

Public and Catholic District School Board Writing Partnership

Course Profile

(for a locally developed course)

Essential Science
Grade 9

• *for teachers by teachers*

Course Profiles are professional development materials designed to help teachers implement the new Grade 9 secondary school curriculum. These materials were created by writing partnerships of school boards and subject associations. The development of these resources was funded by the Ontario Ministry of Education. This document reflects the views of the developers and not necessarily those of the Ministry. Permission is given to reproduce these materials for any purpose except profit. Teachers are also encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for education purposes.

Any references in this document to particular commercial resources, learning materials, equipment, or technology reflect only the opinions of the writers of this sample Course Profile, and do not reflect any official endorsement by the Ministry of Education or by the Partnership of School Boards that supported the Production of the document.

© Queen's Printer for Ontario

Acknowledgments

Public and Catholic School Board Writing Team – Essential Science

Course Profile Writing Team

George Huff, Lead Writer, formerly Scarborough Board of Education and Science Coordinators and Consultants Association of Ontario

Jane Forbes, Halton District School Board

Catherine Kurylo, Upper Grand District School Board

Patrick Likuski, Toronto District School Board

John Rawski, Toronto Catholic District School Board

Joan Tschernow, Toronto Catholic District School Board

Tanya Worobec, Halton District School Board

Lead Board

Halton District School Board

Susan Orchard, Project Manager

Larry Zavitz, Project Coordination

Kelly Terry, Financial Coordination

Science Coordinators and Consultants Association of Ontario

Science Profiles prepared by the Public District School Board Partnership

Unit 3: Chemistry: Exploring Matter

Time: 21 hours

Unit Description

Students develop a concept of matter on the atomic and macroscopic level. Laboratory investigations assist students in understanding that the identity, reactions, and uses of substances are based on their individual properties. Reporting in a variety of formats increases literacy skills. Students gain a renewed respect for safety in and outside the laboratory setting.

Strands and Expectations

Strand(s): Chemistry

Overall Expectations: CHV.01, CHV.02, CHV.03.

Specific Expectations: CH1.01-.04, CH2.01A/B/C/D/E/F, CH2.02-.05, CH3.01-.04.

Activity Title (Time and Sequence)

Activity 1	Lab Safety and Mixing Chemicals	60 minutes
Activity 2	Substances and Their Properties	270 minutes
Activity 3	Pure Substances - Elements and Compounds	270 minutes
Activity 4	Atoms, Molecules, and Formulas	150 minutes
Activity 5	Physical and Chemical Change	210 minutes
Activity 6	Metals and Non-metals	120 minutes
Activity 7	Culminating Activity - A Closer Look at Environmental Chemistry	180 minutes

Task Titles (Type, Time, and Sequence)

Task	Type	Title	Time (minutes)
1.1	Learning	Introduction to Safety Symbols	30
1.2	Assessment	Using and Mixing Chemicals	30
2.1	Learning	Introduction to Properties	45
2.2	Assessment	Properties Identify Substances	30
2.3	Learning/Diagnostic	The Properties of Rubbing Alcohol	60
2.4	Assessment	Looking at an Unknown Liquid	60
2.5	Learning/Assessment	Household Chemicals and Why We Use Them	45
2.6	Learning	Substances and Their Use	30
3.1	Learning	Pure Substances and Mixtures	25
3.2	Learning/Assessment	Is It Really a Pure Substance?	30
3.3	Learning	Elements and Compounds	20
3.4	Diagnostic	Categorizing Models	30
3.5	Learning	Elements and Compounds in Your Life	30
3.6	Learning	Breaking Compounds Apart	60
3.7	Assessment	Breaking Down an Unknown	45
3.8	Learning	Environmental Chemistry	30
4.1	Learning	Getting to Know the Periodic Table	30
4.2	Learning	Atoms and Molecules	30
4.3	Learning	Identifying Atoms and Molecules	30
4.4	Learning	Making Molecules	60
5.1	Learning	Physical Change	45
5.2	Learning/Diagnostic	Chemical Change	60
5.3	Learning	Physical vs. Chemical Change	20
5.4	Learning	Identifying Change	45
5.5	Assessment	Careers in Chemistry	20
5.6	Learning	Making Ice Cream	20
6.1	Learning	What are Metals?	30
6.2	Learning	Properties of Metals	60
6.3	Assessment	Identifying an Unknown	30
7.1	Learning/Assessment	Environmental Chemistry Revisited	30
7.2	Learning/Diagnostic	Environmental Lab	60
7.3	Learning	Research Paper	90

Prior Learning Required

Lab procedures (including lab safety) introduced in Unit 1 are reinforced. Various concepts such as WHMIS standards, properties of matter, and pure substances and mixtures, introduced throughout Grades 7 and 8, are reviewed and reinforced.

General Unit Planning Notes for Unit 3

Specific planning for each activity is described in the Teacher Facilitation sections. However, the following preplanning would be helpful:

- As there are numerous labs, check the Planning Notes for each Activity to ensure you have the required chemicals.
- Activity 2 has extensive equipment list for mini-experiments, check requirements carefully
- Task 7.1 - pre-plan visit with teacher/librarian or book computer lab time to research on Internet
- Periodic Tables are needed in Activity 4. You may distribute simple ones showing symbol and name or more complex ones such as Sargent Welch Periodic Table S-18806. Tables are needed in Activity 4.
- Job shadowing in Task 1.1 and speakers in Task 5.5 require preplanning

Learning/Teaching Strategies or Activities

Activity	Strategy	Description
1	graphic organizer, visual display	Students identify and list household and workplace safety symbols, which are then posted as a constant visual reminder of safe practices in the lab. WHMIS symbols are reviewed with a focus on safety in the classroom.
2	inquiry/experimental, reflection	Students work individually or in pairs to carry out several inquiries into substances and their properties.
3	concept attainment or sorting activity, inquiry/experimental, modeling, research	Pure substances are identified as either elements or compounds. Investigations and modelling are used to reinforce these concepts.
4	reflection, modeling	Hands-on activities help students differentiate between atoms and molecules.
5	inquiry/experimental, reflection	Investigations help students recognize signs of physical and chemical change.
6	inquiry/experimental	Lab activities serve to identify the characteristics that separate metals from non-metals.
7	reflection, inquiry/experimental, research	Students carry out labs and investigate current environmental issues. Introduction to the basic format for conducting research.

Assessment/Evaluation

Activity	Expectations	Tool	Assessing	Who
1.1	CH2.01A	Worksheet Answer Key	knowledge	Teacher
1.2	CH3.01, CH3.03	Reading for Understanding Rubric	knowledge, communication	Teacher
2.1	CH1.01, CH2.01B	Worksheet Answer Key	knowledge	Teacher
2.2	CH1.01, CH2.01B, CH2.01C	Cloze Answer Sheet Worksheet Answer Key Lab Safety Checklist or Lab Procedures Rubric	knowledge, inquiry	Teacher, Peer
2.3	CH1.01, CH2.01B, CH2.01D	Worksheet Answer Key Lab Procedures Rubric	knowledge, inquiry	Teacher, peer
2.4	CH1.01, CH2.01B, CH2.01C, CH2.01D, CH2.01E	Worksheet Answer Key Lab Procedures Rubric Lab Safety Checklist	knowledge, inquiry	Teacher
2.5	CH1.01, CH3.02, CH3.04	Worksheet Answer Key SLL Rubric	knowledge, making connections	Teacher
2.6	CH3.02	Worksheet Answer Key	knowledge	Teacher
3.2	CH1.02	Lab Procedures Rubric Worksheet Answer Key	inquiry	Teacher
3.3	CH1.02	Worksheet Answer Key	knowledge	Teacher
3.4	CH1.02	Worksheet Answer Key	knowledge	Teacher
3.5	CH3.01	Reading for Understanding Rubric	knowledge, communication	Teacher
3.6	CH2.04	Lab Procedures Rubric Worksheet Answer Key	inquiry	Teacher
3.7	CH2.04	Worksheet Answer Key Lab Procedures Rubric	knowledge, inquiry	Teacher
3.8	CH1.02, CH3.01	Reading for Understanding Rubric	knowledge, communication	Teacher
4.2	CH1.03, CH1.04	Notebooks are Important! Checklist	inquiry	Teacher
4.3	CH1.03, CH1.05, CH2.01F	Worksheet Answer Key	knowledge	Teacher
4.4	CH1.03, CH1.05, CH2.01F	Worksheet Answer Key	knowledge	Teacher
5.1	CH1.07	SLL Rubric	knowledge, making connections	Teacher
5.2	CH1.08, CH2.03	SLL Rubric Worksheet Answer Key Lab Procedures Rubric	knowledge, making connections, inquiry	Teacher, Peer
5.3	CH1.07, CH1.08, CH2.02	Worksheet Answer Key	knowledge	Teacher

Activity	Expectations	Tool	Assessing	Who
5.4	CH2.01A, CH2.01C, CH2.01D, CH2.01E, CH2.01F, CH2.02	Lab Procedures Rubric	inquiry	Teacher
5.5	CH3.04	Worksheet Answer Key	making connections	Teacher
5.6	CH1.07, CH2.02	Worksheet Answer Key	knowledge	Teacher
6.1	CH1.06	Worksheet Answer Key	knowledge	Teacher
6.2	CH2.01A, CH2.05	Lab Procedures Rubric Worksheet Answer Key	inquiry	Teacher
6.3	CH1.06, CH2.01A, CH2.05	Worksheet Answer Key	knowledge	Teacher
7.1	CH2.01D	SLL Rubric	knowledge, making connections	Teacher
7.2	CH1.05, CH1.07, CH1.08, CH2.01A, CH2.01C, CH2.02	Worksheet Answer Key Lab Procedures Rubric Lab Safety Checklist	knowledge, inquiry	Teacher
7.3	CH2.01D, CH2.01E	Research Paper Rubric	knowledge, making connections	Teacher

Unit Resources

Halley, Gessener G. *The Condensed Chemical Dictionary*. New York: Van Nostrand Reinhold, most recent edition. ISBN 0-442-23244-6

An excellent resource for answering all those questions such as, What is that used for? What is laughing gas? What's in dynamite?

Miranda, Joseph (ed.). *Milady's Standard: Textbook of Cosmetology, Revised*. Albany: Milady Publishing Company, 1993.

Details the chemistry behind hair dying, and hair permanents.

Prentice Hall Science *Matter: Building Block of the Universe*. Activity Book. New Jersey: Prentice-Hall Inc., 1993. ISBN 0-13-402140-1

Simple worksheets about the properties of matter.

Prentice Hall Science *The Nature of Science*, Activity Book. New Jersey: Prentice-Hall Inc., 1993. ISBN 0-13-400425-6

Simple worksheets about measurement and tools of science.

Prentice Hall Science *The Nature of Science: Review and Reinforcement*, Activity Book. New Jersey: Prentice-Hall Inc., 1993. ISBN 0-13-986050-9

Simple assessment tasks dealing with measurement and tools of science.

Rosen, Seymour. *Chemistry Workshop 1*, New York: Globe Book Company Inc., 1988. ISBN 0-87065-952-9

Soft cover text with a reading level of 4-5 and an interest level 6-12. Topics range from changes of state to differences between physical and chemical changes.

Rosen, Seymour. *Chemistry Workshop 2*, New York: Globe Book Company Inc., 1988.
ISBN 1-55675-704-2

Continuation of Chemistry Workshop 1. Topics range from mixtures to solutions.

Shapiro, Brenda and Stan Shapiro. *Chemistry at Work*. Toronto: Copp Clarke Pitman Ltd., 1989.
ISBN 0-7730-4730-1

A resource of ideas for practical chemistry

Activity 1: Lab Safety and Mixing Chemicals

Time: 60 minutes

Description

The need for procedures regarding the safe handling and use of chemicals in the laboratory, home, and workplace is examined. WHMIS safety symbols are related to those found on household products.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH2.01A, CH3.01, CH3.03.

Planning Notes

Equipment required for Task:

- 1.1 - household and workplace products with various safety symbols collected by teacher. Also collect products from school custodian,
- 1.1 - large version of safety/WHIMS labels to post in classroom,
- 1.1 - prepare for possible co-op volunteer in classroom or job shadowing,
- 1.2 - select/adapt short articles on improper use of chemicals (Appendix 3.1 is an example.).

Prior Learning Required

The need for safety in the laboratory is reinforced through the introduction of household safety symbols. WHMIS symbols originally seen in Grade 7 are reviewed.

Teaching/Learning Strategies

1.1 Learning Task: Introduction to Safety Symbols

Students participate in a teacher-led discussion on safety symbols, found on both home and workplace products, and their use. Students examine the safety labels on a variety of household items and complete a worksheet.

Teacher Facilitation

1. Obtain a variety of household and workplace products with the following clearly labelled symbols - flammable, corrosive, poisonous, explosive [**Note:** These are the four categories for household hazardous products]. Lead a discussion on the products, their safety symbols and hazards.
2. **Enrichment:** If time permits, briefly discuss that the shape of the household safety symbol indicates the level of hazard (e.g., octagon for danger, diamond for warning, triangle for caution) and illustrate these symbols on a variety of products.
3. Enlarge and photocopy household and WHMIS safety symbols from a textbook, or from the Board safety officer or purchase them from a scientific supply house. Have students identify the hazard associated with each symbol.
4. Discuss the meaning associated with each symbol, the relationship between the colour and the shape of the symbol, and the usefulness of these symbols.

-
5. Prepare a worksheet that has:
 - a key of symbols and their meaning,
 - a matching exercise with safety/WHMIS symbols and their meaning,
 - pictures of household/workplace items and a blank for recording hazard indicated on label.
 6. Display both household and WHMIS symbols within the classroom for future reference.
 7. A co-op student could describe WHMIS safety training he/she has undergone and what safety procedures are used on the job. This could also be a job shadowing where safety is the focus of the shadow.

Assessment

Assess using worksheet answer key.

Accommodations

Assign peer helper to aid in completion of worksheet.

1.2 Assessment Task: Using and Mixing Chemicals

Students select a reading article and answer specific questions on safe and unsafe chemical practices in the home and workplace.

Teacher Facilitation

1. Select/adapt several articles (see Appendix 3.1 as an example) outlining the hazards associated with the improper use of some common substances. Some examples are: carbon monoxide (CO) poisoning from indoor use of barbecues, carbon monoxide from a car running in an attached garage, mixing household bleach with Drano, use of paint thinner in an unventilated room or near the flame of a furnace or hot water tank. Include focus questions, e.g., What was the unsafe practice? What happened because of it? How could it have been prevented? and a connections question.
2. Discuss the hazards of working with chemicals in lab and at home. Point out that misuse of chemicals can lead to injury, illness or in extreme cases, even death. Assist students in generating a list of three or four general rules pertaining to the safe handling and use of chemicals. Post rules in the classroom.

Assessment

Assess using Reading for Understanding Rubric (Appendix 1-13).

Accommodations

Enlarge print for students with poor vision. Use scribe and/or peer helper, tape recorder, or computer as an alternative to written response

Activity 2: Substances and Their Properties

Time: 270 minutes

Description

This activity examines how the physical and chemical properties of familiar substances determine their use. Through a series of investigations, students uncover some properties of rubbing alcohol and other familiar substances. Students use their knowledge of properties to investigate an unknown substance and study some of its uses.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH1.01, CH2.01B/C/D/E, CH3.02, CH3.04.

Planning Notes

1. There are many properties that can be used to identify substances. After completion of Activity 2, students should understand:
 - that substances can be identified by their properties;
 - properties determine the use of substances;
 - useful properties are: state at room temperature, colour, electrical conductivity, mass of 1 mL (density), viscosity, dissolving power, solubility (dissolves or does not dissolve), reactivity with an acid, boiling point, melting point. Other properties that are optional include: flammability, rusts in air, lustre or shininess, attraction to a magnet.
2. This profile uses the term "soluble" to indicate if a substance dissolves (e.g., sugar is very *soluble* in water) and "dissolving power" to indicate how well a substance acts as a solvent (e.g., water has a better *dissolving power* for salt than alcohol).
3. The viscosity of a fluid is measured using the time it takes a peppercorn to drop through the liquid. The liquids in this experiment include water, alcohol, corn or canola oil, and glycerin. One way to do this is have the liquid in a clear 2-L plastic pop bottle. There should be an equal depth of liquid for all experiments. Peppercorns can remain at the bottom of the pop bottle. At the end of this unit, pour the liquid into a clean pop bottle and store it for future use.
4. For Task 2.2 use a conductivity apparatus with a 3 or 6 V battery/power source, wire leads with alligator clip, and a 1.5 V light bulb or a simple conductivity apparatus such as the one available from S17 Science, 57 Glen Cameron Road, Unit 6, Thornhill, ON L3T 1P3.
5. For alcohol use methanol (CH₃OH) or rubbing alcohol (CH₃CHOHC₂H₅, also called 2-propanol or isopropyl alcohol).
6. For acid solutions add 10 mL of hydrochloric acid to 90 mL of water. Small amounts of excess acid solution can be flushed down the sink. [Note: 10 mL of 12 M HCl diluted to 1.2 M HCl]
7. Glycerin (glycerol) can be used as the unknown in Task 2.4. It is a colourless, odourless, syrupy liquid that can be purchased in the drug store or a chemical supply house. Glycerin is soluble in water and nontoxic.
8. General laboratory equipment, such as test tubes, beakers, retort stand and clamps, stirring rods, graduated cylinders, and a thermometer, is needed for this activity. Additional materials required for task:
 - 2.1 - canola or corn oil, alcohol, powdered or fine salt, powdered chalk, granite chip, marble (boiling) chip, dilute hydrochloric acid, dropper, ice, hot plate, canned diet and regular pops (e.g. cola and diet cola)
 - 2.2 - peppercorns, canola or corn oil, two 2 L pop bottles, stopwatch or watch with second hand, conductivity apparatus (see Planning Note 4 above), aluminum foil, wooden splint, powdered sulfur, baking soda, dilute hydrochloric acid, spot plates, different grades of motor oil
 - 2.3 - rubbing alcohol, powdered sulfur, baking soda, conductivity apparatus, peppercorns, 2 plastic pop bottles, stopwatch or watch with second hand, powdered sugar, chalk, spot plate
 - 2.4 - glycerin, 250 mL beaker, conductivity apparatus, peppercorns, 1000 mL graduated cylinder, stopwatch or watch with second hand, chalk, salt, spot plate, 100 mL graduated cylinder, balance
 - 2.5 - grease or petroleum jelly, Styrofoam cups, rubbing alcohol, paint thinner, cotton swabs, paper, glycerin

Prior Learning Required

Safe lab practices are stressed. Grade 8 concepts of viscosity and density of liquids are reviewed. Other properties of substances are introduced.

Teaching/Learning Strategies

2.1 Learning Task: Introduction to Properties

Students carry out several mini-experiments to demonstrate the physical and chemical properties that identify substances. Students complete a worksheet summarizing results of mini-experiments.

Teacher Facilitation

1. Teacher leads a discussion on how substances are identified by their properties. For example, water is a colourless (colour) liquid (state at room temperature) that flows easily (viscosity).
2. Prepare a worksheet where students record the results of the mini-experiments.
3. Gather materials for the following mini-experiments and lead students through the following:
 - a) Solubility: Compare the solubility of oil, alcohol, salt, and powdered chalk by placing small amounts of each in separate test tubes of water and shaking to see if they dissolve.
 - b) Density: Compare the density of water and oil. Students use a graduated cylinder to accurately measure 50 mL of water and oil. Find the mass of equal volumes of water and (corn or canola) oil. Remember to subtract the mass of the empty beaker after weighing.
 - c) Reactivity with an acid: Place approximately 1/4 test tube of dilute hydrochloric acid [see Activity 2, Planning Note 6] in each of two test tubes. Slide a granite chip into one and one marble chip (boiling chip) into the second. [**Note:** The marble chips, CaCO_3 , produce bubbles and the granite chips do not; hence different substances have different reactivity to acid.]
 - d) Melting Point: Place an ice-water mixture into a 250 mL beaker. Have students stir carefully with a stirring rod and take the temperature at one-minute intervals using a thermometer. Read and record the melting point temperature.
 - e) Boiling Point: Place water into a 250-mL beaker and heat to boiling on a hot plate. Clamp a thermometer on a retort stand so that its bulb is just touching the surface of the boiling water. Have students observe and record the boiling point temperature of water.
 - f) Density: Students float four cans of pop (e.g., diet cola, diet ginger ale, cola, ginger ale) in water and record differences in how each can floats. [**Note:** Cans of diet pop float and regular pop sink. Aspartame sweetener used in diet drinks is sweeter than glucose; a greater mass of sugar is needed and hence regular pop has a higher density and sinks.]
 - g) Colour: After floating the cans of pop are opened to observe the colour of cola and non-cola pops.
4. After students complete the mini-experiments, lead a discussion on what a property is. Provide simple definitions for those properties directly related to the mini-experiments: state of matter at room temperature, colour, melting point, boiling point, solubility, density, and reactivity to acids. Help students to understand which property was being investigated in each mini-experiment. [**Note:** Use the terms dissolve and dissolving rather than soluble and solubility with the students.]

Safety Precautions

Review general lab rules such as wearing safety goggles and use of a hot plate. Ensure students understand the dangers involved in working with acids: students should use small amounts; dispose of acids properly; should not touch, taste or smell the acid; wear safety goggles; wipe up spills immediately with plenty of water; if acid comes in contact with skin, flush immediately with lots of water and inform the teacher.

Assessment

Create a worksheet answer key.

Accommodations

Pair students to complete experiments. Have a scribe aid in completion of worksheet.

2.2 Assessment Task: Properties Identify Substances

Students complete a cloze worksheet reviewing properties of substances. They then conduct an investigation into two additional properties of matter - viscosity and conductivity. Students complete a worksheet summarizing results of experiments.

Teacher Facilitation

1. Prepare cloze worksheet on properties of substances (see Appendix 3.2).
2. Review properties of matter from mini-experiments from Task 2.1. If necessary, assist students to complete worksheet.
3. Demonstrate lab procedures to be followed when investigating these new properties (e.g., correct use of conductivity apparatus with simple explanation of how it works).
4. Gather materials for experiments described below:
 - a) Viscosity: Investigate viscosity by comparing the time it takes for a peppercorn to drop through a 2 L pop bottle filled with water to the time required for a peppercorn to drop through a 2 L pop bottle filled with oil. Use a stopwatch or watch with a second hand to time the descent.
 - b) Electrical Conductivity: Examine electrical conductivity by using a conductivity apparatus [see Activity 2, Planning Note 4]. Students compare the conductivity of aluminum foil, a wooden splint, and a glass rod.
 - c) Colour, Solubility, Reaction with Acid: Compare the colour of powdered sulfur and baking soda. Place water in two wells of a spot plate and dilute hydrochloric acid in two wells of a spot plate. Add a very small amount of each solid to a well containing acid and a well containing water. Mix with clean glass stirring rods. [Note. Sulfur is yellow, insoluble in water and does not react with acid. Baking soda is white, soluble in water, and reacts with acid to produce a CO₂ gas.]
5. Lead a discussion focussing on the two new properties: conductivity and viscosity. [**Note:** A chemical dictionary, as described in Unit Resources, is handy to answer the questions on the use of substances.]
6. **Extension:** Teacher may wish to connect viscosity with the different grades of automobile motor oil. Provide a comparison of the different grades (10W30, 20W50) and ask students to predict which type they would use during the winter or during the summer.

Safety Precautions

Review proper disposal of oil and safe use of electrical equipment.

Assessment

Assess knowledge of properties using cloze worksheet answer key. Assess results of experiment using worksheet answer key. Students assess one another's safe lab procedure using Lab Safety Checklist (Appendix 1.2) or Lab Procedures Rubric (Appendix 1.3).

Accommodations

Provide a peer helper to assist students with writing when necessary.

2.3 Learning/Diagnostic Task: The Properties of Rubbing Alcohol

Students identify some of the properties of a known substance (rubbing alcohol). Students complete a worksheet summarizing results of experiments.

Teacher Facilitation

1. Prepare a lab worksheet that allows students to record their experimental observations in a chart. Include the melting point and boiling point of rubbing alcohol as well in this chart.
2. Introduce the lab activity by reviewing on the chalkboard each of the different properties of matter. Ask students how they would determine each of these properties. Point out the safety symbol(s) associated with rubbing alcohol. Indicate to students that they will enter their experimental results in a worksheet chart, which summarizes the properties of rubbing alcohol.

-
3. Gather materials for experiments described below:
 - a) **Conductivity:** Investigate conductivity by using a small amount of rubbing alcohol to complete a circuit using a conductivity apparatus [See Activity 2, Planning Note 4]. Place a small amount of alcohol in a 250 mL beaker and insert wire leads into the liquid to determine if the circuit is complete.
 - b) **Viscosity:** Determine the viscosity by recording the time it takes for a peppercorn to drop through equal depths of water and alcohol in 2-L plastic pop bottles. Use a stopwatch or watch with second hand to time the descent of the peppercorns [See Activity 2, Planning Note 3].
 - c) **Density:** Compare the mass of 50 mL of rubbing alcohol with the mass of 50 mL of water. Students use a graduated cylinder to accurately measure 50 mL of each substance. Mass equal volumes of each liquid. Find the mass of 1 mL of each.
 - d) **Dissolving Power of Alcohol:** Put a small amount of rubbing alcohol into two wells of a spot plate. Mix a small amount of powdered sugar in one well and powdered chalk in the second well, stir with a glass rod to determine which solid the alcohol dissolves.
 - e) **Extension:** Teacher may wish to connect the use of rubbing alcohol with the properties contained in the worksheet chart. Do this either through discussion or by including focus questions in the worksheet (e.g., Rubbing alcohol can be used to help reduce a fever by rubbing it over the body. Which properties of rubbing alcohol explain this?)

Safety Precautions

Review general lab procedures such as wearing safety goggles and handling of equipment. Do not experimentally determine the boiling point of alcohol because the fumes are toxic and flammable.

Assessment

Assess using worksheet answer sheet. Peer assessment and diagnostic assessment of lab procedures using Lab Procedures Rubric (Appendix 1.3).

Accommodations

Pair students for lab work. Use peer helper/scribe to complete worksheet.

2.4 Assessment Task: Looking at an Unknown Liquid

Given an unknown, students investigate some of the properties of it. Students observe and record results of tests for the following properties: state at room temperature, colour, conductivity, viscosity, solubility, and density. Students then complete a worksheet in which they determine the name of the unknown by comparing their experimental results with the properties of known liquids.

Teacher Facilitation

1. Prepare a worksheet (such as Appendix 3.3) to guide students through the investigation. Include a chart for students to record their observations.
2. Gather materials for the experiments described below:
 - a) The unknown liquid is glycerin. [See Activity 2, Planning Note 7]
 - b) **State at Room Temperature, Colour and Odour:** Students observe unknown liquid.
 - c) **Conductivity:** Students determine using conductivity apparatus [see Activity 2, Planning Notes 3].
 - d) **Viscosity:** Have students recommend method (e.g., time for peppercorn to drop through a 2 L pop bottle of unknown liquid).
 - e) **Dissolving Power of Unknown Liquid:** Add small amounts of unknown liquid into 2 wells of a spot plate. Use a clean stirring rod to stir a very small of powdered salt into one well. Repeat using powdered chalk. Determine if one, two, or none dissolve.
 - f) **Density:** Measure 50 mL of water and 50 mL of the unknown liquid using a graduated cylinder. Find the mass of each liquid. Make certain to subtract the mass of the empty beaker. Find the mass of 1 mL.

Safety Precautions

Remind students of general lab procedures such as wearing safety goggles and proper use of equipment. Review safe handling of battery when testing for conductivity.

Assessment

Assess using worksheet answer key. Assess lab work using Lab Procedure Rubric (Appendix 1.3) and Lab Safety Checklist (Appendix 1.2).

Accommodations

Allow students to complete assessment task in pairs. Reduce the number of properties the students need to investigate.

2.5 Learning/Assessment Task: Household Chemicals and Why We Use Them

Students conduct teacher designed investigations into substances and the property that determines its use. Students record conclusions on worksheet.

Teacher Facilitation

1. Prepare a worksheet summarizing substance, use, and property that determines its use.
2. Provide three different substances and ask students to determine the use of the substance based on its properties. Possible substances and sample questions are listed below:
 - a) “For a lubricant I need something that is slippery. Here are three substances, which one would be the best lubricant?” The substances are water, grease, or petroleum jelly. Students get two Styrofoam or clear plastic cups and lubricate the rim of one cup and then twist the second cup inside the first to determine which cup moves the easiest.
 - b) “For something to clean grease, I need something that will dissolve the grease. Which would be the best substance?” The substances to be tested are water, rubbing alcohol, and paint thinner. Students use a cotton swab and a spot of grease on a piece of paper. Dip a clean cotton swab into each substance and try to clean the grease off the piece of paper.
 - c) “For perfume, I need something that evaporates off the skin. Which would be the best base to make a perfume?” The substances tested are water, rubbing alcohol, and glycerin. Students place a drop of each substance on to their arm and observe which one evaporates the fastest.
3. Assign SLL entry with vocabulary (e.g. lubricant, evaporate, dissolve, property), focus question (e.g., “Mechanics use motor oil in engines because...”) and connections question (e.g., “A job in which someone would need to know how to clean grease is _____.”, “Another substance that this job might have to use could be _____ because...”).
4. **Extension:** If time permits, have students use a recipe to make a perfume or cologne.

Safety Precautions

Instruct students to wear safety goggles during lab. Use proper disposal of grease and paint thinner.

Assessment

Assess using worksheet answer key and SLL Rubric (Appendix OV-2).

Accommodations

Do some experiments as teacher demonstrations. Discuss SLL entry questions as a class.

2.6 Learning Task: Substances and Their Use

Students use everyday knowledge to complete a chart, which lists various substances and the property that determines their use.

Teacher Facilitation

1. Create a worksheet with a chart for student completion with three columns headings: “Substance, Use, Property” (see Appendix 3.4). Provide students with a word list on the worksheet that allows them to complete the chart for various substances by filling in the missing blank using their knowledge of different substances and their properties.

Assessment

Assess using a worksheet answer key.

Accommodations

Use of peer helper/scribe to complete worksheet.

Website Resources

Chem4kids - <http://www.kapili.com/chem4kids/index.html>

(site describes properties of matter)

Online Introductory Chemistry - <http://scidiv.bbc.ctc.edu/wv/0001-01-Chemistry.html>

(describes physical and chemical properties of matter)

Activity 3: Pure Substances - Elements and Compounds

Time: 270 minutes

Description

Through a concept attainment exercise the student becomes familiar with the terms pure substance, mixture, element, and compound. A variety of household products are classified as pure substance or mixture depending on their composition.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH1.02, CH2.04, CH3.01.

Planning Notes

1. See Appendix 3.5 for a description of the concept attainment exercise and the equipment needed for it.
2. General laboratory equipment, such as test tubes, graduated cylinders, Bunsen burners, test tube holders, and tongs, is needed
3. Equipment required for Task:
 - 3.1 - 15 pictures/models of pure substances and mixtures
 - 3.2 - distilled water, tap or carbonated mineral water, hot plate, and clean watch glass or evaporating dish
 - 3.3 - pictures/models of pure substances (from Task 3.1)
 - 3.4 - pictures/models of elements, compounds, pure substances, and mixtures
 - 3.5 - teacher prepared articles on familiar substances such as sulfuric acid (H_2SO_4), ammonia (NH_3), water (H_2O), chlorine (Cl_2), carbon monoxide (CO), carbon dioxide (CO_2), oxygen (O_2), hydrogen peroxide (H_2O_2), helium (He)
 - 3.6 - copper carbonate (CaCO_3), carbon dioxide sensors (if available)
 - 3.7 - sodium bicarbonate (NaHCO_3), carbon dioxide sensors (if available)
 - 3.8 - select/adapt short articles on environmental chemistry (greenhouse effect, acid rain, phosphate pollution)

Prior Learning Required

The concept of distinguishing matter as either a pure substance or a mixture, established in Grade 7, is reviewed. In this unit, the term “mixture” is used to describe an impure substance. The necessity of safe lab practices is maintained.

Teaching/Learning Strategies

3.1 Learning Task: Pure Substances and Mixtures

Students participate in a teacher-led concept attainment activity to introduce the terms pure substance and mixture. A variety of household products are then classified as pure substances or mixtures by having students read the labels for each item.

Teacher Facilitation

1. Carry out concept attainment described in Appendix 3.5 to establish the idea that pure substances contain one kind of particle and mixtures contain two or more kinds of particles. [**Note:** To avoid confusion the term *mixture* is used instead of impure substance.]
2. Prepare 15 pictures/models of pure substances and mixtures. Describe pure substances (e.g., water, iron) as having only one type of particle. For mixtures show obvious mechanical mixtures (e.g., muddy water, marmalade, orange juice, multicoloured fabric) that have different types of particles.
3. Lead students to discover why you are grouping as you do (i.e., What do the members of each group have in common?). Introduce students to the two new terms.
4. Assist students in generating a short note on pure substances and mixtures.
5. Allow students to read the labels on various household products (baking soda, iodized salt, ketchup, white sugar, milk, glass cleaner, bottled mineral water, coffee, deionized/distilled water, cola) in order to classify them as pure substances or mixtures. [**Note:** Students should recognize that most household substances are mixtures and not "pure" in the chemical sense; 100% pure maple syrup is a mixture of water, sugar, flavours, colour. Chemically pure means only one kind of particle.]

Assessment

None.

Accommodations

Provide peer helper/scribe to aid in note-taking activity.

3.2 Learning/Assessment Task: Is It Really a Pure Substance?

Students conduct a laboratory investigation with distilled water and either carbonated mineral water or tap water to classify each as a pure substance or a mixture. Students recognize from their experimental results that there are impurities in tap water and mineral water. Hence "tap water" is not pure in the chemical sense or in scientific terms. There are other substances dissolved in water obtained from the tap.

Teacher Facilitation

1. Prepare lab worksheet for students to record lab results and answer questions.
2. Gather materials for experiments described below:
 - a) Clean watch glass or evaporating dish before use.
 - b) Obtain two samples of water to be heated to determine which is a "pure substance" and which is a "mixture". Sample #1 is tap water or mineral water. Sample #2 is distilled water.
 - c) Place 4-5 drops of one sample on a clean watchglass or into a clean evaporating dish. Heat both to dryness on a hot plate. Repeat with sample #2 on a clean watchglass. Examine any residue left behind. [**Note:** tap water or mineral water will leave a residue of dissolved minerals and hence are mixtures.]
 - d) Teacher-led discussion focussing on pure substances and mixtures and how they are distinguished. [**Note:** Do not get into any further distinctions of mixtures as solutions and heterogeneous mixtures at this point].
3. **Extension:** Teacher may wish to discuss the various types of bottled waters and their differences. Teacher may wish to discuss the term "pure" when applied to milk or orange juice and help students recognize that these substances are mixtures and are not "pure" in the chemical sense. Milk and orange juice are composed of many different substances. Students can then heat a sample of either and recognize that the residue left behind after the evaporation is proof of impurities in both.

Safety Precautions

Use tongs to handle hot glassware. Allow hot glassware to cool before putting under water.

Assessment

Assess using Lab Procedures Rubric (Appendix 1.3). Assess worksheet using teacher-created answer key.

Accommodations

Pair students for the laboratory work. Some experiments can be done as teacher demonstrations.

3.3 Learning Task: Elements and Compounds

Students participate in teacher-led discussion on elements and compounds. Students complete a worksheet.

Teacher Facilitation

1. Revisit concept attainment activity from Task 3.1. [See Appendix 3.5]
2. Provide definitions of element and compound to include on the worksheet.
3. Create a worksheet for this Task. Students determine whether various substances are elements or compounds based on pictures of molecules. [See Appendix 3.5 #4]
4. Separate the pictures of these pure substances into two groups on the chalkboard – elements and compounds. As pictures are being sorted, help students determine the difference between the two groups.

Assessment

Assess using a worksheet answer key

Accommodations

Provide peer helper/scribe to aid in completing worksheet.

3.4 Diagnostic Task: Categorizing Models

Give students pictures, models, or collections of elements, compounds, mixtures, and pure substances. Students identify as elements or compounds and pure substances or mixtures.

Teacher Facilitation

1. Provide pictures and models of elements, compounds, pure substances, and mixtures.
2. Create a worksheet to lead students through the activity.

Assessment

Make diagnostic assessment using a teacher created answer key.

Accommodations

Pair students in heterogeneous groupings.

3.5 Learning Task: Elements and Compounds in Your Life

Students read a short article and answer focus questions.

Teacher Facilitation

1. Prepare several Reading for Understanding articles on familiar substances (see Appendix 3.6 as an example). Other familiar substances include: ammonia (NH_3), water (H_2O), chlorine (Cl_2), carbon dioxide (CO_2), oxygen (O_2), hydrogen peroxide (H_2O_2), and helium (He). A chemical dictionary may be useful in preparing these articles. Articles should focus on the element/compound and its use in everyday life. Pictures of molecules of each substance must be included with each article so students may determine whether each substance is an element or compound.
2. Prepare questions related to the articles, e.g., Is the substance an element or a compound, What is it used for?, What is the property of the substance that makes it useful?.
3. **Extension:** If time permits, have students briefly report on the substance researched.

Assessment

Assess using Reading for Understanding Rubric (Appendix OV-4).

Accommodations

Read articles as a class instead of individually. Student can complete questions orally.

3.6 Learning Task: Breaking Compounds Apart

Students perform a decomposition lab and complete a worksheet summarizing their results.

Teacher Facilitation

1. **Note:** Teacher may wish to do the decomposition of water that is done in Unit 6 at this point. [**Note:** The decomposition reactions outlined below were chosen to avoid misconceptions – compounds are not always broken down into elements – they are often broken down into other simpler compounds.].
2. Prepare a lab worksheet for the decomposition reaction. Include focus questions on the observable properties of the substances involved in the reaction and whether or not the identified substance produced was an element or compound.
3. Teacher-led discussion introducing the students to the investigation saying that the class is going to look at compounds in further detail by determining if they can be broken down. At the end of the experiment, teacher reinforces the concept that a compound has been broken down into simpler substances, which is decomposition.
4. If students are to identify the substance produced as an element or compound they must be introduced to testing for gases at this point. Oxygen is present when glowing wooden splint bursts into flames. Carbon dioxide is present when a burning wooden splint is extinguished.
5. Heat a sample of green copper carbonate (CuCO_3) to produce carbon dioxide gas and black copper oxide (CuO). Put 1-2 mL of copper carbonate (CuCO_3) into a test tube and heat over a Bunsen burner flame.
6. Test gas with a blazing splint or a carbon dioxide sensor at this time. If possible, allow students to use information or data from Task 3.5 to help answer questions in the lab worksheet.
7. **Extension:** Read an article on airbags. Inflation is due to a decomposition reaction. In a car crash, sparks from a sensor causes solid sodium azide (NaN_3) to rapidly produce a nitrogen gas, which inflates the air bag. This may open up discussion on safety issue and the fact that small people and children should not be riding in the front seat of a car with air bags.

Safety Precautions

Use test tube holder to hold hot equipment. Hold test tube at an angle away from yourself and other students. Wear safety goggles during experiment.

Assessment

Assess lab performance by using Lab Procedures Rubric (Appendix 1.3). Create an assessment tool to evaluate the lab worksheet.

Accommodations

Assign peer helper to aid in completion of worksheet and performance of lab.

3.7 Assessment Task: Breaking Down an Unknown

Students heat an unknown substance (sodium bicarbonate) and identify it as an element or compound based on results.

Teacher Facilitation

1. Prepare worksheet to lead students through lab. Worksheet should include questions such as How do you know that sodium bicarbonate (NaHCO_3) was a compound?
2. Heat a small amount of sodium bicarbonate (NaHCO_3) in a test tube and heat it over a Bunsen burner flame. [**Note:** Sodium bicarbonate will decompose into carbon dioxide gas (CO_2) and solid white sodium carbonate (Na_2CO_3) and water. Students determine if substance heated was an element or a compound based on the production of a gas and new solid.
3. Teacher may wish to test the gas with a blazing splint or a carbon dioxide sensor.

Safety Precautions

Usual safety precautions on heating: use test tube holder, point test tubes away from people, wear safety goggles.

Assessment

Assess using a worksheet answer key. Assess lab work using Lab Procedures Rubric (Appendix 1.3).

Accommodations

Assign peer helper to aid in completion of worksheet and performance of lab.

3.8 Learning Task: Environmental Chemistry

Students read articles on a current environmental problem and complete a worksheet with focus questions.

Teacher Facilitation

1. Select/adapt short articles on current environmental issues such as carbon dioxide (CO₂) gas and the greenhouse effect, sulfur dioxide (SO₂) gas and acid rain, phosphates in detergents and fertilizers which lead to algae blooms in lakes.
2. Prepare a worksheet with focus questions, e.g., What is the problem?, What causes the problem? What are two things you can do to help? and a connections questions, e.g., What are some of the positive uses of this substance?.
3. **Extension:** If time permits, students briefly present information gathered from article.
4. **Extension:** Teachers may introduce a graphing activity, for example, graphing carbon dioxide (CO₂) concentration in the atmosphere versus years. Assign supplementary questions that use the information contained in the graph to gather additional information related to the environmental issue.

Assessment

Assess using Reading for Understanding Rubric (Appendix OV-4).

Accommodations

Complete the activity as a class and complete the questions orally.

Internet Resources

Periodic Table

<http://www.kapili.com/chem4kids/index.html>

(site with Periodic Table discussing the first 18 elements)

Elements, Compounds and Mixtures

<http://chemed.chem.purdue.edu/~genchem/topicreview/bp/ch2/mixframe.html>

<http://pc65frontier.osrhe.edu/hs/science/pelem.htm>

(list of 30 elements and links to periodic table with history and structure of element)

Activity 4: Atoms, Molecules, and Formulas

Time: 150 minutes

Description

The difference between atoms and molecules is explored and used to further develop the concepts of elements and compounds. Molecular model kits are used to have students build models representing the molecules of familiar substances when given a picture and chemical formula.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH1.03, CH1.04, CH1.05, CH2.01F.

Planning Notes

Equipment required for Task:

- 4.1 - Periodic Tables [See general Planning Notes for Unit 3]
- 4.2 - poster and models for continuation of concept attainment (Appendix 3.5) teacher prepared models of water, sulfuric acid (H_2SO_4), wood alcohol (CH_3OH also called methanol), drinking alcohol ($\text{C}_2\text{H}_5\text{OH}$ also called ethanol), and vinegar (CH_3COOH).
- 4.4 - model making material (molecular model kits; candies such as jube jubes or coloured marshmallows, and toothpicks; nuts, bolts, and washers)

Prior Learning Required

This activity continues to build on the idea of pure substances and concept attainment from Activity 3.

Teaching/Learning Strategies

4.1 Learning Task: Getting to Know the Periodic Table

Students participate in an energizing activity involving the names and symbols of familiar elements.

Teacher Facilitation

1. Hand out periodic tables to each student.
2. Introduce the Periodic Table as a list of elements giving the elements name and international symbol. The focus here is not to have students memorize the names and symbols but rather to have students able locate the name and the symbols of some of the more common elements using the Periodic Table as an aid. Elements that should be recognizable include carbon (C), hydrogen (H), oxygen (O), helium (He), sulfur (S), nitrogen (N), iron (Fe), gold (Au), silver (Ag), aluminum (Al), copper (Cu), tin (Sn), chlorine (Cl), mercury (Hg), calcium (Ca), neon (Ne), lead (Pb), sodium (Na), potassium (K), nickel (Ni), uranium (U), and zinc (Zn).
3. Select and prepare any two of the following four activities involving the names and symbols of elements:
 - crossword using symbols and clues;
 - bingo using either teacher-created bingo cards or using a blank periodic table as a bingo card;
 - word search;
 - worksheet activity (see Appendix 3.7).

Assessment

None.

Accommodations

Choose activities so they suit a variety of learning styles.

4.2-Learning Task: Atoms and Molecules

Students participate in a discussion on atoms and molecules and complete a note-taking activity.

Teacher Facilitation

1. Lead discussion on atoms and molecules. Continue to build on the concept attainment exercise from Task 3.1 and 3.3 [see Appendix 3.5]. Discuss atoms and molecules in simplified terms. An atom is the smallest particle of an element. A molecule is made up of two or more atoms attached to each other. Using a molecular model of water (H_2O) as an example, point out that each of the spheres is an atom and that the entire grouping of spheres is a molecule. Repeat with other models of familiar substances, asking students to determine the total number and type of atoms in each molecule. Examples could include: sulfuric acid, (H_2SO_4), wood alcohol or methanol, (CH_3OH), drinking alcohol or ethanol, ($\text{C}_2\text{H}_5\text{OH}$), and vinegar, (CH_3COOH). **[Note:** Assessment is not on molecular formula or molecular shape, but on being able to state the number and type of atoms in a molecule of a substance given its formula.
2. Lead students through note-taking activity.

Assessment

Teacher may want to collect notes and assess using Notebooks are Important! Checklist (Appendix OV-5).

Accommodations

Provide peer helper/scribe to aid in note-taking activity.

4.3 Learning Task: Identifying Atoms and Molecules

From pictures on a worksheet, students distinguish atoms from the molecules.

Teacher Facilitation

1. Prepare worksheet [see Appendix 3.8] with pictures of atoms and molecules. Pictures should include ammonia (NH_3), hydrogen (H_2), carbon dioxide (CO_2), carbon monoxide (CO), hydrogen peroxide (H_2O_2), chlorine (Cl_2), oxygen (O_2), and hydrogen chloride (HCl).

Assessment

Create worksheet answer key.

Accommodations

Provide peer helper/scribe to aid in completion of worksheet.

4.4 Learning Task: Making Molecules

Given a formula, students construct a model of a molecule that represents the formula.

Teacher Facilitation

1. Obtain molecular model kits or other materials for making molecules.
2. Lead a discussion on what a formula is (short form of writing the number and kinds of atoms in a molecule). Using water as an example, write the formula and explain conventions (subscript, number of atoms, etc.).
3. Prepare an activity worksheet containing a list of familiar substances, the formula for each substance, and a picture of a molecule of that substance (see Appendix 3.9).
4. Instruct students that they are to use the information contained in the worksheet to construct molecules for each substance using the material provided. Indicate to students which colour represents which kind of atom. Students then create the molecular model for each substance on worksheet.
5. Using coloured pencils, students complete the worksheet by shading in the appropriate colour for each of the atoms making up a molecule of each substance. Students complete a chart identifying the names of the elements, number of atoms of each element, and total number of atoms in each molecule.
6. If using molecular model kits make sure the choice of molecules will result in the model ending up structurally appropriate.
7. **Extension:** Use a computer model-building program to construct a variety of molecules.
8. **Extension:** If time permits, have the students create a poster that includes a three-dimensional model and uses of a compound.

Assessment

Assess using worksheet answer key.

Accommodations

Assign peer helper to assist in making of models.

Web Site Resources

Periodic Table

<http://www.kapili.com/chem4kids/index.html>

(site with Periodic Table discussing the first 18 elements)

The Phantom's Portrait Parlor

<http://www.miamisci.org/af/sln/phantom>

Common Molecules

<http://iumsc.11.chem.indiana.edu/common/>

(website showing the structure of molecules)

Chem4kids Atoms

<http://www.kapili.com/chem4kids/index.html>

(structure, bonding, naming of atoms)

Atoms, Compounds and Mixtures

<http://chemed.chem.purdue.edu/~genchem/topicreview/bp/ch2/mixframe.html>

(reviews the concept of atoms and molecules)

Activity 5: Physical and Chemical Change

Time: 210 minutes

Description

Students identify signs of physical and chemical change. They then use this information and apply it to various experimental reactions. Careers that require the use of chemistry are looked at in closer detail.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH1.07, CH1.08, CH2.01A/C/D/E/F, CH2.02, CH2.03, CH3.04.

Planning Notes

1. General laboratory equipment such as test tubes, beakers and thermometers are needed.
2. Equipment required for task:
 - 5.1 - a large sealed glass tube/vial containing a few iodine crystals can be purchased from a chemical supply house {**Note:** do not use an open or stoppered tube; if it is not sealed, then omit this demonstration}, hot water bath, hot plate
 - 5.1 - lead-free solder, sugar, ice cubes, bread, bread knife, solid sulfur, mortar and pestle
 - 5.2 - iron or steel wool, iron chloride (FeCl_3) solution, sodium hydroxide (NaOH) solution, calcium, magnesium, dilute hydrochloric acid (HCl)
 - 5.4 - aluminum foil, copper sulfate (CuSO_4) solution, hot plate
 - 5.5 - preparation for job shadowing opportunities (extension)
 - 5.8 – preparation of ice cream mixture the night before use. The mixture contains: 1 egg, 2/3 cup sugar, 1 cup heavy cream (35%), 2 cups half and half cream (10%).
 - 5.8 - crushed ice, salt, small and large ziplock bags

Prior Learning Required

The safety and lab procedures from previous activities are reinforced.

Teaching/Learning Strategies

5.1 Learning Task: Physical Change

Students view physical change demonstrations and make a notebook entry. Students complete an SLL entry.

Teacher Facilitation

1. Teacher demonstrates a variety of physical changes such as melting lead-free solder over a Bunsen burner flame, heating iodine crystals placed in sealed vial in a hot water bath causing the crystals to sublime, dissolving sugar in hot water, melting an ice cube, cutting bread, grinding sulfur in a mortar and pestle. Teacher explains why each is a physical change. Teacher reviews the three states of matter (including names of changes of state where appropriate, but do not assess names of changes of state). Help students come to the conclusion that changes of state, dissolving, and things such as cutting and grinding are all physical changes.
2. Assist students in note-taking activity.
3. Prepare an SLL worksheet with vocabulary (melting, dissolving, cutting, freezing, grinding), focus questions, e.g., Name and describe a physical change of state that you use in your everyday life, What change of state occurs with dry ice? and a connections question, e.g., Where is dry ice used?.

Safety Precautions

Heat iodine gently in hot water bath just until a purple vapour appears; do not melt the substance. [**Note:** See Planning Notes for Activity 5.]

Assessment

Assess using SLL Rubric (Appendix OV-2).

Accommodations

Provide a copy of teacher notes to assist students in note taking. Use scribe for writing.

5.2 Learning/Diagnostic Task: Chemical Change

Students observe teacher demonstrations illustrating chemical change and record observations on a worksheet. Students then carry out experiment and complete worksheet that connects evidence for chemical change to their observations.

Teacher Facilitation

1. Prepare worksheet for demonstrations and experiment that connects labs done to evidence for chemical changes.
2. Gather material for demonstrations and experiments which may include:
 - a) New Colour: Degrease a small ball of steel wool and place in water overnight. Observe changes the next day. [**Note:** Rust is iron oxide (Fe_2O_3).]
 - b) Precipitate: Mix solutions of iron chloride (FeCl_3) and sodium hydroxide (NaOH). [**Note:** Solid iron hydroxide, $\text{Fe}(\text{OH})_3$, is produced. A precipitate is an insoluble solid produced in a liquid during a chemical reaction.]
 - c) Gas, Heat: Drop a small piece of calcium into water. Have students observe, feel the test tube and record their observations [**Note:** Reaction produces gas bubbles (H_2) and heat. A precipitate of $\text{Ca}(\text{OH})_2$ turns the water cloudy or milky. Students may be able to feel the tube has gotten warmer.]
 - d) Teacher may want to introduce test for hydrogen. A burning splint at the mouth of the test tube will “pop” in the presence of hydrogen gas.
3. Discuss evidence of a chemical change (gas produced, colour change, formation of a solid when two solutions are mixed, heat and light is given off). Teacher may wish to introduce temperature sensors or carbon dioxide (CO_2) sensors at this point.
4. Gather material for student experiment. Students put magnesium (Mg) into dilute hydrochloric acid (HCl). The reaction produces heat and gas. Teacher may wish to have students test to see if the gas produced is hydrogen using the burning splint test.

-
5. Assign an SLL worksheet with vocabulary (precipitate, chemical change, combustion), a focus question, e.g., Name and describe a chemical change that you use or see in your life everyday, and a connections question, e.g., What chemical changes occur in a car engine? Why is it important for you to know this?
 6. **Extension:** The teacher may introduce the ideas of product, reactant, formula, and equation at this time.

Safety Precautions

Use a test tube holder and hold test tubes away from people. Do not touch calcium with wet fingers or hands to avoid burns. Dispense only very small pieces of calcium. Both iron chloride and sodium hydroxide are toxic. Take care when handling solutions, acids, and bases. Review procedures for cleaning and neutralizing spills. Wash hands after using chemicals.

Assessment

Diagnostic assessment using worksheet answer key. Assess SLL entry using SLL Rubric (Appendix OV-2). Peer assessment and diagnostic assessment of lab procedures using Lab Procedures Rubric (Appendix 1.3).

Accommodations

Pair students for lab work. Use peer helper/scribe to assist with writing.

5.3 Learning Task: Physical vs. Chemical Change

Students complete worksheet identifying physical and chemical change.

Teacher Facilitation

1. Prepare worksheet describing a variety of scenarios which students identify each as either physical or chemical change and explain why (e.g. cutting bread is a physical change because the bread is the same, it is just in smaller pieces, rusting is a chemical change because a new compound is formed). See Appendix 3.10.

Assessment

Assess using a worksheet answer key.

Accommodations

Provide a peer helper/scribe to assist with writing.

5.4 Learning Task: Identifying Change

Students perform lab and complete worksheet in which students classify reactions as either chemical or physical changes based on evidence gathered.

Teacher Facilitation

1. Prepare a worksheet summarizing experiment observations and conclusions.
2. Gather material for experiment. Lab involves placing a small piece of aluminum foil in a test tube with a solution of copper sulfate (CuSO_4) and heating it in a hot water bath. Students put a similar-sized piece of aluminum foil in a second test tube with the same amount of water. [**Note:** even when water boils, the aluminum is unaffected]. Caution students not to boil all of the water away.
3. Assist students in identification of whether it is a physical or chemical change. [**Note:** Aluminum reacts in copper sulfate (CuSO_4). The aluminum foil gets thinner, red copper metal appears and the blue colour of the solution fades]. Aluminum foil in boiling water is unaffected. Only the water boils and changes state. Only the water undergoes a physical change.
4. **Extension:** Teacher demonstration of cleaning of tarnished silver using hot water, baking soda, and aluminum foil. [**Note:** The tarnish on the silver (Ag_2S) disappears and the aluminum darkens as aluminum sulfide ($\text{Al}_2(\text{SO}_4)_3$) forms. This is a method that could be used at home to clean silver pieces.]

Safety Precautions

Caution students on use of hot plates. Ensure proper disposal of the copper sulfate solution. Copper sulfate is toxic by ingestion. Students should wash their hands after use.

Assessment

Assess with lab work using Lab Procedures Rubric (Appendix 1.3).

Accommodations

Pair students for lab work. Use of peer helper or scribe to assist with writing.

5.5 Assessment Task: Careers in Chemistry

Students complete cloze worksheet on careers in chemistry.

Teacher Facilitation

1. Prepare a cloze worksheet describing careers in chemistry (e.g. cosmetologists use chemicals to perm and colour hair; aestheticians use chemicals for facial, manicure, and pedicure treatments; mechanics use lubricants; firefighters use fire extinguishers, flame retardants, and water bombers which contain chemicals to prevent combustion; foresters use pesticides; chef and fast food cooks rely on chemical changes when cooking and baking).
2. **Extension:** Invite a guest speaker to talk about his/her job, the chemical substances used, and safety precautions needed. Possibilities are a cosmetologist, a chemist from a cosmetics firm, a salesperson from a cleaning products supplier, a fire prevention officer, a technician from a paint manufacture, an arborist or lawn-care person, or a firefighter.
3. **Extension:** If time permits, students may make facial masks using recipes from a book or health food store.
4. **Extension:** Have students job shadow a co-op student and learn about employment opportunities, substances used in industry, and safety precautions that have to be taken.
5. **Extension:** If time permits, students may make environmentally friendly cleaners using recipes from the *Canadian Green Consumer Guide*.

Assessment

Assess using worksheet answer key.

Accommodations

Use peer helper to assist with reading and writing.

5.6 Learning Task: Making Ice Cream

Students make ice cream and complete worksheet answering questions about the process. Students can eat the ice cream at the end of the lab.

Teacher Facilitation

1. Prepare worksheet (see Appendix 3.11).
2. Gather ice cream ingredients and additional materials.
3. Prepare ice cream mixture the night before the activity. The mixture consists of 1 egg, 2/3 cup sugar, 1 cup heavy cream (35%), and 2 cups of half and half cream (10%).
4. Caution students on mixing and squeezing the ice-milk mixture to avoid ripping the ziplock bags.

Safety Precautions

Teachers must identify students with any milk or egg allergies. These students cannot eat the ice cream they prepared or get it near their faces. In the case of severe egg allergies they can only watch from a distance.

Assessment

Assess using a worksheet answer key.

Accommodations

Allow more time for completion of experiment by students with poor motor skills.

Activity 6: Metals and Non-metals

Time: 120 minutes

Description

Properties of metals and non-metals are introduced. Students use these characteristics to classify unknown samples into the appropriate category.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH1.01, CH1.04, CH1.06, CH2.01A, CH2.05, CH3.01, CH3.04.

Planning Notes

Equipment required for Task:

- 6.2 - aluminum strips or wire, copper strips or wire, glass, a conductivity apparatus [see Activity 2, Planning Note 3];
- 6.3 - chips of roll sulfur, zinc strip/electrode or tin strip/electrode (granular Zn or Sn will do if necessary), a conductivity apparatus.

Prior Learning Required

Properties of substances, introduced in Activity 2, are reinforced. Lab safety is focussed on in this Activity.

Teaching/Learning Strategies

6.1 Learning Task: What are Metals?

Students participate in classroom discussion and use information learned to complete a chart comparing the properties of metals and non-metals.

Teacher Facilitation

1. Lead lesson on properties of metals.
2. Create worksheet with a chart comparing properties of metals and non-metals. Teacher may wish to concentrate on three properties - conductivity, lustre, and flexibility. Teacher may refer to lustre as shininess. Teacher can demonstrate malleability using a soft metal such as lead.

Assessment

Assess using worksheet answer key.

Accommodations

Use peer helper/scribe to assist in writing.

6.2 Learning Task: Properties of Metals

Students test properties of various materials. Students complete a worksheet summarizing results and classify materials as either metals or non-metals.

Teacher Facilitation

1. Create worksheet with table, which compares properties of materials.
2. Gather materials for the experiment. Materials to be tested may include aluminum (Al), copper (Cu), glass and wood.
3. Demonstrate how to test the properties of materials. Tests may include an examination of lustre (dull or shiny), flexibility (flexible or brittle) and conductivity (conducts or does not conduct) using a conductivity apparatus.

Safety Precautions

Ensure safe handling and use of battery.

Assessment

Assess using a worksheet answer key. Assess lab work using Lab Procedures Rubric (Appendix 1.3).

Accommodations

Pair students for lab work. Use peer helper/scribe to assist with written work.

6.3 Assessment Task: Identifying an Unknown

Students are given two unknown substances and test to determine which is a metal and which is a non-metal. Students complete a summary sheet.

Teacher Facilitation

1. Prepare lab worksheet. Worksheet should direct students to investigate three properties of the unknown. Students investigate the following properties: lustre, flexibility, and conductivity. For conductivity, students use a small sample of the each material to complete a circuit.
2. Unknowns can be chips of roll sulfur and a metal that was not used in Task 6.1. [**Note:** Zinc (Zn) and tin (Sn) and possibilities as described in the Planning Notes for Activity 6.]

Assessment

Assess using worksheet answer key.

Accommodations

Pair students for lab work. Use peer helper/scribe to assist with written work.

Activity 7: Culminating Activity - A Closer Look at Environmental Chemistry

Time: 180 minutes

Description

Environmental issues are investigated in greater detail through independent labs and research. Students are introduced to the basic format for conducting research.

Strand(s) and Expectations

Strand(s): Chemistry

Expectations: CH1.05, CH1.07, CH1.08, CH2.01A/C/D/E, CH2.02.

Planning Notes

Equipment required for Task:

- 7.2 - samples of carbon dioxide gas (CO_2) are needed. The CO_2 gas can be generated using acid on marble chips (CaCO_3), obtained from a cylinder of compressed CO_2 , or students can exhale their own breath. One method would be to have it in small plastic bags with a straw or small hose for a delivery device,
- 7.2 - sodium phosphate (Na_3PO_4) or ammonium phosphate ($(\text{NH}_4)_3(\text{PO}_4)$) solutions, silver nitrate (AgNO_3) solution in a dropper bottle, dilute sulfuric acid (H_2SO_4), spot plates, phenolphthalein indicator solution in a dropper bottle, sodium hydroxide (NaOH) solution, garbage bags, elastic bands, limewater, plastic tubing. [**Note:** *limewater* is a saturated solution of calcium hydroxide ($\text{Ca}(\text{OH})_2$) which can be purchased from a chemical supply house or easily made by shaking $\text{Ca}(\text{OH})_2$ powder in a large jug of water, letting it sit for several weeks, and then carefully decanting the clear liquid *limewater* off the top. Keep all containers sealed because of the CO_2 in the air.],
- 7.3 – co-ordinate visit with teacher/librarian and/or book computer lab time to research on Internet.

Prior Learning Required

Concepts from previous activities such as molecules and formula, and physical and chemical change are revisited. Lab skills and safety are emphasized.

Teaching/Learning Strategies

7.1 Learning/Assessment Task: Environmental Chemistry Revisited

Students participate in discussion about environmental problems and complete an SLL entry.

Teacher Facilitation

1. Lead a discussion on environmental issues, which includes greenhouse effect and global warming, acid rain and phosphates in aquatic ecosystems.
2. Assign an SLL entry which includes vocabulary (combustion, acid rain, greenhouse effect, detergent, algae) and focus question, e.g., List two ways you contribute to one of these problems. Assign a connections question, e.g., Do you think polluters should be punished more than they are?, Is one of these problems more important in your area?.

Assessment

Assess using SLL Rubric (Appendix OV-2).

Accommodations

Use peer helper for reading and writing. Allow use of computer or tape recorder as an alternative to written response.

7.2 Learning/Diagnostic Task: Environmental Lab

Students, working in pairs, carry out the following experiments and each completes a worksheet.

Teacher Facilitation

1. Prepare worksheet for experiments. Worksheet should include spaces to record student observations and address whether changes produced during investigation were physical or chemical. Students can identify the elements that make up the molecule if formulas are given.
2. Introduce the activity and assessment tool. Group students into pairs to complete the following investigations: precipitation of phosphates, neutralizing acid rain, generation and testing of greenhouse gas.
3. Gather material for experiments described below:

Precipitation of Phosphates

- a) Students put a small amount of sodium phosphate (Na_3PO_4) or ammonium phosphate ($(\text{NH}_4)_3(\text{PO}_4)$) solution into a test tube.
- b) Add silver nitrate (AgNO_3) solution, drop by drop, to test tube
- c) Record the number of drops needed to produce a white precipitate. [**Note:** precipitate is silver phosphate (Ag_3PO_4).]

Neutralizing Acid Rain

- a) Students put a few drops of dilute sulfuric acid (H_2SO_4) into a spot plate. The sulfuric acid will simulate the *acid rain*. [**Note:** You can substitute dilute hydrochloric acid for your acid rain.]
- b) Add a few drops of phenolphthalein indicator. Observe the colour. [**Note:** Phenolphthalein is colourless in a dilute acid and turns bright pink in a base. Students could also measure pH by using litmus paper.]
- c) Add sodium hydroxide base (NaOH) solution, drop by drop, to the liquid in the spot plate
- d) Students record the number of drops needed to change the colour of the solution (neutralize the acid rain). [**Note:** Colour changes to pink just as the solution in the spot plate turns basic.]

Generation of Greenhouse Gases

- a) Identify carbon dioxide (CO_2) as a greenhouse gas. [**Note:** This could be the subject of the research paper in Task 7.3.]
- b) Provide samples of carbon dioxide gas (CO_2) in plastic bags which have a dispensing hose or straw. Students can squeeze slowly [**Note:** See Planning Notes for Activity 7]

-
- c) Put a small sample of limewater in a test tube. [**Note:** A small sample of limewater, a depth in the test tube of 1.5 - 2 cm, requires less carbon dioxide (CO₂) gas to see a precipitate form and also avoids splashing. As you continue to bubble in more exhaust gas, the milkiness will disappear]
 - d) Place one end of a plastic tubing into the limewater and put the other end into the sealed garbage bag.
 - e) Gently squeeze the bag of carbon dioxide (CO₂) gas into the limewater. [**Note:** The limewater will turn cloudy, indicating the presence of carbon dioxide.]

Safety Precautions

Use care in handling solutions, especially silver nitrate (AgNO₃), acids, and bases.

Assessment

Diagnostic assessment using worksheet answer key. Assess lab work using Lab Procedures Rubric (Appendix 1.3) and Lab Safety Checklist (Appendix 1.2).

Accommodations

Use peer helper to assist in completion of worksheet.

7.3 Learning Task: Research Paper

Students complete research paper on a current environmental issue (methane and greenhouse effect, carbon dioxide and greenhouse effect, phosphates and algae blooms, sulfates and acid rain, or fluorocarbons and ozone depletion). Students complete a research template and a drawing showing the problem.

Teacher Facilitation

1. Use research paper template to demonstrate its use using ozone depletion as an example (see Appendix 5.4).
2. Go through the model one-page paper with the students explaining how it follows the template.
3. Prepare materials and book access to library and Internet.
4. Introduce students to assessment tool and format of research paper.

Assessment

Assess using Research Paper Rubric (Appendix 5.5).

Accommodations

Assign a peer helper to assist with reading and research. Use scribe, tape recorder, or computer as an alternative to written response.

Appendices Unit 3

Appendix 3.1: Carbon Monoxide Can Poison You

Reference to Unit 3, A sample resource for Task 1.2

Carbon Monoxide Can Poison You

Fuels such as gasoline, propane, alcohol, charcoal and wood burn in air to produce the gases carbon dioxide, CO_2 , and carbon monoxide, CO . Both gases have no colour and no odour.

Mainly carbon dioxide gas, CO_2 , is produced if there is lots of air or if oxygen is used. We see this in a propane torch. If there is a shortage of oxygen, more carbon monoxide gas is produced.

A furnace that is not getting enough air will produce carbon monoxide gas in the home. Tobacco smoke also contains carbon monoxide. There is lots of carbon monoxide gas in automobile exhaust fumes.

Carbon monoxide gas is highly poisonous or highly toxic to animals. Carbon monoxide gas bonds 200 times more tightly to blood molecules than oxygen. Once the carbon monoxide molecule is "glued" to the blood molecule, the blood cannot carry oxygen from the lungs to the body. You suffocate from lack of oxygen. People who breathe in too much carbon monoxide will slowly go to sleep and die. If caught in time, lots of oxygen will revive the person.

Many towns now require that homes have carbon monoxide detectors to let you know if there is too much carbon dioxide in the home.

Use the information you have read above to help you answer these questions:

1. Name several fuels.
2. When fuels burn, what two gases are produced?
3. When fuels burn, what causes more carbon monoxide gas to be produced?
4. How does carbon monoxide gas kill people?
5. Why should you not use a gas or charcoal barbecue inside the house?
6. What safety advice would you give your parents about running a car in the garage?
7. When burning fuels, how can you reduce the amount of carbon monoxide?

Appendix 3.2: Properties Identify Substances

Reference for Unit 3, Task 2.2

Name _____

Properties Identify Substances

You are identified by your *characteristics*. You are identified by the colour of your hair and eyes, your weight, and the reaction you have to certain tastes and odours. Characteristics or *properties* can also identify substances. For example gold has the following properties:

Property	For Gold
state at room temperature	solid
Colour	yellow
mass of 1 mL (density)	19.3 g/mL
Melting point	693 °C
Electrical conductivity	Good
Reactivity to acid	None
Dissolves in water	No

Use the word list to fill in the blanks:

Word Bank	Properties	melting point	Conductor
State	boiling point	Density	Viscosity
React	dissolves	Colour	

1. When you describe a substance, you look at its characteristics or _____.
2. You can say whether a powder is white or yellow or blue. A metal might be yellow. You are stating the _____ of the substance.
3. When you say whether a substance is a solid, liquid, or gas you are describing its _____.
4. The temperature where a solid changes to a liquid is its _____.
5. The temperature where a liquid changes to a gas is its _____.
6. Heat or electricity might pass easily through a substance. We say it is a good _____ of heat or electricity.
7. If a solid mixes into a liquid so well that you can't see it any more we say the solid _____ easily.
8. A liquid pours easily if it is thin or pours slowly if it is thick. How well a liquid flows is its _____.
9. Sometimes when one substance mixes with another, something happens. A new substance is produced. We see flames, or bubbles or something else. This tells us that the substances _____ with each other.
10. A millilitre of lead has more mass than a millilitre of Styrofoam. The lead has a greater _____.

Appendix 3.3: Looking at an Unknown Liquid

Reference for Unit 3, Task 2.4

Name _____

Looking at an Unknown Liquid

Record your observations about the unknown in the spaces below:

1. **State** _____ 2. **Colour** _____ 3. **Odour** _____

4. **Conductivity** _____

5. **Viscosity of Unknown Liquid** (compared to water and alcohol)

What did you do to check the viscosity? Describe your experiment and the results.

6. **Solubility** of salt and powdered chalk in unknown liquid (compared with alcohol water)

What did you do to check solubility? Describe your experiment and results.

7. **Density:** What is mass of 1 mL of unknown liquid?

Volume of Unknown liquid _____	Mass of unknown liquid _____
--------------------------------	------------------------------

Density (mass of 1 mL) _____

8. Use the properties in this chart to determine what the unknown is

Property	Rubbing Alcohol	Vinegar	Glycerin	Water	Diet Cola	Hydrochloric Acid, Dilute
Boiling point	82.4 ° C	~100 ° C	290 ° C	100 ° C	~100 ° C	~105 ° C
Conductivity	No	slight	no	no	yes	yes
Density (mass per 1 mL)	0.79 g/mL	~ 1 g/mL	1.2 g/mL	1 g/mL	~ 1 g/mL	~1.02 g/mL
Salt dissolves	No	slight	no	yes	yes	slight
Chalk dissolves	No	no	no	no	no	no
Viscosity	Fluid	fluid	syropy	fluid	fluid	fluid
Odour	Slight	yes	no	no	no	yes
Colour	Colourless	colourless	colourless	colourless	brown/black	colourless
Dissolves in water	yes	yes	yes	yes	yes	Yes

(a) Predict what the unknown liquid is?

(b) Why did you choose this substance?

Appendix 3.4: Substances and Their Use

Reference for Unit 3, Task 2.6

Name: _____

Substances and Their Use

Properties of substances determine their use. For example aluminum is used in hydro transmission lines because it conducts electricity and is light (low density).

Complete the chart below, using the words listed in the Word Bank below.

Substance	Use	Property
copper	wiring	
carbon dioxide		does not burn, smothers fires
glass		clear, colourless solid
	drill bits	very hard, cuts into hard things
rubber	shoes, tires, belts	
	clothing	light-weight, wears well
dynamite		explosive, produces great force
	lubricates engine parts	slippery, has a high boiling point
gasoline	fuel	
gold		bends easily, does not rust
tungsten		glows white hot, poor conductor of electricity
nitrates		helps plants grow

Word Bank

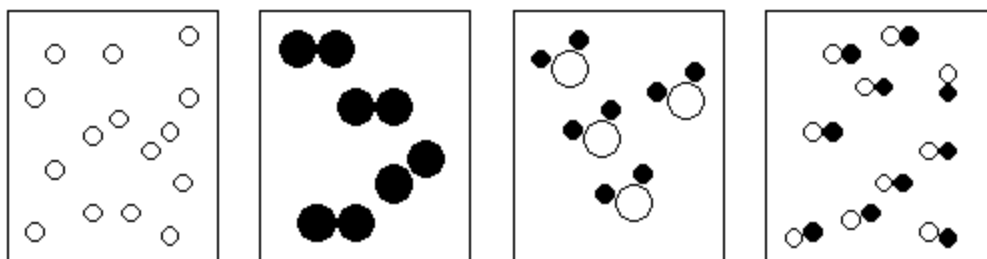
Conductivity	Windows	burns to produce heat	wire in light bulbs
Motor oil	Jewelry	diamond	mining
Flexible	fire extinguishers	fertilizer	nylon

Appendix 3.5: Concept Attainment: Pure Substance vs. Mixture and Element vs. Compound

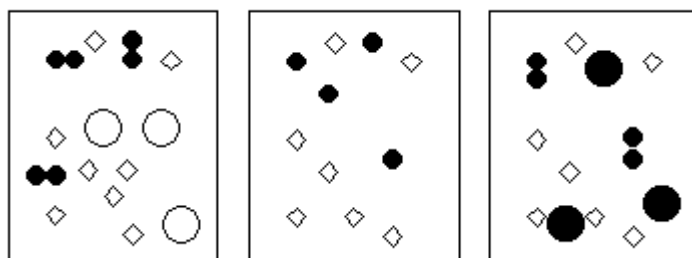
Reference for Unit 3, Teacher Resource for Tasks 3.1, 3.3, and 4.2

See a description of Concept Attainment in Appendix 1.8. The materials are used to establish the concepts of pure substance vs. mixture, element vs. compound and atom vs. molecule.

1. Create a concept attainment data set with “RED” example cards and “BLUE” example cards large enough to display on the chalkboard using the following criteria:
2.
 - RED example cards: 1. All small red single circles, 2. All small purple double circles, 3. All clusters with one large red and two small black circles 4. All clusters with one blue and one green circle, etc. The key is each card contains *one kind* of particle. Concept = “pure substance”



- BLUE example cards: 1. Several small red circles, large green circles and double purple circles intermingled, 2. Several red circles among several black circles, 3. Several double blue circles among several large orange circles, etc. The key is each card contains *more than one kind* of particle. Concept = “mixture”.



3. Attach magnets to the back of each card.
4. Task 3.1: Use the entire data set to help students understand the difference between the concepts of “pure substance” and “mixture”.
5. Task 3.3: Remove the “mixture” data set and use the RED “pure substance” data set for the next step. One group contains the cards with particles containing circles of the same colour and size; concept = elements. The second group contains the cards with all the same kind of particles but each particle has different coloured circles (i.e., RED #3 and #4); concept = compound.
6. Task 4.2: Use the RED pure substance cards to establish the concept of atom and molecule.

Appendix 3.6: Sulfuric Acid

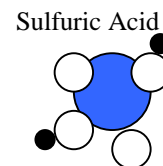
Reference for Unit 3, Task 3.5

Name _____

Sulfuric Acid: An Industrial Acid

Sulfuric acid is a pure substance. All of its particles are the same. A sulfuric acid particle is shown at the right.

Sulfuric acid is syrupy liquid that pours like pancake syrup. It is a very corrosive acid and can give bad *chemical burns*. Sulfuric acid must always be handled with care.



It is the most-used chemical in industry. About half of all sulfuric acid is used to produce fertilizers. Some of its other uses are making steel and refining oil. Making paints, plastics, and soaps also use sulfuric acid.

Battery acid is another name for sulfuric acid. It is the acid used in a car battery. When the car lights are turned on a chemical change in the battery produces energy for electrons. This change *uses up* sulfuric acid. In cold weather this chemical change occurs more slowly.

When the motor is running, the car's generator provides an electric current. This causes another chemical change that *remakes* or *recharges* the battery acid.

Use the information you have read above to help you answer the questions below:

1. How do you know sulfuric acid is a pure substance?
2. Is sulfuric acid an element or a compound? How do you know?
3. Draw and label some pictures of other substances made using sulfuric acid.



Steel
Rod

4. Why is it difficult to start your car in winter?
5. What is the main industrial use of sulfuric acid?

Connections Question:

6. Why is fertilizer important?

[Teacher Note: Question #6 is not a Reading for Understanding Question]

Appendix 3.7: It's Elementary!

Reference for Unit 3, Task 4.1

Name _____

It's Elementary!

The following sentences contain the names of many elements. As you read each sentence, circle the name of the element. Then write the symbol of the element in the space to the right of the sentence. Be sure to use the periodic table to find the symbol. The first two are already.


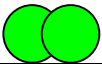
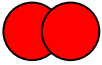

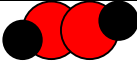


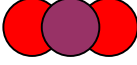

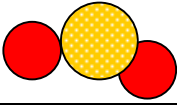

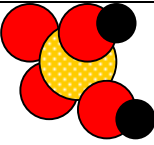
1. Some soft drink cans are made of aluminum. **Al**
2. Steel contains both iron and carbon. **Fe C**
3. Water contains both hydrogen and oxygen.
4. Jewelry can be made of gold, silver or even copper.
5. We filled the balloons with helium.
6. The mercury in the thermometer hit 30°C during the heat wave.
7. A nuclear reactor uses uranium as its fuel.
8. The red coloured lights over the theatre have neon gas in them.
9. The vitamin supplements contain calcium, iron, and potassium.
10. Cities usually put chlorine and fluorine in their water.
11. Computer chips are made of silicon.
12. You can hear a "pop" when you place a glowing splint in a test tube filled with hydrogen gas.
13. Electrical wires in the house are made of the metal copper, but the transmission lines on high towers across Ontario are made of aluminum. Both metals are good conductors of electricity.
14. The human body contains 63% oxygen, 9% hydrogen, and 19% carbon.
15. Some people drink milk because it contains calcium that is needed for bone growth.
16. Canada is the world's largest producer of nickel.
17. Sodium is one of the elements found in table salt.
18. "Galvanized iron" used in metal pails is iron covered with a thin coat of zinc metal.
19. Air contains 78% nitrogen and 21% oxygen and a little bit of neon.
20. Sulfa drugs that kill bacteria contain sulfur.

Appendix 3.8: Identifying Atoms and Molecules

Reference for Unit 3, Task 4.3

Name: _____

Identifying Atoms and Molecules

Name of Substance	Picture of Substance	Atom or Molecule (check one)		Number of Each Atom (if molecule)
		Atom	Molecule	
NH ₃ (ammonia)			<input checked="" type="checkbox"/>	1 nitrogen, 3 hydrogen
Cl ₂ (chlorine)				
O ₂ (oxygen)				
H ₂ O (water)				
H ₂ O ₂ (hydrogen peroxide)				
H ₂ (hydrogen)				
Ne (neon)				
CO ₂ (carbon dioxide)				
CO (carbon monoxide)				
SO ₂ (sulfur dioxide)				
He (helium)				
H ₂ SO ₄ (sulfuric acid)				

Appendix 3.9: Making Molecules

Reference for Unit 3, Task 4.4

Name: _____

Making Molecules

Using molecular kits, construct 4 of the 7 molecules shown below. Be sure to use the correct colours to represent each element.

H = white

O = red

C = black

S = green

N = yellow

When done, show your molecule to the teacher.

Name	Formula	Draw a Picture of the Molecule	Name of Elements	Number of Atoms of Each Element
water	H ₂ O			
ammonia	NH ₃			
hydrogen peroxide	H ₂ O ₂			
carbon dioxide	CO ₂			
carbon monoxide	CO			
methane	CH ₄			
sulfuric acid	H ₂ SO ₄			

Appendix 3.10: Is it a Physical or Chemical Change?

Reference unit 3, Task 5.3

Name: _____

Is It a Physical or Chemical Change?

In a physical change no new substance is formed. For example, snow is solid water that forms from water vapour. In a chemical change a new substance forms. For example diesel fuel burns to give heat, carbon dioxide gas, other gases, smoke, and a flame. Bubbling (gases), a flame or production of heat, colour changes, and a precipitate are often ways you identify a chemical change.

Write physical or chemical next to each change. Give your reason.

Change	Physical or Chemical Change?	Reason
1. Chopping wood		
2. Burning wood on a campfire		
3. Washing your hands		
4. Batteries power your radio		
5. Riding a bicycle - the bike moving		
6. Riding a bicycle – your muscles using food energy		
7. Making ice cubes		
8. Grinding coffee beans		
9. Baking an apple pie		
10. Applying lipstick		
11. Drying clothes		
12. Making popcorn		
13. Soldering two metal pipes together		
14. Turning on a light		
15. A car gets rusty		
16. Cutting up carrots		
17. Burning a candle		
18. Dissolving sugar in tea		
19. Food digesting in the stomach		
20. Bleaching hair		

Appendix 3.11: Making Ice Cream

Reference for Unit 3, Task 5.6

Name: _____

MAKING ICE CREAM

Purpose

To observe and describe matter changing.

Material

- ice cream mixture (from teacher)*
- crushed ice
- thermometer
- water
- salt
- small ziplock bag
- large ziplock bag

Procedure

1. Fill the large ziplock bag about $\frac{1}{2}$ full with crushed ice. Add 50 mL of cold water.
2. Record the temperature of the ice-water mixture. _____ °C
3. Add 100 mL of salt to the ice-water mixture and mix thoroughly.
4. Record the temperature of the ice-water-salt mixture. _____ °C
5. Put 250 mL of the ice cream mixture in the small ziplock bag.
6. Put the smaller bag into the larger bag with the ice-water-salt mixture. Remove all excess air from the large bag and ziplock.
7. Carefully squeeze the large bag until the ice cream is solid. Make sure you keep the small bag covered with ice at all times.

Conclusion

What type of change occurred? How do you know?

Application

1. Why do you think salt was added to the ice-water mixture?
2. Do you think twice as much ice would freeze the ice cream mixture twice as fast?

*[Teacher Note: See instructions for making ice cream mixture and safety note in Task 5.6.]

Unit 4: Physics - Electricity

Time: 21 hours

Unit Description

Students gain an understanding of static and current electricity. Students build simple circuits that model circuits used in everyday life. They analyse this form of energy, energy transformations, conservation of energy, and the impact of each. Safety, experimentation, collaboration, and literacy are part of the focus of this unit.

Strand(s) and Expectations

Strand(s): Physics

Overall Expectations: PHV.01, PHV.02, PHV.03.

Specific Expectations: PH1.01 to PH1.06, PH2.01A/B/C/D/E/F, PH2.02, PH2.03, PH3.01, PH3.02, PH3.03.

Activity Titles (Times and Sequence)

Activity 1	Static Electricity	185 minutes
Activity 2	Current Electricity - What Is A Circuit?	300 minutes
Activity 3	Series and Parallel Circuits	195 minutes
Activity 4	Using Electricity	430 minutes
Activity 5	Building A Model Electrical Car	150 minutes

Task Titles (Types, Time and Sequence)

Task	Type	Title	Time (minutes)
1.1	Diagnostic	Introduction to Static Electricity	55
1.2	Learning/Assessment	Modelling An Atom	30
1.3	Learning/Assessment	Static Electricity and Law Of Electric Charges	40
1.4	Learning/Assessment	Examples of Static Electricity	60
2.1	Diagnostic	Uses of Electricity	20
2.2	Learning	Parts of an Electrical Circuit	60
2.3	Learning/Assessment	Safety in the Lab and at Home	45
2.4	Learning	Building A Circuit and Drawing a Circuit Diagram	45
2.5	Assessment	Circuits	30
2.6	Diagnostic/Learning	Voltage	30
2.7	Learning	Current	30
2.8	Learning/Assessment	Recording Voltage and Current	40
3.1	Diagnostic/Learning	Introduction to Parallel Circuits	45
3.2	Learning	Circuits in Carousel	45
3.3	Assessment	Constructing Series and Parallel Circuits with Three Loads	30
3.4	Learning/Assessment	Household Wiring	30
3.5	Learning/Assessment	Careers and Hobbies Involving Electricity	45
4.1	Learning	Using Electricity To Do Work	20
4.2	Learning/Assessment	Reading An Electrical Bill	20
4.3	Diagnostic/Learning	Peak Trends in Energy Consumption	40
4.4	Assessment	Graphing Data From A Bill	40
4.5	Learning	Life Without Electricity	60
4.6	Assessment	Conservation Of Electricity Presentations	120
4.7	Learning	Environmental Effects Of Producing Electricity	40
4.8	Learning/Assessment	Alternative Sources of Electricity	90
5.1	Learning/Assessment	Introduction to Model Electric Car	30
5.2	Learning/Assessment	How Fast Can It Go?	120

Prior Learning Required

Electricity is taught in Grades 1, 3, 5 and 6 (Appendix OV-6). This unit is built without extensive reliance on previous work. Much is reviewed and reinforced.

General Unit Planning Notes

- Specific planning notes are included for each Activity and Task.
- There is a need for a large number of loads, wires, batteries, switches, and sources as the students are building many circuits. Teachers may want to arrange to borrow/share supplies from another classroom.
- It would be beneficial to arrange a guest speaker or plan a field trip as part of Activities 3.5 and 5.3. These arrangements need to be made in advance.
- Activity 5.2 involves building a model car. Building one in advance will help ensure the teacher is comfortable with the procedure.

Learning/Teaching Strategies or Activities

	Strategy	Description
1	Demonstration, brainstorming, inquiry/experimental, teacher-led discussion, models (picture, dramatization), note-taking, worksheets, CSGL (jigsaw), learning log	Hands-on activities lead students from the concrete to the abstract. Worksheets and note-taking activities provide a structured organizer for students to record their learning. Co-operative small group learning activity (CSGL) encourages development of social skills and sharing of information. A variety of models help students in concept attainment.
2	brainstorming, models (schematic drawings, dramatization), learning log, worksheet, inquiry/experimental, reading for understanding, modelling/coaching, group work	Brainstorming and teacher-lead discussion allow students to go from the known to the unknown. Learning log helps students develop communication skills and making connections. A variety of models help students in concept attainment.
3	Inquiry/experimental, teacher-led discussion, demonstration, carousel, worksheet, group work, reading for understanding, research question	Carousel provides several opportunities to reinforce previous learning.
4	mind-map, learning log, worksheet, brainstorming, presentations, video, comparison activity	Presentations and a comparison activity engage students in organizing, and analysing information as well as making connections.
5	inquiry/experimental, worksheets, learning log, guest speaker, field trip	Group work is encouraged through the building of a model car.

Assessment/Evaluation

Learning Task	Expectations	Tool	Assessing	Who
1.2	PH1.01, PH3.03,	Worksheet Answer Key	knowledge, diagnostic	teacher
1.3	PH1.02	Worksheet Answer Key, Notebooks Are Important! Checklist	knowledge, diagnostic, communication	teacher
1.4	PH3.03	Worksheet Answer Key, Collaborative Group Work Rubric, SLL Rubric	knowledge, diagnostic, communication, and making connections	teacher student
2.3	PH2.01A	Notebooks Are Important Checklist!, SLL Rubric	knowledge, communication and making connections	teacher
2.4	PH1.03, PH1.05, PH2.01A/C, PH2.02	Checklist, Lab Safety Checklist, Lab Procedures Rubric	knowledge, communication, and inquiry	teacher student
2.5	PH1.03, PH1.05, PH2.01A/C, PH2.02	Worksheet Answer Key	knowledge, communication, and inquiry	teacher
2.7	PH2.01A	Worksheet Answer Key, Reading For Understanding Rubric	knowledge, communication	teacher
2.8	PH1.05, PH1.06, PH2.01A/C, PH2.02	Checklist, Lab Procedure Rubric	knowledge, inquiry, communication	teacher
3.2	PH2.02, PH2.01A/B/C/E	Worksheet Answer Key	knowledge and communication	teacher
3.3	PH2.02, PH2.01A/B/C/E	Checklist	knowledge and communication	teacher
3.4	PH3.01	Reading For Understanding Rubric	knowledge and communication	teacher
3.5	PH3.03 PH2.01D	SLL Rubric	connections and communication	teacher
4.1	PH1.04	SLL Rubric	knowledge, communication and making connections	teacher
4.2	PH2.01D/E	Worksheet Answer Key	inquiry and communication	teacher
4.4	PH2.01D/E	Worksheet Answer Key	inquiry and communication	teacher
4.5	PH3.02	Collaborative Group Work Rubric	communication	teacher student

Learning Task	Expectations	Tool	Assessing	Who
4.6	PH3.02	Poster and Presentation Rubric, Worksheet Answer Key	knowledge and communication	teacher
4.7	PH3.02	Worksheet Answer Key	connections	student
4.8	PH2.01D/E/F	Comparison Activity Rubric, SLL Rubric	knowledge, communication, inquiry, and making connections	teacher
5.1	PH1.05	SLL Rubric	knowledge, communication, and making connections	teacher
5.2	PH2.03, PH2.01A/B/C/D/F	Worksheet Answer Key, Rubric for Collaborative Group Work	communication, making connections	teacher

Unit Resources

Bloch, Mars, et al. *Science 9*. Toronto: ITP Nelson, 1999.

Boltz, C.L. *How Electricity is Made*. New York: Facts on File Publications, 1989.

ISBN 0-8160-0039-5

This book would be a good resource for students finding information about sources of energy and electricity in the home.

Catherall, Ed. *Exploring Electricity*. Wayland, East Sussex England: 1989.

ISBN 0-7502-0266-1

This is an excellent resource that explains concepts of electricity in simple language.

Mackie, Dan, *Electricity*. Burlington, Hayes Publishing Limited: 1986.

ISBN 0-88625-133-8

Clear explanations about static and current electricity and suggestions for fun activities in which the students have to build circuits.

Malcolm, Douglas Jr. *How to Build Electronic Projects*. New York: McGraw-Hill Book Company, 1980.

ISBN 0-07-039760-0

A resource for students who want to build more complex electrical circuits. Could be used in co-operation with the technology department.

Rosen, Seymour. *Physics Workshop 1*. New York: Globe Book Company Inc., 1988.

ISBN 1-55675-709-3

Soft cover text with reading level grades 4-5 and an interest level 6-12. Topics range from electricity and energy transformations to the concept of pressure.

Rosen, Seymour. *Physics Workshop 2*. New York: Globe Book Company Inc., 1988.

ISBN 1-55675-710-7

Continuation of Physics Workshop 1. Topics range from static and current electricity, electric currents, and magnetism.

Stevenson, Paul et al. *Sources of Electrical Energy*. Toronto: Science Research Associates Canada Limited, 1982.

ISBN 0-574-09532-2

Part of the SEEDS series (Society, Environment and Energy Development Studies). Simple worksheets and experiment ideas.

Wolfe, Elgin, et al. *SCIENCEPOWER 9*. Toronto: McGraw Hill Ryerson, 1999.

Internet Resources

http://db.bbc.co.uk/education-webguides/pkg-main.p_home

(Starting point for web searches)

<http://www.electricityforum.com/>

(The electricity forum)

<http://www.electricityforum.com/et/previous.htm>

(Electricity Today Magazine)

<http://www.oeb.gob.on.ca>

(Ontario Energy Board)

<http://www.ontariopowergeneration.com/>

(Ontario Power Generation Comp)

<http://www.onhydro.com/>

(Ontario Hydro Services)

<http://www.iemo.com/>

(Independent Electricity Market Operator)

http://www.directelectricity.com/mcoffee/mcoffee_electricity.asp

(OPG – Electricity and Utility links)

Video Resources

Physical Science 1. Walt Disney Company: Magic Lantern Communications Ltd. (distributor), 1994. (37 minutes)

(Bill Nye: the Science Guy series, which uses wacky humour and interesting experiments to demonstrate basic physical science principles. The electricity component discusses electricity, magnetic fields, compasses, and MRI Application in medicine)

Electricity Agency for Instructional Technology, 1992. (15 minutes)

(Science for You series. Children learn how electric motors work, how batteries produce electricity and why we need to find safer, cleaner ways to generate electricity. Demonstrations illustrate electrons, electrical charges and currents.)

Activity 1: Static Electricity

Time: 185 minutes

Description

Students are introduced to the concept of static electricity and the structure of the atom. Through use of a co-operative small group learning structure, students discuss examples of electricity in everyday life.

Strand(s) and Expectations

Strand(s): Physics

Expectations: PH1.01, PH1.02, PH3.03.

Planning Notes

Equipment required for task:

- 1.1 and 1.3 - balloons, fur, string, ebonite rods, glass rods, silk, cotton, strips of acetate plastic, confetti, sawdust, cut out stars, 4 x 4 piece of glass, woolen cloth, metal plate, paper plate.
- 1.2 - simplified diagram of an atom, masking tape, bingo chips
- 1.4 - adapted/written Reading for Understanding articles on industrial uses of electrostatics

Prior Learning Required

This activity builds on what the students learned about static electricity in Grade 3.

Teaching/Learning Strategies

1.1 Diagnostic Task: Introduction to Static Electricity

Students observe teacher demonstrations and discuss why some charged objects attract, and others repel, each other. Time permitting, students perform experiments demonstrating electrostatic phenomena.

Teacher Facilitation

1. Perform the following demonstrations. After each demonstration ask students to suggest reasons for their observations and record these on the board.
 - a) Attach a piece of string to each of two balloons. Rub both balloons with fur. Hold both balloons by the string and try to bring them close together. [**Note:** The negatively charged balloons repel each other. Concept - like negative charges repel each other.]
 - b) Cut two small strips of acetate. Rub each strip with a piece of plastic bag. Bring the plastic strips close to one another. [**Note:** The positively charged acetate strips will repel each other. Concept - like positive charges repel each other.]
 - c) Optional: Rub an ebonite rod with fur (ebonite rod obtains a negative charge). Place a small amount of lycopodium powder (or sawdust) on the end. A few moments later– the particles “jumps off”. [**Note:** The particles become negatively charged and push away from each other and the rod].
 - d) Repeat demonstration b); however, this time rub the second strip of acetate with fur (negatively charging the acetate strip). [**Note:** The two strips with attract each other. Concept - unlike charges attract.]
 - e) Positively charge a plastic strip by rubbing it with a plastic bag. Then, place it near some confetti. [**Note:** The strip attracts the neutral confetti.] Repeat the same demonstration with a negatively charged acetate strip by rubbing with fur. [**Note:** Again, the acetate strip attracts the neutral confetti. Concept - charged objects attract neutral objects.]
 - f) Optional: If time permits, place both the piece of plastic bag and the fur near the confetti to show that they were also charged after they were rubbed with acetate.
 - g) Optional: If time permits, charge the acetate *on one end only* and place it near the confetti to show that the charge is localized to the area that has been rubbed.
 - h) Optional: If time permits, rub a balloon on shirt/sweater and place it against the wall. Ask students to suggest why the balloon would stick to the wall after it has been rubbed on a shirt.
2. Revisit the chalkboard notes and add any additional suggestions they may now have.
3. Optional: If time permits, provide students with material to perform other experiments related to static electricity (e.g., rubbing ebonite rods and glass rods with fur, silk, cotton) and placing them close to confetti, sawdust, water, etc.

-
- Optional Demonstration: Extend the students' exploration of like and unlike charges by creating "dancing stars". Ask the students to cut ~25 small stars and place them on a metal plate. Put plate (with stars on it) under a piece of glass, supported on book, so that the glass is no more than 10 cm away from the plate and is not touching the plate. Rub the piece of glass with a woolen cloth. This should cause the stars to 'dance'. Ask the students to explain what is happening to make the stars lift off the metal plate and then fall back down again. Ask the students to try the same experiment but this time with a paper plate and see if they get the same results.

Assessment

None: this is a diagnostic task. Law of Electric Charges is assessed in Task 1.3.

Accommodations

If students perform experiments, place them in heterogeneous groups to assist one another.

1.2 Learning/Assessment Task: Modelling an Atom

Students participate in a teacher-led discussion on the structure of an atom. Students draw and label a simplified diagram of an atom in their notes. Students, through dramatization, model the parts of the atom.

Teacher Facilitation

- Remind students that everything is made of atoms and that atoms are tiny particles of matter.
- Using diagrams, illustrate a model of an atom – neutrons, protons, and electrons. Tell students the charge on each particle.
- Have students copy the diagram into their notes.
- Dramatization: Assign each student to be a proton, electron, or neutron. Move desks away from center of classroom and put a large circle in center of classroom with masking tape. Have all the students representing protons and neutrons sit in middle of circle. Have the students representing electrons move around outside of the circle. Stress that the electrons are the *only* part of the atom that can move and that the protons and neutrons are "stuck" inside the nucleus.
- Option: Use the overhead and model the atom with three colours of transparent bingo markers of different colours.
- Prepare a cloze summary worksheet (Appendix 4.1) for students to complete.

Assessment

Assess the cloze worksheet using an answer key.

Accommodations

Provide a photocopy of teacher notes and use of peer helper/scribe for note taking.

1.3 Learning/Assessment Task: Static Electricity and Law of Electric Charges

Students develop an understanding of the separation of charge by going through a step-by-step progression of what happens when an ebonite rod is rubbed with fur. They then apply this knowledge to their observations made in Task 1.1 as they learn the Law of Electric Charges.

Teacher Facilitation

- Revisit the structure of the atom. State that each atom has the same number of protons and electrons and that atoms are neutral.
- Demonstrate on the chalkboard the transfer of electrons from cat's fur to an ebonite rod (Appendix 4.2). [**Note:** Explain to students that only electrons from the surface of atoms move.]
- Provide a copy of the worksheet (Appendix 4.2) for students to complete.
- State that static electricity is created when some electrons move from one object to another and stay there. The type of electricity is static in that it does not move continuously as opposed to current electricity.
- Optional Dramatization: If time permits have students model how electrons move from the fur to the ebonite).
- State that *like charges repel* (i.e. negative charges repel negative charges; positive charges repel positive charges). Use this law to review and explain Task 1.1 a-c.

-
7. State that *unlike charges attract* (i.e., negative charges attract positive charges and vice-versa) Use this law to review and explain Task 1.1 d.
 8. State that the pieces of confetti in the task 1.1 are neutral and *that charged objects attract neutral objects*. Use this law to review and explain Task 1.1 e-h.

Assessment

Assess using a worksheet answer key. Assess notebooks using the Notebooks are Important! Checklist (Appendix OV-5).

Accommodations

Provide peer helper/scribe to assist in completion of worksheet.

1.4 Learning/Assessment Task: Examples of Static Electricity

Students read one article on static electricity and participate in a CSGL structure to learn about other static electricity applications in everyday life. Students complete an SLL worksheet.

Teacher Facilitation

1. Prepare Reading for Understanding articles that discuss static electricity in everyday life (e.g., about lightening, plastic wrap, electrostatic air filters, electrostatic painting, and fabric softener). See Appendix 4.3 for an example. The articles should include the concept of insulators and conductors. Include focus questions, e.g., What was the example of static electricity?, Where was the build up of charge located?, Draw a picture of how this happens and a connections question, e.g., How else could static electricity be used to assist us?.
2. Students read and complete the Reading for Understanding worksheet.
3. Choose a CSGL structure from Appendix OV-3 that is appropriate to the co-operative skills of the students (e.g., Round Robin or Round Table) and have students report the different uses of static electricity to one another.
4. Provide SLL worksheet with vocabulary words (e.g., insulator, conductor, electrons, charge, movement). Include focus questions, e.g., Describe one situation in which you encounter static electricity in your every day life and a connections question, e.g., How is static electricity used in the industry.

Assessment

Students self-assess their own worksheets using a worksheet answer key. Use the Rubric for Collaborative Group Work (Appendix OV-4) to assess how well the students worked in their groups. The SLL entry is assessed using the SLL Rubric (Appendix OV-2).

Accommodations

Have someone read articles out loud instead of having them read the articles on their own. Provide the option of a scribe to aid the students in completing the worksheets. Students may complete the SLL entry orally.

Resources

Magnetism: Static Electricity. Walt Disney Company: Magic Lantern Communications Ltd. (distributor), 1995.

In the second program, Static Electricity, students learn why socks stick together when taken from the dryer and the "shocking truth" when Bill Nye handles static electricity. (26 minutes).

Activity 2: Current Electricity - What Is A Circuit?

Time: 300 minutes

Description

Students are introduced to making circuits and how to draw circuit diagrams. There is a fun extension activity provided in which students make music with the circuits they create.

Strand(s) and Expectations

Strand(s): Physics

Expectations: PH1.03, PH1.05, PH1.06, PH2.01A/C, PH2.02, PH3.01.

Planning Notes

1. Before teaching task 2.2 familiarize yourself with common misconceptions (Appendix 4.4) that students have when learning about current electricity. Exercise caution so that students do not confuse voltage with power.
2. Obtain electrical safety brochures from your local hydro utility.
3. Equipment required for task:
 - 2.2 - solar cell, wires, 1.5 V motor, switch, 1.5 V battery, 1.5 V light bulb, cardboard box, household light bulb, approximately 20 Styrofoam balls with toothpicks
 - 2.5, 2.5 - loads, switches, wires, batteries
 - 2.6 - variety of batteries of varying voltage, 1.5 V and 3.0 V batteries, wires, 1.5 V light bulb
 - 2.7 - fuses (and a circuit breaker)
 - 2.8 - loads, switches, wires, circuit diagrams, batteries, multimeter (or voltmeter and ammeter)

Prior Learning Required

This activity builds on what the students have learned about current electricity in Grade 6.

Teaching/Learning Strategies

2.1 Diagnostic Task: Uses of Electricity

Students brainstorm a list of ways electricity is used in everyday life and record this list into their notes.

Teacher Facilitation

1. Lead students through brainstorming activity on uses of electricity and make a chalkboard or overhead summary.
2. Assist students to record a variety of everyday uses in their notes.
3. Explore with students how they think the electrical devices they listed work.

Assessment

This is a diagnostic task that assesses prior knowledge/understanding.

Accommodations

Photocopy teacher's notes for those who have difficulty writing.

2.2 Learning Task: Parts of an Electrical Circuit

Students model, using dramatization, how a circuit works. Students sketch their model circuit into their notes.

Teacher Facilitation

1. The focus of this task is to illustrate the different components of a circuit and what each does.
2. Recreate the solar cell circuit from Unit 1, Task 4.1 with solar cell, wires and motor.
3. Replace the solar cell with a 1.5 V battery/power source and discuss other sources that supply energy to electrons (e.g., generators, wall plugs)
4. Replace the motor with a light bulb and discuss other devices that do work (loads).

-
5. Dramatization: Create a “human” model of a circuit in which small Styrofoam balls represent *electrons*; students standing in a line represents a *conducting wire*; a student next to cardboard box represents a *battery*; and a student holding a light bulb represents a *load*.
 - a) Give all students, except the one representing the battery, a "*parcel of electrons*" (Styrofoam ball) to hold. This will avoid the misconception that the battery creates electrons. Students representing the wire *before* the light bulb start out with a *parcel of electrons* that have a toothpick. The toothpick represents the *energy in the electron*. [Note for teacher Information: The idea of a *parcel of electrons* instead of an electron will assist when dealing with current in Task 2.7]
 - b) Divide the cardboard box into two halves - one half representing the negative or “high energy” terminal and the other half representing the positive or “low energy” terminal. Place parcels of *electrons* (Styrofoam balls) inside both halves of the cardboard box. Attach a toothpick to each *parcel of electrons* in the “high energy” terminal to represent the energy the battery supplies to electrons.
 - c) All students stand in a circle. The student representing the battery takes a *parcel of electrons* (Styrofoam ball) out of the “high energy” or negative terminal and passes it to the first student representing the wire. As he/she does this the first student representing the wire passes his/her *parcel of electrons* to the next student representing the wire. This student, in turn, passes their *parcel of electrons* to the next person and so on until all students in the circuit have passed a *parcel of electrons*.
 - d) When the first *parcel of electrons* with a toothpick reaches the student representing the light bulb. He/she removes the toothpick and raises light bulb picture to represent that the light is on.
 - e) The last person in the circuit places their *parcel of electrons* in the “low energy” terminal portion of the battery. The student representing the battery removes the *parcel of electrons*, places a toothpick on it and puts it in the “high energy” terminal of the battery.
 - f) Emphasize that the only way the *parcel of electrons* can travel is if there is a complete path (circuit) through which the electrons can pass. *Parcels of electrons* move from the negative to the positive terminals of the battery.
 6. Introduce a switch (control) into the circuit. Represent the switch by having one student separate two students representing the wire to model an open switch. The student representing the switch models a closed switch by reconnecting the two students. When the switch is closed, the light bulb is on (student holds light bulb in the air). When the switch is open, the light bulb is off (student holds light bulb down).
 7. Lead students in note-taking activity on terminology (load, wires/conductor, switch/control, and source) and how to sketch the circuit. The sketch should *not* contain correct symbols at this point.

Assessment

This is an introductory activity and should not be formally assessed.

2.3 Learning/Assessment Task: Safety in the Lab and at Home

Students participate in a brainstorming activity, generate list of safety rules and write this list into their notes. Students complete an SLL entry worksheet on electrical safety in the lab and in the house.

Teacher Facilitation

1. Discuss electrical lab safety. For example:
 - a) batteries require safe handling because they contain acids or bases which can burn;
 - b) do not connect the two battery terminals with a wire or you will create a short circuit;
 - c) do not use bare wires;
 - d) have teacher check circuit before you close the switch or connect the power source;
 - e) turn off the power source before you connect the wires.
2. Lead a brainstorming session about electrical safety in the home.

-
3. Generate a list of electrical safety tips on the chalkboard. Have students copy this list into notes. See Appendix 4.5 for examples. Additional safety materials would be available from your local electricity utility.
 4. Discuss ways to avoid short circuits in the home.
 5. Prepare a SLL worksheet with a vocabulary (e.g., acid, battery, bare wire, short circuit, power source). Include focus question, e.g., “Describe two safety precautions an electrician might follow when working.” and a connections question, e.g., “List three electrical safety tips you would give a baby-sitter taking care of a children” or “Give your reasons for each choice.”

Assessment

Assess student notebooks using the Notebooks are Important Checklist! (Appendix OV-5). Assess SLL entry using the SLL Rubric (Appendix OV-2).

Accommodations

Photocopy teacher notes for a student who is having difficulty writing. Give students extra time to complete the SLL entry.

2.4 Learning Task: Building A Circuit and Drawing a Circuit Diagram

Students complete a circuit given one load, one switch, one source, and wires. Students sketch the circuit into their notes. Then, given the correct symbols, students draw a circuit diagram of this circuit.

Teacher Facilitation

1. Review safety rules established in Task 2.3.
2. Provide materials the students need to experiment with making a working circuit. [**Note:** Let the students experiment with making the circuit before you tell them how to do it.]
3. Instruct students to sketch their working circuit.
4. Describe the symbol for each part of the circuit.
5. Provide students with a chart of symbols used in circuit diagrams (Appendix 4.6).
6. Have them draw their circuit diagrams using these symbols.
7. Provide other circuits to practise drawing other circuit diagrams.
8. Require students to show the flow of electrons from negative to positive terminals.

Assessment

Use a checklist to do peer and diagnostic assessment of circuit diagrams. Assess lab performance using shortened versions of the Lab Safety Checklist (Appendix 1.2) and/or the Laboratory Procedures Rubric (Appendix 1.3).

Accommodations

Place students in pairs so they can assist each other in the making of the circuits and drawing circuit diagrams.

2.5 Assessment Task: Circuits

Given a word description of a closed circuit, students build the circuit. Students draw a circuit diagram of this circuit; label its components; and indicate the movement of electrons by using arrows. Students then draw a diagram of the same circuit with the switch open and indicate that the electrons do no flow in an open circuit by omitting the arrows.

Teacher Facilitation

1. Teacher assists students in recognizing that electrons only flow in a complete circuit.
2. Provide students with a word description of a simple series circuit.
3. Create a worksheet that leads students through this assessment task.

Assessment

Assess using a worksheet answer key.

Accommodations

Replace the word description of the circuit with a sketch.

2.6 Diagnostic/Learning Task: Voltage

Students participate in teacher led discussion on voltage. Students make a notebook entry on voltage.

Teacher Facilitation

1. Display a variety of batteries with different voltages. Review that the battery supplies the electrons with energy.
2. Demonstrate the effects of differing voltages on a 1.5 V light bulb by connecting it to a 1.5 V battery and a 3 V battery.
3. Introduce the concept of voltage, which is the energy or "punch" that an electron gets from the battery. This stored energy is delivered to a load such as a light bulb or toaster. Explain how the greater the voltage of the battery, the more energy or "punch" the electrons have to transfer to the load (e.g., a 3.0 V battery does not supply more electrons or current than a 1.5 V battery. It just provides more voltage or "punch" to the electrons to make the light bulb brighter.). State that voltage is measured in volts (symbol V).
4. [Note to teachers: *Voltage* or *Potential Difference* is the energy transferred per unit charge. It is not the same as force and not the same as energy, that is why it has a different name, $V = E/Q$. However, the simplified version above is recommended for this unit]
5. Lead students on short note-taking activity on voltage.

Assessment

This is an introductory activity on voltage and should not be formally assessed.

Accommodations

Provide teacher notes for students who have difficulty writing.

2.7 Learning Task: Current

Students participate in teacher-led discussion on current. Using the circuit model from Task 2.2, students model the concept of current. Students make a notebook entry on current. As an extension students complete a Reading for Understanding activity on voltage and current.

Teacher Facilitation

1. Introduce the idea that current is the flow of electrons (the number of *parcels of electrons* that pass by a point in a circuit in a given time). Discuss the fact that current is measured in amperes (symbol A).
2. Display a fuse and/or a circuit breaker. Explain that it is a safety device for some circuits. If the current is too high, wire in the fuse melts and breaks. A circuit breaker "trips" or "opens". This breaks the circuit the same as an open switch.
3. Recreate the student model of a circuit and have one student count the number of *parcels of electrons* that pass through a point in a circuit in a certain time period - this will be the current flowing through the circuit.
4. [**Note:** For teacher information, current is the quantity of charge to pass a given point in one second. If the *parcel of electrons* is a coulomb, the 6.25×10^{18} electrons have passed a point in one second. This number is a billion times larger than the world's population and is too large for students to comprehend.]
5. Lead students in making a notebook entry on current and voltage
6. **Extension:** If time permits, assign a Reading for Understanding article on how current and voltage affects the human body (see Appendix 4.7 for a sample Reading for Understanding article)

Assessment

This is an introductory activity on current and should not be formally assessed. If the extension activity is completed, assess it using a worksheet answer key and the Reading for Understanding Rubric (Appendix 1.13).

Accommodations

Provide video information instead of a text article on safety devices related to current and voltage. Read the article orally to students who have difficulty reading.

2.8 Learning/Assessment Task: Recording Voltage and Current.

Students create a circuit from a circuit diagram. Students connect a multimeter and record the measurement with correct units

Teacher Facilitation

1. [**Note:** Students are more likely to use a multimeter (which measures both voltage and current) on the work site than a voltmeter or ammeter. As such, this activity is written assuming the teacher has access to multimeters. If multimeters are not available – modify the activity accordingly].
2. Using a simple series circuit diagram on the chalkboard or overhead, demonstrate building the circuit from the diagram.
3. Organize students into groups of four. Give each group a slightly different series circuit diagram (using different loads and number of loads). Ask them to build the circuit.
4. Show students how to connect a multimeter to a circuit to measure voltage.
5. Give each group a multimeter, instruct them to measure and record the voltage across the source *and* across the load(s).
6. Show students how to connect a multimeter to a circuit to measure current.
7. Instruct the students to record the current of their circuit between the source and the load (s).
8. Walk around to each group to check their circuit construction and multimeter connections and readings.
9. **Extension:** If time permits, discuss reasons why the voltage is different across the loads.

Assessment

Prepare a checklist that the teacher can use while walking around the class checking students' measurements of voltage and current. Monitor students' lab performance using the Lab Procedures Rubric (Appendix 1.3).

Accommodations

Prepare a model circuit for the students to use when creating their circuit instead of having the students create the circuit from a diagram. Group students according to ability. Then assign groups so that the higher the ability group the more loads in their circuits.

Resources

Video

Electrical Current: Light and Optics. Walt Disney Company: Magic Lantern Communications Ltd. (distributor), 1995 (52 minutes).

In the first program, Electrical current, Bill Nye "gets a charge" explaining "watts up" with electricity.

Web Sites

<http://www.physics.udel.edu/wwwusers/watson/scen103/99s/clas0308.html#links>

(This site discusses the following electrical safety topics: the current effects on human body; fibrillation and resuscitation; dielectric breakdown and sparking. This site also has links to the following: Electrical Hazards from the MIT Safety Office; Electrical Safety from the Health and Safety Manual at the Lawrence Livermore National Lab; and Using Electricity Safely from Ohio Edison)

<http://www-training.llnl.gov/wbt/hc/Electrical/Static.html>

(static electricity and how it can do harm when cleaning your monitor with a wet cloth while the computer is on)

<http://www-training.llnl.gov/wbt/hc/Electrical/Education.html>

(effects of current on your body)

<http://www-training.llnl.gov/wbt/hc/Electrical/Accident.html>

(how to respond to an electrical accident)

<http://www-training.llnl.gov/wbt/hc/Electrical/Responsibilities.html>
(how to minimize electrical accidents and near accidents)

<http://www-training.llnl.gov/wbt/hc/Electrical/EquipSafe.html>
(tips on safely using electrical equipment)

<http://www-training.llnl.gov/wbt/hc/Electrical/GFCI.html>
(fuses and circuit breakers protect equipment and wiring while ground fault circuit interrupters protect people)

<http://web.mit.edu/safety/apg/05/5-5.html>
(ground faults and ground fault circuit interrupters- their operation and where they may be used)

<http://www.miamisci.org/af/sln/frankenstein/safety.html>

Activity 3: Series and Parallel Circuits

Time: 195 minutes

Description

Students complete a carousel activity exploring parallel and series circuits. Household wiring is also discussed.

Strand(s) and Expectations

Strand(s): Physics

Expectations: PH2.01A/B/C/E, PH2.02, PH3.01.

Planning Notes

Equipment required for task:

- 3.1 – 3V battery, wires, 1.5V light bulbs
- 3.2, 3.3 – *variety* of loads [**Note:** 1.5V buzzers can be purchased at Canadian Tire], switches, wires and sources

Prior Learning Required

This activity builds on what the students have learned about circuits in Grade 6.

Teaching/Learning Strategies

3.1 Diagnostic/Learning Task: Introduction to Parallel Circuits

Students, working in pairs, discover how to make a parallel circuit. Students then draw a circuit diagram using proper symbols.

Teacher Facilitation

1. Provide each pair of students with a 3V battery, wires (provide enough wires so light bulbs can be hooked up in parallel), and two 1.5V light bulbs. Instruct students to create a circuit.
2. Ask students to remove one light bulb from their circuit. [**Note:** If students have connected the light bulbs in series, then the other light bulb “go out”. If students have connected the light bulbs in parallel, then the other light bulb will remain on].
3. If any student(s) have connected the light bulbs in parallel, have them teach the other students how to make a parallel circuit.
4. If no students have connected the light bulbs in parallel, then ask them to try to build a circuit in which they can take out one light and the other light bulb remains on.

5. Lead a discussion on the difference between series and parallel circuits (i.e., when loads are connected in series and one load is removed, the other load(s) are *not* able to function. However, when loads are connected in parallel, and one load is removed the other load(s) remain functioning).
6. Demonstrate how to draw a circuit diagram of a parallel circuit.
7. Instruct students to draw a circuit diagram of their parallel circuit.

Assessment

Diagnostic assessment of circuit diagrams

Accommodations

Group students together so they can get assistance from their peers. Photocopy teacher notes on circuit diagrams so students do not need to create them on their own.

3.2 Learning/Assessment Task: Circuits in Carousel

Given a circuit diagram, students build the correct circuit and vice-versa.

Teacher Facilitation

1. Group students in pairs.
2. Set up three stations around the room as follows using a *variety* of different loads. Depending on class size, two or three sets of stations may be required. Matching the circuit to the correct sketch helps to check to see if the students have created the circuit correctly without the teacher directly doing this.

Station	Students Provided	Students Task
1	* <i>series circuit diagram</i> * number of sketches of circuits	* create the circuit * identify the type of circuit by disconnecting a load * match the circuit to the correct sketch
2	* <i>parallel circuit diagram</i> * number of sketches of circuits	* create the circuit * identify the type of circuit by disconnecting a load * match the circuit to the correct sketch
3	* <i>parallel circuit</i>	* identify the type of circuit by disconnecting a load * draw a correct circuit diagram

3. Create a worksheet in which the students identify the type of circuit, and either match it to the correct sketch or draw a circuit diagram

Assessment

Assess using a worksheet answer key.

Accommodations

Choose the grouping of students so their skills complement each other.

3.3 Assessment Task: Constructing Series and Parallel Circuits with Three Loads.

Given a word description, students construct two circuits containing three loads (one series and one parallel). Students then draw the circuit diagrams for the circuits. Students complete this activity in pairs; however, they must hand in the circuit diagrams individually

Teacher Facilitation

1. Create a checklist for assessing this task.
2. Provide students with required materials and a worksheet with descriptions of two circuits. Students construct both circuits and draw circuit diagrams:
 - a) A parallel circuit containing three loads. Any one load can be disconnected and the other two remaining loads remain operational.
 - b) A series circuit containing three loads. If one load is removed from the circuit, all other loads are no longer functional
3. **Extension:** If time permits, students can measure the voltage and current in the circuits using multimeters.

Assessment

During the task, the teacher records the successful building of the circuits. Upon task completion, students hand in circuit diagrams individually. Assess using a checklist.

Accommodations

Assign students to create circuit with two loads - something they have seen before.

3.4 Learning/Assessment Task: Household Wiring

Students complete Reading for Understanding article on uses of series and parallel circuit in a house.

Teacher Facilitation

1. Provide a Reading for Understanding worksheet on series and parallel circuits in a house (see Appendix 4.8 for an example).

Assessment

Assess using the Reading for Understanding Rubric (Appendix 1.13).

Accommodations

Read article out loud to student(s) for students that have difficulty reading.

3.5 Learning/Assessment Task: Careers and Hobbies Related to Electricity

Students produce a list of careers and hobbies related to electricity. Students complete an SLL worksheet.

Teacher Facilitation

1. Lead a brainstorming session on careers/hobbies related to electricity.
2. Provide students with information on the hobbies and careers listed. Information could come from: newspapers, the Internet, library searches, pamphlets from Ontario Hydro.
3. Consider inviting guest speakers from local hydro provider, inviting parents who work in the electrical field, planning a field trip to the Ontario Science Center or Science North, or planning a field trip to an electrical generation station to achieve this expectation.
4. Prepare an SLL worksheet with appropriate vocabulary (e.g., electricity, career, hydro). Include focus questions, e.g., A career or hobby related to electricity is _____. It is related to electricity because _____. I am interested in this career/hobby because _____ and a connections question, e.g., The way that technology may change this career/hobby in the future is _____.

Assessment

Assess SLL entry using the SLL Rubric (Appendix OV-2).

Accommodations

Allow more time for SLL completion for students who need it.

Resources

Internet

<http://www.physics.udel.edu/wwwusers/watson/scen103/99s/batt-bulb.html>

(This site provides an extension activity in which students construct simple circuits using a combination of batteries and light bulbs. Students measure the relative brightness of the light bulbs with respect to a standard flashlight provided by the instructor)

<http://www.physics.udel.edu/wwwusers/watson/scen103/house/index.html>

(This site includes a demonstration of the progression of circuit loading, which involves calculating the increase in current on a household circuit as a series of devices are used to determine why a circuit was overloaded. An extension activity that can also be modified and used when teaching about electrical safety, and safety devices - such as fuses and circuit breakers)

<http://www.physics.udel.edu/wwwusers/watson/scen103/copper2.html>

(Ever wonder how a AA battery tester works? A circuit diagram is included. It also shows how to replace "copper2" in address with "copper1" to see how a 9 V battery tester works).

Electronics Workbench (1991); free Ontario licensed software

(Both Mac and IBM platform versions are available to all teachers and students in Ontario. This program models a workbench for electronics. The student picks parts from a bin for assembly onto a schematic. Once an analog or digital circuit is created, its activity can be simulated on the computer display. Test equipment is contained within the program.

Activity 4: Using Electricity

Time: 430 minutes

Description

Students explore the different ways electricity is transformed to other types of energy in household appliances. Trends in electrical consumption, ways to electrical energy, and comparing ways of producing electricity are examined and discussed by students.

Strand(s) and Expectations

Strand(s): Physics

Expectations: PH1.04, PH2.01B/D/E/F, PH3.02, PH3.03.

Planning Notes

1. Make connections to the mathematics and geography course that students are taking.
2. Equipment required for task:
 - 4.1 – pictures of forms of energy (people sitting around a fire, a light bulb, a radio speaker)
 - 4.2 – sample electricity bills
 - 4.3 – graph of energy consumption vs. time of day
 - 4.4 – six mythical monthly bills
 - 4.5 – graph showing Ontario's increasing demands for electricity
 - 4.6 – materials for students to prepare posters/comic strips, video
 - 4.7 – video on electricity production and the effects on the environment, probably available from local hydro utility
 - 4.8 – video on alternative forms of energy

Prior Learning Required

This activity builds on what the students have learned about energy transformations and conservation of energy in Grade 5. It also uses graphing skills from mathematics.

Teaching/Learning Strategies

Learning Task 4.1: Using Electricity to do Work

Students generate a list of forms of energy. Students create a table indicating how electricity is transformed within common appliances. Students complete an SLL worksheet.

Teacher Facilitation

1. Provide pictures of forms of energy for students examine.
2. Have students describe what forms of energy they see in the picture (e.g., a light bulb produces light and heat, someone pushing something produces mechanical energy, a speaker produces sound energy).

-
3. Discuss with students that energy is the ability to do work; energy has many different forms; electricity is a form of energy; and that energy is neither created nor destroyed, it just changes form.
 4. Create a table that shows electrical appliances. Electrical energy goes into the appliance. Have students identify the main energy type into which this energy is transformed. Also include other energy types. (e.g., In a hair dryer, electrical energy is changed mainly into heat energy. Air movement, sound energy, and light energy are also produced.)
 5. Prepare an SLL worksheet with appropriate vocabulary (e.g., energy, transformation, heat, sound, mechanical). Include focus questions, e.g., Make a list of three electrical devices you use to get ready for school in the morning and identify the form(s) of energy that each device and a connections question, e.g., Create your own imaginary electrical device. List its function, and identify the energy transformations that it produces.

Assessment

Assess SLL entry using the SLL Rubric (Appendix OV-2)

Accommodations

Assign a peer helper to assist in writing the SLL entry.

4.2 Learning/Assessment Task: Reading an Electrical Bill

Students extract information from a household electrical bill.

Teacher Facilitation

1. Provide the students with a sample electrical bill, or a photocopy of a local bill, that has all *parts* labeled and *simple definitions* besides each label. The bill should include information such as: Account Number, Invoice date (date the bill was sent to the consumer), Months billed (number of months of service the bill is for), Account Name (the consumer's name and mailing address), Amount due (amount due on or before due date), Due date (last day you can pay without penalty), Late Payment amount (amount includes 7% late payment charge), Energy Use (Energy consumed during this billing period measured in kilowatt hours, kWh), Energy Management Information (compares this months energy use with the same month last year).
2. Prepare a similar sample bill; however, this time the parts should not be labeled. Ask the students to label the parts of the bill.
3. Give students a blank table in which they enter information extracted from the sample bill.
4. Instruct students to answer questions about the bill, e.g., How did my electricity use compare to the same time last year? How much more would I have to pay if I pay my bill late?
5. Discuss the answers to the questions together in class.

Assessment

Assess table using a worksheet answer key.

Accommodations

Assign peer helpers to assist in filling out the chart.

4.3 Learning Task: Peak Trends in Energy Consumption

Students view graphs of energy consumption vs. time of day and discuss the peak provincial trends of electrical energy use. Students then create a graph from a data table.

Teacher Facilitation

1. Display a graph of commercial electricity use vs. time for the peak summer day and discuss trends (e.g., When is the most electricity used in business in the summer? Why do you think the peak is at this time?).
2. Discuss the fact that residential electrical use has different peak demands times, e.g., From the graph, when is largest or peak demand for household electricity? Why do you think there is a second peak at 9 PM? See graphs in Appendix 4.11. Discuss reasons why 6-8 PM is the peak energy consumption time for households. Compare with peak commercial energy-draw period.
3. Demonstrate how total residential summer electrical use can be graphed. [See Appendix 4.12]

-
4. Provide students with a data table of consumption vs. time of day for the peak winter day. Lead students through creating a graph of this data. [Appendix 4.12]
 5. Have students identify the peak use time for the graph they created.

Assessment

This is an introductory activity on graphing and should not be formally assessed. However, teachers should formatively assess students' graphs and assist them in making improvements.

Accommodations

Students may want to create the graph using a spreadsheet program.

4.4 Assessment Task: Graphing Data from a Bill

Students extract information from home energy bills and record/summarize this information in a data table. Students construct a graph from energy bill data of kWh vs. month. Students answer questions relating to graph.

Teacher Facilitation

1. Co-ordinate organizing and analysing data and making tables and graphs with the Grade 9 mathematics teacher.
2. Teacher creates six mythical monthly bills. See Appendix 4.9 for sample bills.
3. Provide a worksheet that leads students through: creating a data table from information from the bill; graphing that data; and answering focus questions about the graph, e.g., What are the peak months of consumption?, What are the low times of consumption? and connections questions, e.g., Why do you think the peak times of electrical energy occurred when it did?, Do you think natural gas consumption would peak at the same time of year? Why?

Assessment

Assess using a worksheet answer key.

Accommodations

Students can assemble data table and make graph using a spread-sheet program.

4.5 Learning Task: Life without Electricity

In groups, students discuss what life would be like without electricity. Students brainstorm ways of conserving electricity and record these ideas in their notes.

Teacher Facilitation

1. Lead brief discussion on what life would be like without electricity. (Teacher may want to use the Ice Storm in January of 1998 as a starting point for discussion.)
2. Choose a CSGL structure from Appendix OV-3 that would be appropriate to the activity and the ability of your students (e.g., Think-Pair-Square or Round Robin). Group students and assign each group a household task or daily activity (e.g., making breakfast, doing laundry, watching a movie with friends and making popcorn, getting up and getting ready for school, being at school). Each group has to describe how that activity would be different if it had to be done without electricity.
3. Groups report back to class. Class makes a list of some of the things people could not do if they did not have electricity.
4. Present graph/data showing Ontario's increasing demands on electricity. Look at trends and demands on use. Discuss conservation (i.e., We will not be able to meet demands indefinitely so how do we conserve?). (See Appendix 4.11.)
5. Lead students through brainstorming activity on ways to conserve electricity. Students record these ideas in their notes. Appendix 4.10 is a teacher resource for this activity.

Assessment

Peer- and teacher-assessment the Rubric for Collaborative Group Work (Appendix OV-4) to assess how well the students work in their groups.

Accommodations

Provide teacher notes on conversation list for students with difficulty writing.

4.6 Assessment Task: Conservation of Electricity Presentations

Students prepare a presentation (e.g., poster, video, newspaper ad, comic strip, song, or role play) on conservation and present it to the class. Students record information from each presentation using a handout with focus questions provided by teacher.

Teacher Facilitation

1. Provide students with presentation criteria and outline how each student will be assessed.
2. Instruct students to pick one conservation tip from the list generated in the last class. See Appendix 4.10 for suggestions. Instruct students to prepare a presentation that provide information about their conservation tip.
3. Arrange times for the students to deliver the presentation to the rest of the class.
4. Provide students with a worksheet they to fill in as they listen to their classmates' presentations. In the worksheet, students record the conservation tip each classmate talks about as well as how that conservation tip helps to conserve electricity.

Assessment

Use a modified version of the Poster and Presentation Rubric to assess the presentation (Appendix 2.5). Assess the handout using an answer key.

Accommodations

Allow students to work in pairs to present the information. Provide teacher's notes to aid students who have difficulty writing in completing the worksheet.

4.7 Learning Task: Environmental Effects of Producing Electricity

Students view video on electricity production (hydro, nuclear, fossil fuels) and its effects on the environment (damning of water, pollution, and non-renewable resources)

Teacher Facilitation

1. A video is probably available from your local energy utility or the Ontario Power Generation Corporation. The main sources of electricity in Ontario are falling water or hydro power (e.g., Niagara Falls GS), nuclear power (e.g., Bruce NGS), and burning of fossil fuels (e.g., Nanticoke GS.)
2. Discuss sustainability issues.
3. You may wish to prepare a short-answer question sheet to direct student viewing and for making a brief record of the information in the video.

Assessment

Self-assessment of question sheet using an answer key.

Accommodations

Provide closed-caption video for students with students hearing impairment.

4.8: Learning/Assessment Task: Alternative Sources of Electricity

Students view video on alternative sources of electricity (wind, solar, geothermal, tidal, biomass, and burning garbage). Students compare/contrast an alternative source of electricity with a main source of electricity).

Teacher Facilitation

1. Show video on alternative sources of electricity.
2. Prepare a *short* note on the chalkboard summarizing the main points on the video.
3. Instruct students to choose an alternative source of electricity and compare/contrast it with one of the traditional sources of electricity discussed in Task 4.7 (hydro, nuclear or fossil fuels).
4. Demonstrate how a graphic organizer (e.g., a Venn diagram) or a chart with comparison categories (e.g., energy source or fuel, renewable or non-renewable, waste products, relative cost of energy production, distance to consumer, environmental issues) to aid students in organizing their data.
5. Prepare information sheets on both the traditional and alternative sources of electricity. These information sheets should have enough information to allow students to complete this task. Additional sources of information can be found in the library, the Internet, CD-ROM's, and a variety of pamphlets.

-
6. Prepare an SLL worksheet with vocabulary such as wind, solar, geothermal, nuclear, hydro, fossil fuels. Include focus questions, e.g., What source of electricity should be used in Ontario? Why? and a connections question, e.g., Jobs I could get that would involve helping conserve electricity are.

Assessment

Create a rubric to assess the comparison activity. [**Note:** The rubric should *not* assess knowledge. It should assess the inquiry/communication skills outlined in expectations PH2.01E, and PH2.01F]. Assess the SLL worksheet entry using SLL Rubric (Appendix OV-2).

Accommodations

Allow students to complete a verbal instead of written research report. Provide additional time for completion of the SLL entry

Resources

Internet

<http://www.physics.udel.edu/wwwusers/watson/scen103/problems/hairdryer.html>

(This site provides word problem, which challenges the students to figure out which of two roommates should pay a utility premium for electricity, based on what they use.)

http://www.torontohydro.com/docs/energysaver_cooling2.htm

(Seven easy ways to ensure that your air conditioner is performing efficiently and your home is comfortable.)

http://www.torontohydro.com/docs/windmills_pressrelease.htm

(Toronto Hydro outlines their proposal to build two 20-storey wind turbines)

<http://www.ontariopowergeneration.com>

Videos

Electricity. Agency for Instructional Technology, 1992 (15 minutes)

(from the Science for You series - Children learn how electric motors work, how batteries produce electricity, and why we need to find safer, cleaner ways to generate electricity. Demonstrations illustrate electrons, electrical charges, and currents.)

Hydro Electricity. Bist/Ley Productions/OCEA, 1991 (15 minutes)

(from The Green Earth Club series - shows how hydroelectricity is generated, and the structures built to produce it.)

Electricity, ATV/ASN Productions, 1990 (30 min.)

(from the Wonder Why series and geared to Grades 5-9 - It discusses how electricity is what makes the world go around and how there were many people who helped us to discover what electricity is. It looks at what electricity is and how we depend on it. Students find out that there are many ways to get electricity and travel to power plants to see where it is generated. They also find out that it is important to conserve electricity. This program shows that electricity is found everywhere – from thunderstorms to combs to wall sockets.

Newspaper Articles

McAndrew, Brian. "Pollution Doubles at Coal-Fire Plant." *Toronto Star*, (April 6, 1999)

(Discusses the issues around the doubling of smog-producing air pollution coming from the Lakeview power plant near Toronto.)

Papp, Leslie. "Power Lines Linked to Leukemia Risk." *Toronto Star*, (June 16, 1999)

(Youngsters exposed to high electromagnetic levels from electrical wiring face a greater risk of childhood leukemia.)

Lu, Vanessa. "Bell Blaze Puts City on a Hold for a Day." *Toronto Star*, (July 17, 1999)

(An electrical panel in a downtown Toronto Bell Telephone switching station explodes, causing a small fire which cuts the communication lines out of the heart of Toronto's economy for more than five hours.)

Activity 5: Culminating Activity – Building A Model Electrical Car

Time: 195 minutes

Description

The focus of the activity is bringing together the ideas of the unit and working in groups. Model cars are created in which functioning motors are built using the circuits learned throughout the unit.

Strand(s) and Expectations

Strand(s): Physics

Expectations: PH2.03, PH1.05, PH2.01A/B/C/D/F, PH3.03.

Planning Notes

1. Build and test one of these cars before assigning the project to students.
2. Equipment required for task:
 - 5.1 - batteries, wires, motors
 - 5.2 - thick cardboard, 1.5 V motors, switch, 1.5 V batteries, wires, wheels, axles (thin aluminum or copper rods- wire coat hanger), 0.5 cm wooden dowel cut to 0.5 cm length, paint, scotch or electrical tape, small nail
 - 5.3 - information on hobbies and careers related to electricity
3. In Task 5.3 you may want to arrange for a guest speaker or a class trip

Prior Learning Required

This activity builds on what students have learned throughout this unit.

Teaching/Learning Strategies

5.1 Learning/Assessment Task: Batteries in Series or Parallel

Students are introduced to model car assignment. Students complete two circuits, one with batteries connected in series, one with the batteries connected in parallel. Students complete an SLL entry worksheet.

Teacher Facilitation

1. Introduce assignment [see Appendix 4.13] on building a working model car. The cars are raced to see which car runs the fastest
2. Review concept of voltage with students as being the energy stored in electrons. Display batteries of different voltages and review the idea that the greater the voltage of a battery, the greater the energy that is supplied to electrons. Ask the students how voltage is measured. Ask the students how a motor would react to changes in voltage (i.e., different levels of energy in the electrons).
3. Show batteries hooked up in series and batteries hooked up in parallel and ask students to predict which type of connection supplies the circuit with a greater voltage and therefore cause the motor to run faster.
4. Provide students with two circuit diagrams, one with the batteries hooked up in parallel, and one with the batteries hooked up in series. Instruct students to conduct an investigation to determine whether two batteries connected in series or two batteries connected in parallel cause the motor to spin the fastest.
5. Prepare an SLL worksheet using vocabulary (voltage, motor, speed, parallel, series), focus questions, e.g., The motor turned the fastest when I connected the batteries in _____ because _____ and a connections question, e.g., When I build the model car, ways I can design the car so that it will move quickly are _____.

-
6. **Extension:** If time permits, have students measure the voltage across the batteries in their various trials in strategy 2 and see which type of battery hook up results in the greatest voltage.

Assessment

Assess the SLL worksheet using the SLL Rubric (Appendix OV-2).

Accommodations

Provide students with a model of the parallel and series connections for the batteries instead of having them create them from a circuit diagram. Provide a peer helper/scribe for students who have difficulty in writing.

5.2 Learning/Assessment Task: How Fast Can It Go?

In groups, students build a model car. Students race their car against other cars made. Individually, students complete a worksheet that summarizes the concepts of the unit. As an extension, students time how long it takes for the car to travel in one-metre intervals and construct a distance vs. time graph.

Teacher Facilitation

1. Show students additional components of model car (piece of cardboard for the body of the car, four small wheels, and electric tape to connect things, metal rod to connect the wheels through the body of the car, etc. - see Appendix 4.13).
2. Highlight the following building tips: use electrical tape to connect batteries to car chassis (body); use straws for the metal rods to go through so the axles can turn freely
3. Choose group size (two to four students) appropriate to the ability of your students to work co-operatively.
4. Provide each group with materials needed to build the car. Encourage students to request material that they can use to decorate and name their car.
5. Give students a worksheet that leads them through the building of the car. Students complete the worksheet individually.
6. Organize a car race.
7. **Extension:** If time permits, record the time it takes for the car to travel a set distance. Have students calculate their car's speed using the formula $\text{speed} = \text{distance}/\text{time}$.

Assessment

Assess the worksheet using a worksheet answer key. The quality of the model cars should *not* be assessed nor the winner of the car race. This activity is meant to foster group work and creativity. Use the Rubric for Collaborative Group Work (Appendix OV-4) to assess how well the students worked in their groups.

Accommodations

Arrange the groupings of students so that the student's individual skills complement each other.

APPENDICES UNIT 4

Appendix 4.1: Atoms

Reference for Unit 4, Task 1.2

Label the diagram of the atom and complete the following sentences with the words provided in the word box.

1. _____

2. _____

3. _____

4. _____

Word Box		atoms	neutral	nucleus	same
charge	electrons	negative	not	positive	smallest
protons	neutrons	can	electrons		

Everything is made up of tiny particles called _____. Atoms are the _____ part of something.

An atom is made up of three basic parts – _____, _____ and electrons. Electrons have a _____ charge (-). Protons have a _____ charge (+). Neutrons do not have a charge. They are neutral. Protons and neutrons are located together inside the _____ of an atom. Protons and neutrons can _____ move. Electrons _____ move around the nucleus. _____ are the only part of the atom that can move.

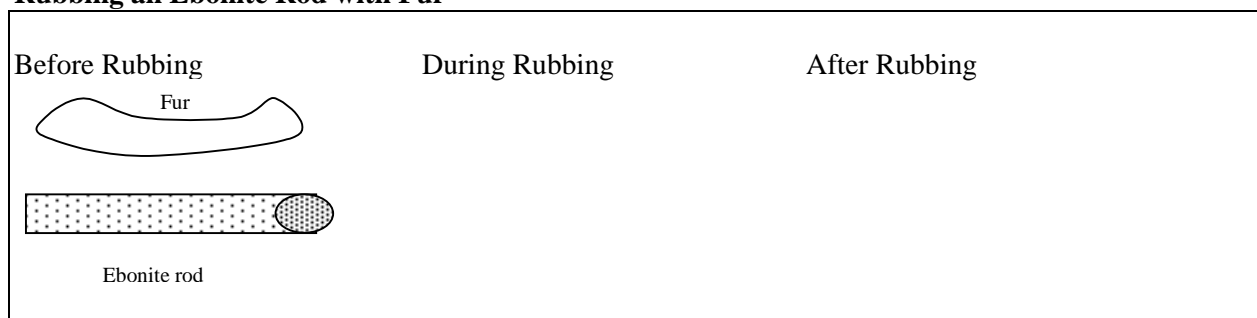
Atoms usually have the _____ number of protons and electrons. The positive charges from the protons and the negative charges from the _____ cancel each other out. Therefore, atoms usually have no charge. Things that have no _____ are called neutral. Atoms are usually neutral. Since objects are made up of atoms, objects are usually _____.

Appendix 4.2: Static Electricity

Reference for Unit 4, Task 1.3

The only part of the atom that moves is the electron. When electrons move from one place to another and then *stay* at that place, it is called *static electricity*. An example of creating static electricity is rubbing an ebonite rod with fur.

Rubbing an Ebonite Rod with Fur



Before Rubbing

Draw an equal number of electrons (-) and protons(+) on the fur. Draw an equal number of electrons (-) and protons (+) on the ebonite rod. They are both neutral.

During Rubbing

Draw another fur touching the ebonite rod. When the ebonite rod is rubbed with fur, the electrons move from the fur to the ebonite rod. Show extra electrons on the ebonite rod.

After Rubbing

Draw the fur and ebonite rod separated. Make certain the ebonite rod has more electrons (-) than protons (+). This means the rod has a negative charge. Make certain the fur has more protons (+) than electrons (-). It has a positive charge.

Law of Electric Charges

1. Like charges repel or move away from each other.
 - positive (+) and positive (+) repel
 - negative (-) and negative (-) repel
2. Unlike charges attract each other.
 - positive (+) and negative (-) attract
 - negative (-) and positive (+) attract
3. Charged objects attract neutral or uncharged objects.
 - positive (+) and neutral (O) attract
 - negative (-) and neutral (O) attract

Appendix 4.3: Electrostatic Painting

Reference for Unit 4 Task 1.4

Name: _____

Electrostatic Painting

This method is used to paint car parts. A spray gun mixes powdered paint with a stream of air. The gun is charged with electricity. The electricity puts a positive charge on each particle of paint.

A metal car part, like a fender, hangs from a hook. It moves along a metal track. Electricity in the track gives the part a negative charge.

The gun sprays the part with the positive paint particles. Unlike charges attract so the paint particles stick to the metal part.

The painted part is heated to 150°C. This melts and bakes the paint onto the part. When the part cools, the paint becomes smooth and hard.

Any paint that does not stick to the part is collected and reused. This wastes less paint than using liquid spray paint such as you use in a spray can at home. This reduces pollution.

Anything metal can be painted using this electrostatic powder coating method.

1. The paint particles have a _____ charge.
2. The metal part has a _____ charge.
3. The paint sticks to the metal because _____ charges attract.
4. What happens to excess paint particles?

1. Why do they paint metal this way?
2. Name 5 items at home or at school that can be painted this way.

(Adapted from "Painting with Powder." *Toronto Star*, (July 10, 1999): page J4)

Appendix 4.4: Misconceptions in Current Electricity

Reference for Unit 4, Teacher Reference for Activity 2

Misconceptions in Current Electricity

Misconception	Scientific Explanation
Battery Current Origin The invisible substance (current) moving in an operating circuit originates in the battery.	CIRCUIT Current Origin Moving charge is a normal constituent of all conducting parts of an electric circuit. Movement through wires involves replacement and recycling of this constituent.
Battery as a Current Source The battery is the source of constant electric current.	Battery as a Potential Source The battery is the source of electric potential which is the causal agent of current propulsion.
Current Diminution Current in an electrical circuit is consumed.	Current Conservation Current in an electrical circuit is conserved.
Current Devaluation Current in an electrical circuit is devalued as it moves around the circuit.	Current Maintenance Current in an electrical circuit is maintained as it moves around a circuit.
Current Independence A battery of a given voltage always gives out a constant current. The current is independent of the circuit to which the battery is connected.	Current Dependence A battery of a given voltage causes a current to flow; the amount of current is dependent on the circuit to which the battery is connected.
Voltage/Current Equivalence Electric current and potential difference are equivalent quantities and behave in the same way.	Voltage/Current Differences Electric current and potential difference are different quantities and behave in different ways.
Local Reasoning Students tend to focus their attention entirely on what is happening at one point in a circuit and ignore what is happening elsewhere.	National Reasoning Students must consider the total circuit. A change in one part of a circuit can affect properties elsewhere in the circuit.

WJT Elgin Wolfe, OISE/UT. Reproduced with permission

Appendix 4.5: Home Electrical Safety Tips

Reference for Unit 4, Teacher Reference for Task 2.3

The following is a list of some home electrical safety tips the teacher can use as a resource for the brainstorming activity in task 2.3.

1. Keep appliances and other electrical devices in good repair.
2. Unplug appliances/devices before attempting to repair them.
3. Turn off breakers/fuses before working on household circuits.
4. Exercise caution when handling electrical devices near water or wet areas (e.g., don't use a hairdryer while in the bathtub, power tools when standing in wet areas, or an electric mower on wet grass).
5. Avoid overloading circuit (e.g., multiple socket devices in an outlet or multiple power bars). The wires could overheat and cause a fire.
6. Don't insert a penny in fuse boxes when a fuse is blown.
7. Don't replace a blown fuse with a fuse of a higher rating.
8. If a fuse "blows"/circuit breaker "trips" repeatedly, have an electrician identify the cause of the problem
9. Check outlets for loose fitting plugs, which can overheat and lead to a fire.
10. Place safety covers on all unused outlets that are accessible to children.
11. Only Type C fire extinguishers are safe for use on electrical fires. Don't pour water on electrical fires. Unplug equipment and use baking soda, a recommended dry chemical or a Type C fire extinguisher.
12. Don't try to hide electrical cords under rugs. Don't rest furniture on electrical cords
13. Don't staple or nail electrical cords to the wall or baseboard.
14. Use extension cords only on a temporary basis.
15. Don't remove grounding pin on a three-prong plug to fit a two-prong outlet. Don't jam a three-prong plug into a two-prong outlet.
16. Replace or repair worn out electrical cords
17. Always hold the plug when you disconnect a device from an electrical outlet. Don't disconnect the device by pulling on the cord.
18. Disconnect appliances such as toasters, coffee makers and irons as soon as you have used them.
19. Don't plant tall trees under power lines.
20. Don't use indoor Christmas lights outdoors
21. Fly kites only in open fields, far from any power lines. Don't touch a kite that is tangled in a power line. Don't fly a kite in wet or stormy weather

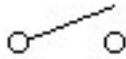
Appendix 4.6: Symbols Used in Circuit Diagrams

Reference for Unit 4, Task 2.4

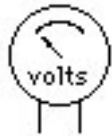
Symbols Used In Circuit Diagrams



Wire



Switch



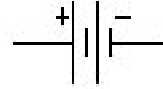
Voltmeter



Speaker



Multimeter



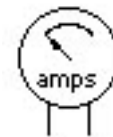
Battery



Resistor



Light Bulb



Ammeter

Appendix 4.7: Voltage, Current, and You

Reference for Unit 4, Task 2.7.

Voltage, Current, and You

Electricity can be measured by its voltage and/or its current. **Voltage** is the energy stored in electrons and is measured in **volts** (V). **Current** is the number of *parcels of electrons* that flow in a circuit and is measured in **amperes** (A).

Avoid coming in contact with electricity. When electricity starts its journey from a power station to your home the voltage can be as high as 500 000 V. Although the voltage is reduced to 120 V or 240 V before it reaches your home it is still high enough to kill you.

Many people don't know it, but current is also very dangerous. The wires in most homes can carry a current of 15 A – this is 300 times greater than the current required to kill you!

How does current affect your body? The nerves in your body are like tiny wires that carry electricity to your muscles. The current in your nerves causes your muscles to **contract** (get shorter). Your heart is a muscle. When your heart muscle contracts it pumps blood throughout your body. This is natural. However, it only takes a small additional amount of current flowing through your heart to cause the heart muscles to stop contracting properly. When this happens, the heart no longer pumps blood and you usually die. The muscles in your chest may become **paralyzed** if a small additional amount of current flows through them. This can cause you to stop breathing. Finally, a current as small as 1 A can cause serious electrical burns.

If a current is flowing through someone, do not touch him or her or the current may flow through him/her to you. Turn the *main* power off and seek medical aid.

A. Circle the correct answer:

1. The energy stored in electrons. ____ (A) voltage (B) current (C) power
2. The flow of electrons is called... ____ (A) voltage (B) power (C) current
3. Voltage is measured in... ____ (A) current (B) volts (C) amperes
4. Current is measured in... ____ (A) amperes (B) volts (C) current

Appendix 4.7: Voltage, Current, and You (Continued)

B. Circle True or False

1. You can die if you touch a 120 V wire. True or False
2. A small amount of current can cause serious burns. True or False
3. Current is not very dangerous. True or False

C. Complete the following sentences. Use the words below.

paralyzed

contract

heart

breathing

1. Current causes your muscles to _____ .
2. The muscles in your chest may become _____ if a small amount of additional current flows through them.
3. When your chest is paralyzed you can stop _____ .
4. When additional current passes through your _____ it stops contracting properly.

D. Answer the following questions in sentences.

1. Why should you *not* touch someone if electricity is passing through them?

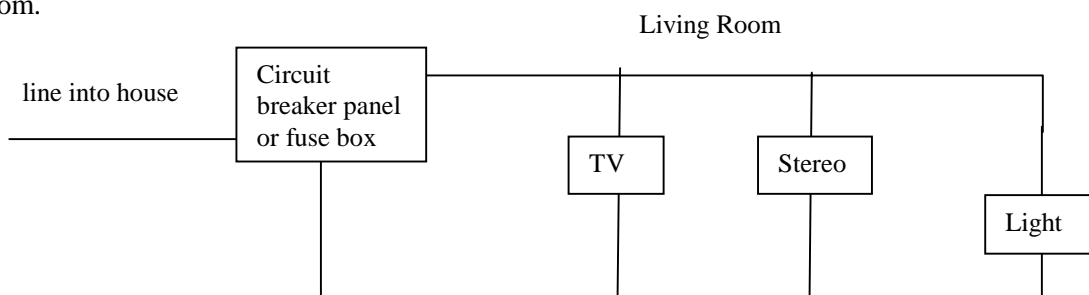
3. How can you get medical aid where you live?

Appendix 4.8: Household Wiring

Reference for Unit 4 task 3.4

Household Wiring

When you turn off the light can you still watch TV? If the stereo is off, can the light still be on? Almost every electrical item in your home is wired in parallel. When one item is switched off, others can still run. The only item wired in series is your fuse box or circuit breaker panel. The fuse or circuit breaker can cut off electricity for safety reasons. Below is a diagram of a possible branch circuit in your living room.



1. Write a P for parallel beside each item wired in parallel in the diagram.
2. Write an S for series beside the panel/fuse box.

Electricity enters a circuit box in your home. There are branch circuits that carry electricity to different parts of your home. Each branch circuit has a fuse or circuit breaker. The fuse or circuit breaker is a safety device that “blows” or opens when too much current tries to flow through the branch circuit. Too much current will cause the wiring to overheat. This might cause a fire. The fuse or circuit breaker cuts off the electricity to that branch when it “blows”. A fuse or circuit breaker is usually for 15, 20 or 40 amperes (A).

The items that use electricity are called *loads*. Some common loads and the current they use are show in the chart below.

Load	Typical Current Used (amperes)
Light bulb	0.5 A
Kettle	12.5 A
Toaster	8 A
Hair dryer	10 A
Refrigerator	1.7A
Microwave oven	5 A
Iron	11 A

If you plug too many loads into one circuit, the circuit breaker will “blow”. For example, using the chart, a kettle (12.5 A) and a toaster (8 A) on the same circuit need 20.5 A. This will “blow” or “trip” a 15 A circuit breaker.

3. Where is the circuit box for your home?
4. What is the purpose of a circuit breaker or fuse?
5. Will two hair dryers blow a 15 A circuit breaker? Why?

Your bathroom may have a special circuit breaker right in the outlet. It has a little red button on it. It is called a GFCI (Ground Fault Circuit Interrupter). If you stand in water while using a hairdryer, you could become part of the circuit. The breaker in the GFCI blows immediately. It protects you from the surge of current.

6. Do you have a GFCI in your home?

Appendix 4.9: Electrical Bill Data

Reference for Unit 4, Task 4.4.

(This information can be used to create sample electrical bills)

Bill 1

- Account Number: 1234567
- Invoice date: February 24, 1998
- Months billed: 2
- Amount due: \$180.11
- Due date: March 9, 1998
- Late Payment amount: \$192.71
- Energy Use: 650 kWh
- Energy Management information:
 - average daily consumption this billing period, 11 kWh
 - average daily consumption last year at this time, 12

Bill 4

- Account Number: 1234567
- Invoice date: August 24, 1998
- Months billed: 2
- Amount due: \$128.29
- Due date: Sept. 7, 1998
- Late Payment amount: \$132.27
- Energy Use: 465 kWh
- Energy Management information:
 - average daily consumption this billing period, 7 kWh
 - average daily consumption last year at this time, 9 kWh

Bill 2

- Account Number: 1234567
- Invoice date: April 27, 1998
- Months billed: 2
- Amount due: \$164.25
- Due date: May 9, 1998
- Late Payment amount: \$175.74
- Energy Use: 591 kWh
- Energy Management information:
 - average daily consumption this billing period, 10 kWh
 - average daily consumption last year at this time, 13 kWh

Bill 5

- Account Number: 1234567
- Invoice date: October 28, 1998
- Months billed: 2
- Amount due: \$134.45
- Due date: November 7, 1998
- Late Payment amount: \$143.86
- Energy Use: 484 kWh
- Energy Management information:
 - average daily consumption this billing period, 8 kWh
 - average daily consumption last year at this time, 9 kWh

Bill 3

- Account Number: 1234567
- Invoice date: June 24, 1998
- Months billed: 2
- Amount due: \$119.45
- Due date: July 11, 1998
- Late Payment amount: \$127.81
- Energy Use: 430 kWh
- Energy Management information:
 - average daily consumption this billing period, 7 kWh
 - average daily consumption last year at this time, 4 kWh

Bill 6

- Account Number: 1234567
- Invoice date: December 12, 1998
- Months billed: 2
- Account Name: Ms. Consumer
- Amount due: \$176.45
- Due date: January 9, 1998
- Late Payment amount: \$188.80
- Energy Use: 635 kWh
- Energy Management information:
 - average daily consumption this billing period, 11 kWh
 - average daily consumption last year at this time, 13 kWh

Appendix 4.10: Ways to Conserve Energy in Your Home

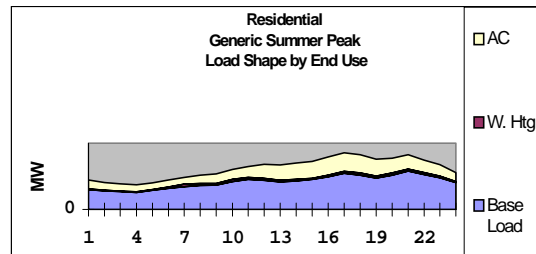
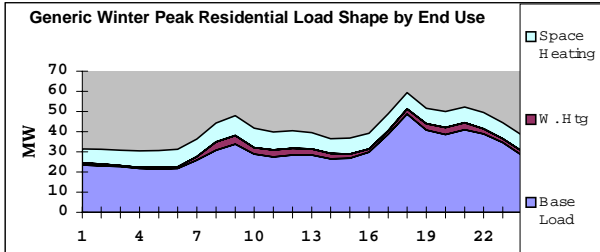
Reference for Unit 4, Teacher Resource for brainstorming session in Task 4.5

1. Regularly clean and replace air conditioner filters.
2. Change furnace filters regularly.
3. Clean the lint filter on your clothes dryer after every load and vacuum the lint from the motor, drum, and pipes at least once a year.
4. Use your microwave to cook. It reduces heat output and uses less than half the energy of a conventional oven.
5. Don't peek while foods are cooking. Each peek costs 20% of the energy in the oven.
6. Use full loads when using your dishwasher, clothes washer and dryer.
7. Thaw frozen foods before putting them in the oven.
8. Don't boil any more water than you need for tea, coffee, or hot chocolate.
9. Cook vegetables in the least amount of water possible. Then turn down the heat when boiling starts.
10. Cook concentrated foods such as turnips in a microwave oven.
11. Turn off the TV and stereo when you are not using them. Turn off lights when they are not in use.
12. Adjust thermostat to provide comfort without overheating. General rule: the setting should be 21°C when relaxing, 20°C when working around the house, 18°C when sleeping at night, and 16°C when the house is empty. [**Note:** A forced-air oil or gas furnace uses electricity to operate the fan!]
13. Turn down your electric water heater and lower the thermostat in your fridge if away for more than two days.
14. During the summer, turn off the air conditioning at night, open the windows and enjoy the comfort of cool evening air. This also improves air quality and removes humid air.
15. Turn off the oven before cooking time is up. The heat in the oven will finish the job.
16. Don't bother preheating the oven if the cooking time is more than one hour.
17. Run the dishwasher only when there is a full load. Run the dishwasher at off peak consumption times.
18. Let dishes air dry instead of using the dryer cycle on a dishwasher.
19. On sunny windy days, dry clothes on the yard line instead of in the dryer.
20. Use detergent formulated for washing clothes in cold water and save on energy to heat hot water.
21. Make sure refrigerators and freezers are properly sealed.
22. Weather strip and caulk windows and doors.
23. Place insulation between living space and unheated areas, such as exterior walls and attic floors.
24. Close damper in fireplace when not in use.
25. W.12.8(e)0.1(sure refrig)12.8(e)0.1(rators and freez)11(ers are properly)12.8(sealed.)]TJT*0.0014 Tc-0.0014 Tw[(2

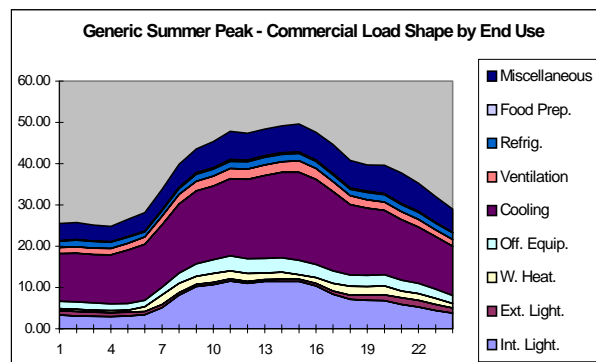
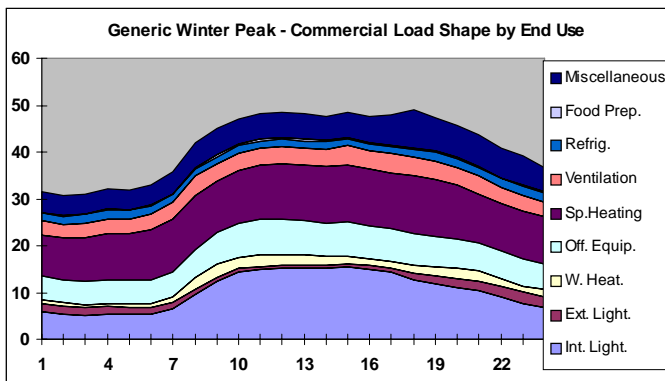
Appendix 4.11: Ontario Electricity Consumption

Reference Unit 4, for Tasks 4.3 and 4.5

Ontario Residential Electricity Consumption During Typical Summer and Winter Days



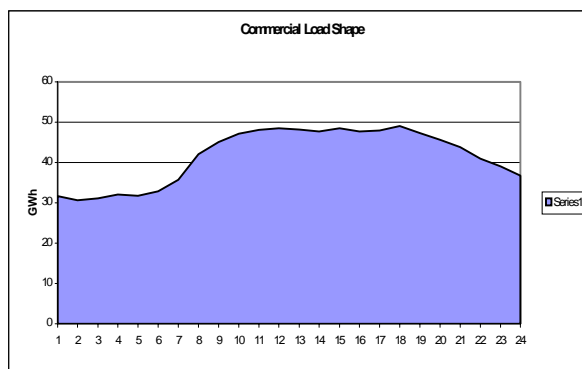
Ontario Commercial Electricity Consumption During Typical Summer and Winter Days



Change in Use of Electricity in Ontario

(Electricity Use in GWh vs. Years 1986-1998)

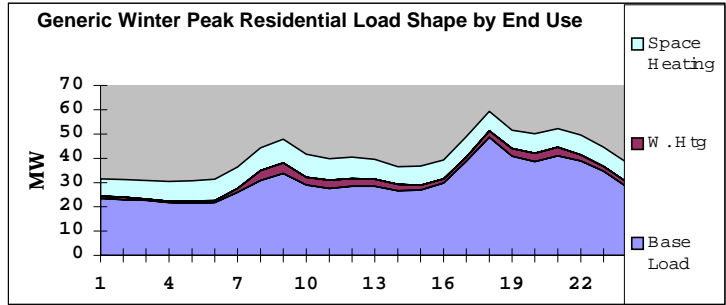
Year	GWh	% Change
1986	115,614	
1987	121,341	4.95%
1988	127,790	5.32%
1989	132,961	4.05%
1990	132,601	-0.27%
1991	131,614	-0.74%
1992	129,980	-1.24%
1993	127,893	-1.61%
1994	129,329	1.12%
1995	131,113	1.38%
1996	131,208	0.07%
1997	133,688	1.89%
1998	137,591	2.92%



This table shows the historic variation in electricity consumption. The recession of 1990 was followed by three more years of load reduction. Since 1994, consumption is increasing again.

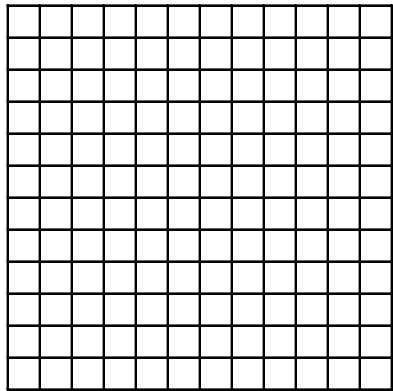
Appendix 4.12: Graphing Residential Use of Electricity

Time (24 h clock)	Power (MW)
1	32
2	31
4	30
5	31
7	36
8	44
9	48
11	40
12	41
14	37
15	37
17	49
18	59
19	52
21	52
22	50
24	38



Graph this data of total electricity use by Ontario homes on a summer day

Time (24 h clock)	Power (MW)
1	27
3	31
5	24
8	31
10	36
12	41
14	42
16	48
18	50
21	50
23	41



Appendix 4.13: Building a Model Car

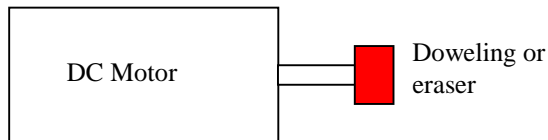
Reference for Unit 4, Task 5.2

Materials needed per group to make model car:

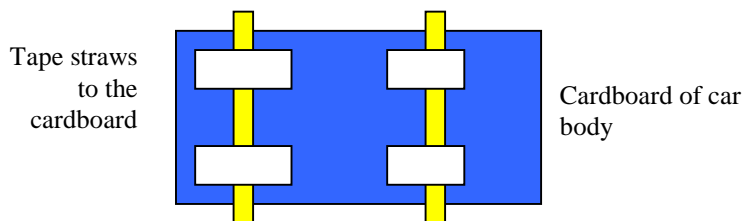
- 4 wheels (diameter 2 cm) can be bought at science supply stores;
- 2 axles (6 cm long) should be thin aluminum or copper rods (obtained from shop or use a wire hanger);
- 1–1.5 V DC motor;
- 1–0.5cm dowel cut 0.5 cm in length. Alternatively, use an eraser from the end of a pencil;
- 2 small drinking straws;
- wires, should have alligator clips on the end so they can be easily attached to the battery;
- minimum of 1–1.5 V battery;
- minimum of 1 battery holder;
- piece of cardboard (thickness of cardboard you find on a cardboard box);
- tape;
- small nails (to hammer hole into wooden dowel).

To Make Model:

1. Cut cardboard to size 15 cm long and 4 cm wide
2. Attach dowel or eraser to motor shaft by using a small nail to create a hole through the centre of the dowel or eraser. Put the shaft of the motor through the hole.

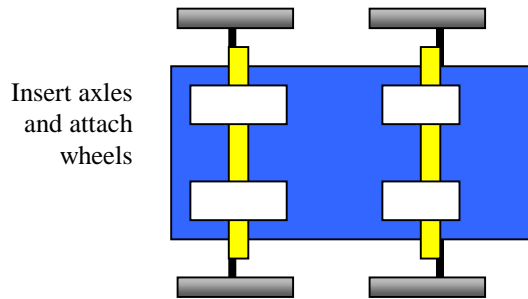


3. Cut drinking straws to 6 cm.
4. Attach drinking straws with tape to underside of cardboard.

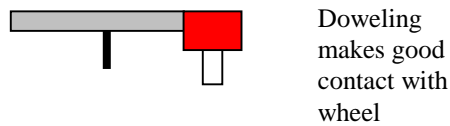


Appendix 4.13: Building a Model Car (Continued)

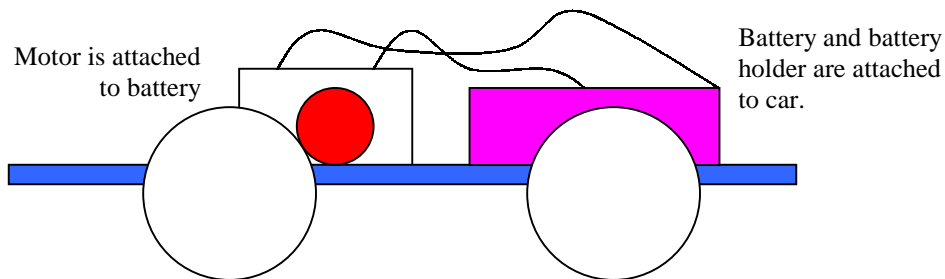
- Slide axles inside the straw and attach wheels to the axles.



- Check to see that the wheels turn easily over a smooth surface.
- Mount motor securely to top end of cardboard with tape. Make sure the doweling on the motor makes contact with the wheel. It is the friction between the doweling and the wheel that cause the wheels to turn.



- Place battery inside battery-holder. Attach the battery-holder to the cardboard with tape.
- Attach wires from the battery-holder to the motor. (When students are doing this, they should create the circuit they decided upon in Task 5.1 and use this circuit to power the motor).



Appendix 4.13: Building a Model Car (Continued)

Questions to lead students through the building of the model:

1. Check off as you collect the following items:
 - 4 wheels (diameter 2 cm)
 - 2 axles (6 cm long)
 - 1–1.5 V DC motor
 - 1–0.5cm dowel cut 0.5 cm in length or eraser from end of pencil.
 - 2 small drinking straws to hold axles
 - wires to connect battery to motor
 - minimum of 1–1.5 V battery with battery holder
 - piece of cardboard for car body
 - tape
 - small nails
2. The doweling should be placed on the shaft of the motor. Once your car is built, the doweling should be touching one of the back wheels of your car. Why do you think this is needed?
3. The straws help the metal rods turn freely. Draw a picture of what you think it might look like on your car.
4. Where will you attach the axles to the cardboard chassis (body) of the car? How will you attach them?
5. Draw a circuit diagram of the electrical circuit from Task 5.1 that will make your motor turn.
6. How will you secure your circuit onto the chassis of the car?
7. What decorations will you put on the car?

Individual questions each student is to complete:

1. Draw a schematic diagram of the electrical circuit in your group's car.
2. Label the components of your circuit.
3. Show the movement of the electrons around the circuit.
4. What energy transformations occurred in the motor?
5. How could the build up of static electricity between the straws and the axles be reduced?

Unit 5: Earth and Space Science

Time: 21 hours

Unit Description

Students explore the solar system and the universe and study applications of space science to better understand how scientists investigate the universe, how the technologies resulting from space exploration affect their lives; and where humans fit into the universe. Skills of inquiry, problem solving, collaboration, and communication are developed.

Strand(s) and Expectations

Strand(s): Earth and Space Science

Overall Expectations: ESV.01, ESV.02, ESV.03.

Specific Expectations: ES1.01, ES1.02, ES1.03, ES1.04, ES2.01A/B/C/D/E, ES2.02, ES3.01, ES3.02, ES3.03.

Activity Titles (Times and Sequence)

Activity 1	Our Solar System	405 minutes
Activity 2	Motion	240 minutes
Activity 3	Outside the Solar System	105 minutes
Activity 4	Exploring Space	330 minutes
Activity 5	Culminating Activity - Travel Brochure	180 minutes

Task Titles (Type, Time and Sequence)

Task	Type	Title	Time (minutes)
1.1	Learning	Tour of the Solar System	60
1.2	Learning	A Closer Look at the Planets	45
1.3	Assessment	Our Planet Earth	120
1.4	Learning	The Sun: Our Energy Source	60
1.5	Assessment	The Sun: A Powerful Star	120
2.1	Learning	Movements of the Earth - Rotation and Revolution	45
2.2	Learning	The Four Seasons	30
2.3	Learning	Motions of the Moon	30
2.4	Learning	Star Gazing	60
2.5	Assessment	Motion in the Night Sky	45
2.6	Assessment	Identifying Constellations	30
3.1	Learning	Tour of the Universe	45
3.2	Learning	Mural of the Universe	60
4.1	Learning	Journey into Space	40
4.2	Assessment	Canada in Space	30
4.3	Learning	Space Timeline	40
4.4	Learning	How Does the Canadarm Work? (Optional)	
4.5	Learning	Life in Space	60
4.6	Learning	Life of a Canadian Astronaut	60
4.7	Learning	Rockets Away	40
5.1	Learning	Introduction to Space Travel	45
5.2	Assessment	Space Travel Brochure	135

Prior Learning Required

Students have had some exposure to Space (Solar System, constellations, and Earth rotations) in Grade 6; however, this unit has been designed without extensive reliance to previous knowledge. Some diagnostic assessment would assist in planning.

General Unit Planning Notes

Specific planning for each activity is described in the Teacher Facilitation sections. However, the following preplanning would be helpful:

- Much of the motion described in Activity 2 occurs on the scale of months. Teachers should consider having students keep logs throughout the course (e.g. sunrise/sunset times, planetary motion, when certain constellations are visible, tracking current space missions, construction of the International Space Station, observing the ISS or Iridium satellites). A few simple skills (e.g., use of the constellation finder) could be taught at the first of the course.
- Contact the Canadian Space Resource Centre (CSRC) as many of the resources needed for this unit can be obtained from here.
- Obtain the *Young Space Scientists Program* resources through your Canadian Space Resource Centre, CSRC, (1-800-511-3500) which provides a magazine of information at an appropriate reading level.

- Highly recommended are subscriptions to magazines such as *SkyNews*, *Astronomy* and *Sky and Telescope*.
- Recommend membership in the Royal Astronomical Society of Canada (RASC), the Astronomical Society of the Pacific (ASP), or the Planetary Society. These organizations provide magazines and many other resources, often specifically for teaching. The RASC membership includes their own journal, *SkyNews*, a book for beginning observers, and the yearly *Observers Handbook* which is used world-wide by amateurs and professionals alike.
- *Starry Night* CD-ROM is an excellent resource to use throughout this unit, especially in Tasks 1.1, 1.2, 2.4, 2.6. You will need to spend some time familiarizing yourself with this CD-ROM in order to see its full potential. It would also be helpful to create worksheets to lead students through this CD.
- Task 1.4 - Co-ordinate with teacher/librarian or book computer time for access to Internet.
- Tasks 2.4, 2.6 - Collect weekly star maps that appear in the *Toronto Star*, local paper, or other sources.
- Tasks 4.5 - Purchase *Living in Space* (book 2) from the CSRC as it is required to complete these activities.
- Task 5.1 - Collect samples of travel brochures to be used for culminating task.
- Task 5.2 - Book computer time for access to Internet.
- The RASC and the Ontario Science Centre both operate portable, inflatable planetariums that hold a full class. This would be a great way to teach identification of constellations.

Teaching/Learning Strategies

Activity	Strategy	Description
1	modelling, presentation, reflection, brainstorming, research	Presentation and modelling are used to introduce students to the Solar System. Students brainstorm and then conduct research on the Sun. Students research and complete a Planet Fact Sheet which will be used in the Culminating Activity.
2	demonstration, modelling, experimental/inquiry, reflection	The motion of the Earth and Moon are modelling in detail. Students are introduced to apparatus such as the Constellation Finder to be used in making observations of the night sky.
3	reflection, visual display	Students learn that our Solar System is only a small part of the universe. A mural is created to reflect its immense size.
4	research, visual display, modelling, reflection	Students research the milestones of space exploration and use the facts to create a Space Timeline. Canadian contributions such as the Canadarm are modelling. Careers and hobbies such as model rocketry are examined in greater detail.
5	reflection, research, visual display	Students draw on the information from the unit and their imaginations to create a travel brochure highlighting a destination in space.

Assessment/Evaluation

Activity	Expectations	Tool	Assessing	Who
1.1	ES1.01, ES1.03	Worksheet Answer Key	Knowledge	teacher
1.2	ES1.03	SLL Rubric	Knowledge, making connections	teacher
1.3	ES1.01, ES1.03	Worksheet Answer Key for Planet Fact Sheet Model/Poster Checklist Rubric for Oral Presentations	knowledge	peer
			communication/knowledge	teacher
			communication	peer
1.4	ES1.04	Reading for Understanding Rubric Rubric for Group Work Rubric for Oral Presentations	knowledge, communication	teacher
			communication	peer
			communication	peer
1.5	ES1.04, ES2.01E	Research Paper Rubric	knowledge, making connections	teacher
2.1	ES1.03	Worksheet Answer Key	knowledge	teacher
2.2	ES1.03	Worksheet Answer Key	knowledge	teacher
2.3	ES1.03	Worksheet Answer Key	knowledge	teacher
2.4	ES2.01B, ES2.01D	Checklist	inquiry	Teacher
2.5	ES2.01E, ES2.02	SLL Rubric Rubric for Collaborative Group Work	knowledge, making connections	teacher
			communication	teacher
2.6	ES2.01B	Worksheet Answer Key	knowledge, inquiry	teacher
3.1	ES1.02	Worksheet Answer Key	Knowledge	teacher
3.2	ES1.02	Checklist	Knowledge	peer
4.1	ES2.01D	Worksheet Answer Key	Knowledge	teacher
4.2	ES2.01D, ES3.02	Worksheet Answer Key	Knowledge	teacher
4.3	ES2.01C, ES3.02	Oral Presentation Rubric	knowledge, communication	teacher
4.4	ES3.02	Lab Procedures Rubric	Inquiry	teacher
4.5	ES2.01C, ES3.01	SLL Rubric	knowledge, making connections	teacher
4.6	ES3.03	Checklist	Knowledge	teacher
5.2	ES2.01A, ES2.01C, ES2.01D	Space Travel Brochure Checklist and Rubric	knowledge, making connections	self/teacher

Unit Resources

Software

Starry Night Deluxe (for Macintosh and Windows)
1998 Sienna Software (www.siennasoft.com)

Real Science! Careers in the Physical Sciences. Seattle: Videodiscovery Inc., 1997.
ISBN 1-56307-498-2

Part of a 4 Volume CD-ROM set that examines careers in various fields of science. Discusses the careers of Solid-State Chemist, Criminologist, Galactic Astronomer, Physicist, Planetary Astronomer, Chemical Engineer, and Radio Astronomer.

Texts

Bloch, Mars, et al. *Nelson Science 9*. Toronto: ITP Nelson, 1999.

Bosak, Susan et al. *Science Is...* Richmond Hill: Scholastic Canada, 199. ISBN 0-590-74070-9

Crelinsten, Jeffrey. *Living and Learning in the Space Age*. Ottawa: Ministry of Supply and Services Canada and Fitzhenry and Whiteside, 1988. ISBN 0-88902-455-3

Dickinson, Terrance. *Exploring The Night Sky*. Willowdale: Firefly Books, 1987.
ISBN 1-55209-302-6

Dickinson, Terrance. *Night Watch*. Willowdale: Firefly Books. ISBN 1-55209-89-7

Dickinson, Terrance. *The Universe and Beyond*. Willowdale: Firefly Books. ISBN 1-55209-361-1

Dickinson, Terrance. *Summer Stargazing*. Willowdale: Firefly Books, 1996.
ISBN 1-55209-014-0

Fraknoi, Andrew. *Resource Materials for Teaching Astronomy*. San Francisco: Astronomical Society of the Pacific, 1999.

Wolfe, Elgin, et al. *SCIENCEPOWER 9*. Toronto: McGraw-Hill Ryerson, 1999.

National Audubon Society Pocket Guides. New York: A. Knopf, Inc., 1995 (Random House of Canada).
Small paperback guides that are richly illustrated

Earth from Space. ISBN 0-679-76057-1

The Sun and Moon. ISBN 0-679-76056-3

Constellations. ISBN 0-679-77998-1

Galaxies and Other Deep Space Objects. ISBN 0-679-77996-5

Planets. ISBN 0-679-77997-3

Periodicals

SkyNews: Canadian Magazine of Astronomy and Stargazing. PO Box 9724, Station T, Ottawa, ON K1G 5A3: National Museum of Science and Technology. ISBN 0840-8939

Internet

Canadian Space Agency
www.space.gc.ca

Canadian Space Resource Centre Ontario
www.spacenet.eybe.on.ca

Astronomical Society of the Pacific
www.aspsky.org

NASA resources for educators
<http://education.nasa.gov/educators.html>
<http://spacelink.nasa.gov>

Educators' Corner of the Canadian Space Agency
www.space.gc.ca/ENG/Educators/menu.html

Canadian Company Assists Mars Mission: "Pedestrian"

<http://www.electricityforum.com/et/oct97/mars.html>

(radio modem keeps Mars Rover in touch with Earth and gives Québec-based company international exposure)

Videos

Hubble Video Tour of the Universe. 1996. 8 min, video available from CSRC #02-4-05

A 'video tour' of images and discoveries made possible by the Hubble Space Telescope progresses from near Earth with the first servicing mission through images of planets, the life cycle of stars, black holes and distant galaxies. Animation and video sequences depict processes and changes occurring in the Universe, such as the impact of a comet, Saturn at ring plane crossing and the birth and death of a star.

Apollo Programs

On the Shoulders of Giants. 1973. 30 min, video available at the CSRC #07.3-03

Documentary showing Apollo 17 journey, first lunar landing, links to the beginning of the Space Shuttle Program.

Solar System Exploration. 1992. 60 min, Video available from the CSRC #10.2-18

A collection of highlights from the Voyager, Magellan, Galileo, and Ulysses missions.

Solar System Exploration. 1992. 30 min, Video available from CSRC #10.2-20

Activity 1: Our Solar System

Time: 405 minutes

Description

In this activity students learn more about our Solar System. They specifically focus on the planets and the Sun. The characteristics of the planets are examined and students choose a planet they would like to research further. Students complete a one-page research paper focussed on problems caused by prolonged exposure to the Sun.

Strand(s) and Expectations

Strand(s): Earth and Space Science

Expectations: ES1.01, ES1.03, ES1.04, ES2.01E.

Planning Notes

Equipment required for Task:

- 1.1 - videos on Solar System (e.g. *Solar System Exploration* Available from Canadian Space Resource Centre, CSRC), model or poster of the Solar System. *The Magic School Bus* - There are at least two videos that deal with the solar system, and an excellent CD-ROM. Slide sets that tour the solar system and/or the universe. Sources include Astronomical Society of the Pacific (ASP)
- 1.1 and 1.2 - *Starry Night* CD-ROM
- 1.2 - NASA Solar System Lithograph Set for Earth and Space Science (includes useful information on the planets on the back of each photo. Available free from Canadian Space resource Centre, CSRC, or NASA)
- 1.3 - materials to make model of planets (Styrofoam balls, plaster of Paris, paint, etc.)

-
- 1.3 - materials for students to illustrate information about the Sun (markers, video recorder, audio tapes)
 - 1.5 - pictures/video clips/newspaper articles on effects of overexposure to the Sun (skin cancer, cataracts in animals, human vision problems, etc.)

Prior Learning Required

Students have had the opportunity in previous units to complete Science Learning Log entries and the One-Page Research Paper Template. The characteristics of the Solar System, introduced in Grade 6, are revisited.

Teaching/Learning Strategies

1.1 Learning Task: Tour of the Solar System

Students view a video on the topic of our Solar System (e.g. *Our Solar System*). Students examine a model or poster of the Solar System. Students participate in dramatizing to model distances of the planets from the Sun. Students complete a worksheet.

Teacher Facilitation

1. Select and show a video that identifies the planets and other objects in the Solar System such as planetary moons, asteroids, meteors and comets and illustrates the order of the planets with respect to the Sun. Guide students through an examination of the model or poster.
2. Depending on the site chosen (e.g., hallway, gymnasium, school campus), calculate and provide all relative distances that the students will need for the modelling.
3. Take students to a gymnasium or field for the modelling demonstration. Students show approximate relative distance from the Sun and walk around demonstrating the Solar System as planets revolve around the Sun. [**Note:** This is only a rough approximation because we know, for example, that Pluto's distance would reach far beyond the confines of a gymnasium. In the soccer pitch or school field, Earth Venus and Mercury would all be within one metre of the Sun and Pluto would be at a far distance].
4. Prepare a Tour of the Solar System worksheet that includes the names of the planets and their order with respect to the Sun (Appendix 5.1).
5. Have students develop a mnemonic memory aid for the order of the planets (e.g., **My Very Educated Mother Just Sent Us Nine Pizzas**).
6. Students may use the *Starry Night* CD-ROM to view the order of the planets.

Safety

Plan for movement of students outside of the classroom.

Assessment

Assess using a worksheet answer key.

Accommodations

Use closed-captioning for deaf and hard of hearing students. Assign an Educational Assistant or peer helper to assist physically challenged students with the moving demonstration activity. Assign a peer helper to aid in completion of worksheet.

1.2 Assessment Task: A Closer Look at the Planets

Students participate in a teacher led discussion and note-taking exercise focusing on the characteristics of the planets. Students complete a Science Learning Log entry worksheet.

Teacher Facilitation

1. Define the meanings of the characteristics of the planets (e.g., satellite, gaseous, rings, composition, atmosphere, temperature) in our Solar System on chalkboard, chart paper or overhead for students to copy into their notebooks.

-
2. Prepare a SLL entry worksheet with vocabulary (e.g. satellite, gaseous, rings, composition, atmosphere, temperature). Include focus questions (e.g., “What planet would you like to explore? Why?”) and a connections question (e.g., “Why do people send astronauts into space?”).

Assessment

Assess the SLL using the SLL Rubric (Appendix OV-2).

Accommodations

Enlarge print size of notes for students with low vision. Provide a copy of teacher notes to aid students in note-taking activity. Use a scribe and/or peer helper, tape recorder or computer as an alternative to written responses.

1.3 Learning/Assessment Task: Our Planet Earth

Students read information from an overhead about Earth and complete a Planet Fact Sheet about Earth (Appendix 5.2A). Students are assigned a planet to investigate and then complete a Planet Fact Sheet (Appendix 5.2B) for their planet. Students make a model of their planet (styrofoam, modelling clay) or poster to present to class.

Teacher Facilitation

1. Use Canadian Space Agency, Canadian Space Resource Centre or NASA website to download pictures with data to assist in preparing an Earth information fact sheet for the overhead (e.g. order of planet, distance from the Sun, composition, length of year and day, atmosphere, temperature, moons, rings). Guide students on how to enter this information onto a blank Planet Fact Sheet using the sample Earth Fact Sheet (see Appendix 5.2A) that you have created.
2. Create blank Planet Fact Sheets for students to complete (see Appendix 5.2B).
3. Prepare information, at the appropriate reading level, on the other eight planets as well as the Sun. The NASA Solar System Lithograph Set is an excellent resource for this.
4. Assign one planet per student and distribute the appropriate information for that planet.
5. Have students prepare their planet to the appropriate size. Provide directions and recommend appropriate size and ways of creating surface effects. Share with students the parameters that you are using to assess the model.
6. Create a display of the models or posters in order with respect to the Sun.
7. Students briefly describe their planet to the class.
8. **Extension:** The students could prepare their models to a common scale that would emphasize the relative size of the planets. [**Note:** the ball from a ball point pen could be used for the smallest planet]

Assessment

Peer assessment of Planet Fact sheets using a teacher developed checklist. Assess the model/poster using a teacher developed rubric or checklist. Peer or formative assessment of presentation using Rubric for Oral Presentations (Appendix 6.6)

Accommodations

Enlarge print on overhead for students with low vision. Use peer helpers to help students complete Planet Fact Sheets.

1.4 Learning Task: The Sun: Our Energy Source

Students participate in a brainstorming session on the importance of the Sun. Students complete a Reading for Understanding worksheet on the Sun's energy. Students work in pairs to illustrate in a creative way (rap, poem, song, picture, comic strip) one or more facts about the importance of the Sun. Students present information to the class.

Teacher Facilitation

1. The focus of this activity is to emphasize the importance of the Sun in providing us with energy. Lead students through brainstorming activity on the Sun as an important source of energy (e.g., source of all energy on Earth such as, natural gas, wood, solar energy, light for photosynthesis).

-
2. Prepare a short Reading for Understanding article on the importance of the Sun. (See Appendix 5.3 as an example.) [**Note:** All energy, except geothermal and nuclear, comes from the sun]
 3. Have students work in pairs to prepare presentation of important fact(s) about the Sun.

Assessment

Assess using the Reading for Understanding Rubric (Appendix 1.13). Assess co-operation on working with others using Rubric for Collaborative Group Work (Appendix OV-4). Peer or formative assessment of presentation using Rubric for Oral Presentations (Appendix 6.6).

Accommodations

Group students appropriately for working in pairs. Peer helper to assist with reading and presentation preparation.

1.5 Assessment Task: The Sun - A Powerful Star

Students participate in a teacher-led discussion on the power of the Sun and the danger of over exposure. Based on discussion, class generates a list of factors attributed to the strength of the Sun and records the list in their notebooks. Students research one of these factors. Students complete a one-page research paper using the One-Page Research Paper Template.

Teacher Facilitation

1. The focus of this activity is to emphasize the danger of too much sun.
2. Lead students through a discussion on the strength of the Sun and the resulting harmful effects of UV radiation (e.g., skin cancer, cataracts in sheep, human vision problems, endangerment of frogs, or effect on crops). Use pictures and/or video clips to aid in the discussion if desired. Use Environment Canada web site or local newspaper or radio station indicating UV level for the day.
3. Aid students in organizing the list and recording it in their notebooks.
4. Instruct students to choose one of these factors and complete a one-page research paper. Students should use the One-Page Research Paper Template (Appendix 5.4) focussing on the problem and any solutions.
5. Provide students with research material and access to the library and the Internet.
6. **Extension:** This topic could be extended to include the environmental factors that affect the energy from the sun (e.g., depletion of ozone layer by fluorocarbons or methane, geothermal warming because of increased carbon dioxide in the atmosphere).

Assessment

Assess using the One-Page Research Paper Rubric (Appendix 5.5)

Accommodations

Assign a peer helper to assist with research and reading. Use scribe, tape recorder, or computer as an alternative to written responses.

Activity 2: Motion

Time: 240 minutes

Description

In this activity students investigate the movements of the Earth and examine the concepts of rotation and revolution, the phases of the Moon, and identifying and tracking constellations through the utilization of several interactive tasks, demonstrations, and models.

Strand(s) and Expectations

Strand(s): Earth and Space Science

Expectations: ES1.03, ES2.02, ES2.01B, ES2.01D, ES2.01E.

Planning Notes

Equipment required for Task:

- 2.1 and 2.2 - light bulb or flashlight, globe of the Earth
- 2.3 - single light source for room, polystyrene ball for each student pair
- 2.4, 2.6 - photocopy Constellation Finder or star maps from the *Toronto Star* or local newspapers
- 2.4, 2.6 - *Starry Night* CD-ROM

Prior Learning Required

Material introduced in Grade 6 (Earth's rotation, constellations in the night sky) is revisited. Models and simulations are the focus for learning.

Learning/Teaching Strategies

2.1 Learning Task: Movements of the Earth - Rotation and Revolution

Students observe a teacher demonstration of the rotation of the Earth on its axis and the revolution of the Earth around the Sun. Students participate in a teacher-led discussion and note-taking activity. Students complete a cloze worksheet.

Teacher Facilitation

1. If you use a light bulb to simulate the Sun, you will not create the impression that the Sun's energy only travels in one direction. Use a light (or flashlight) to illustrate the Sun's rays falling on the globe to show day and night.
2. Mark a point (town) on the globe and rotate the globe to simulate sunrise and sunset. [Emphasize that the Earth spins counterclockwise].
3. The Earth changes its tilt or inclination to the Sun during the year. Demonstrate, using the globe and the Earth's axis, this tilting.
4. Re-emphasize that the amount of time the Earth takes to complete one rotation is called a day. A day is 24 hours long. The Earth takes about 365 days to complete one revolution, or one entire trip around the Sun. This is called a year. Make a connection with the calendars we use.
5. Prepare a cloze worksheet focusing on vocabulary (e.g., orbit, revolution, rotation, axis, motion). Include a picture of Earth showing day and night. Use a town in Ontario as a fixed point to show different times during a 24-hour cycle (Appendix 5.6).
6. **Enrichment:** Discuss the question Why do you think the length of the day is not the same all year long?

Assessment

Assess using worksheet answer key.

Accommodations

Use peer helper to assist with completion of worksheet.

2.2 Learning Task: The Four Seasons

Students observe teacher demonstration illustrating with a model, the seasons of the year. Students draw and label a diagram in their notebooks of the Earth including the tilted axis, the equator and the two hemispheres. Students read a short article and answer questions.

Teacher Facilitation

1. Some introductory questions would assist you in determining how much is remembered from Grade 6 on four seasons.
2. Demonstrate, using a light (or flashlight) and a globe of the Earth, how the tilt of the Earth produces cold and hot seasons. Winter in the Northern Hemisphere occurs when we are tilted away from the Sun and the Sun's rays strike the Earth at a greater angle. [**Note:** It is the oblique angle of the Sun's rays providing less heat energy. The Earth's orbit is actually closer to the Sun in winter].

-
3. **Enrichment:** Heat trays of soil/sod with heat lamps placed perpendicularly to the tray (summer) and at an angle (winter). Keep the distance from the lamp to the nearest portion of the tray constant. Record soil temperature as a function of time, or simply note equilibrium temperature. [**Note:** Don't use too powerful a bulb. The idea is not to bake the soil.]
 4. Prepare a diagram of the Earth in four seasons revolving around the Sun (Appendix 5.7) for students to label and put in their notebooks.
 5. Use a larger version of the diagram on chart paper, the chalkboard, or overhead for students to copy. Lead the students through the labelling step by step for each position of the Earth. Label the equator, northern and southern hemispheres and axis. Identify each season.
 6. Prepare a short Reading for Understanding article on the seasons on Earth including the summer solstice, winter solstice, spring equinox and autumn equinox with focus questions.

Assessment

Assess using worksheet answer key or the Reading for Understanding Rubric (Appendix 1.13).

Accommodations

Use a peer helper to assist with labelling and reading.

2.3 Learning Task: Motions of the Moon

Students observe a teacher-led demonstration showing the Earth-Moon system and how we observe the Sun lighting the Moon. Students work in pairs and participate in a phases of the Moon activity. Students complete a worksheet colouring and labelling the lunar cycle of phases.

Teacher Facilitation

1. Provide a copy of the Phases of the Moon Activity worksheet (Appendix 5.8) for each student.
2. Introduce Moon phases by explaining to the students that the Moon does not give off its own light. It reflects the Sun's light toward Earth. The changing shape and size of the Moon are actually different conditions of lighting called "phases".
3. Demonstrate the Earth-Moon system using a globe, a ping pong ball or small polystyrene ball and a flashlight.
4. Prepare a worksheet for the following student activity.
5. Pair students. Use one single bulb as the light source in the centre of the room as the Sun. [**Note:** This prevents stray light from other pairs confusing students]. For each pair, one student's head represents the Earth. They immediately realize when it is night or day by when the light is shining in their eyes as the Earth (student) rotates. The second student uses the polystyrene sphere and rotates the moon around the head (Earth). Different moon phases are observable at different times of the night (e.g. a new moon is seen in the early evening). It is helpful to mark a few distinguishing "craters" on the moon model so they can determine its rotation. Students simulate the position of the Moon with respect to the Earth and observe the lighting that produces the new moon, first quarter, full moon and last quarter. The student who is not in the Earth position can see that there is no "dark side" of the moon.
6. **Extension:** This can be extended to deducing the length of a lunar "day".
7. **Extension:** Data can be collected throughout the year on the length of shadow at a specific time of (sunny) day.

Assessment

Assess using worksheet answer key.

Accommodations

None specific to this task. Refer to accommodations listed in overview.

2.4 Learning Task: Star Gazing

Students observe teacher demonstration on how to make and use a Constellation Finder or use a constellation map. Students make their own constellation finder and practise using it in class. Students review a constellation map in preparation for night viewing. Students may use the *Starry Night* CD-ROM. Students take map or Constellation Finder home to view the night sky and locate a specified constellation. Students record time, landmark and location of constellation at least twice during the evening.

Teacher Facilitation

1. Prepare materials for making Constellation Finders using instructions in *Nelson Science 9* or *Science 1s*. Ensure each student has their own Constellation Finder with their name on it for future use. Consider collecting the Constellation Finders when students are not using them.
2. Show students how to locate north while using the Constellation Finder. Indicate that the North Star is the only star that does not move. Consider using the *Starry Night* CD-ROM to see what the constellations look like prior to student viewing the night sky.
3. Another method of using the Big Dipper, is described in *Night Watch* (Dickinson), to locate stars and constellations.
4. Prepare constellation maps for the students and review with students. *Starry Night* can also be used to print out star maps
5. **Enrichment:** Obtain inflatable planetarium and use it to demonstrate the night sky to the class.
6. There are three year-round constellations that you can see in the Canadian sky: the Big Dipper, the Little Dipper and Cassiopeia.
7. Assign one of the constellations for night viewing. [**Note:** Be sure to check the position of bright planets. An "extra star" in a constellation can really confuse students]. Students must view the constellation at least twice in the same evening in order to track the constellation's motion. Students should record the time and location of the constellation while standing in the same spot at two different times during the evening (e.g., balcony, backyard, park). Students orient themselves by a specific landmark (e.g., building, tree, skyline) and include the landmark in their diagram). [**Note:** The landmark method is best done with an elevated object - a distinctive tree limb, the corner of a house roof]. The student aligns a certain star in the constellation with the landmark the uses a stake to mark where they are standing. Later, standing in the same position, they can see how the star has "moved" in relation to the landmark. Students draw a diagram that includes their landmark, horizon, position (north, south), and the stars they can see at two different times during the night. Encourage the students to try and track the positions of one or more constellation.

Assessment

Assess using a checklist.

Accommodations

Friends and family can assist students especially those with low vision, to locate the constellation and in recording time and location.

2.5 Assessment Task: Motion in the Night Sky

Students participate in a small group discussion based on teacher-designed focus questions. Students show their drawings to group members and discuss the Star Gazing experience. Students complete an SLL entry worksheet.

Teacher Facilitation

1. Choose a CSGL structure from Appendix OV-3 that is appropriate to this activity (e.g., Round Table or Round Robin).
2. Design focus questions to lead discussion (e.g. Was it difficult to track a constellation?, Did you move or did the constellation move?).
3. Prepare an SLL entry worksheet focussing on newly learned vocabulary (Constellation Finder, constellation, planet, north, horizon). Include focus questions, e.g., Describe what you saw in the sky.

or Did you find any other constellations besides the one you were assigned? and a connections question, e.g., Why did mariners/sailors in ancient time navigate by the North Star? or Name a career where you think using Star Charts may still be helpful?

Assessment

Assess using the SLL Rubric (Appendix OV-2). Assess group skills using Rubric for Collaborative Group Work (Appendix OV-4)

Accommodations

Use peer helper to assist with completion of SLL.

2.6 Assessment Task: Identifying Constellations

Students use Constellation Finder to identify the location of a specific constellation when given a month and time of night. Alternatively, use a star map to identify the location of a constellation. Students complete a worksheet. Students may use the *Starry Night* CD-ROM.

Teacher Facilitation

1. Review the use of the Constellation Finder or star map.
2. Using the *Starry Night* CD-ROM provides good reinforcement prior to or after this Task. You may wish to design an assessment task using this CD-ROM.
3. Prepare a worksheet with questions such as Name two constellations you can see in the fall., Name a constellation on the eastern horizon in the winter.

Assessment

Assess using worksheet answer key. [**Note:** This is a good way to test mastery of the Constellation Finder]

Accommodations

Use a peer helper to assist with reading and completion of worksheet.

Activity 3: Outside the Solar System

Time: 105 minutes

Description

In this activity students have an opportunity to examine the size and components of the universe in more detail. Using their imaginations students create a mural of the universe in an attempt to demonstrate the enormous jump in size moving from a solar system to a galaxy and another enormous jump in size moving from a galaxy to the Universe.

Strand(s) and Expectations

Strand(s): Earth and Space Science

Expectations: ES1.02.

Planning Notes

Equipment required for Task:

- 3.1 - The video *Tour of the Universe* available from CSRC, or use a slide show from a source such as Astronomical Society of the Pacific
- 3.2 - banner poster or chart paper, drawing supplies, string

Prior Learning Required

Students used information gathered from previous activities to recognize that our Solar System is only a small part of the Universe.

Teaching/Learning Strategies

3.1 Learning Task: Tour of the Universe

Students view a video or slide show on the Universe. Students participate in a teacher led discussion on the components of the Universe. Students complete a worksheet.

Teacher Facilitation

1. Select a short video that provides an overview of the components of the universe (e.g., Tour of the Universe, or a short slide show). Explain that the Universe contains huge groups of stars, called galaxies, separated by vast distances.
2. The group of stars to which our Sun belongs is called the Milky Way Galaxy, one of countless galaxies.
3. Illustrate the magnitude of the Milky Way (e.g., If our Solar System is represented by a grain of sand then the Milky Way Galaxy is the size of a football field).
4. Prepare a cloze worksheet that reinforces concepts such as Solar System, galaxy, universe, stars, and Milky Way.

Assessment

Assess using worksheet answer key.

Accommodations

Provide close caption for deaf and hard of hearing students.

3.2 Learning Task: Mural of the Universe

Students participate in a creative activity designing and illustrating the size and components of an imaginary universe on a class mural.

Teacher Facilitation

1. The purpose of this activity is to make students aware of the enormous size of the Universe and that a solar system is a tiny part of the galaxy that is a very small part of the Universe.
2. The class is creating an imaginary "class universe". Each group creates an imaginary galaxy and one solar system in their galaxy.
3. Divide class into small groups of size appropriate to their group skills.
4. Give each group a Bristol board size of paper (black) on which to create their imaginary galaxy. Provide students with drawing materials needed (e.g., markers, crayons, glow-in-the-dark stickers). Provide students with pictures of galaxies they may want to use. [**Note:** Refer to texts for sources showing different shapes of galaxies.]
5. Each group creates their own galaxy on a piece of black paper. They name their galaxy.
6. They create an imaginary solar system that could be found within their galaxy on a separate piece of paper. Their solar system should include a star with five to seven planets orbiting. They should name their planets and their star.
7. Students attach their solar system sheet to their galaxy sheet (this is meant to be a zoom out of a section of their galaxy). Students should attach a string from their solar system to its star location in their galaxy.
8. Post the galaxy posters together to make a mural of the "class universe".
9. Do a follow-up discussion. Stress the two steps (solar system-galaxy and galaxy-universe) which help to emphasize the vastness of the intermediate step of galaxies and the second step to the universe. [**Note:** In many ways they are as important in cosmology as cells are in biology.]
10. Teacher may choose to have students create a 3-dimensional mobile instead of a mural.

Assessment

Peer assessment using the Mural of the Universe Checklist (Appendix 5.9).

Accommodations

Provide extra time for students with poor fine motor skills.

Activity 4: Exploring Space

Time: 330 minutes

Description

In this activity students explore the history of flight which led to space exploration. Canada's contribution to space exploration is further examined. Students research a Canadian astronaut and create a short biography. In preparation for the final activity in this unit, students examine the requirements for living in space. The quest for knowledge and exploration is further examined through the topic of rocket building. Students are given the opportunity to make their own rockets.

Strand(s) and Expectations

Strand(s): Earth and Space Science

Expectations: ES2.01C, ES2.01D, ES3.01, ES3.02, ES3.03.

Planning Notes

Equipment required for Task:

- 4.1 - video *Man's Reach Should Exceed his Grasp*, or *Transformations of Flight*, index cards (available from the Canadian Space Resource Centre, CSRC)
- 4.2 - video *Canada in Space* and poster of Canadian Contributions in Space (both available from the CSRC)
- 4.3 - index cards
- 4.4 - instructions for making a model of the Canadarm from the CSRC
- 4.5 - Purchase the *Living In Space (Book 2)* from the CSRC, and material needed to perform chosen experiments, video: *Life in Space*
- 4.6 - Profiles of astronauts from CSRC video *Reaching for the Stars: Astronaut Training Tape*, Bibliography of a Canadian Astronaut".
- 4.7 - video clip (e.g. launch of Apollo from NASA web site), plastic film canisters, Alka-Seltzer tablets
- 4.8 - purchase *Living and Learning in the Space Age* [see Unit Resources]

Prior Learning Required

The connections learned in the Grade 6 Space Unit are reviewed, including Canadian astronauts and their contributions to space exploration.

Teaching/Learning Strategies

4.1 Learning Task: Journey into Space

Students view a short video on the history of flight and space exploration such as *Man's Reach Should Exceed his Grasp* or *Transformations of Flight*.

Teacher Facilitation

1. Post a blank "class timeline" from 1800 to current time, with 10-year intervals marked, on a large tack board or circling the walls of the room.
2. Focus of this Task is to show powered flight and space travel are relatively recent and the rapid growth in recent years.
3. Select a video illustrating the history of flight and space exploration. These are available from the CSRC.
4. Ask students to note the date of these milestones of flight and space exploration as they watch the movie.

-
- To have a few personal landmarks on the class timeline, have several students enter the year of their birth, the year of their parents' birth, and some other familiar dates (e.g. Canada's birth, the last time Toronto won the Stanley Cup, the "Queen Mum's" birth)
 - Teacher and students enter the milestone dates mentioned in the video onto the timeline. [**Note:** These entries should include only the name of the milestone and the date of when it happened; students are asked to describe these milestones in more detail in task 4.3]

Assessment

None

Accommodations

Use close caption video for deaf and hard of hearing students.

4.2 Assessment Task: Canada in Space

Students view a short video entitled *Canada in Space: 25 Years and Counting* and complete a worksheet with Canadian milestones.

Teacher Facilitation

- Obtain the video from the Canadian Space Resource Centre.
- Create a worksheet that records major Canadian milestones (e.g., launching of the Alouette satellite, first Canadarm used in space)
- Teacher enters the milestones discussed into the class timeline (e.g. 1962- Alouette, 1969- Isis, 1976 - Hermes, 1984 -Space Shuttle Challenger with Marc Garneau, 1981- Canadarm, 1995 - Radarsat, etc.).

Assessment

Assess using worksheet answer key.

Accommodations

Use close caption video for deaf and hard of hearing students.

4.3 Learning Task: Space Timeline

Students participate in creating a timeline. Each student records information for a milestone on an index card. Students select information from worksheets or other sources and present information to the class.

Teacher Facilitation

- Assign students a specific milestone to research in further detail.
- Provide students with an index card. On the index card the students should record date, name and a short description and picture of the event.
- Students attach milestone cards to appropriate positions on the class timeline. Students briefly present their milestone to the class as they add it to the displayed timeline.
- Point out the rapid development of technology and space exploration as evidenced by the bunching of posted index cards near the end of the class timeline.
- Obtain and display a copy of the poster "Canada's Place in Space" from the Canadian Space Resource Centre.

Assessment

Assess presentation using the communication and language portion of the Rubric for Oral Presentations (Appendix 6.6).

Accommodations

Assign a peer helper to assist with reading, research and recording information.

4.4 Learning Task: How Does the Canadarm Work? (Optional)

Students make a model of the end effector of the Canadarm.

Teacher Facilitation

- Obtain the instructions for making the end effector from Canadian Space Resource Centre.
- Make a model for students to use as reference during construction.

-
3. Provide the materials required for students to make the model.
 4. Students use the model to pick up small objects.

Assessment

Assess using Lab Procedures Rubric (Appendix 1.3).

Accommodations

Assign a peer helper to assist with reading instructions and pair students if necessary.

4.5 Learning Task: Life in Space

Students participate in several short activities to simulate living in space. Students complete a worksheet. Then students complete an SLL entry.

Teacher Facilitation

1. Select 5 appropriate activities such as Food, Clothing, Health/Hygiene, and Housing from *Living in Space Book 2* available from CSRC. Information on the International Space Station or the manned Mars mission could also be useful.
2. Demonstrate some dehydrated food obtained from a camping supply store.
3. Provide materials for each activity using a carousel format. Students rotate through each activity, completing a summary worksheet as they progress.
4. Discuss the information contained in the worksheet.
5. Have students complete an SLL worksheet with vocabulary (sponge bath, freeze-dried, Velcro, dehydrated, flight suit). Include focus questions, e.g., The best thing about living in space would be..., The worst thing about living in space would be..., and a connections question, e.g., How has space exploration made positive contributions to our lives on Earth?
6. **Extension:** Students view a video called *Living in Space* available from CSRC and complete a worksheet.

Assessment

Assess SLL using the SLL Rubric (Appendix OV-2).

Accommodations

Assign a peer helper to assist with reading and completion of worksheets.

4.6 Learning Task: Biography of a Canadian Astronaut

Students research the life of a Canadian astronaut and create a biography. View a video such as *Reaching for the Stars: Astronaut Training Tape* or *Biography of a Canadian Astronaut*

Teacher Facilitation

1. Provide print resources (from Canadian Space Resource Centre) or Internet access (e.g., Canadian Space Agency www.space.gc.ca)
2. Students record birthplace and date, education, experience, other training and date of mission(s) on a biography sheet or index card.
3. Obtain the video *Reaching for the Stars: Astronaut Training Tape* or *Seven Days Inside from the CSRC*.
4. Point out that astronauts have other jobs when they are not in space, including payload planning, launch assistance, mission control and personal appearances.

Assessment

Assess using a checklist specific to the biography assignment.

Accommodations

Assign a peer helper to assist with reading, research, and recording information. Use close caption video for deaf and hard of hearing students

4.7 Learning Task: Rockets Away

Students view a short clip of a rocket launch. Students participate in teacher-led discussion on the use of rockets. Students then build a rocket.

Teacher Facilitation

1. Choose an appropriate segment of a video that demonstrates rocket launching (e.g., space shuttles, weather balloons, communication satellites). Lead a discussion around the use of rockets.
2. Show students how to build a simple propulsion system using a clear plastic film canister, effervescent salt tablet or powder and water. Provide cardboard and paint for the students to decorate the outside of the film canister so it resembles a rocket. Gather enough materials for the class including a pair of goggles each. Take the class outside. Put on your goggles along with the class. Fill a canister half-full of water and place on the ground. Place the lid upside down on the ground beside the canister. Place a spoonful of the effervescent powder on the lid (if the salt came in a tablet form it will be necessary to crush the tablet). Quickly turn the lid over onto the canister, press down tightly, turn canister up side down, and back away. The gas pressure produced will propel the bottom of the canister into the air.

Assessment

None.

Accommodation

Use close caption video for deaf and hard of hearing students. You may need assistance for the outside activity for students with physical disabilities.

Activity 5: Culminating Activity - Travel Brochure

Time: 180 minutes

Description

In this final activity students utilize all the information acquired in this unit to create a space travel brochure.

Strand(s) and Expectations

Strand(s): Earth and Space Science

Expectations: ES2.01A, ES2.01C, ES2.01D.

Planning Notes

1. *Resource Materials for Teaching Astronomy* (Fraknoi, 1999) has an excellent version of this activity "The Twelve Tourist Wonders of the Solar System". This activity has twelve unique and exciting activities.
2. Equipment needed for task:
 - 5.1 - video such as *On the Shoulders of Giants*, variety of travel brochures
 - 5.2 - materials needed to complete Space Travel Brochures (paper, markers, glow in the dark stickers, scrapbooks, etc.)

Prior Learning Required

Information students need to complete the travel brochure has been covered in previous activities within this unit.

Teaching/Learning Strategies

5.1 Learning Task: Introduction to Space Travel

Students view a short clip such as the launch in *On the Shoulders of Giants* and complete a note-taking exercise. Students participate in a teacher-led discussion on space travel and travel brochures.

Teacher Facilitation

1. Lead a discussion on why humans like to travel (e.g., adventure, leisure, curiosity, business, knowledge) and ways we travel. Also the popularity of space and alien movies.
2. Show a short clip on a space launch and/or space travel to illustrate space travel (e.g. a part of the Nature of Things video on space travel aired in the spring of 1999 or *On the Shoulders of Giants*).
3. Discuss space vehicles in use (e.g., rocket, shuttle, excursion module, all terrain vehicles) and create a list on the chalkboard or overhead. Add vehicles used on Earth. Refer to the video above or mention the movie “Apollo 13” in discussion.
4. Students make a comparison table in their notes listing transportation on Earth and transportation in space.
5. Show students samples of various travel brochures obtained from a travel agency. People use these brochures to obtain information about a place that they would like to visit.
6. Prepare a sample travel brochure for a trip to the Moon to be used when demonstrating the task to the students.
7. Explain to students that they will be creating a brochure for the planet they researched in Task 1.5.
8. Distribute to the students the Space Travel Brochure Checklist and Rubric (Appendix 5.10) and discuss the required components of the space travel brochure that the students will be producing.

Assessment

None

Accommodations

Use close caption video for deaf and hard of hearing students. Enlarge print on overhead for students with low vision.

5.2 Assessment Task: Space Travel Brochure

Students complete their space travel brochures using their Planet Fact Sheet created in Task 1.3 and other information gathered from previous tasks (e.g., Task 4.5: Life in Space).

Teacher Facilitation

1. Instruct students to use the Space Travel Brochure Checklist and Rubric while working on their brochures to ensure that all the required components have been addressed.
2. Provide research material and access to the library and the Internet if students require more information for their brochure.
3. Encourage students to be creative. The brochure incorporates factual information as well as fiction.
4. Direct and assist students where necessary.
5. (Brochure Task adapted from Mary DiBiase, TCDSB)

Assessment

Students use the Space Travel Brochure Checklist and Rubric (Appendix 5.10) to self-assess their product before submitting it to the teacher. Use the Space Travel Brochure Checklist and Rubric (Appendix 5.10) to assess the completed travel brochure.

Accommodations

Assign a peer helper to assist with reading, research, organizing, and recording information.

Assessment/Evaluation

Assessment tools are listed in each task and in the summary chart at the beginning of the unit.

Accommodations

See Course Overview for general accommodations. In addition some specific accommodations are suggested for each task and are listed after teacher facilitation sections.

APPENDICES UNIT 4

Appendix 5.1: Tour of the Solar System

Reference for Unit 5, Task 1.1

Name: _____

Tour of the Solar System

There is a star at the centre of every solar system. The star at the centre of our Solar System is called the _____.

Large balls of rock or gas move in orbits around our Sun. These objects are called _____.

There are _____ planets in our Solar System.

The closest planet to the Sun is called _____.

The farthest planet from the Sun is called _____.

The nine planets in order from the Sun are:

Planets moving around the Sun	Distance from the Sun

You can remember the names of the planets in our solar system using the first letter of every word in the sentence or mnemonic:

Appendix 5.2A & B: Sample Planet Fact Sheet - Earth

Reference for Unit 5, Teacher reference for Task 1.3

Planet Fact Sheet – Earth

Planet Name: _____ *Earth* _____

Colour seen from space: _____ *blue and white* _____

Distance from the Sun (in millions of kilometres): _____ *152.1* _____

Order from the Sun: _____ *third* _____ Number of Moons: _____ *1* _____

Average Temperature: _____ *22°C* _____

Day Length: (in Earth units) _____ *1.0 day* _____ Year Length: (in Earth units) _____ *365 days* _____

Atmosphere: _____ *nitrogen and oxygen* _____

Composition: _____ *rock and water* _____

Special information: _____ *Earth is our home planet. It is called the ocean planet or the blue planet* _____

Reference for Unit 5, Task 1.3

Name: _____

Planet Fact Sheet

Planet Name: _____

Colour seen from space: _____

Distance from the Sun: (in millions of kilometres) _____

Order from the Sun _____ Number of Moons: _____

Average Temperature: _____

Day Length: (in Earth units) _____ Year Length: (in Earth units) _____

Atmosphere: _____

Composition: _____

Special information:

Appendix 5.3: Energy from the Sun

Reference for unit 5, Task 1.4

Without the Sun there would be no life on Earth. Heat from the Sun keeps the Earth's surface warm. Green plants use light energy from the Sun to produce food.

The Earth is 90 million miles from the Sun. This is just the right distance for the Sun to provide enough heat to keep the Earth at a temperature at which plants and animals on Earth can live. If the distance was greater, the temperature would be too cold and we would freeze. If the distance was smaller, the Earth would be too hot and we would burn up.

The Sun has a major role in producing other sources of energy. For example, hydroelectricity is electricity made from running water. The Sun takes part in producing hydroelectricity by causing water to evaporate. Eventually, this water vapour returns to the earth as rain or snow. This water returns to the rivers. The running water in rivers and waterfalls is used to make electricity at a hydroelectric plant. Niagara Falls is one site of a hydroelectric plant.

The heat energy from the Sun also causes air to heat and move. Moving air causes winds. The winds can be used to turn windmills or generators.

Green plants use sunlight during photosynthesis to make food. Photosynthesis is a chemical reaction that uses water, carbon dioxide, and the Sun's energy to produce sugar or food in green plants. This food is used to make the plant grow. Leaves, apples, wood, tomatoes, and potatoes are all foods produced by plants.

When trees die, nature slowly changes them into substances like coal, oil and natural gas. This process takes millions of years. Wood, coal, oil, and natural gas are all fuels that we get from the Earth to use as fuels. These fuels are burned to produce heat energy. Heat energy can be used to make electricity, to keep our homes warm, or to cook food.

Appendix 5.3: Energy from the Sun (Continued)

1. The Sun provides both _____ and _____ energy to the Earth.
2. The Earth is just the right distance from the Sun so that we do not _____ or _____ on the surface of the Earth.
3. Heat from the Sun causes _____ to evaporate. This substance falls as rain or snow. When this water flows, it can be used to generate hydro _____ power.
4. The Sun's heat also causes air to move. The _____ from this movement can turn _____ and _____, which can make _____ energy.
5. Sunlight is needed for the chemical process of _____ to occur.

Use the words in the following table to complete the sentences above:

heat	freeze	electric	Windmills	electrical	wind
generators	photosynthesis	heat	Burn up	water	light

Complete the following sentences on the Sun's energy:

1. During photosynthesis plants make food or sugar. Three examples of food are _____
2. What types of energy are produced when wood burns? _____
3. When trees and other plants die, after million of years, the dead plants change into _____, _____, or _____
4. All of these substances are _____, which can be burned to produce heat and light.
5. If the Sun were further away from the Earth, what would happen to the water in our lakes and rivers?
6. What sources of energy do we use in Ontario that do *not* depend on the Sun?

Appendix 5.4: One-Page Research Paper Template

Reference for Unit 5, Task 1.5 (Also Reference for Unit 3, Task 7.3)

Introduction: *Students introduce their topic/problem. (e.g. In this paper I will be talking about ozone depletion. I will discuss two causes of ozone depletion and then I will identify several solutions).*

Body #1: *Students identify one cause of the problem they have researched and discuss it. Students are required to write at least three lines.*

Body #2: *Students identify another cause and discuss it. Students are required to write at least three lines.*

Body #3: *Students state the solution(s) to the problem and discuss. Students are required to write at least three lines.*

Conclusion: *Students conclude by re-stating the topic/problem and list the solutions. A personal reflection about the topic may be added in the conclusion.*

Appendix 5.5: One-Page Research Paper Rubric

Reference for Unit 5, Task 1.5

These criteria measure research and inquiry skills.

Criteria	Level 1	Level 2	Level 3	Level 4
Planning: Introduction	- requires assistance to formulate research topic/problem	- research topic/problem is stated with limited focus and clarity	- research topic/problem is focussed and relevant	- research topic/problem is clearly stated and focusses on the objectives of the research
Communication: Language	- information may be copied or anecdotal; lacks clarity	- some information is copied, some is written in students own words; limited clarity	- information is written in students own words, some errors distract readers; moderately clear	- information is written in students own words; minor errors do not distract reader, clear
Recording: Causes and Solutions	- attempted to record information in Body #1 and Body #3 only; may be shorter than three sentences	- attempted to record information in Body #1, #2, and #3; may be shorter than three sentences	- has recorded information in Body #1, #2, and #3; uses three sentences	- has recorded the information in Body #1, #2, and #3; uses at least three sentences
Analysing and Interpreting: Conclusion	- requires assistance to make conclusions based on content	- conclusion adequately summarizes the content of the research problem and solution(s); no analysis of the topic is included	- conclusion re-states the research topic/problem and solution(s); reflects some analysis of the topic through personal reflection	- conclusion is well organized, key concepts are clearly interpreted and content is clearly analysed through insightful personal reflection
Resources	- requires assistance to locate and interpret resources	- a few relevant resources are used to find simple information	- a variety of relevant resources are used to find information	- a wide variety of recent and relevant resources is used to find accurate information

Appendix 5.6: Day and Night on Earth

Reference for Unit 5 Task 2.1

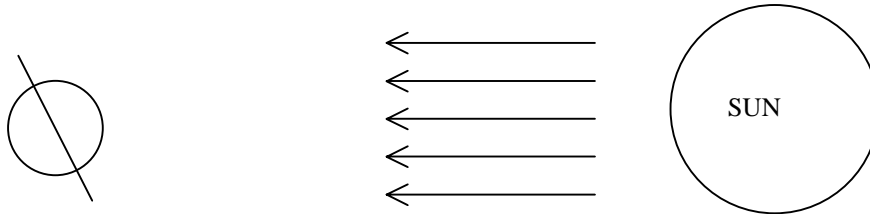
Name: _____

Use the word list to fill in the blanks:

orbit	revolution	rotation	day	horizon
axis	motion	tilted		sunset
half	light	dark		sunrise

The Earth moves around the Sun in an _____. The Earth spins on its _____. The axis is _____ on an angle. Our Sun lights up _____ the Earth. This turning of the Earth on its axis is called its _____.

Label the Sun, the Earth, and the axis. Shade in the dark side of Earth. Label the night side and the day side.

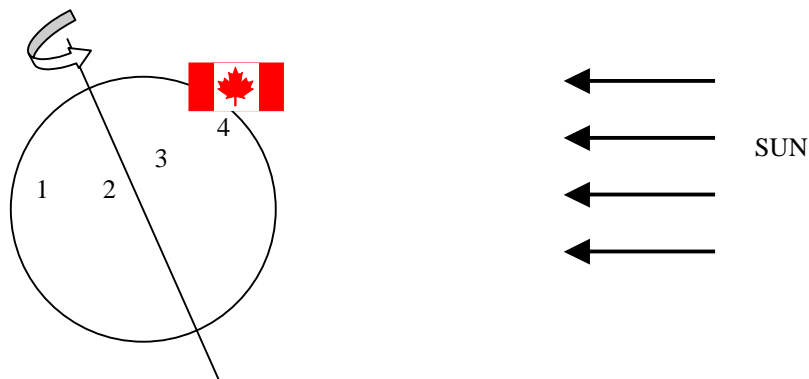


As the Earth rotates, we go from light to _____ and back to _____ again. One complete rotation is called a _____.

As we move from the dark half to the light half, the sun appears on the _____. The sun appears to move upward so we call this time of day _____.

When we go from the light half to the dark half, the sun disappears over the horizon. We call this time of day _____.

Shade in the night side of this diagram.



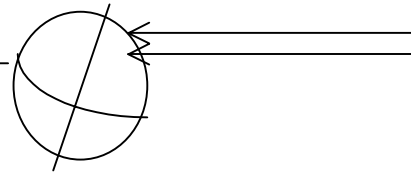
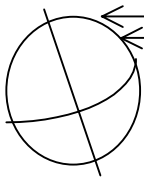
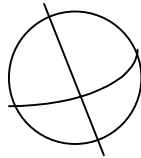
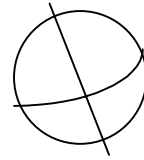
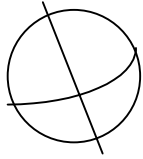
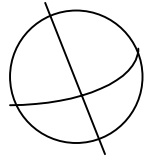
The flag is spinning with the Earth. Write the number in the space beside the correct time:
 _____ 12:00 midnight _____ 12:00 noon _____ 9:00 AM _____ 5:00 AM

Appendix 5.7: The Four Seasons

Reference for Unit 5 Task 2.2

Name: _____

The Four Seasons



In the winter, sun light rays are more _____.
(direct, indirect)

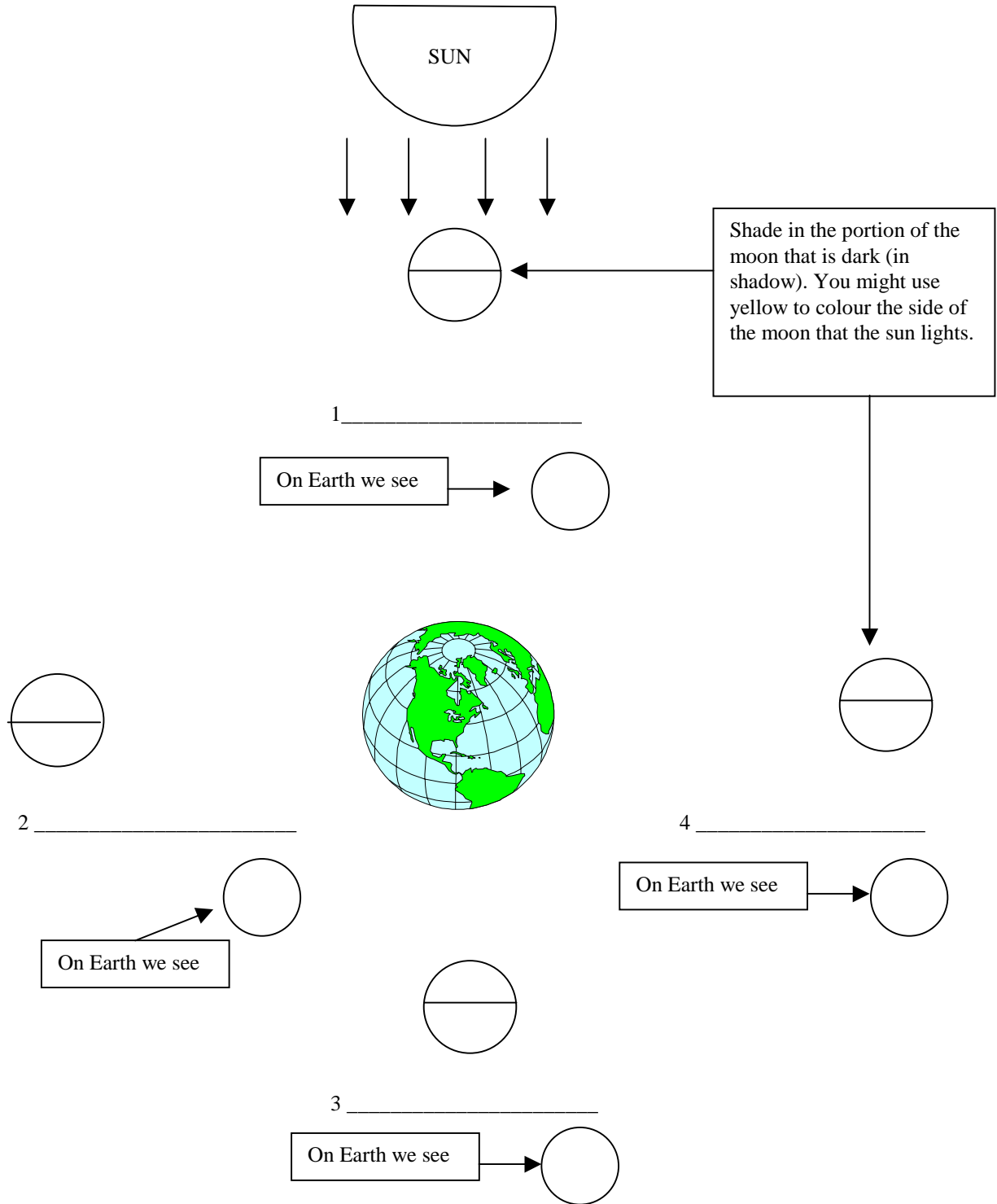
In the summer, sun light rays are more _____.
(direct, indirect)

Appendix 5.8: Phases of the Moon

Reference for Unit 5, Task 2.3

Name: _____

Phases of the Moon



Appendix 5.9: Mural of the Universe Checklist

Reference Unit 5, Task 3.2

Name: _____

Assessing by: _____

- Check each step if it is done on the mural
- chooses a galaxy shape
- creates a galaxy on cardboard (black)
- names the galaxy
- creates one solar system on a separate sheet
- the solar system has between five and seven rotating planets
- the planets in the solar system are named
- has one sun/star in the solar system
- the sun/star is named
- uses string to attach their solar system to their galaxy sheet
- attaches the galaxy/solar system into class universe

Appendix 5.10: Space Travel Brochure Checklist and Rubric

Reference for Unit 5, Task 5.1 and 5.2

General Instructions to students:

- Use a scrapbook for your brochure.
- You are convincing a traveler to go to the planet you chose in Task 1.5.
- Refer to your Planet Fact Sheet and use this information in your brochure.
- You are the travel agent.
- As a travel agent, you are planning the trip (itinerary, accommodations, etc.) for a typical traveler.
- The report should be typed.
- Use the headings listed below.
- The brochure should be appealing and colourful.
- Be creative.
- Use special ideas to make your brochure unique.
- Have fun.

CHECKLIST

Cover Page:

- pictures relate to destination
- name of destination
- your name

Table of Contents:

- names of sections listed with page numbers

Introduction:

- attention grabber in the form of a letter from you (the travel agent) to the tourist
- give general details of destination
- state target age group (e.g., seniors, teens, singles)

Appendix 5.10: Space Travel Brochure Checklist and Rubric (Continued)

Picture/Map of Area:

- a colourful and detailed picture/map of your destination
- include a title

Itinerary:

- point form used
- times and activities/events/tours from sunrise to sunset in the order they happen (e.g., Day 1, Day 2, etc.) stated
- the activities and the highlights described in detail
- information on meals and shopping given
- free time included

Description of Attractions:

- relevant pictures and advertisements of destination
- description of sights given and explained
- creative

Accommodations and Transportation:

- describe accommodations and location (e.g., shuttle, space station, space hotel/motel/lodge)
- airline flight to launch pad, flight to space – times and prices included

Special Considerations:

- customs of inhabitants to consider (e.g. food eaten, marriage, housing, travel)
- government points (e.g. laws of road, passports, police, king/queen or democracy)
- culture (art, language spoken, entertainment, sites to visit, architecture)
- currency used (e.g. names of money used, exchange rate with Canadian dollar)

Conclusion:

- concluding letter to the traveler with the agency's address and phone number

Appendix 5.10: Space Travel Brochure Checklist and Rubric (Continued)

RUBRIC FOR BROCHURE

Criteria	Level 1	Level 2	Level 3	Level 4
Connection to Planet Fact Sheet	- planet not identified - many discrepancies from actual data on planet in Planet Fact Sheet	- planet identified, but takes some time to find information - several discrepancies from information in Planet Fact Sheet that distract reader	- planet identified - obvious connection to information in Planet Fact Sheet, but may have a few errors that do not distract from brochure	- planet clearly identified at first glance - all information agrees with data on chosen planet in Planet Fact Sheet
Components in Checklist	- two or more components are missing	- one or two components are missing or difficult to locate	- all components in checklist are addressed	- all components in checklist are clearly identified
Communication <ul style="list-style-type: none"> • clarity • addresses audience 	- ideas in answers are unclear; traveler still has questions	- ideas are imprecise, but audience knows generally what travel agent means	- ideas and explanations are clear, but some precision is lacking	- ideas are clear and precise; all explanations are attempted with little or no uncertainty
Support Ideas and Information Making Connections	- may identify idea, but have no supporting evidence (e.g., need an oxygen tank on the moon)	- makes simple connections with supporting evidence (e.g., need an overcoat on the moon because it is cold)	- makes and supports connects/inferences (e.g., time to reach different planets corresponds to relative distances from Earth)	- makes and supports complex inferences/connections (e.g., traveller would need weighted boots on Mars because the gravity is so small)
Scientific Knowledge	- several science terms and units are incorrect or missing; considerable distraction for reader	- some science terms and units are used incorrectly; errors distract reader	- correct use of science terms and units; errors distract very little	- correct use of science terms and units; any small errors do not distract reader

Criteria	Level 1	Level 2	Level 3	Level 4
Language Use	- numerous grammar and spelling errors that greatly distract reader	- several grammar and spelling errors that distract the traveller when they are reading the brochure	- some grammar and spelling errors, but they do not distract from the impact of brochure	- no grammar or spelling errors
Communication <ul style="list-style-type: none"> brochure captivates, engages, and convinces traveler 	- audience still uncertain about several details on flight; brochure is incomplete and would not convince a traveller	- brochure does not readily engage audience and leaves some questions unanswered; brochure is complete, but not very inviting	- brochure engages audience so they are convinced to travel; brochure appears complete and attractive	- strongly engages audience and clearly answers questions potential travelers would have; brochure is a polished product and very attractive