Unit 2

Atoms, Elements, and Compounds

Suggested Time: 26 Hours

Unit Overview

Introduction

Atomic theory and its associated findings form the basis for modern chemistry. Building on past explorations using various substances and the particle model of matter, students should become familiar with the basic constituents of atoms and molecules, with chemical symbols themselves, and with common elements and compounds. A strong connection should develop between students' basic ideas about chemistry and related examples in their own lives.

Focus and Context

This unit is primarily focused on inquiry. Students should be exposed to activities that illustrate how knowledge and theories related to atoms and elements have been developed. This unit provides excellent opportunities to distinguish between laws and theories in science and to address a variety of Nature of Science topics.

Science Curriculum Links

In **entry to grade 3**, students begin a cursory look at properties of objects and materials (physical properties). Also, a preliminary look at static electricity and magnetism occurs. By the end of grade 6, students will have encountered and studied properties and changes in materials (properties of physical changes and chemical changes).

Students in **high school** will be involved with a unit of work entitled "Chemical Reactions" in which they will build on the content of this unit to learn to name and write formulas for a variety of ionic and molecular compounds, using the periodic table and a list of ions. In addition, students will classify substances such as acids, bases, or salts based on their characteristics, name, and formula. Students will learn to represent chemical reactions and the conservation of mass using molecular models and balanced symbolic equations. Students will investigate how neutralization involves tempering the effects of an acid with a base or vice versa. Finally, students will illustrate how factors such as heat, concentration, light, and surface area can affect chemical reactions.

In **high school**, students will have the opportunity to further their studies in chemistry in which topics such as organic chemistry, acids and bases, bonding, electrochemistry, solutions and stoichiometry and thermochemistry are addressed.

Curriculum Outcomes

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology 109-2 describe and explain the role of collecting evidence, finding relationships, proposing explanations, and imagination in the development of scientific knowledge 109-13 explain the importance of choosing words that are scientifically or technologically appropriate 109-14 explain the importance of using precise language in science and technology 110-1 provide examples of ideas and theories used in the past to explain natural phenomena 110-3 identify major shifts in scientific world views **Relationships Between Science and Technology** 111-1 provide examples of scientific knowledge that have resulted in the development of technologies 111-4 provide examples of technologies that have enhanced, promoted, or made possible scientific research **Social and Environmental Contexts of Science and Technology** 112-3 explain how society's needs can lead to developments in science and technology 112-8 provide examples to illustrate that scientific and technological activities take place in a variety of individual or group settings 113-4 analyze the design of a technology and the way it functions on the basis of its impact on their daily lives 113-9 make informed decisions about applications of science and technology, taking into account environmental and social advantages and disadvantages	**Initiating and Planning** 208-5 state a prediction and a hypothesis based on background information or an observed pattern of events **Performing and Recording** 209-4 organize data using a format that is appropriate to the task or experiment 209-6 use tools and apparatus safely 209-7 demonstrate a knowledge of WHMIS standards by using proper techniques for handling and disposing of lab materials **Analyzing and Interpreting** 210-1 use or construct a classification key 210-2 compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs, and scatter plots 210-6 interpret patterns and trends in data, and infer and explain relationships among the variables 210-11 state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea 210-16 identify new questions and problems that arise from what was learned	307-12 investigate materials and describe them in terms of their physical properties 307-13 describe changes in the properties of materials that result from some common chemical reactions 307-14 use models in describing the structure and components of atoms and molecules 307-15 identify examples of common elements, and compare their characteristics and atomic structure 307-16 identify and write chemical symbol or molecular formula of common elements or compounds

Laboratory Safety

Outcomes

Students will be expected to

- demonstrate a knowledge of WHMIS standards by using proper techniques for handling and disposing of lab materials (209-7)

Elaborations—Strategies for Learning and Teaching

It is important that the teacher and students discuss lab safety rules based on provincial safety guidelines. Rules should be posted.

Students could complete cross-curricular activities with art or language arts to communicate the rules. Students could create posters to illustrate these rules and remind students of their importance.

Students should be introduced to the existence and use of Material Safety Data Sheets (MSDS). It is not expected that students be able to understand all of the information presented in chemical data sheets. Students should be able to use an MSDS to identify the safety precautions, spill procedures, and first aid requirements. Examples of these data sheets could be posted in the classroom or laboratory for students to read and examine.

Teachers should provide students with access to the Material Safety Data Sheets (MSDS) for the chemicals they will be using in various activities. As part of their pre-lab activities, teachers should ensure students are aware of the safety precautions, first aid, and spill operations for any chemical they will be using in the activity.

Teachers could use a Numbered Heads or Quiz-Quiz trade activity (Appendix B) to help students learn and review WHMIS symbols.

Laboratory Safety

Suggested Assessment Strategies

Presentation

- Design a bulletin board display of safety rules. (209-7)
- Make a poster showing the WHMIS symbols including any household products that display these symbols. (209-7)

Performance

- Prepare a skit/video showing proper lab behaviours. (209-7)

Presentation

- Design a bulletin board display showing all the main headings of a MSDS and the information it contains. (209-7)
- Given the main headings of a MSDS, students research a specific chemical of interest and present their findings in a MSDS format. (209-7)

Journal

- Choose one safety rule and discuss the implications of not following this rule. (209-7)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 8-14
ST p. 480 (Science Skills)
BLM 1-3, 1-4, 1-5, 1-6, 1-7, 1-8, 1-9
TR AC 11, 25

Investigating Matter

Outcomes

Students will be expected to

- compare earlier conceptions of the structure of matter with current conceptions (110-1)
  - define matter

Elaborations—Strategies for Learning and Teaching

Students may believe that everything on Earth is matter. Teachers should probe students for examples that are not matter, such as all types of energy, including light, heat, and sound.

In Grades 7 and 8, students have studied and applied the Particle Theory of Matter. Teachers should indicate that this unit of study will help students further develop and apply this theory to the materials in the world around them.

This unit could begin with a What I Know – Want to Know - Learned (K-W-L) activity (See Appendix B) centered on the topic of matter. Questions such as, "What is matter?", "What do you think matter is made up of?" and "How small can matter be divided?" could allow for an assessment of students' prior understanding and knowledge of this topic.

Students could develop their own classification of matter. For example, grouping items according to solids, liquids, or gases. Through this activity, teachers may gain insight into students' prior knowledge of matter and any misconceptions they may have. Teachers could ask their students to explain their reasons for classifying certain items/objects together. Students should be aware that many common household substances such as milk, ketchup, soap, mayonnaise, etc, are actually combinations/mixtures of two or more states of matter and form a variety of substances known as colloids, suspensions and dispersions (e.g., ketchup is a suspension of tiny solid particles in a liquid, milk is a colloid). Students were exposed to mixtures of two or more states in the Grade 7 unit Mixtures and Solutions. While students may ask about substances that do not fit strictly into the categories of solid, liquid or gas, such as those listed above, classification of matter at this level should be limited to definite solids, liquids and gases.

Students could create a mind map (Appendix B) as they progress through this unit. One possible arrangement would be to have "matter" at the center. Four main branches labeled "properties", "atomic theory", "elements", and "compounds" could form the basis of creating a graphical representation of the main information in this unit.

Investigating Matter

Suggested Assessment Strategies

Journal

- Based on the definition of matter, list materials that are not matter. (110-1)
- Describe a day without matter. (110-1)

Presentation

- Prepare a song, poem, or rant to describe matter. (110-1)
- Create a poster or collage of substances which are mixtures of two more states of matter. (110-1)

Performance

- Arrange student groups to show a solid, a liquid, and a gas. (110-1)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 16
TR AC 24

Properties of Matter

Outcomes

Students will be expected to

- investigate materials and describe them in terms of their physical properties and chemical properties (307-12)
  - distinguish between physical and chemical properties
  - list examples of physical and chemical properties. Include:

  Physical
  - (i) colour
  - (ii) malleability
  - (iii) electrical conductivity
  - (iv) magnetism
  - (v) luster
  - (vi) density
  - (vii) melting/boiling points
  - (viii) texture

  Chemical
  - (i) combustibility
  - (ii) reactivity

Elaborations—Strategies for Learning and Teaching

Students could take part in a brainstorming or KWL session (see Appendix B) to activate student's prior knowledge about chemical and physical properties. Teachers should remind students that they investigated the physical properties of various minerals in the Grade 7 unit entitled, The Earth's Crust. These included color, texture, streak, lustre, and hardness. Teachers could demonstrate the chemical properties of selected minerals by adding vinegar or dilute hydrochloric acid to limestone and quartz.

Students could be asked to compare the physical and chemical properties of a group of similar objects such as different types of gloves (e.g., oven mitts, latex gloves, ski-doo gloves). Students should recognize that the material which is used to construct the glove is chosen based on its physical and chemical properties so that they match the intended use of the glove. For example, the physical property of a ski-doo glove may include: bright, shiny colors to reflect light (to become more visible), exterior material must be water repellent, and a good insulating interior material. Chemical properties may include the use of a fire retardant material. In this particular example, manufacturers may not consider the chemical properties of the ski-doo glove to be the most important.

As a point of interest, teachers could inform students that toxicity is a chemical property. Different substances have different levels of toxicity ranging from none to very poisonous. Students could perform Activity 1-2A on page 17. Teachers should note that specific chemical changes are dealt with later in this unit.

Properties of Matter

Suggested Assessment Strategies

Presentation

- Choose an element or compound and create a visual display or webpage to show the various physical and chemical properties. (307-12)

Paper and Pencil

- Write a story in which the characters are described with physical properties. (307-12)
- Research the physical and chemical properties of a particular substance. (307-12)

Presentation

- Design and contribute to a bulletin board display of physical properties of a variety of materials. (307-12)
- Make a poster showing the relationship between a material (physical properties) and its uses. (307-12)
- Create a fictitious super hero character and include their physical and chemical properties. (307-12)

Performance

- Prepare a skit to show both physical and chemical properties. (307-12)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 17-19, 21-22
BLM 1-10, 1-11
TR AC 24

Properties of Matter (continued)

Outcomes

Students will be expected to

- investigate materials and describe them in terms of their physical properties and chemical properties (307-12)
- state a prediction and a hypothesis based on background information or an observed pattern of events (208-5)
- compile and display data collected during an investigation of the physical and chemical properties of materials (210-2).
- organize data using a format that is appropriate to the task or experiment (209-4)
- state a conclusion based on experimental data and explain how evidence supports or refutes an initial idea (210-11)

Elaborations—Strategies for Learning and Teaching

Core Laboratory Activity: Physical and Chemical Properties

The laboratory outcomes 208-5, 209-4, 210-2, 210-11, and, in part, 307-12 are addressed by completing CORE LAB 1-2C "Physical and Chemical Properties."

Due to environmental and health concerns associated with lead, teachers may substitute the use of lead with zinc. If lead is used, a fume hood is required to remove toxic fumes produced from heating. Teachers should ensure students thoroughly wash their hands after handling the lead. Teachers should be aware that magnesium burns with an intense light and should not be looked at directly when burning as it can cause permanent eye damage. The burning of the metals, specifically magnesium, should be done as a demonstration. Vinegar could be used to replace the use of dilute hydrochloric acid.

Additional testing and/or observations could be done on materials like baking soda, salt, sugar, iron filings, and flour. Students should be encouraged to devise an efficient way to compile and display the data that they have collected from their investigations.

Properties of Matter (continued)

Suggested Assessment Strategies

Resources

www.gov.nl.ca/edu/science_ref/main.htm

Core Lab #3: Physics and Chemical Properties
ST p. 20
ST p. 501 (Science Skills)
TR 1-12, 1-13
TR PS 8
TR AC 4
TR AR 3, 11
BLM 1-18

Atomic Theory

Outcomes

Students will be expected to

- explain the importance of using the terms law and theory in science (109-14)
  - distinguish between a theory and a law

Elaborations—Strategies for Learning and Teaching

This is an opportune time to introduce and discuss theories and laws in science. Students will have heard about the Particle Theory of Matter (Grade 7), the Law of Reflection (Grade 8), etc., and may either ask what the difference is between a law and a theory or will use the terms interchangeably. Unfortunately, even among scientists, there is little consensus between a theory and a law. For example, some physicists speak of the “law of gravitation” while others speak of the “theory of gravitation”. The latter group would say that gravity is, as yet, poorly understood.

This very disagreement points to a useful means of distinguishing between theories and laws. We may think of the terms “theory” and “law” as expressing a degree of confidence in the available experimental and observational evidence. Most laws are supported by different and robust experimental evidence. In contrast, a theory is less well supported – further experimental or observational evidence may be required for its broad acceptance by the relevant scientific community. (For example, a theory may suggest something that has not been, or cannot yet be, produced in experiment.) Theories change or are modified as new or conflicting evidence from experimental data or observations are presented, whereas laws rarely change due to their high degree of confidence.

Even more tentative than a theory is a conjecture. A conjecture may have no experimental or observational support whatsoever. However, in scientific inquiry it is an important convention that conjectures must be testable – we call these “hypotheses”.

Teachers could use a mystery box or black box activity to demonstrate the different level of confidence between laws and theories. To give students a real taste of what it is to be a scientist, the teacher could keep the actual contents of the box a secret even after they have examined it and made their “theory” of its contents based on their observations.

Atomic Theory

Suggested Assessment Strategies

Journal

- Explain the difference between a theory and a law to your younger sibling. (109-14)

Presentation

- Create a display of theories and laws of Science. (109-14)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 24-25

Atomic Theory (continued)

Outcomes

Students will be expected to

- use models in describing the structure and components of atoms (307-14)
  - define atom

Elaborations—Strategies for Learning and Teaching

Teachers should clarify that the individual components of atoms are too small to be viewed and that our understanding of atoms and atomic structure is largely based on evidence gathered from many physical and chemical experiments which explored their relationships with matter and energy.

- distinguish among protons, neutrons, and electrons in terms of their:
  (i) charge
  (ii) relative mass
  (iii) location in the atom

To illustrate the structure of the atom and relative size of the components, teachers may choose to use an analogy. For example, if an atom was the size of a football field, the nucleus would be comparable to the size of a grain of sand at the center of the field.

Teachers should emphasize that scientists have evidence that these components of the atom (protons, electrons, and neutrons) have been subdivided. However, the model including these three components is sufficient to explain the majority of observable phenomena at this grade level. Teachers should encourage students to use the letters p, n and e to represent the number of protons, neutrons, and electrons respectively in any diagrams of the atom.

- identify major changes in atomic theory up to and including the Bohr model (110-3)

Students could be introduced to this topic by presenting them with a 4 x 4 grid and asking them, “How many squares do you see?” Ask students to jot the number down.

The teacher can record the responses of students, realizing that these will vary (generally from 16 to 30). The teacher must acknowledge the fact that all of the responses given are correct as students were asked how many squares they saw. Teachers could relate this variation in the number of squares observed to the development of the Atomic Theory. While the views of the model have changed over time, the atom itself remains the same, just like the 4 x 4 grid did not change; however, student responses varied depending on their perspective.

Atomic Theory (continued)

Suggested Assessment Strategies

Paper and Pencil

- Create a comic strip illustrating the characteristics of protons, neutrons, and electrons. To assess the accuracy of the information presented, teachers could use the table shown below. (307-14)

Particle	Relative Mass	Charge	Location in the atom
Proton			
Electron			
Neutron			

- Create a foldable that illustrates the differences among the subatomic particles. (307-14)
- Create a brochure showing the charge, relative mass, and location for protons, neutrons, and electrons. (307-14)

Performance

- Create in groups of three, a skit that highlights the characteristics of protons, neutrons, and electrons. Each member of the group will represent each subatomic particle. (307-14)
- Use the “Just Like Me” strategy. Each student is given a card with proton, neutron, or electron written on it. The teacher states a characteristic of one of these particles such as “I am positively charged”. The students who share the same characteristic (i.e. all protons) would stand and say “Just like me”. (307-14)
- Students sit in a circle with one student in the centre. The student in the centre would have a card on their back that states whether they are a proton, neutron, or electron. The object of the activity is for the student to determine the type of particle they are by using questions that can be answered with a yes or no response. Once the student has determined their identity, another student enters the circle and the activity continues. (307-14)

Journal

- Imagine you are Aristotle or Empedocles. Explain how you classified matter into the four elements? (110-3)

Presentation

- Prepare a poster that illustrates the concepts of matter proposed by Empedocles and Aristotle. (110-3)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 28

ST pp. 28-29
BLM 1-12, 1-13

ST p. 25

Atomic Theory (continued)

Outcomes

Students will be expected to

- identify major changes in atomic theory up to and including the Bohr model (110-3)

(continued)

- describe the contribution of various individuals (scientists) to the development of current atomic theory. Include:
  - (i) Early Greeks (Empedocles, Democritus, Aristotle)
  - (ii) Dalton
  - (iii) Thomson
  - (iv) Rutherford
  - (v) Bohr

Elaborations—Strategies for Learning and Teaching

Students could explore earlier concepts of the nature of matter such as those of Aristotle and Empedocles who believed matter to be composed of earth, air, fire, and water. Teachers should note that the textbook incorrectly lists these as earth, air, wind, and fire (p. 25). Teachers could have students compare this earlier concept of matter with our present understanding of matter. This would illustrate that understanding of scientific ideas and phenomena change over time. This provides an opportunity for a discussion on the nature of science.

This is meant to be a brief overview of how atomic models/theories have evolved over time as new discoveries are made or observed. It provides an opportunity for students to see how scientific theories are constructed, modified, and at times discarded as new data and evidence are collected.

Teachers should limit their description of atomic theories to the general dates, diagrams, the major development that caused the change in the previous theory, and the utility of each theory. When addressing the theories of the ancient Greeks such as Empedocles and Aristotle, this should be limited to a general description of their belief that all matter was composed of four "elements" (earth; air; water; and fire) and that this was not based on any scientific data. Teachers could use the fact that these ideas remained in place for about 2000 years as an opportunity to discuss the nature of science. In this case, they could point out that the general prevailing opinion of the scientific community is very difficult to change even when empirical evidences shows it is incorrect. Often it takes a great deal of time and debate before new ideas and evidence are accepted.

Teachers could have students summarize the main points of each theory in a table such as the following:

Scientist Name	Key Points of Theory	New observations or evidence that changed the previous model	Diagram or sketch of Model
Early Greeks		XXXXXXX	XXXXXXX
Dalton			
Thomson			
Rutherford			
Bohr			

Atomic Theory (continued)

Suggested Assessment Strategies

Presentation

- Create mobiles representing the various models of the atom. (110-3, 307-14)
- Create posters of each of the atomic models so that they can be arranged in the classroom to create an accurate timeline. (110-3, 111-4)
- Create a 3D model, using household materials, of one of the following models of the atom: Dalton, Thomson, Rutherford, and Bohr. (110-3)

Journal

- Choose a common household substance. How would Aristotle or Empedocles classify it? (110-3)

Performance

- Choose one of the scientists who contributed to the development of the current atomic theory. Create a skit to illustrate how the theory evolved. (110-3, 111-4, 112-8)

Paper and Pencil

- Choose a common scientist and create a cartoom strip showing their discovery and its role in the atomic theory. (110-3, 112-8)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 24-28, 30

Atomic Theory (continued)

Outcomes

Students will be expected to

- identify major changes in atomic theory up to and including the Bohr model (110-3)

(continued)

- describe the contribution of various individuals (scientists) to the development of current atomic theory. Include:
  - (i) Early Greeks (Empedocles, Democritus, Aristotle)
  - (ii) Dalton
  - (iii) Thomson
  - (iv) Rutherford
  - (v) Bohr

Elaborations—Strategies for Learning and Teaching

The processes involved in the development of the atomic model are excellent examples of the nature of science. Models are types of analogies that help students and scientists form conceptual frameworks to organize complex phenomena into understandable forms. Even though it is now possible to view individual atoms of some elements, scientists still cannot see the structure of the atom itself. As a result, they use models to explain observed behavior.

Teachers could use the following to summarize the main features of each model:

- Dalton: Theory is often called the billiard ball model because he saw the atom as being the same throughout and being indivisible.
- Thomson: Theory is referred to as the raisin bun model because he saw the negative electrons as being scattered throughout the positive area of the atom much the same as raisins are dispersed throughout a bun.
- Rutherford: Theory is often called the planetary model because he saw the electrons circling the center of the atom in much the same way planets circle the sun. Proposed that the atom is mainly empty space with very small and heavy nucleus.
- Bohr: Theory is often called the orbital model because he saw the electrons as circling the nucleus at different energy levels away from the nucleus. (Teacher note: students may think of “orbital” as the same as “orbit”. To distinguish between these, teachers could describe an orbit as a specific path whereas an orbital is an area around the nucleus where the electrons can be found. For example, a train follows a specific path while an automobile can theoretically be found anywhere between the shoulders of a road.)

Students may be interested to learn that Rutherford was a student of Thomson and that Bohr worked with Rutherford and developed his model at this time.

As enrichment, students could research on other individuals who have made a contribution to our knowledge and understanding of the atom. Example of these individuals may include: Robert Boyle, Joseph Priestly, Marie Curie, and Max Planck.

Atomic Theory (continued)

Suggested Assessment Strategies

Journal

- If you had a chance to ask one of these scientists a series of questions, explain who would you choose and what would you ask? (110-3, 111-4, 112-8)

Performance

- Choose one of the scientists and create a role-play for the press release following the news of his discovery. Various roles to consider would include: the scientist; media; fellow scientists; and the general public. (110-3, 111-4, 112-8)

Presentation

- Create a trading card for one of the scientists responsible for the atomic theory. Include important statistics such as a picture of the person, dates, models, and significant discoveries. (110-3)

Paper and Pencil

- Create a timeline showing the names of various individuals (scientists) and the atomic theories associated with them. (110-3, 112-8)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 24-28, 30

Atomic Theory (continued)

Outcomes

Students will be expected to

- describe Rutherford's experiment to test Thomson's atomic model as an example of how technologies have enhanced, promoted, or made possible scientific research in chemistry (111-4)
  - recognize that the atomic theory continues to be refined

Elaborations—Strategies for Learning and Teaching

Teachers could address this outcome as they are addressing the change in our understanding of atomic theory from Dalton to Bohr.

Students should understand that some technologies have helped scientists explore and gain a better understanding of the atom and its parts. For example, much of the equipment used in Rutherford's 19th century gold foil experiment, such as vacuum tubes, was not available to earlier scientists. Equipment, such as cyclotrons or particle accelerators, that are used by scientists of today, are allowing them to do different experiments and collect more data than scientists of Rutherford or Bohr's time period could have done.

Students should be aware that our current view of the atom continues to evolve based on new observations and data. Today we have evidence that suggests neutrons and protons are composed of even smaller subunits. Interested students could be directed to research "particle collider" or "particle accelerator" to learn more about how scientists study these tiny particles. Another starting point would be the Science Watch feature "inquiring about quarks" in the student textbook.

- provide examples to illustrate that scientific and technological activities related to atomic structure take place in a variety of individual and group settings (112-8)

It is important that students appreciate that some activities related to chemistry take place in a variety of settings. Many of the scientists who helped to develop the various atomic models, such as Crookes, Thomson, and Rutherford, worked with others in university settings. They used the discoveries of others scientists to help develop their own theories. Teachers could engage students in a nature of science discussion activity in which students attempt to clarify their own thoughts and understandings of who scientists are and where they work. Teachers could use a "draw a scientist" activity as a starting point to this discussion. Students would draw a scientist as they perceive them. This is a good time to discuss stereotypes and misconceptions that students may have of a scientist.

Teachers could use examples such as cooking (individual) and the development of better metallic alloys (groups of chemical engineers), to help students develop a better appreciation of the variety of activities in which chemistry is involved.

Students could investigate how scientists, working together, have used knowledge of atomic structure to build new technologies such as atomic micro-engines and investigate the atom even further.

Atomic Theory (continued)

Suggested Assessment Strategies

Paper and Pencil

- You have a time machine which enables you to visit the "lab" of each of the scientists involved in developing the atomic theory. Create a travel log that highlights what you observed; include the materials and the working environment of the scientist as well as your impression of how well their findings were accepted by the people of that time. (110-3, 111-4, 112-8)

Journal

- Pretend you are J.J. Thompson. Write a letter to Ernest Rutherford that describes the key points of your model of the atom. Then, write a response from the perspective of Rutherford outlining the reason(s) for modifications to Thompson's model. (110-3, 111-4)
- If you had a chance to ask one of the scientists, who studied the atom, a series of questions, explain who would you choose and what would you ask? (110-3, 111-4, 112-8)

Performance

- Create 3D models of the different representations of the atom proposed by Dalton, Thomson, Rutherford, and Bohr using various craft supplies (e.g., Styrofoam balls, modeling clay, pipe cleaners, or toothpicks). (110-3)

Presentation

- Using the medium of your choice (computer, paper, drama, etc), create an advertisement that highlights the advantages of Rutherford's model versus Thomson's model. (110-3, 111-4, 112-8)
- Research a scientist involved with the development of the Atomic Theory and create a poster, webpage, or brochure to display the results. (112-8)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 26-27

Elements

Outcomes

Students will be expected to

- explain the importance of using words that are scientifically appropriate (109-13)

  - define element

- identify and write chemical symbols for common elements. Include: (307-16)

  (i) Hydrogen
  (ii) Sodium
  (iii) Potassium
  (iv) Magnesium
  (v) Calcium
  (vi) Iron
  (vii) Nickel
  (viii) Copper
  (ix) Zinc
  (x) Carbon
  (xi) Nitrogen
  (xii) Oxygen
  (xiii) Neon
  (xiv) Helium
  (xv) Chlorine
  (xvi) Silicon
  (xvii) Silver
  (xviii) Gold
  (xix) Mercury
  (xx) Lead

Elaborations—Strategies for Learning and Teaching

Students should be introduced to the diversity of elements that exist by directing them to the periodic table in the student textbook.

It is not the intent of this course that students be able to recall specific characteristics of each of these elements. Students should be able to associate chemical symbols with their respective chemical name for these 20 elements.

Teachers could engage students in a quiz-quiz-trade activity (see Appendix B).

Elements

Suggested Assessment Strategies

Performance

- Create a song based on a popular/familiar tune (such as Christmas Carols) using only or mainly the names of chemicals. (307-16, 109-13)
- Conduct a spelling bee based on the chemical names of the elements. (307-16, 109-13)
- Using teacher prepared cards, play a "Go-fish" type memory game (See Appendix B). (307-16)
- Create an element crossword puzzle where students have to match the chemical symbol with the element name. (307-16)

Paper and Pencil

- Write an article on a particular element for the school paper. Include its date of discovery, symbol, and usage. (307-15)

Presentation

- Research an element and create a poster showing the uses of your element. (307-15)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 38

ST pp. 39-46
BLM 1-15, 1-16, 1-17
Additional BLM Activity 1

Elements (continued)

Outcomes

Students will be expected to

- identify and write chemical symbols for common elements (307-16)

(continued)

- recognize that elements are represented by an internationally agreed upon system of symbols

- identify each element symbol as either an upper-case symbol or an upper-case letter followed by a lower case letter.

Elaborations—Strategies for Learning and Teaching

Teachers should emphasize the importance of all nations using the same set of symbols to represent elements. This creates a much easier means of communication, and it provides a common scientific language.

To help students develop the association between the element name and its symbol, teachers could subdivide the list of 20 elements into three parts: (i) elements whose symbol is the first letter of its name, (ii) elements whose symbol is made of two letters from its English name, and (iii) elements whose symbol is based on its non-English name. Teachers may want to elaborate on why some elements have very different symbols from what their "English" name suggests. For example, Iron has the symbol Fe, which is derived from its Latin name: Ferrum. Teachers could inform students that while chemical symbols of elements are generally either Greek or Latin in origin, some names are derived from other languages or sources. Interested students could be directed to conduct an internet search.

Students should understand the importance of internationally recognized symbols (IUPAC). For example, Co represents the element cobalt, yet CO represents the chemical formula for the compound carbon monoxide.

Elements (continued)

Suggested Assessment Strategies

Performance

- Play chemical bingo using cards containing the element symbols or names. (307-16)
- Create an element crossword puzzle where students have to match the chemical symbol with the element name (307-16).

Journal

- Explain why the chemical symbols are more useful than the names for students who travel from one place to another in the world (307-16).

Paper/Pencil

- Using the Periodic Table, choose a letter from the alphabet and list all the elements that begin with that letter (307-16).

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 38-40
BLM 1-16, 1-17

ST pp. 39-40
BLM 1-16, 1-17

Elements and the Periodic Table

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• describe and explain the role of collecting evidence, finding relationships, and proposing explanations in the development of the periodic table (109-2)	Note: There is a typographical error in the text on page 50 and BLM 1-19. C, N, O, F and He are not metals. C is a metalloid, and N, O, F and He are non-metals.
- identify the Periodic Table as a listing of all known elements	Teachers should point out that Mendeleev was not the only scientist who worked on the organization of the elements in table form.
- describe Mendeleev's contribution to the development of the modern periodic table	Students should understand that Mendeleev's two main contributions to the development of the periodic table was to first organize the known elements according to their properties and chemical characteristics. The second, and most important contribution, was to recognize that spaces needed to be held for elements that had yet to be discovered. Mendeleev intentionally left many gaps in his Table and suggested that elements would be discovered to fill these gaps. In fact, the gaps he left helped spur the discovery of certain elements. His discovery did not bring him fame and fortune. The importance of his work was not realized until after his death. If students are creating a mind map (see Appendix B), they could add a branch for "periodic table" and add the new information.
- distinguish between atomic number and atomic mass	Students should be able to use a Periodic Table to determine the atomic number and atomic mass of a given element and vice versa.
- using atomic mass and atomic number for an element, determine its number of protons, electrons, and neutrons	Students should be able to use the Periodic table to derive information about the number of protons, neutrons, and electrons in the atoms of common elements. Teachers could inform students that the atomic mass given on any Periodic Table is really an average of the masses of the different forms that an atom can take. Teachers should note that, while the textbook references isotopes, the concept of isotopes should not be taught in this unit.

Elements and the Periodic Table

Suggested Assessment Strategies

Journal

- Suggest a reason why the noble gases were not included in Mendeleev's periodic table (109-2).
- Explain why the atomic masses of most elements are not whole numbers. (210-16)

Paper/Pencil

- Research the most recent additions to the Periodic Table, elements 110 through 116 (109-2).
- Research Dmitri Mendeleev's contribution to the development of the Periodic Table (109-2).
- Construct a timeline of the discovery of the elements tthat were discovered after Mendeleev and how they fit into the proposed periodic table. (109-2)
- How is the atomic number of an element related to the mass number of the same element? (109-13,307-14)
- Oxygen has the atomic number 8. How many protons and electrons would an atom of this element have? (109-13,307-14)
- Create a series of index cards displaying the number of protons, electrons and neutrons for several elements. (109-2, 307-14)

Presentation

- Create a display showing the different versions of Mendeleev's organization of the elements as it progressed to the modern version we have today (109-2).
- Students could research an element to research (atomic number, abundance, extractions, origin of name/symbol, date of discovery, common uses/applications, state at room temperature, etc.). Students could then present their findings to the class in the form of an oral presentation, a poster display, a multi-media presentation or students could put the information on an index card and the class could create their own Periodic Table for display. (109-2)

Performance

- Play a game of "who am I" using the characteristics of a number of elements. Each student will display one of either atomic number, atomic mass, number of protons, number of electrons, number of neutrons, element name or element symbol. (109-2).

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 48-51
BLM 1-19
TR AC 8

ST pp. 48-51

ST p. 49
BLM 1-19

ST pp. 49-50
BLM 1-19

Organization of the Periodic Table

Outcomes

Students will be expected to

- using the Periodic Table, develop an understanding that the elements are grouped on the basis of similar characteristics. Include: (210-1, 307-15)
  - (i) metals
  - (ii) non-metals
  - (iii) metalloids
  - (iv) transition metals

  - list properties of metals. Include:
    - (i) shiny
    - (ii) ductile and malleable
    - (iii) conduct electricity
    - (iv) conduct heat

  - list properties of non-metal elements. Include:
    - (i) dull
    - (ii) non-ductile and non-malleable
    - (iii) do not conduct electricity
    - (iv) do not conduct heat well

  - list properties of metalloids. Include:
    - (i) shiny or dull
    - (ii) non-ductile and non-malleable
    - (iii) may conduct electricity
    - (iv) do not conduct heat well

  - list properties of transition metals. Include:
    - (i) shiny
    - (ii) ductile and malleable
    - (iii) conduct electricity
    - (iv) conduct heat

Elaborations—Strategies for Learning and Teaching

Teachers should highlight the periodic nature of elements and organization of elements due to their similarities. It is not intended that students memorize components of the Periodic Table.

Students could be provided with a list of various objects to place the into different groups and provide a rationale for their classification system. From this activity, teachers could emphasize that just like students placed the objects into groups on the basis of similar properties, so are the elements grouped in the periodic table.

Coverage of the properties and characteristics of the elements in the various groupings should be limited in depth to that which is outlined in the outcomes that follow.

Students should describe metals as ductile and malleable using the following definition: Ductility (ductile) refers to the ability of a substance to be pulled or stretched; Malleability (malleable) refers to the ability of a substance to be bent or molded into various shapes.

Teachers could provide samples of various metals and non-metals and lead a class discussion of the properties of each.

As a group activity teachers could divide their class into two groups and perform an inside-outside circle (see Appendix B). Give students the name of a specific element and ask them to discuss if the element is a metal or non-metal and explain why using the properties of each.

Organization of the Periodic Table

Suggested Assessment Strategies

Paper/Pencil

- Using a blank periodic table, identify each of the groups listed using different colors (210-1, 307-15).

Presentation

- Create a mobile of one of the groups. Include the group name, characteristics of the group, as well as examples of elements in the group (210-1, 307-15).

Performance

- Create an Element Expo. Divide the class into groups and assign a family of elements to each group. The groups research their family/group and prepare a poster, brochure, and any other materials that may be used to highlight their particular group or family (210-1, 307-15).
- Divide the class in half. Have one group read the text on metals and the other group read the text on nonmetals. The teacher will write the headings, metals and nonmetals, on the board. Ask students to identify the "Most Important Point" from the material they have read. This should generate a list of properties of metals and nonmetals. (210-1, 307-15)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 51

ST p. 51

ST p. 53

Organization of the Periodic Table (continued)

Outcomes

Students will be expected to

- using the Periodic Table, develop an understanding that the elements are grouped on the basis of similar characteristics. Include: (210-1, 307-15)

(continued)

- define period
- define family

Elaborations—Strategies for Learning and Teaching

Students should be are able to identify a period as a horizontal row and a family as a vertical column. Students should also know that a chemical family can also be referred to as a group.

Using a periodic table, students should be able to identify an element given its period and or family/group. For example, teachers could ask students to identify which element is found in period 4 and is a member of the halogen family (e.g. bromine). Teachers could indicate the group number associated with various families. For example, the halogens are group number 17. (Note, the traditional "Group A" and "Group B" numbering system has been omitted for this more simplified system of numbering the families from 1 to 18.)

- provide examples of common properties which a family of elements share. Include:
  - (i) alkali metals
  - (ii) alkaline earths
  - (iii) halogens
  - (iv) noble gases

Teachers should limit the discussion of the properties common to the selected families to the information that is in the student textbook.

Teachers should clarify that hydrogen occupies a unique position in the periodic table because it sometimes reacts as a metal and sometimes reacts as a non-metal. As a result, on some periodic tables, it is included with the alkali metals and with the halogens. In other periodic tables, such as the one in their textbook, it is depicted as separate from the rest of the elements. When students draw energy level diagrams of the various elements, teachers could emphasize the similarly of hydrogen's valence level to the alkali metals (i.e., having one electron) and to the halogens (i.e., needing one electron to fill the level). Teachers should limit the discussion of hydrogen's unique position in the periodic table to this.

- use the periodic table to identify new questions and problems that arise from what was learned (210-1, 210-16)

Students could make predictions about an element of a particular family of elements based on the characteristics of that family and verify their predictions through research. Students could be asked to make inferences about the relationships between and among the various families of elements.

Teachers could highlight the uses of elements based upon their distinct properties. For example, incandescent light bulbs are filled with argon, a noble gas, so that the tungsten does not burn out too quickly.

Organization of the Periodic Table (continued)

Suggested Assessment Strategies

Performance

- Play chemical bingo using cards containing the element symbols or names and the Periodic Table, calling out the period and family to identify the elements. (307-16)

Paper and Pencil

- Create a family crest for a chemical family displaying the family name, common properties, and family members. (210-1, 307-15)
- Research interesting facts about a particular chemical family including physical properties, chemical properties, date of discovery, uses and abundance. Present findings in a brochure, poster, or webpage. (210-1, 307-15)
- Compare a helium atom with a sodium atom focusing on their numbers of protons, neutrons, and electrons. (307-15)
- Predict the physical properties of an unfamiliar or uncommon element. (307-12)
- Using a blank Periodic Table to organize the elements based on their properties. Students could develop a time line showing the discovery of the elements. (307-12, 111-4)

Presentation

- Research the element hydrogen focusing on its variety of uses and the various types of compounds it can form, display findings in a poster, brochure, bulletin board display or webpage. (210-2)
- Research the physical and/or chemical properties of one or several common elements using a variety of resources. The results of this research could be shared with the other students. Posters, oral presentations, and multi-media presentations could be used to communicate their findings. (307-12)

Journal

- What would you predict about the chemical properties of potassium given the fact that sodium is a very explosive/reactive element? (307-12)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 52, 54-55

ST pp. 52-57
BLM 1-20, 1-21
Additional BLM Activity 2

ST pp. 54-58

The Periodic Table and Atomic Theory

Outcomes

Students will be expected to

- identify examples of common elements, and compare their characteristics and atomic structure (307-15)
  - define energy level
  - define valence energy level
  - define valence electron
  - draw Bohr-Rutherford diagrams for elements 1 to 18.

Elaborations—Strategies for Learning and Teaching

Students should only be responsibile for the atomic structure of the Bohr-Rutherford models of elements 1 to 18. While the terms “energy level” and “electron shells” are used interchangeably in the student textbook, the term “energy level” is preferred. Students should define energy levels as the space around the nucleus in which electrons may be found. Teachers could clarify that the energy levels are the only spaces in which electrons can be found and that electrons circle the nucleus in irregular paths within their energy level. Electrons that are further from the nucleus have higher energies associated with them than those closer to the nucleus.

Teachers should encourage students to use the term “valence” when referring to electrons or energy levels that are the furthest from the nucleus.

In an earlier section of this unit, students were introduced to the atomic models proposed by both Rutherford and Bohr. Students should understand that we generally combine these two models into one – the Bohr-Rutherford model. This model is the sum total of the work of both scientists and explains the majority of chemical phenomena encountered at the junior and senior high school levels.

Students should explore and be able to represent the different arrangements of electrons in the energy levels of the atom for the first eighteen elements.

Students should understand that energy level diagrams represent the relative energies of an atom’s electrons. These diagrams do not indicate the positions of the electrons in the atom. Electrons do not follow circular paths about the atomic nucleus. Therefore, in drawing the Bohr-Rutherford diagrams, students should refrain from drawing circles around the nucleus but rather indicate the energy shells as horizontal lines.

Teachers should also clarify that energy level diagrams are only one way to represent atomic structure and electron arrangement. If they go on to study more chemistry they will encounter other models.

The use of videos and other visuals about atomic structure and theory appropriate to this grade level are highly recommended as the ideas and structures being investigated are fairly abstract.

The Periodic Table and Atomic Theory

Suggested Assessment Strategies

Presentation

- Create an energy level diagram for one of the first eighteen elements using various craft/art supplies. Display according to their location in the periodic table and discuss periodic trends. (307-15)

Paper and Pencil

- Create an analogy to explain the position of the nucleus and the electrons. (307-15)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 60-62

ST pp. 60-62
BLM 1-22, 1-23, 1-24, 1-25

The Periodic Table and Atomic Theory (continued)

Outcomes

Students will be expected to

- identify examples of common elements, and compare their characteristics and atomic structure (307-15)

(continued)

- draw Bohr-Rutherford diagrams for elements 1 to 18.

- identify the maximum number of electrons which exist in the first three energy levels

Elaborations—Strategies for Learning and Teaching

Students could perform Lab Activity 2-3B: Flaming Metal Ions which relates the flame color to electron arrangement. Students may be curious as to why the colors form. While this is not an outcome for this course, teachers could explain that heating the substance causes the electrons to jump to higher levels. This results in an unstable electron structure. When the electrons fall back to their normal energy level they give off energy which we see as visible light. Since each atom has a specific electron configuration the "jumps and falls" will be unique to that atom/element. As a result, each atom has its own unique color "finger print".

Students should know the maximum number of electrons that each energy level can hold. Students should remember that the maximum number of electrons at each level must be occupied before the electrons fill the next level. Teachers could explain the correlation between this maximum number with the number of elements in each row of the Period Table: 2,8,8,18, etc.

To help explain the process by which energy levels are populated by electrons, teachers could use the analogy of filling seats in an auditorium. In the auditorium, the first row has 2 chairs, the second has 8, the third has 8, and the fourth has 18 chairs. Students file into the auditorium in single file and must fill the chairs from the first row to the last row; they can not move to another row unless all the seats in the previous rows are filled. If 8 students were to enter the auditorium, 2 would sit in the first row and 6 would sit in the second row (leaving two chairs vacant in the second row). If another group of students enter the auditorium, they would first fill the 2 remaining seats in the second row and then move on to the third row and so on.

The Periodic Table and Atomic Theory (continued)

Suggested Assessment Strategies

Paper and Pencil

- Create a foldable using a 8 x 3 grid on legal sized paper to display the Bohr-Rutherford diagrams for the first 18 elements. (307-15)
- Create a comic strip which depcits how the energy levels are filled in a Bohr-Rutherford model. (307-15)

Performance

- Create a rap, song, or poem to explain how energy levels are filled in a Bohr-Rutherford model. (307-15)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 60-62

ST pp. 61-62
BLM 1-26

The Periodic Table and Atomic Theory (continued)

Outcomes

Students will be expected to

- interpret patterns and trends, and explain relationships among variables (210-6)
  - make comparisons of energy level diagrams for elements from the same family (group)

Elaborations—Strategies for Learning and Teaching

Students should be aware that energy level diagrams can be used to illustrate similarities between elements of the same family. For example, elements in the same family have the same number of electrons in their valence energy level.

Teachers could highlight that atoms require a full valence orbital or an empty valence orbital in order to gain chemical stability. It is not intended that teachers discuss the octet rule at this level. Teachers could point out to students that the halogens are the most reactive nonmetals and the alkali metals are the most reactive metals due to their similar electron structure or number of valence electrons (i.e. halogens can gain one electron and become chemically stable with a full valence energy level; alkali metals can get rid of the single electron and the energy level that remains would be stable). This topic will be discussed further in high school Science.

Teachers could clarify that the elements' electronic structure (i.e., their valence energy level structure) dictates how one element will react with another, if at all.

Teachers could use pictures, pictorial Periodic Tables, and videos of common elements to illustrate that elements exhibit physical and chemical properties that are similar to other elements in the same family. For example, all the noble gases are gases at room temperature and all have extremely low boiling points and all are nonreactive. The reason for similar properties is believed to be related to the similar electron structures of elements within the same family (i.e. Alkali metals have 1 valence electron).

The Periodic Table and Atomic Theory (continued)

Suggested Assessment Strategies

Paper and Pencil

- Create a foldable to compare elements from the same family using Bohr-Rutherford diagrams. Include the location of protons, neutrons, electrons, and the maximum number of electrons found at each level. Using the template on page 37 in the text except replace Family Name for element and the names of the elements on the flaps (307 15).

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 62-63

Chemical Compounds

Outcomes

Students will be expected to

- identify and write chemical formula of common compounds (307-16)
  - define compound
  - identify whether a simple compound is ionic or molecular (covalent).
  - identify that a compound is represented by a combination of element symbols known as a chemical formula, which indicates the proportion in which the elements are present
  - list chemical formulas for some common chemical ionic compounds. Include:
    (i) table salt or sodium chloride (NaCl)
    (ii) calcium carbonate ($CaCO_3$)
    (iii) Sodium hydroxide (NaOH)

Elaborations—Strategies for Learning and Teaching

Students should know that ionic compounds are typically formed between metals and nonmetals (e.g. $CaCl_2$) while molecular (covalent) compounds are formed between nonmetals only (e.g. H_2O_2).

Students are not expected to learn how ionic and molecular compounds are formed at the atomic level. This will be addressed in high school Science.

Students should understand that compounds are represented by chemical formulas that indicate the ratio of elements present. For example, in one molecule of water (H_2O) there are two atoms of hydrogen and one atom of oxygen. Other examples of appropriate chemical formulas to explore would be methane (CH_4), carbon dioxide (CO_2), calcium carbonate ($CaCO_3$), propane (C_3H_8), and sodium chloride (NaCl). Using a periodic table, students should be able to identify the number and type of atoms represented in simple ionic and molecular compounds. Students are not expected to be able to identify the types or numbers of atoms present in compounds that contain multiple polyatomic ions (e.g. $Ca(NO_3)_2$, $(NH_4)_2S$, etc) since their chemical formulas include brackets and subscripts.

Teachers could provide a list of compounds requiring students to identify the name and ratio of elements present in each compound. This activity would also to help students become more familiar with the Periodic Table.

Students should be able to recognize the chemical name for these three ionic compounds when given the name and vice versa. Teachers could indicate that students will learn the rules that govern the naming of these and other ionic compounds when they high school Science.

Chemical Compounds

Suggested Assessment Strategies

Performance

- Perform a skit to show the difference between ionic and molecular (covalent) compounds. (307-16)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 72-75
BLM 1-28, 1-29, 1-31

ST p. 82

Naming Chemical Compounds

Outcomes

Students will be expected to

- identify and write chemical formula of common compounds (307-16)

(continued)

- name simple ionic compounds

- list chemical formulas for some common chemical molecular (covalent) compounds. Include:
  - (i) sucrose or table sugar ($C_{12}H_{22}O_{11}$)
  - (ii) carbon dioxide (CO_2)
  - (iii) methane (CH_4)
  - (iv) water (H_2O)

- name simple molecular (covalent) compounds

Elaborations—Strategies for Learning and Teaching

Teachers should provide students with opportunity to name simple ionic compounds using IUPAC rules when given the chemical formula (e.g. K_2S is potassium sulfide). Students are not expected to name compounds containing multivalent metals (e.g. Fe_2O_3) or polyatomic ions (e.g. $MgSO_4$) with the exception of calcium carbonate ($CaCO_3$) and sodium hydroxide (NaOH). Students are not expected to be able to write chemical formulas for ionic compounds.

Students should be able to recognize the chemical name for these four molecular compounds when given the name and vice versa. Teachers could indicate that students will learn the rules that govern the naming of molecular compounds when they do high school Science

Students should recognize that some molecular compounds (such as those listed) have common names. Common names arise because a substance is in everyday use or because it has been around for a long time and are in everyday usage. Most substances with common names pre-date the IUPAC naming system.

Teachers should provide students with opportunity to name simple molecular compounds using IUPAC rules when given the chemical formula (e.g. SO_3 is sulfur trioxide). Students are not expected to write formulas for molecular compounds.

Naming Chemical Compounds

Suggested Assessment Strategies

Paper and Pencil

- Create cards to use in a "Go Fish" activity where you will match the names to the compounds. (307-16)
- Complete the following table (307-16).

Compound Name	Chemical Formula	Element Names	Number of Each Element
Table Salt	NaCL		
Sugar	$C_{12}H_{22}O_{11}$		
Carbon Dioxide	CO2		
Propane	C_3H_8		
Water	H2O		
Calcium Carbonate	$CaCO_3$		

Performance

- Participate in a "Quiz-Quiz-Trade" activity (see Appendix B). Using the chemical formula of a compound, students take turns asking partners to name the compound from the formula. (307-16)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 80-82
BLM 1-32, 1-33

ST p. 83
BLM 1-32

ST pp. 86-89

Changes in Matter

Outcomes

Students will be expected to

- describe changes in the properties of materials that result from some common chemical reactions (307-13)
  - distinguish between physical and chemical changes
  - recognize that chemical changes produce new substances (elements or compounds), but physical changes do not
  - list examples of physical and chemical changes. Include:

Physical

i) change of state
ii) cutting
iii)dissolving

Chemical

i) corrosion
ii) fruit ripening
iii)combustion

- list evidence that a chemical change may have occurred. Include:
  (i) heat is produced or absorbed
  (ii) a new color appears
  (iii) a precipitate is formed
  (iv) a gas is produced
  (v) process is difficult to reverse

Elaborations—Strategies for Learning and Teaching

From previous experience, students may have an understanding that chemical change means that a new substance has been formed.

To help students better appreciate what is meant by a "new substance", teachers should relate this back to the atomic level. For example, during rusting, atoms of iron and atoms of oxygen chemically combine to form something new (i.e. rust). Teachers could also relate this back to the concept of elements. All substances on Earth consist of elements, whether they are comprised of pure elements such as iron or chemical combinations of elements (e.g., iron and oxygen in the compound we commonly call rust).

Teachers should remind students of their observations from the core lab (and possibly Activity 1-2A) in which they observed chemical and physical properties of some substances. Students should be aware that chemical changes are the result of the substance's chemical properties (i.e., if a substance has the chemical property of being able to burn, the act of burning is the chemical change that we observe).

Teachers could use a worksheet containing applications which students have to classify as chemical or physical changes. For example, the darkened ring formed around the top of a ketchup bottle (chemical change). Creating a fog effect at a dance by subliming dry ice (physical change).

Teachers could note that when heat is produced in a chemical reaction, light and/or sound is often also produced.

Teachers could refer back to Activity 1-2A: Bag of Change as a reference point for the evidence for chemical change. In Activity 1-2A, heat is produced, gases are formed, and a color change occurred from blue to green to yellow. Students could investigate the reaction between magnesium and acid by carrying out activity 3-3A. In this activity students will see the gas bubbles form and will be able to see that the gas formed (hydrogen) has different properties than the original materials. They will also see a black precipitate formed (magnesium chloride) and feel a temperature change as the acid reacts with the magnesium metal.

Changes in Matter

Suggested Assessment Strategies

Presenation

- Create a poster or collage of physical and chemical changes (307-12, 307-13)

Journal

- Describe a physical or chemical change that you have taken part in today. (307-12, 307-13)

Performance

- Participate in a "What Am I?" activity. Each student is given a type of change. Students pair up try to identify the type of change that their partner presents to them. They then switch cards and move on to a new partner.
- Participate in a "Quiz-Quiz-Trade" activity (See Appendix B). Using the type of change, students take turns identify the type of change that their partner presents to them
- Students create a visual presentation of physical or chemical changes that occur in their everyday lives.

Paper and Pencil

- Classify each as a chemical or physical change. (307-12, 307-13)

Situation	Physical or Chemical Change
1. Ice melting	
2. Roasting marshmellows	
3. Baking cookies	
4. Fireworks	
5. Slicing an apple	

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 86-94

ST pp. 88-89

Evidence of Change in Matter

Outcomes

Students will be expected to

- describe changes in the properties of materials that result from some common chemical reactions (307-13)

(continued)

- list evidence that a chemical change may have occurred. Include:
  - (i) heat is produced or absorbed
  - (ii) a new color appears
  - (iii) a precipitate is formed
  - (iv) a gas is produced
  - (v) process is difficult to reverse
- recognize that during a chemical change, elements are conserved but compounds are not

Elaborations—Strategies for Learning and Teaching

Teachers should emphasize these observations do not conclusively indicate a chemical change. Rather, this evidence supports the possibility of a chemical change. Many physical changes may fit one or more these categories. For example, while watching water boil, at least two pieces of evidence for a chemical change may be observed (i.e. absorbing heat and producing a gas). However, this is not a chemical change. Also, some chemical reactions are easily reversible (equilibrium reactions) while many physical changes are not easily reversible (shredding paper, sanding down wood).

Students could try to identify physical changes which involve evidence that may suggest chemical changes. For example, when opening a bottle of pop, bubbles/gas appear. This is a physical and not a chemical change. If an ice sculpture melts, the change is not easily reversible, yet it is a physical change. In the case of pH indicators, the colour change may be easily reversible, yet it is a chemical change. Possible leading questions to initiate classroom discussion could include: “Are there examples of changes that are not easily identified as chemical or physical?”, “What does it mean when you say a new substance is formed?”, and “Can you always tell when a substance is different from the starting material?” Students should be aware that the theoretical definitions are more clear cut than operational definitions.

It is not necessary to discuss chemical reactions and reaction types. Teachers should provide an analogy to ensure students understand that elements are rearranged during a chemical change. For example, a teacher may choose to provide a set number of legos of different colours such as 20 blue, 8 white, and 10 red to groups of students. Teachers may ask students to use the legos to construct an object. When constructed students can compare the different objects. If each colour lego represents a different element, each group of students will likely construct a different object (which represents a compound). Students should come to the understanding that the same number and type of elements can sometimes produce different compounds. Teachers can ask each group to disassemble their construction and make another object. This process is analogous to a chemical change/reaction in which elements are arranged to form new compounds.

Evidence of Change in Matter

Suggested Assessment Strategies

Performance

- Students will have the opportunity to view a number of illustrations that depict both chemical and physical changes. They must identify the type of change for each. If the change is identified as chemical, they must provide evidence for their choice. If it is identified as a physical change, they must state the type of change and whether energy is being added or removed. (307-13)

Journal

- While boiling water you add heat and the water bubbles. Is this a physical or chemical change? Discuss. (307-12, 307-13)

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 88-89

ST pp. 88-94

Evidence of Change in Matter (continued)

Outcomes

Students will be expected to

- use tools and apparatus safely (209-6)
- identify new questions about physical and chemical changes that arise from investigations (210-16)
- organize data using a format that is appropriate to the task or experiment (209-4)
- determine, where possible, if the change in a material or object is physical or chemical based on experimental data (210-11)

Elaborations—Strategies for Learning and Teaching

Core Laboratory Activity: Observing Changes in Matter

The laboratory outcomes 209-4, 209-6, 210-11, 210-16 and, in part, 307-13 are addressed by completing CORE LAB 3-3C "Observing Changes in Matter."

Students should note that the lithium ion (Li^{+}) should burn with a red flame, while the calcium ion (Ca^{2+}) should burn with an orange flame. It is important that students make good observations of the flame colors produced from the known samples to produce a standard for comparison.

Students should not leave the wooden splints in the flame too long because the wood will catch fire and the resulting flame will prevent them from observing the colors due to the various ions present. Students should be instructed to hold the wooden splint in the fire for 2 or 3 seconds and observe the color that is immediately apparent. Teachers may substitute wooden splints with nichrome wire containing a small loop at the end.

Evidence of Change in Matter (continued)

Suggested Assessment Strategies

Resources

www.gov.nl.ca/edu/science_ref/main.htm

Core Lab #4: Observing Changes in Matter
ST pp. 92-93
TR 1-52, 1-53
TR AR 3, 5, 11
TR AC 4, 7, 8
BLM 1-18

Chemistry in Everyday Life

Outcomes

Students will be expected to

- provide examples where knowledge of chemistry has resulted in the development of commercial materials. (111-1)
- explain how society's needs can lead to developments in chemistry (112-3)
- analyze the design of a technology and the way it functions on the basis of its impact on their daily lives (113-4)
- make informed decisions about applications of science and technology, taking into account environmental and social advantages and disadvantages (113-9)

Elaborations—Strategies for Learning and Teaching

The **CORE STSE** component of this unit incorporates a broad range of Grade 9 outcomes. More specifically, it targets (in whole or in part) 111-1, 112-3, and 113-1. The STSE component "**Plastics and Modern Life"** can be found in Appendix A.

Students should be are aware of some of the many ways in which chemistry affects or is involved in their everyday life. Medicines, make-up, suntan lotions, clothing, building materials, fertilizers, petrochemicals and their derivatives could be explored. For example, digitoxin is a chemical extracted from a native Newfoundland and Labrador flower called foxglove, which is used for heart attack patients. Another example of chemistry in their daily lives relates to many household cleaners. Students could be made aware of the danger of mixing bleach and toilet bowl cleaner resulting in the production of poisonous chlorine gas.

Students could conduct research on how specific products are made through various chemical reactions.

Students could refer students to the "science watch" feature of chapter 3 of the student textbook for some examples of common substances that are produced from various reactions of chemicals found in petroleum.

Students could conduct research on the development of more efficient and cost-effective ways to extract aluminum from various ores. Students could also research how materials such as nylon and oil-based rubbers were developed and produced.

Chemistry in Everyday Life

Suggested Assessment Strategies

Resources

www.gov.nl.ca/edu/science_ref/main.htm

Core STSE #2: "Plastics and Modern Life," Appendix A