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Investigating
SCIENCE

9



Investigating SCIENCE

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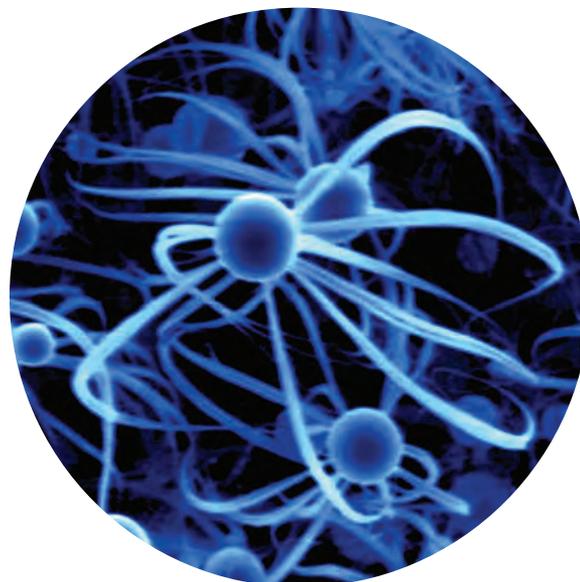
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You are about to begin a scientific exploration using *Investigating Science 9*. To assist you in your journey, this book has been designed with the following features to help you.

1. Unit Overview — what you will learn

The book is divided into four units. Each unit opens with a large photograph that captures one of the ideas that will be covered in the unit.

UNIT A Sustainable Ecosystems

Contents

- 1 Ecosystems are complex, self-regulating systems of organisms and their abiotic environments.**
 - 1.1 Ecosystems
 - 1.2 Nutrient Cycles and Energy Flow
 - 1.3 Interactions in Ecosystems
- 2 Human activity affects the sustainability of ecosystems.**
 - 2.1 Human Use of Ecosystems
 - 2.2 Assessing the Impact of Human Activities on Ecosystems
- 3 Governments, groups, and individuals work to promote sustainable ecosystems.**
 - 3.1 Government Action to Protect Canada's Ecosystems
 - 3.2 Environmental Stewardship

Unit Task

You will be part of a team that is designing a highly sustainable community to be built in your area. You will look into how resources are currently used in your area, and research ways to lessen the impact on your local ecosystems.

Essential Question

How do human activities, both positive and negative, affect the sustainability of ecosystems?

The unit **Contents** lists the Chapters, Key Ideas, and sections in the unit. The orange DI box indicates essential lessons that have additional differentiated instruction support in the Teacher's Resource.

An introduction to the **Unit Task** is provided below the unit Contents. This task is revisited at the end of each chapter, providing you with an opportunity to review key ideas covered in the chapter that will be required to successfully complete the Unit Task.

2. Exploring — adds interest

This spread is an introduction. It has an interesting real-world example to introduce the unit.

Exploring

Cootes Paradise

The lush green of Cootes Paradise hangs up against the hard edge of the city of Hamilton. Cootes Paradise is a wetland located beside the city of Hamilton. A wetland is an area in which the soil is saturated with water for at least part of the year. Wetlands provide a home for many different species of fish, plants, insects, and birds. Many people also use wetlands for camping, fishing, and wildlife viewing.

What caused the plant populations to decrease?

Pollution and urban development have affected Cootes Paradise, but another factor has taken its toll on the wetland—carp. These fish feed in the shallow waters by pulling up the roots of water plants, damaging the plants and sucking the waters as they go. This makes it difficult for water plants and other fish species to survive. Almost 95 percent of the water plants in the marsh have disappeared. This was never supposed to happen.

Taking Action

In 1983, the municipal government of Hamilton and the local community joined together to take on the challenge of restoring Cootes Paradise. One of the many things they did was to install a fishway at the entrance to Cootes Paradise. It allows small fish to enter the wetland but prevents large fish from entering. The large fish are then captured and inspected. Wetland fish species are returned to Cootes Paradise, but adult carp are not. The fishway project has been a tremendous success and wetland plant and fish species are recovering.

11 Science, Technology, Society and the Environment

Pesticide Use Across the Country

Province/Territory	Year	Pesticide Use (kg/ha)
Canada (Average)	1994	~15
	2007	~10
Alberta	1994	~10
	2007	~5
British Columbia	1994	~10
	2007	~5
Manitoba	1994	~10
	2007	~5
Ontario	1994	~10
	2007	~5
Quebec	1994	~10
	2007	~5
Atlantic Provinces	1994	~10
	2007	~5

1. Why does each province show less use?

2. Which one of the regions on the graph is the province that had the highest pesticide use in 1994 and 2007?

3. Which province had the lowest pesticide use in 1994 and 2007?

4. What percentage of pesticides used in provinces in New Brunswick in 1994 and 2007?

5. Which province did not change pesticide use over the period of the study?

6. Did pesticide use in the country increase or decrease between 1994 and 2007?

7. An important step in solving environmental problems is to get the government and local firms to pesticide usage. How has the graph shown the progress which province did first, the province to reduce its pesticide use?

8. How has pesticide use changed in Ontario between 1994 and 2007? Has it increased or decreased? Explain why.

This activity connects the themes of Science, Technology, Society, and the Environment to what you are learning.

3. Chapter Introduction — organizes the topics

Each chapter starts with an engaging visual designed to motivate your interest and provide discussion opportunities for the class.

1 Ecosystems are complex, self-regulating systems of organisms and their abiotic environments.

Skills You Will Use

In this chapter you will:

- Interpret data from undisturbed and disturbed ecosystems and graph the results, and explain the importance of biodiversity for all sustainable ecosystems.

Concepts You Will Learn

In this chapter, you will:

- Describe the complementary processes of photosynthesis and cellular respiration with respect to the flow of energy and the cycling of matter within ecosystems, and explain how human activities can disrupt the balance achieved by these processes.
- Describe the limiting factors and explain how these factors affect the carrying capacity of an ecosystem.
- Identify Earth's four spheres (biosphere, hydrosphere, atmosphere, and geosphere) and describe how these spheres interact to maintain sustainability and biodiversity.

Why It Is Important

There are many different ecosystems on Earth. If we know how an ecosystem functions as a system, we can analyze how human activities sometimes disrupt ecosystems and make them unsustainable. We can then help to repair or restore ecosystems.

Science Reading

Visualize to Understand

Good readers picture words and whole phrases of text in their minds. Preview the key terms and main words/phrases in section 3.1 and use the words or parts of words you know to begin constructing a picture of ecosystems.

Key Terms

- abiotic • atmosphere • biodiversity • biosphere • biotic • carrying capacity • cellular respiration • ecosystem • energy pyramid • hydrosphere • limiting factor • organisms • nutrient cycle • photosynthesis • population

The right side of the page provides learning support for you by listing What Skills You Will Use, Concepts You Will Learn, and Why This Is Important. A **Before Reading** or **Before Writing** strategy starts the Before, During, and After literacy activities for each chapter.

4. Sections — engaging information on the topics

There are two or three sections in each chapter. Each section starts with a reading and a Quick Lab activity.

1.1 Ecosystems

Many cultures, especially those with a history of living close to the land, hold a deep respect for the natural world. For example, Cree and other First Nations teach that the members of each generation must be careful stewards of the Earth to ensure the survival of at least the next seven generations. For this to be possible, the natural environment must be used in a sustainable way. **Sustainability** is the environmental measure that populations of plants, animals, and other living organisms can continue to interact and to reproduce indefinitely. It also means that biodiversity is preserved. **Biodiversity** is the number of different types of organisms in an area. The more types of organisms there are in an area, the more biodiversity the area has. High levels of biodiversity are associated with a healthy, sustainable environment.

Planet Earth

High above the planet, the International Space Station offers a breathtaking view of Earth (Figure 1.1). Canadian astronaut Terry Williams has been privileged to see that view first-hand. After returning to Earth, he had this to say about his experience:

"I am truly in awe of the beauty of the planet, and it's something I've been able to experience in so many different environments, whether in space, under water, camping, hiking, climbing mountains or whatever. For me, it generates a sense of planetary stewardship."

Sustainability is a way of acting that involves taking personal responsibility for the management and care of something. Planetary stewardship means working to take care of the whole world. A very common term for this is environmental stewardship. The **environment** is all the living and non-living things that exist on Earth as well as their interactions with each other. The beautiful blue sphere that astronauts have photographed from space helps us remember that the resources in our environment are limited. All life depends on what is contained on that sphere. While the view from space is new to us, the idea of the importance of environmental stewardship is far from new.

Table 1.1 Canadian Biodiversity

Category	Number of Species
Mammals (e.g., deer)	4 500
Reptiles and amphibians (e.g., snakes, frog)	13 500
Fish (e.g., trout)	23 000
Crustaceans (e.g., shrimp)	40 000
Mollusks (e.g., clams)	70 000
Sponges (e.g., glass sponges)	10 000
Birds (e.g., doves)	10 000
Insects (e.g., bees)	950 000
Arachnids (e.g., spiders)	70 000
North and Central American plants	270 000
Fungi and lichens (e.g., mushrooms)	100 000

Each section includes a summary of what you will learn in the section.

The **Quick Lab** activity is a short, informal learning experience using simple materials and equipment.

During Reading and **During Writing** literacy activities provide you with an opportunity to consolidate your understanding. The **Learning Checkpoint** allows you to check your understanding of what you have just read. **Words Matter** helps you understand a term by describing its origin.

Table 5.2 Selected Element Names and Symbols

English Name	Symbol	Non-English Name and Meaning
Non-Metals		
hydrogen	H	Hydro: Greek: water-generating
helium	He	Helios: Greek: Sun
lithium	Li	Lithos: Greek: stone
boron	B	Al-Burj: Arabic: the star
carbon	C	Char: Latin: coal
nitrogen	N	Nitrum: Latin: saltpeter
oxygen	O	Genese: Greek: to generate
fluorine	F	Fluor: Latin: to melt
phosphorus	P	Phosphoros: Greek: light-bearing
sulfur	S	Chalcite: Latin: yellow stone
iodine	I	Iodo: Greek: violet
calcium	Ca	Calx: Latin: lime
strontium	Str	Strontian: Scottish Gaelic: Strontian
barium	Ba	Barium: Latin: named for barium
cesium	Cs	Cæsium: Latin: named for caesium
rubidium	Rb	Rubrum: Latin: red
potassium	K	Potash: Arabic: pot
cadmium	Cd	Cadmia: Latin: named for cadmia
indium	In	Indium: Latin: named for India
tin	Sn	Stannum: Latin: tin
antimony	Sb	Stibium: Latin: named for stibium
tellurium	Te	Telluris: Latin: Earth
polonium	Po	Polonia: Latin: Poland
thallium	Tl	Thallos: Greek: seaweed
lead	Pb	Plumbum: Latin: lead

Learning Checkpoint

- What would happen if you had a mixture of hydrogen and oxygen?
- Give an example of a metal element and its following properties:
 - is a solid at room temperature
 - is ductile
 - is a good conductor of electricity
 - is a good conductor of heat
 - is a good conductor of sound
 - is a good conductor of light
 - is a good conductor of heat
 - is a good conductor of sound
 - is a good conductor of light
- How do you think the properties of a metal element are related to its atomic structure?
- How do you think the properties of a non-metal element are related to its atomic structure?

Some Common Elements

Human history has long been influenced by the availability of certain elements. Iron, for example, occurs naturally in Earth's crust as iron ores, which have been used since ancient times. The Iron Age began several thousand years ago, when technologies to obtain iron from iron ores became widespread. When another element, carbon, was added to iron, steel was formed.

Two other elements, hydrogen and oxygen, can combine to make water, a pure substance vital to living organisms. Another two elements, sodium and chlorine, can combine to make another pure substance that is vital to life: table salt. Without either water or salt, life as we know it could not survive.

Iron (Fe)

Iron is quite common, and once separated from ores, it can be used for a wide range of items. Iron is very strong, and when combined with carbon to make steel, it is even stronger (Figure 5.24). Another advantage of steel is that it can be made fairly resistant to corrosion. In contrast, plain iron corrodes easily in moist air, forming an orange compound known as rust.

Like most metals, iron is a soft grey and can be melted and shaped when heated. It is hard enough to keep a sharp edge, a property that people have used for centuries in order to make tools and household items.

7. Unit Task — lets you demonstrate learned skills

A task at the end of each unit presents an opportunity for you to demonstrate what you've learned. You'll work in a group or individually. The task requires you to apply some of the skills and knowledge that you have acquired during the unit.

UNIT A Task
Building a Sustainable Community

Getting Started
Choosing your site builds and brings more excitement about recycling and being more resourceful in your sustainable lifestyle. Imagine if your entire community adopted such practices as a way of life. Then an opportunity will arise. They have been a more eco-village. Eco-villages are completely self-sufficient, sustainable communities designed to have a minimal footprint on surrounding ecosystems. Eco-villages carefully control their land and food consumption. Eco-villages try to live, work, and play in a small region to minimize commuting, which reduces energy consumption. Working a short distance to work or school can be a lot more satisfying than spending hours a day in traffic.

Criteria for Success
You will work in groups and independently as part of a team designing a new eco-village. You will evaluate a specific task for the team, such as:
 • food specialists
 • water manager
 • waste manager
 • public facilities
 • recreation specialist
 You will research aspects of the eco-village during its year of research and continue with the other team members to build the village.
 For the area of expertise you wish to research, you will:
 • evaluate the ways the community will contribute to sustainability
 • outline specific changes that will increase the sustainability of your eco-village

What You Need to Know
Most eco-villages share several key characteristics, including the following:
 • use of renewable energy sources
 • agriculture that is closely linked to natural conditions
 • resourceful use of techniques and materials that have a minimal impact on the environment
 • homes that have the capacity to provide clean water and sewage solutions without relying on a centralized system

What You Need
 • computer with internet access
 • procedure
 1. In your group, brainstorm aspects of your local community that are unsustainable. Organize these thoughts into the following categories: buildings, food, technology, water, waste, and recreation. Brainstorm possible solutions with:
 • current building design and construction techniques
 • current building design and construction practices
 • energy demand at global, national, and local levels
 • local water sources and how much people use for such things as irrigation, washing, and hot water
 • how well your community recycles, reuses, and recycles
 • local ecological issues such as habitat change or fragmentation or pollution

Assessing Your Work
 2. Decide which report role each person will assume. Use the results of the group brainstorming that result in your final scenario to fill a group's response.
 3. **Minimum:** Do an internet search to find keywords such as "eco-village," "sustainable community," "permaculture," to find information related to the aspect of sustainable communities plan or meaning.
 4. As a group, decide on the final location for your eco-village. Keep in mind that your village must be able to flourish as a location. Your location must have enough access to building materials, water, people of employment and schools.
 5. Collaborate with your team to design an eco-village and incorporate some of each member's ideas.
 6. Consider how to connect your design ideas. Will you create a compound, a PowerPlant connection, a public transit system, or use some other method?
 7. Present your eco-village design.
 8. Do you think building a completely sustainable community is possible? Explain.
 9. What were the advantages and disadvantages of having a group of experts create the eco-village design?

8. Unit Review — connects what you have learned

The Unit Review is an opportunity to review the concepts, skills, and ideas you have learned in the unit.

UNIT A Review
ASSESSMENT CHALLENGES

Key Terms Review
3. Create a concept map that illustrates your understanding of the following terms and how they relate to sustainability concepts:
 • abiotic factors
 • atmosphere
 • biogeochemical
 • biotic factors
 • carrying capacity
 • cellular respiration
 • ecosystem
 • equilibrium
 • homeostasis
 • limiting factors
 • biogeochemical
 • population
 • sustainability

Key Concept Review
7. Ecosystems are complex, self-regulating systems of organisms and their abiotic environments.
 2. There are abiotic factors that could affect a population of squirrels.
 3. How is food chain related to a food web?
 4. How do different car parts, dogs, cat products, and grasshoppers use (or connect) a food chain with the above organisms?
 (a) Draw a diagram to your desktop.
 (b) Add a measure of energy for the organisms in your diagram.

Connect Your Understanding
 18. Explain why it is more accurate to define the biosphere as a global ecosystem rather than a global community.
 19. Hypothesize what would happen as an ecosystem that had all of its decomposers removed.
 20. Insects are food for your health and are responsible for many diseases that eat humans, animals, and plants. All efforts should be taken to completely eradicate insects on the planet.
 (a) Evaluate the validity of this statement. Support your answer.
 (b) If true:
 21. Study:
 (a) Why?
 (b) How?
 (c) What?
 (d) How?

Skills Practice
 33. The diagram shows the setup for a tank full of fish was added to all the test tubes. A small aquatic plant was placed in test tubes B and C. Carbon dioxide forms carbonic acid when it dissolves in water. Phosphoric acid is a substance that forms when the presence of carbonic acid. A few drops of phenolphthalein were added to each test tube. The table shows the initial observations for the experiment. The tubes A and B were placed in a dark, cool location. Test tubes C and D were placed in a sunny location.
 (a) What is the purpose of test tubes A and C?
 (b) Using your knowledge of the carbon cycle, predict what will happen for each test tube.
 (c) Explain your predictions for each test tube.
 (d) The experiment is repeated, but each test tube is filled with cold tap water instead of water from a dark tank of fish. Predict the initial and final colour of the water in each test tube.
 34. A pitcher plant is a carnivorous plant that traps insects such as crickets. The insects die inside the plant and decompose. The liquid absorbs the nutrients from their decomposing bodies that the soil does not contain. The pitcher plants are circumscribed by herbivorous mammals. Draw a food chain that represents this scenario.
 35. In a particular ecosystem, it has been determined that the secondary consumers use 1200 kJ of energy.
 (a) How much energy was used in the producers in that same food chain?
 (b) How much energy would be used by the

Revisit the Big Ideas and Fundamental Concepts
 41. The term "ecosystem" is short for ecological system. Ecosystems are complex, self-regulating systems of organisms and their abiotic environments.
 (a) What is ecology?
 (b) What is an ecosystem?
 (c) Using the example of an aquatic ecosystem that has algae, a fish that eats algae, a bear that eats algae eaters, and eagles that eat bears, explain how matter cycles and energy flows through the ecosystem.
 (d) Suppose the population of algae eaters suddenly increased due to an increase in algae. How might the ecosystem self-regulate to return the algae-eater population?
 42. Explain how sustainability and biodiversity are interrelated.
 43. Write the five most factors that increase loss of biodiversity on Earth?
 44. What are wetlands, and what is the most devastating effects of human activities on wetlands?
 45. Suppose you were given the task of assessing the water quality of a lake, ecosystem, and yourself based on measurements of the water done by sending water samples to labs for analysis. What are some types of tests you would order to be done on the water?
 46. Governments are able to take various kinds of actions that affect groups around the world. They can make treaties with other countries and also pass laws. Explain how creating treaties and passing laws have worked to promote sustainable ecosystems in Ontario.
 47. What kinds of actions are available to individuals in Canada to help make our world ecologically sustainable?
 48. The polluting of Lake Erie is a dramatic example of how activities in your neighbourhood can affect other parts of the province or even the world. Compile a short report that outlines how one or more personal activities could have a negative impact on distant ecosystems. Then propose solutions to lessen those impacts on ecosystems.
 49. Governments, groups, and individuals can work together to promote sustainability of ecosystems. Choose one of these that you have learned about and explain what environmental issues they have tackled and their solutions to the problem. Explain what you have learned and suggest additional actions that they could take.
Reflection
 50. Suppose you were to share a small part of your friends, family and neighbours to make their aware of various factors that affect the sustainability of ecosystems. How do you think they would think you could do to make them aware of the problems and the possible solutions?
 51. What is the most important thing you learned in this unit about the causes of ecosystem?

Science, Technology, Society, and the Environment
 48. The polluting of Lake Erie is a dramatic example of how activities in your neighbourhood can affect other parts of the province or even the world. Compile a short report that outlines how one or more personal activities could have a negative impact on distant ecosystems. Then propose solutions to lessen those impacts on ecosystems.

Table: Fish Catches 1990-2004

Year	Total Commercial Landings	Total Aquaculture Sales Harvested
1990	76,345	40,214
1995	82,524	40,521
1998	82,854	51,167
1999	314,060	22,572
2002	307,489	91,498
2004	229,627	127,528

Table: Fish Catches 2002, 2004

Year	Wild Population	Value added
2002	100,000	100,000
2004	100,000	100,000

Key Terms Review
This is a chance to review the important terms in the unit

Key Concept Review
Questions designed to review your basic understanding of the key concepts in each chapter of the unit

Connect Your Understanding
Questions that require you to use the ideas in more than one chapter in your answers

Skills Practice
Questions related to specific skills you have learned in the unit

Science, Technology, Society, and the Environment
Opportunities to express your thoughts about ideas related to Science, Technology, Society, and the Environment issues discussed in the unit

Reflection
Opportunities to express your thoughts about ideas you have discovered in the unit

Revisit the Big Ideas and Fundamental Concepts
Questions that revisit the Big Ideas and Fundamental Concepts covered in the unit

9. Other Features — bring science to life

Here are other features you will find in each unit. Each one has a different purpose and is designed to help you learn about the ideas in the unit.

Investigating Careers in Science
Here you will find profiles of great Canadians in science as well as careers in science based on the different types of science studied in each unit.

Investigating CAREERS in Science

Great CANADIANS in Science **Tolerance** **Julie Payette**

Julie Payette is a Canadian astronaut who spent 28 days in space, orbiting the Earth and completing 25 orbits. She is the first Canadian woman to fly in space. She is also a former professional figure skater and a member of the Canadian Space Agency.

Science in My FUTURE **Robotics Engineer**

Robotics engineers design and build robots that can perform tasks that are difficult or dangerous for humans. They work in a variety of industries, including manufacturing, healthcare, and space exploration.

SCIENCE Everywhere

Cool Symbiosis

Discover the amazing world of symbiosis, where different organisms live together and benefit from each other. From the relationship between a clownfish and a sea anemone to the partnership between a monarch butterfly and a milkweed plant, symbiosis is everywhere.

Science Everywhere
This feature presents interesting information about concepts covered in the unit.

COOL IDEAS from JAY INGRAM

Save the Stars ... with Dark-Night Preserves

Light pollution is a growing problem that is making it difficult to see the stars in the night sky. One way to help is by creating dark-night preserves, which are areas where artificial light is minimized.

Cool Ideas
This feature is written by Discovery Channel *Daily Planet* host Jay Ingram to connect concepts covered in the unit to findings coming from current research.

10. Skills Reference — provides skills information and practice

These pages provide references to lab safety and other basic scientific skills that will help you as you do the activities. Remember to check the Skills Reference when you need a reminder about these skills.

Skills Reference 1

Safety Symbols

Safety symbols identify potential hazards. When you see any of the following symbols, either in this book or on a product, take extra care.

Safety Symbols in This Book

When you see this symbol, wear goggles or safety glasses while doing the activity.

When you see this symbol, wear gloves while doing the activity.

When you see this symbol, wear a lab coat while doing the activity.

When you see this symbol, wear a lab apron while doing the activity.

When you see this symbol, wear a lab apron and safety glasses while doing the activity.

When you see this symbol, wear a lab apron and safety glasses while doing the activity.

When you see this symbol, wear a lab apron and safety glasses while doing the activity.

WHMIS Symbols

There are symbols you might see on the materials you use in your classroom. You will see them occasionally in the Materials and Equipment lists for activities where a substance that needs a warning is used. These symbols are called Workplace Hazardous Materials Information System (WHMIS) symbols. They are placed on hazardous materials used in lab sites and in textbooks.

Skills Reference 2

The Inquiry Process of Science

Scientists are always asking a lot of questions. They are always inquiring. They want to understand why the things they observe and measure happen. Experiments are important tools scientists use to help them answer their questions.

STEP 1 | Ask a cause-and-effect question.

Having a question to ask is the first step in the inquiry process. The question you ask should be a cause-and-effect question. It should be something you can test in a lab.

STEP 2 | Plan the experiment.

Once you have a question, you need to plan how to answer it. This involves deciding what you will measure, what you will change, and what you will keep the same.

STEP 3 | Carry out the experiment.

Now it's time to do the experiment. Follow the plan you made in step 2, and collect data as you go.

STEP 4 | Analyze the data.

Once you have collected data, you need to analyze it. Look for patterns in the data, and see if they support your hypothesis.

STEP 5 | Draw a conclusion.

Based on your analysis, you can draw a conclusion about whether your hypothesis was supported or not.

Hint: Always try to do a control experiment. This means you should have one trial where you don't change anything, just to see what happens naturally.

Now it is time to start. We hope you will enjoy your scientific exploration using *Investigating Science 9!*

Biology UNIT A: Sustainable Ecosystems	Chemistry UNIT B: Atoms, Elements, and Compounds
<p>Big Ideas</p> <ul style="list-style-type: none"> • Ecosystems are dynamic and have the ability to respond to change, within limits, while maintaining their ecological balance. • People have the responsibility to regulate their impact on the sustainability of ecosystems in order to preserve them for future generations. 	<p>Big Ideas</p> <ul style="list-style-type: none"> • Elements and compounds have specific physical and chemical properties that determine their practical uses. • The use of elements and compounds has both positive and negative effects on society and the environment.
<p>Fundamental Concepts</p> <ul style="list-style-type: none"> • Systems and Interactions • Sustainability and Stewardship • Change and Continuity 	<p>Fundamental Concepts</p> <ul style="list-style-type: none"> • Matter • Structure and Function • Sustainability and Stewardship
<p>Overall Expectations</p> <ol style="list-style-type: none"> 1. assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts 2. investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems 3. demonstrate an understanding of the dynamic nature of ecosystems, particularly in terms of ecological balance and the impact of human activity on the sustainability of terrestrial and aquatic ecosystems 	<p>Overall Expectations</p> <ol style="list-style-type: none"> 1. assess social, environmental, and economic impacts of the use of common elements and compounds, with reference to their physical and chemical properties 2. investigate, through inquiry, the physical and chemical properties of common elements and compounds 3. demonstrate an understanding of the properties of common elements and compounds, and of the organization of elements in the periodic table

Earth and Space Science UNIT C: The Study of the Universe	Physics UNIT D: The Characteristics of Electricity
<p>Big Ideas</p> <ul style="list-style-type: none"> • Different types of celestial objects in the solar system and universe have distinct properties that can be investigated and quantified. • People use observational evidence of the properties of the solar system and the universe to develop theories to explain their formation and evolution. • Space exploration has generated valuable knowledge but at enormous cost. 	<p>Big Ideas</p> <ul style="list-style-type: none"> • Electricity is a form of energy produced from a variety of non-renewable and renewable sources. • The production and consumption of electrical energy has social, economic, and environmental implications. • Static and current electricity have distinct properties that determine how they are used.
<p>Fundamental Concepts</p> <ul style="list-style-type: none"> • Matter • Energy • Systems and Interactions • Structure and Function • Change and Continuity 	<p>Fundamental Concepts</p> <ul style="list-style-type: none"> • Energy • Systems and Interactions • Structure and Function
<p>Overall Expectations</p> <ol style="list-style-type: none"> 1. assess some of the costs, hazards, and benefits of space exploration and the contributions of Canadians to space research and technology 2. investigate the characteristics and properties of a variety of celestial objects visible from Earth in the night sky 3. demonstrate an understanding of the major scientific theories about the structure, formation, and evolution of the universe and its components and of the evidence that supports these theories 	<p>Overall Expectations</p> <ol style="list-style-type: none"> 1. assess some of the costs and benefits associated with the production of electrical energy from renewable and non-renewable sources, and analyze how electrical efficiencies and savings can be achieved, through both the design of technological devices and practices in the home 2. investigate, through inquiry, various aspects of electricity, including the properties of static and current electricity, and the quantitative relationships between potential difference, current, and resistance in electrical circuits 3. demonstrate an understanding of the principles of static and current electricity

Science Safety Procedures

You will be doing many activities in this book.

When doing an activity, it is very important that you follow the safety rules below. Your teacher may have safety instructions to add to this list.

Before You Begin

1. Read and make sure you understand the instructions in the text or in any handouts your teacher may provide. Follow your teacher's direction always. Never change or start an activity without approval.
2. Watch for "Caution" notes such as the one below. These notes will tell you how to take extra care as you work through the activity. Make sure you understand what the cautions mean.

CAUTION: Tie back long hair, and be careful around open flames. Do not touch calcium metal with your bare hands as the metal will react with moisture in your skin.

3. Learn to recognize the safety symbols and the warning symbols for hazardous materials as seen on the next page. These include WHMIS symbols. WHMIS is the Workplace Hazardous Materials Information System.
4. Keep your work area uncluttered and organized.
5. Know the location of fire extinguishers and other safety equipment.
6. Always wear safety goggles and any other safety clothing as requested by your teacher or identified in this book.
7. If you have long or loose hair, tie it back. Roll up long sleeves.
8. Inform your teacher if you have any allergies or medical conditions or anything else that might affect your work in the science classroom.
9. Review the Material Safety Data Sheet (MSDS) for any chemicals you use in the lab. See an example of one on the next page.



Wear proper safety equipment when doing science activities.

Safety Symbols

-  When you see this symbol, wear goggles or safety glasses while doing the activity.
-  This symbol tells you that you will be using glassware during the activity. Take extra care when handling it.
-  When you see this symbol, wear an apron while doing the activity.
-  When you see this symbol, wear insulated gloves to protect your hands from heat.
-  This symbol tells you that you will be working with sharp objects. Take extra care when handling them.
-  When you see this symbol, wear gloves while doing the activity.
-  This symbol tells you that you will be working with wires and power sources. Take extra care when handling them.
-  This symbol tells you that you will be working with fire. Make sure to tie back loose hair. Take extra care around flames.

WHMIS Symbols

-  compressed gas
-  biohazardous infectious material
-  dangerously reactive material
-  corrosive material
-  oxidizing material
-  flammable and combustible material
-  poisonous and infectious material causing immediate and serious toxic effects
-  poisonous and infectious material causing other toxic effects

<h2>Material Safety Data Sheet</h2>			
NFPA Classification	DOT / TDG Pictograms	WHMIS Classification	PROTECTIVE CLOTHING
Health  Flammability 0 Reactivity 2 Specific Hazard W		 	    
Section I. Chemical Product and Company Identification			
PRODUCT NAME/ TRADE NAME Sulfuric Acid			
SYNONYM Oil of vitriol, Dipping acid, Sulphuric acid	MSDS NUMBER:		
CHEMICAL NAME Sulfuric acid	REVISION NUMBER		
CHEMICAL FAMILY Inorganic acid.	MSDS prepared by the Environment, Health and Safety Department on:		
CHEMICAL FORMULA H ₂ SO ₄	24 HR EMERGENCY TELEPHONE NUMBER:		
MATERIAL USES Agricultural use: Manufacture of chemical products. Industrial applications: Manufacture of inorganic products.			

In Canada, manufacturers of all hazardous products used in workplaces, including schools, must provide information sheets about their products. The Material Safety Data Sheet (MSDS) identifies the chemical and physical hazards associated with each substance. It includes physical data, such as melting point and boiling point, toxicity, health effects, first aid, and spill and leak cleanup procedures. WHMIS regulations require employers to make these sheets available to employees who use hazardous substances in their work. The above is an example of an MSDS for a substance that you might use in a science activity.

During the Activity

10. Report any safety concerns you have, or hazards you see (such as spills) to your teacher.
11. Don't chew gum, eat, or drink in your science classroom.
12. Never taste anything in science class.
13. Never smell any substance directly. Instead, gently wave your hand over it to bring its vapours toward your nose.



14. Handle all glassware carefully. If you see cracked or broken glass, ask your teacher how to dispose of it properly.
15. Handle knives and other sharp objects with care. Always cut away from yourself, and never point a sharp object at another person.
16. Heat solids and liquids only in open heat-resistant glass containers and test tubes. Use tongs or protective gloves to pick up hot objects.

17. When you heat test tubes, make sure that the open end is pointing away from you and anyone else in the room.



18. When heating a substance, make sure the container does not boil dry.
19. If any part of your body comes in contact with a chemical, wash the area immediately and thoroughly with water. If you get anything in your eyes, do not touch them. Wash them immediately and continuously with water for 15 min. Inform your teacher.
20. Keep water or wet hands away from electrical outlets or sockets.
21. Use tools safely when cutting, joining, or drilling. Make sure you know how to use any tools properly.
22. Use special care when you are near objects in motion, gears and pulleys, and elevated objects.
23. Make sure equipment is placed safely so that people will not knock it over or trip

over it. Report any damaged equipment to your teacher immediately.

- 24.** Treat all living things with respect. Follow your teacher's instructions when working with living things in the classroom or on a field trip.

When You Finish the Activity

- 25.** Make sure you close the containers of chemicals immediately after you use them.
- 26.** Follow your teacher's instructions to safely dispose of all waste materials.

- 27.** Always wash your hands well with soap, preferably liquid soap, after handling chemicals or other materials. Always wash your hands after touching plants, soil, or any animals and their cages or containers.
- 28.** When you have finished an experiment, clean all the equipment before putting it away. Be careful with hot plates and equipment that have been heated as they may take a long time to cool down.

Learning Checkpoint

Your teacher will give you a copy of an MSDS for bleach solution. Use this MSDS to answer questions 1–8.

- List three synonyms for the name "bleach."
- Bleach solution has two ingredients. What are they? Which of these ingredients is hazardous?
- Find the hazard identification section. Under "Emergency Overview," there is a short summary. Find the summary, and record it.
- Read the list of potential health effects. Copy down the potential health effect caused by eye contact.
- Find the section under "First Aid Measures," and record the instructions for what to do in case of eye contact.
- If a fire were to break out near bleach, should the bleach itself be considered a fire hazard? What special equipment is required to fight a fire in which bleach is present?
- Suppose someone drank bleach. Should the first aid procedure include inducing vomiting to get the solution out of the person? What other treatments are possible?
- Find out what is meant by the term "chronic exposure."
- Why is it important for all students to follow the safety rules in a science class?
- List precautions used in the science laboratory to minimize the following risks.
 - poisoning
 - scalding
 - eye damage
- List the steps you should take before starting a science activity.
- Draw a sketch of your classroom or science lab indicating the location of all emergency equipment and exits.