Senior 1

Cluster 2: Atoms and Elements

Overview

This cluster builds on the particle theory of matter introduced in previous grades. Students will

- become familiar with the basic constituents of matter by learning about the historical development of the atomic model and the periodic table.
- investigate the properties of elements and compounds.
- acquaint themselves with chemical symbols and families.
- become familiar with natural phenomena and everyday technologies that demonstrate chemical change.

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-01 Describe how historical ideas and models have furthered our understanding of the nature of matter.

Include: Greek ideas, alchemy, Lavoisier.

GLO: A1, A2, A4

Skills and Attitudes Outcomes

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia (ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

S1-0-8e. Discuss how peoples of various cultures have contributed to the development of science and technology.
GLO: A4, A5

S1-0-9a. Appreciate and respect that science and technology have evolved from different views held by women and men from a variety of societies and cultural backgrounds.
GLO: A4

SUGGESTIONS FOR INSTRUCTION

(2 HOURS)

➢ Entry-Level Knowledge

Students have not previously studied atomic structure in K–8 Science. They have studied positive and negative charges as they relate to the concept of electricity (Grade 6); the particle theory of matter, pure substances, mixtures, and solutions (Grade 7); and have reviewed the particle theory of matter (Grade 8).

➢ Notes for Instruction

Help students gain an appreciation for the importance of keen observations. They should also learn to appreciate how scientists have progressively extended their knowledge over time through experimentation. Introduce students to a more sophisticated way of explaining the differences among elements. Discuss how models of matter were developed through experimental evidence and the contributions of ancient Greek philosophers, alchemists, and modern chemists.

➢ Student Learning Activities

Journal Writing

Students use a Compare and Contrast frame to describe how alchemists and early chemists were similar to and different from modern chemists. (See *SYSTH*, page 10.15)

Remember, the work of alchemists was not accepted even in their own time, but many prominent individuals (e.g., Sir Isaac Newton) were practitioners of the craft. Students write a letter assuming the role of one of the persons with whom an alchemist might have had contact.

Students write a short story describing how they think a common element could have been discovered. They reflect on and respond to the following question: Do you think it was necessary to understand the atom in order to make this discovery?

Students begin to build a science timeline to learn the origins of early chemistry, and the development of models of matter based on each scientist’s specific contributions.

Class Discussion S1-0-8e, 9a

Students discuss social and political issues of ancient Greece and their impacts on the advancement of scientific thought (e.g., exclusive presence of men in science, importance of thinkers, lack of experimentation).

(continued)

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/ Test

Students

- describe how the concept of matter has changed throughout history.
- match historical descriptions of ideas/models/concepts with the people who proposed them.
- create a timeline outlining the changes in thinking about matter.
- compare and contrast the activities of early philosophers with the activities of alchemists. Compare these two groups to modern scientists.

Teacher Background

Ancient Greek philosophers wondered why matter behaved as it did. They studied it and came up with many ideas, but they did almost no experimentation. During this time, Empedocles proposed that matter was composed of "four elements:" earth, fire, air, and water. Democritus suggested matter was made of tiny particles that could not be broken down further. He called these particles "atomos" which means indivisible. Socrates and Aristotle rejected this idea, and the ideas of Empedocles prevailed in the scientific world for the next 2000 years.

Alchemists were the first people to perform experiments. They believed that some elements could be changed into other elements, and had three main goals:

- To change base metals, like lead and tin, into valuable ones, like gold. In this process, they discovered new elements as well as many new facts about existing materials.
- To find the substance that would give them eternal life.
- To produce a universal solvent that would dissolve all substances.

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

3.1 Investigation: Making a Logical Model, p. 80

3.2 Developing Models of Matter, p. 82

Skills Handbook:
#2 Scientific Inquiry
#3 Research

Sciencepower 9

5.3 Compounds and Elements, p. 75

Appendix B: Using Resources and the Internet Effectively

Appendices

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

2.2 Blackline Master
Historical Ideas About the Nature of Matter

SYSTH

10.15 Building a Scientific Vocabulary

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-2-01 Describe how historical ideas and models have furthered our understanding of the nature of matter.

Include: Greek ideas, alchemy, Lavoisier.

GLO: A1, A2, A4

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ **Student Learning Activities (continued)**

Student Research

Student groups investigate the methods used by early scientists as they tried to make sense of their world.

Teacher Demonstration

Provide evidence through demonstrations to support the existence of smaller particles in nature. Explain how it was logical for the people of ancient Greece to speculate about the smallest particles of matter.

- Hold up a piece of aluminum foil, and ask students what type of material it is made of. Then tear the foil in half, and ask the same question. Repeat the same procedure several times. This will help lead to an understanding that an atom is the smallest particle of matter.
- Blow up a balloon with a scented fluid inside of it. Discuss why the odour will travel throughout the room. This will help reinforce the concept of atoms as tiny particles of matter.

Visual Displays S1-0-5c
Students display their timeline of the evolution of the concept of matter, including chronological dates, scientists' names, and diagrams of matter.

Student Research

Students research the development of scientific thought as it relates to matter and include early ideas about the nature of science.

SUGGESTIONS FOR ASSESSMENT

Research Report/Presentation

Students or student groups research and report on the development of scientific thought as it relates to matter and early ideas about the nature of science. Students could present a

- written report
- oral presentation
- newspaper article
- dramatic presentation
- pictorial representation (poster/pamphlet)

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Display

Students or student groups prepare visual displays that represent the timeline of the evolution of the concept of matter, and could include posters, diagrams, charts, models, and concept maps.

Laboratory Report/Demonstration

Students record their observations during a teacher demonstration and explain them in terms of their understanding of matter.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Teacher Background

Modern Chemists (17^{th}–18^{th} centuries) used the scientific method to investigate the physical world when the focus was on determining the properties of pure substances and attempting to explain their composition.

Sir Francis Bacon was one of the first scientists to develop new knowledge as a result of experimentation.

Robert Boyle believed that the Greek philosophers' four-element theory could be improved, and he helped lay the foundation for the concept of elements and compounds.

Antoine de Lavoisier defined the term "element" and identified 23 different elements. He based his investigations on careful measurement and observations. He recognized that mixtures exist, and identified air as a mixture of oxygen and some other gas.

SUGGESTED LEARNING RESOURCES

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-02 Investigate the historical progression of the atomic model.

Include: Dalton, Thomson, Rutherford, Bohr, and quantum model.

GLO: A1, A2, A4, D3

Skills and Attitudes Outcomes

S1-0-5a. Select and use appropriate methods and tools for collecting data or information.
GLO: C2; TFS: 1.3.1

S1-0-8c. Describe examples of how scientific knowledge has evolved in light of new evidence, and the role of technology in this evolution.
GLO: A2, A5

S1-0-8d. Describe examples of how technologies have evolved in response to changing needs and scientific advances.
GLO: A5

SUGGESTIONS FOR INSTRUCTION
(3 HOURS)

➢ Notes for Instruction

Students understand from previous learning outcomes how observation and experimentation can support our understanding of nature and the development of models.

Provide students with an understanding of the concept of the “atom” and the development of the model of the atom, including all of its components. As previously demonstrated, define “atom” as the smallest particle of any given type of matter.

Discuss the possible existence of units that are smaller than an atom (i.e., subatomic particles: protons, neutrons, and electrons).

Use the following analogy to help students appreciate the size of the subatomic particles within the atom.

Atom = Skydome, Toronto

Nucleus = baseball

Protons = marbles inside baseball

Electrons = mosquitoes buzzing around baseball

Use the following chart to demonstrate the characteristics of the three fundamental subatomic particles of matter.

Subatomic Particle	Symbol and Charge	Mass	Location
Proton	p+	1 amu	nucleus
Neutron	n	1 amu	nucleus
Electron	e–	1/1837amu	electron shell

Students should gain an understanding of the need for revision from one model to the next. Therefore, discuss Dalton, Thomson, Rutherford, and Bohr models in detail, including the presence of protons, electrons, neutrons, nucleus, and electron shells’ energy levels.

Discuss the quantum model very briefly, as it will be discussed in more detail in future Senior Years science courses. (See Teacher Background)

➢ Student Learning Activities

Prior Knowledge Activity

Students write down anything they know about the atom, including sketches to illustrate what they think an atom might look like. Guiding questions could include:

(continued)

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- match five models of the atom with their descriptions and with the scientist who developed them.
- describe reasons for revisions of previous models of the atom.
- using the Bohr model of the atom, discuss the statement: "If it is true that protons repel one another, how can they be positioned together in the nucleus?"
- describe the subatomic particles in terms of size, location, who discovered them, charge, and symbol.
- compare and contrast each of the five atomic models.

Teacher Background

All matter has mass.

AMU = atomic mass unit = 1.66×10^{-27} kg.

Proton and neutron have a mass of 1 amu, while the electron is almost 2000 times less massive.

According to classical physics, the Bohr model could not exist. Electrons do not move in definite orbits around the nucleus; rather, they move randomly in electron clouds called orbitals. Work principally done by Schrödinger and others linked the energy levels of atoms to the electromagnetic spectrum. As electrons moved from one energy level to another, energy in the form of light was either radiated or absorbed. The energy released or absorbed occurred in fixed amounts or quanta of energy, hence the quantum model of the atom.

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

3.3 Inside the Atom, p. 87

3.4 A "Planetary" Model of the Atom, p. 90

BLM 3.2a, 3.2b Atomic Theories and Models

BLM 3.3 Subatomic Particles Worksheet

BLM 3 Review Models for Atoms: Word Search

Sciencepower 9

7.1 Probing the Atom, p. 228

7.2 Bohr-Rutherford Model, p. 236

BLM 7-5 Subatomic Particles

BLM 7-6 Rutherford's Theory

BLM 7-18 Concept Mapping: Parts of the Atom

BLM 7-19 Composition of Atoms

BLM 7-22 Vocabulary Puzzle

7-C Investigation: Modeling the Atom, p. 251

Appendices

2.3 Blackline Master Models of Atomic Structure

Success for All Learners

6.108 Teaching and Learning Strategies

(continued)

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-2-02 Investigate the historical progression of the atomic model.

Include: Dalton, Thomson, Rutherford, Bohr, and quantum model.

GLO: A1, A2, A4, D3

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print, electronic, specialists, other resource people. (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2b. Evaluate the reliability, bias, and usefulness of information.
(ELA: S1: 3.2.3, 3.3.3) GLO: C2, C4, C5, C8; TFS: 2.2.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6; TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

SUGGESTIONS FOR INSTRUCTION
(3 HOURS)

➢ **Student Learning Activities (continued)**

- What shape is an atom?
- What particles does it consist of?
- What size is an atom?
- Where do you find an atom?
- Can you see an atom with the unaided eye, or do you need a microscope?
- Who do you think discovered the atom?
- What other models of the atom, if any, have been developed?

Student Research S1-0-2a, 2b, 2c, 5a

Students learn about the lives of these four scientists, and the experiments they performed to develop their model.

Collaborative Teamwork S1-0-4e

Students use a Jigsaw to learn about the five models of the atom and develop a Concept Relationship frame for each scientist and his model, illustrating the differences and the need for revisions to the model. (See *SYSTH*, page 11.20)

Visual Displays S1-0-5c

Students display the evolving models of the atom, including detail about the components of the atom and the scientist who developed the model.

Journal Writing

Students write an account of their own atomic models as if they were research scientists like those studied previously.

Oral Presentation/Debate: Student groups debate the pros and cons of each of the five models.

Visual Displays S1-0-5c

Students interactively view a video about the structure of the atom using a “LAPS” strategy.

L = listen to what is said in the video.

A = ask three questions that could be on a test.

P = picture or illustrate a concept discussed in the video.

S = summarize 15 key points addressed in the video.

Role-Playing: Students act out the role of the particles in the five atomic models.

Newspaper Article: Students write a fact-based article using newly acquired knowledge to describe one of the five atomic models.

Suggestions for Assessment

Research Report/Presentation

Students or student groups research and report on the following:

- the scientists involved in the development of the atomic model
- the revisions made to the scientists' model as novel facts were discovered
- the problems that arose with the inability of the scientists' model to be consistent with new evidence

Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations
- song or poem
- a student-generated test or series of questions and answers

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Displays

Students prepare visual displays that represent the evolving models of the atom. These displays could include posters, models, concept maps, and diagrams.

Debate

Assess the information students present in support of or against each of the five models of the atom. (See *SYSTH*, pages 4.19–4.22)

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

Appendices

5.2 Rubric for the Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

SYSTH

3.19 Cooperative Learning and Science

4.19 Science — Technology — Society — Environment Connections

11.20 Developing Scientific Concepts Using Graphic Displays

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-03 Define element and identify symbols of some common elements.

Include: the first 18 elements and K, Ca, Fe, Ni, Cu, Zn, I, Ag, Sn, Au, W, Hg, Pb, U.

GLO: C2, D3

Skills and Attitudes Outcomes

S1-0-5a. Select and use appropriate methods and tools for collecting data or information.
GLO: C2; TFS: 1.3.1

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia (ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

SUGGESTIONS FOR INSTRUCTION
(1/2 HOUR)

➢ Notes for Instruction

Define "element" as a pure substance that cannot be broken down into simpler substances (i.e., elements are made of identical atoms).

An understanding of elements is needed to examine exact numbers of subatomic particles and to draw Bohr models (S1-2-04).

Discuss the diversity of sources of names for the elements. (Berzelius developed a naming system in 1817 as a way to provide symbols that would communicate clearly across language barriers.)

Define "chemical symbol" as an abbreviation of the name of the element and discuss the following rules when naming:

- a single-letter symbol is always capitalized (e.g., Carbon = C)
- the first letter of a two-letter symbol is always capitalized, while the second letter is lower case (e.g., Aluminum = Al)

Note: Briefly discuss the connection between elements with Latin (or other source) names and their symbols, Gold = Au (Latin name aurum), Silver = Ag (argentum), Tungsten = W (from the German Wolfram), Lead = Pb (Plumbum), Scandium = Sc (from region of its discovery, Scandinavia), Berkelium = Bk (from the University of California at Berkeley where the element was created), Einsteinium = Es (in honour of the contributions of the physicist Albert Einstein).

Refer to the periodic table of the elements (See Appendix 2.9) to help students link elements they currently know with others that are not familiar.

➢ Student Learning Activities

Class Discussion

Students brainstorm examples of chemical symbols they have encountered in their daily lives, and suggest which element the symbol represents. Flash cards can be used to familiarize students with the elements and symbols.

Students generate lists of elements with which they are familiar (e.g., calcium in milk for bone development, iron metal filings used to show the magnetic lines of force from magnets, oxygen in the atmosphere and the Earth's crust).

Game: Students play Element Bingo to gain more exposure to the chemical symbols. (See Appendix 2.4)

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- write the names and symbols for the first 18 elements and the most common elements.
- explain why an international system of chemical naming is important and necessary.
- match the name of an element to its use, and its symbol.

(continued)

Suggested Learning Resources

Science 9

2.7 Chemical Symbols and Formulas, p. 58

Sciencepower 9

6.1 Symbols for the Elements, p. 192

6.2 Elements on Planet Earth, p. 198

6-D Investigation: The Story of Aluminum, pp. 210–12

Appendices

2.4 Student Learning Activity Chemical Symbol Bingo

(continued)

Prescribed Learning Outcomes
Students will...
(continued) **S1-2-03** Define element and identify symbols of some common elements. Include: the first 18 elements and K, Ca, Fe, Ni, Cu, Zn, I, Ag, Sn, Au, W, Hg, Pb, U. GLO: C2, D3

Suggestions for Instruction
(1/2 hour)

➢ **Student Learning Activities (continued)**

Vocabulary: Students create/complete crossword puzzles to connect the name of an element with its use and symbol.

Student Research S1-0-5a

Students research the history of element symbols and names, from early alchemists in the Middle Ages, to Dalton's symbols in the 1800s, to modern symbols used today.

Visual Displays S1-0-5c

Students create displays of a few of the most common elements to illustrate their symbols, uses, abundance, and properties.

Journal Writing

Students reflect and respond to the following questions:

- Why do you think some elements such as gold and silver have been around for centuries, while others were only discovered in the 20th century?
- Why are some symbols similar to the name of the element, while others are not? (Answer: language spoken by scientist, geographic location of discovery, characteristic of element, etc.)

Suggestions for Assessment

Research Report/Presentation

Students or student groups research and report on the history of element symbols and names. Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Displays

Students prepare visual displays that feature a few of the most common elements and illustrate their symbols, uses, abundance, and properties. Displays can be in the form of posters, charts, or concept maps.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

SYSTH

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-04 Explain the atomic structure of an element in terms of the number of protons, electrons, and neutrons and explain how these numbers define atomic number and atomic mass.

GLO: D3, E2

Skills and Attitudes Outcomes

S1-0-1b. Select and justify various methods for finding the answers to specific questions. (Math: S1: A-1) GLO: C2

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print, electronic, specialists, other resource people. (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources. (ELA: S1: 3.3.2) GLO: C2, C4, C6; TFS: 2.3.1, 4.3.4

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia (ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ Notes for Instruction

Use a periodic table of the elements to familiarize students with the position of the element's name, symbol, atomic mass (also called mass number), and atomic number.

Define atomic mass (mass number) and atomic number as follows:

- *Atomic mass (mass number):* The average mass of an atom of the element (can also be described as the sum of the number of neutrons and protons in the nucleus of an atom).
- *Atomic number:* The number of protons in the nucleus of an atom.

The standard atomic notation or shorthand representation for an element's symbol, atomic number, and atomic mass is written as follows:

(atomic mass written in upper left, as superscript)

C^{12}_{6} (chemical symbol)

(atomic number written in lower left, as subscript)

Note: Atomic mass is rounded to the nearest whole number.

Caution: Changes to the number of electrons and neutrons will be discussed in Senior 2 Science. Do not discuss ions and isotopes in Senior 1 Science.

➢ Student Learning Activities

Problem Solving S1-0-1b

Using a table, students determine the number of protons, electrons, and neutrons of any element.

Element	Atomic #	Atomic Mass	# of protons	# of electrons	# of neutrons

(continued)

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- distinguish between atomic mass and atomic number.
- determine the number of fundamental particles in the atom of an element given the atomic number and atomic mass.
- determine which particles can be used to identify an element.
- determine which particles represent the mass of an atom.
- determine the element from the number of subatomic particles within the atom.

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

3.3 Inside the Atom, p. 87

Sciencepower 9

7.3 A New Basis for the Periodic Table, p. 245

7-B Investigation: Inferring the Number of Neutrons, p. 250

Appendices

2.5 Student Learning Activity Determining the Number of Atomic Particles

Prescribed Learning Outcomes

Students will...

(continued)

S1-2-04 Explain the atomic structure of an element in terms of the number of protons, electrons, and neutrons and explain how these numbers define atomic number and atomic mass.

GLO: D3, E2

Suggestions for Instruction
(2 hours)

➢ **Student Learning Activities (continued)**

Game (S1-0-1b): Students create questions/answers for a "Jeopardy" game that illustrates their understanding of this outcome. For example,

Question: "This element has six protons in its nucleus."

Answer: "What is Carbon?"

Student Research S1-0-2a, 2c

Students investigate the methods used to determine or calculate the atomic mass of elements by both Mendeleev and the modern periodic table.

Visual Displays S1-0-5c

Students plot graphs of various characteristic physical properties of elements versus atomic mass and atomic number using a spreadsheet and a graphing program.

Suggestions for Assessment

Research Report/Presentation

Students or student groups research and report on the methods used by Mendeleev and the modern periodic table to determine or calculate the atomic mass of elements. Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Displays

Students prepare visual displays that feature a few of the most common elements and illustrate their symbols, uses, abundance, and properties. Displays can be in the form of posters, charts, or concept maps.

Teacher Background

The number of fundamental particles (subatomic) in an atom can be determined by knowing the atomic number and atomic mass, and that there is an important difference in these numbers.

- Number of protons is equal to the atomic number.
- Number of electrons is equal to the atomic number (In a neutral atom, proton # = electron #).
- Number of neutrons is calculated by subtracting the atomic number from the atomic mass.

For example: sodium Na^{23}_{11}

Atomic number = 11

Atomic mass = 22.990

Protons = 11

Electrons = 11

Neutrons 23 – 11 = 12

Elements can be identified by the number of protons they contain, as this value never changes. If this value is known, the element can be identified because proton number = atomic number.

Suggested Learning Resources

Appendices

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-05 Assemble or draw Bohr atomic models for the first 18 elements and group them according to the number of outer shell electrons.

GLO: A2, C2, D3

Skills and Attitudes Outcomes

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia (ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding. (ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ Notes for Instruction

Students have studied the structure of the atom including subatomic particles and have been introduced to a diagram of the Bohr model in previous learning outcomes.

Students use Bohr diagrams to represent the electronic structure of elements (i.e., protons and neutrons are located in the nucleus, electrons are located in electron shells (energy levels or orbits) around the nucleus).

Caution: Although more than three electron shells exist, do NOT diagram Bohr models beyond the first 18 elements.

Once students can draw Bohr diagrams successfully, ask them to arrange their diagrams according to the number of electrons in the outermost shell, and look for patterns. For example:

- H, Li, and Na all have one electron in their outermost shell and should be grouped together.
- O and S have six electrons in their outermost shell and should be grouped together.

(This exercise will lead into a discussion of the arrangement of elements and reactivity, which is addressed in later learning outcomes.)

➢ Student Learning Activities

Visual Displays S1-0-5c, 6a

Students draw Bohr models for the first 18 elements on separate index cards and then arrange the cards into groups based on patterns they see in the outer shell electron positions.

Students compare and contrast their groupings with those of a modern periodic table.

Students construct a three-dimensional model of a given atom using atomic model kits if available. Other objects, such as toothpicks and multi-coloured marshmallows, could be used if kits are not available.

Class Activity: For a class-centred activity, draw Bohr Models of a selection of elements. Students determine the number of protons and neutrons in the nucleus. Draw this on the board, and then draw in rings to represent electron shells. Add electrons to the correct unfilled electron shells, filling shells closest to the nucleus first, then progressing outward.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students draw Bohr diagrams for any of the first 18 elements, including the number and correct position of protons, electrons, neutrons, nucleus, and electron shells.

Visual Displays

Students or student groups prepare visual displays that represent the first 18 elements of the periodic table as Bohr diagrams. Displays can be in the form of posters or index cards.

Teacher Background

The exact number of electrons positioned in electron shells is important.

The first shell closest to the nucleus can hold a maximum of **two** electrons and must be filled before electrons are placed in any additional shell.

The second shell can hold a maximum of **eight** electrons and must be filled before electrons are placed in any additional shell.

The third shell can also hold a maximum of **eight** electrons and must be filled before electrons can be placed in any additional shell.

The exact position of electrons within the electron shell is not important, however, electrons should be spaced equally throughout the electron shell.

Suggested Learning Resources

Science 9

BLM 3.4: Bohr-Rutherford Diagrams Worksheet

Sciencepower 9

BLM 8-1: Outer Electrons

Appendices

2.1 Blackline Master
Vocabulary

2.6 Blackline Master
Bohr Model Diagrams

2.7 Student Learning Activity
Drawing Bohr Model Diagrams

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-06 Investigate the development of the periodic table as a method of organizing elements.

Include: periods, families (groups).

GLO: A2, A4, B2, E1

Skills and Attitudes Outcomes

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(3 HOURS)

➢ **Entry-Level Knowledge**

Students have not previously studied the periodic table; however, in Grades 5 and 8, they have discussed the physical properties of matter, such as density and solubility, with respect to solids, liquids, and gases.

➢ **Notes for Instruction**

Students should study Dmitri Mendeleev's periodic table (1869), which included the 64 elements known at the time. Discuss how Mendeleev used his periodic table to predict the properties of missing elements, leaving blank spaces within the table for "undiscovered elements."

Students should also use a modern periodic table to examine how families or groups of elements are organized in terms of periodic law.

Define "*period*" as horizontal rows on the periodic table (with a numbering system of 1–7 from the top to the bottom of the table) representing an electron shell or orbit in the Bohr model and an energy level in the quantum model of the atom.

Define "*groups*" or "*families*" as the vertical columns on the periodic table (with an IUPAC numbering system of 1–18 from left to right across the table or an old labelling system of Roman numerals I – VIII, followed by the letter "A" or "B") containing elements with similar physical and chemical properties, and the same number of electrons in their outermost shell/orbit (called valence electrons).

Note: Roman numeral group number = number of valence electrons.

The groups or families studied in Senior 1 include:

- Alkali Metals (IA)
- Alkaline Earth Metals (IIA).
- Hydrogen (belongs in a family by itself, due to its special properties)
- Chalcogens (VI-A)
- Halogens (VII-A)
- Noble Gases (VIII-A) (have eight valence electrons and are, therefore, chemically stable and unreactive)

Define "*Periodic Law*" as elements arranged according to atomic number resulting in a reoccurring pattern of similar properties in different elements.

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- locate elements given their period and group.
- compare and contrast Mendeleev's periodic table with the modern periodic table.
- define "family" of elements.
- describe the five families stating one characteristic of each.

Teacher Background

Mendeleev's periodic table organized elements by atomic mass and helped to establish the concept of families of elements with similar physical and chemical properties. He accurately predicted the elements gallium and germanium, demonstrating the validity of his periodic table as a powerful predictive tool.

Henry Moseley's work with X-ray diffraction did much to confirm the order of elements in the periodic table proposed by Mendeleev. Moseley revised Mendeleev's table and arranged elements according to atomic number in order to incorporate the noble gases and elements that did not "fit" their position in terms of properties.

(continued)

Suggested Learning Resources

Science 9

4.1 Organizing the Elements, p. 104

4.2 Activity: Inventing a Periodic Table, pp. 106–7

4.3 Activity: Exploring the Modern Periodic Table, pp. 108–9

4.4 Groups of Elements, pp. 110–13

4.5 Investigation: Groups of Elements and Compounds, pp. 114–16

BLM 4.4a Classification of the Elements Worksheet

BLM 4 Review: Periodic Table Crossword

BLM 4.4b Chemical Groups Jigsaw

Sciencepower 9

6.4 Families of Elements, p. 215

BLM 6-20 Mendeleev's Periodic Table

BLM 6-22 Word Maze

BLM 6-23 Symbols for the Elements

6-F Investigation: Meet the Modern Periodic Table, pp. 219–22

Appendix C: Periodic Table of the Elements

Appendices

2.8 Teacher Support Material Development of the Periodic Table

2.9b Blackline Master Organization of the Periodic Table

2.10 Student Learning Activity "What Element am I?

(continued)

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-2-06 Investigate the development of the periodic table as a method of organizing elements.

Include: periods, families (groups).

GLO: A2, A4, B2, E1

SUGGESTIONS FOR INSTRUCTION

(3 HOURS)

➢ **Student Learning Activities**

Collaborative Teamwork S1-0-4e

Students examine and discuss a variety of periodic tables constructed over time to determine the basis for their design and the criteria used to classify elements in each table.

Students use a Jigsaw activity to learn the names and properties of the chemical families.

Game: Students create questions/answers for a game that identifies an element based on its family name, group number, period, and/or properties (or vise versa). For example,

1. Statement: Found in a family by itself.
   Response: "What is Hydrogen?"
2. Statement: Found in period 4 and is the basis of life on Earth.
   Response: "What is Carbon?"

Student Research: Students research and prepare a presentation that explains the evolution of the periodic table since 1869.

Problem Solving S1-0-6a

Given a copy of the modern periodic table on which the properties of certain elements are hidden, students predict the properties of these elements in the same manner as Mendeleev.

Laboratory Activity

Students examine the physical and chemical properties of some elements, then group the elements, and invent their own periodic table.

Journal Writing S1-0-5c

Students suggest how they would classify all the elements known today and ensure their classification system was universal.

Students view a video about the periodic table using a "LAPS" strategy.

L = listen to what is said in the video.

A = ask three questions that could be on a test.

P = picture or illustrate a concept discussed in the video.

S = summarize 15 key points addressed in the video.

Students complete Concept Frames, Compare and Contrast charts, or Word Cycles to demonstrate their knowledge of the concepts and vocabulary related to the periodic table and its evolution. (See *SYSTH*, pages 10.15, 10.21, 11.24)

Suggestions for Assessment

Research Report/Presentation

Students or student groups research and report on the evolution of the periodic table since 1869. Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Displays

Students describe the process they used when looking for patterns as they grouped the index cards to create/invent their own periodic table.

Suggested Learning Resources

Appendices

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

SYSTH

10.15, 10.21 Building a Scientific Vocabulary

11.23–11.24 Developing Scientific Concepts Using Graphic Displays

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-07 Investigate the characteristic properties of metals, non-metals, and metalloids and classify elements according to these properties.

Examples: ductility, conductivity of heat and electricity, lustre, reactivity…

GLO: D3, E1

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print, electronic, specialists, other resource people. (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2b. Evaluate the reliability, bias, and usefulness of information.
(ELA: S1: 3.2.3, 3.3.3) GLO: C2, C4, C5, C8; TFS: 2.2.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6; TFS: 2.3.1, 4.3.4

S1-0-3c. Plan an investigation to answer a specific scientific question.
Include: materials, variables, controls, methods, safety considerations.
GLO: C1, C2

S1-0-4a. Carry out procedures that comprise a fair test. Include: controlling variables, repeating experiments to increase accuracy and reliability of results.
GLO: C1, C2; TFS: 1.3.1

S1-0-4b. Demonstrate work habits that ensure personal safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment. GLO: B3, B5, C1, C2

S1-0-4c. Interpret relevant WHMIS regulations.
Include: symbols, labels, Material Safety Data Sheets (MSDS).
GLO: C1, C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia (ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ Entry-Level Knowledge

Students have been introduced to the concept of chemical families or groups in previous outcomes.

➢ Notes for Instruction

Relate the location of the metals, nonmetals, and metalloids on the periodic table. Demonstrate some physical properties of metals, nonmetals, and metalloids.

Caution: Demonstration and laboratory activities may involve dangerous chemicals. Ensure everyone is aware of laboratory safety and chemical disposal procedures, household and workplace hazard symbols, and WHMIS regulations.
(See *Science Safety*)

Students collect and examine labels of various household products and respond to the following:

- Identify and explain the symbols and the dangers associated with each product.
- What is the significance of the geometric shape of the household symbols? Why do they vary?
- Compare the warning labels on chemicals with those on household products.

➢ Student Learning Activities

Collaborative Teamwork S1-0-4e

Small student groups list 10 items made of metal, including the composition and properties of the metal that make it useful for that particular item.

Laboratory Activity S1-0-3c, 4a, 4b, 4c

Students examine and perform various tests on metals and nonmetals to determine their properties, including conductivity, lustre, malleability, ductility, and state of matter.

Student Research S1-0-2a, 2b, 2c

Students research useful applications of certain metals, nonmetals, and metalloids throughout history, e.g., in early North American Aboriginal societies. Students could also investigate the science and technology of mining and metallurgy.

Visual Displays S1-0-5c

Students create a poster illustrating when an element was discovered, its physical and chemical properties, its uses, and its abundance on Earth.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- differentiate among metals, nonmetals, and metalloids based on their position in the periodic table.
- classify elements as metals, nonmetals, and metalloids based on their properties.
- describe the properties of metals, nonmetals, and metalloids.
- outline safety procedures that should be followed when performing given experiments or disposing of specific hazardous chemicals.
- discuss the importance of WHMIS.
- match the WHMIS symbols with their description and name.

Research Report/Presentation

Students or student groups research and report on the use of certain metals, nonmetals, and metalloids today and throughout history. Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Displays

Students or student groups prepare a visual display that illustrates the properties, uses, and the importance of any element on the periodic table. Displays can be in the form of posters, information technology presentations, or models.

Laboratory Report

Students prepare a report describing the observed properties of metals, nonmetals, and metalloids. Use a checklist to assess students' safety practices. (See *Science Safety*)

(continued)

Suggested Learning Resources

Science 9

2.2 Investigation: Classifying Elements, pp. 48–49

2.3 Putting Metals to Work, p. 50

2.12 Metal Extraction and Refining in Canada, p. 70

2.13 Explore an Issue: A Mine in the Community, p. 74

Sciencepower 9

6.2 Elements on Planet Earth, p. 198

6.3 Science and Technology of Metallic Elements, p. 205

BLM 6-1 Identifying Metals

BLM 6-11 Classification of the Elements

BLM 6-17 Researching an Element

BLM 6-13 Using Material Safety Data Sheet (MSDS)

6-B Investigation: Comparing the Reactivity of Metals, pp. 201–02

Appendices

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

(continued)

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-2-07 Investigate the characteristic properties of metals, non-metals and metalloids and classify elements according to these properties.

Examples: ductility, conductivity of heat and electricity, lustre, reactivity…

GLO: D3, E1

SUGGESTIONS FOR INSTRUCTION

(2 HOURS)

Suggestions for Assessment

Teacher Background

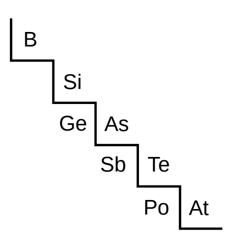
Metals constitute more than 75% of the elements. They are located throughout the periodic table, and are concentrated on the left side and centre.

Physical properties: shiny, generally silver-grey in colour (except gold and copper), malleable, ductile, solid at room temperature (except mercury), conduct heat, and conduct electricity.

Nonmetals constitute about 15% of the elements. They are located on the far-right side of the periodic table.

Physical properties: no lustre, brittle (not malleable or ductile), nonconductors or insulators of heat, nonconductors or insulators of electricity (except graphite), and either solid or gas at room temperature (except bromine).

Metalloids constitute about 6% of the elements, and are located on the "staircase" of the periodic table.



Metalloids have properties of both metals and nonmetals.

Physical properties: all are solid at room temperature, some have lustre, they tend to behave like nonmetals (except in terms of electrical conductivity), and are semiconductors.

Suggested Learning Resources

Laboratory Safety

Science Safety, Manitoba Education and Training, 1997
www.edu.gov.mb.ca/docs/support/scisafe/

Be safe! A health and safety reference for Science and Technology Curriculum, Science Teachers' Association of Ontario, 1998
http://www.stao.org/

Appendices

2.11 Blackline Master
Metals — Nonmetals — Metalloids

2.12 Student Learning Activity
WHMIS Symbols

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-08 Relate the reactivity and stability of different families of elements to their atomic structure.

Include: alkali metals, alkaline earths, chalcogens, halogens, noble gases.

GLO: D3, D4, E1, E2

Skills and Attitudes Outcomes

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-6a. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ **Entry-Level Knowledge**

Students have studied the Bohr model of atomic structure and the organization of the periodic table in previous learning outcomes.

➢ **Notes for Instruction**

Pose the question: “What would happen if sodium and chlorine were put into the same container and heated gently?” Draw Bohr diagrams to help explain the result.

Caution: Do not discuss ionic or covalent bonding, or the concept of ions, as this will be discussed in Senior 2, Senior 3, and Senior 4 Science courses.

➢ **Student Learning Activities**

Journal Writing S1-0-5c, 6a

Students identify which of three elements is the most reactive, and explain why (e.g., oxygen, neon, and fluorine).

Students view a video on chemical families using a “LAPS” strategy. (See *Success for All Learners*, page 6.108)

L = listen to what is said in the video.

A = ask three questions that could be on a test.

P = picture or illustrate a concept discussed in the video.

S = summarize 15 key points addressed in the video.

Laboratory Activity

Students investigate the link between atomic structure and periodicity.

Case Study: Students study the importance of metal reactivity to technology (e.g., the use of reactive elements to create “fireworks”).

Visual Displays

Students draw Bohr diagrams for the first 18 elements (or examine diagrams drawn earlier) and classify them into their respective families. Students reflect on and respond to the following questions:

- What similarities do you notice for all the elements of each family?
- How do the outer shell electrons help you determine the reactivity of the element?

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Test/Quiz

Students

- explain variations in chemical reactivity of elements based on their position on the periodic table relative to the noble gases.
- explain why the alkali metals and halogens are the most reactive families.
- explain why the noble gases are generally unreactive.
- explain why the outer shell of electrons is an important factor for determining chemical properties.

Laboratory Report

Students prepare a report explaining the link between atomic structure and reactivity based on their observations.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

SUGGESTED LEARNING RESOURCES

Science 9

4.5 Investigation: Groups of Elements and Compounds, pp. 114–16

4.8 Investigation: Linking Atomic Structure and Periodicity, pp. 122–23

4.9 Activity: Groups of Elements Profile, p. 124

3.7 Explore an Issue: Fireworks, pp. 98–99

Sciencepower 9

8.1 Explaining Chemical Families, p. 258

Success for All Learners

6.108 Teaching and Learning Strategies

Teacher Background

The chemical reactivity of an element is determined by the number of electrons in its outer shell or orbit (valence electrons). All atoms want to become structurally and, thereby, chemically stable. An atom achieves this stability when it has a filled outer shell (i.e., eight valence electrons). Recall the noble gases have eight valence electrons and are chemically stable and unreactive.

The atoms of all other elements can achieve this stability only through losing electrons (alkali metals, alkaline earth metals), gaining electrons (halogens, chalcogens), or sometimes sharing electrons. For example, sodium has one electron in its outer shell. Chlorine has seven electrons in its outer shell. Since elements want a stable structure (a filled outer shell), a simple transfer of the outer electron from sodium to chlorine occurs. Now both elements have filled outer shells (sodium's next shell in becomes its outer shell).

Hydrogen has a combining capacity of 1 and will either lose, gain, or share one electron to fill its outer shell.

The alkali metals are very reactive because they have one more electron than the noble gases. The alkaline earth metals are less reactive because they have two additional electrons than the noble gases but are still considered reactive. The halogens are very reactive because they have one fewer electron than the noble gases.

The chalcogens are less reactive because they have two fewer electrons than the noble gases but are still considered reactive.

Alkali metals and halogens readily combine to form compounds involving the transfer of electrons.

Alkaline earth metals and chalcogens also readily combine to form compounds involving the transfer of electrons.

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-09 Compare elements to compounds.

Include: atoms, molecules.

GLO: D3, E1, E2

Skills and Attitudes Outcomes

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ Entry-Level Knowledge

Students have studied pure substances, mixtures, and solutions as well as the particle theory of matter in Grade 7.

The particle theory of matter was reviewed in Grade 8.

➢ Notes for Instruction

Review the particle theory of matter. Consider Dalton's atomic theory to help students distinguish between the properties of elements and compounds.

Define the molecule, element, and compound as follows:

A *Molecule* is composed of a cluster of atoms and can be broken down into those atoms during a chemical change.

An *Element* is a pure substance whose molecules are made up of identical atoms.

A *Compound* is a pure substance whose molecules are made of different kinds of atoms. Compounds can be broken down into simpler substances called elements.

➢ Student Learning Activities

Class Discussion

Discuss the fact that only 112 of the 10 million known pure substances are elements. The rest are compounds.

Students reflect on and respond to the following questions:

- Are there elements that are also compounds?
- Are there atoms that are also molecules?

Prior Knowledge Activity

Students brainstorm to develop a list of common (real-life) chemicals or substances (e.g., salt, sugar, baking soda) and speculate about the chemical composition.

Laboratory Activity S1-0-4e

Student groups bring samples of household products in their original packaging, examine the labels, and list the names of chemicals that make up the product. Each group discusses its findings with the whole class. The class records the findings in a table (see sample below).

Name of Substance	Compound/Elements
Toothpaste	sodium fluoride
Baking soda	sodium bicarbonate

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- discuss the makeup of a compound, element, atom, molecule, and pure substance.
- classify examples of pure substances as elements or compounds.

Visual Displays

- Students build models of compounds and molecules from building blocks or molecular model kits.
- Students or student groups prepare displays containing common household chemicals. Displays can be in the form of posters, information technology presentations, index cards, or models.

Teacher Background

Dalton's atomic theory (1808) is a refinement of the particle theory of matter. Dalton explained the differences among elements in terms of the different kinds of particles called atoms.

A pure substance is defined as a substance that contains only one kind of particle. A mixture is defined as a substance that contains two or more pure substances.

(continued)

Suggested Learning Resources

Science 9

2.1 Models of Matter: The Particle Theory, p. 44

2.8 Atoms, Molecules, and the Atmosphere, p. 60

2.9 Activity: Building Models of Molecules, pp. 62–63

3.5 Investigation: Using Electrons to Identify Elements, pp. 94–95

BLM 2 Classification of Matter Concept Map

BLM 2.1 Particle Theory of Matter

Sciencepower 9

5.4 Atomic Theory, p. 183

6.2 Elements on the Planet Earth, p. 198

BLM 8-19 Kitchen Chemistry

BLM 7-2 Elements and Colours

(continued)

Prescribed Learning Outcomes

Students will...

(continued)

S1-2-09 Compare elements to compounds.

Include: atoms, molecules.

GLO: D3, E1, E2

Suggestions for Instruction

(1-1/2 hours)

➢ **Student Learning Activities (continued)**

Laboratory Activity

Students perform flame tests to obtain evidence of the presence of a metal element in a compound or mixture.

Journal Writing S1-0-6a

Students name as many compounds as they can from their previous knowledge or experience.

Students use a Compare and Contrast frame to illustrate the relationship among atoms, elements, molecules, and compounds. (See *SYSTH*, pages 10.15, 10.24)

Students create a list of at least 20 pure substances that they know of. A review of differences between pure substances and mixtures may be necessary at this time to help students avoid generating lists that contain mixtures. Have students classify the substances as elements or compounds in chart form.

Pure substance	Element	Compound
Salt		
Water		
Gold		
Ozone		
Carbon Dioxide		

Models: Students build models of compounds and molecules from building blocks or molecular model kits to illustrate the relationship among atoms, elements, compounds, and molecules.

Visual Displays S1-0-5c

Students collect and post pictures of common chemicals and chemical names throughout the classroom.

Students create a concept map depicting the relationships among the terms associated with this learning outcome.

Suggestions for Assessment

Laboratory Report

Students prepare a lab report based on the flame tests of different elements.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

SYSTH

10.15, 10.24	Building a Scientific Vocabulary
11.38–11.39	Laboratory Report Outline
13.21	Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-10 Interpret chemical formulas of elements and compounds in terms of the number of atoms of each element.

Examples: He, H_2, 0_2, H_2O, CO_2, NH_3…

GLO: C2, D3

Skills and Attitudes Outcomes

S1-0-4a. Carry out procedures that comprise a fair test.
Include: controlling variables, repeating experiments to increase accuracy and reliability of results.
GLO: C1, C2; TFS: 1.3.1

S1-0-4b. Demonstrate work habits that ensure personal safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment.
GLO: B3, B5, C1, C2

S1-0-4c. Interpret relevant WHMIS regulations.
Include: symbols, labels, Material Safety Data Sheets (MSDS).
GLO: C1, C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION
(3 HOURS)

➢ **Entry-Level Knowledge**

Students have studied the relationship among atoms, elements, and compounds in previous learning outcomes.

➢ **Notes for Instruction**

Define a chemical formula as the combination of chemical symbols that indicate what elements make up the compound and the number of atoms of each element present. For example: H_2O.

H = symbol for hydrogen. The number following H indicates the number of hydrogen atoms present.

O = symbol for oxygen. The number following O indicates the number of oxygen atoms present. When no value is shown, it is treated as 1.

Avoid discussing detailed molecular bonding or structure. It is sufficient that students should recognize that a particular pure substance is made up of the same type of molecules, all sharing the same chemical formula.

➢ **Student Learning Activities**

Prior Knowledge Activity

Students draw a diagram to show their mental picture of a specific molecule such as water (H_2O), carbon dioxide (CO_2), or oxygen (O_2).

Problem Solving

Students complete a chart demonstrating chemical formulas. For example:

Name of Compound	Formula of molecule	Elements present	Number/Type of atoms
Water	H_2O	Hydrogen	2 atoms H
		Oxygen	1 atom O

Models: Students use building blocks or molecular model kits to further their understanding of compounds.

Case Study: Students investigate tests used to identify elements and compounds (e.g., flame tests, spot tests, etc.).

Laboratory Activity S1-0-4a, 4b, 4c, 4e

Students perform a laboratory assignment to determine what gases make up the composition of air.

Teacher Demonstration

Students record their observations during a demonstration of the electrolysis of water and identify the gases formed.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Test/Quiz

Students

- determine the number of atoms and elements within the molecule of a compound.
- interpret a chemical formula in terms of the elements present in the molecule and the number of atoms of each element.

Visual Displays/Models

Students build molecular models to represent various compounds, given the ratio of elements they contain. Assess using an observation checklist.

Laboratory Report

Students prepare a report based on the identification of gases within air. Students record their observations and explain them in terms of their understanding of matter.

Suggested Learning Resources

Science 9

2.4 Investigation: Breaking Compounds and Elements, pp. 52–53

2.5 Case Study: Testing for Elements and Compounds, pp. 54–55

2.6 Identifying Mystery Gases, pp. 56–57

2.9 Building Models from Molecules, pp. 62–63

4.7 Explore an Issue: Ozone: a Global Environmental Hazard, pp. 120–21

BLM 2.7a How to Count Atoms

BLM 2.7b Counting Atoms Worksheet

Sciencepower 9

6.1 Symbols for the Elements, p. 192

BLM 6-3 Anatomy of Chemical Formula

6-A Investigation: Interpreting Chemical Formulas, pp. 195–96

5-D Investigation: Decomposing Water with Electricity, pp. 180–82

Appendices

2.1 Blackline Master Vocabulary

2.13 Student Learning Activity Chemical Formulas

Prescribed Learning Outcomes

Students will...

S1-2-11 Investigate properties of substances and explain the importance of knowing these properties.

Examples: usefulness, durability, safety…

GLO: A5, B2, D3, E1

Skills and Attitudes Outcomes

S1-0-4a. Carry out procedures that comprise a fair test.
Include: controlling variables, repeating experiments to increase accuracy and reliability of results.
GLO: C1, C2; TFS: 1.3.1

S1-0-4b. Demonstrate work habits that ensure personal safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment.
GLO: B3, B5, C1, C2

S1-0-4c. Interpret relevant WHMIS regulations.
Include: symbols, labels, Material Safety Data Sheets (MSDS).
GLO: C1, C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

Suggestions for Instruction
(1-1/2 hours)

➢ Entry-Level Knowledge

Students have studied physical and chemical changes and the properties of substances in Grade 5.

Students have studied physical properties like density and solubility with respect to solids, liquids, and gases in Grade 8.

➢ Notes for Instruction

Discuss the importance of knowing and understanding the properties of materials in order to understand their usefulness, cost to society, safety, durability, production, and disposal. For example:

Iron rusts at room temperature when exposed to oxygen and water. Platinum does not react and is very strong. Hydrogen peroxide is very unstable and breaks down when exposed to light, and therefore must be stored in a dark container.

Emphasize that materials are selected for their properties (e.g., solidity, density, melting point, viscosity, malleability, hardness, durability, stability, plasticity, conduction of electricity, etc.).

Environmental considerations also affect material selection. Materials that are cheap to make and last a long time are not always the most desirable from the standpoint of our environment. For example, plastics are very durable but are not readily biodegradable or necessarily "environment-friendly."

➢ Student Learning Activities

Prior Knowledge Activity

Students brainstorm answers to the following questions: What properties of aluminum are important to its use? Aluminum is one of the most abundant elements in the Earth's crust and is relatively cheap today, but in the 19th century, it was more expensive than gold. Why?

Student Research/Journal Writing

Students discuss how the properties of different substances influence their use (e.g., hot air balloons versus gas-filled balloons [reactivity with air, density, flammability]; antifreeze is useful because it has a low freezing point). Students research to find their own examples.

(continued)

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- describe the importance of understanding the properties of substances in determining their usefulness.
- discuss the environmental impact of certain types of products.
- identify both positive and negative aspects of using different substances to accomplish a specific function.

Research Report/Presentation

Students or student groups research the resources, energy requirements, and chemical processes involved in the production, use, and disposal of a specific item. Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations
- visual displays (posters, pamphlets, etc.)

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

1.3 Investigation: Identifying Substances Using Properties, pp. 20–21

1.4 Case Study: In Search of Safer Paint, pp. 22–23

BLM 1 Matter Concept Map

BLM 1.2 Properties of Matter

Sciencepower 9

BLM 5-1 Let's Look at Properties and Change

5-B Investigation: Testing for Gases, pp. 177–78

Appendix D: Properties of Common Substances

Appendices

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-2-11 Investigate properties of substances and explain the importance of knowing these properties.

Examples: usefulness, durability, safety…

GLO: A5, B2, D3, E1

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ **Student Learning Activities (continued)**

Journal Writing

Students list the various substances that become garbage during a typical day, and write an account of how these materials and their properties have an impact on the environment (e.g., students compare metals that rust with metals that are coated with plastic and do not degrade easily).

Laboratory Activity S1-0-4a, 4b, 4c, 4e

Students investigate different types of matter and the changes that occur when they are combined, heated, mixed with water, etc. (e.g., baking soda and vinegar or sodium bicarbonate and water to inflate a balloon).

Case Study: Students study products that are being made safer for human use and the environment (e.g., unleaded gasoline, water-based inks and paints).

Student Research

Students research and report on the resources, energy requirements, and chemical processes involved in the production, use, and disposal of a specific item (e.g., plastic milk bottles, aluminum cans, newspapers).

Suggestions for Assessment

Laboratory Report/Case Study

Students prepare a lab based on the identification of gases from the electrolysis of water.

Students record their observations and explain them in terms of their understanding of matter.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

SYSTH

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-12 Differentiate between physical and chemical changes.

GLO: D3, E1, E3

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources. Include: print, electronic, specialists, other resource people. (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms. Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources. (ELA: S1: 3.3.2) GLO: C2, C4, C6; TFS: 2.3.1, 4.3.4

S1-0-4a. Carry out procedures that comprise a fair test. Include: controlling variables, repeating experiments to increase accuracy and reliability of results. GLO: C1, C2; TFS: 1.3.1

S1-0-4b. Demonstrate work habits that ensure personal safety of others, as well as consideration for the environment. Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment. GLO: B3, B5, C1, C2

S1-0-4c. Interpret relevant WHMIS regulations. Include: symbols, labels, Material Safety Data Sheets (MSDS). GLO: C1, C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. (ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ Notes for Instruction

Define physical and chemical changes and properties as follows:

During a *physical change*, the substance remains the same even though it may change state or form (shape).

During a *chemical change*, the original substance is changed into one or more different substances that have different properties. Atoms stay the same but molecules are transformed, so the products are different substances than the reactants. Changes in colour or temperature, and/or the production of a gas are some of the indicators of a chemical change.

Physical properties include colour, texture, odour, lustre, clarity, taste, state of matter, hardness, malleability, ductility, mp, bp, crystal form, solubility, viscosity, density.

Chemical properties include combustibility, and reaction with acid.

➢ Student Learning Activities

Class Discussion

Students discuss and determine if the following examples describe a physical or chemical change.

- margarine spoils in the fridge
- chocolate goes soft in the hot sun
- clear liquid is mixed with a base and turns purple
- leaves change from green to red
- metal on a bike frame turns from silver to reddish-brown
- water disappears from a glass over time
- sawdust forms from wood being cut with a saw
- brown liquid forms when coffee grounds are put into hot water
- ice breaks into smaller pieces
- CO_2 is dissolved in carbonated drinks

(continued)

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Test/Quiz

Students

- provide concise descriptions of physical and chemical changes.
- identify whether changes are physical or chemical and explain why.

Research Report/Presentation

Students or student groups research and report on careers that require knowledge of the physical and chemical properties of substances. Reports can be presented as

- written reports
- oral presentations
- newspaper articles
- dramatic presentations
- visual displays (posters, pamphlets, etc.)

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

1.2 Properties of Matter, p. 16

1.7 Physical and Chemical Changes, p. 28

Career Profile: Biochemistry and Ethics, p. 86

BLM 1.11b Matter and Change Crossword

Sciencepower 9

5.1 Exploring the Nature of Matter, p. 156

5-A Investigation: Chemical or Physical Change, pp. 160–63

Appendices

2.1 Blackline Master Vocabulary

2.14 Student Learning Activity Physical and Chemical Changes

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

(continued)

Prescribed Learning Outcomes

Students will...

(continued)

S1-2-12 Differentiate between physical and chemical changes.

GLO: D3, E1, E3

Suggestions for Instruction
(2 hours)

➢ **Student Learning Activities (continued)**

Journal Writing

- Students compare the “danger factor” between chemical and physical changes.
- Students compare and contrast physical and chemical changes and properties.
- Students investigate physical and chemical properties of products in their homes and assess their potential uses and associated risks.

Teacher Demonstration/Laboratory Activity
S1-0-4a, 4b, 4c, 4e

Students observe a variety of simple demonstrations to distinguish between chemical and physical changes and identify some characteristics of each. For example:

- Add salt to water and evaporate water to recover salt.
- Add Mg to HCl and demonstrate that Mg cannot be recovered by evaporation.
- Add dry ice to water so that the dry ice vigorously boils. Demonstrate how the carbon dioxide gas cannot be recovered by evaporation.

Students perform experiments to investigate the characteristic properties of matter (e.g., test for the presence of different gases, observe the state of different substances, test for conductivity, magnetism, boiling point, flammability, etc.).

Student Research

Students research and report on potential careers that rely on an understanding of physical and chemical properties of substances.

Suggestions for Assessment

Laboratory Report

Students explain and report their observations of physical and chemical changes. (See *SYSTH*, page 11.26)

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

SYSTH

11.26 Developing Scientific Concepts Using Graphic Displays

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-13 Experiment to determine indicators of chemical change.

Examples: colour change, production of heat and/or light, production of a gas or precipitate or new substance…

GLO: C2, D3, E3

Skills and Attitudes Outcomes

S1-0-4a. Carry out procedures that comprise a fair test. Include: controlling variables, repeating experiments to increase accuracy and reliability of results.
GLO: C1, C2; TFS: 1.3.1

S1-0-4b. Demonstrate work habits that ensure personal safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment. GLO: B3, B5, C1, C2

S1-0-4c. Interpret relevant WHMIS regulations. Include: symbols, labels, Material Safety Data Sheets (MSDS).
GLO: C1, C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ Entry-Level Knowledge

Students have studied the concept of chemical change in previous outcomes.

➢ Notes for Instruction

Students must consider several clues in order to determine the type of change that has taken place. One test is not enough to signify that a chemical change has occurred. Two or more tests will provide better evidence that a chemical change has occurred.

Compare reactants and products from a chemical equation to help students understand if chemical changes have occurred (e.g., $C + O_2 \rightarrow CO_2$; carbon mixes with oxygen to produce a new substance — carbon dioxide). Alternatively, in the example: $H_2O_{(l)} \rightarrow H_2O_{(g)}$; liquid water changes into water vapour. Evaporation has occurred. This is a physical change.

➢ Student Learning Activities

Class Discussion

Students brainstorm and discuss common chemical reactions. Students speculate why the following events occur:

- The rooftops of the Parliament Buildings in Ottawa have turned from reddish-brown to green. The Statue of Liberty in New York harbour has also turned from reddish-brown to green.
- The wax of a candle melts but also disappears.
- Garbage starts to smell after a period of time.
- Metal surfaces, when exposed to water, rust.

Laboratory Activity/Teacher Demonstration
S1-0-4a, 4b, 4c, 4e

Students observe teacher demonstrations that provide examples of various indicators of chemical changes. For example:

- burning candle (gas, heat, light)
- mixing vinegar with baking soda (gas)
- burning steel wool (light and heat)
- adding hydrogen peroxide to manganese dioxide (gas)
- mixing potassium iodide with lead (II) nitrate (colour change, precipitate forms)
- mixing sugar with sulfuric acid (new substance, heat)
- burning magnesium ribbon (light, new substance)
- mixing any base solution with phenolphthalein indicator (colour change)

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- list observations that indicate a chemical change has taken place.
- discuss how to determine if a colour change is a physical or chemical change.

Laboratory Report/Demonstration

Students explain and report their observations of demonstrations involving indicators of chemical changes. (See *SYSTH*, page 11.26)

Teacher Background

Several indicators or clues of chemical changes can be observed qualitatively and quantitatively. For example:

- bubbles of gas
- heat loss or gain
- light emission
- colour changes
- solid material called precipitate forms in a liquid
- production of a new substance
- changes in properties of original substances (reactants)
- changes that are difficult to reverse

Note: All clues or indicators suggest a new substance has been produced but any one of the indicators could also be accompanied by a physical change.

(continued)

Suggested Learning Resources

Science 9

1.6 Investigation: Chemical Magic, pp. 26–27

1.8 Investigation: Observing Changes, pp. 32–33

Sciencepower 9

BLM 1.7a Clues that a Chemical Change has Happened

Appendices

5.5 Lab Report Assessment

SYSTH

11.26 Developing Scientific Concepts Using Graphic Displays

Chapter 14 Technical Writing in Science

PRESCRIBED LEARNING OUTCOMES
Students will...
(continued) **S1-2-13** Experiment to determine indicators of chemical change. *Examples: colour change, production of heat and/or light, production of a gas or precipitate or new substance…* GLO: C2, D3, E3

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ **Student Learning Activities (continued)**

Journal Writing

Have students write a journal entry discussing examples of common daily reactions that involve chemical changes.

Laboratory Activity S1-0-4a, 4b, 4c, 4e

Students perform investigations in which they are asked to identify substances and observe changes of chemical reactions.

Suggestions for Assessment

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

SYSTH

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-2-14 Investigate technologies and natural phenomena that demonstrate chemical change in everyday situations.

Examples: photography, rusting, photosynthesis, combustion, baking…

GLO: A3, A5, B1, B2

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print, electronic, specialists, other resource people. (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2b. Evaluate the reliability, bias, and usefulness of information.
(ELA: S1: 3.2.3, 3.3.3) GLO: C2, C4, C5, C8; TFS: 2.2.2, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia (ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

S1-0-8a. Distinguish between science and technology.
Include: purpose, procedures, products.
GLO: A3

S1-0-8c. Describe examples of how scientific knowledge has evolved in light of new evidence, and the role of technology in this evolution.
GLO: A2, A5

S1-0-8d. Describe examples of how technologies have evolved in response to changing needs and scientific advances.
GLO: A5

S1-0-8f. Relate personal activities and possible career choices to specific science disciplines.
GLO: B4

S1-0-9b. Express interest in a broad scope of science- and technology-related fields and issues.
GLO: B4

SUGGESTIONS FOR INSTRUCTION
(1-1/2 HOURS)

➢ Notes for Instruction

Discuss technologies and natural phenomena that involve chemical reactions to help students appreciate the extent of chemical changes occurring in both natural and artificial environments.

Discuss chemical changes that are the result of technology (e.g., corrosion, electroplating, combustion, pollution resulting from production of fertilizers, silver tarnishing, preservatives, baking, forensic science, influence of drugs on the human body, synthetic drugs, and photography, etc.).

Discuss natural phenomena that demonstrate chemical change (e.g., photosynthesis, respiration, fermentation, decomposition, digestion, hormonal responses in the human body, etc.).

➢ Student Learning Activities

Students brainstorm and discuss both natural occurrences and artificial occurrences of chemical changes.

Laboratory Activity/Teacher Demonstration

Students investigate the importance of chemical changes in various technologies (e.g., electroplating, chemical fertilizers, film processing, baking, etc.). Students perform an experiment that examines and stops the oxidation of fresh fruit.

Field Study: Students take a walking tour in or around the school and list the applications of science that they notice (e.g., the materials used to build the school; how the school is heated, cooled, ventilated, and lit; uses of electricity, vehicles, fuels, plants, pollution, their own bodies.

Guest Speaker (S1-0-2b): Invite a guest speaker into the classroom from a farm supply company, a manufacturing plant, a bakery, a film processing lab, a hair salon, or a mechanic shop to discuss the role of chemical changes in his or her business. Students prepare questions in advance of the visit. Questions could include:

- What background/education/experience is required for your job?
- What is the role that chemical changes play in your line of work?
- What safety procedures are in place in your work environment?
- Describe a typical work day.

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students answer the following questions:

- How are chemistry and chemical change related to food?
- Describe the importance of chemical compounds and chemical changes to various industries (e.g., farming, gardening, baking, forensic science, hair styling, pharmacy, water treatment, automotive, etc.).

(continued)

Suggested Learning Resources

Science 9

1.9 Corrosion, p. 34

1.10 Investigation: Preventing Corrosion, pp. 36–37

1.11 Combustion, p. 38

2.11 Plant Nutrients and Fertilizers, p. 66

3.7 Explore an Issue: Fireworks: Electron Jumps in Action, pp. 98–99

BLM 1.11a Changes in Matter Map

Sciencepower 9

8.4 Chemicals in Your Life, p. 277

(continued)

Prescribed Learning Outcomes
Students will...
(continued) **S1-2-14** Investigate technologies and natural phenomena that demonstrate chemical change in everyday situations. *Examples: photography, rusting, photosynthesis, combustion, baking…* GLO: A3, A5, B1, B2

Suggestions for Instruction
(1-1/2 hours)

➢ **Student Learning Activities (continued)**

Student Research/Report S1-0-2a

Students research and report on any modern technology that relies on chemical reactions.

Throughout history, women have had the main responsibility for preparing and preserving food for their families. Speculate on their knowledge of the properties of different substances, and how they used this information.

Collaborative Teamwork S1-0-4e

Student groups draft proposals that promote a new material to a manufacturing company — a material that changes either physically or chemically. The proposal should answer the question: How does this property make it useful?

Visual Displays S1-0-4e, 5c

Students or student groups prepare a visual display of technologies that rely on chemical changes.

Journal Writing

Students reflect and write about what a day in their lives would be like without chemical changes. They respond to the question: In what ways would their regular routines and activities be altered?

Suggestions for Assessment

Research Report/Presentation:

Students or student groups research and report on any technology that relies on chemical reactions, or create a proposal that promotes some sort of new material to a manufacturing company. Reports can be presented as:

- written reports
- oral presentations
- newspaper articles
- dramatic presentations

Textbooks, library reference materials, Internet sites, and other print and electronic media can be used for research and presentations.

Visual Display

Students or student groups prepare a visual display of technologies that rely on chemical changes. The display may include posters, diagrams, concept maps, or models.

Laboratory Report/Demonstration

Students explain their observations of demonstrations involving technologies that rely on chemical changes. (See *SYSTH*, page 11.26)

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

Appendices

5.2 Rubric for Assessment of Class Presentations

5.3 Rubric for the Assessment of a Research Project

SYSTH

11.26 Developing Scientific Concepts Using Graphic Displays

13.21 Writing to Learn Science

NOTES