# Science 11 (2016)

## Course Overview

*Revised (January 2017)*

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## Overview

The purpose of this document is to provide an introduction to the *Science 11 (2016)* course and supplementary resource packages that were developed by a committee of teachers representing various school divisions. The entire course package consists of this course overview and four supplementary resource packages, one for each of the units of study, namely:

- *Science 11 (2016) Resource Package – Career Investigation*
- *Science 11 (2016) Resource Package – Climate and Ecosystem Dynamics*
- *Science 11 (2016) Resource Package – Chemical Reactions*
- *Science 11 (2016) Resource Package – Force and Motion in Our World*

The following individuals participated in the development of the *Science 11 (2016)* course and resource packages.

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School divisions wishing to receive copies of this course should submit a request to the ministry at curriculum@gov.sk.ca. The necessary documents will be sent back to the school division so they can submit an application through Blackboard. Once approval is received from the Ministry of Education, the school division may start using this course.

If a student is being considered for *Science 11 (2016)*, or any other modified course of study, the student and the parents/caregivers of the student must be consulted prior to being enrolled in a Locally Modified Course of Study. Consult *Policy and Procedures for Locally Modified Courses of Study* for further information.

# Introduction

Science is a required area of study in Saskatchewan's Core Curriculum. Students require *Science 10* and a 20-level science course in order to meet graduation requirements. A modified course (*Science 11*) can be used to fulfill the grade 10 science requirement.

The *Science 11 (2016)* course and resource packages were developed to reflect the structure of the renewed *Science 10* curriculum. Therefore, teachers should use *Science 10* to assist with unit planning and instruction for *Science 11 (2016)*. The renewed *Science 10* curriculum is available at http://www.curriculum.gov.sk.ca.

Each resource package contains the following sections:

- A table of contents that shows which outcome(s) each lesson supports
- The outcomes and indicators relevant to that unit of study
- Lessons, consisting of:
    - Outcomes and indicators the lesson supports
    - Lesson overview
    - Instructional document (s)
        - Teacher support material and/or student handouts
    - Supporting resources

Some outcomes are addressed in more than one of the suggested lessons within a unit; therefore teachers need not use all of the suggested lessons. Teachers may request an electronic version of this course package from their school division office so that they can modify the instructional documents to meet diverse needs.

# Adaptive Dimension

In order to meet the variety of students' needs, flexibility is required within the school program to enable schools and teachers to adapt instructional materials, methods, and the environment to provide the most appropriate educational opportunities for all students. The Adaptive Dimension is used to:

- help students achieve curriculum outcomes
- maximize student learning and independence
- lessen discrepancies between achievement and ability
- promote a positive self-image and feeling of belonging
- promote a willingness to become involved in learning
- provide opportunities for all students to be engaged in learning.

The intent of the Adaptive Dimension applies to all programs and courses of instruction. The key variables of instruction are differentiated--the content (what students will learn), the learning processes (how students will interact with the content), and the learning products (how students will demonstrate learning and mastery of content), and the instructional setting or environment. Whenever possible, students should learn a regular curricula and be supported through the Adaptive Dimension.
Some students may not be able to complete a particular regular provincial course even though adaptations to curriculum materials and topics, instruction, and environment have been made. This

may require the development of a modified (Science 11) course to meet student needs to which the Adaptive Dimension may be applied.

## Broad Areas of Learning

There are three Broad Areas of Learning that reflect Saskatchewan's Goals of Education. Science education contributes to student achievement of the Goals of Education through helping students achieve knowledge, skills and attitudes related to these Broad Areas of Learning.

**Lifelong Learners**
Students who are engaged in constructing and applying science knowledge naturally build a positive disposition towards learning. Throughout their study of science, students bring their curiosity about the natural and constructed world, which provides the motivation to discover and explore their personal interests more deeply. By sharing their learning experiences with others, in a variety of contexts, students develop skills that support them as lifelong learners.

**Sense of Self, Community, and Place**
Students develop and strengthen their personal identity as they explore connections between their own understanding of the natural and constructed world and perspectives of others, including scientific and Indigenous perspectives. Students develop and strengthen their understanding of community as they explore ways in which science can inform individual and community decision making on issues related to the natural and constructed world. Students interact experientially with place-based local knowledge to deepen their connection to and relationship with nature.

**Engaged Citizens**

As students explore connections between science, technology, society and the environment, they experience opportunities to contribute positively to the environmental, economic and social sustainability of local and global communities. Students reflect and act on their personal responsibility to understand and respect their place in the natural and constructed world, and make personal decisions that contribute to living in harmony with others and the natural world.

## Cross-curricular Competencies

The Cross-curricular Competencies are four interrelated areas containing understandings, values, skills and processes which are considered important for learning in all areas of study. These competencies reflect the Common Essential Learnings and are intended to be addressed in each area of study at each grade.

**Developing Thinking**
Learners construct knowledge to make sense of the world around them. In science, students develop understanding by building and reflecting on their observations and what is already known by themselves and others. By thinking contextually, creatively and critically, students develop deeper understanding of various phenomena in the natural and constructed world.

**Developing Identity and Interdependence**
This competency addresses the ability to act autonomously in an interdependent world. It requires the learner to be aware of the natural environment, of social and cultural expectations and of the possibilities for individual and group accomplishments. Interdependence assumes the possession of a positive self-concept and the ability to live in harmony with others and with the natural and constructed world. In science, students examine the interdependence among living things within local, national and global environments and consider the impact of individual decisions on those environments.

**Developing Literacies**
Literacies are multi-faceted and provide a variety of ways, including the use of various language systems and media, to interpret the world and express understanding of it. Literacies involve the evolution of interrelated knowledge, skills and strategies that facilitate an individual's ability to participate fully and equitably in a variety of roles and contexts – school, home, and local and global communities. In science, students collect, analyze and represent their ideas and understanding of the natural and constructed world in multiple forms.

**Developing Social Responsibility**
Social responsibility is how people positively contribute to their physical, social, cultural and educational environments. It requires the ability to participate with others in accomplishing shared or common goals. This competency is achieved by using moral reasoning processes, engaging in communitarian thinking and dialogue and taking social action. Students in science examine the impact of scientific understanding and technological innovations on society.

# Aim and Goals

The aim of K-12 science education is to enable all Saskatchewan students to develop scientific literacy. Scientific literacy today embraces Euro-Canadian and Indigenous heritages, both of which have developed an empirical and rational knowledge of nature. A Euro-Canadian way of knowing about the natural and constructed world is called science, while First Nations and Métis ways of knowing nature are found within the broader category of Indigenous knowledge.

Diverse learning experiences based on the outcomes in this curriculum provide students with many opportunities to explore, analyze, evaluate, synthesize, appreciate and understand the interrelationships among science, technology, society and the environment (STSE) that will affect their personal lives, their careers and their future.

**Goals** are broad statements identifying what students are expected to know and be able to do upon completion of the learning in a particular area of study by the end of Grade 12. The four goals of K-12 science education are to:

- **Understand the Nature of Science and STSE Interrelationships** – Students will develop an understanding of the nature of science and technology, their interrelationships and their social and environmental contexts, including interrelationships between the natural and constructed world.
- **Construct Scientific Knowledge** – Students will construct an understanding of concepts, principles, laws and theories in life science, in physical science, in earth and space science and in Indigenous knowledge of nature and then apply these understandings to interpret, integrate and extend their knowledge.

- **Develop Scientific and Technological Skills** – Students will develop the skills required for scientific and technological inquiry, problem solving and communicating, for working collaboratively, and for making informed decisions.
- **Develop Attitudes that Support Scientific Habits of Mind** – Students will develop attitudes that support the responsible acquisition and application of scientific, technological and Indigenous knowledge to the mutual benefit of self, society and the environment.

## Inquiry

Inquiry learning provides students with opportunities to build knowledge, abilities and inquiring habits of mind that lead to deeper understanding of their world and human experience. Inquiry is more than a simple instructional method. It is a philosophical approach to teaching and learning, grounded in constructivist research and methods, which engages students in investigations that lead to disciplinary and interdisciplinary understanding.

Inquiry builds on students' inherent sense of curiosity and wonder, drawing on their diverse backgrounds, interests and experiences. The process provides opportunities for students to become active participants in a collaborative search for meaning and understanding.

Secondary students who are engaged in inquiry in science should be able to:

- identify questions and concepts that guide scientific investigations.
- design and conduct scientific investigations.
- use technology and mathematics to improve investigations and communications.
- formulate and revise scientific explanations and models using logic and evidence.
- recognize and analyze alternative explanations and models.
- Communicate and defend a scientific argument.

(NRC, 1996, pp. 175, 176)

## Creating Questions for Inquiry in Science

Inquiry focuses on the development of questions to initiate and guide the learning process. Students and teachers formulate questions to motivate inquiries into topics, problems and issues related to curriculum content and outcomes.

Well-formulated inquiry questions are broad in scope and rich in possibilities. Such questions encourage students to explore, observe, gather information, plan, analyze, interpret, synthesize, problem solve, take risks, create, conclude, document, reflect on learning and develop new questions for further inquiry.

> *Good science inquiry provides many entry points – ways in which students can approach a new topic – and a wide variety of activities during student work.*
>
> *(Kluger-Bell, 2000, p.48)*

In science, teachers and students can use the four learning contexts of Scientific Inquiry, Technological Problem Solving, STSE Decision Making, and Cultural Perspectives (see Learning Contexts section of this document for further information) as curriculum entry points to begin their inquiry. The process may evolve into interdisciplinary learning opportunities reflective of the holistic nature of our lives and an interdependent global environment.

Developing questions evoked by student interests has the potential for rich and deep learning. These questions are used to initiate and guide the inquiry and give students direction for investigating topics, problems, ideas, challenges or issues under study.

Essential questions that lead to deeper understanding in science should:

- center on objects, organisms and events in the natural world;
- connect to science concepts outlined in the curricular outcomes;
- lend themselves to empirical investigation; and,
- lead to gathering and using data to develop explanations for natural phenomena.

(NRC, 2000, p. 24)

The process of constructing questions for deep understanding can help students grasp the important disciplinary or interdisciplinary ideas that are situated at the core of a particular curricular focus or context. These broad questions lead to more specific questions that can provide a framework, purpose and direction for the learning activities in a lesson, or series of lessons, and help students connect what they are learning to their experiences and life beyond school.

Questions give students some initial direction for uncovering the understandings associated with a unit of study. Questions can help students grasp the big disciplinary ideas surrounding a focus or context and related themes or topics. They provide a framework, purpose and direction for the learning activities in each unit and help students connect what they are learning to their experiences and life beyond the classroom. Questions also invite and encourage students to pose their own questions for deeper understanding.

## General Suggestions for Teaching Science 11 (2016)

Students in *Science 11 (2016)* may be capable of completing the same activities as students in *Science 10*, but may require appropriate adaptations to meet individual learning needs. For example, students may need additional time to complete a particular activity, may require more guidance while performing the activity or may require additional assistance with reading through a lab and interpreting the procedure to carry out the steps of the investigation.

Students in modified courses, such as *Science 11 (2016)*, often experience success with assignments when given some guidance, or a template. For example, doing a complete lab write-up beginning with a blank sheet of paper may be too much of a challenge. However, if a student is provided a partial lab write-up and required to fill in information as they carry out the investigation, they will likely experience more success with the task. Note that throughout each of the units in this course outline you will find some lessons where the instructional documents (Student Handout) are designed this way. Teachers may also want to look at incorporating additional lessons structured in this way.

Incorporating educational videos into lessons may facilitate the learning of some concepts in any course. Teachers need to pay attention to student learning styles when using video, particularly in a modified course. Some suggestions for use of video would be to watch the video in short clips as well as provide the students with sufficient guidance (including handouts) to assist them with gathering important information from the video.

## Outcomes and Indicators

**Outcomes** are statements of what students are expected to know and be able to do by the end of a grade or secondary level course in a particular area of study. Therefore, all outcomes are required. The outcomes provide direction for assessment and evaluation, and for program, unit and lesson planning. Critical characteristics of an outcome include the following:

- focus on what students will learn rather than what teachers will teach;
- specify the skills and abilities, understandings, knowledge and/or attitudes students are expected to demonstrate;
- are observable, assessable and attainable;
- are written using action-based verbs and clear professional language (educational and subject-related);
- are developed to be achieved in context so that learning is purposeful and interconnected;
- are grade and subject specific;
- are supported by indicators which provide the breadth and depth of expectations; and,
- have a developmental flow and connection to other grades where applicable.

**Indicators** are representative of what students need to know and/or be able to do in order to achieve an outcome. When teachers are planning for instruction, they must comprehend the set of indicators to understand fully the breadth and the depth of learning related to a particular outcome. Based on this understanding of the outcome, teachers may develop their own indicators that are responsive of students' interests, lives and prior learning. These teacher-developed indicators must maintain the intent of the outcome.

The outcomes and indicators in this locally modified course have been adapted from the renewed *Science 10* outcomes and indicators. The modified outcomes and indicators are also identified in each of the resource packages that accompany this course. Further information about learning contexts and the Foundations of Scientific Literacy is available in the *Science 10* curriculum document.

# Science 11 (2016) Outcomes at a Glance

| Career Exploration |
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| SCI11-CI1 Investigate career paths related to various branches and sub-branches of science. |

| Climate and Ecosystem Dynamics |
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| SCI11-CD1 Analyze the impact of human actions on the local and global climate and the sustainability of ecosystems. |
| SCI11-CD2 Examine factors that influence Earth's climate system and consider the role of the natural greenhouse effect. |
| SCI11-CD3 Examine biodiversity and interactions among populations within communities. |
| SCI11-CD4 Explore the role of feedback mechanisms in biogeochemical cycles and in maintaining stability in ecosystems. |

| Chemical Reactions |
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| SCI11-CR1 Examine the properties of chemical reactions, including the role of energy changes, and applications of acids and bases. |
| SCI11-CR2 Name and write formulas for common ionic and molecular chemical compounds, including acids and bases. |
| SCI11-CR3 Represent chemical reactions and conservation of mass symbolically using models, word and skeleton equations and balanced chemical equations. |
| SCI11-CR4 Examine factors that affect the rate of chemical reactions. |

| Force and Motion in Our World |
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| SCI11-FM1 Research motion-related technologies and their impacts on self and society. |
| SCI11-FM2 Investigate the motion of objects that travel at a constant speed in a straight line. |
| SCI11-FM3 Investigate the motion of objects that undergo acceleration. |
| SCI11-FM4 Explore the relationship between force and motion for objects moving in one dimension. |

## Legend

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| SCI11-CI1a | |
| SCI11 | Course name |
| CI | Unit of study |
| 1 | Outcome number |
| a | Indicator |
| [CP, DM, SI, TPS] | Learning context(s) that best support this outcome |
| (A, K, S, STSE) | Foundation(s) of Scientific Literacy that apply to this indicator |

| Science 11 (2016) - Career Investigation | |
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| **All outcomes contribute to the development of all K-12 science goals.** | |
| **Outcomes** | **Indicators** |
| SCI11-CI1 Investigate career paths related to various branches and sub-branches of science.<br><br>[DM] | a. Explore the breadth of science-related work roles and who is engaged in those work roles in the community. (STSE, S, A)<br>b. Develop a profile of a specific individual involved in a science career, addressing factors such as their educational and personal background, what drew them to their career, the focus of their work and their advice for others who wish to pursue a similar career. (STSE, S, A)<br>c. Research the range of science-related programs offered by post-secondary institutions in Saskatchewan and across the country. (STSE, S, A)<br>d. Research the educational qualifications of people engaged in science-related careers. (STSE, S, A)<br>e. Attend a science-related career fair and analyze career choices based on information gathered. (STSE, S, A)<br>f. Identify how personal activities and interests relate to topics in secondary science curricula. (STSE, S, A)<br>g. Represent the range of career options available related to a specific branch or sub-branch of science. (STSE, S, A) |

| Science 11 (2016) - Climate and Ecosystem Dynamics | |
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| **All outcomes contribute to the development of all K-12 science goals.** | |
| **Outcomes** | **Indicators** |
| SCI11-CD1 Analyze the impact of human actions on the local and global climate and the sustainability of ecosystems.<br><br>[CP, DM] | a. Examine the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal experience and research. (A, S, STSE)<br>b. Reflect upon your personal view of humanity's relationship with the environment. (STSE, A)<br>c. Research and/or consult with people from Indigenous and/or other cultures to see how they view relationships between living organisms and their ecosystems, and the role of humans in those relationships. (STSE)<br>d. Examine the positions of First Nations and government agencies responsible for the stewardship and management of resources, including the duty to consult. (STSE, A)<br>e. Identify changes in the scientific worldview of sustainability and |

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| | human's responsibility to protect ecosystems, considering key milestones and publications such as *Our Common Future*, *Rio Declaration on Environment and Development*, *Agenda 21*, *Convention on Biological Diversity* and the *Bonn Declaration*. (STSE, A)<br>f. Discuss why it is important to consider economic, social justice and environmental perspectives when examining sustainability. (STSE, A)<br>g. Discuss and analyze the validity of information from various human, print and electronic sources (e.g., government publications and community resources), with respect to sustainability, sustainable development and education for sustainable development. (S)<br>h. Provide examples of human actions that have contributed to the anthropogenic (human caused) greenhouse effect. (K, STSE)<br>i. Identify how scientists observe changes to the key indicators of climate change (e.g., $CO_2$ concentration, global surface temperature, Arctic sea ice area, land ice mass and sea level) to support the scientific understanding of climate change. (K, STSE, A)<br>j. Reflect upon individual and societal lifestyle choices and behaviours that can help to minimize anthropogenic (human caused) sources of global climate change. (K, STSE)<br>k. Discuss and reflect upon the current and potential future effects of ongoing changes to Earth's climate systems on the people and the environment in Saskatchewan and Canada's Arctic region. (K, STSE) |
| SCI11-CD2 Examine factors that influence Earth's climate system and consider the role of the natural greenhouse effect.<br><br>[DM, SI] | a. Differentiate between weather and climate, and the impacts of each on daily life. (K, STSE)<br>b. Understand that Earth's climate system results from the exchange of thermal energy and moisture between the sun, ice sheets, oceans, solid earth and the biosphere over a range of timescales. (K, A)<br>c. Investigate and illustrate how Earth's axial tilt, rotation and revolution around the sun cause uneven heating of Earth's surface, resulting in the Coriolis Effect and jet streams. (S, K)<br>d. Explain and illustrate how greenhouse gases (e.g., water vapour, carbon dioxide, methane, nitrous oxide, sulphur dioxide and ozone), particles, clouds and surface albedo affect the amount of solar energy absorbed and re-radiated at various locations on Earth. (K)<br>e. Identify natural sources (e.g., volcanoes, fire, evaporation and living organisms) of the primary greenhouse gases in Earth's atmosphere and discuss how they contribute to the natural greenhouse effect. (K, A)<br>f. Illustrate the natural greenhouse effect, the reflectivity of Earth's surface or the relationship between Earth's axial tilt and the seasons. (S, STSE, A) |
| SCI11-CD3 Examine biodiversity and interactions among populations within communities. | a. Discuss the importance of biodiversity and maintaining biodiversity. (S, K)<br>b. Compare the biodiversity and climatic characteristics of several of Earth's major biomes. (S, K)<br>c. Estimate the abundance of organisms in a local ecosystem. (S) |

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| [DM, SI] | d. Discuss ethical and cultural perspectives related to studying biotic components of ecosystems, including the potential benefits and consequences of technologies (e.g., radio collar) and techniques (e.g., mark and recapture) used to collect data. (K, STSE, A)<br>e. Investigate various ways in which natural populations attempt to maintain equilibrium, and relate this equilibrium to the resource limits of an ecosystem with reference to concepts such as carrying capacity, natality, mortality, immigration and emigration. (S, K)<br>f. Examine how factors such as invasive species, habitat loss and climate change affect biodiversity within an ecosystem, and can result in species becoming at-risk (i.e., vulnerable, threatened and extirpated). (K, STSE) |
| SCI11-CD4 Explore the role of feedback mechanisms in biogeochemical cycles and in maintaining stability in ecosystems.<br><br>[CP, DM, SI] | a. Create a representation of a feedback mechanism that is relevant to a specific biogeochemical (e.g., carbon, nitrogen, phosphorus and water) cycle. (S)<br>b. Examine how human actions can affect the cycling of matter and flow of energy through ecosystems. (K, A, STSE)<br>c. Illustrate the processes of nitrification and denitrification in terrestrial and aquatic ecosystems. (K)<br>d. Observe the connections between the water cycle and other biogeochemical cycles. (K, S) |

| **Science 11 (2016) - Chemical Reactions** | |
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| **All outcomes contribute to the development of all K-12 science goals.** | |
| **Outcomes** | **Indicators** |
| SCI11-CR1 Examine the properties of chemical reactions, including the role of energy changes, and applications of acids and bases.<br><br>[CP, SI] | a. Create a representation about the prevalence of chemistry in our lives. (A, S)<br>b. Research the ways in which people from various times and cultures, including First Nations and Métis, have applied their understanding of the transformation of materials to produce new substances. (STSE)<br>c. Observe and describe a variety of chemical reactions, including synthesis, decomposition, combustion, single replacement and double replacement. (S, K)<br>d. Apply knowledge of Workplace Hazardous Materials Information System (WHMIS 1998 and WHMIS 2015) standards by selecting and applying proper techniques for handling and disposing of lab materials and interpreting *Materials Safety Data Sheets* (MSDS) and *Safety Data Sheets* (SDS). (K, STSE, A)<br>e. Explore endothermic and exothermic chemical reactions, including identifying where or how energy is absorbed or released in the reaction and identifying potential benefits and consequences of the reaction. (K, S)<br>f. Observe and describe practical examples of chemical reactions |

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| | involving acids and bases, including neutralization reactions such as those involved in chemical spills, soda-acid fire extinguishers and antacids. (S, STSE) |
| SCI11-CR2 Name and write formulas for common ionic and molecular chemical compounds, including acids and bases.<br><br>[SI] | a. Name and write formulas for common binary ionic compounds, using the periodic table and a list of common ions. (S)<br>b. Identify substances as ionic or molecular, based on their properties (e.g., melting/boiling point, electrical conductivity and solubility). (S)<br>c. Identify names and formulas for common molecular and organic compounds (e.g., methane, propane, butane, octane, methanol, ethanol and glucose), using the periodic table and a list of numerical Greek prefixes. (S)<br>d. Investigate the properties of household acids and bases, including selecting and using appropriate instruments for safely collecting evidence. (S, A)<br>e. Investigate how certain substances, including those traditional to First Nations and Métis cultures, can serve as acid-base indicators. (K, STSE, A)<br>f. Identify how the pH scale is used to classify substances as acidic, basic or neutral. (S, STSE, A) |
| SCI11-CR3 Represent chemical reactions and conservation of mass symbolically using models, word and skeleton equations and balanced chemical equations.<br><br>[SI, DM] | a. Explain the concept of conservation of mass in understanding and interpreting chemical reactions. (K, S)<br>b. Represent chemical reactions, organic compounds and conservation of mass using models and word equations. (S, K, A)<br>c. Represent chemical reactions and conservation of mass using skeleton equations and balanced equations. (S, K, A)<br>d. Differentiate between the use of subscripts and coefficients in representing the numbers of atoms and molecules present in chemical reactions. (S)<br>e. Categorize chemical reactions as synthesis, decomposition, combustion, single replacement and double replacement, including acid base neutralization. (S, K, A)<br>f. Verify whether a chemical equation is correctly balanced, and correct any errors. (S)<br>g. Explain why scientists represent chemical reactions using models, word and skeleton equations and balanced chemical equations. (STSE) |
| SCI11-CR4 Examine factors that affect the rate of chemical reactions.<br>[SI] | a. Provide examples of chemical reactions that occur over a range of time scales. (K)<br>b. Predict how temperature of the reactant(s), concentration of the reactant(s) and surface area of the reactant(s) might affect the rate of a chemical reaction. (S, A)<br>c. Perform an experiment to determine how the temperature of the reactant(s), concentration of the reactant(s) and surface area of the reactant(s) affect chemical reaction rates. (S, STSE)<br>d. Collect and organize data related to rates of chemical reactions. (S, A)<br>e. Interpret data related to chemical reaction rates. (S, A)<br>f. Reflect upon data collection and analysis procedures, and suggest |

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| | improvements to increase precision and accuracy. (S, A, STSE)<br>g. Use the collision model to explain differences in chemical reaction rates. (K, STSE)<br>h. Value the processes for drawing conclusions in science. (A, STSE)<br>i. Work co-operatively with team members to develop and carry out a plan. (S, A) |

| **Science 11 (2016) - Force and Motion in Our World** | |
|---|---|
| **All outcomes contribute to the development of all K-12 science goals.** | |
| **Outcomes** | **Indicators** |
| SCI11-FM1 Research motion-related technologies and their impacts on self and society.<br><br>[DM, TPS] | a. Create a representation of different types of motion and motion-related technologies from various cultures, including Indigenous cultures worldwide. (S, STSE)<br>b. Research the historical development of a motion-related technology including improvements to the technology from past to present. (STSE)<br>c. Design and construct a prototype of an object that meets a student-identified interest related to motion. (STSE, S, A)<br>d. Assess the design and function of a motion-related technology using student-identified criteria such as safety, cost, availability and impact on everyday life and the environment. (STSE) |
| SCI11-FM2 Investigate the motion of objects that travel at a constant speed in a straight line.<br><br>[SI] | a. Provide examples of objects that exhibit, or appear to exhibit, uniform motion. (K)<br>b. Discuss the concept of 'frame of reference' in determining whether an object is in motion and in constructing representations of an object's motion. (S, K, A)<br>c. Carry out experiments to determine the properties of uniform motion, using technologies such as photogates, motion detectors, ticker timers and stopwatches to collect distance and time data effectively and accurately. (S, STSE, A)<br>d. Discuss the importance of distinguishing between scalar (e.g., distance, speed and time) and vector (e.g., position, displacement, velocity and acceleration) quantities. (K)<br>e. Interpret graphs (i.e., distance-time, position-time, speed-time and velocity-time) using data obtained from objects undergoing uniform motion or through computer simulations (e.g., a person walking). (S, A) |
| SCI11-FM3 Investigate the motion of objects that undergo acceleration.<br><br>[SI] | a. Carry out experiments to determine the properties of accelerated motion, including identifying variables to be tested, using appropriate sampling procedures for data collection, collecting and recording data and analyzing data to generate conclusions. (S, STSE)<br>b. Apply the concept of 'rate of change' to operationally define speed. (K) |

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| | c. Convert measurements to the same units when solving motion problems. (K) |
| SCI11-FM4 Explore the relationship between force and motion for objects moving in one dimension.<br><br>[SI, TPS] | a. Pose questions about the ways in which forces cause objects to move or change their motion. (A, S)<br>b. Investigate the effects of applying constant forces to objects at rest and to objects moving at a constant velocity in a straight line. (S, A)<br>c. Demonstrate the role of friction in changing the position and/or motion of an object. (K, S)<br>d. Provide examples of technologies that have been developed to increase or decrease frictional forces between two or more surfaces. (STSE)<br>e. Analyze data to verify the relationship between the acceleration of an object and the net force acting on it. (S)<br>f. Provide examples of Newton's three laws of motion in practical situations such as sports, flight and transportation. (K, A) |

## Assessment and Evaluation of Student Learning

Assessment and evaluation require thoughtful planning and implementation to support the learning process and to inform teaching. All assessment and evaluation of student achievement must be based on the outcomes in the provincial curriculum.

Assessment involves the systematic collection of information about student learning with respect to:

- achievement of provincial curriculum outcomes;
- effectiveness of teaching strategies employed; and,
- student self-reflection on learning.

Evaluation compares assessment information against criteria based on curriculum outcomes for the purpose of communicating to students, teachers, parents/caregivers and others about student progress and to make informed decisions about the teaching and learning process.

There are three interrelated purposes of assessment. Each type of assessment, systematically implemented, contributes to an overall picture of an individual student's achievement.

**Assessment for learning** involves the use of information about student progress to support and improve student learning, inform instructional practices, and:

- is teacher-driven for student, teacher and parent use;
- occurs throughout the teaching and learning process, using a variety of tools; and,
- engages teachers in providing differentiated instruction, feedback to students to enhance their learning and information to parents in support of learning.

**Assessment as learning** actively involves student reflection on learning, monitoring of her/his own progress, and:

- supports students in critically analyzing learning related to curricular outcomes;
- is student-driven with teacher guidance; and,
- occurs throughout the learning process.

**Assessment of learning** involves teachers' use of evidence of student learning to make judgements about student achievement and:

- provides opportunity to report evidence of achievement related to curricular outcomes;
- occurs at the end of a learning cycle, using a variety of tools; and,
- provides the foundation for discussions on placement or promotion.

## Key Resources

Many resources that were reviewed and recommended for *Science 10* are also suggested for use in *Science 11 (2016)*. It should be noted that the teacher may need to adapt and modify the resources to meet the diverse needs of the students. For further information (including order numbers) for these resources refer to the *Science 10* tab at www.curriculum.gov.sk.ca.

- *BC Science 10* (2008) – McGraw-Hill Ryerson
- *Investigating Science 10* (2009) – Pearson
- *Nova Scotia Science 10* (2011) – McGraw-Hill Ryerson
- *Science 10* (2001) – Nelson
- *Science 10: Concepts and Connections* (2001) – Nelson
- *Science Perspectives 10* (2010) – Nelson
- *SciencePower 10* (2000) – McGraw-Hill Ryerson

## References

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