SCIENCE 10

Course Description

This course combines life science, earth science, and physical science through three major themes. The study of factors that influence Earth's climate and ecosystems includes examining the role of human actions and feedback mechanisms. The second theme involves study of the characteristics and rates of chemical reactions and how to represent chemical reactions using models, works, and equations. Lastly, students will investigate the motion of objects and the role of forces in causing motion. Student inquiry will guide investigations of these topics as well as related careers.

Prerequisite: Science 9

NOTE:

- This document only contains the draft outcomes and indicators for Science 10. The Science 9 document – available at www.curriculum.gov.sk.ca – outlines the philosophy of science curricula and contains all of the components that comprise an entire curriculum. It will be similar to the completed Science 10 document.
- Schools are required to implement Science 10 during the 2014-15 school year.

OUTCOMES *are statements of what students are expected to know and be able to do by the end of a grade in a particular area of study. Outcomes provide direction for assessment and evaluation, and for program, unit, and lesson planning. All outcomes are mandatory.*

INDICATORS *are representative of what students need to know and/or be able to do to achieve an outcome. Indicators represent the breadth and depth of learning related to a particular outcome.*

- All science outcomes and indicators emphasize one or more of the foundations of scientific literacy; these represent the "what" of the curriculum.
- The four learning contexts (Scientific Inquiry, Technological Problem Solving, Cultural Perspectives, and STSE Decision Making) represent different processes for engaging students in achieving curricular outcomes; they are the "how" of the curriculum.
- Although some outcomes may be organized into units of study, teachers are not required to structure student learning into these or any other distinct units.

Questions about science curriculum should be directed to:

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Science 10 Outcomes

Career Investigation
SCI10-CI1 Investigate career paths related to various science disciplines and sub-disciplines.

Climate and Ecosystem Dynamics
SCI10-CD1 Assess the consequences of human actions on the local, regional, and global climate and the sustainability of ecosystems.
SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect.
SCI10-CD3 Examine biodiversity through the analysis of interactions among populations within communities.
SCI10-CD4 Investigate the role of feedback mechanisms in biogeochemical cycles and in maintaining stability in ecosystems.

Chemical Reactions
SCI10-CR1 Explore the characteristics of a variety of chemical reactions, including the role of energy changes.
SCI10-CR2 Name and write formulas for common ionic and molecular chemical compounds, including acids and bases.
SCI10-CR3 Represent chemical reactions and conservation of mass symbolically using models, word and skeleton equations, and balanced chemical equations.
SCI10-CR4 Investigate the rates of chemical reactions, including factors that affect the rate.

Force and Motion in Our World
SCI10-FM1 Explore the development of motion-related technologies and their impacts on self and society.
SCI10-FM2 Investigate and represent the motion of objects that travel at a constant speed in a straight line.
SCI10-FM3 Investigate and represent the motion of objects that experience constant acceleration.
SCI10-FM4 Explore the relationship between force and motion for objects moving in one and two dimensions.

CAREER INVESTIGATION

Science 10: Career Investigation	
Outcomes	Indicators
SCI10-CI1 Investigate career paths related to various branches and sub-branches of science.	a. Create a representation of connections between various branches and sub-branches of science. (STSE, S, A) b. Explore the breadth of science-related work roles and who is engaged in those work roles in the community. (STSE, S, A) c. 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) d. Research the range of science-related programs offered by post-secondary institutions in Saskatchewan and across the country. (STSE, S, A) e. Identify supports that professional societies and organizations provide to those engaged in science-related careers in Saskatchewan. (STSE, S, A) f. Research the educational qualifications of people engaged in science-related careers. (STSE, S, A) g. Attend a science related career fair, and analyze career choices based on information gathered. (STSE, S, A) h. Identify how personal activities and interests relate to topics in secondary science curricula. (STSE, S, A) i. Create a publication to represent the range of career options available related to a specific branch of science. (STSE, S, A)

Science 10: Climate and Ecosystems Dynamics	
Outcomes	Indicators
SCI10-CD1 Assess the consequences of human actions on the local, regional, and global climate and the sustainability of ecosystems. [CP, DM]	a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (A, S, STSE) b. Reflect upon your personal view of humanity's relationship with the environment. (STSE, A) c. Research how people from Aboriginal and other cultures view relationships between living organisms and their ecosystems, and the role of humans in those relationships. (STSE) d. Evaluate changes in the scientific world view (paradigm shift) of sustainability and 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) e. Discuss why it is important to consider economic, social justice, and environmental perspectives when examining sustainability. (STSE, A) f. Select, integrate, and analyze the validity of information from various human, print, and electronic sources (e.g., government publications, community resources, and personally collected data), with respect to sustainability, sustainable development, and education for sustainable development. (S) g. Provide examples of human actions that have contributed to the anthropogenic greenhouse effect. (K, STSE) h. Research how scientists examine 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) i. Reflect upon individual and societal behavioural and lifestyle choices that can help to minimize anthropogenic sources of global climate change. (K, STSE) j. Develop, present, and defend a position or course of action based on personal research related to mitigating the effects of global or local climate change or to enhancing the sustainability of an ecosystem, taking into account human and environmental needs. (S, A, STSE) k. Assess 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)
SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI]	a. Compare weather and climate, and the impacts of each on daily life. (K, STSE) 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) c. Investigate how Earth's tilt, rotation, and revolution around the sun cause uneven heating of Earth's surface, resulting in global convection currents, the Coriolis effect, jet streams, thermohaline circulation of the oceans, and

Science 10: Climate and Ecosystems Dynamics	
	climate zones. (S, K) d. Hypothesize how energy transfer, weather, and climate might be different if Earth had a different axial tilt, diameter, and/or period of rotations and revolutions. (S, STSE, A) e. Explain how greenhouse gases (e.g., water vapour, carbon dioxide, methane, nitrous oxide, sulphur dioxide, and ozone), particles and clouds, and surface albedo affect the amount of solar energy absorbed and re-radiated at various locations on Earth. (K) f. Explain the role of natural sources (e.g., volcanoes, fire, evaporation, and living organisms) of the primary greenhouse gases in Earth's atmosphere and how they contribute to the natural greenhouse effect. (K, A) g. Design, construct, and evaluate the effectiveness of a model used to illustrate the natural greenhouse effect, the reflectivity of Earth's surface, or the relationship between Earth's tilt and the seasons. (S, STSE, A) h. Investigate, through laboratory activities or simulations, heat transfer in air and water, including heat involved in phase changes. (S, A) i. Examine how interactions between heat, pressure, and the Coriolis effect result in global wind patterns, ocean currents, jet streams, and extreme weather (e.g., hurricanes, tornadoes, pressure systems, and thunderstorms). (S, STSE) j. Analyze weather and atmospheric data to identify patterns in temperature and atmospheric pressure, and changes in those patterns locally, regionally, and globally. (S) k. Provide examples of positive and negative feedback mechanisms in Earth's climate system. (K, STSE) l. Provide examples to show how scientific understanding may be refined in light of new evidence. (STSE)
SCI10-CD3 Examine biodiversity through the analysis of interactions among populations within communities. [DM, SI]	a. Discuss the importance of biodiversity and maintaining biodiversity within ecosystems, biomes, and the entire planet. (S, K) b. Understand that scientists describe biomes as resulting from the interaction of biotic and abiotic factors such as insolation, precipitation, latitude, altitude, and geography. (A, K) c. Compare the biodiversity and climatic characteristics of several of the earth's major biomes. (S, K) d. Estimate the abundance of organisms in a local ecosystem using random (e.g., quadrat), systematic (e.g., line transect and belt transect) and/or stratified sampling techniques. (S) e. Analyze primary or secondary population data to determine the population density, percentage frequency, and/or percentage cover of one or more organisms in an ecosystem. (S) f. 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) g. Construct and/or interpret graphs of population dynamics of humans and other species to determine population trends within an ecosystem. (S, A)

Science 10: Climate and Ecosystems Dynamics	
	h. 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) i. Examine the relationship between the biodiversity of an ecosystem, its primary productivity, and ecological resilience. (K, S) j. 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) k. Analyze how the bioaccumulation and biomagnification of human-made substances can affect the viability and biodiversity of organisms and populations in an ecosystem. (K, STSE)
SCI10-CD4 Investigate the role of feedback mechanisms in biogeochemical cycles and in maintaining stability in ecosystems. [CP, DM, SI]	a. Discuss systems in terms of their type (e.g., open, closed, and isolated) equilibrium (e.g., dynamic, static, stable, and unstable), and their associated feedbacks (e.g., positive and negative). (K) b. Create a representation of a feedback mechanism involved in a specific biogeochemical (e.g., carbon, nitrogen, phosphorus, and water) cycle. (S) c. Explore Indigenous ways of understanding the role of matter and energy in the environment. (STSE, K) d. Describe how human actions can affect the flow of energy and the cycling of matter through ecosystems. (K, A, STSE) e. Research the role of photosynthesis, respiration, and sinks in the cycling of carbon through the environment. (K, A) f. Design and carry out an investigation to determine the effect of carbon dioxide levels on photosynthesis and/or to determine the effect of nitrogenous-based fertilizer on plant or algal growth. (S, A) g. Compare the processes of nitrification and denitrification in terrestrial and aquatic ecosystems. (K) h. Research the short-term and long-term effects of small-scale and large-scale agricultural practices on the cycling of phosphorus, nitrogen, and other nutrients in an ecosystem. (K, A, STSE) i. Analyze the interdependence between the water cycle and other biogeochemical cycles. (K, S)

CHEMICAL REACTIONS

Science 10: Chemical Reactions	
Outcomes	Indicators
SCI10-CR1 Explore the characteristics of a variety of chemical reactions, including the role of energy changes. [CP, SI]	a. Create a representation about the prevalence of chemistry in our lives. (A, S) 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 make new substances. (STSE) c. Observe and describe a variety of chemical reactions, including synthesis, decomposition, combustion, single replacement, double replacement, and acid base neutralization. (S, K) d. Explain why it can be difficult to classify changes as physical or chemical, including reference to the reversibility of the reaction. (K, A) e. Differentiate between reactants and products in chemical reactions. (K) f. Investigate 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) g. Research practical examples of chemical reactions involving acids and bases, including neutralization reactions such as those involved in chemical spills, soda-acid fire extinguishers, and antacids. (S, STSE) h. Demonstrate knowledge of Workplace Hazardous Materials Information System (WHMIS) standards by selecting and applying proper techniques for handling and disposing of lab materials and interpreting Materials Safety Data Sheets (MSDS). (K, STSE, A)
SCI10-CR2 Name and write formulas for common ionic and molecular chemical compounds, including acids and bases. [SI]	a. Discuss the relationship between an element's position on the periodic table, its chemical characteristics, and its valence electrons. (K, A) b. Discuss the importance of valence electrons, and whether they are shared or transferred, in determining bond type in chemical compounds. (K) c. Name and write formulas for common ionic compounds and compounds involving polyatomic ions, using the periodic table and a list of common ions. (S) d. Analyze the relationship between the structure of ionic compounds, their common names, and their chemical formulas. (K) e. Classify substances as ionic or molecular, based on their characteristics and the results of student conducted tests (e.g. melting/boiling point, electrical conductivity, and solubility). (S) f. Relate the characteristics (e.g., solubility, conductivity in solution or gaseous form, high melting point, and brittleness) of ionic compounds to their uses. (STSE, K) g. Name and write 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) h. Design and carry out investigations to determine the characteristics of acids and bases, including selecting and using appropriate instruments for safely collecting evidence. (S, A) i. Classify substances as acids, bases, or salts, based on observable

Science 10: Chemical Reactions	
	characteristics, name, and chemical formula. (S) j. Investigate how certain substances, including those traditional to First Nations and Métis cultures, can serve as acid-base indicators. (K, STSE, A) k. Describe how the pH scale is used to classify substances as acidic, basic, or neutral. (S, STSE, A) l. Name and write formulas for common acids and bases, using the periodic table, a list of ions, and rules for naming acids and bases. (S) m. Explain the importance of scientific nomenclature systems such as the International Union of Pure and Applied Chemistry (IUPAC) naming conventions in communicating information about chemical compounds. (STSE, A)
SCI10-CR3 Represent chemical reactions and conservation of mass symbolically using models, word and skeleton equations, and balanced chemical equations. [SI, DM]	a. Design and safely carry out an experiment to confirm the Law of Conservation of Mass, identifying and controlling major variables. (A, S) b. Explain the importance of the concept of conservation of mass in understanding, interpreting, and predicting results of chemical reactions. (K, S) c. Represent chemical reactions, organic compounds, and conservation of mass using models and word equations. (S, K, A) d. Represent chemical reactions and conservation of mass using skeleton equations and balanced equations. (S, K, A) e. Translate word equations to balanced chemical equations and balanced chemical equations to word equations. (S, K) f. Differentiate between the use of subscripts and coefficients in representing the numbers of atoms and molecules present in chemical reactions. (S) g. Categorize chemical reactions as synthesis, decomposition, combustion, single replacement, and double replacement, including acid base neutralization. (S, K, A) h. Verify whether a chemical equation is correctly balanced, and correct any errors. (S) i. Provide examples of the importance of pH measurements in areas such as biology, chemistry, food science, environmental science, and water treatment. (K, STSE) j. Research the operation of technologies designed to monitor and manage pH in various applications such as swimming pools, consumer products, and soil. (K, S, STSE) k. Discuss the value of representing chemical reactions using models, word and skeleton equations, and balanced chemical equations. (STSE)
SCI10-CR4 Investigate the rates of chemical reactions, including factors that affect the rate. [SI]	a. Provide examples of chemical reactions that occur over a range of time scales. (K) b. Predict how factors such as temperature of the reactant(s), concentration of the reactant(s), surface area of the reactant(s), and the presence or absence of catalysts or inhibitors might affect the rate of a chemical reaction. (S, A) c. Formulate scientific questions about the rates of chemical reactions and the factors that affect rates of chemical reactions. (S, STSE) d. Design and perform an experiment to determine how various factors affect

Science 10: Chemical Reactions	
	chemical reaction rates, including identifying and controlling major variables. (S, STSE, A) e. Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of data related to rates of chemical reactions. (S, A) f. Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables related to chemical reaction rates. (S, A) g. Reflect upon data collection and analysis procedures, and suggest improvements to increase precision and accuracy. (S, A, STSE) h. Use the collision model to explain differences in chemical reaction rates. (K, STSE) i. Value the processes for drawing conclusions in science. (A, STSE) j. Research how the rates of chemical reactions are controlled in everyday situations as well as in agricultural and industrial applications. (STSE) k. Work co-operatively with team members to develop and carry out a plan, and troubleshoot problems as they arise when investigating rates of reactions. (S, A)

FORCE AND MOTION IN OUR WORLD

Science 10: Force and Motion in Our World	
Outcomes	Indicators
SCI10-FM1 Explore the development of motion-related technologies and their impacts on self and society. [DM, TPS]	a. Create a representation of different types of motion and historical and contemporary motion-related technologies from various cultures, including First Nations and Metis. (S, STSE) b. Describe how motion that may appear imperceptible to humans (e.g., continental drift, subatomic particles, light, blood circulating, and galaxies) can be measured using appropriate technologies. (K, STSE) c. Evaluate the historical development of a motion-related technology, including the role of continued testing in the development and improvement of the technology. (STSE) d. Design, construct, and evaluate a prototype of an object that meets a student-identified need related to motion. (STSE, S, A) e. Evaluate 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) f. Describe examples of Canadian contributions to science and technology in motion-related fields such as transportation, sport science, or space science. (STSE)
SCI10-FM2 Investigate and represent the motion of objects that travel at a constant speed in a straight line. [SI]	a. Provide examples of objects that exhibit, or appear to exhibit, uniform motion. (K) 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) c. Construct scale diagrams of displacement vectors [i.e., collinear, non-collinear (perpendicular), and non-collinear (non-perpendicular)] to represent changes in an object's position. (S, A) d. Design and carry out experiments to determine the characteristics 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) e. Discuss the importance of distinguishing between scalar (e.g., distance, speed, and time) and vector (e.g., position, displacement, velocity, and acceleration) quantities when studying motion. (K) f. Construct and analyze graphs (i.e., distance-time, position-time, speed-time, and velocity-time) using student-collected data obtained from objects undergoing uniform motion or through computer simulations. (S, A) g. Describe quantitatively the relationship among distance, time, and speed for everyday objects that undergo simple linear uniform motion. (K) h. Derive the relationship between speed, distance, and time (i.e., $v = \frac{\Delta d}{\Delta t}$) and between velocity, displacement, and time (i.e., $\vec{v} = \frac{\overrightarrow{\Delta d}}{\Delta t}$)from student-collected data. i. Solve problems related to uniform motion. (S)

Science 10: Force and Motion in Our World	
SCI10-FM3 Investigate and represent the motion of objects that experience constant acceleration. [SI]	a. Design and carry out experiments to determine the characteristics of constant acceleration, including identifying variables to be tested, developing appropriate sampling procedures for data collection, collecting and recording data, and analyzing data to generate conclusions. (S, STSE) b. Evaluate the relevance, reliability, and adequacy of data and data collection methods, including identifying and explaining sources of error and uncertainty in measurements. (STSE, S) c. Apply the concept of 'rate of change' to operationally define speed, velocity, and acceleration. (K) d. Demonstrate the importance of converting measurements to the same units when solving motion problems. (K) e. Differentiate between the concepts of instantaneous and average as they relate to speed and velocity. (K) f. Construct and analyze graphs (i.e., distance-time, position-time, speed-time, and velocity-time) that represent the motion of objects that undergo constant acceleration. (S) g. Solve problems related to constant acceleration using the equations of motion (e.g., $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$, $\Delta\vec{d} = \vec{v_i}t + \frac{1}{2}\vec{a}\Delta t^2$). (S) h. Value the role and contribution of science and technology in understanding phenomena that are directly observable and those that are not. (A)
SCI10-FM4 Explore the relationship between force and motion for objects moving in one and two dimensions. [SI, TPS]	a. Pose questions about the ways in which forces cause objects to move or change their motion. (A, S) b. Investigate the effects of applying constant forces to objects at rest and to objects moving at a uniform velocity in a straight line. (S, A) c. Add force vectors in one and two dimensions [i.e., collinear, non-collinear (perpendicular) and non-collinear (non-perpendicular)] using vector diagrams to determine the net force acting on an object. (S) d. Demonstrate the role of friction in changing the position or motion of an object. (K, S) e. Provide examples of technologies that have been developed to increase or decrease frictional forces between two or more surfaces. (STSE) f. Design, construct, and evaluate a prototype of a technology that increases or decreases frictional forces in specific settings to meet identified criteria related to the motion of objects. (S, STSE, A) g. Analyze student collected data to verify the relationship between the acceleration of an object and the net force acting on it. (S) h. Describe and provide examples of Newton's three laws of motion in practical situations such as sports, flight, and transportation. (K, A)