Prince Edward Island
CANADA

Department of Education
English Programs

Atlantic Canada Science Curriculum

Science 421 A

Grade 10

CURRICULUM

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Introduction

Background

The curriculum described in *Foundation for the Atlantic Canada Science Curriculum* and in *Title of Guide* 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 science framework described in the pan-Canadian *Common Framework of Science Learning Outcomes K to 12.*

Rationale

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 lifelong learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences which provide opportunity to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, their careers, and their futures.

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
- analysing 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 which reflects a constructive, active view of the learning process. Learning occurs not by passive absorption, but rather as students actively construct their own meaning and assimilate new information to develop 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 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.

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 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 the proposing, creating, and testing of prototypes, products, and techniques in an attempt to reach an optimum 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 not only important in their own right; 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 equal 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 classes. In order to adapt to the needs of all learners, teachers must create opportunities that permit students to have their learning styles addressed.

As well, teachers must not only remain aware of and avoid gender and cultural biases in their teaching, they must strive to actively address cultural and gender stereotyping with respect to student interest and success 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.

When making instructional decisions, teachers must consider individual learning needs, preferences, and strengths, and the abilities, experiences, interests, and values that learners bring to the classroom. Ideally, every student should find his/her learning opportunities maximized in the science classroom.

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 validate students when they achieve the outcomes to the maximum of their abilities.

It is important that teachers articulate high expectations for all students and ensure that all students have equal opportunities to experience success as they work toward the achievement of designated outcomes. A teacher 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 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.

Regional curriculum in science suggests experiences that support learning within STSE, skills, knowledge, and attitudes. It also reflects the three major processes of science learning: inquiry, problem solving and decision making. When assessing student progress, it is helpful for teachers to know some activities/skills/actions that are associated with each process of science learning. Examples of these are illustrated in the following lists. Student learning may be described in terms of ability to perform these tasks.

Inquiry

- define questions related to a topic
- refine descriptors/factors that focus practical and theoretical research
- select an appropriate way to find information
- make direct observations
- perform experiments, record and interpret data, and draw conclusions
- design an experiment which tests relationships and variables
- write lab reports that meet a variety of needs (limit the production of “formal” reports) and place emphasis on recorded data
- recognize that the quality of both the process and the product are important

Problem Solving

- clearly define a problem
- produce a range of potential solutions for the problem
- appreciate that several solutions should be considered
- plan and design a product or device intended to solve a problem • construct a variety of acceptable prototypes, pilot test, evaluate, and refine to meet a need
- present the refined process/product/device and support why it is “preferred”
- recognize that the quality of both the process and the product are important

Decision Making

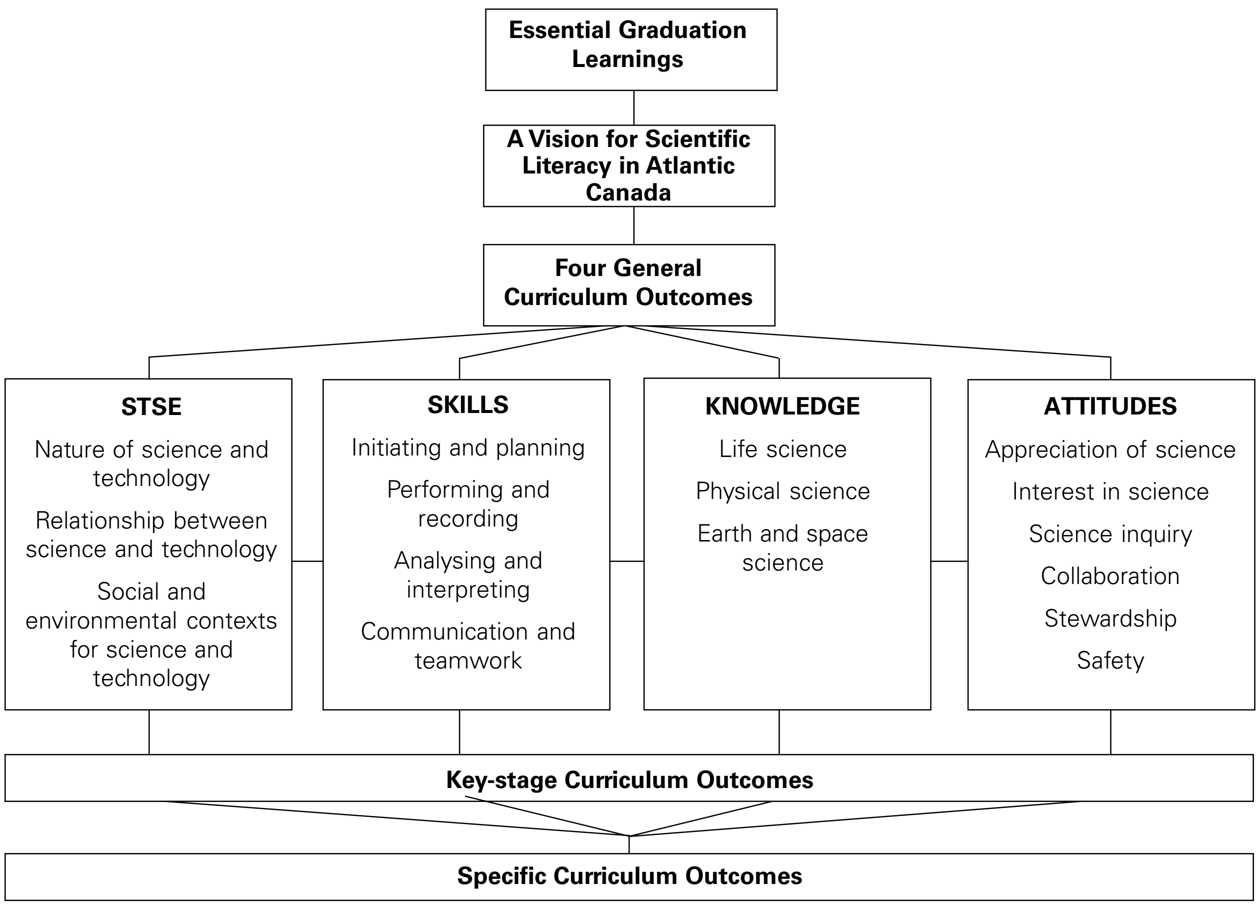
- gather information from a variety of sources
- evaluate the validity of the information source
- evaluate which information is relevant
- identify the different perspectives that influence a decision
- present information in a balanced manner
- use information to support a given perspective
- recommend a decision and provide supporting evidence
- communicate a decision and provide a “best” solution

Outcomes

Outcomes Framework

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 *Common Framework of Science Learning Outcomes K to 12*. The conceptual map shown in Figure 1 provides the blueprint of the outcomes framework.

FIGURE 1



This curriculum guide outlines grade-level-specific curriculum outcomes, and provides suggestions for learning, teaching, assessment, and resources to support students' achievement of these outcomes. Teachers should consult the *Foundation for the Atlantic Canada Science Curriculum* for descriptions of the essential graduation learnings, vision for scientific literacy, general curriculum outcomes, and key-stage curriculum outcomes. (**Or provinces may insert here**).

Curriculum Guide Organization

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

Specific curriculum outcomes are organized in four 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 four 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 which is then extended in a subsequent unit. Likewise, it is possible that one unit focusses on a skill or context which will then be built upon later in the year. In some cases the rationale is related to weather and the necessity of dealing with Life or Earth science units in the fall or spring.

It is also possible that units or certain aspects of units can 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, grow plants, and so forth. These cases may warrant starting the activity early and overlapping it with the existing unit. In all cases logical situations and contexts should be taken into consideration when decisions such as these are made. 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

All units comprise a two-page layout of four columns as illustrated in Figure 2. In some cases the four-column spread continues to the next two-page layout. Each unit comprises outcomes grouped by a topic which is indicated at the top of the left page.

Column One: Specific Curriculum Outcomes

The first column lists a group of related specific curriculum outcome statements. 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 brackets after the outcome statement. Some STSE and skills outcomes have been written in an age-appropriate 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 in order 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 Two: Suggestions for Learning and Teaching

The second column describes the learning environment and experiences that will support students' achievement of the outcomes listed in the first column. Elaborations of the outcomes may also be included in this column, as well as background information.

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

Column Three: Suggestions for Assessment

The third column provides suggestions for ways that students' achievement of the outcomes may be assessed. These suggestions reflect a variety of assessment techniques which include, but are not limited to, informal/formal observation, performance, journal, paper and pencil, interview, 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: Notes

Provincial section

FIGURE 2
Curriculum Outcomes Organization:
The Four-Column, Two-Page Spread

Topic			
Outcomes • Outcome based on pan-Canadian outcomes (###,###) • Outcome based on pan-Canadian outcomes (###)	**Suggestions for Learning and Teaching** Suggested activities and elaborations of outcome Suggested activities and elaborations of outcome	**Suggestions for Assessment** **Informal/Formal Observation** **Performance** • sample assessment item (###) **Journal** **Paper and Pencil** **Interview** • sample assessment item (###) **Presentation** **Portfolio**	**Notes** Authorized and recommended resources that address outcomes

Unit Overview

At the beginning of each unit, there is a two-page synopsis. On the first page, introductory paragraphs give 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 that will be addressed at later 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 will be addressed in the unit. The numbering system used is the one followed in the pan-Canadian document:

100s - Science-Technology-Society-Environment (STSE) outcomes

200s - Skills outcomes

300s - Knowledge outcomes

400s- Attitude outcomes (see pages 10-18)

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

FIGURE 3
Unit Overview

Unit Title: Unit Overview		**Unit Title: Curriculum Outcomes**		
Introduction	Synopsis of the unit	**STSE**	**Skills**	**Knowledge**
Focus and Contexts	Focus: inquiry, decision making, or problem solving. Possible contexts suggested	###Science-Technology-Society-Environment outcomes from *Common Framework of Science Learning Outcomes K to 12*	###Skills outcomes from *Common Framework of Science Learning Outcomes K to 12*	###Knowledge outcomes from *Common Framework of Science Learning Outcomes K to 12*
Curriculum Links	Links to concepts studied within the K to 12 science curriculum			

Attitude Outcomes

It is expected that certain attitudes will be fostered and developed throughout the entire science program, entry to grade 12. The STSE, skills, and knowledge outcomes contribute to the development of attitudes, and opportunities for fostering these attitudes are highlighted in the *Suggestions for Learning and Teaching* secion of each unit.

Attitudes refer to generalized aspects of behaviour that are modelled for students by example and reinforced 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 they learn.

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

The following pages present the attitude outcomes from the pan-Canadian *Common Framework of Science Learning Outcomes K to 12.*

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

From entry through grade 3 it is expected that students will be encouraged to . . .

Appreciation of science

400 recognize the role and contribution of science in their understanding of the world

Evident when students, for example,

- give examples of science in their own lives
- give examples of how objects studied and investigations done in class relate to the outside world
- recognize that scientific ideas help us to explain how or why events occur

Interest in science

401 show interest in and curiosity about objects and events within the immediate environment

402 willingly observe, question, and explore

Evident when students, for example,

- ask “why” and “how” questions about observable events
- ask many questions related to what is being studied
- participate in show-and-tell activities, bringing objects from home or sharing a story or an observation
- ask questions about what scientists do
- express enjoyment from being read to from science books
- seek out additional information from library books and digital discs
- express enjoyment in sharing science-related information gathered from a variety of sources, including discussions with family members and friends
- ask to use additional science equipment to observe objects in more detail
- express the desire to find answers by exploring and conducting simple experiments

Scientific inquiry

403 consider their observations and their own ideas when drawing a conclusion

404 appreciate the importance of accuracy

405 be open-minded in their explorations

Evident when students, for example,

- raise questions about the world around them
- willingly record observations in a given format
- compare results of an experiment with other classmates
- use observations to draw a conclusion or verify a prediction
- take the time to measure with care
- willingly explore a change and its effects
- choose to follow directions when they complete a simple investigation
- express the desire to find answers by conducting simple experiments

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

From entry through grade 3 it is expected that students will be encouraged to . .

Collaboration

406 work with others in exploring and investigating

Evident when students, for example,

- willingly share ideas and materials
- respond positively to others' questions and ideas
- take on and fulfil a variety of roles within the group
- participate in science-related activities with others, regardless of their age or their physical or cultural characteristics
- respond positively to other people's views of the world

Stewardship

407 be sensitive to the needs of other people, other living things, and the local environment

Evident when students, for example,

- ensure that living things are returned to an adequate environment after a study is completed
- demonstrate awareness of the need for recycling and willingness to take action in this regard
- show concern for other students' feelings or needs
- care for living things that are kept in their classroom
- clean reusable materials and store them in a safe place
- willingly suggest how we can protect the environment

Safety

408 show concern for their safety and that of others in carrying out activities and using materials

Evident when students, for example,

- are attentive to the safe use of materials
- insist that classmates use materials safely
- act with caution in touching or smelling unfamiliar materials, refrain from tasting them, and encourage others to be cautious
- point out to others simple and familiar safety symbols
- put materials back where they belong
- follow given directions for set-up, use, and clean-up of materials
- wash hands before and after using materials, as directed by teacher
- seek assistance immediately for any first aid concerns such as cuts, burns, and unusual reactions
- keep the work station uncluttered, with only appropriate materials present

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

From grades 4 to 6 it is expected that students will be encouraged to . . .

Appreciation of science

409 appreciate the role and contribution of science and technology in their understanding of the world

410 realize that the applications of science and technology can have both intended and unintended effects

411 recognize that women and men of any cultural background can contribute equally to science

Evident when students, for example,

- recognize that scientific ideas help explain how and why things happen
- recognize that science cannot answer all questions
- use science inquiry and problem-solving strategies when given a question to answer or a problem to solve
- plan their actions to take into account or limit possible negative and unintended effects
- are sensitive to the impact their behaviour has on others and the environment when taking part in activities
- show respect for people working in science, regardless of their gender, their physical and cultural characteristics, or their views of the world
- encourage their peers to pursue science-related activities and interests

Interest in science

412 show interest and curiosity about objects and events within different environments

413 willingly observe, question, explore, and investigate

414 show interest in the activities of individuals working in scientific and technological fields

Evident when students, for example,

- attempt to answer their own questions through trial and careful observation
- express enjoyment in sharing and discussing with classmates science-related information
- ask questions about what scientists in specific fields do
- express enjoyment in reading science books and magazines
- willingly express their personal way of viewing the world
- demonstrate confidence in their ability to do science
- pursue a science-related hobby
- involve themselves as amateur scientists in exploration and scientific inquiry, arriving at their own conclusions rather than those of others

Scientific inquiry

415 consider their own observations and ideas as well as those of others during investigations and before drawing conclusions

416 appreciate the importance of accuracy and honesty

417 demonstrate perseverance and a desire to understand

Evident when students, for example,

- ask questions to clarify their understanding
- respond constructively to the questions posed by other students
- listen attentively to the ideas of other students and consider trying out suggestions other than their own
- listen to, recognize, and consider differing opinions
- open-mindedly consider non-traditional approaches to science
- seek additional information before making a decision
- base conclusions on evidence rather than preconceived ideas or hunches
- report and record what is observed, not what they think ought to be or what they believe the teacher expects
- willingly consider changing actions and opinions when presented with new information or evidence
- record accurately what they have seen or measured when collecting evidence
- take the time to repeat a measurement or observation for confirmation or greater precision
- ask questions about what would happen in an experiment if one variable were changed
- complete tasks undertaken or all steps of an investigation

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

From grades 4 to 6 it is expected that students will be encouraged to . . .

Collaboration

418 work collaboratively while exploring and investigating

Evident when students, for example,

- participate in and complete group activities or projects
- willingly participate in co-operative problem solving
- stay with members of the group during the entire work period
- willingly contribute to the group activity or project
- willingly work with others, regardless of their age, their gender or their physical or cultural characteristics
- willingly consider other people's views of the world

Stewardship

419 be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment

Evident when students, for example,

- choose to have a positive effect on other people and the world around them
- frequently and thoughtfully review the effects and consequences of their actions
- demonstrate willingness to change behaviour to protect the environment
- respect alternative views of the world
- consider cause and effect relationships that exist in environmental issues
- recognize that responding to their wants and needs may negatively affect the environment
- choose to contribute to the sustainability of their community through individual positive actions
- look beyond the immediate effects of an activity and identify its effects on others and the environment

Safety

420 show concern for their safety and that of others in planning and carrying out activities and in choosing and using materials

421 become aware of potential dangers

Evident when students, for example,

- look for labels on materials and seek help in interpreting them
- ensure that all steps of a procedure or all instructions given are followed
- repeatedly use safe techniques when transporting materials
- seek counsel of the teacher before disposing of any materials
- willingly wear proper safety attire, when necessary
- recognize their responsibility for problems caused by inadequate attention to safety procedures
- stay within their own work area during an activity, to minimize distractions and accidents
- immediately advise the teacher of spills, breaks, or unusual occurrences
- share in cleaning duties after an activity
- seek assistance immediately for any first aid concerns such as cuts, burns, and unusual reactions
- keep the work station uncluttered, with only appropriate materials present

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

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

Appreciation of science

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

Interest in science

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

Scientific inquiry

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 biassed or inaccurate interpretations
- report the limitations of their designs
- respond sceptically 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

From grades 7 to 9 it is expected that students will be encouraged to . . .

Collaboration

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

Stewardship

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

Safety in science

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 such as burns, cuts, or unusual reactions
- keep the work area uncluttered, with only appropriate materials present

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

From grades 10 to 12 it is expected that students will be encouraged to . . .

Appreciation of science

436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not

437 appreciate that the applications of science and technology can raise ethical dilemmas

438 value the contributions to scientific and technological development made by women and men from many societies and cultural backgrounds

Evident when students, for example,

- consider the social and cultural contexts in which a theory developed
- use a multi-perspective approach, considering scientific, technological, economic, cultural, political, and environmental factors when formulating conclusions, solving problems, or making decisions on an STSE issue
- recognize the usefulness of being skilled in mathematics and problem solving
- recognize how scientific problem solving and the development of new technologies are related
- recognize the contribution of science and technology to the progress of civilizations
- carefully research and openly discuss ethical dilemmas associated with the applications of science and technology
- show support for the development of information technologies and science as they relate to human needs
- recognize that western approaches to science are not the only ways of viewing the universe
- consider the research of both men and women

Interest in science

439 show a continuing and more informed curiosity and interest in science and science-related issues

440 acquire, with interest and confidence, additional science knowledge and skills, using a variety of resources and methods, including formal research

441 consider further studies and careers in science- and technology-related fields

Evident when students, for example,

- conduct research to answer their own questions
- recognize that part-time jobs require science- and technology-related knowledge and skills
- maintain interest in or pursue further studies in science
- recognize the importance of making connections between various science disciplines
- explore and use a variety of methods and resources to increase their own knowledge and skills
- are interested in science and technology topics not directly related to their formal studies
- explore where further science- and technology-related studies can be pursued
- are critical and constructive when considering new theories and techniques
- use scientific vocabulary and principles in everyday discussions
- readily investigate STSE issues

Scientific inquiry

442 confidently evaluate evidence and consider alternative perspectives, ideas, and explanations

443 use factual information and rational explanations when analysing and evaluating

444 value the processes for drawing conclusions

Evident when students, for example,

- insist on evidence before accepting a new idea or explanation
- ask questions and conduct research to confirm and extend their understanding
- criticize arguments based on the faulty, incomplete, or misleading use of numbers
- recognize the importance of reviewing the basic assumptions from which a line of inquiry has arisen
- expend the effort and time needed to make valid inferences
- critically evaluate inferences and conclusions, cognizant of the many variables involved in experimentation
- critically assess their opinion of the value of science and its applications
- criticize arguments in which evidence, explanations, or positions do not reflect the diversity of perspectives that exist
- insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position taken can be judged
- seek new models, explanations, and theories when confronted with discrepant events or evidence

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

For grades 10 to 12 it is expected that students will be encouraged to . . .

Collaboration

445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas

Evident when students, for example,

- willingly work with any classmate or group of individuals, regardless of their age, gender, or physical and cultural characteristics
- assume a variety of roles within a group, as required
- accept responsibility for any task that helps the group complete an activity
- give the same attention and energy to the group's product as they would to a personal assignment
- are attentive when others speak
- are capable of suspending personal views when evaluating suggestions made by a group
- seek the points of view of others and consider diverse perspectives
- accept constructive criticism when sharing their ideas or points of view
- criticize the ideas of their peers without criticizing the persons
- evaluate the ideas of others objectively
- encourage the use of procedures that enable everyone, regardless of gender or cultural background, to participate in decision making
- contribute to peaceful conflict resolution
- encourage the use of a variety of communication strategies during group work
- share the responsibility for errors made or difficulties encountered by the group

Stewardship

446 have a sense of personal and shared responsibility for maintaining a sustainable environment

447 project the personal, social, and environmental consequences of proposed action

448 want to take action for maintaining a sustainable environment

Evident when students, for example,

- willingly evaluate the impact of their own choices or the choices scientists make when they carry out an investigation
- assume part of the collective responsibility for the impact of humans on the environment
- participate in civic activities related to the preservation and judicious use of the environment and its resources
- encourage their peers or members of their community to participate in a project related to sustainability
- consider all perspectives when addressing issues, weighing scientific, technological, and ecological factors
- participate in social and political systems that influence environmental policy in their community
- examine/recognize both the positive and negative effects on human beings and society of environmental changes caused by nature and by humans
- willingly promote actions that are not injurious to the environment
- make personal decisions based on a feeling of responsibility toward less privileged parts of the global community and toward future generations
- are critical-minded regarding the short- and long-term consequences of sustainability

Safety

449 show concern for safety and accept the need for rules and regulations

450 be aware of the direct and indirect consequences of their actions

Evident when students, for example,

- read the label on materials before using them, interpret the WHMIS symbols, and consult a reference document if safety symbols are not understood
- criticize a procedure, a design, or materials that are not safe or that could have a negative impact on the environment
- consider safety a positive limiting factor in scientific and technological endeavours
- carefully manipulate materials, cognizant of the risks and potential consequences of their actions
- write into a laboratory procedure safety and waste-disposal concerns
- evaluate the long-term impact of safety and waste disposal on the environment and the quality of life of living organisms
- use safety and waste disposal as criteria for evaluating an experiment
- assume responsibility for the safety of all those who share a common working environment by cleaning up after an activity and disposing of materials in a safe place
- seek assistance immediately for any first aid concerns like cuts, burns, or unusual reactions
- keep the work station uncluttered, with only appropriate lab materials present

Specific Curriculum Outcomes

Grade 10 Science: Introduction

As with science curriculum at other grades, this consists of four units: one Life science, one Earth and Space science, and two Physical science units. The Common Framework of Science Learning Outcomes considered this to be the final science course that all students would be expected to follow. It is intended to help students prepare for selecting optional science courses at high school.

It is suggested that each unit be allocated approximately one quarter of the time available for the course.

Life Science: Sustainability of Ecosystems

This unit extends the concepts gained by analysing habitats and ecosystems to the issue of sustainability. The learners are challenged to think about large-scale systems and the flow of matter and energy within those systems. It is intended that students recognize the earth as essentially a closed system, which means sustainable use of resources becomes a major concern.

Earth and Space Science:

This unit is designed to guide the learner to understand major concepts associated with atmospheric conditions that produce our weather. Students may construct weather data collection instruments and collect, analyse, and interpret their data, as well as those from a variety of other sources. The influence of matter and energy exchanges on weather system development is central to the unit. Students are also encouraged to attempt weather forecasting and consider how weather affects our society.

Physical Science: Chemical Reactions

This unit builds on the previous study of atomic structure and the significance of the periodic table by asking students to observe some chemical reactions. How these reactions are initiated and proceed, and what products result are considered. In preparation for later chemistry courses, these investigations require students to name and write formulas and to begin representing chemical reactions in symbolic form.

Physical Science: Motion

This unit offers the first opportunity for students to observe, measure, and describe motion in a mathematical fashion. Analysis is restricted to one dimension only with uniform (constant) motion and uniformly accelerated motion. As the unit develops, direction becomes important with vector notation being introduced. The learning outcomes encourage a study of motion in contexts which are familiar to students in this age group.

Unit 1

Life Science:

Sustainability of Ecosystems

24 hours (19 classes)

Unit Overview

Introduction

The focus on protecting the environment has grown substantially since the 1950s. Many would argue that not only is the focus too late, but it is not nearly enough to reverse the damage caused by the spend now/pay later attitude which has been so prevalent in our society. Owing to a change in environmental attitudes, today's students are much more aware of the fragile nature of the environment. Despite technological advances, which allow more efficient use of natural resources/systems, the drive to be economically competitive puts stress on the delicate environmental balance.

Much of the economy in Atlantic Canada is based on harvesting within fragile ecosystems. Examining how external factors affect the dynamic equilibrium which exists in an ecosystem provides valuable information. This process will be extended to encompass both equilibrium and sustainability of the environment within a province, region, country, and global biosphere. This unit allows students to understand the interrelationship of local ecosystems, our increasing awareness of ecosystems on a global scale, and the need to sustain the health of ecosystems at all levels.

Focus and Content

Many outcomes can be accomplished by using a **decision-making** focus, thereby moving students to think globally at a more sophisticated level, and to explore the concept of sustainability for the first time. Activities in the unit also provide an opportunity to focus on **observation/inquiry**. The local environment and economy may be conducive to an extensive ecosystem study. Time allocated for this unit will greatly affect the depth and scope of investigation. A spring or autumn time frame might be best for field work.

Curriculum Links

Sustainability of ecosystems connects with other clusters in the science curriculum to varying degrees. Through elementary grades students learn about the "Needs and Characteristics of Living Things" and "Air and Water in the Environment," "Exploring Soils" and "Habitats and Communities." "Diversity of Life" in grade 6 is directly linked to this unit as it considers how the characteristics of living things permit systems of classification and how varying conditions relate to adaptations. More directly linked is the grade 7 "Interactions within Ecosystems" unit. This unit concentrates on the flow of energy and matter through food webs in observable ecosystems. In grades 11/12 the optional courses provide Life Science opportunities in the units "Evolution," "Change and Diversity," and "Interactions Among Living Things." *Consider developing the connection between this unit and "Chemical Reactions"* and *"Weather Dynamics,"* also in grade 10.

Curriculum Outcomes

Students will be expected to

STSE

Nature of Science and Technology.
114-1 explain how a paradigm shift can change scientific world views

114-5 describe the importance of peer review in the development of scientific knowledge

Relationships between Science and Technology.
116-1 identify examples where scientific understanding was enhanced or revised as a result of human invention of a technology

Social and Environmental Contexts of Science and Technology.
117-3 describe how Canadian research projects in science and technology are funded

118-1(2) compare and analyse the risks and benefits to society and the environment of applying scientific knowledge or introducing a new technology

118-5 defend a decision or judgment and demonstrate that relevant arguments can arise from different perspectives

118-9 propose a course of action on social issues related to science and technology, taking into account human and environmental needs

SKILLS

Initiating and Planning
212-4 state a prediction and a hypothesis based on available evidence and background information

Performing and Recording
213-7 select and integrate information from various print and electronic sources or from several parts of the same source

213-8 select and use apparatus and material safely

Analysing and Interpretation
214-1 describe and apply classification systems and nomenclature used in the sciences

214-3 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots

Communication and Teamwork
215-1 communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others

215-4 identify multiple perspectives that influence a science-related decision or issue

215-5 develop, present and defend a position or course of action, based on findings

KNOWLEDGE

318-1 illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen

331-7 describe how soil composition and fertility can be altered and how these changes could affect an ecosystem

318-2 describe the mechanisms of bioaccumulation, and explain its potential impact on the viability and diversity of consumers at all trophic levels

318-5 explain various ways in which natural populations are kept in equilibrium, and relate this equilibrium to the resource limits of an ecosystem

331-6 analyse the impact of external factors on an ecosystem

318-3 explain why ecosystems with similar characteristics can exist in different geographical locations

318-4 explain why different ecosystems respond differently to short-term stresses and long-term changes

318-6 explain how biodiversity of an ecosystem contributes to its sustainability

Life Science: Sustainability of Ecosystems

How does sustainability fit into your paradigm and society's paradigm?

Outcomes

Students will be expected to

- identify examples where scientific understanding about an ecosystem was enhanced or revised as a result of human invention or related technologies (116-1)
- analyse the impact of external factors on an ecosystem (331-6,
- explain how biodiversity of an ecosystem contributes to its sustainability (318-6)

Elaboration – Strategies for Learning and Teaching

Note to Teachers: The pathway described will meet all required outcomes and allow for the unit to be covered in 25 hours. Care must be taken in not adding topics which, however interesting, may prevent the completion of the other units.

Nelson 1.1, 1.2, 1.3 *(2.5 hours or 2 classes)*

Ecosystems can be adversely affected by human intervention. Students should look at factors that contribute to the decline in frog populations across Canada. Which of these factors are due to human intervention and man-made technologies? In the Teachers Resource, page 12, there is a suggestion for an activitiy that works well using post-it notes of four different colours.

Students should familiarize themselves with the classification system for at-risk species. A discussion could ensue on the factors that cause various species to fit into this classification system. Are any of these factors external in nature? Are any of these factors due to human intervention?

Students should understand the importance of maintaining an ecosystem's biodiversity in order for that ecosystem to be sustainable. Discussion should also centre on how balance and biodiversity can be restored in ecosystems and that damage done to ecosystems is not necessarily irreversible.

Life Science: Sustainability of Ecosystems
How does sustainability fit into your paradigm and society's paradigm?

Tasks for Instruction and/or Assessment

Note to Teachers:
Portfolios can be used as a means of assessing the entire unit. Many of the assessment suggestions can be used as part of an overall portfolio assessment. There are many ways in which portfolios can be assembled as an assessment tool; thus, the specific content can be determined by the teacher. Suggestions for content are experimental results, posters, illustrations, creative writing, videos, group projects,and reports.

Discussion
In a group identify things that you could do to help frog populations recover.

Research
Research a species in Canada or on PEI that is on the endangered list of the classification system for at-risk species? Choose one species and determine what initiatives are underway to improve the status of that species. What could you do to help? (Ex. piping plover, eskimo curlew, leatherback turtle). (Visit www.science.nelson.com). (Note to teachers: Students can possibly use Applied BLM 2 as a template).

Paper and Pencil
Define the term "biodiversity". Explain why biodiversity is important to the sustainability of an ecosystem. Give one example of an ecosystem with high biodiversity and one example of an ecosystem with low biodiversity.

Resources

<u>*Nelson 10*</u>
Transparencies are available for each unit which may be helpful.

Sec 1.1 # 1-3,4a,c,5,7
Additional BLM 1

Sec 1.2 # 1,2,4a
(optional - 3a do as a paper)
BLM 1.2
p.85 #16 is a good activity for students to do in their notebooks.
Additional BLM 2

Sec 1.3 # 1-3,4a
(optional - 5 do as a paper)

Life Science: Sustainability of Ecosystems

What are the factors affecting the sustainability of an ecosystem?

Outcomes

Students will be expected to

- state a prediction and a hypothesis based on available evidence and background information (212-4)
- select and use apparatus and material safely (213-8)
- compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots (214-3)

Elaboration – Strategies for Learning and Teaching

Ideally, an in-depth study of a local ecosystem may be undertaken to collect data.

Nelson 1.5, 1.8 *(1.25 hours or 1 class)*

Students should investigate the term “ecology” and examine biotic factors (disease, reproductive rates, predator/prey, competition, symbiosis) and abiotic factors (space, temperature, oxygen, light, water) and the role that they play in affecting populations of ecosystems. Students should research the term “ecotone” and how ecotones add to the biodiversity of ecosystems thus guarding against extinction.
How do artificial and natural ecosystems differ? Students should appreciate the differences in the biotic and abiotic factors in both of these types of ecosystems.

Nelson 1.6 or 1.9 *(2.5 hours or 2 classes)*
Student groups should do *Investigation 1.6 or 1.9* according to which is locally available. Time should be alloted in class for a prelab where clear directions are given to the tasks required of the student groups and the time permitted for the out-of-class and in-class components of the investigation.

Note to Teachers: Parks Canada will provide free interpreters on diversity, forestry, etc.

Life Science: Sustainability of Ecosystems

What are the factors affecting the sustainability of an ecosystem?

Tasks for Instruction and/or Assessment

Pencil and Paper

What role do ecotones play in guarding against extinction?

Journal

Speculate on reasons as to why the abiotic factors in the artificial ecosystem (Table 1 p.29) are higher than in the natural ecosystem and that the reverse is true for the biotic factors.

Activity

Depending on the area surrounding your school, Sec1.6 or Sec 1.9 may not be easily completed by students. Alternate activities could involve a trip to a pond ecosystem where samples could be collected and biodiversity investigated using a microscope. Lab diagrams of findings should be drawn. A visit to one of the following ecosystems may be an option where diversity versus monoculture (see table 1 p.29) is examined.

- pond ecosystem
- seashore ecosystem
- meadow vs potato field or soccer field or grain field
- salt water marsh

Resources

Nelson 10

Sec 1.5 # 1-5
BLM 1.5 do as an activity in notebooks.
Additional BLM 5

Sec 1.8 #a-j, 1-4
#5 class discussion
BLM 1.8
Additional BLM 9

Sec 1.6 Procedure # 1-4, 7-10
Understanding Concepts # 1-5

Sec 1.9 Procedure #1-8
Understanding Concepts # 1-3

Life Science: Sustainability of Ecosystems
Sustainability Issues in an Ecosystem

Outcomes

Students will be expected to

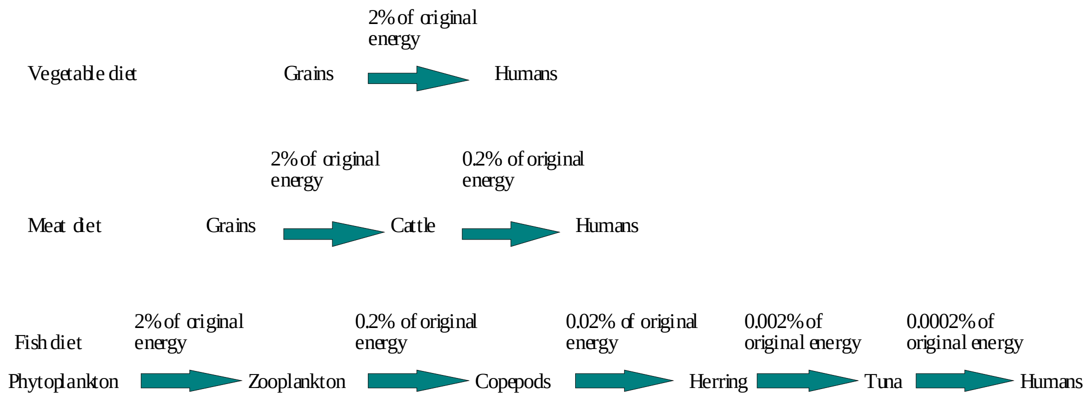
- describe and apply classification systems and nomenclature used in the sciences (214-1)
- analyse and interpret information in a variety of formats (214-3A)

Elaboration – Strategies for Learning and Teaching

Nelson 1.11*(2.5 hours or 2 classes)*

Note to Teachers: Do a brief introduction using section 1:10, discussing terms and showing disgrams.

Students should examine the classification of organisms into trophic levels. Food chains and food webs in ecosystems should be introduced. As well students should examine the relationship between length of food chains and energy transfer capability. Energy flow in food chains can be illustrated as shown below



or using graphs called pyramids (see Nelson 10 p.37). Students will be expected to analyse and interpret the information displayed in the pyramid graphs for energy, numbers, and biomass.

Note to Teachers: This may be an appropriate time to have a quiz (1 class).

Life Science: Sustainability of Ecosystems
Sustainability Issues in an Ecosystem

Tasks for Instruction and/or Assessment

Poster

Use a concept map in poster or power point format to illustrate a food web containing three or more trophic levels. Explain the energy transfer from one trophic level to the next. By what factor does the energy transfer capability seem to be decreasing. (See Skills Handbook, p.706-707).

Resources

Nelson 10
Sec 1.11 # 1-15
BLM 1.11a & b

See Project Wild Resource

See Beyond Monet: Teaching Strategies

Life Science: Sustainability of Ecosystems
Extension to the biosphere.

Outcomes

- illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen (318-1)
- propose a course of action on social issues related to science and technology taking into account human and environmental needs (118-9)
- describe the role peer review has in the development of scientific knowledge (114-5)
- compare the risks and benefits to the biosphere of applying new scientific knowledge and technology to industrial processes (118-1)
- describe the mechanisms of bioaccumulation and bioamplification, and explain its potential impact on the viability and diversity of consumers at all trophic levels (318-2)

Elaboration – Strategies for Learning and Teaching

Nelson 2.1, 2.5, and 2.6 *(3.75 hours or 3 classes)*
Note to Teachers: The carbon, nitrogen, and oxygen cycles will be covered in detail in Biology. Take care to not do these in too great detail. The issues of human impact on these systems could be focus of these sections, rather than an in-depth study of the workings of each cycle.

Students should examine the cycling of carbon, nitrogen, and oxygen in ecosystems. The complementary processes of photosynthesis and cellular respiration in the carbon cycle should be examined.
A brief examination of the complementary processes of nitrification and denitrification in the nitrogen cycle is required.
The issue of human impact on the carbon cycle should be discussed. Student discussion could include ideas on how, as individuals, people can each make a small contribution to reducing their impact on the carbon cycle.

Nelson 2.2 *(2.5 hours or 2 classes)*
Student groups should research what peer review is and how it works. A class discussion could ensue about the credibility of research that is not peer reviewed. Students should become proficient in determining the credibility of articles published in magazines, journals, and on the internet. Students should research this topic on the internet or talk with a university professor currently involved with a research project. If possible, invite one of the mentors from the STAS site to discuss peer review with the class. Students should also appreciate that a great deal of scientific knowledge was and is still being developed through pure scientific research. Many times practical applications for new scientific knowledge is conceived at a later time by completely different individuals. Many examples can be found of new products being developed with the benefits immediately apparent but with adverse side effects only coming to light years later. A case in point is pesticides. Students may be able to talk with experts in the field to determine the process involved in developing, testing, and marketing a new pesticide.
Students should investigate the mechanisms of bioaccumulation and bioamplification.

Life Science: Sustainability of Ecosystems
Extension to the biosphere.

Tasks for Instruction and/or Assessment

Jigsaw Group Project (Groups of four)
Students in each group will choose a topic to work on: the carbon cycle, the nitrogen cycle, or the phosphorous cycle (about 5 minutes). Groups will reform into groups examining a common topic and 20 minutes will be given for research, making notes, preparing a poster, etc on their topic. After 20 minutes, the original groups will re-form where each member is responsible to teach their researched topic.

Journal
Write a paragraph detailing the impact humans have on disrupting the balance of the carbon cycle.

Interview
Interview people in the community with varying views on the new PEI crop rotation legislation and report your findings to the class.

Project/Poster (1.25 hours or 1 class)
Student groups could research a project and present the results in the form of a poster or a power point presentation. Project ideas could be drawn from:
a) Sec 1.4 - What is the value of wolves?
b) Sec3.9 - How many potatoes are enough?
c) Sec 3.10 - Logging Forests
d) Sec 4.8 - Crude oil in marine ecosystems
e) Sec 4.9/4.10 - Managing fish populations: can we create a sustainable fishery?

Note to Teachers: This project could be due at the end of the unit and might possibly form the basis for a significant portion of the evaluation of the second half of this unit.

Research
Determine the areas of research that will be conducted at the new National Research Council Laboratory that will be built at UPEI. (117-3)

Interview
Interview a local scientist discussing the importance of peer review in their studies of environmental issues. (114-5)

Resources

<u>*Nelson 10*</u>

Sec 2.1 # 1,2,4-6
BLM 2.1(review purposes)
Additional BLM 16

Sec 2.5 # 1-6,7a,b,
8 (discussion)
Additional BLM 15

Sec 2.6 # 1-14, omit 5,12

Sec 2.2 # 1-9

BLM 2.2

Life Science: Sustainability of Ecosystems
Extension to the biosphere (cont'd)

Outcomes

Students will be expected to

- explain how a paradigm can change scientific world views in understanding sustainability (114-1)
- select and integrate information from various print and electronic sources (213-7)
- communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others (215-1)
- explain variuos ways in which natural populations are kept in equilibrium, and relate this equilibrium to the resource limits of an ecosystem (318-5)

Elaboration – Strategies for Learning and Teaching

Nelson 2.11 *(1.25 hours or 1 class)*
Student groups should engage in a debate on the paradigm shift in thinking on pesticide useage. The debate teams should collect information from various sources to support their position and determine how best to communicate their argument during the debate.

Nelson 2.9 and 2.10 *(1.25 hours or 1 class)*
Section 2.9 should be covered quickly only dealing with the terms: natality, mortality, immigration, emigration, dynamic equilibrium, and open and closed populations.

In section 2.10 factors that determine the biotic potential of a species should be examined. Students should appreciate the biotic and abiotic factors that limit the biotic potential of a species. The carrying capacity of a species has been attained when the population of that species is in dynamic equilibrium. Several of these factors can be considered as density-independent factors while still others may be classed as density-dependent factors.

Life Science: Sustainability of Ecosystems
Extension to the biosphere (cont'd)

Tasks for Instruction and/or Assessment

Presentation
Engage in a debate on the pros and cons of pesticide useage.

Investigation
Research the pesticides used in organic farming as opposed to those used in traditional farming.

Discussion
What pesticides are used on lawns or gardens in suburbia? Research the effects these pesticides may have on the environment.

Research

Conduct a seach in order to complete the following table.

Biotic potential	Fox	Rabbit
Birth potential		
Capacity for survival		
Procreation		
Length of reproductive life		

Compare the biotic potential of foxes and rabbits. Are these populations interconnected?

Resources

Sec 2.11 debate p.82

Sec 2.9 #3,4
BLM 2.9c as an overhead

Sec 2.10 # 1 or 3 or 4

Life Science: Sustainability of Ecosystems

Outcomes

- explain why ecosystems with similar characteristics can exist in different geographical locations (318-3)
- describe how soil composition and fertility can be altered and how these changes can affect an ecosystem (331-7)
- explain why different ecosystems respond differently to short-term stresses and long-term changes (318-4)

Elaboration – Strategies for Learning and Teaching

Nelson 3.1, 3.3, and 3.7 (*2.5 hours or 2 classes)*

Students should examine Fig. 1 on p.88 and notice the four biomes in Canada. They should discuss how similar ecosystems can exist in such varied locations.

Terms such as litter, topsoil, subsoil, and bedrock should become familar to students. Issues such as leaching and acid deposition should be studied. Methods of combating acid deposition and leaching should be discussed.

Students should read and discuss factors that cause short-term stress and long-term change in ecosystems. Many of the farming practices that we see around us and take for granted have had affects on the ecosystems around us. Humans, by their very nature, affect ecosystems. The ability to think and the mind-set of expanding our economy makes it inevitable that human activity will change natural ecosystems. The trick is to have a reasonable balance between growth and the status quo. Students should come to appreciate the unique place that humans occupy in the world around them and the amount of control that humans have over all ecosystems on Earth.

Life Science: Sustainability of Ecosystems

Tasks for Instruction and/or Assessment

Biome Game (For review purposes)
Prepare enough game boards for groups of four. Divide poster board into four equal quadrants each labelled with one of the four Canadian biomes (Tundra, Boreal Forest, Deciduous Forest, and Grassland). Write each of the abiotic factors and communities on a post-it note and place the notes in the correct quadrant. Groups should be prepared to defend their position.

Abiotic Factors

precipitation from 25-75 cm/yr
low precipitation
fertile soil
cool but no permafrost
changeable weather
longer growing season than some forests (on 2 notes)
permafrost layer below soil
higher temperatures than some forests (on 2 notes)
poor soil quality
rich, fertile soil
precipitation up to 100 cm/yr
acidic soil with some water
precipitation over 40 cm/yr
coldest temperatures
shortest growing season

Biotic Factors

mosses and lichens
wolves (write on 2 notes)
voles, mice
snowshoe hares
deer (on 2 notes)
artic foxes
tree squirrels
shrews, mice
snakes
weasels
seed-eating birds
wolverines
tree and ground squirrels
bison
grey wolves
lemmings
caribou
coniferous trees
hawks
woodpeckers
grasshoppers
black bears
deciduous trees
pine martins
rapid-flowering plants
fescue grasses
many insects
ptarmigan
many shrubs, ferns

Resources

Sec 3.1 # 1-3,5,8-10

BLM 3.1 (note: communities should be labelled biotic factors).

Sec 3.3 # 1-3,5,7,8

BLM 3.3

Sec 3.7 # 1-4

BLM 3.7

Unit 1	Time Required 24 hours (19 classes)	Resources
1.1, 1.2, & 1.3	2.5 hours (2 classes)	Sec 1.1 #1-3,4a,c,5,7 ABLM 1 Sec 1.2 #1,2,4a BLM 1.2 Sec 1.3 #1-3,4a ABLM 2
1.5, 1.8	1.25 hours (1 class)	Sec 1.5 #1-5 BLM 1.5 (do as an activity in notebooks ABLM 5 Sec 1.8 #a-j,1-4, (#5 discussion) BLM 1.8 ABLM 9
1.6 or 1.9	2.5 hours (2 classes)	BLM 1.9 ABLM 10 Sec 1.6 Procedure #1-4,7-10 Understanding Concepts #1-5 Sec 1.9 Procedure #1-8 Understanding Concepts #1-3
1.11	2.5 hours (2 classes)	Sec 1.11 #1-15 BLM 1.11a & b Project Wild Resource Beyond Monet: Teaching Strategies
Class Quiz	1.25 hours (1 class)	
2.1, 2.5 & 2.6	3.75 hours (3 classes)	Sec 2.1 #1,2,4-6 BLM 2.1 (review purposes) ABLM 16 Sec 2.5 #1-6,7a,b, (#8 discussion), ABLM 15 Sec 2.6 #1-4,6-11,13,14
2.2	2.5 hours (2 classes)	Sec 2.2 #1-9 BLM 2.2
2.11	1.25 hours (1 class)	Sec 2.11 p.82 debate BLM 2.11 a,b
2.9, 2.10	1.25 hours (1 class)	Sec 2.9 #3,4 Sec 2.10 #1,3,or 4 BLM 2.9c (use as overhead)
3.1, 3.3, & 3.7	2.5 hours (2 classes)	Sec 3.1 #1-3,5,8-10 BLM 3.1 Sec 3.3 #1-3,5,7,8 BLM 3.3 Sec 3.7 #1-4 BLM 3.7
Class Quiz	1.25 hours (1class)	

Unit 2

Physical Science:

Motion

19 hours(15 classes)

Unit Overview

Introduction

The concept of motion allows students to investigate and develop their interest in the sports that are part of their daily lives. Students will not only have opportunities to investigate the principles of kinematics but will also be encouraged to apply its development into areas of individual interest. Whether they choose Olympic sports events or personal leisure activities such as snowmobiling or biking, students will develop their understanding of the concepts of displacement, velocity, and acceleration.

Focus and Context

The unit on motion should have two principle focuses- **inquiry** and **problem solving**. Students will be able to examine questions which inquire into the relationships between and among observable variables that affect motion. Once these relationships are understood, design investigations can begin to address the problems associated with those questions. By applying mathematical and conceptual models to qualitative and quantitative data collected, motion can be graphically represented. This will provide a visual representation of aspects of velocity and acceleration. Mathematics and graphical analysis allow us to see basic similarities in the motion of all objects. In addition, the unit provides opportunities to explore **decision making** as the students investigate the developments in design technology.

Curriculum Links

Prior to grade 10, the study of motion receives little depth of treatment. Indirect connections are found with “Forces and Simple Machines” in grade 5 and “Flight” in grade 6. In grades 11 and 12, those students who pursue studies in Physics will develop further connections in “Force, Motion, Work, Energy, and Momentum.” The study of motion will also develop a strong link to Mathematics in grades 9 and 10 where “Data Management” included the collection, display, and analysis of data.

Curriculum Outcomes

Students will be expected to

STSE

Nature of Science and Technology
114-3 evaluate the role of continued testing in the development and improvement of technologies

114-6 relate personal activities and various scientific and technological endeavors to specific science disciplines and interdisciplinary studies

115-1 distinguish between scientific questions and technological problems

115-4 describe the historical development of a technology

Relationships between Science and Technology
116-7 analyse natural and technological systems to interpret and explain their structure and dynamics

Social and Environmental Contexts of Science and Technology
117-8 identify possible areas of further study related to science and technology

117-10 describe examples of Canadian contributions to science and technology

118-3 evaluate the design of a technology and the way it functions on the basis of identified criteria such as safety, cost, availability, and impact on everyday life and the environment

SKILLS

Initiating and Planning
212-4 state a prediction and hypothesis based on available evidence and background information

212-6 design an experiment and identify specific variables

212-7 formulate operational definitions of major variables

212-9 develop appropriate sampling procedures Performing and Recording

213-3 use instruments for collecting data effectively and accurately

213-4 estimate quantities

Analysing and Interpreting
214-5 interpret patterns and trends in data, and infer or calculate linear and non-linear relationships among variables

214-8 evaluate the relevance, reliability, and adequacy of data and data collection methods

214-10 identify and explain sources of errors and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty

Communication and Teamwork
215-2 select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results

KNOWLEDGE

325-1 Describe quantitatively the relationship among displacement, time, and velocity

325-2 Analyze graphically and mathematically the relationship among displacement, time, and velocity

325-3 Distinguish between instantaneous and average velocity

325-4 Describe quantitatively the relationship among velocity, time, and acceleration

Physical Science: Motion

Outcomes

- estimate quantities (213-4)
- identify and explain sources of errors and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty (214-10)
- select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results (215-2)

Elaboration – Strategies for Learning and Teaching

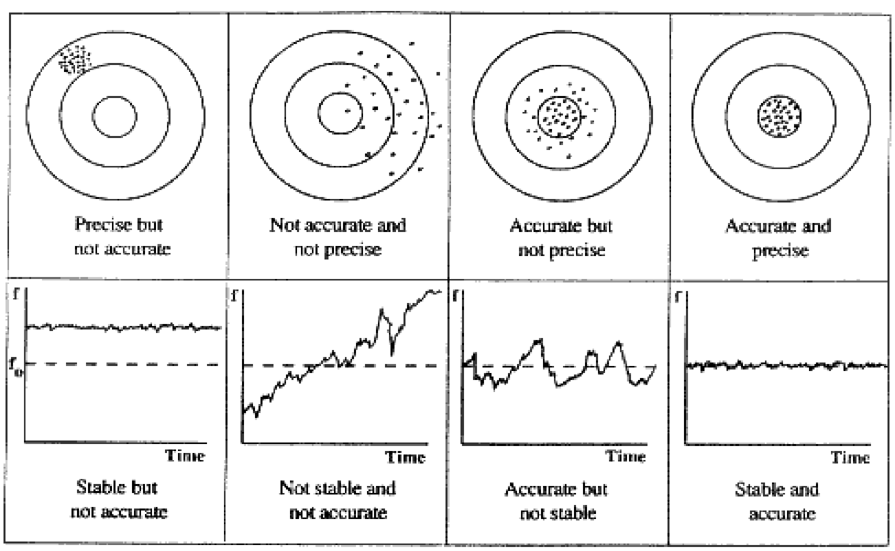
Throughout this unit, it is important that the differences between speed-velocity, distance-displacement, and average velocity-constant velocity be recognized and the names consistently used. Also, if students are provided with various examples of motion to investigate, they will begin to develop a thorough understanding of the concepts of displacement and velocity. The suggested way to introduce this cluster of outcomes is to investigate the linear motion of an Olympic runner. However, the study of motion can easily be applied to many Olympic events, personal interests such as skiing, swimming, snowmobiling, bicycling or orienteering, or the motion of objects. Note, in grade 9 mathematics, students have been exposed to data collection, graphing and its analysis.

Nelson Chapter 9 Introduction *(3.75 hours, 3 classes including 9.2)*
The activity in the introduction is an excellent way for students to determine aprropriate units to use for various measurements and is a worthwhile lead-in to the next section on accuracy, precision, and significant figures.
Nelson 9.2
Student groups should discuss the diferences between accuracy and precision. **Precision** relates to the quality of the measuring device used. The precision of a measuring device is limited by the finest division on its scale. **Accuracy**, on the other hand, relates to the ability of the user of the measuring device. It is the extent to which a measured value agrees with the accepted value. An analogy might be drawn from golf. Assuming that we have 3 golfers; a pro, a consistent slicer, and a beginner trying to hit shots straight down the middle of a fairway. If a blanket were laid out on middle of the fairway, 200 metres off the tee the pro could probably land most balls on the blanket. She has both precision and accuracy. If she were using a measuring instrument she could measure a quantity as precisely as the instrument would allow and she would be able to do it repeatedly. The slicer might be able to put most balls on a blanket 15 metres off to the right. He has precision but poor accuracy. What he does, he does consistently but the result is not accurate. If he were using a measuring instrument, he would consistently get the same measurement albeit an inaccurate one. The beginner has neither precision nor accuracy. His shots/measurements are all over the place, **DUCK!**
Significant figures and the subsequent rules should be examined as well.

Physical Science: Motion

Tasks for Instruction and/or Assessment

Group Activity
Do the 'Activity' on p.341 in Nelson 10.



Resources

Activity p.341

Sec 9.2 # 1-12
BLM 9
BLM 9.2 a,b
ABLM 7,8

Physical Science: Motion

Outcomes

- describe the historical development of a technology (115-4)
- describe examples of Canadian contributions to science and technology (117-10)
- state a prediction and hypothesis based on available evidence and background information (212-4)
- design an experiment and identify specific variables (212-6)
- formulate operational definitions of major variables (212-7)
- develop appropriate sampling procedures (212-9)
- use instruments for collecting data effectively and accurately (213-3)
- valuate the relevance, reliability, and adequacy of data and data collection methods (214-8)

Elaboration – Strategies for Learning and Teaching

Nelson 9.3 or 10.1 or 11.6 or 12.3 *(Include with section 9.2)*
These sections may give students ideas on a technology that they may be interested in researching. Microscopes, telescopes, off-road vehicles, advances in skates or skis are possible areas of research. Areas where Canada was in the lead in developing a technology would be especially interesting such as snowmobiles or the clapskate.

Nelson 9.4 *(1.25 hours, 1 class)*
This investigation should enable students to understand the relationship between distance, speed, and time. It will give them a chance to comment on the most environmentally friendly modes of transportation as well.

Physical Science: Motion

Tasks for Instruction and/or Assessment	Resources
Project Research the historical development of a technology bringing in the improvements in safety, costs, etc that the technology allowed.	Sec 9.3, 10.1, 11.6, or 12.3 Sec 9.3 ABLM 9 Sec 10.1 ABLM 18 Sec 11.6 ABLM 33,34
Laboratory Students will complete a formal lab write-up for Investigation 9.4. Refer to Skills Handbook on p.691 for lab write-up instructions.	Sec 9.4 #1-4 ABLM 10,11(teacher reference)

Physical Science: Motion

Outcomes

- describe quantitatively the relationship among displacement, time, and velocity (325-1)
- distinguish between instantaneous and average velocity (325-3)
- analyze graphically and mathematically the relationship among displacement, time, and velocity (325-2)
- interpret patterns and trends in data, and infer or calculate linear and non-linear relationships among variables (214-5)

Elaboration – Strategies for Learning and Teaching

Nelson 9.5 *(2.5 hours, 2 classes)*

Initially students should read and discuss this section which deals with distance, speed, and time and familiarize themselves with the units for each of these quantities. The concepts of constant speed, instantaneous speed, and average speed should be explored.

Constant speed is a speed in which equal distances are covered in equal times, ie. the speed is constant.

Instantaneous speed is the speed of an object at a particular moment in time.

Most moving objects are continually changing their speed (a car moving in the city, for example). To make this continually changing speed manageable, physicists, many times use **average speed** which is calculated by looking at how far an object travels during a particular duration of time. For example, if a car travels 200 km in 4 hours, then the **average speed** of the car would be 50 km/h. The car would definitely not be able to maintain a constant speed of 50 km/h for all 4 hours that it was moving. Thus the formula for **average speed** is a very useful formula in Physics.

$$v_{av} = \frac{\Delta d}{\Delta t}$$

Nelson 9.7 *(2.5 hours, 2 classes)*

This discussion will be limited to distance, time, and speed. It may be helpful for teachers to look at pages 69 and 70 in the Math 421A curriculum guide. A number of examples covered on those pages fits very nicely with what is happening here. The **slope** of the linear graphs represents a constant speed.

Note to Teachers: Although the outcomes talk about displacement and velocity, the focus will remain on distance and speed. Teachers should only deal briefly with the differences between distance and displacement and between speed and velocity. For more information see sections 11.1 and 11.7.

Physical Science: Motion

Tasks for Instruction and/or Assessment

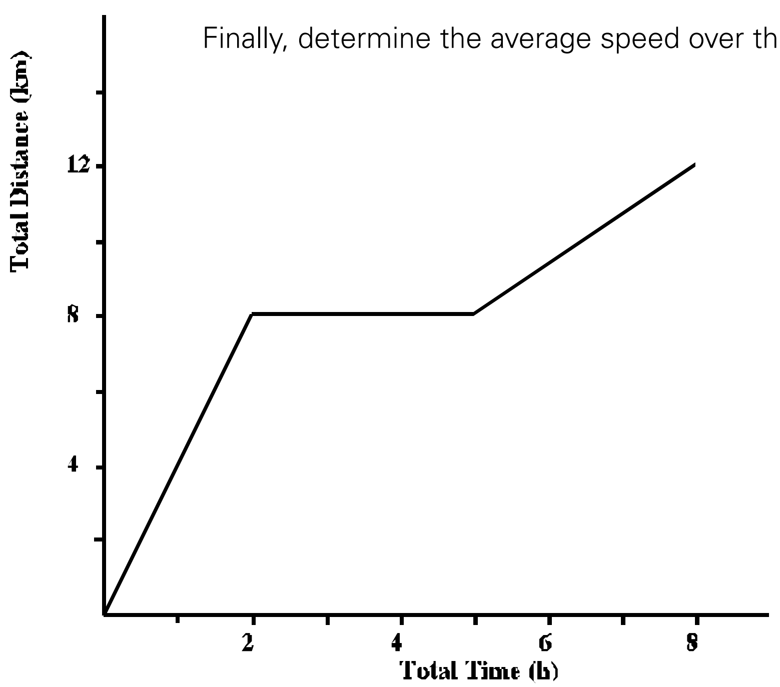
Oral Presentation
Explain the differences between distance and displacement. Use examples or any visual aids necessary to illucidate the audience.

Oral Presentation
Using any materials necessary, clearly explain the differences between speed and velocity. Justify your explanation with some simple examples from real life.

Research
Research the area of 'Maglev' (magnetic levitation) trains. What is the current speed record set by a Maglev train in Japan in November 2003? Are Maglev trains the wave of mass transit in the future? What are some of the issues involved with this new generation of trains?

Group Activity
Analyze the following graph to determine the average speed in the first 2 hours, the time span from 2 till 5 hours, and from 5 till 8 hours.

Finally, determine the average speed over the entire 8 hour trip.



Resources

Sec 9.5 # 1-12

BLM 9.5 a,b,d

Sec 9.7 # 1-7

ABLM 14,15

Physical Science: Motion

Outcomes

- evaluate the role of continued testing in the development and improvement of technologies (114-3)
- evaluate the design of a technology and the way it functions on the basis of identified criteria such as safety, cost, availability, and impact on everyday life and the environment (118-3)
- relate personal activities and various scientific and technological endeavors to specific science disciplines and interdisciplinary studies (114-6)
- distinguish between scientific questions and technological problems (115-1)
- describe quantitatively the relationship among velocity, time, and acceleration (325-4)

Elaboration – Strategies for Learning and Teaching

Nelson 9.8 *(homework assignment, no class time required)*

The problem of traffic congestion is a growing concern in many cities worldwide. Toronto's smart highway is a very modest beginning in addressing one of the major problems facing cities today. City centres are emptying out with people moving to suburbia. With this shift, people resign themselves to a daily commute which lengthens every year. My wife's brother lives in Burlington and commutes to Toronto every day. In the 1970's his commute took 45 minutes each way. Today it takes 1.25 to 1.5 hours each way, making for a very long workday. Only so many highway lanes can be built therefore making existing highways more efficient is a major focus of many urban planners today. Students could research other mass transit projects around the world such as the Maglev train research going on in Japan and France. Students could investigate other areas where technologies are being continually improved. It is common knowledge that the computer that one buys is probably obsolete by the time you take it out of the box.

Students might be able to investigate the differences between pure scientific research and the work done by engineers. The work done by both complement each other. The behind the scenes work done by the pure scientist is vital to the discovery of new knowledge. Without that new knowledge, engineers could not dream up applications of that new knowledge.

Nelson 10.3 *(2.5 hours, 2 classes)*

Acceleration is the rate of change in speed of an object.

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t}$$

v_f *is the final speed*

v_i *is the initial speed*

Students will only deal with **constant acceleration** where the same change in speed occurs in each equal time interval.

Students should understand that acceleration is a rate of change of speed and thus the units are speed/time (ex. m/s/s or m/s^2). Acceleration can be a positive quantity (gaining speed) or a negative quantity (losing speed).

Physical Science: Motion

Tasks for Instruction and/or Assessment

Project/Presentation

Investigate a technology showing how it has evolved through continued research and refinement through the years. Examples could be hockey equipment, automobile engines, house construction, clothing materials, cancer treatments, etc.

Poster Project

Design a radical new form of transportation. Draw any necessary diagrams showing the mode of transportation envisioned. Be able to explain in a reasonable amount of detail how the concept would work. Support your design with as much scientific theory as possible.

Research

Choose a technology and investigate its development from the early stages through to the present day.

Project

Use the internet to research the take-off speeds of various aircraft and the length of runway required for each aircraft to take off. Determine the rate of acceleration of each aircraft , assuming they experience constant acceleration. Present the results of your research in a poster format.

Resources

Sec 9.8 #1-4
ABLM 16

Choose appropriate chapter review questions (as time permits).

Sec 10.3 # 1-16
BLM 10.3 b,c (overheads)
BLM 10.3 d (homework)

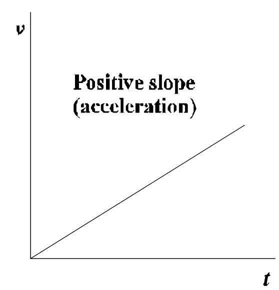
Physical Science: Motion

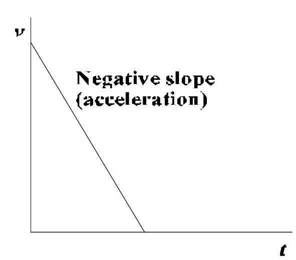
Outcomes

- describe quantitatively the relationship among velocity, time, and acceleration (325-4)

Elaboration – Strategies for Learning and Teaching

Nelson 10.4 *(3.75 hours, 3 classes)*
Graphically we have seen that the slope of a distance - time graph represents speed. In this section students will learn that the slope of a speed - time graph yields the acceleration of the object being observed. Because we are working only with constant acceleration the graphs will all be linear with either positive or negative slope.



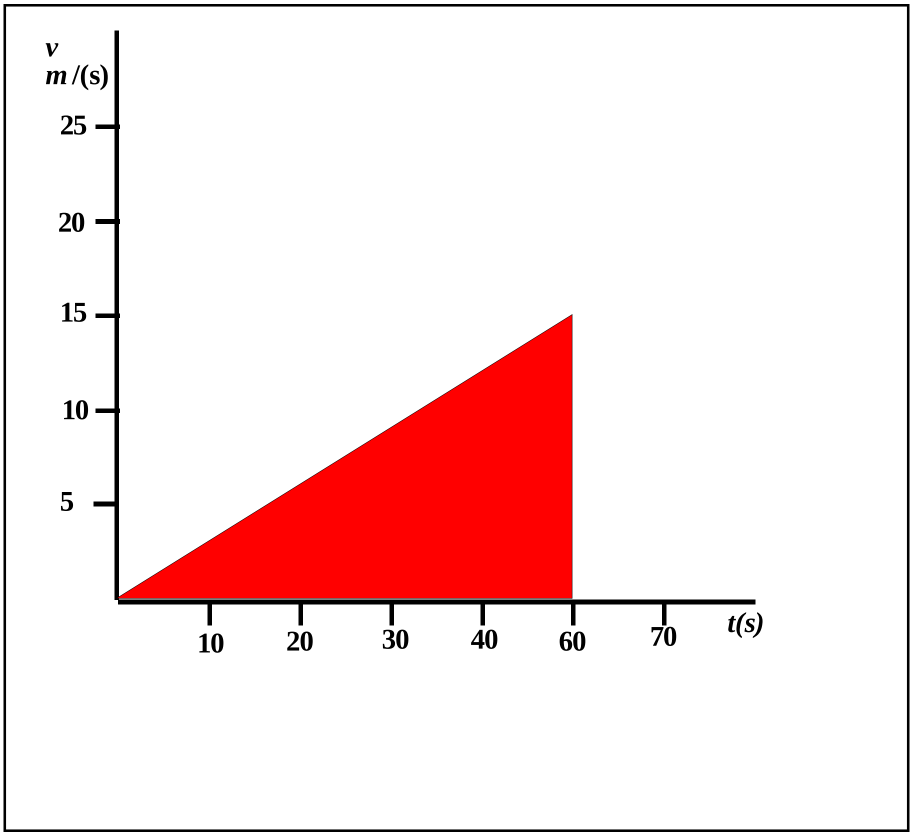


Nelson 10.6 *(1.25 hours, 1 class)*
Students should analyse distance-time and speed-time graphs of automobiles as displayed in Figure 4 on p.397.

Physical Science: Motion

Tasks for Instruction and/or Assessment

Activity
Determine the distance travelled in the following graph.



Resources

Sec 10.4 # 1-8, 11

BLM 10.4 a (overhead)
BLM 10.4 b (activity)
ABLM 20

Sec 10.6 a-j
Understanding concepts #1

Significant Digits (Figures)

1. Every nonzero digit in a measurement is significant.
Ex. 14.3 m, 536 m, and 0.396 m all have 3 significant figures.

2. Zeros appearing between nonzero digits are significant.
Ex. 30.45 m, 5001 m, and 3.408 m all have 4 significant figures.

3. Zeros appearing in front of all nonzero digits are not significant.
Ex. 0.54 m, 0.0043 m, and 0.00064 m all have 2 significant figures.

4. Zeros at the end of a number and to the right of a decimal point are significant.
Ex. 31.00 m, 7.000 m, and 5.010 m all have 4 significant figures.

5. Zeros at the end of a number and to the left of a decimal point are not significant if they serve as place markers to show the magnitude of a number.
Ex. the zeros in 300 m, 6000 m, and 23,230 m are probably not significant. *If these zeros were measured then they are significant.* To avoid ambiguity, the measure ments should be written in standard form. 3.00×10^2 m, 6.000×10^3 m, and 2.3230×10^4 m have 3, 4, and 5 significant figures respectively.

Significant Digits (Figures) in Calculations

When perfoming calculations, an answer cannot be more precise than the least precise measurement.
For **addition or subtraction**, the answer can have no more digits to the right of the decimal point than the least precise value involved.

1. Perform the operation required (addition or subtraction).

2. Round off the result to correspond to the least precise value involved.

Ex. 6.48 m + 18.2 m = 24.68 (18.2 is precise to only a tenth of a m)
thus 24.68 is rounded off to the nearest tenth yielding **24.7 m**

For **multiplication or division**, the answer must contain no more significant figures than the measure ment with the least number of significant figures. The position of the decimal point has nothing to do with the number of significant figures in the answer.

1. Perform the operation.

2. Round off the result to correspond to the measurement with the least number of significant figures.

Ex. 2.652 m X 13.1 m = 34.7412 m^2 rounded to 3 significant figures yields 34.7 m^2

Unit 2 Motion	**Time Required 19 hours (15 classes)**	**Resources**
Introduction & 9.2	3.75 hours (3 classes)	Activity p.341 BLM 9 BLM 9.2 a,b ABLM 7,8
9.3 or 10.1or 11.6 or 12.3	no class time required	Sec 9.3 ABLM 9 Sec 10.1 ABLM 18 Sec 11.6 ABLM 33,34
9.4	1.25 hours (1 class)	Sec 9.4 #1-4 ABLM 10,11 (for teacher reference)
9.5	2.5 hours (2 classes)	Sec 9.5 #1-12 BLM 9.5 a,b,d
9.7	2.5 hours (2 classes)	Sec 9.7 #1-7 ABLM 14,15
9.8	Homework assignment	Sec 9.8 #1-4 ABLM 16
10.3	2.5 hours (2 classes)	Sec 10.3 #1-16 BLM 10.3 b,c (overhead) BLM 10.3 d (homework)
10.4	3.75 hours(3 classes)	Sec 10.4 #1-8,11 BLM 10.4a, BLM 10.4b, ABLM 20
10.6	1.25 hours(1 class)	Sec 10.6 a-j, understanding concepts #1
Class Quiz	1.25 hours (1 class)	

Unit 3

Chemical Reactions

31 hours (24 classes)

Unit Overview

Introduction

After students have developed an understanding of atomic structure and the periodic table in grade 9, the study of chemical reactions provides them with an opportunity to apply their understanding of atomic structure to how chemicals react. By naming and writing common ionic and molecular compounds, and by balancing a variety of equation types, students begin to make connections to a variety of chemical examples in everyday life.

Focus and Context

This unit emphasizes the social and environmental contexts of science and technology associated with air and water pollution, and should have a principal focus of **observation** and **inquiry**. However, there are opportunities for **decision making** as well as **design technology** in the laboratory research components of this unit. Atlantic Canada offers a possible context for this unit because it is particularly affected by acid precipitation and other forms of air pollution owing to prevailing winds in North America. These winds carry large amounts of air pollutants from the more populated and industrialized regions of the United States and Canada. The problem is further complicated by our own industrial plants and power generation plants. In addition, much of our region has thin soils and granite bedrock, which makes the region highly sensitive to acid damage. In this context students will consider how chemical reactions are associated with technologically produced problems such as acid rain, and look at some steps that can be taken to counter the effects of acid rain.

Curriculum Links

The study of chemical reactions in grade 10 connects readily with topics covered as early as grade 1 where students are introduced to materials and their senses, as well as in grade 2 where students are introduced to the idea of liquids and solids. These early considerations of states of matter are given more attention and detail in grade 5 as properties and changes in materials are studied. By grade 7, students cover in some detail the concept of mixtures and solutions. As mentioned in the above paragraph, there are very strong links between the topics of atomic structure in grade 9 and the chemistry studied in grade 10. For those who pursue chemistry in grade 11 and 12, the material covered in grades 7, 9 and 10 offers a solid foundation to build on as students undertake a more detailed look at traditional chemistry topics such as acids and bases, solutions, and stoichiometry; and electrochemistry.

Curriculum Outcomes

Students will be expected to

STSE

Nature of Science and Tech.
114-8 describe the usefulness of scientific nomenclature systems

Relationships between Science and Technology
116-3 identify examples where technologies were developed on the basis of scientific understanding

116-5 describe the functioning of domestic and industrial technologies, using scientific principles

Social and Environmental Contexts of Science and Technology
117-1 compare examples of how society influences science and technology

117-5 provide examples of how science and technology are an integral part of their lives and community

117-7 identify and describe science- and technology-based careers related to the science they study

118-5 defend a decision or judgment, and demonstrate that relevant arguments can arise from different perspectives

SKILLS

Initiating and Planning
212-3 design an experiment, identifying and controlling major variables

212-8 evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making
Performing and Recording

213-2 carry out procedures controlling the major variables and adapting or extending procedures where required

213-5 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data

213-9 demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials

Analysing and Interpreting
214-5 interpret patterns and trends in data, and infer or calculate linear and non linear relationships among variables

214-15 propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan

Communication and Teamwork
215-6 work co-operatively with team members to develop and carry out a plan, and troubleshoot problems as they arise

KNOWLEDGE

319-2 (I) classify substances as acids, bases, or salts, based on their characteristics

321-2 describe how neutralization involves tempering the effects of an acid with a base or vice versa

319-1 (I) name and write formulas for some common molecular compounds, including the use of prefixes

319-1 (II) name and write formulas for some common ionic compounds (both binary and complex), using the periodic table, a list of ions, and appropriate nomenclature for metal and non-metal ions

319-2 (II) classify substances as acids, bases, or salts, on the basis of their names and formulas

319-3 illustrate, using chemical formulas, a wide variety of natural and synthetic compounds that contain carbon

321-1 represent chemical reactions and the conservation of mass, using molecular models and balanced symbolic equations

321-3 illustrate how factors such as heat, concentration, light, and surface area can affect chemical reactions

Chemical Reactions

Investigating chemical reactions is a key to understanding nature.

Outcomes

Students will be expected to

- describe the usefulness scientific nomenclature systems (114-8)
- provide examples of how science and technology are an integral part of their lives and their community (117-5)
- demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials (213-9)
- design an experiment, carry out procedures identifying and controlling major variables and adapting or extending procedures where required(212-3, 213-2)
- classify substances as acids, bases, or salts, based on their characteristics (319-2(I))

Elaboration – Strategies for Learning and Teaching

At the beginning of each unit is a challenge project. One asessment possibility is to have a student or group of students prepare a presentation and present it to the class later in the term.

Time required for introduction, 5.2, and 5.1 is 3.75 hours or 3 classes

<u>Nelson Ch 5 Introduction and 5.2</u>

The introductory activity and section 5.2 are appropriate opportunities to introduce students to WHMIS and safety issues in the laboratory.

Safe practices and proper use of equipment are very important in the laboratory. For all laboratory activities in this unit, ensure students recognize WHMIS standards. As a homework assignment students should read pp.658-660 on safety symbols and safety in the laboratory. Students should briefly examine acids and bases on an introductory level by studying Figure 1 p.290. For example stomach acid is mainly hydrochloric acid with a pH of 1.5, strong enough to dissolve certain metals. Some examples of bases are shown in Table 1 on p.320. Various scales that are used for measuring different quantities could be mentioned. Examples are: Richter Scale(strength of earthquakes), Beaufort Scale(wind force scale), and the pH Scale for measuring how acidic or basic a soution is(see Figure 1 p.296).

<u>Nelson 5.1</u>

A discussion on the classification of matter as shown in Figure 2 p.172 should come about. Most materials found in nature are mixtures. Students should understand that a mixture is a physical combination of 2 or more substances that are not chermically combined. The composition of mixtures may vary. A heterogeneous mixture is not uniform in composition; its components are readily distinguishable. Examples are stew or soil. A homogeneous mixture or solution is completely uniform in composition; its components are not distinguishable. Examples are air, salt water, or blood. The composition of blood for example can vary from one person to the next. In fact a person's blood composition can vary depending on health, diet, or physical activity. Students should read and discuss this section to learn about pure substances, elements, and compounds. As well, physical and chemical properties should be discussed and students could be shown some examples of physical and chemical changes, reactants and products. The question of chemical safety should be considered the systems used to identify hazardous chemical examined.

Chemical Reactions

Investigating chemical reactions is a key to understanding nature.

Tasks for Instruction and/or Assessment

Paper and Pencil

Make a list of household chemicals. In a group, divide up this list and check the WHMIS data sheets to determine how these chemicals should be handled and stored. Record your group's findings in a table and display it on the wall.

Resources

Introduction p.171 Do Reflect on Learning and Activity

Sec 5.2 have a discussion on #6-8 p.179
BLM 5gs, 5.1c

Sec 5.1 # 1-12, omit #3
BLM 5.1a,b

Chemical Reactions

Outcomes

- interpret patterns and trends in data, and infer or calculate linear and non-linear relationships among variables (214-5)
- identify and describe science and technology-based careers related to the science they study (117-7)
- name and write formulas for some common ionic compounds (both binary and complex), using the periodic table, a list of ions, and appropriate nomenclature for metal and non-metal ions (319-1(II)

Elaboration – Strategies for Learning and Teaching

<u>Nelson 5.3 *(2 hours, 1.5 classes)*</u>

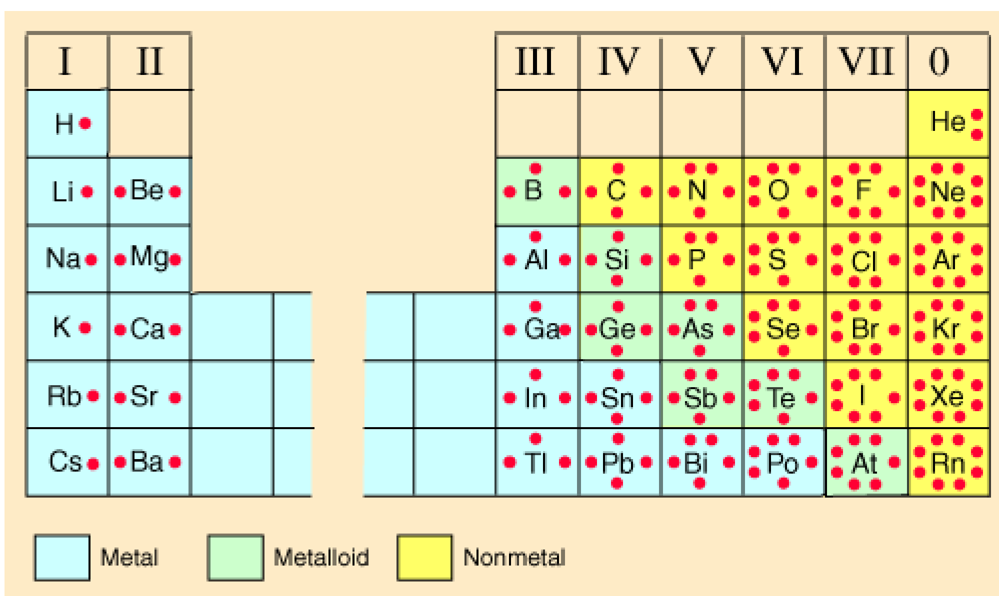
Student groups should do the investigation on testing properties of substances. At the end of a unit is an example of the proper format for a lab write-up. Supply students with the accompanying Blackline Master for this section.

<u>Sec 5.4 or 6.15 or 7.12 or 8.13 *(Homework)*</u>

Students should read one of the career profiles or research one of special interst to them and write a journal entry on that career.

<u>Sec 5.5 *(2.5 hours, 2 classes)*</u>

Student groups should read and discuss this section on the periodic table and its breakdown into the various chemical families and the atomic structure of atoms using Bohr diagrams and later Lewis diagrams.



Note to Teachers: Students could be provided with b/w copies of the periodic table so that the chemical families could be highlighed using different colours. See Blackline Master 5.5a.

Chemical Reactions

Tasks for Instruction and/or Assessment	Resources
Laboratory Investigation Do the testing properties of substances investigation (Sec 5.3) and complete a formal lab write-up.	Sec 5.3 # 1-6
Journal Students should read and research a science related career of interest to them and write a summary in their journal of what interested them about that career.	Sec 5.4 or 6.15 or 7.12 or 8.13
Chemical Bingo Activity Students may fill bingo card with elements of their choice. The teacher randomly chooses elements. For a Bingo card template, see ABLM 6. (This activity can also be used in section 5.12 for naming compounds.	Sec 5.5 # 1-8

Chemical Reactions
An introduction to formula writing.

Outcomes

Students will be expected to

- name and write formulas for some common ionic compounds (both binary and complex), using the periodic table, a list of ions, and appropriate nomenclature for metal and non-metal ions (319-1(II)
- name and write formulas for some comon molecular compounds, including the use of prefixes (319-1(I))
- identify examples where technologies were developed on the basis of scientific understanding (116-3)
- describe the functioning of domestic and industrial technologies, using scientific principles (116-5)
- compare examples of how society influences science and technology (117-1)

Elaboration – Strategies for Learning and Teaching

Nelson 5.6, 5.7, 5.8 & 5.9 *(5 hours, 4 classes)*
Note: First class test could be administered at the end of section 5.8.
Students should be introduced to the concepts of ionic and molecular compounds. Ionic compounds are composed of positive and negative ions while molecular compounds are composed of molecules. Section 5.7 can be covered by assigning Blackline Masters 5.7a,b,c for homework.
Students should investigate how Lewis Diagrams may be used to illustrate electron transfer in ionic bonding. Students should also be able to write formulas for ionic compounds and name those compounds.

Nelson 5.11 *(1.25 hours, 1 class)*
Students should examine molecular compounds and how they are formed by covalent bonding. It is recommended that teachers use Lewis diagrams rather than the criss cross methods to illustrate molecular bonding. Students should appreciate that pressure and temperature can cause elements to bond in many different ratios.

Acids and bases are molecular compounds that break into ions in water.

Nelson 5.12 & 5.13 *(1.25 hours, 1 class)*
Students should examine organic compounds and their sources. Students should understand that all organic compounds contain carbon and hydrogen, along with other possible elements such as oxygen. Some compounds containing carbon ($CaCO_3$ and CO_2 for example) are classed as inorganic. Emphasize the point that organic compounds are far more numerous in our world than inorganic compounds. Hydrocarbons in particular and their many uses should be investigated. No systematic naming of organic compounds is required at this time. Illustrations by drawings or building models should be limited to common organic compounds such as methane [CH_4], propane [C_3H_8], butane [C_4H_{10}], octane [C_8H_{18}], and ethanol [C_2H_5OH]. However a discussion about common, but complex, compounds as CFCs and polyethylene would be worthwhile. Students should read and discuss the differences between natural and synthetic substances and the role each plays in peoples daily lives.

Chemical Reactions

An introduction to formula writing.

Tasks for Instruction and/or Assessment

Journal

Research the introduction of the IUPAC naming system, as well as the ACS (American Chemical Society) naming system, and determine their roles in naming compounds. Debate the need for a standard system for naming compounds.

Project

Design a flowchart that can be used for naming compounds.

Demonstration

The demo on p.207 on organic compounds should be shown to students.

Resources

Sec 5.6 # 1-5

Sec 5.7 Blackline Masters 5.7 a,b,c

Sec 5.8 # 1-10
Blackline Master 5.8
Additional BLM 3
Additional BLM 4

Sec 5.9 # 1-7
Blackline Master 5.9

Sec 5.11 # 1-6,9
8 a-c with the class
BLM 5.11

Sec 5.12 # 1-5
BLM 5.12

Sec 5.13 # 1-8,11
BLM 5.13

Chemical Reactions

Outcomes

- defend a decision or judgement and demonstrate that relevant arguments can arise from different perspectives (118-5)

- represent chemical reactions and the conservation of mass, using molecular models, and balanced symbolic equations (321-1)

- evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making (212-8)

- compile and organize data, using appropriate formats and data treatments to facilitate interpretation of data (213-5)

Elaboration – Strategies for Learning and Teaching

Nelson 5.14 *(Homework journal assignment)*

Students should read this section and construct a journal response examining the issues involved in using natural or synthetic substances.

Introduction to Nelson Chapter 6, 6.1, & 6.3*(1.25 hours, 1 class)*

In the introduction don't do the 'Reflect' or the 'Activity'. Use this as a lead-in to what happens in chemical reactions more carefully through the use of word equations.

Invite students to read and discuss section 6.3 and the Law of Conservation of Mass. Discuss the environmental implications of this law.

Nelson 6.2 & 6.4 *(2 hours, 1.5 classes)*

Student groups should investigate measuring mass in chemical changes and finding the missing mass in certain reactions.

Chemical Reactions

Tasks for Instruction and/or Assessment	Resources
Journal Write a journal response outlining both sides of the natural vs synthetic debate.	Sec 5.14 *Choose appropriate chapter review questions (as time permits)*
Students should be able to predict products for simple chemical reactions by the time they have finished this section. *Journal* In your own words, explain the purpose of writing a word equation.	Sec 6.1 *Activity & # 1-4* Sec 6.3 # 1-6
Laboratory Students should do Investigation 6.2 & 6.4.	Sec 6.2 # 1-5, 8a Sec 6.4 # 1-4

Chemical Reactions

An introduction to equation writing

Outcomes

Students will be expected to

- represent chemical reactions and the conservation of mass, using molecular models, and balanced symbolic equations (321-1)

Elaboration – Strategies for Learning and Teaching

Nelson 6.5, 6.6, 6.7, & 6.10 *(5 hours, 4 classes)*

Students should become familiar with skeleton equations and balanced chemical equations. Students should examine different types of chemical reactions such as: combustion, synthesis and decomposition, and single and double displacement reactions and confirm the conservation of atoms, using molecular models. They should be introduced to identifying reactants and predicting the products of a reaction. Here are some suggestions:

$C (s) + O_2 (g) \rightarrow CO_2 (g)$
carbon + oxygen carbon dioxide

$CO_2 (g) + H_2O (l) \quad H_2CO_3 (aq)$
carbon dioxide + water carbonic acid

$CH_4 (g) + 2O_2 (g) \quad CO_2 (g) + 2H_2O (g)$
methane + oxygen carbon dioxide + water

$S_8 (s) + 8O_2 (g) \quad 8SO_2 (g)$
sulphur + oxygen sulphur dioxide

$SO_2 (g) + H_2O (l) \quad H_2SO_3 (aq)$
sulphur dioxide + water sulphurous acid

The use of 3-D models allows students to better visualize how natural systems operate and scientific concepts are applied. A full knowledge of accurate molecular structures is not required in grade 10, but molecular models should be used so that the students have some knowledge of which atoms are attached to which atoms.

Chemical Reactions

An introduction to equation writing

Tasks for Instruction and/or Assessment

Paper and Pencil

Write a balanced equation and indicate the reaction type (combustion, synthesis, decomposition, single displacement, or double displacement) for each of the following: (*Give students the more complicated formulas such as butane).*

1. H_2O (l) H_2 (g) + O_2 (g)
2. Cl_2 (g) + LiI (aq)   LiCl (aq) + I_2 (s)
3. KOH (aq) + H_3PO_4 (aq) K_3PO_4 (aq) + H_2O (l)
4. butane (gas) + oxygen (gas)   carbon dioxide (gas) + water (vapour)
5. solid sodium + chlorine (gas)   solid sodium chloride (321-1)

→

Performance

Encouragement should be given to making and using 3-dimensional models for presentations and balancing chemical equations. Three-dimensional models constructed by students can be assessed by the teacher for correctness with regard to the attachment of atoms to other atoms and the conservation of atoms in chemical reactions. (321-1)

Resources

Sec 6.5 # 1-5
Activity optional
Blackline Master 6.5a,b,c
Additional BLM 7
Sec 6.6 # 1-5,
discuss 6 & 7

Sec 6.7 # 1-5

Sec 6.10 # 1-3
BLM 6.13
Additional BLM 9

Chemical Reactions

A qualitative introduction to rates of chemical reactions

Outcomes

Students will be expected to

- evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making (212-8)
- compile and organize data, using appropriate formats and data treatments to facilitate interpretation of data (213-5)
- represent chemical reactions and the conservation of mass, using molecular models, and balanced symbolic equations (321-1)
- illustrate how factors such as heat, concentration, and surface area can affect chemical reactions (321-3)

Elaboration – Strategies for Learning and Teaching

Nelson 6.8, 6.9, 6.11,& 6.12 *(2 hours, 1.5 classes)*

These four investigations focus on synthesis, decomposition, single and double displacement reactions. One carousel lab will cover all four types. Neutralization reactions could be the example used for the double displacement component of this laboratory. Teachers should ensure that an insoluble salt is a product and therefore visible to students. Examples are:

$$H_2SO_4 + Ca(OH)_2 \longrightarrow 2H_2O + CaSO_4$$

$$H_2CO_3 + Mg(OH)_2 \longrightarrow 2H_2O + MgCO_3$$

any Group II

Nelson 7.3, 7.1, 7.2, & 7.5 *(1.25 hours, 1 class)*
Student groups should investigate the influence that temperature. concentration, and surface area have on rates of reactions.
Investigations 7.1, 7.2, & 7.5 should be done as a demonstration by the teacher in order that students gain a qualitative understanding (slow, medium, fast) of these factors and how they affect reaction rates .

Chemical Reactions

A qualitative introduction to rates of chemical reactions

Tasks for Instruction and/or Assessment

Carousel Laboratory (Types of Chemical Reactions Lab at the end of the unit)

Students can investigate four types of reactions using this methodology.

Demonstration

A teacher demonstration of factors affecting reaction rates could be done using sections 7.1, 7.2 and 7.5.

Resources

Sec 6.8, 6.9, 6.11 & 6.12
Additional BLM 10

Choose appropriate chapter review questions (as time permits)

Choose appropriate unit review questions (as time permits)

Sec 7.3 # 1a,b
BLM 7.3c (overhead)

Sec 7.1 # 1,2,6,7

Sec 7.2 # 1-3

Sec 7.5 # 1-6

Balancing Ionic Compound Formulas

Element	+ ion	Element	- ion	Compound Name	Formula
Calcium	2+	Oxygen	2-	Calcium oxide	CaO
Hydrogen		Sulfur			
Lithium		Chlorine			
Sodium		Chlorine			
Sodium		Oxygen			
Potassium		Sulfur			
					CaF_2
				Lithium oxide	
					MgO
				Hydrogen chloride	
					KCl
Aluminum		Chlorine			
Lithium		Phosphorous			
Aluminum		Nitrogen			
Aluminum		Oxygen			
Magnesium		Phosphorous			

Naming Ionic Compounds Containing Polyatomic Ions

A. Write the correct name for each of these compounds:

* *Be sure to include Roman numerals with transition metals**

1. $Fe(OH)_2$
2. $(NH_4)_3PO_4$
3. $AlPO_4$
4. $Cu(C_2H_3O_2)_2$
5. $CaCO_3$
6. NH_4OH
7. $Si(SO_4)_2$
8. Ag_3PO_4
9. $Hg(ClO_3)_2$
10. K_2SO_3

B. Write formulas for each of the following ionic compounds.

1. Chromium (VI) phosphate
2. Aluminum cyanide
3. Potassium chromate
4. Ammonium chloride
5. Iron (III) nitrate
6. Titanium (II) acetate
7. Magnesium hydrogen phosphate **
8. Lead (II) sulfate
9. Tin (II) nitrite
10. Potassium permanganate

Naming Ionic Compounds Containing Polyatomic Ions Answers

A.

1. iron (II) hydroxide
2. ammonium phosphate
3. aluminum phosphate
4. copper (II) acetate
5. calcium carbonate
6. ammonium hydroxide
7. silicon sulfate
8. silver phosphate
9. mercury (II) chlorate
10. potassium sulfite

B.

1.	Cr^{6+} PO_4^{3-}	$Cr(PO_4)_3$
2.	Al^{3+} CN^{-}	$Al(CN)_3$
3.	K^{+} CrO_4^{2-}	K_2CrO_4
4.	NH_4^{+} Cl^{-}	NH_4Cl
5.	Fe^{3+} NO_3^{-}	$Fe(NO_3)_3$
6.	Ti^{2+} CH_3COO^{-}	$Ti(CH_3COO)_2$
7.	Mg^{2+} HPO_4^{2-}	$MgHPO_4$
8.	Pb^{2+} SO_4^{2-}	$PbSO_4$
9.	Sn^{2+} NO_2^{-}	$Sn(NO_2)_2$
10.	K^{+} MnO_4^{-}	$KMnO_4$

Ionic and Covalent Compounds Review

1. Fill in the formula for each ionic compound formed by the metals and nonmetals in the chart below.

Non-metals

Metals		N	F	S	O	P	Cl
	Li						
	Mg						
	Al						
	Ca						
	Na						

2. **Complete this question on a separate sheet of paper.** Write the formula for each compound named. Draw Bohr diagrams to show the covalent bonding in the following compounds. (Overlapping outer shells).

A) Hydrogen cyanide

B) Dinitrogen monoxide

C) Hydrogen monofluoride

D) Nitrogen trihydride

E) Ammonium (the polyatomic ion)

F) Carbon dioxide

3. Write balanced formulas for the following ionic compounds using polyatomic ions.

A) Aluminum hydroxide

B) Potassium chlorate

C) Sodium cyanide

D) Calcium chlorate

E) Ammonium oxide

Types of Chemical Reactions

Objective: Observe chemical reactions in order to determine reaction type.
Write balanced equations for each reaction

Materials:

bunsen burner	scoopula	aluminum foil	copper wire
tongs	droppers	0.1 M $CuCl_2$ (aq)	MnO_2
goggles	splints	3% H_2O_2	6.0 M HCl (aq)
test tubes	mossy zinc	$Cu(NO_3)_2$ (aq)	NaOH (aq)
test tube rack		K_2CrO_4 (aq)	$Sr(NO_3)_2$ (aq)

Safety concerns and organization:
Take care using acids
Wear safety goggles at all times
Run liquid waste down the sink and place solid waste in the garbage
Clean all test tubes and lab table surface and surrounding area before leaving each station
10 minutes are allowed at each station - do all work, including observations, and as much of the data sheet as possible while at each station
Stations may be done in any order
The teacher will indicate when to change stations

Procedure:

1) Using tongs, place the end of a copper wire in a bunsen burner flame. Examine and record the obersvations.

2) Pour 1-2 ml of hydrogen peroxide into a test tube. Add a pinch of manganese dioxide. Listen and watch. Hold a glowing (not flaming) splint in the mouth of the test tube in order to test the type of gas produced. Record your obersvations. (A. "pop" indicates H_2 (g) while continued burning indicates the presence of O_2 (g)).

3) Carefully fill a test tube 1/4 full of hydrochloric acid. Place the test tube in the test tube rack. Add a piece of mossy zinc. Record you observations. Hold a burning wood splint in the mouth of the test tube in order to determine the type of gas produced. Record they type of gas produced.

4) a) Place 5 drops of $Cu(NO_3)_2$ (aq) into a test tube. Add 5 drops of K_2CrO_4 (aq). Record observations. b) Conduct the same procedure using $Sr(NO_3)_2$ (aq) and NaOH (aq).

5) Measure 10 ml of 0.1 M $CuCl_2$ (aq) into a test tube. Add a small square of aluminum foil. Shake gently and record your observations.

Data/Results **Name________________**

1) Observations

How do you know that there was a reaction?

What gas did the copper react with?____________________

Balanced reaction:

Reaction type (2 types possible): ___________________ & ___________________________

2) Observations:

Type of gas produced: _____________________________

Balanced reaction (hint: is MnO_2 "used up" in reaction?):

Reaction type ______________________________

3) Observations

Type of gas produced: _______________________

Balanced reaction:

Reaction type: _______________________________

4) **a**) Observations:

Balanced reaction (hint: all nitrates are soluble):

Reaction type: ________________________

b) Observations:

Balanced reaction:

Reaction type: ____________________

Sample Lab Format

Purpose: State the objective of the lab.

Apparatus: List all materials used in the lab.

Procedure: Briefly summarize the procedures carried out to complete the experiment.

Observations: Note any observations made while doing the experiment, include specific questions in the text of the lab. *Answer all questions in complete sentences.*

Data: Complete all tables, charts, graphs, and sketches.

Lab Drawings: To be done on unlined paper in pencil ONLY.

Lab Questions: Answer any questions at end of the lab in complete sentences.

Conclusions: Include what you learned, what you would you do differently, success/failure of lab and why.

Unit 3 Resources	Time Required 31 hours (24 classes)	
Introduction 5.2, 5.1	3.75 hours (3 classes)	Reflect on Learning & Activity Sec 5.2 #6-8, BLM 5gs, 5.1c Sec 5.1 #1-12,omit 3 BLM 5.1a,b
5.3	2 hours (1.5 classes)	Sec 5.3 #1-6
5.4 or 6.15 or 7.12 or 8.13	Homework	
5.5	2.5 hours (2 classes)	Sec 5.5 #1-8
5.6, 5.7, 5.8 & 5.9	5 hours (4 classes)	Sec 5.6 #1-5 Sec 5.7 BLM 5.7a,b,c Sec 5.8 #1-10, ABLM 3,4 Sec 5.9 #1-7, BLM 5.9
5.11	1.25 hours (1class)	Sec 5.11 #1-6,9, (8a-c withclass) BLM 5.11
5.12, 5.13	1.25 hours (1 class)	Sec 5.12 #1-5, BLM 5.12 Sec 5.13 #1-8,11, BLM 5.13
5.14	Homework	
Inroduction to Ch 6 6.1, 6.3	1.25 hours (1 class)	Sec 6.1 Activity & #1-4 Sec 6.3 #1-6
6.2, 6.4	2 hours (1.5 classes)	Sec 6.2 #1-5,8a Sec 6.4 #1-4
6.5, 6.6, 6.7 & 6.10	5 hours (4 classes)	Sec 6.5 #1-5, (Activity optional) BLM 6.5 a,b,c , ABLM 7 Sec 6.6 #1-5, discuss 6,7 Sec 6.7 #1-5 Sec 6.10 #1-3,BLM 6.13,ABLM 9
6.8, 6.9, 6.11& 6.12	2 hours (1.5 classes)	ABLM 10
7.3, 7.1, 7.2 & 7.5	1.25 hours (1 class)	Sec 7.3 #1a,b BLM 7.3c (overhead) Sec 7.1 #1,2,6,7 Sec 7.2 #1-3

2 class tests are suggested for this unit. The first could occur at the end of section 5.8.

Unit 4

Earth and Space Science:

Weather Dynamics

17 hours (13 classes)

Unit Overview

Introduction

Global climate and local weather patterns are affected by many factors and have many consequences. This unit asks students to consider questions such as "What decisions do we face because of weather conditions?"; "How are our lives affected by changing weather conditions (short-term) and changing climate (long-term)?"; and "What causes these weather patterns?"

In Atlantic Canada weather patterns change frequently. Each season provides interesting weather conditions that influence how we dress, how we feel physically and psychologically, and how we interact socially. The direction from which air masses move, and the atmospheric pressures and temperatures in those air masses contribute to changes that can be quite significant in any given season. Rapid temperature rises in spring may cause significant snow melt; clear and dry weather in summer raises the risk of grassland/forest fires; autumn sees the arrival of storms from the Caribbean; winter snowfall and temperature variations depend upon the north/south drift of the atmospheric jet stream. These changes influence Atlantic Canadians in a variety of ways.

Focus and Context

By considering questions that you and your students generate, various learning and assessment activities will meet specific curriculum outcomes. Although this unit focusses on **decision making**, there are opportunities for **observation** and **inquiry** as well as **problem solving** and **design technology.** Sections in the unit ask students to consider heat energy and its transfer, energy exchange within and between systems, and to observe weather data and the impact of weather forecasting.

Curriculum Links

"Weather Dynamics" connects with other clusters across many grade levels, such as "Daily and Seasonal Change" (grade 1); "Air and Water in the Environment" (grade 2); "Weather" (grade 5), which includes the water cycle, changes in air caused by heating, and patterns of change in local conditions. "Heat" (grade 7) includes temperature and its measurement, methods of heat travel, the particle model of matter, and qualitative treatment of heat capacity. "Water Systems on Earth" (grade 8) links ocean currents to regional climates and the influence of polar icecaps. This unit will support optional studies in grades 11-12 such as Life Science: "Interaction of Living Things"; Chemistry: "Thermochemistry"; Physics: "Force, Motion, Work," "Energy, Momentum, and Waves"; Earth and Space Science: "Earth Systems and Processes."

Prior to grade 10, students have also considered weather and climate in our region through the social studies curriculum introduced in 1998.

Curriculum Outcomes

Students will be expected to

STSE

Nature of Science and Technology

114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies

115-2 illustrate how science attempts to explain natural phenomena

115-6 explain how scientific knowledge evolves as new evidence comes to light

Relationships between Science and Technology

116-1 identify examples where scientific understanding was enhanced or revised as a result of the invention of a technology

Social and Environmental Contexts of Science and Technology

117-6 analyse why scientific and technological activities take place in a variety of individual and group settings

117-10 describe examples of Canadian contributions to science and technology

118-7 identify instances in which science and technology are limited in finding the answer to questions or the solution to problems

SKILLS

Initiating and Planning

212-1 identify questions to investigate that arise from practical problems and issues

Performing and Recording

213-2 carry out procedures controlling variables and adapting or extending procedures where required

213-3 use instruments effectively and accurately for collecting data

213-6 use library and electronic research tools to collect information on a given topic

213-7 select and integrate information from various print and electronic sources or from several parts of same source

Analysing and Interpreting

214-3 Compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots

214-10 identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty

214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion

KNOWLEDGE

331-1 describe and explain heat transfer within the water cycle

331-2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents

331-3 describe how the hydrosphere and atmosphere act as heat sinks within the water cycle

331-4 describe and explain the effects of heat transfer within the hydrosphere and atmosphere on the development, severity, and movement of weather systems

331-5 analyse meteorological data for a given time span and predict future weather conditions, using appropriate methodologies and technologies

Earth and Space Science: Weather Dynamics

Outcomes

- describe and explain heat transfer within the water cycle (331-1)
- carry out procedures controlling variables and adapting or extending procedures where required (213-2)
- describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents (331-2)
- describe how the hydrosphere and atmosphere act as heat sinks within the water cycle (331-3)
- use instruments effectively and accurately for collecting data (213-3)
- illustrate how science attempts to explain natural phenomena (115-2)

Elaboration – Strategies for Learning and Teaching

Nelson Ch 13 Introduction, 13.1, and 13.2 *(2.5 hours, 2 classes)*
Invite students to read and discuss the Introduction to Chapter 13. In section 13.1 students should read page 502 to be able to differentiate between the terms **Weather** and **Climate**.

In section 13.2 students will learn about the transfer of energy to the Earth from the Sun. Students should understand the following terms:

- radiation
- conduction
- convection
- advection
- albedo
- heat sink
- heat capacity

Nelson 13.8 , 13.11, & 14.2 *(3.75 hours, 3 classes)*
Students should investigate what the hydrosphere is and the effects that heat transfer have on the water cycle and cloud formation. Clouds should be classified with a view to weather prediction. Low and high air pressure systems should be examined and how their interaction is affected by the jet stream. The focal point of this series of outcomes is how heat transfer from the Sun affects the hydrosphere and atmosphere thus creating the weather on Earth.

Earth and Space Science: Weather Dynamics

Tasks for Instruction and/or Assessment

Introductory Activity
Keep a two week record of various meteorological data such as temperature, minimum and maximum temperatures, barometric pressure. (To be finished by Kim).

Activity
Do the Activity on page 505 in order to observe convection currents in water. Try to generalize your observations to convection currents in the atmosphere. (213-2)

Activity
Do the activity on page 524 in order to examine salt water evaporation. (213-3)

Activity
Do the activity on page 531 where clouds can be formed inside a jar. (212-1)

Activity
Do the cloud activity on p. 533. (213-7, 214-3, 214-10, 331-5).

Resources

BLM 14gs

Sec 13.2 # 1-10,
(11, optional)
BLM 13.2

Activity p.505
Sec 13.1 # 1-4, 9
(10, optional)

Sec 13.8 # 1-9
Additional BLM 7

Sec 13.11 # 1-8,
(10-12 optional)
Transparency 13.11
BLM 13.11b

Choose appropriate chapter review questions (as time permits).

Additional BLM 8

Sec 14.2 #1-7
BLM 14.2b
Additional BLM 1
Additional BLM 12

Earth and Space Science: Weather Dynamics

Outcomes

- identify instances in which science and technology are limited in finding the answers to questions or the solution to problems (118-7)
- describe and explain the effects of heat transfer within the hydrosphere and atmosphere on the development, severity, and movement of weather systems (331-4)
- explain how scientific knowledge evolves as new evidence comes to light (115-6)
- identify examples where scientific understanding was enhanced or revised as a result of the invention of a technology (116-1)

Elaboration – Strategies for Learning and Teaching

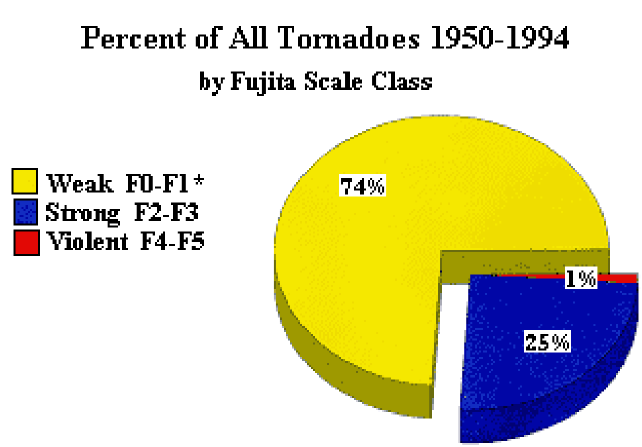
Chapter 15 Introduction, 15.2 *(0.625 hours, 0.5 class)*
Invite students to read the introduction for homework. In class, discuss extreme weatehr events, some of which students may have experienced or at least read about. Students could discuss the accuracy of weather predictions and the problems that meteorologists encounter when predicting weather. Examples are the many times that tornadoes hit without warning or at least sufficient warning, hurricanes or snow storms hitting an area when it was not predicted.

In section 15.2 students should examine the defintions of a:

- weather watch
- weather advisory
- weather warning

Nelson 15.3 *(1.25 hours, 1 class)*
Students should read and discuss this section on thunderstorms and tornadoes. Tornadoes may be a component of thunderstorms. A thunderstorm may be present without a tornado developing but a tornado cannot develop in the absence of a thunderstorm. The use of Doppler radar as a tracking device for weather systems should be investigated.The scale for measuring wind speeds of tornadoes is the Fujita scale.

The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.



Earth and Space Science: Weather Dynamics

Tasks for Instruction and/or Assessment

Activity
Do the activity on page 579 in groups. (118-7)

Activity
Do the activity on page 586 on determining distance from lightning to a person. (212-1)

Resources

Activity p.579

Activity p.585

Sec 15.3 p.588 # 1,2,4 - 6
BLM 15.3 (Table only)

Earth and Space Science: Weather Dynamics

Outcomes

- describe and explain the effects of heat transfer within the hydrosphere and atmosphere on the development, severity, and movement of weather systems (331-4)
- identify instances in which science and technology are limited to finding the answer to questions or the solution to problems (118-7)
- describe examples of Canadian contributions to science and technology (117-10)
- analyse why scientific and technological activities take place in a variety of individual and group settings (117-6)

Elaboration – Strategies for Learning and Teaching

The order in which the following sections may be done is variable.

Nelson 15.6 *(1.25 hours, 1 class)*

Variuos categories of cyclones, hurricanes, typhoons, and tropical cyclones, are investigated. All are cyclones with the names merely indicating the location each type of storm. Intensities of these storms can vary according to the temperature of the hydrosphere and atmosphere. Typically typhoons and tropical cyclones can be more intense due to warmer water conditions in the area. Storm surges are a concern as well to people living in coastal regions that are prone to cyclones.

Nelson 15.7 *(0.625 hours, 0.5 class)*

Blizzards or white hurricanes are a reality in Canada. A blizzard is a snow-storm with winds above 55 km/h, the temperature well below normal, and visibility less than 0.2 km. Blizzards can be the result of warm moist air from the Gulf of Mexico or the Atlantic mixing with a cold Artic air mass driven by the jet stream. Blizzards rotate counterclockwise.

Nelson 15.9 *(1.25 hours, 1 class)*

Extreme heat can be exascerbated by high humidity. These conditions are both accounted for using the **humidex index** (see Table 1, p.605).
Human perception of extreme cold can be amplified by strong winds. The effects of a combination of cold and wind on humans is measured using the **wind chill factor** (see Figure 4, p.606).

Nelson 15.12 *(1.25 hours, 1 class)*

El Nino and La Nina have far reaching effects and should be understood by students. Atmospheric and surface water temperatures cycle through highs and lows. These variations in temperature cause ocean currents, surface winds, and atmospheric pressures to go through cycles as well. El Nino is a shift towards warmer than usual temperatures while La Nina is colder than normal temperatures in the Pacific ocean. The effects of events should be investigated to appreciate the global impact that the Pacific Ocean has on world climate.
Scientists must collectively collect data from many locations around the world to improve their understanding of these two cycles.

Earth and Space Science: Weather Dynamics

Tasks for Instruction and/or Assessment	Resources
Research Students should research the occurance of major hurricanes in the last 50 years and their relative strengths. Students could interview people with personal accounts of having lived through severe weather events. (213-6)	Sec 15.6 # 1 - 7 Transparency 13.1 Transparency 15.6a BLM 15.6 b BLM 15.6c (homework)
Presentation Students should present an oral and/or a visual record of blizzards on PEI in the last 50 years. Parents or relatives could prove to be a rich source for old photos of blizzards. (213-6)	Sec 15.7 # 1 - 10
Project Write a paper on the development of the “Humidex” scale. (117-10, 213-6)	Sec 15.9 # 1-8, 10
Written Assignment Research El Nino or La Nina and present your findings in a power point presentation or poster form. Focus your study on the efforts that many countries collectively are making in trying to understand and predict these phenomena. (117-6)	Sec 15.12 # 1,2,4 BLM 15.12

Unit 4 Weather	**Time Required** **17 hours (13 classes)**	**Resources**
Introduction to Ch 13 13.2, 13.1	2.5 hours (2 classes)	BLM 14gs Sec 13.2 #1-10 (11 optional) BLM 13.2, Activity p.505 Sec 13.1 #1-4,9 (10 optional)
13.8,13.11,14.2	3.75 hours (3 classes)	Sec 13.8 #1-9, ABLM 7 Sec 13.11 #1-8 (10-12 optional) Transparency 13.11 BLM 13.11 b, ABLM 1, 12
Introduction to Ch 15 15.2	0.625 hours (0.5 class)	Activity p.579
15.3	1.25 hours (1 class)	Activity p.585 Sec 15.3 #1,2,4-6 BLM 15.3 (Table only)
15.6	1.25 hours (1 class)	Sec 15.6 #1-7 Transparency 13.1 Transparency 15.6a BLM 15.6b BLM 15.6c (homework)
15.7	0.625 hours (0.5 class)	Sec 15.7 #1-10
15.9	1.25 hours (1 class)	Sec 15.9 #1-8,10
15.12	1.25 hours (1 class)	Sec 15.12 #1,2,4 BLM 15.12