KNOWLEDGE AND EMPLOYABILITY SCIENCE GRADES 8 AND 9

Knowledge and Employability courses provide students who meet the criteria with opportunities to experience success and become well prepared for employment, further studies, citizenship and lifelong learning.

VISION

Through Knowledge and Employability courses, students become active and responsible citizens, achieve their educational and career goals, improve quality of life for themselves and their families and positively impact their communities.

PHILOSOPHY AND RATIONALE

The development of the Knowledge and Employability courses was based on input received from consultations with education stakeholders throughout the province. The distinctive sequence of courses was designed to meet the educational needs of students who learn best:

- when focusing on the development and application of reading, writing and mathematical literacy,[1] and on essential employability skills
- through experiential learning activities
- when meaningful connections are made between schooling and personal experiences.

Knowledge and Employability courses assist students in:

- transitioning from school to the workplace and community
- preparing for responsible citizenship
- gaining recognition, respect and value from employers and further education providers.

Knowledge and Employability courses promote student skills, abilities and work ethics, including:

- academic and occupational skills of a standard determined by the workplace to be necessary for success
- practical applications through on- and off-campus experiences and/or community partnerships
- career development skills to explore careers, develop a career-focused portfolio and assess career skills
- interpersonal skills to ensure respect, support and cooperation with others.

1. Mathematical literacy: Selecting and applying appropriate mathematical operations, problem-solving strategies, tools and technology, and communicating using mathematical vocabulary in home, workplace and community experiences.

Aboriginal Perspectives and Experiences
For historical, constitutional and social reasons, an understanding of First Nations, Métis and Inuit (FNMI) experiences and perspectives, and recognition that First Nations, Métis and Inuit students have particular needs and requirements, is necessary to enable all students to be respectful and responsible citizens.

Knowledge and Employability courses serve to facilitate positive experiences that will help Aboriginal students better see themselves in the curriculum and assist non-Aboriginal students to develop a better understanding of Alberta's First Nations, Métis and Inuit peoples.

GOALS OF KNOWLEDGE AND EMPLOYABILITY COURSES

Knowledge and Employability courses provide students with practical and applied opportunities to develop competencies necessary to meet or exceed the following goals. Knowledge and Employability courses prepare students to:

- earn a senior high school credential
- enter the workplace upon leaving school with employability and occupational skills that meet industry standards
- make successful transitions to other courses or to further education and training
- become responsible and contributing members of society.

CROSS-CURRICULAR, COMMUNITY AND WORKPLACE CONNECTIONS

Programs of study and resources for Knowledge and Employability courses are distinctive, in part, because they promote cross-curricular, community and workplace connections.

Cross-curricular Connections
Knowledge and Employability courses promote the integration of subjects to emphasize their interrelationships and connections to other school subjects. The philosophy of Knowledge and Employability courses is that students learn best when they can clearly recognize, in their course work, connections, applications and relevance to a variety of everyday experiences. Organizing for instruction may include thematic units, subject integration within units and/or projects in other subjects.

Community and Workplace Connections
Knowledge and Employability courses provide students with practical and applied opportunities to develop basic reading, writing and mathematical literacy. Community and workplace connections ensure learning within applied contexts, connecting the school with environments beyond school, and may include tours to local businesses and industries, mentorships, job shadowing and work experience.

Knowledge and Employability courses promote the development of career portfolios that help students connect their school experience to the world beyond school. Each portfolio will include exemplars of the student's on- and off-campus experiences and can be used when the student is seeking employment or further education/training opportunities. Items appropriate for inclusion in career portfolios include résumés, samples of written work, awards and/or their representations, teacher and self-evaluation checklists, workplace assessment tools and employer letters of recommendation.

SAFETY

Safety is emphasized and relevant information is incorporated throughout Knowledge and Employability courses, including basic safety rules and guidelines and information regarding the safe use of tools, equipment and materials in school, home, community and workplace settings.

TECHNOLOGY

The Information and Communication Technology (ICT) curriculum is infused throughout the Knowledge and Employability courses, including the use of computers and other technology, to support the instruction of technology within an applied context.

ESSENTIAL UNIVERSAL SKILLS AND STRATEGIES

Knowledge and Employability courses emphasize the universal skills and strategies that are essential to all students, including the following:

- Interpersonal skills promote teamwork and respect for, support of and cooperation with others.
- Critical thinking promotes the analysis and appropriate applications of information.
- Creative thinking promotes the identification of unique connections among ideas and insightful approaches to questions and issues.
- Decision-making processes promote the making of timely and appropriate decisions.
- Problem-solving processes promote the ability to identify or pose problems and apply learning to consider the causes and dimensions of, and the solutions to, problems.
- Metacognition[2] enables students to become more aware of, and have greater control over, their own thinking and learning processes.

RELATIONSHIP TO OTHER COURSES

Each Knowledge and Employability course is consistent with the rationale, philosophy, program foundations and organization of other secondary courses. This consistency enables students, as appropriate, to progress through the Knowledge and Employability course sequence and/or to other secondary courses.

ENROLLMENT IN KNOWLEDGE AND EMPLOYABILITY COURSES

Students may take one or more courses in the sequence at any time during grades 8 through 12. Students may be enrolled in only Knowledge and Employability courses or in a combination of Knowledge and Employability and other secondary courses.

Information regarding the identification of students for enrollment in one or more courses can be accessed in the *Knowledge and Employability Courses Handbook, Grades 8–12*.

RATIONALE AND PHILOSOPHY OF KNOWLEDGE AND EMPLOYABILITY SCIENCE

Knowledge and Employability science courses focus on developing and applying essential science skills, knowledge and attitudes needed for everyday living at home, in the workplace and in the community. Science competencies are developed through the investigation of science-related problems, questions and issues and through everyday applications that help students understand and appreciate the role of science in society.

Knowledge and Employability science courses emphasize career and life skills, teamwork, communication skills and thinking processes. Each grade level is developed within a scientific-inquiry framework, emphasizing problem-solving and decision-making skills based on students' abilities and everyday applications.

Diverse learning experiences within science courses provide students with opportunities to explore, examine and appreciate the interrelationships among science, technology, society and the environment. These learning experiences also develop understandings that will affect the lives of students at home, in the workplace and in the community.

2. Metacognition: Learning-to-learn strategies; awareness of processes and strategies one uses when learning.

SCIENCE FOUNDATIONS

Knowledge and Employability science courses promote the development of the four foundations of science.

Foundation 1: Science, Technology and Society (STS)
Students will explore their everyday home, workplace and community environments, gather information, develop ideas and use technology and other tools to make decisions about their personal lives. Students will recognize the influence of science on decision making by individuals, communities and society.

Foundation 2: Knowledge
Students will investigate theories, models, concepts, processes and principles in life science, physical science and Earth and space science, with an emphasis on application to everyday living.

Foundation 3: Skills
Students will develop skills in scientific communication and teamwork, initiating and planning, performing and recording, and analyzing and interpreting to answer questions, solve problems and make decisions in their everyday lives.

Foundation 4: Attitudes
Knowledge and Employability science courses emphasize the development of positive attitudes and behaviours related to collaboration, mutual respect, safety and stewardship in everyday living.

GOALS

The principal goal of the Knowledge and Employability science courses is to develop science competencies to assist students in becoming contributing members of society and independent and lifelong learners. These competencies include:

- communication and teamwork skills for use in collaborative group work
- attitudes that enable the responsible use of knowledge and skills
- the selection and application of appropriate science skills, tools and strategies to understand and interpret the world
- the exploration of interests and ideas, using appropriate problem-solving and decision-making strategies
- the application of science understandings, skills and attitudes to everyday life/work situations.

UNITS OF STUDY

When science components are organized into appropriate contexts, students can use their knowledge to solve problems and make decisions in relation to their everyday experiences.

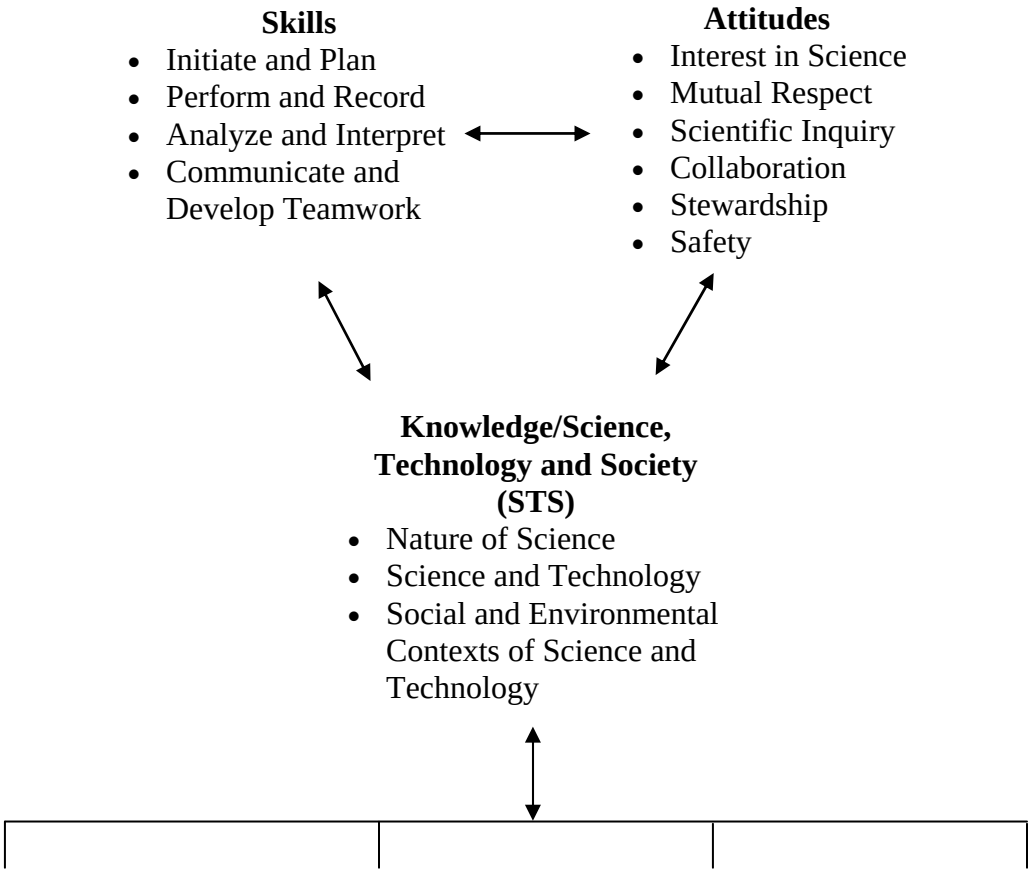
The units of study provide the contexts within which the skills, attitudes, knowledge and science, technology and society (STS) outcomes are developed, based on students' abilities and everyday living at home, in the workplace and in the community.

Each unit of study has focusing questions to provide direction for inquiry. Specific outcomes include key concepts.

Examples
Many of the outcomes are supported by examples. The examples **do not form part of the required program** but are provided as an illustration of how the outcomes might be developed. Illustrative examples are written in *italics* and are separated from the outcomes by being placed in parentheses.

KNOWLEDGE AND EMPLOYABILITY SCIENCE

Knowledge and Employability science provides basic science literacy. The courses promote awareness, understanding and the development and application of science skills, knowledge and attitudes for successful living at home, in the workplace and in the community.



Units of Study: Contexts for Developing Knowledge, Skills and Attitudes

Grade 8
Mix and Flow of Matter
Cells and Systems
Light and Optical Systems
Mechanical Systems
Freshwater and Saltwater Systems

Grade 9
Biological Diversity
Matter and Chemical Change
Environmental Chemistry
Electrical Principles and Technologies
Space Exploration

Science 10-4
Investigating Properties of Matter
Understanding Energy Transfer Technologies
Investigating Matter and Energy in Living Systems
Investigating Matter and Energy in Environmental Systems

Science 20-4
Applications of Matter and Chemical Change
Understanding Common Energy Conversion Systems
Disease Defence and Human Health
Motion, Change and Transportation Safety

GRADE 8

Unit A: Mix and Flow of Matter (Science and Technology Emphasis)

Overview

The materials that we use—including natural and manufactured ones—often take the form of fluids. Students learn that such diverse substances as air, natural gas, water and oil are fluids. They learn that the properties of individual fluids are important to their use, including such properties as density, buoyancy, viscosity and the fluid's response to changes in temperature and pressure.

Focusing Questions

1. What are fluids?
2. What are the properties of fluids?
3. How do we use, handle and safely dispose of fluids in our daily lives?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- WHMIS and household safety symbols
- pure substances, mixtures and solutions
- concentration
- buoyancy
- properties of fluids
- viscosity and flow rate
- density
- pressure

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate and describe fluids used in technological devices and everyday materials
   - list common examples of fluids found in the home and in technological devices, living things and natural environments *(e.g., air, water, oil, paint, blood)*
   - identify the Workplace Hazardous Materials Information System (WHMIS) and household safety symbols for labelling substances and describe the safety precautions to follow when handling, storing and disposing of substances

2. investigate and describe the composition of fluids and interpret the behaviour of materials in solution
   - distinguish between pure substances and mixtures, using common examples
   - investigate the solubility of different substances and describe how solutions can have different concentrations

3. investigate and compare the properties of gases and liquids and relate variations in their viscosity, density and buoyancy
   - investigate the effects of changes in temperature and viscosity on flow rates
   - conduct investigations on the properties of fluids
   - compare the densities of materials and explain how the differences in density of solids, liquids and gases affect buoyancy
   - identify that pressure is a force per unit area
   - describe applications of fluid pressure in everyday situations *(e.g., water pressure in hoses and air pressure in tires)*

4. identify and describe technologies based on properties of fluids
    - describe technologies based on flow rate and viscosity *(e.g., appropriate use of motor oils in different seasons, ketchup and mustard squeeze bottles)*
    - describe how fluids are transported from one place to another *(e.g., oil and gas pipelines, pumps).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to resolve problems, investigate issues and/or complete experiments, using appropriate technology at home, in the workplace and in the community

- identify practical problems *(e.g., how boats can be used to transport materials)*
- identify prior knowledge and determine information gaps *(e.g., use a K–W–L chart)*
- state a prediction to guide an investigation
- conduct an experiment and identify the major variables *(e.g., apply a known procedure to measure the solubility of different substances).*

Performing and Recording

Students will:

apply science-related performing and recording skills to investigate problems, questions and issues; perform experiments; and record information, using appropriate technology, at home, in the workplace and in the community

- identify the variables to be examined in an investigation or experiment
- identify information and sources that may be inaccurate, incomplete and/or biased
- conduct procedures, controlling the major variables *(e.g., conduct a test to compare the viscosity of different fluids)*
- use instruments effectively and accurately to collect data (*e.g., measure the volume of a given sample of liquid)*
- use materials and apparatus safely *(e.g., wear safety goggles during investigations of solution properties)*
- organize data, using a format that is appropriate to the task or experiment *(e.g., demonstrate the use of a chart or database for organizing information).*

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to investigations/experiments and assess personal and group performance, using appropriate technology, at home, in the workplace and in the community

- identify patterns and relationships in information
- identify and suggest explanations for discrepancies in data *(e.g., explain a loss in the volume of a liquid by identifying such factors as evaporation or absorption by a filtering material)*
- identify new questions and problems that arise from what was learned (*e.g., "What techniques are used to dispose of motor oil?").*

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- communicate questions, ideas, plans and results, using a variety of strategies *(e.g., speaking and/or writing, lists, notes in point form, data tables, graphs, drawings, computer technology, presentations)*
- communicate a position on an issue or problem, based on personal/group findings
- work cooperatively with team members to develop and conduct a plan and to troubleshoot problems as they arise.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., repeat, at home, a science investigation conducted at school)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show awareness that knowledge of fluid characteristics has developed in many societies and cultures, including Aboriginal cultures)*
Scientific Inquiry	• use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., regularly repeat measurements or observations to increase the precision of evidence)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., assume responsibility for their share of work when preparing for investigations and when gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., wear proper safety attire without being reminded)*.

Unit B: Cells and Systems (Nature of Science Emphasis)

Overview

Living things take a variety of forms, as reflected in their structures, internal processes and ways of responding to their environments. Finding patterns within this diversity has been a major challenge in the biological sciences and has led to the development of ideas regarding systems, cells, structures and functions. Using these ideas, students learn to interpret life at a variety of levels, from individual cells to complex organisms. To develop their understanding, students investigate ways that components of a living system work together and, through these studies, learn that healthy organisms—including healthy humans—function as balanced systems within a life-supporting environment.

Focusing Questions

1. What are the systems of the body and how do they work together?
2. How are human body systems similar to and different from other organisms?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- organisms
- cells
- organs
- tissues
- systems
- structure and function

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate living things and identify ideas used to interpret their general structure, function and organization
   - define organism and give examples
   - apply the concept of system when describing familiar organisms and examine their general structure and function
   - illustrate and explain how different organisms have similar functions that are met in a variety of ways *(e.g., recognize food gathering as a common function of animals and note a variety of food-gathering structures)*

2. investigate and describe the role of cells within living things
   - describe the role of the cell as a basic unit of life
   - describe similarities and differences between single-celled and multicelled organisms *(e.g., compare, in general terms, an amoeba and a grizzly bear)*
   - distinguish between plant and animal cells *(e.g., distinguish between cell walls and cell membranes)*
   - examine plant and animal structures and identify contributing roles of cells, tissues and organs

3. interpret the healthy function of human body systems and describe ways the body reacts to internal and external stimuli
   - describe, in general terms, the functions of the different body systems *(e.g., the respiratory, digestive and excretory systems)*
   - identify and describe the roles of organs and tissues in supporting the healthy functioning of the human body *(e.g., the role of the lungs in exchanging oxygen and carbon dioxide)*
   - describe how to maintain healthy body systems *(e.g., the impact of exercise on the heart and lungs)*

4. describe areas of scientific investigation leading to new knowledge about body systems and to new medical applications
    - describe ways in which research about cells, organs and systems has brought about improvements in human health and nutrition *(e.g., development of medicines, diets based on the needs of organs such as the heart)*
    - investigate factors that affect the healthy functioning of the human respiratory, circulatory and digestive systems *(e.g., investigate the effect of illness, aging or air quality on the function of the respiratory system).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about relationships among observable variables at home, in the workplace and in the community

- identify questions to investigate (*e.g., identify questions that arise from their own observations of plant and animal diversity)*
- develop definitions of major variables and other aspects of their investigations *(e.g., define body systems in terms of their functions).*

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- use instruments, including microscopes, effectively and accurately to collect data *(e.g., use a microscope to produce a clear image of a cell)*
- observe and record data and produce simple line drawings *(e.g., draw cells and organisms)*
- organize data, using a format that is appropriate to the task or experiment *(e.g., compare the structure of two or more organisms, using charts and drawings).*

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to assess possible explanations at home, in the workplace and in the community

- identify the strengths and weaknesses of different methods of collecting and displaying data *(e.g., compare methods of measuring heart rate)*
- identify and suggest explanations for discrepancies in data *(e.g., explain variations in heart rate, in the same individual, at different points in the day)*
- compile and display data in a variety of formats, including diagrams, flow charts, tables and graphs *(e.g., prepare charts that compare the structures of different organisms)*
- identify new questions that arise from what was learned.

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- communicate questions, ideas, plans and results, using a variety of strategies *(e.g., speaking and/or writing, lists, notes in point form, data tables, graphs, drawings, computer technology, presentations)*
- work cooperatively with team members to develop and conduct a plan and troubleshoot problems as they arise *(e.g., prepare a presentation on the digestive system)*
- receive, understand and incorporate the ideas of others *(e.g., use an agreed-upon procedure for preparing diagrams and charts)*
- evaluate individual and group processes used in planning, problem solving and decision making and when completing a task.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., explore media on topics related to the diversity of living things and the maintenance of health)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., recognize that a wide range of people working in different fields have contributed to scientific and medical knowledge)*
Scientific Inquiry	• use scientific methods to carefully gather evidence when investigating problems and issues
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., assume responsibility for their share of work when preparing for investigations and when gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., show interest in the health of individuals in their family and community)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., wear proper safety attire without being reminded).*

Unit C: Light and Optical Systems (Nature of Science Emphasis)

Overview

Our understanding of the world is largely based on what we see—both directly and aided by optical devices that improve and extend our vision. Such tools as the microscope and telescope have helped extend knowledge in a variety of science fields, from the study of cells and stars to studies of the nature of light itself. In learning about light, students investigate its interactions with different materials and interpret its behaviour.

Focusing Questions

1. What do we know about the nature of light?
2. What technologies have been developed that use light, and what principles of light do they show?
3. What changes have taken place in lighting systems over the past two generations?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- sources of light
- microscopes and telescopes
- contribution of optical technologies to daily living
- vision and lenses
- reflection and refraction
- transmission and absorption
- images
- imaging technologies

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate the nature of light and the role of optical systems in our lives
   - describe what light is and how it travels
   - identify various natural and artificial sources of light *(e.g., the sun, stars, light bulb)*
   - investigate the effects of light and lenses on images, using microscopes, telescopes and other optical devices

2. investigate the transmission of light
   - describe how light is reflected, refracted, transmitted and absorbed
   - investigate how various materials reflect, refract, transmit and absorb light

3. investigate and examine the science of image formation and vision and related technologies
   - describe, in general terms, how concave and convex lenses function
   - describe how the human eye and a camera are similar
   - compare the human eye to other organisms
   - investigate the development of new technologies to enhance human vision *(e.g., laser surgery)*
   - investigate emerging technologies for storing and transmitting images in digital form *(e.g., digital cameras, infrared imaging).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about relationships among observable variables and conduct investigations to address those questions at home, in the workplace and in the community

- identify questions to investigate *(e.g., ask about the role eyeglasses play in improving vision)*
- conduct an experiment and identify the major variables
- state a prediction based on background information or an observed pattern of events
- formulate definitions of major variables and other aspects of their investigations.

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- conduct procedures, controlling the major variables
- observe and record data and produce simple line drawings *(e.g., produce a drawing of the path of a light beam toward and away from a mirror)*
- use instruments effectively and accurately to collect data
- organize data, using a format that is appropriate to the task *(e.g., demonstrate the use of a chart or spreadsheet for organizing data)*
- use tools and apparatus safely.

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to assess possible explanations at home, in the workplace and in the community

- identify the strengths and weaknesses of different methods of collecting and displaying data
- state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea *(e.g., write a conclusion based on the refraction of light through different media)*
- identify new questions that arise from what was learned *(e.g., ask questions about new technologies for improving human vision).*

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- receive, understand and act on the ideas of others
- summarize their findings in an appropriate manner.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., seek information from a variety of sources)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show an awareness of and respect for the research, care and craftsmanship involved in developing the means to enhance human vision)*
Scientific Inquiry	• use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., ask questions to clarify meaning or to confirm their understanding)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., consider alternative ideas and interpretations suggested by members of the group)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., recognize that light can contribute to light pollution)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., select safe methods of using optical devices).*

Unit D: Mechanical Systems (Science and Technology Emphasis)

Overview

Machines are used for many purposes in our daily lives when we need to transfer energy into motion or move materials in a controlled way. In learning about mechanical devices, students investigate how components are linked so that energy is transferred efficiently and desired functions are performed. A comparison of past and present technologies helps students recognize that different approaches have been used over time to meet common needs. Evaluations of efficiency, effectiveness and impacts on daily life, the community and the environment are important considerations in this unit.

Focusing Questions

1. What mechanical systems do we use every day?
2. How do mechanical systems affect our everyday lives?
3. How do mechanical systems relate to the human body?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- systems
- design and function
- simple machines
- work and energy
- mechanical advantage

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. demonstrate the development of science and technology by describing and comparing mechanical devices that have been improved over time
   - identify the source of energy for some familiar mechanical devices
   - investigate and provide examples of mechanical devices used in the past to meet particular needs *(e.g., describe and interpret devices developed to move water or be moved by water, such as the Persian wheel, mill wheel)*
   - investigate how a common need has been met in different ways over time *(e.g., development of different kinds of lifting devices)*
   - investigate how trial and error and scientific knowledge both play a role in technological development *(e.g., development of aircraft)*

2. examine simple machines by describing the structures, functions and component parts of the overall system
   - identify and classify a variety of simple, everyday machines and mechanical systems, including those of traditional Aboriginal societies, such as travois and teepees
   - identify and classify a variety of simple machines (levers), using fulcrum, load and force
   - identify linkages and power transmissions in mechanical devices and describe their general function *(e.g., identify the purpose and general function of gear systems within a mechanical device)*
   - recognize that mechanical systems are a combination or modification of one or more simple machines
   - identify the relationship between the design and function of simple machines and mechanical systems
   - describe the mechanical advantage of using simple machines
   - identify the sources of energy (*e.g., humans, batteries, electricity)* for familiar mechanical devices

3. investigate and describe the transmission of force and energy between parts of a mechanical system

- describe how simple machines and mechanical systems provide a mechanical advantage and influence speed and force
- recognize that work is measured in joules
- investigate a common mechanical device *(e.g., bicycle, vacuum cleaner, water pump)*

4. examine the social and environmental contexts of science and technology, as they apply to the development of mechanical devices
   - apply a set of criteria to evaluate a given mechanical device
   - examine the design and function of a mechanical device in relation to its efficiency and effectiveness
   - illustrate how technological development is influenced by advances in science.

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables and conduct investigations to address those questions at home, in the workplace and in the community

- identify practical problems *(e.g., identify how the efficiency of a mechanical device impacts its output)*
- identify questions to investigate arising from practical problems *(e.g., "How can the efficiency of a mechanical device be improved?")*
- apply methods and tools for collecting data to solve problems.

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- research information relevant to a given problem
- collect relevant information from various print and electronic sources
- construct and test simple machines
- organize data, using a format that is appropriate to the task
- use materials and apparatus safely.

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to assess possible explanations at home, in the workplace and in the community

- identify and correct the practical problems of simple machines *(e.g., adjust a pulley system to lift a load)*
- evaluate designs and prototypes in terms of function, reliability, safety, efficiency and impact on the environment *(e.g., pulley hoist system, such as window blinds).*

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- use specific language that is scientifically and technologically appropriate *(e.g., use such terms as system, component and function when describing a mechanical system)*
- communicate questions, ideas, plans and results, using a variety of strategies *(e.g., speaking and/or writing, lists, notes in point form, data tables, graphs, drawings, computer technology, presentations)*
- work cooperatively with team members to develop and conduct a plan and to troubleshoot problems as they arise.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., investigate examples of mechanical devices in their home and community)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., appreciate that different approaches to problems lead to different solutions)*
Scientific Inquiry	• use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., report the limitations of designs of simple machines)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., accept various roles within a group, including leadership)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., consider the impacts of simple machines on society and the environment)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., manipulate materials carefully, using skills learned in class or elsewhere).*

Unit E: Freshwater and Saltwater Systems (Social and Environmental Contexts Emphasis)

Overview

Earth is sometimes described as the water planet: over two-thirds of Earth's surface is covered by oceans and freshwater features. By exploring examples of aquatic systems, students come to appreciate the dynamic nature of these systems and learn about the interaction of landforms, sediments, water and climate. Students also investigate factors that affect the distribution and health of living things in aquatic environments and the supply and quality of water for human use.

Focusing Questions

1. What are the characteristics of freshwater and saltwater systems?
2. How do freshwater and saltwater systems affect us, other organisms and our land?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- water quality
- evaporation and distillation
- climate
- erosion and deposition
- stream characteristics
- glaciers and icecaps
- adaptations to aquatic ecosystems

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. describe the distribution and characteristics of water in local and global environments and identify the significance of water supply and quality to the needs of humans and other living things
   - describe, in general terms, the distribution of water in Alberta, Canada and the world
   - distinguish an aquatic ecosystem from other types of ecosystems
   - compare adaptations of organisms to freshwater and saltwater ecosystems
   - recognize that fresh water and salt water contain varying amounts of different substances
   - describe, in general terms, how fresh water can be generated from salt water by using evaporation and distillation
   - test and compare the water quality of various samples from the area

2. investigate the linkages among landforms, water and climate
   - investigate and describe the water cycle
   - investigate, describe and illustrate the characteristics of a stream
   - describe wave erosion and wave deposits
   - identify evidence of glacial action and examine factors affecting the growth and attrition of glaciers and polar icecaps *(e.g., identify factors that affect the size of polar ice sheets and the Columbia Icefield)*
   - relate climate and weather to glaciers, icecaps and water supply

3. examine factors affecting productivity and species distribution in marine and freshwater environments

- investigate life forms found in fresh water and salt water and identify examples of adaptations to these environments *(e.g., describe examples of fish and invertebrate species found in a local freshwater environment)*
- investigate examples of seasonal, short-term and long-term change in populations of living things found in aquatic environments
- examine the relationship between water quality and living things

4. examine human impacts on aquatic systems and identify the roles of science and technology in addressing related questions, problems and issues
   - examine human water uses
   - investigate the human impact on the supply and quality of water *(e.g., identify pollutants in ground water and surface water systems resulting from domestic and industrial use)*
   - investigate the human impact on the distribution of freshwater and saltwater organisms
   - identify current practices and technologies that improve water quality *(e.g., research alternatives for ensuring safe water supplies)*
   - provide examples of problems that cannot be solved through the use of technology alone *(e.g., pollution, bacteria, retreating of the ice fields).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables at home, in the workplace and in the community

- identify science-related issues and problems
- identify questions to investigate, arising from science-related issues
- select appropriate methods and tools for collecting relevant data and information *(e.g., conduct a search, using a wide variety of electronic sources).*

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- research information relevant to a given issue
- select and integrate information from two sources.

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to assess possible explanations at home, in the workplace and in the community

- apply given criteria to evaluate evidence and sources of information
- interpret patterns in data and explain relationships among the variables *(e.g., predict future stocks of fish based on long-term data).*

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas and procedures at home, in the workplace and in the community

- use appropriate vocabulary, including science and technology terminology, to communicate ideas and procedures
- communicate questions, ideas, plans and results, using lists, notes in point form, data tables, graphs, drawings and oral language *(e.g., create a concept map linking the different stages of the water cycle)*
- evaluate individual and group processes used in problem solving and decision making and when completing a task.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., express an interest in conducting scientific investigations; take an interest in media reports on environmental issues)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show awareness of and respect for the contributions of indigenous peoples to knowledge of the environment)*
Scientific Inquiry	• use evidence when evaluating approaches to investigations, problems and issues *(e.g., consider observations and ideas from a number of sources before drawing conclusions)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., share observations with members of a group and consider alternative ideas suggested by group members)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., consider immediate and long-term consequences of personal and group actions)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., manipulate materials carefully, using skills learned in class or elsewhere).*

GRADE 9

Unit A: Biological Diversity (Social and Environmental Contexts Emphasis)

Overview
Biological diversity is reflected in the range of species found in local and global environments and by subtle variations in characteristics found within individual species. In this unit, students learn that diversity is maintained through natural processes of sexual and asexual reproduction, though the survival of individual species—and variations within those species—may be influenced by ecological and human-caused factors. Students examine trends toward loss of diversity and examine related issues concerning environmental quality and the impact of technologies.

Focusing Questions
1. What is biological diversity?
2. How are humans similar to and different from other organisms?

Key Concepts
The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- biological diversity
- species
- habitat
- populations
- natural and artificial selection
- inheritance
- diversity within and among species
- niches
- asexual and sexual reproduction

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate and examine diversity within and among species, the importance of diversity and the various environments in which species live
   - investigate biological diversity within and among species, including humans
   - define community, population, habitat and niche and relate them to diversity within and among species
   - recognize that species are dependent on others and their environment

2. examine the nature of reproductive processes and their role in transmitting species characteristics
   - distinguish between asexual and sexual reproduction and identify examples of asexual reproduction *(e.g., fission in the amoeba, budding in the hydra)* and sexual reproduction *(e.g., cross-fertilization in seed plants, sexual reproduction in mammals)*
   - examine how inherited traits influence diversity and survival within and among species
   - distinguish those characteristics that can be inherited from those that cannot (*e.g., recognize that eye colour is inherited but scars are not)*
   - identify and distinguish between examples of natural and artificial selection *(e.g., evolution of beak shapes in birds versus development of milk production in dairy cows)*

3. identify impacts of human action on species survival and on variations within species
    - investigate human impact on diversity *(e.g., agriculture and habitat destruction)*
    - examine ongoing changes in biological diversity through loss of habitat and the extinction of species *(e.g., investigate the effect of changing land use on the survival of wolf or grizzly bear populations)*
    - examine local and global strategies for minimizing loss of species *(e.g., breeding of endangered populations in zoos).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables at home, in the workplace and in the community

- examine science-related issues
- examine questions arising from science-related issues
- state a prediction, based on background information or an observed pattern of events.

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- observe and record data and produce simple line drawings *(e.g., compare two related plants by measuring, describing and drawing them)*
- research information relevant to a given issue.

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to develop and assess possible explanations at home, in the workplace and in the community

- interpret patterns in data and explain relationships among the variables *(e.g., examine data on changing animal populations)*
- apply given criteria to evaluate evidence and sources of information.

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate procedures and results at home, in the workplace and in the community

- communicate questions, ideas, plans and results, using lists, notes in point form, data tables, graphs, drawings, oral language and other means
- evaluate individual and group processes used when investigating an issue.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., select and explore media on topics related to species diversity)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show awareness that the scientific study of changing animal and plant populations can arise from a variety of global needs, involving many individuals and organizations)*
Scientific Inquiry	• value and use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., consider ideas and perceptions critically, recognizing that the obvious is not always correct)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., use active listening, paraphrasing and questioning skills to understand other points of view)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., minimize environmental impacts during studies by avoiding sampling that will affect a plant or an animal population)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., follow safety procedures in outdoor investigations).*

Unit B: Matter and Chemical Change (Nature of Science Emphasis)

Overview

Different materials have different properties. In this unit, students are introduced to the formal study of chemical substances through laboratory investigations and introductory studies of chemical theory. In the laboratory, students observe and compare chemical substances and, following safety procedures, investigate the properties of materials and the ways they interact. In conjunction with these studies, students are introduced to ideas about elements and compounds and corresponding structural ideas about atoms and molecules. A general introduction to the periodic table, to chemical nomenclature and to simplified ways of representing chemical reactions is included.

Focusing Questions

1. What are the properties of materials?
2. What evidence do we have of chemical change?
3. What safety standards are required when handling common household and workplace chemicals?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- Workplace Hazardous Materials Information System (WHMIS)
- atoms and molecules
- elements and compounds
- reactants and products
- periodic table
- chemical nomenclature (introductory treatment)

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate materials and describe them in terms of their physical and chemical properties
   - identify and compare Workplace Hazardous Materials Information System (WHMIS) and household safety symbols
   - relate WHMIS and household safety symbols to safety in the classroom, home and workplace *(e.g., recognize that mixing chemicals at home and in the workplace may result in safety hazards, such as harmful fumes or high temperatures)*
   - identify that all matter is made of atoms and molecules
   - distinguish between elements and compounds
   - describe and classify materials based on their composition and properties, including:
     – distinguishing between pure substances, solutions and mechanical mixtures
     – distinguishing between metals and nonmetals

2. describe patterns in chemical reactions
   - identify potentially harmful reactions
   - describe evidence of chemical change in reactions between familiar materials, by:
     – describing combustion and corrosion
     – observing various chemical reactions
   - describe the main differences between physical and chemical changes *(e.g., change of state, the creation of odour, new products, and temperature change)*

3. describe ideas used when interpreting the chemical nature of matter
   - apply the particle model of matter to explain the states of matter
   - recognize the periodic table as a tool used to display and organize elements according to their properties *(e.g., metals and nonmetals, reactivity)*
   - describe the parts of an atom *(e.g., neutrons, protons and electrons)*

4. apply simplified chemical nomenclature when describing elements, compounds and chemical reactions
   - identify reactants and products in simple chemical reactions
   - write word equations for common chemical reactions that produce water, table salt, rust, oxygen and carbon dioxide
   - describe familiar chemical reactions by using word equations and chemical formulas and by constructing models of reactants and products *(e.g., describe combustion reactions, such as carbon + oxygen = carbon dioxide [$C + O_2 = CO_2$])*.

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables at home, in the workplace and in the community

- define questions and problems to facilitate investigations
- state a prediction, based on background information or an observed pattern of events.

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- conduct procedures, controlling the major variables
- use appropriate methods and tools to collect data and information to solve problems *(e.g., conduct a search for information about chemical elements, using appropriate print and electronic sources)*
- observe and record data and produce simple drawings *(e.g., study a molecule and represent it through a drawing)*
- demonstrate knowledge of WHMIS standards by using proper techniques for the storage, handling and disposal of laboratory materials
- research information relevant to a given question *(e.g., research properties of materials)*.

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to develop and assess possible explanations at home, in the workplace and in the community

- display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables and bar graphs
- identify discrepancies in data
- state a conclusion, based on experimental data
- identify new questions and problems that arise from what was learned.

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- receive, understand and act on the ideas of others *(e.g., follow given safety procedures)*
- evaluate individual and group processes used in planning and conducting investigative tasks.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., express a degree of satisfaction at understanding science concepts that are challenging)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show an interest in the contributions that women and men—with different views and backgrounds and at different times—have made in the development of modern science)*
Scientific Inquiry	• value and use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., seek data that is accurate and based on appropriate methods of investigation)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., become involved in decision making that requires full-group participation)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., recognize that the materials individuals develop may have environmental impacts when discarded)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., read the labels of materials before using them and ask for help if safety symbols are not clear or understood).*

Unit C: Environmental Chemistry (Social and Environmental Contexts Emphasis)

Overview

Environments are often viewed from a physical and biological perspective, but to fully understand how they function, it is important to view them from a chemical perspective as well. A study of environmental chemistry helps students understand that chemical substances make up the underlying fabric of the world and are part of the process in all natural cycles and changes. Through this unit, students also become aware of human-produced chemical substances that enter and interact with environments, and they investigate the potential impacts of different substances on the distribution and abundance of living things.

Focusing Questions

1. What chemicals are beneficial to humans and other organisms?
2. What chemicals are harmful to humans and other organisms?
3. How do chemicals play a role in our environment?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- chemicals essential to life
- ingestion and absorption of substances
- air and water quality
- hazards and risk assessments
- organic and inorganic material
- acids and bases

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
   - describe, in general terms, the ingestion or absorption of materials by living things
   - describe, in general terms, and illustrate the processes by which chemicals are introduced and dispersed in the environment *(e.g., dilution in streams, biomagnification through food chains)*
   - identify common organic and inorganic substances that are essential for the health and growth of humans and other living things *(e.g., identify protein as essential for muscle development; identify calcium as an essential material for bones)*
   - investigate sources of information to identify types of foods and the quantities required for healthy living, including *Canada's Food Guide to Healthy Eating*
   - recognize that a balanced diet, containing proteins, fats, carbohydrates, vitamins and minerals, contributes to overall health
   - compare the diet of traditional Aboriginal society to that of contemporary North American society in relation to the maintenance of healthy lifestyles

2. identify processes for measuring different substances in the environment and for monitoring air and water quality
   - identify the ways in which humans affect air and water quality through the use of chemicals at home and in the workplace
   - identify laws that support clean air and water supplies
   - identify acids, bases and neutral substances, based on their pH *(e.g., use indicator solutions or pH meters to measure the pH in water supplies)*
   - describe effects of acids and bases on living things *(e.g., acid rain in lakes, antacids for upset stomachs)*

3. examine mechanisms affecting the distribution of potentially harmful substances within an environment
    - recognize that toxins can be produced in chemical processes
    - describe and evaluate methods used to transport, store and dispose of hazardous household and workplace chemicals
    - investigate potential risks resulting from consumer practices and industrial processes *(e.g., flushing unused prescription drugs down the toilet, industrial ground water use).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables at home, in the workplace and in the community

- identify science-related issues *(e.g., identify issues regarding the use of soil fertilizers)*
- identify questions arising from practical problems and issues *(e.g., ask questions about the nutritional requirements of different living things).*

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- identify data and information that is relevant to the issue
- use instruments and materials effectively and accurately to collect data *(e.g., measure and compare the pH in household products)*
- organize data, using a format that is appropriate to the task or experiment
- use materials and apparatus safely.

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to develop and assess possible explanations at home, in the workplace and in the community

- identify the strengths and weaknesses of different ways to display data
- identify discrepancies in data
- apply given criteria to evaluate evidence and sources of information
- identify new questions and problems that arise from what was learned.

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- work cooperatively with team members to develop and conduct a plan
- receive, understand and act on the ideas of others *(e.g., seek and achieve group consensus on the procedures to be used in an investigative activity).*

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., participate in extracurricular activities, such as a science fair)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., consider more than one perspective when formulating conclusions)*
Scientific Inquiry	• value and use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., consider observations and ideas from a number of sources during investigations)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., assume responsibility for their share of the work during investigations)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., show respect for all forms of life)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., take the time to organize their work area so accidents can be prevented).*

Unit D: Electrical Principles and Technologies (Science and Technology Emphasis)

Overview

Electricity provides the means to energize many devices, systems and processes that are part of our technological environment. Electrical devices are used to transfer and transform energy, to provide mechanisms for control and to transmit information in a variety of forms. In this unit, students learn about electrical conversions and the societal and environmental implications associated with the production and use of electrical energy. Using a conversion, problem-solving approach, students create and modify circuits. Students also develop skills for evaluating technologies by comparing alternative designs and by considering their efficiency, effectiveness and environmental impact.

Focusing Questions

1. How do we obtain and use electrical energy?
2. How can we use technology and other methods to increase electrical efficiency at home and in the workplace?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- forms of energy
- energy transformation
- static and current electricity
- renewable and nonrenewable energy sources
- storage of electrical energy
- energy transmission
- circuits

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate the use of devices to convert various forms of energy to electrical energy and electrical energy to other forms
   - identify and describe everyday forms of energy *(e.g., mechanical, chemical, thermal and electrical)*
   - examine and list common forms of energy conversion
   - identify examples of energy transfer and transformation *(e.g., chemical energy transformed into electrical energy and then to light energy in a flashlight; mechanical energy transformed into electrical energy and then transferred through power grids)*
   - investigate the use of different chemicals, chemical concentrations and designs for electrical storage cells *(e.g., build and test different forms of wet cells)*

2. describe technologies used for transfer and control of electrical energy
   - assess the potential danger of electrical devices by referring to the voltage and current rating (amperage) and distinguish between safe and unsafe activities
   - distinguish between static and current electricity
   - identify electrical conductors and insulators
   - create and explain simple series and parallel electrical circuits
   - describe the relationship among current, voltage and resistance and relate it to amperes, volts and ohms

3. identify energy inputs and outputs for example devices and systems
    - identify the forms of energy inputs and outputs in a device or a system
    - compare the energy inputs and outputs of a device
    - identify ways to reduce electrical energy input
    - investigate techniques for reducing energy waste in common household devices *(e.g., efficient forms of lighting)*

4. describe and discuss the societal and environmental implications of the use of electrical energy
    - identify alternative sources of electrical energy, including oil, gas, coal, wind, waves and batteries *(e.g., identify renewable and nonrenewable sources for generating electricity)*
    - identify the by-products of electrical generation and their impacts on the environment *(e.g., identify the potential impacts of coal-fired electricity generation)*
    - identify uses of electrical technologies and their impact *(e.g., identify benefits and issues related to the use of electrical technologies for storing and transmitting personal information)*
    - identify the impact of the disposal of electrical technologies
    - identify concerns regarding the conservation of energy resources.

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables at home, in the workplace and in the community

- identify questions to investigate arising from practical problems and issues *(e.g., identify such questions as, "How can the amount of electric current in a circuit be controlled?")*
- state a prediction and a hypothesis based on background information or an observed pattern of events.

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- use materials and apparatus safely *(e.g., use appropriate sources of electrical energy and follow procedures to ensure personal and group safety)*
- use instruments effectively and accurately to collect data *(e.g., use voltmeters).*

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to develop and assess possible explanations at home, in the workplace and in the community

- test the design of a constructed device or system
- evaluate designs and prototypes in terms of function, reliability, safety, efficiency, use of materials and impact on the environment *(e.g., evaluate the environmental impact of a wet-cell design)*
- identify discrepancies in data
- identify potential sources of error.

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- work collaboratively with team members to develop and conduct a plan and to troubleshoot problems as they arise
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, data tables, graphs, drawings, oral language and other means *(e.g., use charts to present data on the voltage and current found in series and parallel circuits).*

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., participate in extracurricular activities, such as a science fair)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show awareness of and respect for the scientific thinking, craftsmanship and collaborative effort that go into the development of electrical devices and systems)*
Scientific Inquiry	• value and use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., ask questions to clarify meaning or confirm understanding)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., assume responsibility for their share of the work during investigations)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., identify potential conflicts between responding to human wants and needs and protecting the environment, considering future generations)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., select safe methods when using electrical devices).*

Unit E: Space Exploration (Science and Technology Emphasis)

Overview

Technologies have played an essential role in the study of space and in the emerging use of space environments. Our modern understanding of space has developed in conjunction with advances in techniques for viewing distant objects, for transmitting images and data through space and for manned and unmanned space exploration. A study of space exploration provides an opportunity for students to examine how science and technology interact and to learn how one process augments the other. Students become aware that technologies developed to meet the challenges of space are applied to new purposes.

Focusing Questions

1. What do we use to explore space?
2. How does space exploration affect us in our daily lives?
3. What technologies have been developed?

Key Concepts

The following key concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- technologies for space exploration and observation
- position and motion in space
- composition and characteristics of bodies in space
- life-support technologies
- communication technologies

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. investigate and describe the ways in which human understanding of Earth and space has depended on technological development
   - identify different perspectives on the nature of Earth and space, based on culture and science *(e.g., describe Aboriginal views of space and those of other cultures)*
   - investigate the contributions of technological advances, including optical telescopes and space travel, to a scientific understanding of space
   - describe the characteristics of the celestial bodies that make up the solar system and compare their characteristics with those of Earth
   - investigate techniques for determining the position and motion of objects in space *(e.g., phases of the moon, Earth's seasons, planets, star systems and the movement of human-made satellites)*
   - relate events on Earth to events/activities in space *(e.g., weather, solar flares and the moon's effect on tides)*

2. identify problems scientists face when developing technologies for space exploration and describe technologies developed for life in space
   - examine space environments and identify challenges that must be met when scientists develop life-supporting systems *(e.g., examine variations in gravity, temperature, availability of water)*
   - investigate technologies used for life-support systems *(e.g., investigate systems that involve the recycling of water and air)*
   - investigate technologies used for space transportation
   - identify materials and processes developed to meet needs in space
   - identify that technologies contributing to space travel and space exploration affect our everyday lives *(e.g., radio transmission, global positioning system, space stations)*

3. examine issues and opportunities arising from the application of space technology and identify the alternatives
    - recognize the risks and dangers associated with space exploration *(e.g., space junk, fuel expenditure, satellites burning up in the atmosphere)*
    - investigate Canadian contributions to space research and to the astronaut program *(e.g., Canadarm)*
    - identify factors that are important to decisions regarding space exploration and development *(e.g., investigate political, environmental and ethical issues related to the ownership and use of resources in space).*

Skill Outcomes

Initiating and Planning

Students will:

apply science-related initiating and planning skills to ask questions about the relationships among observable variables at home, in the workplace and in the community

- identify the practical problems of space exploration *(e.g., identify problems that must be addressed in developing a life-supporting space environment)*
- state a prediction or hypothesis based on background information or an observed pattern of events *(e.g., predict the next appearance of a comet, based on past observations).*

Performing and Recording

Students will:

apply science-related performing and recording skills to conduct investigations into the relationships among observations and to gather and record data at home, in the workplace and in the community

- research information relevant to a given problem
- select information from various print and electronic sources
- organize data, using a format that is appropriate to a given task or experiment *(e.g., maintain a log of observed changes in the night sky).*

Analyzing and Interpreting

Students will:

apply science-related analyzing and interpreting skills to examine data and to develop and assess possible explanations at home, in the workplace and in the community

- identify the strengths and weaknesses of different methods of collecting and displaying data *(e.g., compare Earth-based observations with those made from spacecraft)*
- identify new questions and problems that arise from what was learned *(e.g., identify questions to guide further investigations, such as, "What limits travelling distance and duration of space exploration?").*

Communication and Teamwork

Students will:

apply science-related communication and teamwork skills to work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results at home, in the workplace and in the community

- receive, understand and act on the ideas of others
- work cooperatively with other team members to develop and conduct a plan and to troubleshoot problems as they arise.

Attitude Outcomes

Students will be encouraged to develop and display an interest in science and scientific inquiry, mutual respect, collaboration, stewardship and safety at home, in the workplace and in community situations.

	Students will be encouraged to:
Interest in Science	• show interest in science-related questions and issues and pursue personal interests and career possibilities within science-related fields *(e.g., express interest in and describe media programs on space science and technology)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show an interest in the contributions that men and women from many cultural backgrounds have made to the development of modern science and technology)*
Scientific Inquiry	• value and use scientific methods to carefully gather evidence when investigating problems and issues *(e.g., consider observations and ideas from a number of sources before drawing a conclusion)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., share ideas and observations with other members of the group)*
Stewardship	• demonstrate sensitivity when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., consider immediate and long-term consequences of personal and group actions)* • recognize that the traditional Aboriginal lifestyle supports a unique relationship with the environment
Safety	• demonstrate concern for safety when planning, conducting and reviewing activities *(e.g., select safe methods and tools for collecting evidence).*