

New Brunswick Department of Education

The Teaching Framework
Biology 11 and 12

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Martha McClure	Learning Specialist, Educational Programs and Services, New Brunswick Department of Education, Fredericton
Alison Bartlett	Teacher, Riverview High School, Riverview
Tim Beatty	Teacher, Riverview High School, Riverview
Alexis Christmas	Teacher, Fredericton High School, Fredericton
Paul Dunnett	Teacher, Kennebecasis High School, Quispamsis
Anne Furlotte	Teacher, Bathurst High School, Bathurst
Misty Gallant	Teacher, Moncton High School, Moncton
Paul Kettela	Teacher, Woodstock High School, Woodstock
Nancy MacKinnon	Teacher, Tantramar High School, Sackville
Danny MacLean	Teacher, Tobique Valley High School, Plaster Rock
Ken McDowell	Teacher, James M. Hill Memorial High School, Miramichi
Lawrence McGillivray	Teacher, Moncton High School, Moncton
Natalie Miller	Teacher, Tantramar High School, Sackville
Susan Mills	Teacher, Tantramar High School, Sackville
Debby Peck	PhD Candidate, Science Education, University of New Brunswick, Fredericton
Michael Swift	Teacher, Sussex Regional High School, Sussex
Christine Whalen	Teacher, Moncton High School, Moncton
Jill Yates-McInnis	Teacher, Chipman Forest Avenue School, Chipman

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Introduction

Background

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

The development of these curricula involved further revision of the *Atlantic Canada Science Curriculum* for Biology 11 and Biology 12, in consultation with educators in New Brunswick over a 3-year period (as listed in the Acknowledgements).

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 life-long 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, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, their careers, and their future.

Program Design & 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
- analyzing 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, analyzing data, and interpreting data are fundamental to engaging in science. These activities provide students opportunity to understand and practice 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 class. In order to adapt to the needs of all learners, teachers must create opportunities that would 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 regarding 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 individuals' 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 equitable 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 provides 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 analyzing, 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 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 both 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 both quality of both the process and the product are important

Decision Making

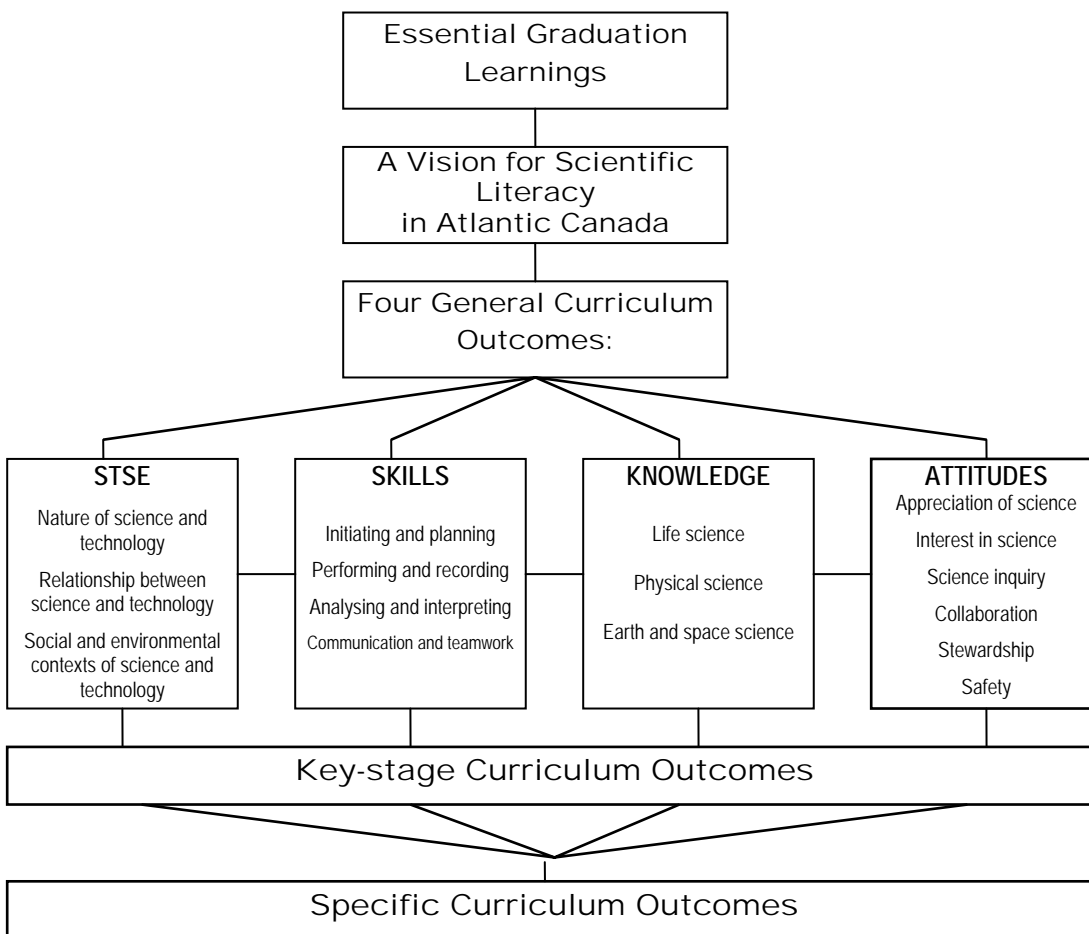
- gather information from a variety of sources
- evaluate the validity of the information source
- evaluate which information is relevant
- identify the different perspectives that influence a decision
- present information in a balanced manner
- use information to support a given perspective
- recommend 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.

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, the general curriculum outcomes, and ultimately the essential graduation learnings.

Specific curriculum outcomes are organized in three 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 three 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 focuses 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.

Extended time frames may be needed to collect data over time on such things as weather patterns or plant growth. These cases may warrant starting the activity prior to the unit in which it will be used. In all cases logical situations and contexts should be taken into consideration when these types of decisions 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.

All units comprise a two-page layout of four columns as illustrated in Figure 2. Each unit is comprised of outcomes grouped by a topic which is indicated at the top of the left page.

Unit Organization

Column One: Essential Learning Outcomes

The first column lists a group of **NB prescribed outcomes** that relate to the pan-Canadian *Specific Curriculum Outcomes* listed at the beginning of each unit. These are based on the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. This column also includes appropriate extensions for those students enrolled in **Biology 111** or **Biology 121**. 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.

Curriculum outcomes for each unit 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:
Elaborations*

The second column includes **Elaborations** of the outcomes, as well as background information. Also included are **Teaching Suggestions**, and **Optional** extensions of the topic. 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:
Tasks for Instruction and/or
Assessment*

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

This column will refer teachers to the supporting text and other resources. For current useful websites, and shared teacher resources, teachers are directed to the NB government Teacher Portal at: <https://portal.nbed.nb.ca/>

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

Topic			
<i>NB Prescribed Outcomes</i>	<i>Elaborations</i>	<i>Tasks for Instruction and/or Assessment</i>	<i>Notes</i>
<ul style="list-style-type: none"> • Outcomes based on Pan-Canadian Specific Learning Outcomes • Additional outcomes for Level 1 course • Optional outcomes to be completed after completion of above outcomes 	Elaborations of outcomes listed in column one Teaching Suggestions	Informal/Formal Observation Performance Journal Interview Paper and Pencil Presentation Portfolio	References to prescribed text and supporting resources. References to Appendices.

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: Pan Canadian Specific Curriculum Outcomes		
		STSE	Skills	Knowledge
Introduction	Synopsis of the unit	###Science-Technology-Society-Environment outcomes from <i>Common Framework of Science Learning Outcomes K to 12</i>	###Skills outcomes from <i>Common Framework of Science Learning Outcomes K to 12</i>	###Knowledge outcomes from <i>Common Framework of Science Learning Outcomes K to 12</i>
Focus and Contexts	Focus: Inquiry, Decision Making, or Problem Solving. Possible contexts suggested			
Curriculum Links	Links to concepts studied within the K-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* section of each unit.

Attitudes refer to generalized aspects of behaviour that are modeled 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-12

Attitude Outcome Statements

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

Appreciation of science	Interest in science	Scientific inquiry
<p>400 recognize the role and contribution of science in their understanding of the world</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>401 show interest in and curiosity about objects and events within the immediate environment</p> <p>402 willingly observe, question, and explore</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>403 consider their observations and their own ideas when drawing a conclusion</p> <p>404 appreciate the importance of accuracy</p> <p>405 be open-minded in their explorations</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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-12

Attitude Outcome Statements

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

Collaboration	Stewardship	Safety
<p>406 work with others in exploring and investigating</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>407 be sensitive to the needs of other people, other living things, and the local environment</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>408 show concern for their safety and that of others in carrying out activities and using materials</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 like cuts, burns, and unusual reactions – keep the work station uncluttered, with only appropriate materials present

Common Framework of Science Learning Outcomes K-12

Attitude Outcome Statements

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

Appreciation of science	Interest in science	Scientific inquiry
<p>409 appreciate the role and contribution of science and technology in their understanding of the world</p> <p>410 realize that the applications of science and technology can have both intended and unintended effects</p> <p>411 recognize that women and men of any cultural background can contribute equally to science</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>412 show interest and curiosity about objects and events within different environments</p> <p>413 willingly observe, question, explore, and investigate</p> <p>414 show interest in the activities of individuals working in scientific and technological fields</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>415 consider their own observations and ideas as well as those of others during investigations and before drawing conclusions</p> <p>416 appreciate the importance of accuracy and honesty</p> <p>417 demonstrate perseverance and a desire to understand</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> –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-12

Attitude Outcome Statements

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

Collaboration	Stewardship	Safety
<p>418 work collaboratively while exploring and investigating</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – participate in and complete group activities or projects – willingly participate in cooperative 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 	<p>419 be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>420 show concern for their safety and that of others in planning and carrying out activities and in choosing and using materials</p> <p>421 become aware of potential dangers</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 like cuts, burns, and unusual reactions – keep the work station uncluttered, with only appropriate materials present

Common Framework of Science Learning Outcomes K-12

Attitude Outcome Statements

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

Appreciation of science	Interest in science	Scientific inquiry
<p>422 appreciate the role and contribution of science and technology in our understanding of the world</p> <p>423 appreciate that the applications of science and technology can have advantages and disadvantages</p> <p>424 appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>425 show a continuing curiosity and interest in a broad scope of science-related fields and issues</p> <p>426 confidently pursue further investigations and readings</p> <p>427 consider many career possibilities in science- and technology-related fields</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>428 consider observations and ideas from a variety of sources during investigations and before drawing conclusions</p> <p>429 value accuracy, precision, and honesty</p> <p>430 persist in seeking answers to difficult questions and solutions to difficult problems</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – ask questions to clarify meaning or confirm their understanding – strive to assess a problem or situation accurately by careful analysis of evidence gathered – propose options and compare them before making decisions or taking action – honestly evaluate a complete set of data based on direct observation – critically evaluate inferences and conclusions, basing their arguments on fact rather than opinion – critically consider ideas and perceptions, recognizing that the obvious is not always right – honestly report and record all observations, even when the evidence is unexpected and will affect the interpretation of results – take the time to gather evidence accurately and use instruments carefully – willingly repeat measurements or observations to increase the precision of evidence – choose to consider a situation from different perspectives – identify biased or inaccurate interpretations – report the limitations of their designs – respond skeptically to a proposal until evidence is offered to support it – seek a second opinion before making a decision – continue working on a problem or research project until the best possible solutions or answers are identified

Common Framework of Science Learning Outcomes K-12

Attitude Outcome Statements

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

Collaboration	Stewardship	Safety in science
<p>431 work collaboratively in carrying out investigations as well as in generating and evaluating ideas</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>432 be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment</p> <p>433 project, beyond the personal, consequences of proposed actions</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>434 show concern for safety in planning, carrying out, and reviewing activities</p> <p>435 become aware of the consequences of their actions</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – read the labels on materials before using them, and ask for help if safety symbols are not clear or understood – readily alter a procedure to ensure the safety of members of the group – select safe methods and tools for collecting evidence and solving problems – listen attentively to and follow safety procedures explained by the teacher or other leader – carefully manipulate materials, using skills learned in class or elsewhere – ensure the proper disposal of materials – immediately respond to reminders about the use of safety precautions – willingly wear proper safety attire without having to be reminded – assume responsibility for their involvement in a breach of safety or waste disposal procedures – stay within their own work area during an activity, respecting others' space, materials, and work – take the time to organize their work area so that accidents can be prevented – immediately advise the teacher of spills, breaks, and unusual occurrences, and use appropriate techniques, procedures, and materials to clean up – clean their work area during and after an activity – seek assistance immediately for any first aid concerns like burns, cuts, or unusual reactions – keep the work area uncluttered, with only appropriate materials present

Common Framework of Science Learning Outcomes K-12

Attitude Outcome Statements

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

Appreciation of science	Interest in science	Scientific inquiry
<p>436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not</p> <p>437 appreciate that the applications of science and technology can raise ethical dilemmas</p> <p>438 value the contributions to scientific and technological development made by women and men from many societies and cultural backgrounds</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>439 show a continuing and more informed curiosity and interest in science and science-related issues</p> <p>440 acquire, with interest and confidence, additional science knowledge and skills, using a variety of resources and methods, including formal research</p> <p>441 consider further studies and careers in science- and technology-related fields</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>442 confidently evaluate evidence and consider alternative perspectives, ideas, and explanations</p> <p>443 use factual information and rational explanations when analysing and evaluating</p> <p>444 value the processes for drawing conclusions</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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

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Collaboration	Stewardship	Safety
<p>445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>446 have a sense of personal and shared responsibility for maintaining a sustainable environment</p> <p>447 project the personal, social, and environmental consequences of proposed action</p> <p>448 want to take action for maintaining a sustainable environment</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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 	<p>449 show concern for safety and accept the need for rules and regulations</p> <p>450 be aware of the direct and indirect consequences of their actions</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> – 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