KNOWLEDGE AND EMPLOYABILITY SCIENCE 10-4, 20-4

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 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.

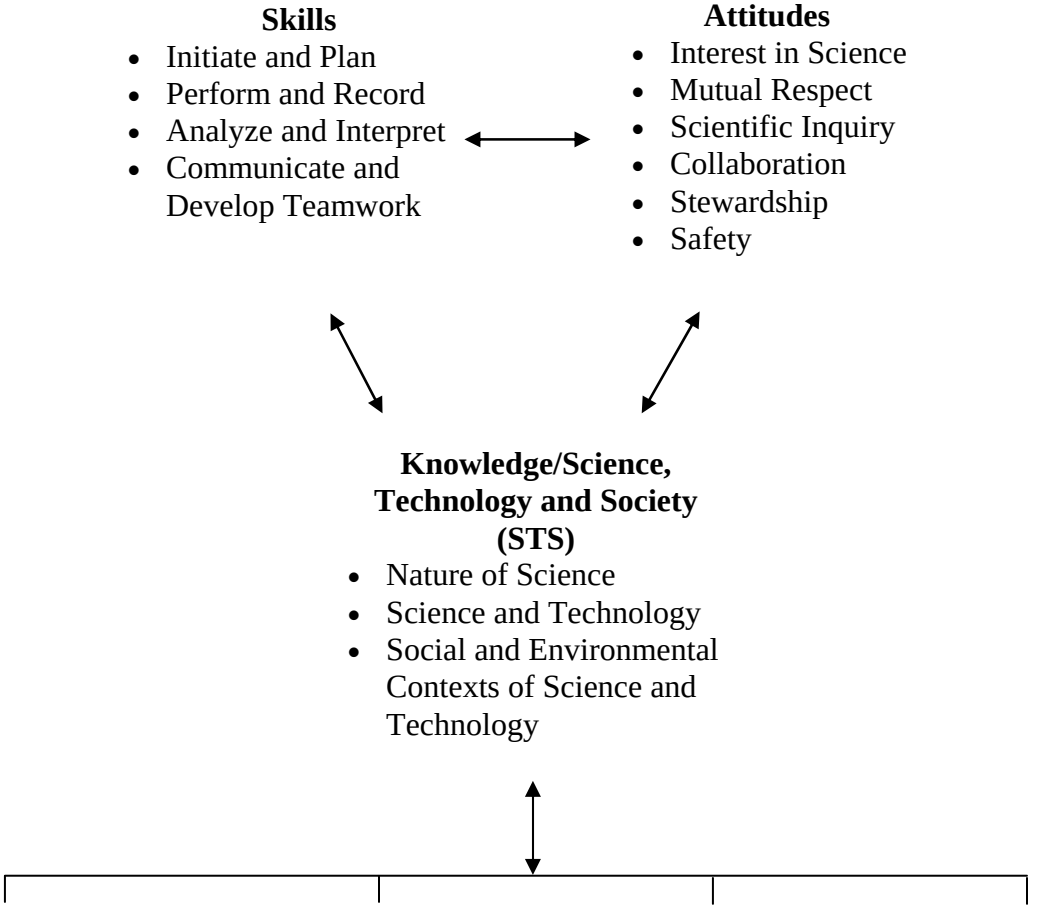
The units of study provide the contexts within which the skills, attitudes, knowledge and science, technology and society (STS) outcomes are developed, based on students' abilities and everyday living at home, in the workplace and in the community.

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

SCIENCE 10-4

Unit A: Investigating Properties of Matter (Nature of Science Emphasis)

Overview

Handling chemicals safely, whether at home or in the workplace, requires an understanding of the properties of pure substances and mixtures. Students actively investigate the properties of a variety of matter, including mixtures and solutions and elements and compounds encountered in everyday life. The atom as the basic building block of matter is introduced. Students also investigate the classification of elements on the periodic table.

Focusing Questions

1. How do we use properties to classify matter?
2. How can an understanding of matter be used in the home, community and workplace?
3. What safety standards exist for the use, storage and transportation of chemicals, and how are these standards applied at home, in the community 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.

- safe handling, storage and disposal of household materials
- Workplace Hazardous Materials Information System (WHMIS) and Hazardous Household Product Symbols (HHPS)
- solutions and solubility of household substances
- dilution and concentration
- preparing solutions
- separating mixtures
- acids and bases
- the periodic table: metals, nonmetals and metalloids
- elements and compounds
- corrosion and rusting

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

Students will:

1. classify various forms of matter, including commonly used household substances, on the basis of their properties and relate these properties to safe use, storage and disposal
    - communicate and demonstrate safe handling, storage and disposal of household and workplace substances, using the Workplace Hazardous Materials Information System (WHMIS) and Hazardous Household Product Symbols (HHPS)
    - compare and contrast the properties of pure substances and mixtures *(e.g., zinc and brass, iron and stainless steel, acetic acid and vinegar, pure water and salt water)*
    - relate the properties of pure substances and mixtures to practical applications *(e.g., salting icy roads, adding antifreeze to automobile radiators)*
    - differentiate between the physical and chemical properties of matter
    - apply the particle model of matter to explain the physical properties of the phases of matter

2. describe solutions and solubility, solutes and solvents and describe how these concepts are applied to the production of prepared foods and useful materials
   - define solute, solvent, solution and solubility
   - provide examples of mixtures that form homogeneous solutions *(e.g., vinegar and water)*
   - provide examples of mixtures that do not form homogeneous solutions *(e.g., oil and water)*
   - describe examples of the effect of temperature change on solubility and explain this effect on the basis of the particle model of matter *(e.g., concentration of brines for pickling and syrups for canning)*
   - compare the volume of packaging waste resulting from the use of concentrated and diluted forms of products *(e.g., orange juice, fabric softener)* and relate this to the need for recycling and environmental preservation
   - describe, in general terms, the pH scale as an indicator of acidity or basicity *(e.g., a pH of less than 7 indicates an acid, a pH of greater than 7 indicates a base)*
   - investigate the corrosive effects of environmental factors such as acids, bases, salts, humidity and temperature *(e.g., corrosion of iron by acid rain and spray from ocean water)*
   - identify the potential dangers of mixing common household and industrial chemicals *(e.g., not mixing ammonia cleaners with bleach, not adding water when diluting acid)*

3. describe the properties of elements and compounds and have a basic understanding of the periodic table
   - identify that elements can combine to form compounds and that compounds break down into their constituent elements
   - describe the difference among metals, nonmetals and metalloids on the basis of their properties *(e.g., luster, conductivity, malleability, brittleness, state of matter)*
   - use the periodic table to locate the names and properties of elements
   - identify and write word equations for common elements and simple compounds *(e.g., hydrogen and oxygen produce water, iron and oxygen produce rust, carbon and oxygen produce carbon dioxide, sodium and chlorine produce salt).*

Skill Outcomes

Initiating and Planning

Students will:

ask questions about the relationships among observable variables and conduct investigations to address those questions

- answer questions about science-related problems
- state a prediction and a hypothesis based on background information or on an observed pattern of behaviour
- identify the major variables related to an investigation/experiment
- carry out investigations/experiments
- use appropriate methods and tools to collect data and information *(e.g., separate a mixture, using standard techniques such as filtration and evaporation).*

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- perform experiments and/or conduct investigations *(e.g., investigate properties such as physical appearance, density, solubility, magnetism and melting point of sample materials in the laboratory)*
- organize data, using a format that is appropriate to the task or experiment *(e.g., prepare a chart that describes the properties of common household solutions and lists procedures for their safe use, storage and disposal)*
- select information from various print and electronic sources or from several parts of the same source *(e.g., use current, reliable information sources to investigate elements and compounds; upload and download text, image, audio and video files on the safe handling of chemicals in the workplace).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- examine patterns and trends in data and give possible explanations
- state a possible conclusion based on experimental data and explain how the evidence gathered supports or refutes the initial prediction.

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- receive, understand and act on the ideas of others *(e.g., share information and learn from others)*
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means *(e.g., write, in point form, how chemicals are used in the laboratory, in the home and in the workplace).*

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., research answers to questions such as, "What is the pH of shampoo and other cleaning solvents used around the home?")*
Mutual Respect	• appreciate that scientific understating evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., recognize the contribution of science and technology to the progress of civilizations)*

Scientific Inquiry	• apply a variety of strategies to investigate questions, problems and issues and apply scientific methods to carefully gather evidence when investigating problems and issues *(e.g., ask questions to ensure personal understanding)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., work collaboratively with any classmate or group and share responsibility for any errors made or any difficulties encountered)*
Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., evaluate the long-term impact of waste disposal, such as paints and cleaning solutions, on the environment and the quality of life of living organisms)*
Safety	• show concern for safety when planning, conducting and reviewing activities *(e.g., read the label on materials before using them, interpret the WHMIS symbols and consult a reference document if safety symbols are not understood; seek medical assistance immediately for any first-aid concerns, such as cuts, burns or unusual reactions).*

Unit B: Understanding Energy Transfer Technologies (Science and Technology Emphasis)

Overview

Energy can be transferred by heat and by the use of force or distance multipliers called machines. The optimal design of such technologies is based upon an understanding of energy transfer, heat, temperature and force. Students understand that the design of energy transfer technologies takes into consideration the need for safety and for efficiency as a means of reducing reliance upon nonrenewable energy resources.

Focusing Questions

1. How do common energy transfer technologies work in meeting our daily needs?
2. Why are efforts to promote energy conservation, by improving the efficiency of these technologies, important to society?

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.

- cooling and heating systems based on radiation, convection, conduction
- particle model of matter, temperature, thermal energy and heat
- methods that reduce the loss of heat from buildings, our bodies and constructed devices
- absorption and loss of heat
- protection against thermal energy transfer
- energy transfer
- reducing reliance on nonrenewable energy sources

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

Students will:

1. examine how natural and technological cooling and heating systems are based on the transfer of thermal energy (heat) from hot to cold objects
    - observe cooling systems as applications that are based on the principle that heat transfers from warmer to cooler objects *(e.g., air conditioners, automobile radiators)*
    - describe the three ways that thermal energy transfers from warmer to cooler objects; i.e., radiation, convection and conduction
    - compare and evaluate the efficiency of contemporary structures to traditional Aboriginal structures in terms of heat retention
    - describe the particle model of matter, in which every object consists of particles in motion, and describe the effect of temperature on this motion *(e.g., observe Brownian motion)*
    - examine the roles of convection and conduction in distributing heat in natural and technological systems *(e.g., sea and land breezes, cast-iron pots and pans)*
    - describe how large bodies of water, such as oceans and lakes, have a moderating influence on climate *(e.g., compare the climates of Vancouver and Calgary)*

2. investigate common methods and devices designed to control the transfer of thermal energy
    - investigate technologies that reduce thermal energy transfer *(e.g., clothing construction strategies, insulation, cavity walls)*
    - examine devices and methods that protect against potentially dangerous thermal energy transfer *(e.g., household appliances, protective clothing worn by firefighters, internal combustion engine)*
    - examine variations in absorption or loss of heat in a substance being heated or cooled, manipulating variables, including the amount and type of material *(e.g., motor oil, cooking oil, water)*

3. describe and compare simple machines as devices that transfer energy and multiply forces or distances
    - describe simple machines as devices that transfer energy *(e.g., screws, ramps, hammers, hockey sticks, tennis rackets)*
    - describe simple machines as either force multipliers or distance multipliers
    - examine common household machines in terms of force multipliers and ways in which work is made easier *(e.g., can openers, crowbars, automobile jacks, scissors and hedge clippers).*

Skill Outcomes

Initiating and Planning

Students will:

ask questions about the relationships among observable variables and conduct investigations to address those questions

- identify questions to investigate arising from practical problems and issues *(e.g., investigate common machines that change the direction, speed or magnitude of a force, such as automobile jacks, can and bottle openers, meat grinders, bicycles and ramps)*
- state a prediction and a hypothesis based on background information or on an observed pattern of events *(e.g., hypothesize the relationship between the rate of thermal conduction in different materials and insulative properties)*
- conduct an experiment and identify the major variables.

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- use instruments effectively and accurately to collect data *(e.g., collect data on daily household energy consumption by recording electricity and gas meter readings over a two-week period; organize and display data)*
- use tools, technology and apparatus safely *(e.g., build a container to keep material hot or cold).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- examine patterns and trends in data and explain possible relationships among the major variables *(e.g., suggest possible reasons for daily fluctuations in domestic energy consumption)*
- identify potential applications of findings *(e.g., perform an experiment to investigate how well various materials insulate; graph temperature changes)*
- test and evaluate designs and prototypes in terms of function, reliability, safety, efficiency, use of materials and impact on the environment *(e.g., test insulating materials and methods; determine the efficiency of a machine).*

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- receive, understand and act on the ideas of others *(e.g., revise laboratory reports based on feedback from others)*
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means *(e.g., draw diagrams that show the differences between particles in solids, liquids and gases; communicate, using the terms thermal energy and temperature).*

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 and use a variety of methods and resources to increase knowledge and skills and to solve problems; recognize that part-time jobs require science- and technology-related knowledge and skills)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., recognize that the use of modern Western approaches to technology are not the only ways in which people, such as Aboriginal peoples, have met their needs)*
Scientific Inquiry	• apply a variety of strategies to investigate questions, problems and issues and apply scientific methods to carefully gather evidence when investigating problems and issues *(e.g., ask questions and conduct research to increase understanding)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., seek the point of view of others and consider a multitude of perspectives; accept constructive criticism when sharing ideas or points of view)*
Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., promote actions and technologies that are not injurious to the environment; consider the impact of technology and weigh scientific, technological and ecological factors)*
Safety	• show concern for safety when conducting and reviewing activities *(e.g., keep the work station uncluttered, with only appropriate materials present).*

Unit C: Investigating Matter and Energy in Living Systems (Science and Technology Emphasis)

Overview

Life processes require the exchange of matter between living systems and the external environment. Students investigate life processes at the organism and system level. In closely studying the digestive and circulatory systems, students understand that a healthy diet and lifestyle is crucial to their wellness.

Focusing Questions

1. What lifestyle choices will increase the health of our organs and organ systems?
2. How do cells, which are microscopic and invisible to the naked eye, work together in organs and organ systems to carry out life functions?

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.

- structures and functions of, and the relationship between, the digestive and circulatory systems
- diets and human nutritional needs
- social influences on human diet-induced disorders and circulatory diseases
- structure and function of plant and animal cell parts
- life functions common to living systems
- functions of cells in organs and organ systems
- photosynthesis and respiration
- capture, storage and use of energy by living organisms
- role of technology to monitor life functions

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

Students will:

1. examine, in general terms, the exchange of matter by the digestive and circulatory systems, the functional relationship between the two systems and the need for a healthy diet and lifestyle
    - investigate human nutritional needs, using *Canada's Food Guide to Healthy Eating* and other resources
    - assess the nutrient components of prepared foods by reading labels and evaluate a variety of popular diets in terms of nutrient composition
    - explain, in general terms, how diets that include excessive amounts of certain foods may influence body function *(e.g., foods high in cholesterol, salt, fats)*
    - examine and discuss the role of mixed and vegetarian diets in meeting human nutritional needs
    - recognize how diet/eating habits, other than traditional foods, have impacted Aboriginal and other cultures
    - examine the intake and processing of matter by the digestive system *(e.g., foods are broken down into molecules that are absorbed into the blood stream from the intestine; food intake leads to increased blood sugar and mineral levels)*
    - describe, in general terms, the role of the heart and lungs in the circulatory system and in the exchange and distribution of matter processed by the digestive system

2. examine disorders of the digestive and circulatory systems induced by genetic, lifestyle and environmental factors
   - describe, in general terms, how the digestive and circulatory systems interact to assist in the maintenance of balance (homeostasis) in the human organism
   - explain that illness and possibly death may result when the body cannot accommodate major disturbances within the digestive, excretory and circulatory systems *(e.g., appendicitis, kidney failure, heart attacks)*
   - examine a technology that is used to diagnose imbalances *(e.g., endoscope, stethoscope*) or to intervene and preserve balance (homeostasis) *(e.g., kidney dialysis machine, pacemaker)*
   - examine the effect of social factors on human digestive and circulatory well-being and disorders *(e.g., ulcers, anorexia, bulimia, high blood pressure, heart and arterial diseases, as they relate to fitness level and diets)*

3. describe, in general terms, the structure and function of plant and animal cell parts
   - examine the structure of the major parts of plant and animal cells, including the cell membrane, nucleus, vacuole, mitochondrion, chloroplast and cell wall

4. identify and compare, in general terms, the life functions common to living systems, from cells to organ systems
   - examine the relationship between photosynthesis and cellular respiration in terms of biological energy storage *(e.g., capture of energy from the sun in glucose during photosynthesis and the release of energy from glucose during cellular respiration)*
   - examine life functions common to living systems *(e.g., energy conversion, response to the environment, growth, reproduction, conservation or dissipation of thermal energy, torpor, dormancy, hibernation, estivation, vascular skin, sweat gland behaviour)*
   - identify the organs and systems in plants and animals that perform life functions
   - identify the major human organ systems that perform critical life functions *(e.g., energy conversion, response to the environment, growth, reproduction, conservation or dissipation of thermal energy)*
   - examine how cell structure is adapted for specific life functions *(e.g., stomata on the leaves for water balance; skin cells are flat to cover a large surface area; plant cell walls provide structural support; nerve cells are long for transmission of impulses; storage of chemical energy in roots such as sugar beets, stems such as sugar cane and fruits such as apples)*
   - identify the role of modern technology in monitoring critical life functions in humans *(e.g., ultrasound, heart monitor, blood pressure cuff, blood glucose monitoring devices).*

Skill Outcomes

Initiating and Planning

Students will:

ask questions about relationships among observable variables and conduct investigations to address those questions

- identify strategies, tools and other resources for gathering and organizing information/data
- identify questions arising from practical problems and issues *(e.g., conduct a search, using a wide variety of electronic sources, when investigating technology used to monitor critical life functions)*
- identify the consequences of various strategies to solve problems
- identify the variables related to an investigation or experiment.

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- conduct procedures, controlling the major variables *(e.g., identify the manipulated, responding and controlled variables for an experimental investigation of the effect of exercise on heart rate)*
- use instruments effectively and accurately to collect data *(e.g., prepare wet mounts of tissue and observe cellular structures specific to plant and animal cells; observe structures using microscopes)*
- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., use models, computer simulations)*
- use tools and apparatus safely *(e.g., use the compound microscope to identify cellular structures, from prepared slides of plant and animal tissue or from microslides, and accurately represent these structures in clearly labelled diagrams).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea *(e.g., observe the feeding behavior of paramecia and compare to the processes that occur in a human organism)*
- identify problems in the way a prototype or constructed device functions *(e.g., examine models of organs that perform a specific function)*
- identify new questions and problems that arise from what was learned *(e.g., "How do water and dissolved materials move in living plant and animal cells?").*

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- receive, understand and act on the ideas of others *(e.g., revise prototype designs based on feedback from others)*
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (*e.g., research the physiological basis of a specific disorder in one of the systems studied; present this information to peers in oral form or in a document, using style sheets and word-processing techniques)*
- defend a position on an issue or a problem, based on their findings *(e.g., research how individual lifestyles, such as smoking, inactivity and stress, and eating habits, such as a high fat diet, affect the functioning of the circulatory system).*

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., research the answers to their own questions)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., recognize the contribution of science and technology to the progress of civilization)*
Scientific Inquiry	• apply a variety of strategies to investigate questions, problems and issues and use factual information and rational explanations when investigating problems and issues
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., provide the same attention and energy to the group's product as to a personal assignment)*
Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., consider all perspectives when addressing issues; weigh scientific, technological and ecological factors)*
Safety	• show concern for safety when conducting and reviewing activities *(e.g., keep the work station uncluttered, with only appropriate materials present).*

Unit D: Investigating Matter and Energy in Environmental Systems (Social and Environmental Contexts Emphasis)

Overview

Energy from the Sun sustains living systems and maintains equilibrium in the biosphere. In the biosphere, matter is recycled along natural pathways. Students learn, however, that increasing human population, human activity, use of energy and reliance on manufactured materials are having an impact on the movement of energy in the biosphere. This raises global concerns about sustainability.

Focusing Questions

1. How does human activity influence the natural flow of energy in the environment?
2. Should humans as a species be concerned about the effect of their activities on other species and the 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.

- role of living organisms in cycling matter
- food chains, food webs and energy pyramids
- maintaining equilibrium in the biosphere
- recycling of human-generated wastes
- biodegradable materials
- impact on modern agricultural technologies
- biotic and abiotic factors and ecosystems
- factors affecting population growth
- human impact on ecosystems

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

Students will:

1. examine how the flow of matter in the biosphere is cyclical along characteristic pathways and can be disrupted by human activity
   - examine natural food chains, food webs and energy pyramids
   - investigate how human societies, including traditional Aboriginal societies, influence the cycling of matter in the biosphere
   - examine the costs and benefits of technological developments that result in materials the ecosystem cannot recycle *(e.g., disposable plastics, heavy metals)*
   - examine how biodegradable materials reduce the impact of human-made products on the environment
   - compare the recycling of matter by society with the natural cycling of matter through ecosystems
   - examine the impact of modern agricultural technology on the cycling of matter through natural pathways
   - identify the needs and interests of society that have led to technologies with unforeseen environmental consequences *(e.g., fishing technologies that result in harvesting rates that are higher than reproduction rates, use of pesticides such as DDT, impact of automobile emissions on atmospheric composition)*

2. examine a local ecosystem in terms of its biotic and abiotic components and describe the factors that maintain its equilibrium
   - describe, in general terms, the characteristics of two Alberta biomes *(e.g., parkland, boreal forest, mountain, grassland)*
   - define ecosystems in terms of biotic and abiotic factors *(e.g., common plants and animals, latitude, altitude, topography)*

- examine how various abiotic factors influence biodiversity in an ecosystem *(e.g., climate, substrate, temperature, elevation)*
- explain how various factors influence the size of populations *(e.g., immigration, emigration, birth rate and death rate, food supply, predation, disease, number of offspring produced, climate change)*
- examine how interactions among organisms limit populations *(e.g., predation, parasitism, competition)*
- examine the relationship between land-use practices and altering ecosystems *(e.g., swamp drainage, slash-and-burn forestry, agriculture)*
- recognize the purpose of environmental laws.

Skill Outcomes

Initiating and Planning

Students will:

ask questions about relationships among observable variables and conduct investigations to address those questions

- identify questions arising from practical problems and issues *(e.g., develop questions related to recycling, ozone thinning)*
- identify the manipulated, responding and controlled variables *(e.g., investigate the amount of waste materials produced by a school or family on a daily or weekly basis)*
- select appropriate methods and tools to collect data and information to solve problems *(e.g., conduct a search for environmental projects, using a wide variety of electronic sources).*

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- conduct procedures, controlling the major variables *(e.g., perform experiments to demonstrate that cellular respiration releases thermal energy)*
- organize data, using a format that is appropriate to the task or experiment *(e.g., review the data collected in an ecosystem study and present this information in a written or graphic format or in an oral presentation to peers)*
- select and integrate information from various print and electronic sources *(e.g., research the influence of a specific living organism, such as sea birds, on the cycling of matter through the biosphere and communicate information in the form of a clearly written report; create a database or spreadsheet to convey information on populations).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs
- identify the possible strengths and weaknesses of different methods of collecting and displaying data *(e.g., examine methods used to collect and display biotic and abiotic data from an ecosystem)*
- state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea

- identify new questions and problems that arise from what was learned *(e.g., "Should there be more controls on bringing live animals and plants to Canada and other countries?"; "How can we reduce the amount of household wastes?").*

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- receive, understand and act on the ideas of others *(e.g., revise text documents based on feedback from others)*
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means *(e.g., represent the movement of matter and energy in an ecosystem, using food chains, food webs or pyramids, and communicate this information in the form of a graphic illustration)*
- work cooperatively with team members to carry out a plan *(e.g., perform a field study on an aquatic or terrestrial ecosystem)*
- defend a position on an issue or a problem, based on their findings *(e.g., investigate reduction of household wastes)*
- use a variety of strategies to troubleshoot group work 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., demonstrate an interest in science and technology topics not directly related to classroom studies)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., consider scientific, technological, economic, cultural, political and environmental factors when formulating conclusions, solving problems or making decisions on a Science, Technology and Society [STS] issue)*
Scientific Inquiry	• seek and relate evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., insist on evidence before accepting a new idea or explanation for waste reduction)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., be attentive when others speak; be nonjudgmental in the discussion of ideas and plans)*

Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., examine their personal role in the preservation of the environment; make a personal decision based on feelings of responsibility toward less privileged parts of the global community and toward future generations)*
Safety	• show concern for safety when conducting and reviewing activities *(e.g., consider safety and show concern for the environment when disposing of used materials).*

SCIENCE 20-4

Unit A: Applications of Matter and Chemical Change (Science and Technology Emphasis)

Overview
Students extend their understanding of matter by investigating and classifying simple chemical reactions used at home and in the workplace. Students also become aware that many different materials can be created from a relatively small number of components and that technologies based on chemical change are widely used in producing useful materials for our daily use.

Focusing Questions
1. What are some of the chemical reactions that are important in society and in meeting our personal needs?
2. How is knowledge about types of chemical reactions applied in technological products and processes found 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.

- commonly used materials and chemical change in everyday life
- Workplace Hazardous Materials Information System (WHMIS) and Hazardous Household Product Symbols (HHPS)
- evidence of chemical change
- description and classification of combustion and rusting reactions, acid-base reactions and simple composition and decomposition reactions
- chemical reactions at home and in the workplace
- environmental effects of chemical change technologies

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

Students will:

1. identify how everyday life depends upon technological products and processes that produce useful materials and energy
   - identify common materials and their uses and describe how everyday life has changed over the past 100 years with the development of new materials *(e.g., acids, bases, alloys, plastics, ceramics, fibres, composites*)
   - identify examples of the chemical changes involved in cooking, cleaning, personal care and gardening *(e.g., acids in vinegar, citrus fruits and rhubarb react with aluminum kitchen cookware; bases in drain cleaners react with grease; pesticides interfere with metabolic processes in living systems)*
   - identify and apply appropriate safety standards, including WHMIS and HHPS, at home, in the workplace and in the community when using chemicals

2. investigate and classify chemical reactions
   - name simple compounds from chemical formulas and recognize the names of substances that are used everyday
   - understand the relationship among chemical formulas, composition and name *(e.g., simple acids, bases, salts)*
   - investigate and identify evidence of chemical change *(e.g., change of phase, appearance, colour, odour, energy such as heat and light)*

- investigate the changes to reactants and products in fossil fuel combustion and rusting reactions
- investigate and classify endothermic and exothermic reactions *(e.g., chemicals mixing in a cold pack, burning natural gas)*
- investigate and classify simple composition and decomposition reactions *(e.g., tarnishing of silver, electrolysis of water)*
- identify simple composition, decomposition, combustion and neutralization reactions when they are given word and/or chemical equations, products and reactants

3. examine common technological products and processes encountered in everyday life and the workplace and examine their potential effects on the environment
   - examine common acid-base neutralization reactions *(e.g., neutralization of stomach acid by antacids, use of lemon juice on fish dishes)*
   - investigate chemical processes occurring in everyday life *(e.g., acid-base reactions in cleaning and food processing, dyeing hair, washing clothes, gasoline combustion in an automobile engine, swimming pool maintenance, rusting metal)*
   - give possible examples of how technology has addressed the problem of corrosion *(e.g., protect with paint, oil, plastic or metal; use alloys)*
   - examine greenhouse gases and air pollution resulting from combustion reactions *(e.g., carbon dioxide and carbon monoxide released when methane is burned in a household furnace)*
   - examine technologies used to reduce the emissions that cause acid deposition.

Skill Outcomes

Initiating and Planning

Students will:

ask questions about relationships among observable variables and plan and conduct investigations to address those questions

- identify questions to investigate that arise from practical problems and issues *(e.g., "What environmental factors have the greatest effects on rusting?")*
- identify the potential strengths and weaknesses of possible solutions to a given practical problem
- select appropriate methods and tools to collect data and conduct investigations and experiments.

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- conduct procedures, controlling the major variables
- compile and organize data, using appropriate formats and data treatments to facilitate interpretation *(e.g., lists in charts and tables; observe physical and chemical changes)*
- use library and electronic research tools to collect information on a given topic *(e.g., list automobile technologies that are used to reduce harmful emissions)*
- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., prepare an inventory of and classify useful acids and bases used in a typical day)*
- construct and test a prototype of a device or system and troubleshoot problems as they arise
- demonstrate a knowledge of WHMIS standards by selecting and applying the proper techniques for handling and disposing of materials *(e.g., recognize substances, circumstances and actions that may be hazardous to people and the environment).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables and graphs *(e.g., report findings of their investigations of chemical change)*
- apply criteria to evaluate evidence and sources of information *(e.g., evaluate information on the technologies used to reduce the emissions that cause acid deposition)*
- state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea *(e.g., report on the results of an investigation into the effectiveness of antacid tablets)*
- identify practical problems in the way a technological device or system functions *(e.g., suggest ways to reduce air pollution or rusting).*

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- communicate questions, ideas and intentions and receive, understand, support and respond to the ideas of others *(e.g., use appropriate communication technology to elicit feedback from others)*
- work collaboratively with team members to conduct a plan and to troubleshoot as problems arise
- evaluate individual and group processes used in planning, problem solving and decision making and in the completion of a task *(e.g., assess processes used to construct a device that reduces CO emissions).*

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., maintain interest or pursue further studies in science; recognize that part-time jobs require science- and technology-related knowledge and skills)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., recognize the contribution of chemistry and technology to the progress of civilization)*
Scientific Inquiry	• seek and apply evidence when evaluating alternative approaches to investigations, problems and issues

Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., accept responsibility for any task that helps the group complete an activity; be attentive when others speak; share responsibility for errors made or difficulties encountered by the group)*
Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., walk, rather than drive, to neighbourhood stores to reduce emissions of greenhouse gases; assume part of the collective responsibility for the impact of humans on the environment)*
Safety	• show concern for safety when conducting and reviewing activities *(e.g., write safety and waste-disposal concerns into a laboratory procedure; seek assistance immediately for any first-aid concerns, such as cuts, burns or unusual reactions)*.

Unit B: Understanding Common Energy Conversion Systems (Science and Technology Emphasis)

Overview

Students investigate a variety of important energy conversions occurring in biological, chemical, physical and technological systems. Although energy appears in many forms and is essentially conserved, in each energy transformation the availability of useful energy decreases. Students learn that the technologies for extracting, processing and using fossil fuels involve converting energy into more useful forms for our use.

Focusing Questions

1. What energy conversions occur in biological, chemical, physical and technological systems?
2. How efficient are various energy converters at converting energy to useful forms?

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.

- energy transformations and conservation
- generation and distribution of electricity
- energy consumption and electrical household devices as converters of energy
- rate of energy transfer and efficiency
- chemical and energy changes in chemical and biological systems
- living organisms as energy converters
- formation, extraction and combustion of fossil fuels
- fossil fuel-based technologies and quality of life for further generations

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

Students will:

1. investigate and interpret the transformation and conservation of various forms of energy in physical and technological systems
   - investigate evidence of energy transformations in the home and everyday contexts *(e.g., simple machines, electrical devices, chemical reactions)*
   - design, construct and evaluate a simple model or device that transforms energy from one form to another *(e.g., windmill, water wheel, model vehicle powered by rubber bands/mousetraps/ carbon dioxide/electric motor)*
   - describe an energy transformation system in terms of input, converter and output *(e.g., an electric kettle)*
   - examine the law of conservation of energy to trace energy transformation, dissipation and availability in physical and technological systems *(e.g., swinging pendulum)*

2. investigate electrical energy conversion devices in terms of energy conversions, rate of energy transfer and efficiency
   - examine electrical power generation in terms of converting thermal/hydro/wind/solar/nuclear energy into electricity
   - compare the efficiency of electrical power distribution systems by tracing the energy conversions that occur in a variety of household devices *(e.g., power tools, electric automobiles, microwave and conventional ovens, fluorescent and halogen light bulbs)*
   - examine why the useful output energy in machines is always less than the input energy
   - devise a plan for making more efficient use of household energy conversion devices *(e.g., use of full loads in a dishwasher or clothes dryer; use of appropriate wattage light bulbs or compact fluorescent light bulbs)*

3. investigate the energy conversions associated with change in chemical and biological systems
   - investigate the common chemical reactions that produce or absorb energy *(e.g., light and heat emitted by the combustion of fossil fuels, cold and hot packs)*
   - examine and list the requirements of photosynthesis *(e.g., carbon dioxide, water, chlorophyll in chloroplasts and sunlight)*
   - examine the process of respiration in which glucose and oxygen are converted to energy, carbon dioxide and water
   - describe food as fuel for the human body *(e.g., meeting its needs for normal metabolic functions, exercise and growth or repair of cells)*
   - identify the sources of energy in food *(e.g., carbohydrates, fats and protein)* and explain, in general terms, why there needs to be a balance between food intake and energy output
   - examine the factors that affect metabolism *(e.g., age, level of fitness, time of day, exercise/ activity)* and compare daily energy requirements of individuals at various stages of growth and activity levels *(e.g., energy requirements of a newborn, teenager, office worker and labourer; energy requirements while sleeping, running)*
   - examine the formation of fossil fuels *(e.g., oil, coal and natural gas)*

4. examine the impact of fossil fuel-based technologies and their importance in meeting human needs
   - explain the importance of the fossil fuel industry in Alberta in meeting energy requirements
   - compare present fossil fuel consumption, by industry, homes and automobiles, with projected consumption in the future
   - examine the sources of fossil fuels and the extraction and refining processes
   - assess the impact of fossil fuel-based technologies on the environment
   - assess the importance of combustion reactions to a modern industrial society and describe the implications of depleting fossil fuel reserves.

Skill Outcomes

Initiating and Planning

Students will:

ask questions about relationships among observable variables and conduct investigations to address those questions

- investigate questions that arise from practical problems and issues *(e.g., "How can we measure the power of the human body?")*
- formulate operational definitions of major variables *(e.g., define power, energy and metabolism)*
- identify the potential strengths and weaknesses of practical problems
- evaluate and select appropriate instruments for problem solving, inquiry and decision making *(e.g., describe how to measure the energy output of a device or process and select the proper tools for the task).*

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- conduct procedures, controlling the major variables
- compile and organize data, using appropriate formats and data treatments to facilitate interpretation *(e.g., lists in charts and tables, sources of energy in foods)*
- use library and electronic research tools to collect information on a given topic *(e.g., collect data on the energy requirements of individuals at varying stages of growth and levels of activity)*

- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., collect background information to investigate obesity, starvation or anorexia nervosa)*
- construct and test a prototype of a device or system and troubleshoot problems as they arise *(e.g., construct a device that uses solar or wind energy).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables and graphs *(e.g., report findings from an experiment that measures the power of the human body)*
- state a conclusion, based on experimental data, and describe how evidence gathered supports or refutes an initial idea *(e.g., describe why the input energy of machines is always greater than the output energy)*
- identify practical problems in the way a technological device or system functions
- evaluate a personally designed and constructed device on the basis of predeveloped criteria *(e.g., assess an energy conversion).*

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- communicate questions, ideas and intentions and receive, interpret, understand, support and respond to the ideas of others *(e.g., collect and display data on household energy consumption by reading and recording data from electricity and gas meters over a two-week period)*
- select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results
- work cooperatively with team members to 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., research answers to their own questions, such as, "How could I reduce my personal energy consumption?")*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., consider social and cultural contexts when discussing body images; recognize the contribution and skill of technologists in the extraction of oil from the tar sands)*

Scientific Inquiry	• seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., expend the effort and time required to make valid conclusions)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., participate with others in peaceful conflict resolution; share the responsibility for errors made or difficulties encountered by the group)*
Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., participate in the social and political systems that influence environmental policy in their community)*
Safety	• show concern for safety when conducting and reviewing activities *(e.g., assume responsibility for the safety of all those who share a common working environment by cleaning up after an activity and disposing of materials in a safe place).*

Unit C: Disease Defence and Human Health (Social and Environmental Contexts Emphasis)

Overview

The human organism as a living system is affected by a variety of environmental and genetic factors. Students investigate the nature of these factors, their effects on the health of the human organism and how social conditions and decisions play a role. Students learn about the body's natural defence systems and about medical techniques used to minimize the risk of exposure to environmental toxins and disease-causing agents. Although inheritance is well understood, minimizing genetic disorders is a complex issue, involving scientific, ethical and social perspectives.

Focusing Questions

1. How do social, environmental and genetic factors affect human health?
2. How have improved sanitary conditions, personal hygiene and developments in modern medicine, e.g., aseptic techniques, vaccinations and antibiotics, enhanced human health?

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.

- social impact on human health
- role of environmental factors; e.g., toxins, disease-causing agents
- communicable and noncommunicable diseases
- human actions to reduce contamination by disease-causing agents
- role of the human body's defence systems
- principles of simple inheritance
- impact of recent genetic research on societal decision making

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

Students will:

1. describe how human health is affected by environmental factors and describe the need for action by society to improve human health
    - describe, in general terms, how human diseases may arise from an interaction of variables, including poor nutrition, stress, disease-causing agents and environmental contamination
    - examine the relationship between social conditions and disease *(e.g., hunger and malnutrition; sanitation and bacterial, viral, fungal diseases)*
    - list the social and economic impact of pandemic diseases on past and present societies *(e.g., Black Death; 1918 Influenza; severe acute respiratory syndrome (SARS); impact of European diseases, such as tuberculosis, on Canada's First Nations communities)*
    - examine, from a historical perspective, the connection between diseases and contaminated drinking water, air pollution and personal hygiene
    - examine the impact of public health initiatives and the maintenance of high standards of personal hygiene in fostering healthier societies and individuals *(e.g., provision of potable water, clean air standards, treatment of human and animal wastes, safe handling of food)*

2. examine the relationship between human health and environmental disease-causing agents
    - distinguish between communicable and noncommunicable diseases
    - investigate the conditions necessary for the growth of a specific disease-causing agent *(e.g., viruses, fungi, bacteria)*
    - describe how different communicable diseases are transmitted and how they affect human health *(e.g., common cold, influenza)*

- examine how noncommunicable diseases are transmitted and how they affect human health *(e.g., food poisoning due to salmonella or E. coli, cholera, dysentery)*
- investigate how a specific food-handling or preparation process is designed to prevent microbial contamination of the final product *(e.g., freezing, pickling, salting, vacuum packaging and radiation)*

3. examine the natural mechanisms that protect the human organism from disease-causing agents
   - examine the role of the human organism's physical defences in preventing infection by disease-causing agents *(e.g., skin, mucus membranes, tears, saliva, digestive system)*
   - investigate the role of blood components *(e.g., white blood cells and antibodies)* in controlling pathogens
   - describe, in general terms, how the immune system protects the body by attacking foreign or abnormal proteins
   - investigate how different antibiotic therapies, vaccines or medications are used to treat or prevent a disease *(e.g., measles, rabies, tetanus, smallpox, tuberculosis)*
   - investigate how the overuse and improper use of antibiotics may lead to the development of resistance in bacteria *(e.g., use of prescription antibiotics for viral infections)*

4. describe the role of genes in inherited characteristics and human health
   - describe the role of genes in inherited characteristics *(e.g., hitchhiker's thumb; earlobe attachment; hair, skin and eye colour)*
   - identify the role of chromosomes in determining the sex of human offspring.

Skill Outcomes

Initiating and Planning

Students will:

ask questions about relationships among observable variables and conduct investigations to address those questions

- investigate questions that arise from practical problems and issues *(e.g., "How effective are commercially available antibacterial cleaners on bacteria found in the home or school?")*
- evaluate and select appropriate instruments for problem solving, inquiry and decision making *(e.g., decide what needs to be measured and select the proper procedures and tools for the task).*

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- conduct procedures, controlling the major variables
- use instruments effectively and accurately to collect data *(e.g., observe prepared slides of various disease-causing agents or prepared slides of the cellular components of human blood)*
- compile and organize data, using appropriate formats and data treatments to facilitate interpretation *(e.g., graph results of a simulated spread of infection; track the population growth of bacteria)*
- use library and electronic research tools to collect information on a given topic *(e.g., use current, reliable information sources to investigate the spread of diseases, such as severe acute respiratory syndrome (SARS), tuberculosis, cholera)*
- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., investigate genetic diseases on the Internet).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables and graphs *(e.g., graph the incidence of a particular disease over time)*
- assess the reliability and adequacy of data
- state a conclusion, based on experimental data, and describe how evidence gathered supports or refutes an initial idea *(e.g., hand washing by hospital staff reduced infection in patients in the 1800s)*
- identify practical problems in the way a technological device or system functions.

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- communicate questions, ideas and intentions and receive, interpret, understand, support and respond to the ideas of others *(e.g., participate in a variety of electronic group formats)*
- select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results
- work cooperatively with team members to carry out a plan and to troubleshoot problems as they arise
- evaluate individual and group processes used in planning, problem solving and decision making and in the completion of 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., investigate health issues; investigate careers, such as practical nursing and work in the food service industry)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., research ethical dilemmas associated with advancements in genetics)*
Scientific Inquiry	• seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., insist on evidence before accepting new ideas or explanations)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., assume a variety of roles as required; be attentive when others speak)*

Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment *(e.g., share the responsibility for maintaining clean air and clean water)*
Safety	• show concern for safety when conducting and reviewing activities *(e.g., follow proper food-handling and preparation processes when working in the kitchen; show consideration when ill by limiting the exposure of others to disease-causing agents)*.

Unit D: Motion, Change and Transportation Safety (Nature of Science Emphasis)

Overview
There is a greater risk of being injured or killed while travelling in a motor vehicle than when engaging in other common activities. Recognizing risk, governments and the transportation industry are working on new safety systems and practices designed to protect passengers. Students learn that these systems are based upon an understanding of the law of conservation of momentum.

Focusing Questions
1. What transportation factors in our community help reduce passenger risk?
2. How has knowledge about moving objects and conservation of momentum affected the design of automobiles, safety regulations and practices governing transportation?

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.
- reaction time, speed and safe following distance
- effects of collision durations
- safety systems designed to reduce collision effects
- transportation safety regulations

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

Students will:
1. distinguish between scientific evidence and personal opinion to examine the need for safety systems and regulations
   - list the factors influencing the ability to make sudden stops *(e.g., degree of wakefulness, visual acuity, state of mind, road and weather conditions)*
   - examine the need to stay a safe distance behind another automobile when travelling at highway speeds *(e.g., maintaining a two-second gap under normal driving conditions)*
   - discuss the consequences of a shorter or longer reaction time
   - list traffic safety factors *(e.g., reasons why some traffic lights stay yellow for three seconds and others for five seconds, reasons why some traffic lights have advanced warning flashers, speed bumps, guardrails, rumble strips)*
   - list the ways passengers can protect themselves from injury in accidents
   - identify the dangers faced by individuals in a motor vehicle accident
   - compare the death and injury rate in motor vehicle accidents to other causes of death and injury among adults and teenagers

2. apply the principles underlying the motion of objects to explain the need for safety devices and practices
   - examine how seat belts and air bags function in terms of momentum and dispersal of force *(e.g., explain why one cannot brace for a collision as a means of protection; explain why babies must be placed in special seats and not on a passenger's lap)*
   - examine data and strategies comparing vehicle occupant injuries, for belted and unbelted occupants, before and after seat-belt legislation
   - compare the functioning of first- and second-generation air bags and explain the need to improve the design of air bags *(e.g., the design of first-generation air bags assumed drivers to be adult males who were not wearing seat belts; for the second-generation design, these assumptions were revised to reduce speed and force of air bag deployment)*
   - examine the application of the law of conservation of momentum in one dimension in a variety of situations involving two objects *(e.g., rear-end collision, recoil, jumping from a boat, traffic accidents, two people on skates pushing each other).*

Skill Outcomes

Initiating and Planning

Students will:

ask questions about relationships among observable variables and conduct investigations to address these questions

- investigate questions that arise from practical problems and issues *(e.g., "How long does it take emergency personnel to respond to an emergency?")*
- conduct an experiment, identifying the major variables *(e.g., investigate how air bags work, using a partially inflated beach ball or plastic bag and a steel ball or rock to model the functioning of the air bag)*
- state a prediction and hypothesis based on available evidence and background information
- formulate general definitions of major variables *(e.g., force, momentum)*
- evaluate and select appropriate instruments for problem solving, inquiry and decision making.

Performing and Recording

Students will:

conduct investigations into the relationships among observations and gather and record data

- conduct procedures, controlling the major variables *(e.g., test different materials for use as a seat belt)*
- use instruments effectively and accurately to collect data *(e.g., develop a questionnaire to elicit community opinions about wearing seat belts)*
- compile and organize data, using appropriate formats and data treatments to summarize conclusions
- use library and electronic research tools to collect information on a given topic *(e.g., compare the risks involved in day-to-day transportation with other activities).*

Analyzing and Interpreting

Students will:

examine data and develop and assess possible explanations

- apply classification systems and nomenclature used in the sciences *(e.g., use terms such as force, speed, momentum)*
- compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables and graphs *(e.g., draw a force–time graph for an investigation, comparing the effectiveness of cushioned and noncushioned toy automobiles)*
- examine patterns and trends in data
- assess the reliability and adequacy of data
- state a conclusion, based on experimental data, and describe how evidence gathered supports or refutes an initial idea *(e.g., investigate the statements, "More traffic accidents occur on Monday mornings." and "More pedestrians than drivers are killed by cars.").*

Communication and Teamwork

Students will:

work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures and results

- communicate questions, ideas and intentions and receive, interpret, understand, support and respond to the ideas of others
- use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results *(e.g., graph results, using appropriate scales)*
- evaluate individual and group processes used in planning, problem solving and decision making and in the completion of a task *(e.g., group processes used to evaluate cars for their safety features).*

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., use a variety of methods and resources to increase their own knowledge and skills related to safety and driving)*
Mutual Respect	• appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., appreciate the benefits that have resulted from a better understanding of the law of conservation of momentum)*
Scientific Inquiry	• seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., describe safety issues in transportation)*
Collaboration	• work collaboratively when conducting investigations and when generating and evaluating ideas *(e.g., help motivate others, listen to the points of view of others)*
Stewardship	• demonstrate sensitivity and responsibility when pursuing a balance between the needs of humans and the requirements for a sustainable environment
Safety	• show concern for safety when conducting and reviewing activities *(e.g., consider safety regulations for drivers; respect others' space, materials and work during an activity).*