Atlantic Canada Science Curriculum
Grade 8

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Contents

Foreword

The pan-Canadian *Common Framework of Science Learning Outcomes K to 12*, released in October 1997, assists provinces in developing a common science curriculum framework.

New science curriculum for the Atlantic Provinces is described in *Foundation for the Atlantic Canada Science Curriculum (1998)*.

This curriculum guide is intended to provide teachers with the overview of the outcomes framework for science education. It also includes suggestions to assist teachers in designing learning experiences and assessment tasks.

Introduction

Background

The curriculum described in *Foundation for the Atlantic Canada Science Curriculum* was planned and developed collaboratively by regional committees. The process for developing the common science curriculum for Atlantic Canada involved regional consultation with the stakeholders in the education system in each Atlantic province. The Atlantic Canada science curriculum is consistent with the framework described in the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*.

Aim

The aim of science education in the Atlantic provinces is to develop scientific literacy.

Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become life-long learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

Program Design and Components

Learning and Teaching Science

What students learn is fundamentally connected to how they learn it. The aim of scientific literacy for all has created a need for new forms of classroom organization, communication, and instructional strategies. The teacher is a facilitator of learning whose major tasks include

- creating a classroom environment to support the learning and teaching of science
- designing effective learning experiences that help students achieve designated outcomes
- stimulating and managing classroom discourse in support of student learning
- learning about and then using students' motivations, interests, abilities, and learning styles to improve learning and teaching
- assessing student learning, the scientific tasks and activities involved, and the learning environment to make ongoing instructional decisions
- selecting teaching strategies from a wide repertoire

Effective science learning and teaching take place in a variety of situations. Instructional settings and strategies should create an environment that reflects a constructive, active view of the learning process. Learning occurs through actively constructing one's own meaning and assimilating new information to develop a new understanding.

The development of scientific literacy in students is a function of the kinds of tasks they engage in, the discourse in which they participate, and the settings in which these activities occur. Students' disposition towards science is also shaped by these factors. Consequently, the aim of developing scientific literacy requires careful attention to all of these facets of curriculum.

Learning experiences in science education should vary and should include opportunities for group and individual work, discussion among students as well as between teacher and students, and hands-on/minds-on activities that allow students to construct and evaluate explanations for the phenomena under investigation. Such investigations and the evaluation of the evidence accumulated provide opportunities for students to develop their understanding of the nature of science and the nature and status of scientific knowledge.

Writing in Science

Learning experiences should provide opportunities for students to use writing and other forms of representation as ways to learning. Students, at all grade levels, should be encouraged to use writing to speculate, theorize, summarize, discover connections, describe processes, express understandings, raise questions, and make sense of new information using their own language as a step to the language of science. Science logs are useful for such expressive and reflective writing. Purposeful note making is also an instrinsic part of learning in science that can help students better record, organize, and understand information from a variety of sources. The process of creating webs, maps, charts, tables, graphs, drawings, and diagrams to represent data and results helps students learn and also provides them with useful study tools.

Learning experiences in science should also provide abundant opportunities for students to communicate their findings and understandings to others, both formally and informally, using a variety of forms for a range of purposes and audiences. Such experiences should encourage students to use effective ways of recording and conveying information and ideas and to use the vocabulary of science in expressing their understandings. It is through opportunities to talk and write about the concepts they need to learn that students come to better understand both the concepts and related vocabulary.

Learners will need explicit instruction in, and demonstration of, the strategies they need to develop and apply in reading, viewing, interpreting, and using a range of science texts for various purposes. It will be equally important for students to have demonstrations of the strategies they need to develop and apply in selecting, constructing, and using various forms for communicating in science.

The Three Processes of Scientific Literacy

An individual can be considered scientifically literate when he/she is familiar with, and able to engage in, three processes: inquiry, problem solving, and decision making.

Inquiry

Scientific inquiry involves posing questions and developing explanations for phenomena. While there is general agreement that there is no such thing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analysing data, and interpreting data are fundamental to engaging in science. These activities provide students with opportunities to understand and practise the process of theory development in science and the nature of science.

Problem Solving

The process of problem solving involves seeking solutions to human problems. It consists of proposing, creating, and testing prototypes, products, and techniques to determine the best solution to a given problem.

Decision Making

The process of decision making involves determining what we, as citizens, should do in a particular context or in response to a given situation. Decision-making situations are important in their own right, but they also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Meeting the Needs of All Learners

Foundation for the Atlantic Canada Science Curriculum stresses the need to design and implement a science curriculum that provides equitable opportunities for all students according to their abilities, needs, and interests. Teachers must be aware of and make adaptations to accommodate the diverse range of learners in their class. To adapt instructional strategies, assessment practices, and learning resources to the needs of all learners, teachers must create opportunities that will permit them to address their various learning styles.

As well, teachers must not only remain aware of and avoid gender and cultural biases in their teaching, they must also actively address cultural and gender stereotyping (e.g., about who is interested in and who can succeed in science and mathematics). Research supports the position that when science curriculum is made personally meaningful and socially and culturally relevant, it is more engaging for groups traditionally under-represented in science, and indeed, for all students.

While this curriculum guide presents specific outcomes for each unit, it must be acknowledged that students will progress at different rates.

Teachers should provide materials and strategies that accommodate student diversity, and should validate students when they achieve the outcomes to the best of their abilities.

It is important that teachers articulate high expectations for all students and ensure that all students have equitable opportunities to experience success as they work toward achieving designated outcomes. Teachers should adapt classroom organization, teaching strategies, assessment practices, time, and learning resources to address students' needs and build on their strengths. The variety of learning experiences described in this guide provide access for a wide range of learners. Similarly, the suggestions for a variety of assessment practices provide multiple ways for learners to demonstrate their achievements.

Assessment and Evaluation

The terms **assessment** and **evaluation** are often used interchangeably, but they refer to quite different processes. Science curriculum documents developed in the Atlantic region use these terms for the processes described below.

Assessment is the systematic process of gathering information on student learning.

Evaluation is the process of analysing, reflecting upon, and summarizing assessment information, and making judgments or decisions based upon the information gathered.

The assessment process provides the data, and the evaluation process brings meaning to the data. Together, these processes improve teaching and learning. If we are to encourage enjoyment in learning for students now and throughout their lives, we must develop strategies to involve students in assessment and evaluation at all levels. When students are aware of the outcomes for which they are responsible and of the criteria by which their work will be assessed or evaluated, they can make informed decisions about the most effective ways to demonstrate their learning.

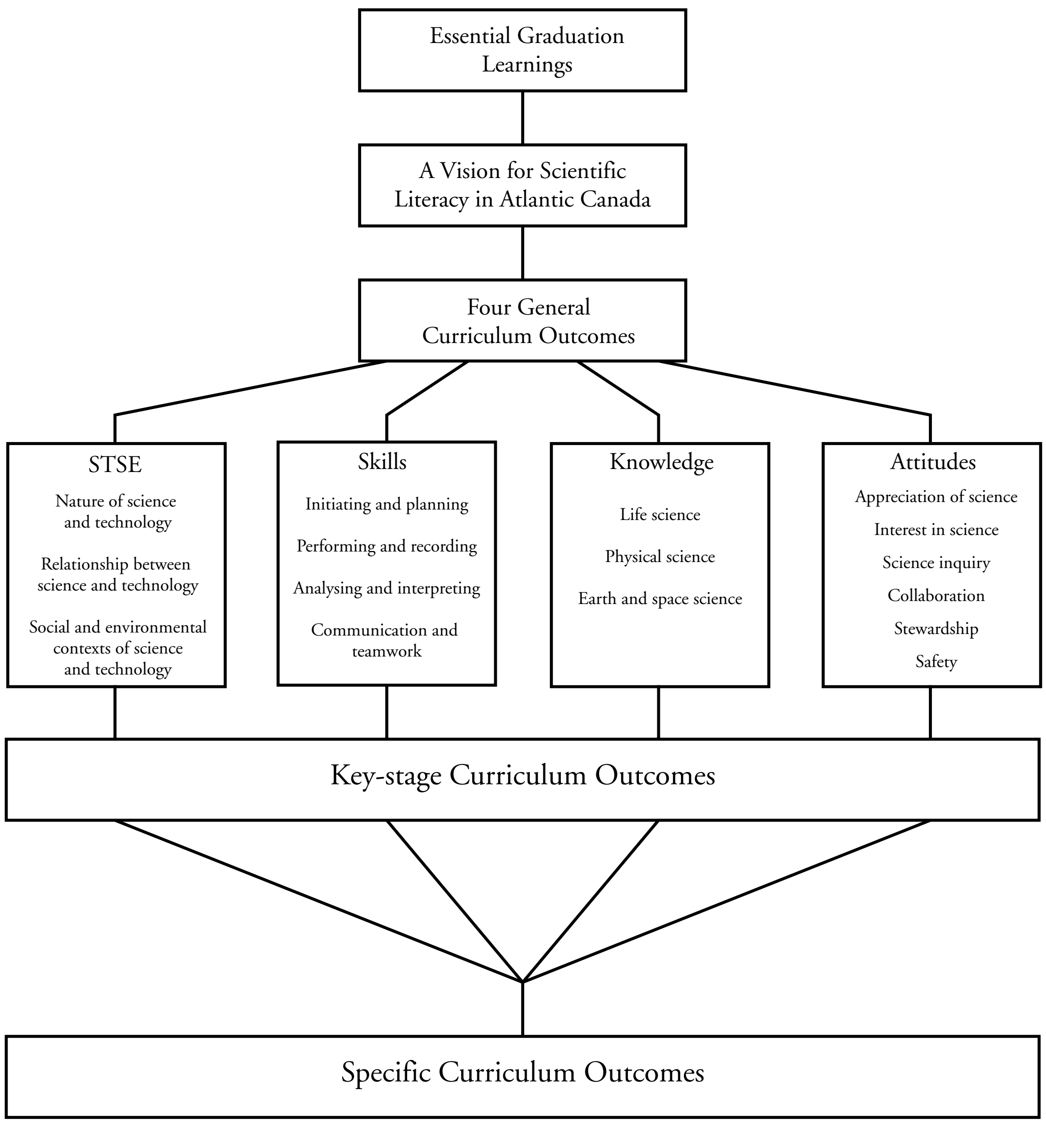
The Atlantic Canada science curriculum reflects the three major processes of science learning: inquiry, problem solving, and decision making. When assessing student progress, it is helpful to know some activities/skills/actions that are associated with each process of science learning. Student learning may be described in terms of ability to perform these tasks.

Curriculum Outcomes Framework

Overview

The science curriculum is based on an outcomes framework that includes statements of essential graduation learnings, general curriculum outcomes, key-stage curriculum outcomes, and specific curriculum outcomes. The general, key-stage, and specific curriculum outcomes reflect the pan-Canadian C*ommon Framework of Science Learning Outcomes K to 12*. The diagram below provides the blueprint of the outcomes framework.

Outcomes Framework



Essential Graduation Learnings

Essential graduation learnings are statements describing the knowledge, skills, and attitudes expected of all students who graduate from high school. Achievement of the essential graduation learnings will prepare students to continue to learn throughout their lives. These learnings describe expectations not in terms of individual school subjects but in terms of knowledge, skills, and attitudes developed throughout the curriculum. They confirm that students need to make connections and develop abilities across subject boundaries and to be ready to meet the shifting and ongoing opportunities, responsibilities, and demands of life after graduation. Provinces may add additional essential graduation learnings as appropriate. The essential graduation learnings are

Aesthetic Expression

Graduates will be able to respond with critical awareness to various forms of the arts and be able to express themselves through the arts.

Citizenship

Graduates will be able to assess social, cultural, economic, and environmental interdependence in a local and global context.

Communication

Graduates will be able to use the listening, viewing, speaking, reading, and writing modes of language(s) as well as mathematical and scientific concepts and symbols to think, learn, and communicate effectively.

Personal Development

Graduates will be able to continue to learn and to pursue an active, healthy lifestyle.

Problem Solving

Graduates will be able to use the strategies and processes needed to solve a wide variety of problems, including those requiring language, mathematical, and scientific concepts.

Technological Competence

Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

General Curriculum Outcomes

The general curriculum outcomes form the basis of the outcomes framework. They also identify the key components of scientific literacy. Four general curriculum outcomes have been identified to delineate the four critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered interrelated and mutually supportive.

Science, Technology, Society, and the Environment

Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology.

Skills

Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Knowledge

Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

Attitudes

Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

Key-Stage Curriculum Outcomes

Key-stage curriculum outcomes are statements that identify what students are expected to know, be able to do, and value by the end of grades 3, 6, 9, and 12 as a result of their cumulative learning experiences in science. The key-stage curriculum outcomes are from the *Common Framework for Science Learning Outcomes K to 12*.

Specific Curriculum Outcomes

Specific curriculum outcome statements describe what students are expected to know and be able to do at each grade level. They are intended to help teachers design learning experiences and assessment tasks. Specific curriculum outcomes represent a framework for assisting students to achieve the key-stage curriculum outcomes, the general curriculum outcomes, and ultimately, the essential graduation learnings.

Specific curriculum outcomes are organized in units for each grade level. Each unit is organized by topic. Grade 8 Science units and topics follow.

Earth and Space Science: Water Systems on Earth

- Waves, Tides, and Water Currents
- Shorelines
- Ocean Basins and Continental Drainage Systems
- Oceans and Species Distribution
- Glaciers and Polar Icecaps

Physical Science: Fluids

- Floating and Sinking–Density
- Forces in Fluids
- Viscosity of Liquids

Physical Science: Optics

- Properties of Visible Light
- Reflection
- Refraction and Dispersion
- Electromagnetic Radiation

Life Science: Cells, Tissues, Organs, and Systems

- Cells
- Interdependence among Cells, Tissues, Organs, and Systems
- Healthy/Unhealthy Systems
- Interdependence of Body Systems

The following pages outline Grade 8 Science specific curriculum outcomes grouped by units and topics.

Earth and Space Science: Water Systems on Earth

Students will be expected to

Waves, Tides, and Water Currents

- carry out procedures in order to investigate how temperature differences in water cause currents (209-1)
- state a conclusion based on experimental data about the formation of water currents (209-4, 210-11)
- explain how waves and tides are generated (311-10a)
- formulate operational definitions, on the basis of investigations of waves for
  - wave length
  - wave height
  - crest
  - trough (208-7)

Shorelines

- select and integrate information, from various print and electronic sources, related to processes of erosion and deposition that result from wave action and water flow (209-5, 311-11)
- explain how waves and tides interact with shorelines (311-10b)
- provide examples of various technologies designed to contain damage due to waves and tides (112-3)
- prepare a presentation or report on the effect of tides and waves on a shoreline, and evaluate individual and group processes used in planning and completing the task (211-2, 211-4)

Ocean Basins and Continental Drainage Systems

- describe processes that lead to the development of ocean basins and continental drainage systems (311-7)
- select and integrate information from various print and electronic sources to provide examples of technologies that have enabled scientific research involving ocean basins (111-3, 209-5)
- provide examples of how technologies used to investigate the ocean floor have improved over time (110-8)
- identify some strengths and weaknesses of technologies used to investigate the ocean floor (210-3)
- provide examples of public and private Canadian institutions that support scientific and technological research involving the oceans (112-5)

Oceans and Species Distribution

- apply the concept of systems to show how changes in one component of a body of water causes change in other components in that system (111-6)
- describe the interactions of the ocean currents, winds, and regional climates (311-9)
- analyse factors that affect productivity and species distribution in marine and fresh water environments (311-8)
- predict and interpret trends in populations of a marine species from graphical data by interpolating and extrapolating data (210-4, 210-6)
- describe some positive and negative effects of marine technologies in the ocean (113-2)
- provide examples of problems related to the oceans that cannot be resolved using scientific and technological knowledge (113-10)

Glaciers and Polar Icecaps

- describe factors that effect glaciers and polar icecaps, and describe their consequent effects on the environment (311-12)
- identify new questions that arise from the study of glaciers and polar icecaps (210-16)

Physical Science: Fluids

Students will be expected to

Floating and Sinking–Density

- describe the relationship among the mass, volume, and density of solids, liquids, and gases using the particle model of matter (307-8)
- analyse quantitatively the density of various substances and suggest explanations for discrepancies in data, such as the measurement of the volume of irregular objects by water displacement (210-7, 307-11)
- explain the effects of changes in temperature on the density of solids, liquids, and gases and relate the result to the particle model of matter (307-9)
- describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
- identify questions to investigate arising from practical problems involving floating, sinking, and density (208-2)
- work co-operatively with team members to design an experiment and identify major variables in order to investigate floating, sinking, and density (208-6, 211-3)

Forces in Fluids

- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- test and compare a student-constructed dynamometer with a commercial dynamometer (210-13)
- calibrate a student-constructed dynamometer with known masses (210-14)
- describe qualitatively the difference between mass and weight (309-1)
- provide examples of technologies that have been developed because of our understanding of density and buoyancy (111-1)
- explain quantitatively the relationship between force, area, and pressure (309-3)
- describe the science underlying hydraulic technologies (111-5)
- explain qualitatively the relationship among pressure, volume, and temperature when liquid and gaseous fluids are compressed or heated (309-4)

Viscosity of Liquids

- compare the viscosity of various liquids (307-6)
- design an experiment to test the viscosity of various common fluids and identify the major variables (208-6)
- describe factors that can modify the viscosity of a liquid (307-7)
- use a temperature-measuring technology effectively and accurately for collecting data in temperature-viscosity investigations (209-3)

- demonstrate a knowledge of WHMIS standards by demonstrating the correct methods of disposal of various oils, for example (209-7)
- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

Physical Science: Optics

Students will be expected to

Properties of Visible Light

- identify and describe the following properties of visible light:
  - travels in a straight line (rectilinear propagation)
  - speed of light in air is 300,000 km/s
  - reflection
  - refraction and dispersion
  - travels in a vacuum and in some types of media (308-8)

Reflection

- describe the laws of reflection of visible light and their applications in everyday life
- regular versus diffuse reflection
- angle of incidence = angle of reflection (308-9)
- formulate operational definitions for incidence, reflection, and the normal (208-7)
- estimate angles of incidence and reflection (209-2)
- work co-operatively and collaboratively with others to plan and safely construct an optical device using mirrors (209-6, 211-1)
- identify and correct practical problems in the way a constructed optical device functions (210-14)

Refraction and Dispersion

- rephrase questions related to refraction in a testable form (208-1)
- predict the effect of transparent media of varying densities on the angle of refraction of light (208-5)
- estimate angles of refraction (209-2)
- describe qualitatively how visible light is refracted (210-11, 308-10)
- estimate focal length of a convex lens by finding it focal point (209-2)
- describe how optical technologies have developed through systematic trial-and-error processes constrained by the optical properties of the materials (109-5)
- provide examples of optical technologies that enable scientific research and related personal activities associated with such technologies (109-10, 111-3)

Electromagnetic Radiation

- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves (308-11)
- compare the properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves (308-12)
- explain the importance of using the words frequency and wavelength correctly (109-13)
- provide examples related to optics that illustrate that scientific and technological activities take place individually and in group settings (112-8)
- describe possible negative and positive effects of technologies associated with electromagnetic radiation (113-2)

Life Science: Cells, Tissues, Organs, and Systems

Students will be expected to

Cells

- illustrate and explain that the cell is a living system that exhibits the following characteristics of life (304-4)
- explain that growth and reproduction depend on cell division (304-6)
- distinguish between plant and animal cells (304-5)
- use a light microscope or microviewer correctly to produce a clear image of cells (209-3)
- work co-operatively with team members to develop and construct models of cells (211-3)
- explain that it is important to use proper terms when comparing plant and animal cells (109-13)

Interdependence among Cells, Tissues, Organs, and Systems

- relate the needs and functions of various cells and organs to the needs and functions of the human organism as a whole (304-8)
- explain structural and functional relationships between and among cells, tissues, organs, and systems in the human body (304-7)
- compare the early idea that living organisms were made of air, fire, and water with the modern cell theory (110-2)
- evaluate individual and group processes used in researching the roles of the main organ systems (211-4)

Healthy/Unhealthy Systems

- describe the basic factors that affect the functions and efficiency of the human respiratory, circulatory, digestive, excretory, and nervous systems (304-9)
- illustrate examples of conflicting evidence related to how we should maintain and/or treat body systems (110-5)
- describe the science underlying various technologies used to assist or replace unhealthy organs or systems (111-5)

Interdependence of Body Systems

- rephrase questions into testable form about the factors that affect physical fitness and health (208-1)
- design and carry out an experiment to compare and contrast heart rate and breathing rate in an individual during various levels of activity, and identify and control the major variables (208-6, 209-1)
- suggest explanations for variations in the heart rate and the breathing rate of an individual during various levels of activity when the experiment is repeated (210-7)
- describe three examples of the interdependence of various systems of the human body (304-10)
- provide examples of careers that are associated with the health of body systems (112-10)
- make informed decisions about applications of science and technology that are associated with human body systems, taking into account personal and social advantages and disadvantages (113-8)

Attitude Outcomes

It is expected that the Atlantic Canada science program will foster certain attitudes in students throughout their school years. The STSE, skills, and knowledge outcomes contribute to the development of attitudes, and opportunities for fostering these attitudes are highlighted in the Elaborations—Strategies for Learning and Teaching sections of each unit.

Attitudes refer to generalized aspects of behaviour that teachers model for students by example and by selective approval. Attitudes are not acquired in the same way as skills and knowledge. The development of positive attitudes plays an important role in students' growth by interacting with their intellectual development and by creating a readiness for responsible application of what students learn.

Since attitudes are not acquired in the same way as skills and knowledge, outcome statements for attitudes are written as key-stage curriculum outcomes for the end of grades 3, 6, 9, and 12. These outcome statements are meant to guide teachers in creating a learning environment that fosters positive attitudes.

Common Framework of Science Learning Outcomes K to 12, Attitude Outcome Statements

For grades 7–9 it is expected that students will be encouraged to

Appreciation of Science	Interest in Science	Scientific Inquiry
422 appreciate the role and contribution of science and technology in our understanding of the world 423 appreciate that the applications of science and technology can have advantages and disadvantages 424 appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds *Evident when students, for example,* • recognize the potential conflicts of differing points of view on specific science-related issues • consider more than one factor or perspective when formulating conclusions, solving problems, or making decisions on STSE issues • recognize the usefulness of mathematical and problem-solving skills in the development of a new technology • recognize the importance of drawing a parallel between social progress and the contributions of science and technology • establish the relevance of the development of information technologies and science to human needs • recognize that science cannot answer all questions • consider scientific and technological perspectives on an issue • identify advantages and disadvantages of technology • seek information from a variety of disciplines in their study • avoid stereotyping scientists • show an interest in the contributions women and men from many cultural backgrounds have made to the development of science and technology	425 show a continuing curiosity and interest in a broad scope of science-related fields and issues 426 confidently pursue further investigations and readings 427 consider many career possibilities in science- and technology-related fields *Evident when students, for example,* • attempt at home to repeat or extend a science activity done at school • actively participate in co-curricular and extra-curricular activities such as science fairs, science clubs, or science and technology challenges • choose to study topics that draw on research from different science and technology fields • pursue a science-related hobby • discuss with others the information presented in a science show or on the Internet • attempt to obtain information from a variety of sources • express a degree of satisfaction at understanding science concepts or resources that are challenging • express interest in conducting science investigations of their own design • choose to investigate situations or topics that they find challenging • express interest in science- and technology-related careers • discuss the benefits of science and technology studies	428 consider observations and ideas from a variety of sources during investigations and before drawing conclusions 429 value accuracy, precision, and honesty 430 persist in seeking answers to difficult questions and solutions to difficult problems *Evident when students, for example,* • ask questions to clarify meaning or confirm their understanding • strive to assess a problem or situation accurately by careful analysis of evidence gathered • propose options and compare them before making decisions or taking action • honestly evaluate a complete set of data based on direct observation • critically evaluate inferences and conclusions, basing their arguments on fact rather than opinion • critically consider ideas and perceptions, recognizing that the obvious is not always right • honestly report and record all observations, even when the evidence is unexpected and will affect the interpretation of results • take the time to gather evidence accurately and use instruments carefully • willingly repeat measurements or observations to increase the precision of evidence • choose to consider a situation from different perspectives • identify biased or inaccurate interpretations • report the limitations of their designs • respond skeptically to a proposal until evidence is offered to support it • seek a second opinion before making a decision • continue working on a problem or research project until the best possible solutions or answers are identified

Common Framework of Science Learning Outcomes K to 12, Attitude Outcome Statements *(continued)*

For grades 7–9 it is expected that students will be encouraged to

Collaboration	Stewardship	Safety in Science
431 work collaboratively in carrying out investigations as well as in generating and evaluating ideas *Evident when students, for example,* • assume responsibility for their share of the work to be done • willingly work with new individuals regardless of their age, their gender, or their physical or cultural characteristics • accept various roles within a group, including that of leadership • help motivate others • consider alternative ideas and interpretations suggested by members of the group • listen to the points of view of others • recognize that others have a right to their points of view • choose a variety of strategies, such as active listening, paraphrasing, and questioning, in order to understand others' points of view • seek consensus before making decisions • advocate the peaceful resolution of disagreements • can disagree with others and still work in a collaborative manner • are interested and involved in decision making that requires full-group participation • share the responsibility for carrying out decisions • share the responsibility for difficulties encountered during an activity	432 be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment 433 project, beyond the personal, consequences of proposed actions *Evident when students, for example,* • show respect for all forms of life • consider both the immediate and long-term effects of their actions • assume personal responsibility for their impact on the environment • modify their behaviour in light of an issue related to conservation and protection of the environment • consider the cause-and-effect relationships of personal actions and decisions • objectively identify potential conflicts between responding to human wants and needs and protecting the environment • consider the points of view of others on a science-related environmental issue • consider the needs of other peoples and the precariousness of the environment when making decisions and taking action • insist that issues be discussed using a bias-balanced approach • participate in school or community projects that address STSE issues	434 show concern for safety in planning, carrying out, and reviewing activities 435 become aware of the consequences of their actions *Evident when students, for example,* • read the labels on materials before using them, and ask for help if safety symbols are not clear or understood • readily alter a procedure to ensure the safety of members of the group • select safe methods and tools for collecting evidence and solving problems • listen attentively to and follow safety procedures explained by the teacher or other leader • carefully manipulate materials, using skills learned in class or elsewhere • ensure the proper disposal of materials • immediately respond to reminders about the use of safety precautions • willingly wear proper safety attire without having to be reminded • assume responsibility for their involvement in a breach of safety or waste disposal procedures • stay within their own work area during an activity, respecting others' space, materials, and work • take the time to organize their work area so that accidents can be prevented • immediately advise the teacher of spills, breaks, and unusual occurrences, and use appropriate techniques, procedures, and materials to clean up • clean their work area during and after an activity • seek assistance immediately for any first aid concerns like burns, cuts, or unusual reactions • keep the work area uncluttered, with only appropriate materials present

Curriculum Guide Organization

Specific curriculum outcomes are organized in units for each grade level. Each unit is organized by topic. Suggestions for learning, teaching, assessment, and resources are provided to support student achievement of the outcomes.

The order in which the units of a grade appear in the guide is meant to suggest a sequence. In some cases, the rationale for the recommended sequence is related to the conceptual flow across the year. That is, one unit may introduce a concept that is then extended in a subsequent unit. Likewise, one unit may focus on a skill or context that will be built upon later in the year.

Some units or certain aspects of units may also be combined or integrated. This is one way of assisting students as they attempt to make connections across topics in science or between science and the real world. In some cases, a unit may require an extended time frame to collect data on weather patterns, plant growth, etc. These cases may warrant starting the activity early and overlapping it with the existing unit. In all cases, the intent is to provide opportunities for students to deal with science concepts and scientific issues in personally meaningful and socially and culturally relevant contexts.

Unit Organization

Each unit begins with a two-page synopsis. On the first page, introductory paragraphs provide a unit overview. These are followed by a section that specifies the focus (inquiry, problem solving, and/or decision making) and possible contexts for the unit. Finally, a curriculum links paragraph specifies how this unit relates to science concepts and skills addressed in other grades so teachers will understand how the unit fits with the students' progress through the complete science program.

The second page of the two-page overview provides a table of the outcomes from the *Common Framework of Science Learning Outcomes K to 12* that the unit will address. The numbering system used is the one in the pan-Canadian document as follows:

- 100s—Science-Technology-Society-Environment (STSE) outcomes
- 200s—Skills outcomes
- 300s—Knowledge outcomes
- 400s—Attitude outcomes (see pages 21–22)

These code numbers appear in brackets after each specific curriculum outcome (SCO).

The Four-Column Spread

All units have a two-page layout of four columns as illustrated below. In some cases, the four-column spread continues to the next two-page layout. Outcomes are grouped by a topic indicated at the top of the left page.

Two-Page, Four-Column Spread

LIFE SCIENCE: INTERACTIONS WITHIN ECOSYSTEMS

Components of an Ecosystem

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	Questions directed to vhe students concerning local habitats and the changes or proposed changes to them can elicit interest and discussion at the beginning of the unit of study—questions, such as “What do you think will happen to the wildlife in an area if a baseball field is built?” or “What kinds of animals would a community attract if a proposed landfill site were built?”
• identify, delimit, and investigate questions related to a local ecosystem (208-2, 208-3)	Students should develop questions to investigate, such as “What types of species live in a particular ecosystem?” Students have investigated and studied components and elementary relationships of and in ecosystems in grades 4 and 6. A K-W-L (What I Know–Want to Learn–Learned) chart can be started. With this approach, previous knowledge and understanding can be assessed and areas of common interests can be identified. Students will need to visit a local habitat in order to make observations. They may visit an area that is or is going to be modified in order to gain an appreciation of how changes might affect the ecosystem.
• use instruments effectively and accurately to investigate components of an ecosystem (209-3) • organize and record data collected in an investigation of an ecosystem (209-4) • describe interactions between biotic and abiotic factors in an ecosystem (306-3)	At this level, activities exploring the interactions and the environment should be limited to the following physical or abiotic factors in the environment: temperature, moisture, light, aeration, and salinity. A class discussion of the area and a visit to the area will permit the students to observe and note what is there. Students can use instruments such as magnifying glasses, field binoculars, and hand-held microscopes to closely observe organisms in the ecosystem. Students can use thermometers to compare temperatures at different locations in the area being investigated. Light meters can also be used by some students to investigate any differences in light intensities. Upon return to class, students can attempt to classify the features and components of the ecosystem they observed which may lead to an emergent understanding of the biotic and abiotic factors in the area studied.
• identify the roles of producers, consumers, and decomposers in a local ecosystem and describe both their diversity and their interactions (304-2) • classify organisms as producers, consumers, and decomposers (210-1)	By discussing the roles and the needs of the living things identified in the ecosystem, students can extend their understanding of the roles and relationships among the producers, consumers, and decomposers. Students should know that one of the most important roles green plants have in any ecosystem is that of being a food (energy) source for consumers and decomposers. The process of photosynthesis can be explored by placing seedlings in light and darkness for several days to see the effect light has on plants. Glass containers can be placed on small plants to view the transpired water condensed on the inside of the glass. Small squares of cardboard or aluminium foil can be carefully attached to both sides of a leaf on a plant and removed several days later to observe its effects.

20 ATLANTIC CANADA SCIENCE CURRICULUM: GRADE 7

LIFE SCIENCE: INTERACTIONS WITHIN ECOSYSTEMS

Components of an Ecosystem

Tasks for Instruction and/or Assessment

Observation

- Does the student use the instrument for collecting data (e.g., magnifying glass) appropriately and safely? (209-3)

Journal

- The thing that surprised me the most when I visited our ecosystem was ... (304-2, 306-3)
- Two questions I would like to investigate related to my local ecosystem are ... (208-2, 208-3)

Paper and Pencil

- Explain what might happen to plants if the atmosphere were to be polluted by dust from a major volcano eruption or air pollution. (306-3)
- Choose a biotic factor and an abiotic factor and describe their interaction. (306-3)
- How do you interact with biotic and abiotic factors in your environment? Think of how you affect biotic and abiotic factors in your environment. (306-3)
- Draw/sketch a particular ecosystem and note some of the interactions that take place. (306-3)
- Personify an abiotic factor and describe its possible interactions with other abiotic and biotic factors (creative writing). (306-3)
- Create a classified list of organisms from your field study and describe how the organisms interact in the ecosystem. (209-4, 210-1, 304-2)

Interview

- Is soil necessary for plant growth? Explain your answer. (306-3)

Presentation

- Work in small groups to create a bulletin-board display to show how abiotic factors affect living things. (306-3)

Resources/Notes

ATLANTIC CANADA SCIENCE CURRICULUM: GRADE 7 **21**

Column One: Outcomes

The first column provides the specific curriculum outcomes. These are based on the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. The statements involve the Science-Technology-Society-Environment (STSE), skills, and knowledge outcomes indicated by the outcome number(s) that appears in parenthesis after the outcome. Some STSE and skills outcomes have been written in a context that shows how these outcomes should be addressed.

Specific curriculum outcomes have been grouped by topic. Other groupings of outcomes are possible and in some cases may be necessary to take advantage of local situations. The grouping of outcomes provides a suggested teaching sequence. Teachers may prefer to plan their own teaching sequence to meet the learning needs of their students.

Column one and column two define what students are expected to learn, and be able to do.

Column Two: Elaborations—Strategies for Learning and Teaching

The second column may include elaborations of outcomes listed in column one, and describes learning environments and experiences that will support students' learning.

The strategies in this column are intended to provide a holistic approach to instruction. In some cases, they address a single outcome; in other cases, they address a group of outcomes.

Column Three: Tasks for Instruction and/or Assessment

The third column provides suggestions for ways that students' achievement of the outcomes could be assessed. These suggestions reflect a variety of assessment techniques and materials that include, but are not limited to, informal/formal observation, performance, journal, interview, paper and pencil, presentation, and portfolio. Some assessment tasks may be used to assess student learning in relation to a single outcome, others to assess student learning in relation to several outcomes. The assessment item identifies the outcome(s) addressed by the outcome number in brackets after the item.

Column Four: Resources/Notes

This column provides an opportunity for teachers to make note of useful resources.

Earth and Space Science: Water Systems on Earth

Introduction

Over two-thirds of Earth's surface is covered by oceans and freshwater features. Because of this, our planet has been nicknamed the "Blue Planet" owing to its appearance from space. A study of Earth's marine and freshwater systems provides opportunity for students to learn about the relationship between the geomorphology of Earth and the dynamics of oceans and freshwater basins. As students develop these understandings, they should be able to explain how these geological features have developed and their impact on society.

Each of the Atlantic Provinces has considerable shorelines, ranging from towering steep cliffs to flat sandy beaches. In addition, most people in our region live close to the ocean and have many experiences with it. Our region's close proximity to the ocean, as well as the influence the ocean has on our climate, economy, and lifestyles should make this unit particularly relevant to many students.

Focus and Context

The focus of this unit is inquiry. Students should also have the opportunities to investigate how the oceans and the shorelines interact, what relationships exist between ocean currents, wind, and climates, and how these abiotic factors impact upon life in and around the oceans. The context of this unit could include the local coastlines in a region, as well as how the ocean and local coastlines interact.

Science Curriculum Links

Students are introduced to and explore the effects of wind, water, and ice on the landscape, and they should be able to demonstrate a variety of methods of weathering and erosion in grade 4. As well, students relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation in grade 5.

Curriculum Outcomes

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology **110-8** describe examples of how technologies have been improved over time **Relationships Between Science and Technology** **111-3** provide examples of technologies that have enabled scientific research **111-6** apply the concept of systems as a tool for interpreting the structure and interactions of natural and technological systems **Social and Environmental Contexts of Science and Technology** **112-3** explain how society's needs can lead to developments in science and technology **112-5** provide examples of public and private Canadian institutions that support scientific and technological research and endeavors **113-2** describe possible positive and negative effects of a particular scientific or technological development, and explain how different groups in society may have different needs and desires in relation to it **113-10** provide examples of problems that arise at home, in an industrial setting, or in the environment that cannot be solved using scientific and technological knowledge	**Initiating and Planning** **208-7** formulate operational definitions of major variables and other aspects of their investigations **Performing and Recording** **209-1** carry out procedures in order to investigate how temperature differences in water cause currents **209-4** organize data using a format that is appropriate to the task or experiment **209-5** select and integrate information from various print and electronic sources or from several parts of the same source **Analysing and Interpreting** **210-3** identify strengths and weaknesses of different methods of collecting and displaying data **210-4** predict the value of a variable by interpolating or extrapolating from graphical data **210-6** interpret patterns and trends in data, and infer and explain relationships among the variables **210-11** state a conclusion based on experimental data, and explain how evidence gathered supports or refutes and initial idea **210-16** identify new questions and problems that arise from what was learned **Communication and Teamwork** **211-2** communicate questions, ideas, intentions, plans, and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language, and other means **211-4** evaluate individual and group processes used in planning, problem solving, decision making, and completing a task	**311-10** explain how waves and tides are generated and how they interact with shorelines **311-11** describe processes of erosion and deposition that result from wave action and water flow **311-7** describe processes that lead to the development of ocean basins and continental drainage systems **311-9** describe the interactions of the ocean currents, winds, and regional climates **311-8** analyse factors that affect productivity and species distribution in marine and fresh water environments **311-12** describe factors that affect glaciers and polar icecaps, and describe their consequent effects on the environment

Waves, Tides, and Water Currents

Outcomes

Students will be expected to

- carry out procedures in order to investigate how temperature differences in water cause currents (209-1)
- state a conclusion based on experimental data about the formation of water currents (209-4, 210-11)
- explain how waves and tides are generated (311-10a)
- formulate operational definitions, on the basis of investigations of waves for
  - wave length
  - wave height
  - crest
  - trough (208-7)

Elaborations—Strategies for Learning and Teaching

To begin this unit, students may be asked if they have ever seen or experienced exceptional events involving waves or tides. Surge tides and large waves produced by storms can produce a context to set the scene for this unit of study. Students can also be asked if they have ever felt the force (energy) of waves and/or currents while standing or swimming in a body of water.

Students should follow a set of procedures that will permit them to experience the formation of water currents. Using a large beaker of water at room temperature, for example, students can investigate how temperature differences in the water cause currents. By placing a drop of food colouring near a bag of ice located at the edge of the beaker, students will see that colder water moves down. The reading of thermometers placed inside the beaker wll permit the students to gather evidence that the colder water moves downward.

Most shoreline processes are either directly or indirectly related to the action of waves. An understanding of waves is very important for the study of shorelines. **Note:** *Waves are generated primarily by the wind and transfer the energy of the wind across the surfaces of bodies of water. When the waves come into contact with the shoreline, the energy is then used to erode the coast as well as reshape it.*

Students can investigate wave structure by generating waves in a basin, sink or large baking pan. Ropes and Slinkys may also be used to illustrate and investigate wave action and the direct relationship between the shape of waves and the forces used to create them. The students should be able to identify or determine the wave length, height, crest, and trough of an ocean wave.

Other types of waves on oceans are quite rare. Tsunamis (caused by earthquakes) and tidal bores also cause waves in oceans and estuaries. Students should come to understand that all waves are essentially similar in structure.

Tides are the rising and falling of the ocean's surface because of gravitational interactions with the moon and the sun. It is sufficient for students at this age level to know that tides are generated by gravitational forces. It is not necessary to delve into the reasons for the frequency of tides nor the differences in tidal forces. It would be appropriate to investigate local conditions that accentuate or nullify tidal forces, such as the tides of the Bay of Fundy or the smaller tides in other regions.

Waves, Tides, and Water Currents

Tasks for Instruction and/or Assessment

Observation and Performance

- Conduct an investigation into how temperature differences create water currents.
- Observation checklist for assessment (see sample below) (209-1, 209-4, 210-11)

Observation	Rarely			Always
Carries out procedures carefully	1	2	3	4
Uses instruments effectively	1	2	3	4
Organizes, compiles, and displays data	1	2	3	4

Journal

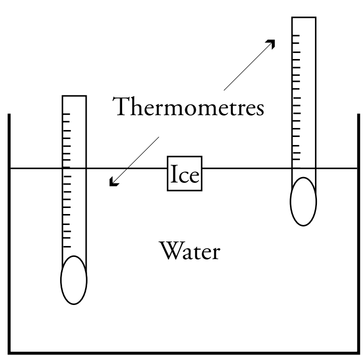
- Watch a video about waves and wave types and write a summary in your journal. (311-10a)

Paper and Pencil

- Write a short story in which waves and their effects are described. (311-10a)
- Construct a graph of the mean high and low tides of several communities along the Atlantic coast. Using this graph, predict the mean high and low tides in neighbouring communities. (311-10a)
- Research the Newfoundland tsunami of 1929. Report its cause and how it affected Newfoundland. (311-10a)

Presentation

- Using props, design a model that illustrates wave features. (311-10a)
- Using the following diagram, illustrate what you observed when you placed the ice and a drop of food colouring into the water. (209-1, 209-4, 210-1)



Resources/Notes

Appendices

- Convection Currents
- Give Me a Wave

Shorelines

Outcomes

Students will be expected to

- select and integrate information, from various print and electronic sources, related to processes of erosion and deposition that result from wave action and water flow (209-5, 311-11)
- explain how waves and tides interact with shorelines (311-10b)
- provide examples of various technologies designed to contain damage due to waves and tides (112-3)
- prepare a presentation or report on the effect of tides and waves on a shoreline, and evaluate individual and group processes used in planning and completing the task (211-2, 211-4)

Elaborations—Strategies for Learning and Teaching

Early in the unit, students may have the opportunity to bring personal observations and experiences to a study of shorelines. By beginning with a focus on shorelines and how they are different and yet similar in many ways, students can begin to explore the reasons for the differences and similarities. Pictures and videos of a variety of shorelines can further stimulate discussion regarding the features of shorelines. If a class has access to a shoreline, a class trip may be taken to survey the type of shoreline in the local community. If the students live in or by a community that has a harbour that is dredged periodically, questions related to the origin of the material that is dredged could be explored. Students can twin with another community within the Atlantic provinces or on the west coast of Canada in order to compare and contrast shorelines and/or tidal phenomena.

Students should have opportunities to investigate technological attempts to prevent or reduce damage to coastal areas due to wave action and tides. Students could use local exemplars such as piers, jetties, breakwaters, dykes, dune vegetation, and coastline reconfiguration to help them investigate and understand their uses.

Identification of and focus on the two main factors influencing shorelines, wave action and tidal action, can help students to appreciate the ongoing influence these two energy sources have on our shoreline. Examples of intense wave action such as that produced during a winter storm and hurricanes can help illustrate how shorelines can be changed quickly over a short period of time. Students may offer local examples of how people have used technologies to slow down the effect of wave and tidal erosion and deposition. Sea walls, the use of large boulders against wharves, the use of jetties and groynes are examples that can be used to illustrate our attempt to cope with the effects of tides and waves. If historical data are available, students can relate wave action, ocean currents, and tides to the local shoreline over a period of time.

Students should prepare a presentation or report of their investigations into the effects of tides and waves on shorelines. They may do this individually or in small groups. A self or group assessment on the various aspects of their research about waves and tides and how they interact with shorelines should be completed.

Shorelines

Tasks for Instruction and/or Assessment

Performance

- Complete a self-assessment checklist for research and presentation skills (see sample below). (211-2, 211-4)

Self-assessment	Poor			Good
Made a plan for doing the research.	1	2	3	4
Used a variety of resources.	1	2	3	4
Summarized information clearly and in my own words.	1	2	3	4
Information is organized so others can understand it.	1	2	3	4

Paper and Pencil

- Write a letter to a politician describing the need to fund a particular technology to protect a local shoreline. (112-3)
- Compose a poem which describes the action and effect of waves on a shoreline. (311-10b, 311-11)

Presentation

- Research the history of a local shoreline to determine its evolution over time. Report on its changes in a report or in sketches. (211-2, 311-11)
- Prepare a report comparing three to four different shorelines that are exposed to different conditions (sheltered versus open, shoreline composition, for example). (311-10b)
- Create three-dimensional models of structures and technologies used to contain damage due to wave and tidal action. (112-3, 209-5)
- Prepare a multimedia presentation that illustrates the effects waves and tides have on shorelines. (209-5, 311-10b)
- Prepare a photo essay that depicts erosion and deposition due to wave action and water flow. (209-5, 311-11)
- Through a series of sketches/drawings, describe how a local shoreline or waterway has been modified owing to the processes of erosion and disposition as a result of wave action or water flow. (211-2, 311-11)

Resources/Notes

Appendices

- Runoff

Ocean Basins and Continental Drainage Systems

Outcomes

Students will be expected to

- describe processes that lead to the development of ocean basins and continental drainage systems
  - glaciation
  - continental drift
  - erosion
  - volcanic action (311-7)
- select and integrate information from various print and electronic sources to provide examples of technologies that have enabled scientific research involving ocean basins (111-3, 209-5)
- provide examples of how technologies used to investigate the ocean floor have improved over time (110-8)
- identify some strengths and weaknesses of technologies used to investigate the ocean floor (210-3)
- provide examples of public and private Canadian institutions that support scientific and technological research involving the oceans (112-5)

Elaborations—Strategies for Learning and Teaching

The investigation and study of the processes that lead to the development of ocean basins and continental drainage systems are often based on evidence and data collected from indirect observations (for example sonar readings, satellite imaging) and inferential geological processes. This unit provides an opportunity to investigate some of the technologies used to gather evidence about the ocean floor. Investigating the utility of technologies such as sonar, core sampling, satellite imaging, bathyscaphs, tracking devices, and underwater photography and videography in helping us to explore and understand the ocean floor will help students to better appreciate the interconnectedness of various science disciplines and how we can learn about parts of the world from indirect observation. Students should investigate how some technologies used to investigate the oceans have changed and improved over time. Local diving club members can be invited to give a presentation about how diving equipment has changed over the years. Fishers can be interviewed to find out how sounders have changed and evolved.

Students should explain, through investigations, research, and/or discussions, that all technologies have their own particular strengths and weaknesses. Classroom activities designed to gather data using indirect observation would allow students to extrapolate their experiences to a greater scale. A closed shoebox filled with Plasticine or a variety of other objects at varying depths can be investigated indirectly, for example, by making small holes in the top at various regular intervals and using a measuring device such as a calibrated straw (in cm) to collect data on the unseen “bottom.” Students could then graph their data in various ways to get cross-sectional views of the “bottom.” Students should be encouraged to identify the strengths and weaknesses in these types of data collection activities. Students will see that they can determine relative depths but are unable to identify the composition of the “bottom,” using this method.

References to, and investigation of, Canadian institutions involved with research of the oceans and the ocean floor may be made throughout the study of the unit. Environment Canada (weather), the Oceanography Departments at Dalhousie University and Memorial University, the Federal Department of Fisheries and Oceans, Bedford Institute of Oceanography, Fisheries and Marine Institute of Memorial University, and the Oceans Sciences Centre of Memorial University are only a few of the many institutions and groups that do research into ocean-related topics. Students can be encouraged to inquire about the general focus at these institutions and organizations.

Ocean Basins and Continental Drainage Systems

Tasks for Instruction and/or Assessment

Journal

- In a journal entry, list or discuss the benefits and limitations of using technologies that allow humans to study the ocean floor indirectly (sonar) as opposed to directly (bathyoliths). (110-8, 111-3)

Paper and Pencil

- Write to a Canadian institution that studies oceans and ocean bottoms to inquire about their primary mandate. (112-5)
- Compare various depth sounders from nautical catalogues to identify their strengths and weaknesses. (210-3)

Presentation

- Research and report on one or more technologies used to gather information about ocean basins and continental drainage systems. (110-8)
- Create a three-dimensional model that illustrates major drainage systems in North America. (311-7)
- Create a poster that illustrates sea-floor spreading in the Atlantic ocean basin. (209-5, 311-7)
- Research and report on a technology used to explore and survey the ocean floor. (111-3, 209-5)
- Create a photo-essay of the development of diving technologies. (110-8, 111-3)
- Compose a multimedia presentation about the capabilities of submarines to explore great ocean depths. (111-3)
- Prepare a poster that illustrates the major topographic features found in oceans. (209-5)
- Use the Internet or print sources to investigate and learn about the development and evolution of diving apparatus over time. Prepare a poster of the changing technologies related to diving equipment. (110-8, 111-3)

Resources/Notes

Appendices

- What's Down There?

Oceans and Species Distribution

Outcomes

Students will be expected to

- apply the concept of systems to show how changes in one component of a body of water causes change in other components in that system (111-6)
- describe the interactions of the ocean currents, winds, and regional climates (311-9)
- analyse factors that affect productivity and species distribution in marine and fresh water environments
- predict and interpret trends in populations of a marine species from graphical data by interpolating and extrapolating data (210-4, 210-6)

Elaborations—Strategies for Learning and Teaching

The interactions among the atmosphere, the ocean, and the land are complex and necessary for most life forms to occur. Students can investigate how the salinity of a body of water affects the types of organisms that live in a particular region. Investigations that enable students to see the relationship between water temperature and its ability to hold dissolved gases (for example warm and cold pop) permit them to better understand a particular relationship. Students can also investigate relationships such as changes in water temperature and species distribution or how the local climate might be affected.

Experiences that develop notions about how oceans and ocean currents such as the Labrador current and the Gulf Stream influence our regional climates should be made available to students. Students should understand that surface currents carry tropical heat to various parts of the ocean. The Gulf Stream, for example, influences the general climate of the Atlantic provinces.

Students should be able to explain how currents, convections, and winds are affected by temperature, density differences, and the Earth's rotation. El Niño and La Niña and their impact on the world's climates can be a context for discussion and investigation. The effect that wind has on water is probably the one with which most students will have personal experience. In an investigation how oceans influence onshore breezes can be compared and contrasted to offshore breezes which are prevalent in our coastal communities.

Students should analyse the effect that the following factors have on water systems: temperature, pollution, overfishing, and upwelling (311-8).

Students have explored and investigated biotic and abiotic factors and their relationships in grade 7. The abiotic factors that create ocean currents and influence environments also have an impact on types of organisms that inhabit our waters. Students can investigate how the above factors, as well as salinity and ocean currents, affect productivity and species distribution in marine environments and freshwater environments.

The use of population graphs of certain species over time permit students to interpolate and extrapolate populations from the graphs. Students can compare population graphs with graphs of water temperature and salinity, for example, and suggest possible relationships.

Oceans and Species Distribution

Tasks for Instruction and/or Assessment

Paper and Pencil

- Explain how a change in the temperature of the surface water could affect the other regions in a body of water. (111-6)
- Write a poem/song describing the interaction of ocean currents, winds, and regional climates. (210-6, 311-9)
- Using graphical data, predict populations of a given marine species by interpolating and extrapolating data. (210-4, 210-6)
- Create an appropriate graphical representation of the yearly catches of an ocean species. Extrapolate the probable landings for the next three years on the basis of the data. (210-4, 210-6)
- Write a speech to be given to a Young Naturalist Society meeting in which you describe and explain factors that influence species populations and distributions. (311-8)

Interview

- Using a graphical representation of the estimated population of a given aquatic species, ask a student to interpolate or extrapolate information from the graph. (210-4)

Presentation

- Create a poster illustrating the primary ocean currents that affect the climate of the Atlantic coast of Canada. (311-9)
- Produce a multimedia presentation that communicates the ocean currents and winds that affect the climate of your region. (210-6, 311-9)
- Gather information from DFO and local fishers regarding present fish populations and methods that were used to gather the data in each case. Compare and contrast the methods for gathering information, the manipulation of the data, and the accuracy of the resulting findings based on the data in each case. (210-4)

Resources/Notes

Appendices

- Making Connections

Oceans and Species Distribution *(continued)*

Outcomes

Students will be expected to

- describe some positive and negative effects of marine technologies in the ocean (113-2)
- provide examples of problems related to the oceans that cannot be resolved using scientific and technological knowledge (113-10)

Elaborations—Strategies for Learning and Teaching

Students can investigate the use of improved fishing technologies and the trends in landed catches of marine species over the years. An investigation of the types of fishing vessels used in the twentieth century and the number of fishers in the industry will permit the students to identify any correlations that might exist.

Students should investigate several technologies that either impact or are impacted upon by the oceans. These may include the Confederation Bridge between Prince Edward Island and New Brunswick, oil rigs on the east coast, Sable gas development, Fundy tidal power, factory and/ or freezer trawlers, and oil tankers.

The movement of icebergs by ocean currents along the Labrador coast, past Newfoundland and into the waters off the east coast can be explored to ascertain their effects on shipping and deep sea oil exploration in the North Atlantic and elsewhere. Teachers can use the context of oil exploration to examine and discuss what effects oil rigs have on the ocean floor and how they may impact upon the ocean environment and the fisheries. This context also permits an investigation into aspects associated with oceans that can neither be controlled nor solved using present scientific and technological knowledge, such as influencing iceberg drifts, polar icecap fluctuations and preventing hurricanes.

Students should identify and explore problems related to oceans that are not always resolved using science and technology. Often, group and societal needs and wishes dictate the direction of ocean resource uses and development. Problems and issues that are often encountered and debated, such as which types of fisheries we could and should sustain (for example, cod and seals) and what effect development has on the environment (for example, oil/gas drilling and oil tankers), may help to illustate that decisions and actions by groups are not always completely based on scientific or technological knowledge. When students recognize that science cannot answer all questions, this can begin a discussion about attitude outcomes and their relationship and appreciation of science.

Oceans and Species Distribution *(continued)*

Tasks for Instruction and/or Assessment

Journal

- A student in class was overheard saying "I don't eat fish so I really don't care what happens to the fishery." Write a short letter to this person explaining the effects that pollution and/or overfishing could have on the economic and social way of life of that person. (113-2)

Paper and Pencil

- In a short story, describe the potential for disaster if a major oil spill ever occurred on the east coast of Canada. (113-2)
- Select an offshore oil/gas project such as Hibernia or Sable gas. Investigate the following (113-2):
  – What are some economic benefits and costs of the project?
  – What are the uses of the product in our region?
  – What are some environmental considerations of the project?
- Research and report on the effects oil spills have had on coastlines in Canada. (113-2)
- Identify several uses of ocean resources that could be influenced by factors other than science or technology. (113-10)
- Choose an important issue or problem related to oceans or ocean resources that has been or is being studied. Create a chart in which different positions and points of view are put forth regarding the issue (for example, the seal hunt, cod fishery, aquaculture development, oil exploration, ...). (113-10)

Presentation

- In pairs, research and report on one of the possible factors that influences the population of the fish stocks. (113-2)

Resources/Notes

Appendices

- What's Down There?

Glaciers and Polar Icecaps

Outcomes

Students will be expected to

- describe factors that affect glaciers and polar icecaps, and describe their consequent effects on the environment (311-12)
- identify new questions that arise from the study of glaciers and polar icecaps (210-16)

Elaborations—Strategies for Learning and Teaching

The study of the polar icecaps as well as glaciers in northern Canada and Greenland provides a context to investigate how factors such as global warming and periodic ice ages have influenced the size of these ice bodies and the mean level of the oceans of the world. Rising global temperatures are associated with a rise in sea level and regional climatic changes. Students should explain that sea levels rise because of thermal expansion of water and the melting of glaciers and icefields. Discussion of everyday examples of liquids expanding when heated, such as water in a radiator or gasoline in a gas tank on a warm day, will lead to predictions about the volume of ocean water if heated. In a time of debate about global warming, students will be able to explore the topic, speculate and formulate questions about the effect global warming will have on glaciers and the polar icecap, and consequently on ocean levels and coastal communities in our region. Students should be encouraged to identify new questions that arise from their study of glaciers and polar icecaps. Students can, for example, pose questions related to how specific areas in the Atlantic region may be affected by fluctuations in the size of the polar icecaps and glaciers.

Students can investigate past historical and geological events that have illustrated the results of ocean-level fluctuations over long periods of time. Global warming and cooling trends can be associated with this investigation. Students can contact, via e-mail, various groups that are concerned with global warming and its consequences to gather information from their perspective. (These changes can be the focus of investigations into the effect of global warming on the creation and reduction of present and future icecaps and glaciers.)

Glaciers and Polar Icecaps

Tasks for Instruction and/or Assessment

Performance

- Design and carry out an activity in which the effects of heat on the volume of water can be observed. (311-12)

Journal

- Speculate on what might happen to your community with an increase in the mean annual temperature. What types of new questions or problems might be posed or created with an increase in the mean annual temperature? (210-16)

Paper and Pencil

- Research the periodic ice ages and produce/construct a time line. (311-2)
- Create a graph or poster illustrating the extent of sea ice in the Canadian Arctic over the past decade. (311-12)
- Investigate changes in a regional climate that have occurred in the recent past and report on the effects of the change. (311-12)
- Write a newspaper article about the effects a rise in sea level would have on cities like Halifax, Charlottetown, Saint John, or St. John's. (311-12)

Presentation

- Produce a pictorial essay of a regional climate change in a particular area of the world. (311-12)
- Investigate and report on the location of your local, regional, national, or continental coastlines with periodic fluctuations in the sizes of glaciers and polar icecaps. (311-12)

Resources/Notes

Appendices

- Shapes of the Land
- Sing a Song of Fluids
- When it Pours

Physical Science: Fluids

Introduction

Fluids, including air and water, are essential in most industrial processes. They form the basis of hydraulic and pneumatic devices and machines. Students will explore the properties of fluids, including viscosity and density, and explain them, using the particle theory. They will also have an opportunity to understand the buoyant forces acting on floating, submerged, and sunken objects. As students conduct their investigations, they will recognize the practical applications of the properties of fluids in the operation of simple machines.

Focus and Context

The focus of this unit is on the inquiry process. Students will also have the opportunity to design and carry out activities based on fluids. The context is the students' knowledge and use of fluids and buoyancy. Ocean-going vessels and oil rigs provide a context to investigate why some things sink and some things float.

Science Curriculum Links

In grade 2, students explore the properties of different liquids and observe objects that sink and float. In grade 6, students are introduced to air as a fluid in the context of flight. Students will have an opportunity to investigate various systems to determine the percent efficiency of energy transformations in a high school physics course.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-10 relate personal activities in formal and informal settings to specific science disciplines

Relationships Between Science and Technology

111-1 provide examples of scientific knowledge that have resulted in the development of technologies

111-5 describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solve practical problems

Social and Environmental Contexts of Science and Technology

112-7 provide examples of how science and technology affect their lives and their community

Skills

Students will be expected to

Initiating and Planning

208-2 identify questions to investigate arising from practical problems and issues

208-6 design an experiment and identify major variables

Performing and Recording

209-3 use instruments effectively and accurately for collecting data

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

Analysing and Interpreting

210-7 identify, and suggest explanations for, any discrepancies in data

210-12 identify and evaluate potential applications of findings

210-13 test the design of a constructed device or system

210-14 identify and correct practical problems in the way a prototype or constructed device functions

Communication and Teamwork

211-3 work co-operatively with team members to develop and carry out a plan and troubleshoot problems as they arise

Knowledge

Students will be expected to

307-8 describe the relationship between the mass, volume, and density of solids, liquids, and gases using the particle model of matter

307-11 analyse quantitatively the density of various substances

307-9 explain the effects of changes in temperature on the density of solids, liquids, and gases and relate the results to the particle model of matter

307-10 describe situations in daily life where the density of substances naturally changes or is intentionally altered

309-2 describe the movement of objects in terms of balanced and unbalanced forces

309-1 describe qualitatively the relationship between mass and weight

309-3 describe quantitatively the relationship among force, area, and pressure

309-4 explain qualitatively the relationships among pressure, volume, and temperature when liquid and gaseous fluids are compressed or heated

307-6 compare the viscosity of various liquids

307-7 describe factors that can modify the viscosity of a liquid

Floating and Sinking—Density

Outcomes

Students will be expected to

- describe the relationship among the mass, volume, and density of solids, liquids, and gases using the particle model of matter (307-8)
- analyse quantitatively the density of various substances and suggest explanations for discrepancies in data, such as the measurement of the volume of irregular objects by water displacement (210-7, 307-11)

Elaborations—Strategies for Learning and Teaching

Students should be given the opportunity to come up with a working definition of density through exploration and hands-on/minds-on activities involving objects that sink and float. Students can make predictions about whether a variety of objects will sink or float and then test their predictions. This activity provides the student with a chance to compare and contrast reasons why they believe objects behave as they do in water.

Students should use conceptual diagrams of particles in a variety of representative substances. Lead and aluminum density blocks, for example, can be explored and experienced by students in order to gain an understanding of relationships among the mass, volume, and density of solids. Students can investigate how various liquids (for example, oil, salt water, distilled water) float on one another. Hydrometers can be used to investigate the densities of a variety of liquids.

Students have had mathematical experiences in determining the volume of some types of regularly shaped solids. This will provide some prerequisite skills and knowledge that will help them determine the density of these objects, given the mass of the objects. Students can investigate how different masses and volumes of the same material produce equivalent ratios, thus the same density. Students can be challenged to determine the volume of regularly and irregularly shaped objects that sink and float, given only an overflow water container and a graduated cylinder, for example. To learn about volume, students may construct regular solids from uniform building blocks, measure volumes of liquids poured in a calibrated beaker, and determine the volumes of irregular solids immersed in a beaker by measuring the volume of the displaced fluid. Students can have experiences with malleable but non-compressible solids such as clay and malleable and compressible solids such as plastic foam.

Students can discuss possible reasons for discrepancies in volume readings when using the water displacement method for determining the volume of an irregular solid. Note whether students honestly report and record all observations, even when the evidence is unexpected and will affect the interpretation of results. This is an indicator of value put by students on accuracy, precision, and honesty in scientific inquiry.

Floating and Sinking—Density

Tasks for Instruction and/or Assessment

Performance

- Use materials (styrofoam balls, marbles, for example) and a container to represent the relationship among the mass, volume, and density of substances. (307-8)
- Use a beaker of water and a balance to determine the density of a stainless steel bolt. (307-11)
- Determine the volume of water displaced by irregular-shaped objects and compare results with other groups. Suggest why some measurements vary. (210-7, 307-11)

Journal

- A solid block of iron sinks in water. A ship made out of the same amount of iron floats. In your own words, explain why this can happen. (307-8)

Paper and Pencil

- Prepare a short explanation for a grade five student about density and floatation. (307-8)
- Research how fish, blimps, ships, or submarines operate with regard to density and buoyancy. (307-8)

Resources/Notes

Appendices

- Is It Dense?
- Massive Overflow

Floating and Sinking—Density *(continued)*

Outcomes

Students will be expected to

- explain the effects of changes in temperature on the density of solids, liquids, and gases and relate the result to the particle model of matter (307-9)
- describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
- identify questions to investigate arising from practical problems involving floating, sinking, and density (208-2)
- work cooperatively with team members to design an experiment and identify major variables in order to investigate floating, sinking, and density (208-6, 211-3)

Elaborations—Strategies for Learning and Teaching

Students should be given the opportunity to measure mass in order to compare different amounts of matter. Students should also have the opportunity to use technological apparatus such as equal arm balances, beakers, and graduated cylinders when carrying out their investigations. Variations in readings of these tools will help students to appreciate the need for accurate measurement and how some errors can be explained when comparing to a norm.

Students should develop the concept that density is a property of matter. This can be accomplished by providing learning opportunities that involve using volume to determine density in the context of floating and sinking.

Students can do a variety of activities to experience and describe the effect that temperature change has on the volume. Then students can look at the density of solids, liquids, and gases to set the stage for a conceptual understanding of what happens using the particle model of matter. This is an extension of the conceptual understanding required in the unit on "Heat" from *Atlantic Canada Science Curriculum: Grade 7* .

Hot air balloons, submarines, and scuba gear are a few examples of situations that may be used to study and eventually describe how the density of some substances changes or is changed. Students can investigate situations in nature where the density of substances change naturally such as in fish (air bladders) and ice.

After a demonstration in which a ball of non-soluble clay that sinks in a container of water, students can be challenged to make the malleable clay into an object that floats and to try to explain why it would float when the shape changes in a certain way. Through such activities, students can be led to develop an understanding that the variable that determines whether an object sinks or floats is the relation of its mass to its total new volume. Variables such as the shape and mass distribution of the object can be explored and tested. A co-operative team approach can be used to design and test questions such as "What factors affect the amount of cargo a barge or boat can hold?" If students motivate others in the team, collaboration is evident and meets an attitiude outcome.

Through exploration and investigation, students should understand and appreciate that the density of objects determines why they float or sink or do neither.

If an object is less dense than the fluid in which it is immersed, it will float. If an object is more dense than the fluid in which it is immersed, it will sink.

Floating and Sinking—Density *(continued)*

Tasks for Instruction and/or Assessment

Observation

- Do students consider other questions or problems to investigate involving density and floating and sinking? (208-2, 211-3)
- Do students perform the displacement activity carefully, take accurate measurements, and record data carefully? (207-11)
- Develop a checklist/rubric on the planning and design of an experiment to investigate the amount of cargo a clay or aluminum shaped "boat" will hold. (208-6, 211-3)

Paper and Pencil

- Using a sketch/cartoon, have students illustrate the volume of a gas at different temperatures using the particle model of matter. (307-9)
- Create a series of cartoons to illustrate what happens to gases when temperatures increase or decrease. The particle model of matter should be evident in this series. (307-9)
- Do group-and self-assessment of the work to design an experiment based on floating and sinking. (206-6, 211-3)

Presentation

- Use sketches or models to illustrate what happens to the densities of solids, liquids, and gases when they are subjected to temperature changes (particle model of matter). (307-9)
- Create a mural that illustrates everyday uses of technologies and living things in which the density of substances are changed naturally or intentionally. (307-10)

Resources/Notes

Appendices

- Madly Off in All Directions
- Floating Art
- Tower of Liquids

Forces in Fluids

Outcomes

Students will be expected to

- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- test and compare a student-constructed dynamometer with a commercial dynamometer (210-13)
- calibrate a student-constructed dynamometer with known masses (210-14)
- describe qualitatively the difference between mass and weight (309-1)
- provide examples of technologies that have been developed because of our understanding of density and buoyancy (111-1)
- explain quantitatively the relationship between force, area, and pressure (309-3)

Elaborations—Strategies for Learning and Teaching

Buoyancy can be used to investigate the concept of density. Many students have had experiences with the forces involved in objects that sink and float in water, for example. Students can compare units of mass (grams, kilograms) with the forces (Newtons) they exert on Earth by using spring scales and various balances. Students should be given the chance to construct and test a spring balance, using an elastic band, and compare and contrast it to a commercial dynamometer (force meter). This activity can be extended to weighing various masses in water to observe the buoyant force of the fluid (the mass remains constant and the weight changes). Force sensors, if available, may be used. The construction of Cartesian Divers provides for discussion and illustration of unbalanced forces. The story of the origin of Archimedes Principle can be related and demonstrated as the next step in the study of forces and displacement of fluid as related to density.

Students should be given the opportunity to relate personal observations when swimming and/or lifting objects in the water. Students can also relate what happens to objects such as beach balls when one tries to immerse them in water. Students can be introduced to simple force vectors when investigating and representing the various forces in play when an object floats or sinks.

Throughout this unit, students should have opportunities to relate various technologies which are based on the principles of density and buoyancy to our scientific knowledge of these principles. Technologies such as personal floating devices, research submersibles, and diving equipment should be explored and related to the scientific understanding and knowledge of density and buoyancy.

Students should investigate and solve problems involving Pascal's principle and the equation

– $\text{pressure (Pascal)} = \dfrac{\text{force (N)}}{\text{area (m}^2\text{)}}$

A study of unbalanced forces can also lead to an investigation of pressure in fluids (air and water) and solids. Many opportunities for designing experiments and identifying major variables related to relationships among force, area, and pressure are available for students. How weight and pressure are related can be demonstrated with flat-heeled shoes and high-heeled shoes, for example. Relationships between fluid depth and pressure can also be investigated by using cans with holes at varying depths to illustrate how the water will leak out when put in the cans. Investigations into air pressure at various altitudes will help students gain an appreciation of how the pressure of a gas is dependent upon altitude as opposed to that of liquids. Hot air balloons can be utilized to demonstrate this point.

Forces in Fluids

Tasks for Instruction and/or Assessment

Performance

- Design and construct Cartesian Divers to explain pressure/volume changes. (309-2)

Journal

- How could you explain the difference between mass and weight to an elementary student? (309-1)

Paper and Pencil

- List and explain the steps taken to calibrate a student-constructed dynamometer to standard masses. (210-14)
- Why does a rock feel lighter in the water? Draw a force diagram to illustrate your answer. (111-1)
- How much pressure would be exerted on the floor beneath an object that weighs 800 N and has a base area of $2m^2$? (309-3)
- What would happen to the pressure if the weight of the object remained the same but the area of its base were cut in half? (309-3)
- How many Newtons of force on a stick with a base area of $0.01m^2$ would be required to produce a pressure of 1000 Pascals. (309-3)

Presentation

- Research and report upon a technology that was designed using the scientific principles of buoyancy. (111-1)
- Investigate the term **displacement** as it refers to ships and report on your findings. (309-2)

Resources/Notes

Appendices

- Hydrometer Hijinks
- Bobbing for Buoyancy
- Cartesian Condiments
- Cartesian Conundrum
- A Pressing Problem

Forces in Fluids *(continued)*

Outcomes

Students will be expected to

- describe the science underlying hydraulic technologies (111-5)
- explain qualitatively the relationship among pressure, volume, and temperature when liquid and gaseous fluids are compressed or heated (309-4)

Elaborations—Strategies for Learning and Teaching

Students should be introduced to the term *Pascal* when doing investigations involving pressure. One Pascal is a very small amount of pressure. Students can try to imagine the pressure beneath one apple that is flattened to cover an area of one square metre, for example.

An investigation of hydraulic systems and pipeline systems will enable the students to better understand the relationship among force, area, and pressure. Students should be involved with activities that illustrate Pascal's Principle, which states that any change in pressure applied to a fluid in a confined space is transferred unchanged throughout the fluid. Water-filled balloons and plastic bottles allow for a kinestetic appreciation of the principle. Students can build a model, using hydraulic syringes, to illustrate and describe hydraulics in a simple system. A common example and application of Pascal's Principle with which many students have had experiences, is the automobile lift pump seen in automobile service stations. A field trip to a local service centre will permit students to see a variety of technologies based on Pascal's Principle used in this context. Hydraulic chairs (dentist's, hairdresser's, office) can be investigated to explore technology using this principle. A water-spraying toy can be examined to see how it functions. Many types of farm machines and heavy construction equipment such as bulldozers can be investigated to learn about other practical applications of Pascal's Principle.

Pressure sensors (if available) can be used with computer interface technology to explore, illustrate, and demonstrate pressure changes. These sensors can easily measure changes in gas pressure, and can help students make an abstract concept more concrete and measurable.

Students should investigate and explore what happens to fluids when the temperature of the fluid is altered. Air-filled balloons and balls may be cooled or placed in warm settings to observe changes in their volume. Students can use tire pressure gauges to measure pressure changes at various temperatures. Students can place their thumbs on the nozzle of a bicycle pump to experience pressure. Invite a mechanic to class to talk about the pressure of fluids in various automobile systems as the temperature increases in various systems. **Note to teacher:** *Investigations should be limited to two variables and the third variable kept constant at this level.*

Forces in Fluids *(continued)*

Tasks for Instruction and/or Assessment

Journal

- The technology I have seen that works on Pascal's Principle is a... It functions in this way (sketch). (111-5)

Paper and Pencil

- Sketch a simplified hydraulic system and briefly explain its benefits. (309-3)
- Using a concept map, show the relationships between pressure, volume and temperature when liquids and gases are compressed or heated. (309-4)
- Why does a barber have to step on or pump the barber's chair in order to make it raise? (111-5)

Interview

- Why would a bicycle pump get warm in the air compression chamber when the pump is being used? (309-4)

Presentation

- Explain how a water-spraying toy functions using Pascal's Principle. (111-5)

Resources/Notes

Appendices

- Tight Squeeze
- Lift It

Viscosity of Liquids

Outcomes

Students will be expected to

- compare the viscosity of various liquids (307-6)
- design an experiment to test the viscosity of various common fluids and identify the major variables (208-6)

Elaborations—Strategies for Learning and Teaching

Many students have had first-hand experience with the viscosity of a variety of liquids. For many students, viscosity is related to how "runny" something is. It is explained in terms of rate of flow of a liquid. An informal discussion of various common liquids will permit the teacher to gauge the familiarity the students have with this concept. Some types of liquids that can be discussed and investigated may include molasses, corn syrup, vinegar, dishwashing liquid, shampoo, water, pop, and cooking oil. Flow rate sensors can be used to investigate and measure viscosity.

Providing opportunities for hands-on experiences that demonstrate the viscosities of a variety of liquids provides the students with concrete learning experiences upon which other concepts related to viscosity, such as the particle model of matter, can be addressed.

Students, for example, can be challenged to design a method for testing the viscosity of several liquids such as water and various cooking oils and syrups, and identify the major variables in the test. The student-generated test for viscosity can be compared and contrasted with another test for viscosity, such as using a syringe and a constant pressure (weight) on the syringe to determine which tube empties first. Students can measure the flow rate of various liquids on an inclined plane. Once again, students can be asked to determine and control as many variables as possible in the prepared test.

- describe factors that can modify the viscosity of a liquid (307-7)
- use a temperature-measuring technology effectively and accurately for collecting data in temperature-viscosity investigations (209-3)
- demonstrate a knowledge of WHMIS standards by demonstrating the correct methods of disposal of various oils, for example (209-7)

Students should describe viscosity in terms of temperature and concentration.

Using water baths, students can heat various cooking oils to see what effect temperature has on the viscosity of liquids. It is important that students *do not* heat oils or other similar liquids in a single pot on a heating device as it could cause an oil or grease fire. Thermometers or temperature probes can be used to collect data in this activity. Students should be exposed to good safety and disposal practices when dealing with various liquids other than water. Note whether students assume responsibility for waste disposal procedures; this is an indicator for safety and meets an attitude outcome.

Opportunities for discussion should be provided and linkages to the practical applications of our knowledge of the viscosity of liquids should be made throughout this section of the unit. Everyday experiences using warm and cold liquids will allow students to make the transfer to applications such as using various liquids in different situations depending on the use of the fluid and the fluid itself.

Viscosity of Liquids

Tasks for Instruction and/or Assessment

Observation

- Interview students during an appropriate activity to ascertain if they can read a thermometer properly. (209-3)
- How do students clean up and dispose of oils used in their investigations? (209-7)

Observation/Paper and Pencil

- Prepare a four-point rubric to assess and evaluate the design and carrying out of an experiment to test the viscosity of various common fluids. (208-6)

Pencil and Paper

- Prepare a lab report on the viscosity of liquids. (208-6, 307-6, 307-7)
- Create a chart or table of various liquids found in the kitchen indicating their relative viscosities. (307-6)

Presentation

- Prepare a graph that communicates the varying viscosity of honey or maple syrup as the concentration or temperature increases or decreases. (307-6)

Resources/Notes

Appendices

- Flowing Along

Viscosity of Liquids *(continued)*

Outcomes

Students will be expected to

- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

Elaborations—Strategies for Learning and Teaching

Opportunities should be made available for students to propose and learn about potential, everyday applications related to the viscosity of liquids. Examples related to the world of cooking may include the various viscosities of such foodstuffs as pancake batter and sugared icing (concentrations). Another example is how the temperature of engine oil dictates how quickly it will drain from an engine during an oil change. Students can investigate the preparation of various types of maple syrup and honey products that have various viscosities. Some students may investigate the uses of various motor oils for different engines and different seasons.

Viscosity of Liquids *(continued)*

Tasks for Instruction and/or Assessment

Presentation

- Interview a mechanic or a person who works with heavy machinery to find out how they deal with the viscosity of the oils they use at different temperatures. Prepare a short written report. (210-12)
- Create a poster showing several liquids that can serve different purposes because of their different viscosities (engine oils, maple syrup, ketchup, ...). (210-12)
- Research and report on oil viscosity problems that make pipeline transport of oil a challenge. (109-10, 112-7)
- Work in small groups to prepare a presentation on “Why liquids of varying viscosity are needed/used in today’s society.” (210-12)

Resources/Notes

Physical Science: Optics

Introduction

Applications using the principles of light have resulted in devices that have improved scientific techniques and contributed to the quality of life. In this unit of study, basic concepts that are introduced include the properties of visible light including the reflection and refraction of light. Various reflecting and refracting technologies will also be explored and investigated.

Students should be given opportunities to experience and observe the properties of light using hands-on activities. Opportunities and activities designed to investigate and explore the properties of light provide the basis for more in-depth experimentation with materials in order to investigate reflection and refraction of light.

Focus and Context

The focus of this unit is inquiry. A possible context could be the variety of everyday experiences the students have with the reflection and refraction of light. Students encounter reflection when they get up in the morning and use a mirror, for example. Buses and cars have a variety of reflective devices that can be explored. Eyeglasses and other refracting technologies can be investigated. In addition, students should have ample opportunity to investigate and study various technologies that are associated with electromagnetic radiation and to explore their positive and negative attributes and their impact on our way of life.

Science Curriculum Links

In grade 4, students begin their formal investigation and study of light. Sources of light and how light travels are topics explored. As well, the students investigate how white light can be separated into its composite colours. They also compare how light interacts in a variety of optical devices such as kaleidoscopes, periscopes, telescopes, and magnifying glasses.

In grades 11 and 12, students have the chance to learn about the wave and particle models of light. In addition, they are provided with opportunities that enable them to explain, qualitatively and quantitatively, the phenomena of wave interference, diffraction, reflection, refraction, and the Doppler-Fizeau effect.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-5 describe how technologies develop as a systematic trial-and-error process that is constrained by the properties of materials and the laws of nature

109-10 relate personal activities in formal and informal settings to specific science disciplines

109-13 explain the importance of choosing words that are scientifically or technologically appropriate

Relationships Between Science and Technology

111-3 provide examples of technologies that have enabled scientific research

Social and Environmental Contexts of Science and Technology

112-8 provide examples to illustrate that scientific and technological activities take place in a variety of individual or group settings

113-2 describe possible positive and negative effects of a particular scientific or technological development, and explain how different groups in society may have different needs and desires in relation to it

Skills

Students will be expected to

Initiating and Planning

208-1 rephrase questions in a testable form and clearly define practical problems

208-5 state a prediction and a hypothesis based on background information or an observed pattern of events

208-7 formulate operational definitions of major variables and other aspects of their investigations

Performing and Recording

209-2 estimate measurements

209-6 use tools and apparatus safely

Analysing and Interpreting

210-11 state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea

210-14 identify and correct practical problems in the way a prototype or constructed device functions

Communication and Teamwork

211-1 receive, understand, and act on the ideas of others

Knowledge

Students will be expected to

308-8 identify and describe properties of visible light

308-9 describe the laws of reflection of visible light and their applications in everyday life

308-10 describe qualitatively how visible light is refracted

308-11 describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves

308-12 compare properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves

Properties of Visible Light

Outcomes

Students will be expected to

- identify and describe the following properties of visible light:
  - travels in a straight line (rectilinear propagation)
  - speed of light in air is 300,000 km/s
  - reflection
  - refraction and dispersion
  - travels in a vacuum and in some types of media (308-8)

Elaborations—Strategies for Learning and Teaching

This unit of study may begin with a K-W-L activity. By posing some motivating questions about light and some of its properties, students' conceptions about light can be assessed and used in the further development of lessons. Questions about sources of light, what light is and where it can come from will set the stage for introductory, exploratory activities.

Students can be asked about the technologies they know of that are developed with a knowledge of the properties of light. Questions about technologies such as periscopes would set the stage for challenges early in the unit.

Students should have the opportunity to investigate the properties of light throughout the course of this unit. The suggestions on this page are not meant to be prerequisites or even sequential but they are intended to give suggestions about the types of activities that will help students to develop a conceptual understanding about the nature and properties of light.

Students can investigate light to see how it travels in a straight line (rectilinear propagation) by constructing and using a light box. Students will be able to see how a light beam travels in a straight line when looking into the light box from the side when a light source is directed at the pinhole at one end. By placing a source of smoke (extinguished piece of wooden splint) or chalk dust in the box, students can see how light is dispersed or scattered by the smoke or dust particles. Black material can be placed at the opposite end of the light box in order to observe how light is absorbed and not reflected in this case. Mirrors can be fixed in the light box allowing the viewer to see how a beam of light is reflected. A prism can be placed in the box, and light could be refracted into its composite colours.

Activities in which shadows are produced will provide further experiences to illustrate that light travels in a straight line. Students can use a variety of mirrors, lenses, and other media to investigate and explore the reflecting and refracting properties of light. Inverted images in pinhole cameras can be used to provide further evidence for rectilinear propagation.

Students should have experiences investigating light as it travels through some materials such as clear glass (transparent) and plastics (translucent). In most cases, light cannot travel through materials and is reflected totally (white) or partially (the colours we see).

Properties of Visible Light

Tasks for Instruction and/or Assessment

Performance

- Plan and perform an activity to illustrate that light travels in a straight line. (308-8)
- Draw a “microscopic” view of what happens when a light beam strikes smoke or dust particles. (308-8)

Journal

- What are some things about light that you now know after your investigation? (308-8)

Interview

- What can you say about the angle of incidence and the angle of reflection from a beam of light in a light box? (308-8)

Presentation

- Investigate and report on “sharp” and “fuzzy” shadows. (308-8)
- Create a bulletin board display of everyday materials or objects that are either transparent, translucent, or opaque. (308-8)
- Create and display an art project which uses (shows) the properties of light. (308-8)

Portfolio

- Investigate umbras and penumbras produced in a solar eclipse and explain their differences and similarities. (308-8)

Resources/Notes

Appendices

- A Shadow of Yourself
- Line Up Light

Video

- Bill Nye: Light and Optics– great overview of light-bending, lens. Good intro or conclustion.

Reflection

Outcomes

Students will be expected to

- describe the laws of reflection of visible light and their applications in everyday life
  - regular versus diffuse reflection
  - angle of incidence = angle of reflection (308-9)
- formulate operational definitions for **incidence**, **reflection**, and **the normal** (208-7)

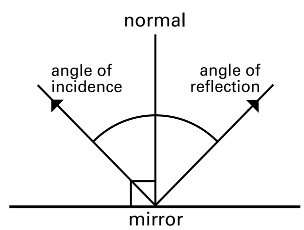
- estimate angles of incidence and reflection (209-2)

- work co-operatively and collaboratively with others to plan and safely construct an optical device using mirrors (209-6, 211-1)
- identify and correct practical problems in the way a constructed optical device functions (210-14)

Elaborations—Strategies for Learning and Teaching

Students have had numerous experiences with reflected light. The everyday use of, and exposure to, mirrors provide many personal references for students. Mirrors, and other devicescan be used to further investigate reflected light and the images they produce. Real and virtual images can be observed and discussed. Experiences with flat, convex and concave mirrors should be made available to the students to illustrate the different effects and uses of these types of reflection. Metal pots and spoons, as well as fabricated concave and convex mirrors, can be used to compare and contrast the reflections from each type. Surveillance mirrors in stores and vehicles, school-bus mirrors, some sideview mirrors, and "circus" or distorting mirrors may demonstrate the uses of these types of mirrors. Ray diagrams can be used to help students conceptualize the reflection of light in many of the activities and explorations. Students can begin to gain a qualitative appreciation of the effects and uses of concave and convex mirrors.

Students can explore and investigate regular and diffuse reflection in activities that compare the reflected light from smooth aluminum foil or a mirror with crumpled aluminum foil or paper. Through these experiences and discussions of reflected beams, students should be able to estimate angles of incidence and reflection. Students should learn that the angles of incidence and reflection are estimated or measured with respect to the normal.



Students should be challenged to construct a periscope, or design and build a "classroom" surveillance system, using a number of small, plane, and/or convex mirrors. Such problem-solving activities will permit the students to use the laws of reflection in a given context. Observe the students to ascertain if they strive to assess the problem accurately by careful analysis of evidence gathered.

Students should have the opportunity to work in pairs or in small groups to plan, design, and problem solve these activities. Students can defend their plans/designs/models by describing how they work to other groups, to the class as a whole, or by preparing a detailed poster or written report. Note whether the students share responsibilities for difficulties encountered during the activity. This is also an indicator of how scientists work collaboratively and represents an attitude outcome.

Reflection

Tasks for Instruction and/or Assessment

Observation/Performance

- Construct an assessment rubric to assess the process and product for the construction of an optical device. (209-6, 211-1)

  4 Worked co-operatively and collaboratively with group members. Worked safely with materials. Optical device illustrates the laws of reflection very well. Student communicates understanding of law of reflection very well.

  3 Worked co-operatively and collaboratively with group members. Optical device illustrates the laws of reflection. Student derives law of reflection from activity.

  2 Worked well during most of the activity with group members. Optical device illustrates the laws of reflection. Student has difficulty explaining laws of reflection.

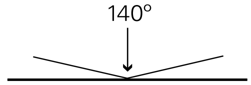
  1 Does not work well with group members. Optical device is incomplete or is incapable of demonstrating laws of reflection. Cannot describe laws of reflection.

Performance

- Estimate and then measure the angle incidence and reflection using a mirror at a particular angle in a light box. (209-2)

Paper and Pencil

- Produce a simple ray diagram that helps to compare and contrast regular and diffuse reflection. (308-9)
- Given the diagram below, estimate the angle of incidence and reflection of the light beam. (308-9)



Interview

- Explain why an ambulance vehicle has the word “ambulance” in reverse lettering on its hood. (308-9)

Portfolio

- Make a list or create a small scrapbook of various reflecting technololar uses. (308-9)

Resources/Notes

Appendices

- Light at Work
- Up Periscope
- Make a Kaliedoscope
- Larger Than Life

Refraction and Dispersion

Outcomes

Students will be expected to

- rephrase questions related to refraction in a testable form (208-1)
- predict the effect of transparent media of varying densities on the angle of refraction of light (208-5)
- estimate angles of refraction (209-2)
- describe qualitatively how visible light is refracted (210-11, 308-10)

Elaborations—Strategies for Learning and Teaching

Refraction is the bending of light when it crosses the boundary between two transparent media. Light slows down as it travels from air through other media such as water and glass. A possible analogy for refraction is a car travelling on the highway. If the car runs into a sandy shoulder, it veers and slows down. This models the refracted light that is caused by its travelling through a denser medium. If wheels and an axle from a toy vehicle are available, the unit can be rolled on bare floor onto carpet to simulate the speed of light going through a different medium. If the unit hits straight on, it slows down but does not bend. If the wheels hit at an angle, one wheel will slow down before the other, and the direction of the wheels will change, which is analogous with refracted light.

Students should be given the chance to observe a beam of light as it passes through various transparent media such as air, water, mineral oil, transparent plastic, glass, and sugar or salt solutions. Students should be asked to observe and describe how the refracted light bends at the interface and what happens when the angle of entry is changed. By placing a pencil in a transparent beaker containing a variety of transparent liquids, students can test predictions about what may happen to the appearance of the pencil in the medium, as well as how the appearance changes in the different media. Students should attempt to relate refraction to physical properties of the transparent materials. These physical properties include density, viscosity, and colour. To demonstrate a concern for safety, establish whether or not the students keep the work area uncluttered with only the appropriate materials present.

Students can use prisms to investigate how light from different sources is refracted and dispersed. Students can observe and experience what happens to light that is dispersed in a mixture of water and a few drops of milk.

- estimate focal length of a convex lens by finding its focal point (209-2)

Students should explore and investigate the focal point and focal length of convex lenses. Magnifying glasses, for example, can be used to focus light to a point (focal point). Students can then estimate and perhaps even measure the focal length from the focal point to the lens. It is not necessary to address all the cases involving multiple focal points that are possible in some instances. Students can investigate and explore real and virtual images with convex lenses and concave mirrors. It is not intended that students investigate real and virtual images quantitatively. Students should come to understand the applications of convex and concave lenses and mirrors in technologies such as telescopes, microscopes, cameras, eyeglasses, car headlights, and flashlights.

Refraction and Dispersion

Tasks for Instruction and/or Assessment

Observation

- Use an observation checklist (see sample below) to assess inquiry and investigation skills of students on the basis of their investigation of how light refracts in different media.
(208-1, 208-5, 209-2, 210-11, 211-1)

Observation	Poor			Good
Initiating and planning	1	2	3	4
Conducting and recording	1	2	3	4
Analysing and interpreting	1	2	3	4
Communicating	1	2	3	4

Performance

- Develop a plan or a set of procedures in order to investigate and compare how light refracts in liquids A, B, and C.
(208-5, 308-10)
- With several classmates, devise a way to demonstrate, using your bodies, how a beam of light is refracted. (308-10)

Paper and Pencil

- Draw the resultant spectrum of light beams when white light is refracted by a prism. (308-8, 308-9)
- Give an example of a question related to the refraction of light that could lead to a test or experiment. (208-1)
- In a sketch, indicate where you had estimated the focal length of a particular convex lens to be and where you found it to be after an investigation. (209-2)
- Draw a diagram showing how light is refracted in a variety of media. (308-10)
- Predict and estimate the angle of refraction of a light beam in water and in cooking oil for several angles of incidence. (208-5, 209-2)
- Given the optical densities of a variety of liquids, compare the angle of refracted light in each. (210-11)

Resources/Notes

Appendices

- Pouring Light

Refraction and Dispersion *(continued)*

Outcomes

Students will be expected to

- describe how optical technologies have developed through systematic trial-and-error processes constrained by the optical properties of the materials (109-5)

- provide examples of optical technologies that enable scientific research and relate personal activities associated with such technologies (109-10, 111-3)

Elaborations—Strategies for Learning and Teaching

Students can investigate and describe the development and evolution of an optical technology such as a microscope, telescope, reading glasses, contact lenses, or fibre optics. Students, when researching or investigating the invention and development of contact lenses, for example, will discover and discuss the development and use of this technology and its dependence on the development of a material that would lend itself to this particular use. As materials are modified and improved through systematic trial and error, contact lenses become more useful and widespread. Students can interview a nurse, doctor or medical technician to learn about the development of medical technologies that function owing to an understanding and application of optics.

Students should be aware of the scientific research that occurs because of optical technologies. Students should also be aware that personal activities such as using a telescope or magnifying glass are related to the study of optics. Magnifying glasses, eyeglasses, contact lenses, microscopes, telescopes, and cameras can be used as examples.

Refraction and Dispersion *(continued)*

Tasks for Instruction and/or Assessment

Paper and Pencil

- Make a list of as many domestic technologies that are related to optics as you can. (109-10, 111-3)

Presentation

- Create a time line illustrating the invention and development of optical technologies such as microscopes, telescopes, reading glasses, contact lenses, lasers, and variable tint lenses. (109-5, 109-10, 111-3)
- Create a science/science career bulletin board related to optical technologies (for example, reading glasses—optometry/optometrist; telescope—astronomy/astronomer; microscope—bacteriology/bacteriologist; data transmission—physics/technician). (111-3)
- Create a poster that illustrates the historical development of the optical microscope or the telescope. (109-5)

Resources/Notes

Electromagnetic Radiation

Outcomes

Students will be expected to

- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves (308-11)
- compare the properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves (308-12)
- explain the importance of using the words **frequency** and **wavelength** correctly (109-13)
- provide examples related to optics that illustrate that scientific and technological activities take place individually and in group settings (112-8)
- describe possible negative and positive effects of technologies associated with electromagnetic radiation (113-2)

Elaborations—Strategies for Learning and Teaching

Many students have heard of the various forms of electromagnetic radiation such as microwaves and radio waves but will not necessarily know that there is a connection among them. It is important to use learning activities that illustrate the relationship among the various forms of electromagnetic radiation, their similarities and differences.

A basic introduction to wave theory is appropriate at this level. Students may have investigated the characteristics of ocean waves which they can then compare to light waves. The use of oscillating ropes and/or Slinkys will enable students to have a visual representation of some of the key features of waves such as wave speed, wavelength, and frequency. During their investigation of electromagnetic radiation, students should learn that electromagnetic waves are transverse waves and do not require a medium in which to travel. With one end of a three-to four-metre piece of rope, which is attached to a fixed point at the other end, students can model the characteristics of waves: amplitude, wavelength, and frequency. By changing one of these features, students can observe and note how the others change. This is a qualitative exploration and appreciation of the differences and similarities of the different types of electromagnetic radiation.

Students should realize that white light, when refracted by a prism, illustrates the different wavelengths of visible electromagnetic radiation. The spectrum is often indicated as a continuum of colours with the shortest waves being at the violet end and the longest at the red end. Students can investigate the colour combinations when the three primary colours of light (red, green, and blue) are mixed.

Throughout the unit, students should be made aware of scientific and technological activities that involve individuals such as lens makers, and groups such as astronomy teams investigating and surveying the universe.

Students should investigate the various uses of electromagnetic radiation and identify problems or issues related to particular kinds. Ultraviolet radiation (UVA rays) getting through the atmosphere and storage of radioactive materials are but two of many issues that can be addressed in this section.

Students should investigate common technologies that incorporate the use of electromagnetic radiation and explore their possible positive and negative effects. Microwave ovens, X-ray machines, cellular phones, and the nuclear industry are some examples of technologies that can be explored.

Electromagnetic Radiation

Tasks for Instruction and/or Assessment

Paper and Pencil

- Use the terms wavelength and frequency to describe several types of electromagnetic radiation. (109-13, 308-11)
- How are various types of electromagnetic radiation used by people? (113-2, 308-8)
- Research and write a report on the invention and use of the Morse code. (112-8, 308-11)
- Investigate the differences and similarities between an incandescent and a fluorescent light bulb. What are the advantages and disadvantages of each? Report your findings to the class. (113-2)
- Research the development and utilization of X-rays in medicine or industrial settings. What are the safety precautions used when working with X-rays? (109-5, 112-8, 113-2)

Presentation

- Create a chart/diagram of the various types of electromagnetic radiation and give a property for each type. (308-11)
- Keep a class bulletin board of careers associated with optics encountered throughout the unit. (113-2)
- Research and report on the benefits and dangers of X-rays or emissions from computer screens. (113-2, 308-8)
- Research the terms primary colours and secondary colours and produce an art display that shows what they mean. (308-12)
- Interview a short wave operator and report on the types of electromagnetic radiation that are employed by her/him. (308-11)
- Produce a visual representation or model of the main types of electromagnetic radiation based on wavelength and frequency. (308-11, 308-12)
- Prepare a visual display of technologies associated with optics or electromagnetic radiation outlining the positive and negative effects of these technologies (for example, contact lenses and tanning salons). (113-2)

Resources/Notes

Appendices

- A Group Wave

Life Science: Cells, Tissues, Organs, and Systems

Introduction

In previous explorations of living things, students have not encountered the cell as a basic building block and functional unit of life. At this level, these notions are explored in a rigorous fashion to ensure that students understand the cell's critical importance to all life. These new understandings allow students to study the human organism from a holistic perspective.

Students will continue to study the different body systems but not in minute detail. From activities, students should start to appreciate a correlation between healthful living and healthy systems. This is the first time that students deal with the systems as an integrated whole.

Focus and Context

The focus of this unit of study is on decision making. Using the context of healthy/non-healthy lifestyle choices, and how these choices impact on cells, tissues, organs, and systems, students should appreciate their interconnections and use them to make informed choices when it comes to their health.

Science Curriculum Links

In grade 1, students begin their study of living things by investigating the basic needs and characteristics of living things. By the end of grade 2, students explore animal growth and changes and, by the end of grade 3, plant growth and changes.

In grade 5, students are expected to be able to describe the structure and function of the major organs of the digestive, excretory, respiratory, circulatory, and nervous systems. As well, they investigate and demonstrate how skeletal, muscular, and nervous systems work together.

In grade 9, students will investigate the process of cell division more closely within the context of sexual and asexual reproduction. A beginning investigation into the cell's genetic information will also occur. In senior high school, students may choose a course in biology in which mitosis and meiosis are described in detail and the structure and function of the female and male mammalian reproductive systems are analysed and described. Cell theory is also addressed at this level; major organelles visible with the light and electron microscope are described and cellular processes investigated.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-13 explain the importance of choosing words that are scientifically or technologically appropriate

110-2 distinguish between ideas used in the past and theories used today to explain natural phenomena

110-5 illustrate examples of conflicting evidence for similar scientific questions

Relationships Between Science and Technology

111-5 describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solve practical problems

Social and Environmental Contexts of Science and Technology

112-10 provide examples of science- and technology-based careers in their province or territory

113-8 make informed decisions about applications of science and technology, taking into account personal and social advantages and disadvantages

Skills

Students will be expected to

Initiating and Planning

208-1 rephrase questions in a testable form and clearly define practical problems

208-6 design an experiment and identify major variables

Performing and Recording

209-1 carry out procedures controlling the major variables

209-3 use instruments effectively and accurately for collecting data

Analysing and Interpreting

210-7 identify and suggest explanations for discrepancies in data

Communication and Teamwork

211-3 work co-operatively with team members to develop and carry out a plan, and troubleshoot problems as they arise

211-4 evaluate individual and group processes used in planning, problem solving, decision making, and completing a task

Knowledge

Students will be expected to

304-4 illustrate and explain that the cell is a living system that exhibits all the characteristics of life

304-6 explain that growth and reproduction depend on cell division

304-5 distinguish between plant and animal cells

304-8 relate the needs and functions of various cells and organs to the needs and functions of the human organism as a whole

304-7 explain structural and functional relationships between and among cells, tissues, organs and systems in the human body

304-9 describe the basic factors that affect the functions and efficiency of the human respiratory, circulatory, digestive, excretory, and nervous systems

304-10 describe examples of the interdependence of various systems of the human body

Cells

Outcomes

Students will be expected to

- illustrate and explain that the cell is a living system that exhibits the following characteristics of life (304-4)
- explain that growth and reproduction depend on cell division (304-6)
- distinguish between plant and animal cells (304-5)
- use a light microscope or microviewer correctly to produce a clear image of cells (209-3)
- work co-operatively with team members to develop and construct models of cells (211-3)
- explain that it is important to use proper terms when comparing plant and animal cells (109-13)

Elaborations—Strategies for Learning and Teaching

Students should be given opportunities to investigate and observe examples of cells that are or have demonstrated the basic characteristics of life: growth, locomotion, stimulus/response, and reproduction. Students should describe the cell in terms of growth, locomotion, stimulus/response, and reproduction. This unit provides an excellent opportunity to estimate measurements of various kinds and to further develop skills in using a light microscope. Students can investigate cellular growth and reproduction by germinating corn or similar seeds and watching the growth of root tips. If adequate materials are available, cross-sections of the root tips can be prepared and stained to observe evidence of cellular growth and reproduction. Commercial slides are available in which some cells are identified in the process of mitosis.

Thin onion layers or lettuce can also be prepared to observe cell structures and evidence of reproduction. Students should be able to identify and differentiate between cell walls and cell membranes in given samples. The nucleus should also be identified. Commercially prepared animal cell slides should be compared and contrasted with plant cells. It is important to note that students should not harvest live human cells in this activity. Students should be taught the skills necessary to maintain and use the light microscope safely and effectively. At this level students should investigate the following structural characteristics of plant and animal cells: cell wall/membrane, nucleus, cytoplasm, vacuoles, and chloroplasts. Students should also compare and contrast these structural characteristics between these two types of cell.

Samples of paramecium and amoeba can be used to explore and investigate movement in cells. The use of the fixed video camera/microscope, if available, facilitates whole group observation of cells. Students often believe that cells are two-dimensional, as they sometimes appear under the microscope. Three-dimensional drawings or models will help students develop the concept of cells. Students can model the three-dimensional nature of animal cells by filling a plastic bag (cell membrane) with gelatin, and putting in various fruits or vegetables for cell parts. This plastic bag can then be put inside a plastic see-through sandwich container (cell wall). Both of these models could be stacked to show differences in plant and animal tissue, and different groups of containers can be stacked to model organs. Students should become familiar with and be able to use the terms **cell wall**, **cell membrane**, **vacuoles**, **nucleus**, **cytoplasm**, and **chloroplasts**.

Cells

Tasks for Instruction and/or Assessment

Performance

- Locate the cell wall of a plant cell when being viewed through a light microscope. (109-13)
- Draw pictures or make models of plant and animal cells. Indicate the following on your model or picture: cell wall, cell membrane, vacuole, nucleus, chloroplast. (109-13, 304-5)

Journal

- How would you explain the growth of an organism? (304-6)

Paper and Pencil

- Write a poem about cells and how they exhibit characteristics of life. (304-4)
- Produce a travel brochure that describes a plant or animal cell as if it were a large theme/amusement park. (109-13, 304-5)

Presentation

- Create a cartoon or a series of cartoons/sketches that illustrate the basic characteristics of life. (304-4)
- Create a three-dimensional model of an animal and/or plant cell illustrating the cell wall, cell membrane, nucleus, cytoplasm, vacuoles, and chloroplasts. (109-13, 211-3, 304-5)
- Prepare a play with group members playing the various parts of a particular cell and explaining their function. (109-13, 304-5)

Portfolio

- Make drawings/sketches of the various cells observed when using a light microscope. Label the parts you can identify. (109-13, 304-5)

Resources/Notes

Appendices

- It's a Small World
- Building a Model of a Cell
- Unseen World
- A Cell Factory

Video

- Understanding Cells; functions of organelles–good as intro or reviw of cell parts, functions

Interdependence among Cells, Tissues, Organs, and Systems

Outcomes

Students will be expected to

- relate the needs and functions of various cells and organs to the needs and functions of the human organism as a whole (304-8)

- explain structural and functional relationships between and among cells, tissues, organs, and systems in the human body (304-7)
- compare the early idea that living organisms were made of air, fire and water with the modern cell theory (110-2)
- evaluate individual and group processes used in researching the roles of the main organ systems (211-4)

Elaborations—Strategies for Learning and Teaching

It is important that students have the chance to explore and carry out investigations that lead to a better understanding of the interdependence and interconnectedness of the various systems of the human body as well as the structural and functional relationships between and among the cells, tissues, organs, and systems. Students should begin to understand how oxygen (O_2), carbon dioxide (CO_2), nutrients, and waste products are procured, produced and/or transported by the various systems in the body.

Students should have the opportunity to relate and compare the needs and functions of cells and organs to the human organism as a whole. Students should explain the relationships between breathing (inhaling O_2 and exhaling CO_2) and the cells' needs regarding these gases. The energy for cellular activity originates in the food eaten and digested by the human organism. Waste material from cellular processes must be eliminated, and the human organism is designed to facilitate this necessary function. Demonstrating the results of cellular respiration using yeast and sugared water illustrates the production of heat and CO_2. This process can be related to humans having a constant body temperature and needing to get rid of the CO_2 produced during cellular respirations as well as requiring food (sugar) and air (oxygen) to allow cellular respiration to take place.

Students can be shown a variety of prepared cells using a micro-projector to illustrate the variety of cells in a person. The shape and function of a variety of cells can be highlighted. A prepared cross-section of cardiac tissue can illustrate how similar cardiac muscle cells work in unison to form heart tissue. An organ, such as the heart, can be observed and studied through software or videos. Organ systems can be investigated to see how various organs, such as those that make up the digestive system, work in unison and harmony. Model cells made in the previous section may be stacked to form tissues and organs in order to demonstrate how these are related.

Students should work together to research the role of the main organ systems in getting oxygen and food to cells and getting rid of the wastes produced. Students can prepare some form of presentation or media project to communicate their findings and evaluate the group processes during the activity.

Interdependence among Cells, Tissues, Organs, and Systems

Tasks for Instruction and/or Assessment

Observation

- Complete self- and group-evaluations upon completion of research of human organ systems. (211-4)

Paper and Pencil

- Create a concept map that illustrates the interdependence of a number of organ systems. (304-7)
- In a story, personify a cell and have it explain how it gets oxygen (O_2), rids itself of waste products, and nourishes itself. (304-7)
- How might a muscle cell rely on a red blood cell? (304-7)
- Explain how the needs of a cell are related to the functions of major body processes as a whole. (304-8)

Interview

- Why do you think ancient peoples had different theories and explanations regarding the make-up of our bodies from those we have today? (110-2)

Presentation

- Create a skit/play in which students play the parts of the cells, tissues and organs of a particular system in order to demonstrate their connectedness. (304-7)

Portfolio

- Research and report on the various tissues and organs that are used to make the muscular system function. (304-7)

Resources/Notes

Appendices

- The Respiratory System
- Heart Walk

Video

- Total Fitness

Healthy/Unhealthy Systems

Outcomes

Students will be expected to

- describe the basic factors that affect the functions and efficiency of the human respiratory, circulatory, digestive, excretory, and nervous systems (304-9)
- illustrate examples of conflicting evidence related to how we should maintain and/or treat body systems (110-5)

- describe the science underlying various technologies used to assist or replace unhealthy organs or systems (111-5)

Elaborations—Strategies for Learning and Teaching

Students should be given the chance to explore positive and negative factors, such as nutrition, exercise, and other lifestyles, that affect the functions and efficiency of the human respiratory, circulatory, digestive, excretory, and nervous systems. Students should be encouraged to explore and learn about what practices or lifestyles contribute to healthy and unhealthy systems. Students may work in pairs or small groups to investigate and explore how certain lifestyles positively or negatively affect body systems. For example, students can investigate how certain foods and/or diets affect the function and performance of several body systems such as the circulatory and digestive systems. Students can communicate their findings in the form of a presentation, a multimedia report or a written report. **Note:** *This is not intended to be a detailed study of the various body systems. It is important to address this section holistically and not dwell on terminology and the memorization of anatomical details.*

By providing a variety of learning experiences designed to highlight positive and negative factors affecting the systems of our bodies, students will hopefully appreciate the personal and social consequences involving our overall health. Representatives from the Canadian Lung Association or the Canadian Cancer Society can be invited to class to give a presentation about their organization and their cause. Note whether or not students listen to the point of view of others; this meets an attitude outcome. Students can do research to learn about the lifestyle choices we make that affect body systems in a positive or a negative way. Conflicting evidence with respect to scientific questions such as various treatments for cancer and the use of controversial treatments and therapies to repair and heal body systems should be taken advantage of for the classroom debate to illustrate the fact that scientific knowledge is tentative and subject to review in light of new evidence. Other suggestions for potentially controversial treatments might include laser eye treatment, breast implants, and procedures to help overweight people lose weight.

During this study, students should note the technologies that have been designed to assist damaged organs and/or systems. The dialysis machine which filters the blood and artificial hearts which pump blood throughout the body are examples that may be investigated. Students should relate to the science behind the technologies investigated. Hearing aids, artificial limbs controlled by electrical impulses from nerves, artificial heart valves, respirators, and pacemakers are other examples that may be explored and discussed.

Healthy/Unhealthy Systems

Tasks for Instruction and/or Assessment

Observation

- Research and debate the availability and use of soft drinks in a school setting. (304-9)

Journal

- Write a personal response to conflicting evidence regarding the nutritional advice of a meat producer and a vegetarian. (110-5, 304-9)

Pencil and Paper

- In a report, describe how factors such as proper nutrition, exercise, and other healthy lifestyles affect the various systems of the body. (304-9)
- Survey students in the school on nutrition, exercise, and incidence of illness. Compile and analyse the results and draw conclusions. (110-5, 304-9)
- How does lack of exercise affect several of the main body systems? (304-9)

Presentation

- Produce a poster with pictures of technologies used to aid or replace organs or body parts/systems. Briefly describe their function with regard to what they do and how they aid or replace particular organs, systems or body parts (for example pacemaker, insulin pump, dialysis machine). (111-5)
- Interview an audiologist to find out what technologies are available to people who have limited hearing ability. Prepare an audiovisual presentation for the class. (111-5)

Portfolio

- Using current/popular newspapers and magazines, make a collection of advertisements that promote healthy development of various body systems. (110-5, 304-9)

Resources/Notes

Appendices

- We Have a System

Video

- Total Fitness
- Understanding Cells

Interdependence of Body Systems

Outcomes

Students will be expected to

- rephrase questions into testable form about the factors that affect physical fitness and health (208-1)
- design and carry out an experiment to compare and contrast heart rate and breathing rate in an individual during various levels of activity, and identify and control the major variables (208-6, 209-1)
- suggest explanations for variations in the heart rate and the breathing rate of an individual during various levels of activity when the experiment is repeated (210-7)
- describe three examples of the interdependence of various systems of the human body (304-10)
- provide examples of careers that are associated with the health of body systems (112-10)

Elaborations—Strategies for Learning and Teaching

Activities demonstrating the relationship between the respiratory and the circulatory systems give the students the opportunity to develop notions about the interdependence of various body systems. For example, students can rephrase questions such as "Does lifestyle have an effect on physical fitness?" to "How does an athlete's heart rate compare to that of a non-athlete?"

Students can design an experiment in which heart rates and breathing rates can be compared and contrasted during various levels of activity. Students should also identify and control the major variables of the experiment. Students, for example, can record their breathing and heart rates before and after walking stairs. They will have to control such variables as how to collect and determine the heart and breathing rates, how long to conduct the activity, and how to conduct the activity. If available, students can use computer interface equipment to measure heart rate and breathing rate.

Students can repeat their experiment at another time or day. In this way, the data collected from both or all experiments can be compared, and any variations in this data can be discussed and explained by the students. Opportunities for cross-curricular planning and integration with physical education and/or health curricula are available here.

Students should be given an opportunity to investigate and learn about the interdependence and interactions of several body systems. Students may investigate the interactions between some of the following systems: circulation/muscular, nervous/muscular, digestive/excretory, digestive/circulatory, digestive/circulatory, and respiratory/circulatory, for example. Students should actively investigate the various pairs of systems in order to best understand and appreciate their interactions.

Students should be invited to provide examples of careers that deal directly or indirectly with the health of body systems such as lab and X-ray technicians, physiotherapists, nutritionists, doctors, and public-health nurses. People with these careers may be invited to class to share what they do and how it involves the body systems investigated in this unit of study. The expression of interest in science- and technology-related careers is an indication of a positive attitudinal outcome.

Interdependence of Body Systems

Tasks for Instruction and/or Assessment

Observation

- Create a rubric with the students that will help students plan for the assessment of an experiment involving the respiratory and the circulatory systems. (208-6, 209-1)

Performance

- Design, plan, and carry out a procedure whereby heart rate and breathing rate are compared and contrasted in a variety of levels of activity. (208-6, 209-1)

Paper and Pencil

- How do the skeletal and muscular systems work together to help us move? Research and report your findings. (304-10)
- In an essay, explain how a particular food/drink is required and utilized by systems in the body. (304-10)
- Choose two body systems to research and highlight relationships. (304-10)
- Prepare a brochure that one might find in a doctor's office that informs the reader about the relationships between the respiratory and circulatory systems. (304-10)
- Identify two or three reasons for discrepant results in the investigations of heart and breathing rates. (210-7)

Interview

- How might you rephrase the following question into a testable form: "How does exercise affect heart rate?" (208-1)

Presentation

- Create a mural of careers that deal with the health of body systems. (112-10)

Portfolio

- Interview a nurse or health-care worker about the interdependence of several body systems. (113-8)

Resources/Notes

Appendices

- The Heart of the Matter
- Body Work

Video

- Total Fitness

Interdependence of Body Systems *(continued)*

Outcomes

Students will be expected to

- make informed decisions about applications of science and technology that are associated with human body systems, taking into account personal and social advantages and disadvantages (113-8)

Elaborations—Strategies for Learning and Teaching

This outcome may be addressed by using a decision-making model in the science or health program. Developments in science and technology related to our health and the health of various body systems can be addressed by asking students to imagine life without sports and fitness equipment, for example. "Which body systems would be affected?" and "What would be the consequences?" are questions that can lead to discussions concerning developments related to health issues.

Discussion and reflection regarding what we know about various lifestyles and their effects on body systems (such as deciding to exercise or stop smoking on the basis of scientific research) provide a worthwhile opportunity for students to make informed personal decisions about their own health. Students can investigate risk-analysis models used by insurance companies and advertisements for various fitness machines. Other possibilities for research and discussion are the use of sunscreen, food additives, and steroids, as well as health-related issues that arise in newspapers and magazines.

Interdependence of Body Systems *(continued)*

Tasks for Instruction and/or Assessment

Presentation

- Prepare a report regarding the advantages and disadvantages of using food additives. (113-8)
- Prepare an advertisement for newspaper or radio regarding participation in a particular activity and its effects on a body system. (113-8)

Resources/Notes

Appendices

- You Decide