Environmental Science 21 (2017)

Course Overview

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Overview

The purpose of this document is to provide an introduction to the *Environmental Science 21 (2017)* 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:

- *Environmental Science 21 (2017) Resource Package – Atmosphere*
- *Environmental Science 21 (2017) Resource Package – Human Population and Pollution*
- *Environmental Science 21 (2017) Resource Package – Aquatics*
- *Environmental Science 21 (2017) Resource Package – Terrestrial Ecosystems*

The following individuals participated in the development of the *Environmental Science 21 (2017)* 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 *Environmental Science 21 (2017)*, 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 (*Environmental Science 21*) can be used to fulfill the 20-level science requirement.

The *Environmental Science 21 (2017)* course and resource packages were developed to reflect the structure of the renewed *Environmental Science 20* curriculum. Therefore, teachers should use *Environmental Science 20* to assist with unit planning and instruction for *Environmental Science 21 (2017)*. The renewed *Environmental Science 20* 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
- 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 (*Environmental Science 21*) 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 Environmental Science 11 (2017)

Students in *Environmental Science 21 (2017)* 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 *Environmental Science 21 (2017)*, 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 *Environmental Science 20* 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 *Environmental Science 20* curriculum document.

Legend

ES21-CI1a	
ES21	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

Environmental Science 21 Outcomes at a Glance

Career Exploration
ES21-CE1 Identify environmental science related career paths in Saskatchewan, Canada and the world.

Student-Directed Study
ES21-SDS1 Explore one or more topics of personal interest relevant to *Environmental Science 21* in depth.

The Nature of Environmental Science
ES21-ES1 Discuss the methods, mindsets and purposes of environmental science.

Atmosphere and Human Health
ES21-AH1 Explore the impact of human activities on indoor and outdoor air quality and the need to minimize risks to human health.
ES21-AH2 Examine how scientists use data to investigate the effects of a changing climate on society and the environment.

Human Population and Pollution
ES21-HP1 Outline technologies and processes used for mitigating and managing resource use, waste generation and pollution associated with a growing human population.

Aquatic Systems
ES21-AS1 Recognize the function and observe the condition of freshwater aquatic systems such as rivers, streams, lakes, wetlands and watersheds.
ES21-AS2 Explain the need to maintain healthy water for humans and the environment.

Terrestrial Ecosystems
ES21-TE1 Discuss the role of soil in terrestrial ecosystems.
ES21-TE2 Identify the role plants play in an ecosystem, including ways in which humans use plants.
ES21-TE3 Recognize the need for intact habitat to support animal populations and biodiversity.

Environmental Science 21 (2017) - Career Exploration	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES21-CE1 Identify environmental science related career paths in Saskatchewan, Canada and the world. [CP, DM]	a. Generate a list of occupations that require a background in environmental science through research and/or participation in events such as a career fair or job shadow. (K, S) b. Identify the connection between topics in *Environmental Science 21* and occupations. (S, A, STSE) c. Examine the roles, responsibilities, educational qualifications and personal and professional qualities common to people involved in environmental-science related jobs. (S, A) d. Research a chosen career, using criteria such as: a. the training program, including on the job training b. the work they are trained to do c. the types of facilities in which they are employed d. hours/shifts worked e. current wages received in Saskatchewan f. physical and mental stresses experienced g. workplace hazards and safety considerations h. other professionals they interact with i. your personal suitability for this career (K, S, A, STSE) e. Communicate research findings related to environmental science occupations through a display, brochure, video, presentation software, website or orally. (K, S, A, STSE)

Environmental Science 21 (2017) – Student-Directed Study	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES21-SDS1 Explore one or more topics of personal interest relevant to Environmental Science 21 in depth. [CP, DM, SI, TPS]	a. Carry out an experiment following established scientific protocols to investigate a question of interest related to one or more of the topics of *Environmental Science 21*. (S, A, K, STSE) b. Discuss the purpose and benefits of a specific municipal, provincial, territorial or federal policy, legislation, regulation, order, incentive or practice related to the environment and/or sustainability. (S, STSE) c. Summarize an environmental impact assessment of a real or hypothetical development. (S, STSE) d. Develop an action plan, which may contain a desired future state, goals, targets, strategies and performance measures, to address a

	specific environmental issue. (S, STSE) e. Discuss the applicability of William Forster Lloyd's "tragedy of the commons" to contemporary principles of sustainable development. (S) f. Assemble and reflect on a portfolio that demonstrates an understanding of an environmental science topic of interest to the student. (S, A) g. Share the results of student-directed research through a display, presentation, performance, demonstration, song, game, commercial, fine art representation, video or research paper. (S) h. Use a provided tool (e.g., rubric, checklist, self-evaluation form or peer-evaluation form) to assess the process and products involved in a student-directed study. (S, A)

Environmental Science 21 (2017) – The Nature of Environmental Science	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES21-ES1 Discuss the methods, mindsets and purposes of environmental science. [CP, DM]	a. Reflect upon how one's connection with the environment is influenced by personal experiences and cultural understandings. (K, STSE, A) b. Engage in place-based learning to gain a deeper understanding and appreciation of the environment. (S, STSE) c. Recognize essential characteristics of First Nations and Métis worldviews regarding the environment, including the importance of the four elements (i.e., earth, water, wind and fire), a sense of interconnectedness with the environment and respect for Mother Earth. (STSE, K) d. Recognize environmental science as a newly developing field that integrates knowledge, theories, models and processes from other scientific disciplines such as ecology, atmospheric science, biology, chemistry, physics, oceanography, geology and human geography to investigate human impacts on the environment. (K, STSE) e. Outline key events, including the industrial revolution, medical revolution, green revolution (agriculture) and the environmental revolution (stewardship), of the environmental movement and their interrelationships with environmental science. (K, STSE, S) f. Examine how principles of sustainability (i.e., environmental, economic and social justice) are integral to environmental science. (STSE) g. Examine how data produced through environmental science can be used in environmental impact assessments, such as those outlined in the *Canadian Environmental Assessment Act, 2012*. (STSE)

Environmental Science 21 (2017) – Atmosphere and Human Health	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES21-AH1 Explore the impact of human activities on indoor and outdoor air quality and the need to minimize risks to human health. [SI, DM]	a. Pose questions regarding how human activities and technologies have influenced air quality. (S) b. Recognize the role of stratospheric ozone layer depletion as a contributor towards human health issues such as cancers and cataracts. (STSE, K, A) c. Describe the sources of indoor air pollutants (e.g., particulate matter, radon, mold and allergens). (K, STSE) d. State the sources of outdoor air pollutants (i.e., particulate matter, sulphur dioxide, nitrogen dioxide, volatile organic chemicals (VOCs), carbon monoxide, lead, tropospheric ozone and sulphuric acid) and their potential effects on human health. (K, STSE, A) e. Relate government regulations regarding outdoor air quality (e.g., Air Quality Health Index (AQHI) and the National Ambient Air Quality Objectives (NAAQOs)) and legislation (e.g., *Canadian Environmental Protection Act, 1999* and *The Clean Air Act* in Saskatchewan) to minimizing risks to human health. (S, K, STSE) f. Investigate the sources and production of industrial and photochemical smog and identify measures that can be undertaken to mitigate their effects to human health. (K, STSE, A) g. Carry out a process to assess indoor or outdoor air quality, using appropriate technologies to collect and analyze data. (S, A) h. Identify technologies and processes such as air scrubbers, baghouse filters, electrostatic precipitators and catalytic converters that were developed to reduce contaminants in industrial emissions and motor vehicles. (K, STSE, S) i. Understand the importance of using a personal protective device or substance (e.g., sunscreen, mosquito repellent or protective clothing) in protecting a person from an environmental factor. (STSE, S, A) j. Recognize the relationship between human population density and human health. (S, STSE)
ES21-AH2 Examine how scientists use data to investigate the effects of a changing climate on society and the environment. [CP, DM, SI]	a. Examine the types of questions that scientists attempt to answer with respect to Earth's climate and past, present and potential future climate changes. (STSE, A) b. Examine how different techniques (e.g., satellite imagery, ice core samples and dendrology) provide scientists with a variety of data regarding climate change. (K, STSE) c. Investigate the Arctic as an indicator region of climate change, including the impact on traditional lifestyles of northern peoples, given the general vulnerability to climate change effects at northern versus equatorial latitudes. (K, STSE) d. Identify the contributions of Indigenous knowledge in policy decisions related to climate change. (K, STSE)

	e. Note that a consensus exists regarding the reality of anthropogenic climate change. (STSE) f. Interpret climate data (e.g., tables, maps, graphs, visualizations and other representations) to determine climate patterns and trends over specific periods. (S, STSE) g. Recognize how climate models simulate important aspects of past and present climate and climate changes. (K, STSE, S) h. Recognize how the effects of climate change on one earth system (i.e., geosphere, hydrosphere, atmosphere and biosphere) can produce effects across other earth systems. (K, STSE) i. Investigate the potential impacts of climate change on the agriculture, energy, forestry, transportation and/or tourism sectors in Saskatchewan. (K, STSE, S) j. Hypothesize how life on earth might respond to a changing global climate given different scenarios change such as sea level rise, extreme weather events, water shortages, increased spread of disease, flooding and acidification of the oceans. (K, STSE, S, A)

Environmental Science 21 (2017) – Human Population and Pollution	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES21-HP1 Outline technologies and processes used for mitigating and managing resource use, waste generation and pollution associated with a growing human population. [CP, DM, SI]	a. Identify factors that have contributed to historical and contemporary trends in human population growth and that may influence future growth. (K) b. Outline the environmental impact of human population changes with respect to resource use, waste generation and pollution. (STSE, K) c. Identify First Nations and Métis beliefs and practices that demonstrate a sustainable perspective on using resources wisely and minimizing waste. (K, STSE, S) d. Assess the importance of food security and access to medicine to support a growing human population. (K) e. Analyze benefits and challenges associated with the use and production of fertilizer for food crops necessary to sustain a growing human population. (K, STSE) f. Describe technologies and processes that have been developed to minimize the impacts of mining, forestry and/or agricultural operations on air, water and soil quality and quantity. (STSE, K) g. Investigate the waste generated throughout the life cycle of a product. (STSE, S) h. Carry out a waste audit and propose a plan of action for waste reduction and/or diversion based on the findings. (S, A, K) i. Investigate technologies and processes (e.g., sewage treatment plants, incineration, composting, engineered landfills and curbside

	recycling) used for storing, handling and disposing of human and/or livestock waste. (K, STSE)

Environmental Science 21 (2017) – Aquatic Systems	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES21-AS1 Recognize the function and observe the condition of freshwater aquatic systems such as rivers, streams, lakes, wetlands and watersheds. [CP, DM, SI]	a. Measure abiotic factors (e.g., turbidity, temperature, dissolved oxygen and particulates) of an ecosystem using a variety of techniques and technologies (e.g., probe ware, pH paper, Secchi disk, Imhoff settling cone and chemical water quality test kit) effectively and safely. (S, STSE, A) b. Examine the diversity of life in a specific aquatic ecosystem through water sampling, classifying aquatic biota, assessing biodiversity and calculating a water quality index and/or algal productivity. (K, S) c. Assess the interdependencies between abiotic (e.g., pH, dissolved oxygen, turbidity, temperature, total dissolved solids, phosphorous, nitrogen, stream flow and biochemical oxygen demand [BOD]) and biotic factors in a functioning aquatic ecosystem. (K) d. Understand how an integrated watershed management approach can address issues (e.g., water supply, drainage, storm water runoff, habitat protection and water rights) that affect water quality and the health of all living things within a watershed. (S) e. Describe the benefits of riparian zones and wetlands (e.g., marshes, swamps, bogs and fens) in protecting water resources. (K) f. Recognize that natural aquatic ecosystems have a range of conditions (i.e., oligotrophic to eutrophic) and they can be affected by human actions (i.e., cultural eutrophication). (K)
ES21-AS2 Explain the need to maintain healthy water for humans and the environment. [SI, DM]	a. Recognize that only a very small percentage of global water is available for consumption. b. Recognize that there are health challenges such as the spread of disease, mercury in fish, blue-green algae and *E. coli* in drinking water that result from changes to the condition of aquatic systems. (STSE, K) c. Identify that there are water quality standards such as the *Saskatchewan Surface Water Quality Objectives* and the *Canadian Water Quality Index* and legislation such as the *Canada Water Act* and the *International River Improvements Act*. (STSE, K) d. Examine how individuals, organizations (e.g., watershed associations), First Nations and government agencies (e.g. Saskatchewan Water Security Agency) work to ensure clean and abundant water through producing water regulations and allocation policies. (K, STSE) e. Describe the operation and effectiveness of technologies and processes developed to protect drinking water sources. (K, STSE) f. Recognize the impacts of point source and non-point source pollution

	on humans and aquatic systems. (STSE, K, A) g. Investigate the role of muskeg and moss in water filtration and food preservation for First Nations and Métis and other communities. (K, STSE, A) h. Discuss technologies such as desalinization plants, water treatment plants and home water filtration systems, which are designed to maintain and improve water quality. (K, STSE, A) i. Understand the importance of source water protection for a community`s drinking water recognizing the precautionary principle. (STSE, A, S)

Environmental Science 21 (2017) – Terrestrial Ecosystems	
All outcomes contribute to the development of all K-12 science goals.	
Outcomes	**Indicators**
ES20-TE1 Discuss the role of soils in terrestrial ecosystems. [SI, DM, CP]	a. Discuss how First Nations and Métis people value soil as an integral component of Mother Earth, including traditional ways of looking after soil (e.g. three sisters planting). (STSE, A) b. Recognize how the breakdown of parent material through various processes (e.g., weathering, erosion, deposition and decomposition of organisms) results in soil with varying properties (e.g., colour, texture, structure and pH). (K) c. Collect and analyze soil data (e.g., pH, nitrate, phosphate, potassium, porosity and moisture) using technologies such as sensors and soil test kits safely and effectively. (A, S, STSE) d. Research causes and consequences of soil degradation (e.g., wind and water erosion, salinity and desertification) and mitigation strategies (e.g., conservation tillage, contour farming, grassed waterways and shelterbelts) used to reduce the loss of topsoil. (A, K) e. Recognize the role and diversity of organisms (e.g., nitrogen fixing bacteria, fungi, mycorrhizae, insects, plants and protists) found within soil environments. (K) f. Examine how phenomena such as erosion, desertification and soil pollution, whether natural or human-caused, affect soil productivity and food production. (STSE) g. Investigate how composting systems work to maintain and improve soil quality. (S, STSE)
ES21-TE2 Identify the role plants play in an ecosystem, including the ways in which humans use plants. [SI, CP, DM]	a. Discuss the many roles of plants including their roles as providers of ecological goods and services as well as natural capital. (K) b. Examine the significance (e.g., medicinal, spiritual, nutritional and shelter) of plants, including tobacco, in First Nations and Métis cultures. (K, STSE) c. Explain how plant morphology and physiology determines the role of plants in an ecosystem (e.g., anchoring soil, filtering air and water,

	providing shelter for other organisms and providing organic matter to the ecosystem). (K) d. Identify how plant pollination and reproduction occurs. (K) e. Explain the role of plants in reducing greenhouse gases, as well as potential impacts of climate change on plant growth and distribution. (STSE) f. Examine the types and yields of agricultural and/or horticultural crops grown in Saskatchewan. (STSE, K) g. Differentiate among various agriculture practices (e.g., industrial, traditional, subsistence, sustainable agriculture, organic farming, urban agriculture, local food and community supported agriculture). (STSE) h. Recognize the advantages and disadvantages of forestry practices (e.g., selective cutting, clear cutting, shelterwood system and integrated resource management). (STSE) i. Examine the impact of agriculture or forestry on a natural ecosystem. (S) j. Grow plants for purposes such as food, diversity (with native plants), medicine and habitat restoration. (S, STSE)
ES21-TE3 Recognize the need for intact habitat to support animal populations and biodiversity. [SI, CP, DM]	a. Explain the need for habitat protection and restoration in terms of biodiversity (e.g., genetic diversity, species diversity and habitat diversity) and resilience within ecosystems. (K) b. Describe examples of First Nations and Métis people's contributions in recognizing the effects of natural and human-caused changes to habitat on historical migration patterns of animals in Saskatchewan. (STSE, A) c. Examine how habitat management and protection decisions are influenced by the extent to which Indigenous land rights (e.g., custodians of the land versus individual land ownership) are reflected through the spirit and intent of various treaties. (K, STSE, A) d. Explain the roles of individuals, governmental and non-governmental organizations such as the Saskatchewan Prairie Conservation Action Plan, Ducks Unlimited and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and legislation such as the *Species at Risk Act* (SARA) in protecting and maintaining habitats and biodiversity. (A) e. Relate an organism's specific adaptations and behaviour to its niche in an ecosystem. (K) f. Identify how human activities such as agriculture, mining, oil and gas development, forestry, urbanization and recreation might impact to an animal's range and habitat. (K) g. Discuss the implications of invasive species on ecosystems in Saskatchewan. (K) h. Evaluate the importance of a keystone species in a specific terrestrial ecosystem. (S) i. Provide examples of projects undertaken to restore damaged or destroyed habitats. (STSE)

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 *Environmental Science 20* are also suggested for use in *Environmental Science 21 (2017)*. 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 *Environmental Science 20* tab at www.curriculum.gov.sk.ca.

- *Environmental Science: A Canadian Perspective* (2013) – McGraw-Hill Ryerson
- *Pearson Environmental Science* (2011) – Pearson
- *Visualizing the Environment (Canadian Ed)* (2010) – John Wiley & Sons

References

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