evaluate individual and group processes used in planning and carrying out investigative tasks
Attitude Outcomes	
1. Interest in science	Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields

2. Mutual respect	Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds
3. Scientific inquiry	Seek and apply evidence when evaluating alternative approaches to investigations, problems, and issues
4. Collaboration	Work collaboratively in carrying out investigations and in generating and evaluating ideas
5. Stewardship	Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment
6. Safety	Show concern for safety in planning, carrying out, and reviewing activities

Unit Assessment Plan

Activity	Outcomes	Formative	Summative	Date	Weight
KWL	Pre-assessment	✓		Sept. 4	n/a
Individual Whiteboards	varies	✓		varies	n/a
Exit slips	Most knowledge outcomes	✓		Daily	n/a
Frayer Models, SEE-I, Venn diagrams etc.	K1.1, 1.2, 2.1, 2.5, 3.2, 3.4	✓		varies	n/a
Quizzes (group/partner)	varies	✓		varies	n/a
Worksheets	varies	✓		varies	n/a
Lab Reports	Varies (skills & knowledge outcomes)	✓		varies	n/a
Quizzes (individual)	Quiz 1: K3.2, K2.1, K1.2, K1.5, K2.3, K2.7 Quiz 2: K3.1, 3.2, 3.3, 3.4, 4.1		✓	Sept. 15 Sept. 22	16.5% 16.5%
[Nature of Science Emphasis] Performance Task with Lab Report	GLO 1, K2.5, 2.6, 3.2, 3.4, 4.2, 4.5 S1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, 3.3, 3.4, 4.1, 4.2 ICT F.3.3, C.7.2		✓	Sept 25 - 28	16.5%
Unit Test	Most knowledge outcomes		✓	Oct 1	50%

Calendar: Unit at a glance

September – Monday	Tuesday	Wednesday	Thursday	Friday
31	1	2 FIRST DAY OF SCHOOL Intro/PLE & course outline	3 Nature of science	4 Lab safety
7 HOLIDAY	8 Soap lab	9 Topic 1: Exploring (classifying) matter	10 Topic 2: changes in matter	11 Conservation of Mass
14 Atomic theory webquest	15 Quiz Origins & patterns in the PT	16 Topic 5: periodic table	17 Topic 6: Chemical compounds	18 Topic 6: chemical compounds
21 Topic 7: chemical reactions	22 Quiz Naming Ionic compounds	23 Naming molecular compounds	24 Reaction rate	25 Performance task
28 Performance Task	29 Performance Task	30 Review	**October** 1 UNIT TEST	

Calendar: Daily unit schedule

Lesson Title	Date & Time	Outcomes	Instructional strategies/activities	Assessments	Materials
Course Intro	Sept 2 20 min	N/A	- Intro to me, course outline, quick tour of the classroom, innakotsiiyinni - Ice breakers: switch sides if…; ball bomb game? - Let ss know I will be emailing them an introduction and asking them for some info - If time, do elephant toothpaste – address related questions (AEIOU) - If time, get discussions going about recent news in science (e.g. eating bugs as a protein source) Think-pair-share - Homework: fill out student interest survey - REMIND ss to bring photo ID to get textbooks	Assessment of general understanding of science through discussion	"switch sides if…" questions Name tags, markers 2 soft foam balls; Course outline; Demo: hydrogen peroxide, yeast, dish soap, food coloring, beaker, garbage bag or plastic tray (to contain the mess); Links to news articles Student interest surveys
Nature of Science & course overview	Sept 3 75 min	N/A	- Monty Python video clip; discussion – what is science? - Nature of science survey (20 min) - What is science? Video clip (13 min) KWL for chemistry (in groups) (20 min) - Fill out in groups of 3-4 (leave extra room), then gallery walk with stickers - Ss return to their own and add anything they forgot - Leave posters up in classroom – will return at end of unit (or use as exit tickets)	Discussion (F) KWL (pre-assessment)	https://www.youtube.com/watch?v=ZEKsi0jjbsg (4 min) Nature of science – survey cards PPT What is science? Video clip: https://www.youtube.com/watch?v=YwYEy5AXwlQ Flip chart paper/poster board (can cut in half) Tape to put up posters Stickers for ss Markers
KWL & atomic theory webquest	Sept 4 75 min	**3.2 I can distinguish between observation and theory, and I can provide examples of how models and theoretical ideas are used in explaining observations** **S2.4** **ICT C.1.1, C.3.2, C.7.2**	Meme: "gravity : just a theory" FITB notes (15 min) - Observation vs theory - Models and theoretical ideas help explain observations (brainstorm examples) - Intro to the atom – ss will find out the rest in the Webquest Atomic theory (observations lead to theories) – Webquest (35 min)	Discussion (F) Webquest worksheet (F)	Flip chart paper/poster board (can Webquest http://thompsonsclass.com/atom.php & worksheet (in folder)

WEEK 1					
Lab Safety	Sept 8 75 min	**2.1 Identify and evaluate dangers of caustic materials and potentially explosive reactions** **S2.3**	Atomic theorists matching game (review) (15 min) Lab Safety (15 min) - Watch lab safety video with FITB notes - FITB notes: http://lsteam.org/zombie-college/docs/zombie_college_5_rules_classroom_activity.pdf - 5 rules of lab safety video: https://youtu.be/S6WARqVdWrE (11) FITB notes (10 min) - WHMIS - Caustic & potentially explosive reactions Tableau – groups of 4 (drama outcome?) - Use props (draw the symbols and put them on beakers, etc., draw flame - There should be at least 4 lab safety issues	Certification (F) Scenarios (F)	Video clips FITB notes scenarios
Classifying matter	Sept 9 75 min	**1.2** Describe and apply different ways of classifying materials based on their composition and properties, including: a. Distinguish between pure substances, solutions, and mechanical mixtures b. Distinguish between metals and non-metals c. Identifying and applying other methods of classification **S2.3**	- classification demo (15 mins) - FITB notes (15 mins) -3 ways to classify matter - group quiz (10 mins) - go over as a class - Lab: pure substance or solution? (25 min) - How would you classify each substance and why? - which substances were most difficult to classify? - Cleanup & exit ticket (Got it – almost – nope & hand in lab assignment)	Group quiz (F) Lab Qs – results and discussion (F)	Examples of solids, liquids, gases, metals & non-metals, solutions & pure substances FITB notes & PPT Quiz questions Lab: mystery vials, procedure sheets
Physical and chemical change	Sept 10 75 min	**1.5 I can identify conditions under which properties of a material are changed, and I can critically evaluate if a new substance has been produced** **2.3 I can observe and infer evidence that a chemical reaction has occurred between familiar household materials**	- brainstorm "properties" of materials →weight rating of a garbage bag as a physical property vs burning the bag as a chemical property - FITB notes & PPT - chemical or physical group quiz - Lab: physical and chemical changes - has a new substance been produced? - what evidence is there that a chemical reaction has occurred?	Group quiz (F) Lab Qs (F) – procedure, results, discussion	Garbage bag(s), student books/binders, match, something safe in which to burn the bag FITB notes & PPT Quiz questions Lab:

Conservation of mass	Sept 11 75 min	**2.7 I can identify evidence for the conservation of mass in chemical reactions, and I can demonstrate and describe techniques by which that evidence is gathered**	- Lab set up (hook) - FITB notes & PPT (direct instruction) o Theories/models o Law of Conservation of Mass (15 mins) - Lab: mass & chemical change (30 mins/55)	Lab data & analysis questions	Quizzes FITB notes/PPT Lab: Steel wool, balloon, 250mL Erlenmeyer flask, vinegar, balance
WEEK 2					
Origins of and patterns within the PT	Mon. Sept 14 75 min	**3.1 I can demonstrate an understanding of the origins of the periodic table, and relate patterns in the physical and chemical properties of elements to their positions in the periodic table (at least up to the first 18 elements)** **2.4 I can distinguish between materials that react readily and those that do not (e.g., I can compare reactions of different metals to a dilute corrosive solution)** **S4.1, ICT C.7.1**	- Flame test demo (10 min) - Periodic table battleship (20 mins) - http://www.periodictable.com/Elements/034/index.html - FITB notes & PPT (direct instruction) o Origins of the periodic table o Element symbols o Metals vs non-metals o Chemical families – group 1 reactivity with water video clips (20 min) - Create your own element: describe its properties and justify its place in the periodic table; describe its reactivity in relation to other elements in its group (formative) (20 min)	Create your own element (F)	Flame test – ion solutions, wire loops, Bunsen burner, matches PT battleship boards, dry erase markers, erasers PPT, FITB notes
Topic 5: The periodic table	Tues. Sept 15	**3.3 I can use the periodic table to identify the number of protons, electrons and other information about each atom; I can describe, in general terms, the relationship between the structure of atoms in each group and the properties of elements in that group**	"Think like a proton and be positive" and other jokes about the periodic table Quiz FITB notes - Information that the periodic table gives us (mass number, protons, electrons, neutrons, valence electrons) (20 min) - Mini whiteboard questions - Periodic table Bingo (20 min) - Worksheet (10 min)	Whiteboards (F) Bingo (F) Worksheet (F)	Quiz FITB notes & PPT Bingo sheets & questions worksheet
	Wed. Sept 16	**4.1 I can read and interpret chemical formulas for compounds of two elements**	Salt vs sodium – what's the difference? https://www.youtube.com/watch?v=YvSkXd_VVYk	marshmallow modelling worksheet (F)	Video clip FITB notes/PPT

Topic 6: chemical compounds	75 min	**4.4 Assemble or draw simple models of molecular and ionic compounds** **4.3 (a) I can identify examples of combining ratios/number of atoms per molecule found in some common materials** **S2.2**	FITB notes & PPT (direct instruction) - Reading and interpreting chemical formulas - Combining in ratios - Ionic and molecular (intro) Marshmallow modelling activity; elements combine in ratios (Worksheet)		Marshmallows & toothpicks worksheets
Topic 6: chemical compounds Charges, predicting combinations	Thurs Sept 17 75 min	**4.3 (b) use information on ion charges to predict combining ratios in ionic compounds of two elements** **S4.1**	Sugar solution vs salt solution vs salt pile demo PPT/notes - Ionic compounds - Oxidation numbers - Predicting how elements will combine Ionic speed dating activity	Speed dating worksheet (F)	Sugar solution, salt solution, salt & conductivity tester PPT/notes Ionic speed dating worksheet
	Fri. Sept 18 50 min	**K1.1** Investigate and describe properties of materials such as melting point, solubility, and conductivity **3.4** Distinguish between ionic and molecular compounds, and describe the properties of some common examples of each **S2.3, 3.1, 3.3** **ICT C.6.1**	Recall: salt/sugar conductivity demo NOTES/PPT - Properties of ionic compounds - Properties of molecular compounds Lab: Comparing Ionic and Molecular Properties pg 142 SF	Lab data, analysis & Venn diagram	FITB notes/PPT Lab: wax shavings, potassium iodide, sodium chloride, sugar, Epsom salts, 200 mL beakers, stir sticks, scoopulas, hot plates, conductivity testers Lab handouts
WEEK 3					
Naming ionic compounds	Sept 21	**4.1 I can read and interpret chemical formulas for compounds of two elements, and give IUPAC name and common name of these compounds**	"telephone" style chemical formula demo – naming is important FITB notes & PPT (direct instruction) - Naming ionic compounds & group quiz Naming ionic compounds worksheet	Group quiz (F) Worksheet (F)	Chemical formula cards for demo FITB notes/PPT
Naming Molecular compounds	Sept 22	**4.1 I can read and interpret chemical formulas for compounds of two elements,**	Recall naming rules for ionic compounds FITB notes & PPT	Individual whiteboards (F)	Whiteboards, markers, erasers PPT/notes

		and give IUPAC name and common name of these compounds	- Molecular compounds: ending changed to "ide" AND use prefixes (mono, di, tri, etc.)	Naming worksheet	Naming worksheet
Topic 7: chemical reactions	Sept 23	**2.5 I can observe heat generated or absorbed in chemical reactions, and identify examples of exothermic and endothermic reactions** **4.5 I can describe familiar chemical reactions, and represent these reactions by using word equations and chemical formulas, and by constructing models of reactants and products**	Quiz Demo: elephant toothpaste (exothermic reaction) FITB notes - Chemical reactions: reactants and products - Evidence of chemical reactions - Chemical equations - Breaking chemical bonds - Exothermic & endothermic (20 min) Models of reactants & products worksheet	Quiz (S) Worksheet (F)	Quizzes Elephant toothpaste: dish soap, potassium iodide, food coloring, hydrogen peroxide, Erlenmeyer flask, tray for containment FITB notes/PPT Chemical equations worksheet
Topic 8: Reaction rate	Sept 24	**2.2 I can describe combustion, corrosion and other reactions involving oxygen** **2.6 I can identify conditions that affect rates of reactions** **S1.3, 2.2, 3.1**	Demo – whoosh bottle: is this exothermic or endothermic? → transition to combustion FITB - Combustion, corrosion, photosynthesis, cellular respiration - Factors affecting rates of reaction Lab of demos - Reaction rates (20 min) with demo/lab (students make observations and determine the factor affecting the reaction rate) Corn starch demo (surface area) Glow stick demo (temperature) Vinegar/chalk demo (concentration) Elephant toothpaste (catalyst) Introduce performance task (20 min)	Lab of demos write-up (F)	Whoosh bottle, isopropyl alcohol, matches, safety goggles, fire extinguisher PPT/notes Lab: corn starch, BBQ lighter, glow sticks, hot & cold water, chalk, weak & strong acetic acid, elephant toothpaste ingredients Demo/Lab handout Performance task handout
WEEK 4					

Performance Task	Sept 25, 28, 29	**GLO 1, K2.5, 2.6, 3.2, 3.4, 4.2, 4.5** **S1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, 3.3, 3.4, 4.1, 4.2** **ICT F.3.3, C.7.2**	In pairs, students will design and conduct an experiment to explore the effect of one of the factors affecting reaction rates on the rate of the breakdown of hydrogen peroxide by yeast (Full task shown below)	Full lab report (S) (Rubric below)	Lab materials, task handout (below)

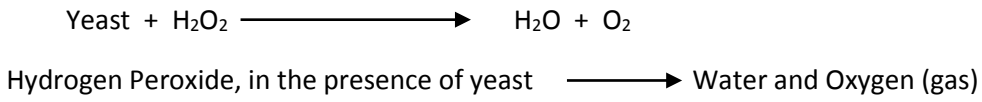
Reaction Rates Performance Task

You will be investigating chemical reactions. During this activity, you will work with a partner (or possibly two partners). However, you must keep your own individual lab notes because after you finish you will work independently to write a report about your investigation.

The Problem

Millions of chemical reactions are occurring in your body all of the time. Hydrogen peroxide, H2O2, a substance that is poisonous to cells, is a by-product of some of these chemical reactions. Most living things, including yeast, contain an enzyme that helps the breakdown of hydrogen peroxide into other substances that are not poisonous. The reaction between hydrogen peroxide and yeast is similar to the breakdown of hydrogen peroxide that can occur in the cells of your body. Yeast is a catalyst that allows the reaction to take place.

When yeast and hydrogen peroxide are mixed together, hydrogen peroxide, H2O2, is broken down into water, H2O, and oxygen gas, O2, as shown below.



Your Task

A number of different variables, such as the concentration of the hydrogen peroxide solution, the relative amount of yeast, and the temperature at which the reaction occurs, can affect the rate at which yeast breaks down hydrogen peroxide. Today you and your partner(s) will design and conduct an experiment to explore the effect of one of the factors on the rate of the breakdown of hydrogen peroxide by yeast.

Materials

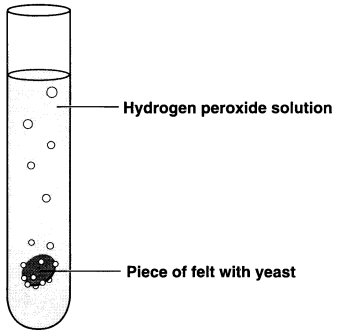
You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials or equipment if they are available:

Hydrogen peroxide (3%)	Forceps
Packet of yeast	5 paper cups
20 pieces of felt	1 small lid for paper cup
5 test tubes, brush, and rack	2 Styrofoam cups
Labeling dots	2 lids for Styrofoam cups
Access to ice/ice water	3 plastic spoons
Access to tap water	Graduated cylinder
Access to a clock with a second hand	Thermometer
Access to a calculator	Access to warm water (50^0-60^0C)
Paper towels for cleanup	Balloons/ Gas collectors
Safety equipment to include splash proof goggles and aprons	

Yeast solution should be anywhere from 50 to 200 ml of water for each packet.

Hydrogen peroxide should be anywhere from 100 to 500 ml of water for every 10 ml of hydrogen peroxide.

One method to time the rate of the reaction is to fill one test tube about 3/4 full with the hydrogen peroxide solution. Using the forceps, soak a piece of felt in the yeast solution and then drop it into the test tube containing hydrogen peroxide solution. The felt should sink to the bottom of the test tube. As the yeast helps break down the hydrogen peroxide, oxygen gas bubbles are formed on the felt and it rises to the top as illustrated in the diagram below. Another method is to time how long it takes a balloon to fill with oxygen gas.



"REACTIONS" DIRECTIONS:

1. Select one variable, either temperature or the concentration of the hydrogen peroxide solution or concentration of yeast solution. You will explore the effect of this variable on the rate of breakdown of hydrogen peroxide by yeast.
2. In your own words, clearly state the problem you are going to investigate. Include a clear definition of the controlled, manipulated, and responding variables that will be studied.
3. Design an experiment to solve the problem. Your experimental design should match your statement of the problem, should control the variables, and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate. Show your design to your teacher before you begin your experiments.
4. After receiving permission from your teacher, work with your partner to carry out your experiments. Your teacher's approval does not necessarily mean that your teacher thinks your experiments are well designed. It simply means that in your teacher's judgment your experiments are not dangerous or likely to cause an unnecessary mess.

5. While conducting your experiments, take careful notes on the pages provided. Space is also provided for charts, tables, or graphs. Your notes will not be scored, but they will be helpful to you later as you work independently to write about your experiments and the results. You must keep your own notes because you will not work with your lab partner when you write your report.

Directions for Writing Your Laboratory Report

Working on your own, summarize your experiments and results. You may use your own notes that you took previously while working with your partner
Your report should include:

- A clear statement of the problem you investigated. Include a clear identification of the independent and dependent variables that were studied.
- A description of the experiment you carried out. Your description should be clear and complete enough so that someone could easily replicate your experiment.
- The results of your experiment. Tables, charts, and/or graphs should be used where appropriate and should be properly labeled. Space for your data is provided.
- Your conclusions from your experiment. State the trends you found as accurately as possible. Your conclusions should be fully supported by data.
- Comments about how valid you think your conclusions are. In other words, how much confidence do you have in your results and conclusions? Any factors that contribute to a lack of confidence in the results or conclusions should be discussed. Also, include the ways that your experiment could be improved if you were to do it again.

Rubric SCORE

Problem Definition

- The problem is stated clearly. Clear identification of independent and dependent variables 3
- The problem is stated adequately. Adequate identification of independent and dependent variables 2
- The problem is poorly stated. Poor identification of independent and dependent variables 1
- The statement of the problem is very limited or missing altogether. No identification of variables 0

Experimental Design

- The experimental design matches the stated problem. Variables are controlled. The procedures are clear, complete, and replicable. A control is included if appropriate.....3
- The experimental design generally matches the stated problem. Attempt at controlling variables is made. Procedures are generally complete. Minor modifications or clarifications may be needed.....2
- The experimental design matches the stated problem to some extent. Little attempt to control variables.
- Procedures are incomplete. Major modifications or clarifications may be needed 1
- The experimental design does not match the stated problem, is very incomplete or missing. There is no attempt to control variables.....0

Data Presentation (Graphs)

- Data are well organized and presented in an appropriate manner 3
- Data are organized and presented in an appropriate manner. Minor errors or omissions may be present 2
- Data are poorly organized or presented in an inappropriate manner. Major omissions or errors may be present..... 1
- Data are very poorly organized or presented in an inappropriate manner or missing altogether 0

Conclusions/Validity

- Conclusions are related to the stated problem and fully supported by data and the validity of .the conclusions are discussed.....3
- Conclusions are generally related to the stated problem and supported by data. Minor errors in interpretation of results may be present. Discussion of the validity of conclusions is limited 2
- Conclusions are related to the stated problem and supported by data to a limited extent. Major errors in the interpretation of results may be present. There is little discussion of the validity of conclusion 1
- Conclusions are not related to the stated problem, not supported by data or are missing. There is no discussion of conclusions.....0

Unit Resources

Science Focus 9
Science in Action 9
Learnalberta.ca
Alberta program of studies
engagingstudents.blackgold.ca
YouTube – Bozeman Science
YouTube – Periodic Table of Videos
YouTube – TED ED
www.ptable.com