## Good Spirit School Division

# Science 18

**February 2015**

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# Science 18 Aims and Goals

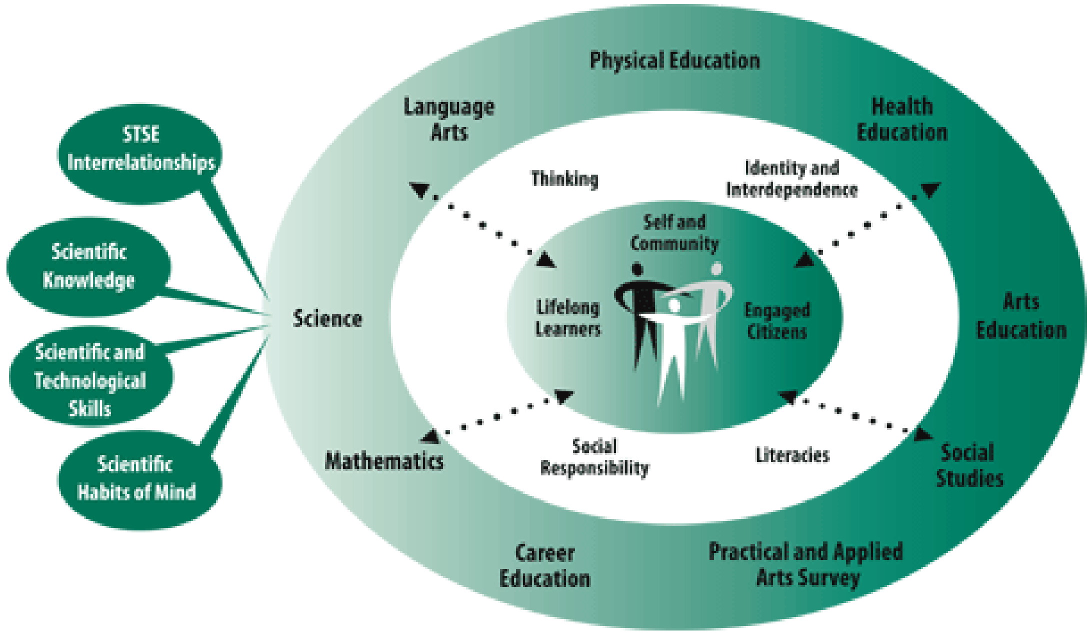
(taken from Grade 9 Science Saskatchewan Online Curriculum)

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.




# Teaching Science 18

(taken from Grade 9 Science Saskatchewan Online Curriculum)

## 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, interdisciplinary, and trans-disciplinary understanding.

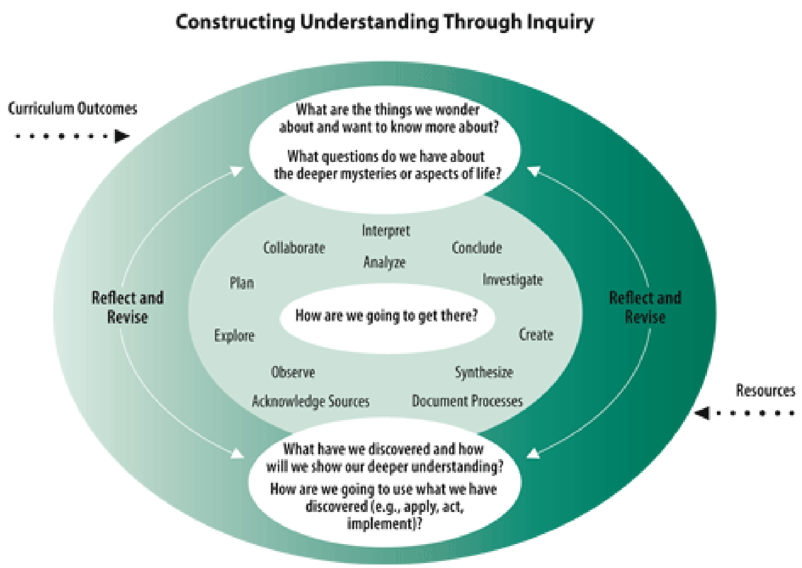
Inquiry builds on students' inherent sense of curiosity and wonder, drawing on their diverse backgrounds, interests, and experiences. The process provides opportunities for students to become active participants in a collaborative search for meaning and understanding.

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

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.
- (NRC, 1996, pp. 145, 148)

An important part of any inquiry process is student reflection on their learning and the documentation needed to assess the learning and make it visible. Student documentation of the inquiry process in science may take the form of works-in-progress, reflective writing, journals, reports, notes, models, arts expressions, photographs, video footage, or action plans.

Inquiry learning is not a step-by-step process, but rather a cyclical process, with various phases of the process being revisited and rethought as a result of students' discoveries, insights, and construction of new knowledge. Experienced inquirers will move back and forth among various phases as new questions arise and as students become more comfortable with the process. The following graphic shows various phases of the cyclical inquiry process.




Inquiry focuses on the development of questions to initiate and guide the learning process. These questions are formulated by teachers and students 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.

## Creating Questions for Inquiry in Science

In science, teachers and students can use the four learning contexts as curriculum entry points to begin their inquiry; however, the process may evolve into trans-disciplinary learning opportunities, as reflective of the holistic nature of our lives and interdependent global environment.

It is essential to develop questions that are evoked by student interests and have 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.

The process of constructing questions for deep understanding can help students grasp the important disciplinary or trans-disciplinary 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. They also invite and encourage students to pose their own questions for deeper understanding.
Students should recognize that science is often unable to answer "why" questions; in these instances, scientists rephrase their inquiries into "how" questions.

## An Effective Science Education Program

An effective science education program supports student achievement of learning outcomes through:

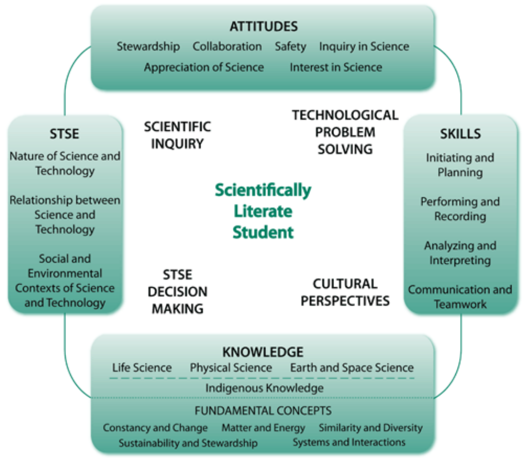
- foundations of scientific literacy
- learning contexts
- nature of scientific discourse
- modeling in science
- laboratory work
- safety
- technology in science
- science challenges.

All science outcomes and indicators emphasize one or more foundations of scientific literacy; these represent the "what" of the curriculum. The learning contexts represent different processes for engaging students in achieving curricular outcomes; they are the "how" of the curriculum. The four units of study at each grade serve as an organizing structure for the curriculum.

Scientists construct models to support their explanations based on empirical evidence. Students need to engage in similar processes through authentic laboratory work. During their investigations, students must follow safe practices in the laboratory, as well as in regard to living things.

Technology serves to extending our powers of observation and to support the sharing of information. Students should use a variety of technology tools for data collection and analysis, for visualization and imaging, and for communication and collaboration, throughout the science curriculum.

To achieve the vision of scientific literacy outlined in this curriculum, students must increasingly become engaged in the planning, development, and evaluation of their own learning activities. In the process, students should have the opportunity to work collaboratively with others, to initiate investigations, to communicate findings, and to complete projects that demonstrate learning. Teachers and students may also choose to engage in science challenge activities as a means of achieving learning outcomes.




## Foundations of Scientific Literacy

The K-12 goals of science education parallel the foundation statements for scientific literacy described in the Common Framework of Science Learning Outcomes K to 12 (CMEC, 1997). These four foundation statements delineate the critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered interrelated and mutually supportive.

## Foundation 1: Science, Technology, Society, and the Environment (STSE) Interrelationships

This foundation is concerned with understanding the scope and character of science, its connections to technology, and the social context in which it is developed. This foundation statement should be considered the driving force of scientific literacy. Three major dimensions address this foundation.

### Nature of Science and Technology

Science is a social and cultural activity anchored in a particular intellectual tradition. It is one way of knowing nature, based on curiosity, imagination, intuition, exploration, observation, replication, interpretation of evidence, and consensus making over this evidence and its interpretation. More than most other ways of knowing nature, science excels at predicting what will happen next, based on its descriptions and explanations of natural and technological phenomena. Science-based ideas are continually being tested, modified, and improved as new ideas supersede existing ideas. Technology, like science, is a creative human activity, but is concerned with solving practical problems that arise from human/social needs, particularly the need to adapt to the environment and to fuel a nation's economy. New products and processes are produced by research and development through the processes of inquiry and design.

### Relationships between Science and Technology

Historically, the development of technology has been strongly linked to the development of science, with each making contributions to the other. While there are important relationships and interdependencies, there are also important differences. Where the focus of science is on the development and verification of knowledge; in technology, the focus is on the development of solutions, involving devices and systems that meet a given need within the constraints of the problem. The test of science knowledge is that it helps us explain, interpret, and predict; the test of technology is that it works - it enables us to achieve a given purpose.

### Social and Environmental Contexts of Science and Technology

The history of science shows that scientific development takes place within a social context that includes economic, political, social, and cultural forces along with personal biases and the need for peer acceptance and recognition. Many examples can be used to show that cultural and intellectual traditions have influenced the focus and methodologies of science, and that science, in turn, has influenced the wider world of ideas. Today, societal and environmental needs and issues often drive research agendas. As technological solutions have emerged from previous research, many of the new technologies have given rise to complex social and environmental issues which are increasingly becoming part of the political agenda. The potential of science, technology, and Indigenous knowledge to inform and empower decision making by individuals, communities, and society is central to scientific literacy in a democratic society.

## Foundation 2: Scientific Knowledge

This foundation focuses on the subject matter of science including the theories, models, concepts, and principles that are essential to an understanding of the natural and constructed world. For organizational purposes, this foundation is framed using widely accepted science disciplines.

## Life Science

Life science deals with the growth and interactions of life forms within their environments in ways that reflect the uniqueness, diversity, genetic continuity, and changing nature of these life forms. Life science includes the study of topics such as ecosystems, biological diversity, organisms, cell biology, biochemistry, diseases, genetic engineering, and biotechnology.

## Physical Science

Physical science, which encompasses chemistry and physics, deals with matter, energy, and forces. Matter has structure, and its components interact. Energy links matter to gravitational, electromagnetic, and nuclear forces in the universe. The conservation laws of mass and energy, momentum, and charge are addressed in physical science.

## Earth and Space Science

Earth and space science brings local, global, and universal perspectives to student knowledge. Earth, our home planet, exhibits form, structure, and patterns of change as do our surrounding solar system and the physical universe beyond. Earth and space science includes such fields of study as geology, hydrology, meteorology, and astronomy.

## Traditional and Local Knowledge

A strong science program recognizes that modern science is not the only form of empirical knowledge about nature and aims to broaden student understanding of traditional and local knowledge systems. The dialogue between scientists and traditional knowledge holders has an extensive history and continues to grow as researchers and practitioners seek to better understand our complex world. The terms "traditional knowledge", "Indigenous Knowledge", and "Traditional Ecological Knowledge" are used by practitioners worldwide when referencing local knowledge systems which are embedded within particular world views. This curriculum uses the term "Indigenous Knowledge" and provides the following definitions to show parallels and distinctions between Indigenous knowledge and scientific knowledge.

## Indigenous Knowledge

"Traditional [Indigenous] knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview" (International Council for Science, 2002).

## Scientific Knowledge

Similar to Indigenous knowledge, scientific knowledge is a cumulative body of knowledge, know-how, practices, and representations maintained and developed by people (scientists) with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations, and meanings are part and parcel of cultural complexes that encompass language, naming and classification systems, resource use practices, ritual, and worldview.

## Fundamental Ideas - Linking Scientific Disciplines

A useful way to create linkages among science disciplines is through fundamental ideas that underlie and integrate different scientific disciplines. Fundamental ideas provide a context for explaining, organizing, and connecting knowledge. Students deepen their understanding of these fundamental ideas and apply their understanding with increasing sophistication as they progress through the curriculum from Kindergarten to Grade 12. These fundamental ideas are identified in the following chart.

## Constancy and Change Matter and Energy Similarity and Diversity Systems and Interactions Sustainability and Stewardship

The ideas of constancy and change underlie understanding of the natural and constructed world. Through observations, students learn that some characteristics of materials and systems remain constant over time whereas other characteristics change. These changes vary in rate, scale, and pattern, including trends and cycles, and may be quantified using mathematics, particularly measurement.

Objects in the physical world are comprised of matter. Students examine materials to understand their properties and structures. The idea of energy provides a conceptual tool that brings together many understandings about natural phenomena, materials, and the process of change. Energy, whether transmitted or transformed, is the driving force of both movement and change.

The ideas of similarity and diversity provide tools for organizing our experiences with the natural and constructed world. Beginning with informal experiences, students learn to recognize attributes of materials that help to make useful distinctions between one type of material and another, and between one event and another. Over time, students adopt accepted procedures and protocols for describing and classifying objects encountered, thus enabling students to share ideas with others and to reflect on their own experiences.

An important way to understand and interpret the world is to think about the whole in terms of its parts and alternately about its parts in terms of how they relate to one another and to the whole. A system is an organized group of related objects or components that interact with one another so that the overall effect is much greater than that of the individual parts, even when these are considered together.

Sustainability refers to the ability to meet our present needs without compromising the ability of future generations to meet their needs. Stewardship refers to the personal responsibility to take action in order to participate in the responsible management of natural resources. By developing their understanding of ideas related to sustainability, students are able to take increasing responsibility for making choices that reflect those ideas.

## Foundation 3: Scientific and Technological Skills and Processes

This foundation identifies the skills and processes students develop in answering questions, solving problems, and making decisions. While these skills and processes are not unique to science, they play an important role in the development of scientific and technological understanding and in the application of acquired knowledge to new situations. Four broad skill areas are outlined in this foundation. Each area is developed further at each grade level with increasing scope and complexity of application.

### Initiating and Planning

These are the processes of questioning, identifying problems, and developing preliminary ideas and plans.

### Performing and Recording

These are the skills and processes of carrying out a plan of action, which involves gathering evidence by observation and, in most cases, manipulating materials and equipment. Gathered evidence can be documented and recorded in a variety of formats.

### Analyzing and Interpreting

These are the skills and processes of examining information and evidence, organizing and presenting data so that they can be interpreted, interpreting those data, evaluating the evidence, and applying the results of that evaluation.

### Communication and Teamwork

In science and technology, as in other areas, communication skills are essential whenever ideas are being developed, tested, interpreted, debated, and accepted or rejected. Teamwork skills are also important because the development and application of ideas rely on collaborative processes both in science-related occupations and in learning.

## Foundation 4: Attitudes

This foundation focuses on encouraging students to develop attitudes, values, and ethics that inform a responsible use of science and technology for the mutual benefit of self, society, and the environment. This foundation identifies six categories in which science education can contribute to the development of scientific literacy.

### Appreciation of Science

Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural, and ethical events./p>

### Interest in Science

Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school, and in the community.

### Inquiry in Science

Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge.

### Collaboration

Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school.

### Stewardship

Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment.

### Safety

Students engaged in science and technology activities will be expected to demonstrate a concern for safety and doing no harm to themselves or others, including plants and animals.

## Learning Contexts

Learning contexts provide entry points into the curriculum that engage students in inquiry-based learning to achieve scientific literacy. Each learning context reflects a different, but overlapping, philosophical rationale for including science as a Required Area of Study:

- The **scientific inquiry** learning context reflects an emphasis on understanding the natural and constructed world using systematic empirical processes that lead to the formation of theories that explain observed events and that facilitate prediction.
- The **technological problem solving** learning context reflects an emphasis on designing and building to solve practical human problems similar to the way an engineer would.
- The **STSE decision making** learning context reflects the need to engage citizens in thinking about human and world issues through a scientific lens in order to inform and empower decision making by individuals, communities, and society.
- The **cultural perspectives** learning context reflects a humanistic perspective that views teaching and learning as cultural transmission and acquisition (Aikenhead, 2006).

These learning contexts are not mutually exclusive; thus, well-designed instruction may incorporate more than one learning context. Students need to experience learning through each learning context at each grade; it is not necessary, nor advisable, for each student to attempt to engage in learning through each learning context in each unit. Learning within a classroom may be structured to enable individuals or groups of students to achieve the same curricular outcomes through different learning contexts.

A choice of learning approaches can also be informed by recent well-established ideas on how and why students learn:

- Learning occurs when students are treated as a community of practitioners of scientific literacy.
- Learning is both a social and an individual event for constructing and refining ideas and competences.
- Learning involves the development of new self-identities for many students.
- Learning is inhibited when students feel a culture clash between their home culture and the culture of school science.

## Scientific Inquiry (SI)

Inquiry is a defining feature of the scientific way of knowing nature. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Inquiry is a multifaceted activity that involves:

- making observations, including watching or listening to knowledgeable sources
- posing questions or becoming curious about the questions of others
- examining books and other sources of information to see what is already known
- reviewing what is already known in light of experimental evidence and rational arguments
- planning investigations, including field studies and experiments
- acquiring the resources (financial or material) to carry out investigations
- using tools to gather, analyze, and interpret data
- proposing critical answers, explanations, and predictions
- communicating the results to various audiences.

By participating in a variety of inquiry experiences that vary in the amount of student self-direction, students develop competencies necessary to conduct inquiries of their own - a key element to scientific literacy.

## Technological Problem Solving (TPS)

The essence of the technological problem solving learning context is that students seek answers to practical problems. This process is based on addressing human and social needs and is typically addressed through an iterative design-action process that involves steps such as:

- identifying a problem
- identifying constraints and sources of support
- identifying alternative possible solutions and selecting one on which to work
- planning and building a prototype or a plan of action to resolve the problem
- testing and evaluating the prototype or plan.

By participating in a variety of technological and environmental problem-solving activities, students develop capacities to analyze and resolve authentic problems in the natural and constructed world.

## STSE Decision Making (DM)

Scientific knowledge can be related to understanding the relationships among science, technology, society, and the environment. Students must also consider values or ethics, however, when addressing a question or issue. STSE decision making involves steps such as:

- clarifying an issue
- evaluating available research and different viewpoints on the issue
- generating possible courses of action or solutions
- evaluating the pros and cons for each action or solution
- identifying a fundamental value associated with each action or solution
- making a thoughtful decision
- examining the impact of the decision
- reflecting back on the process of decision making.

Students may engage with STSE issues through research projects, student-designed laboratory investigations, case studies, role playing, debates, deliberative dialogues, and action projects.

## Cultural Perspectives (CP)

Students should recognize and respect that all cultures develop knowledge systems to describe and explain nature. Two knowledge systems which are emphasized in this curriculum are First Nations and Métis cultures (Indigenous knowledge) and Euro-Canadian cultures (science). In their own way, both of these knowledge systems convey an understanding of the natural and constructed worlds, and they create or borrow from other cultures technologies to resolve practical problems. Both knowledge systems are systematic, rational, empirical, dynamically changeable, and culturally specific.

Cultural features of science are, in part, conveyed through the other three learning contexts, and when addressing the nature of science. Cultural perspectives on science can also be taught in activities that explicitly explore Indigenous knowledge or knowledge from other cultures.

Addressing cultural perspectives in science involves:

- recognizing and respecting knowledge systems that various cultures have developed to understand the natural world and technologies they have created to solve human problems
- recognizing that science, as one of those knowledge systems, evolved within Euro-Canadian cultures

- valuing place-based knowledge to solve practical problems
- honoring protocols for obtaining knowledge from a knowledge keeper, and taking responsibility for knowing it.

By engaging in explorations of cultural perspectives, scientifically literate students begin to appreciate the world views and belief systems fundamental to science and to Indigenous knowledge.

## Explanations, Evidence, and Models in Science

Science is a way of understanding the natural world using internally consistent methods and principles that are well-described and understood by the scientific community. The principles and theories of science have been established through repeated experimentation and observation and have been refereed through peer review before general acceptance by the scientific community. Acceptance of a theory does not imply unchanging belief in a theory, or denote dogma. Instead, as new data become available, previous scientific explanations are revised and improved, or rejected and replaced. There is a progression from a hypothesis to a theory using testable, scientific laws. Many hypotheses are tested to generate a theory. Only a few scientific facts are considered natural laws (e.g., the Law of Conservation of Mass).

Scientists use the terms *laws*, *theories*, and *hypotheses* to describe various types of scientific explanations about phenomena in the natural and constructed world. These meanings differ from common usage of the same terms:

- Law - A law is a generalized description, usually expressed in mathematical terms, that describes some aspect of the natural world under certain conditions.
- Theory - A theory is an explanation for a set of related observations or events that may consist of statements, equations, models, or a combination of these. Theories also predict the results of future observations. A theory becomes a theory once the explanation is verified multiple times by different groups of researchers. The procedures and processes for testing a theory are well-defined within each scientific discipline, but they vary between disciplines. No amount of evidence proves that a theory is correct. Rather, scientists accept theories until the emergence of new evidence that the theory is unable to adequately explain. At this point, the theory is discarded or modified to explain the new evidence. Note that theories never become laws; theories explain laws.
- Hypothesis - A hypothesis is a tentative, testable generalization that may be used to explain a relatively large number of events in the natural world. It is subject to immediate or eventual testing by experiments. Hypotheses must be worded in such a way that they can be falsified. Hypotheses are never proven correct, but are supported by empirical evidence.
- Scientific models are constructed to represent and explain certain aspects of physical phenomenon. Models are never exact replicas of real phenomena; rather, models are simplified versions of reality, generally constructed in order to facilitate study of complex systems such as the atom, climate change, and biogeochemical cycles. Models may be physical, mental, or mathematical or contain a combination of these elements. Models are complex constructions that consist of conceptual

objects and processes in which the objects participate or interact. Scientists spend considerable time and effort building and testing models to further understanding of the natural world.

When engaging in the processes of science, students are constantly building and testing their own models of understanding of the natural world. Students may need help in learning how to identify and articulate their own models of natural phenomena. Activities that involve reflection and metacognition are particularly useful in this regard. Students should be able to identify the features of the physical phenomena their models represent or explain. Just as importantly, students should identify which features are not represented or explained by their models. Students should determine the usefulness of their model by judging whether the model helps in understanding the underlying concepts or processes. Ultimately, students realize that different models of the same phenomena may be needed in order to investigate or understand different aspects of the phenomena.

## Laboratory Work

Laboratory work is often at the centre of scientific research; as such, it should also be an integral component of school science. The National Research Council (2006, p. 3) defines a school laboratory investigation as an experience in the laboratory, the classroom, or the field that provides students with opportunities to interact directly with natural phenomena or with data collected by others using tools, materials, data collection techniques, and models. Laboratory experiences should be designed so that all students - including students with academic and physical challenges - are able to authentically participate in and benefit from those experiences.

Laboratory activities help students develop scientific and technological skills and processes including:

- initiating and planning
- performing and recording
- analyzing and interpreting
- communication and teamwork.

Laboratory investigations also help students understand the nature of science, specifically that theories and laws must be consistent with observations. Similarly, student-centered laboratory investigations help to emphasize the need for curiosity and inquisitiveness as part of the scientific endeavor. The National Science Teachers Association [NSTA] position statement The Integral Role of Laboratory Investigations in Science Instruction (2007) provides further information about laboratory investigations.

A strong science program includes a variety of individual, small, and large group laboratory experiences for students. Most importantly, the laboratory experience needs to go beyond conducting confirmatory "cook-book" experiments. Similarly, computer simulations and teacher demonstrations are valuable but should not serve as substitutions for hands-on student laboratory activities.

Assessment and evaluation of student performance must reflect the nature of the laboratory experience by addressing scientific and technological skills. As such, the results of student investigations and experiments do not always need to be written up using formal laboratory reports. Teachers may consider alternative formats such as narrative lab reports for some experiments. The narrative lab report enables students to tell the story of their process and findings in a less structured format than a typical lab report.

In a narrative lab report, students answer four questions:

- What was I looking for?
- How did I look for it?
- What did I find?
- What do these findings mean?

The answers are written in an essay format rather than using the structured headings of Purpose, Procedure, Hypothesis, Data, Analysis, and Conclusion that are typically associated with a formal lab report. For some investigations, teachers may decide it is sufficient for students to write a paragraph describing the significance of their findings.

## Safety

Safety in the classroom is of paramount importance. Other components of education (resources, teaching strategies, facilities) attain their maximum utility only in a safe classroom. To create a safe classroom requires that a teacher be informed, aware, and proactive and that the students listen, think, and respond appropriately.

Safe practice in the laboratory is the joint responsibility of the teacher and students. The teacher's responsibility is to provide a safe environment and to ensure the students are aware of safe practice. The students' responsibility is to act intelligently based on the advice which is given and which is available in various resources.

Kwan and Texley (2003) suggest that teachers, as professionals, consider four Ps of safety: prepare, plan, prevent, and protect. The following points are adapted from those guidelines and provide a starting point for thinking about safety in the science classroom:

- **Prepare**
  - Keep up to date with your personal safety knowledge and certifications.
  - Be aware of national, provincial, division, and school level safety policies and guidelines.
  - Create a safety contract with students.
- **Plan**
  - Develop learning plans that ensure all students learn effectively and safely.

    - Choose activities that are best suited to the learning styles, maturity, and behaviour of all students and that include all students.
    - Create safety checklists for in-class activities and field studies.
- **Prevent**
    - Assess and mitigate hazards.
    - Review procedures for accident prevention with students.
    - Teach and review safety procedures with students, including the need for appropriate clothing.
    - Do not use defective or unsafe equipment or procedures.
    - Do not allow students to eat or drink in science areas.
- **Protect**
    - Ensure students have sufficient protective devices, such as safety glasses.
    - Demonstrate and instruct students on the proper use of safety equipment and protective gear.
    - Model safe practice by insisting that all students, visitors, and yourself use appropriate protective devices.

The definition of safety includes consideration of the well-being of all components of the biosphere, such as plants, animals, earth, air, and water. From knowing what wild flowers can be picked to considering the disposal of toxic wastes from chemistry laboratories, the safety of our world and our future depends on our actions and teaching in science classes. It is important that students practice ethical, responsible behaviours when caring for and experimenting with live animals. For further information, refer to the NSTA position statement *Responsible Use of Live Animals and Dissection in the Science Classroom* (2008).

Safety in the science classroom includes the storage, use, and disposal of chemicals. The Workplace Hazardous Materials Information System (WHMIS) regulations under the Hazardous Products Act govern storage and handling practices of chemicals in schools. All school divisions must comply with the provisions of the Act. Chemicals should be stored in a safe location according to chemical class, not just alphabetically. Appropriate cautionary labels must be placed on all chemical containers and all school division employees using hazardous substances should have access to appropriate Materials Safety Data Sheets. Under provincial WHMIS regulations, all employees involved in handling hazardous substances must receive training by their employer. Teachers who have not been informed about or trained in this program should contact their Director of Education. Further information related to WHMIS is available through Health Canada and the Saskatchewan Ministry of Advanced Education, Employment and Labour.

## Technology in Science

Technology-based resources are essential for instruction in the science classroom. Technology is intended to extend our capabilities and, therefore, is one part of the teaching toolkit. Individual, small group, or class reflection and discussions are required to connect

the work with technology to the conceptual development, understandings, and activities of the students. Choices to use technology, and choices of which technologies to use, should be based on sound pedagogical practices, especially those which support student inquiry. These technologies include computer technologies as described below and non-computer based technologies.
Some recommended examples of using computer technologies to support teaching and learning in science include:

- **Data Collection and Analysis**
  - Data loggers permit students to collect and analyze data, often in real-time, and to collect observations over very short or long periods of time, enabling investigations that otherwise would be impractical.
  - Databases and spreadsheets can facilitate the analysis and display of student-collected data or data obtained from scientists.
- **Visualization and Imaging**
  - Simulation and modeling software provide opportunities to explore concepts and models which are not readily accessible in the classroom, such as those that require expensive or unavailable materials or equipment, hazardous materials or procedures, levels of skills not yet achieved by the students, or more time than is possible or appropriate in a classroom.
  - Students may collect their own digital images and video recordings as part of their data collection and analysis or they may access digital images and video online to help enhance understanding of scientific concepts.
- **Communication and Collaboration**
  - The Internet can be a means of networking with scientists, teachers, and other students by gathering information and data, posting data and findings, and comparing results with students in different locations.
  - Students can participate in authentic science projects by contributing local data to large-scale web-based science inquiry projects such as Journey North (www.learner.org/north) or GLOBE (www.globe.gov).

## Science Challenges

Science challenges, which may include science fairs, science leagues, Science Olympics, Olympiads, or talent searches, should be considered as instructional methods suitable for students to undertake in any unit, across units, or in conjunction with other subject areas. Teachers may incorporate science challenge activities as an integral component of the science program or treat them similar to other extracurricular activities such as school sports and clubs. If science challenges are undertaken as a classroom activity, teachers should consider these guidelines, adapted from the NSTA position statement *Science Competitions* (1999):

- Student and staff participation should be voluntary and open to all students.
- Emphasis should be placed on the learning experience rather than the competition.

- Science competitions should supplement and enhance other learning and support student achievement of curriculum outcomes.
- Projects and presentations should be the work of the student, with proper credit given to others for their contributions.
- Science competitions should foster partnerships among students, the school, and the science community.

Science challenge activities may be conducted solely at the school level, or with the intent of preparing students for competition in one of the regional science fairs, perhaps as a step towards the Canada Wide Science Fair. Although students may be motivated by prizes, awards, and the possibility of scholarships, teachers should emphasize that the importance of doing a science fair project includes attaining new experiences and skills that go beyond science, technology, or engineering. Students learn to present their ideas to an authentic public that may consist of parents, teachers, and the top scientists in a given field.

Science fair projects typically consist of:

- An experiment, which is an original scientific experiment with a specific, original hypothesis. Students should control all important variables and demonstrate appropriate data collection and analysis techniques.
- A study, which involves the collection of data to reveal a pattern or correlation. Studies can include cause and effect relationships and theoretical investigations of the data. Studies are often carried out using surveys given to human subjects.
- An innovation, which deals with the creation and development of a new device, model, or technique in a technological field. These innovations may have commercial applications or be of benefit to humans.

Youth Science Foundation Canada (www.ysf.ca) provides further information regarding science fairs in Canada.

# Outcomes and Indicators

## Life Science: Sustainability of Ecosystems

**SE1 Explore cultural perspectives on sustainability.**

a. Examine how various cultures view the relationships between living organisms and their ecosystems.
b. Explain human responsibility to protect ecosystems.
c. Demonstrate how society’s needs and functions affect one’s community.

**SE2 Examine biodiversity within local ecosystems.**

a. Observe a range of organisms to illustrate the biodiversity within a local ecosystem.
b. Demonstrate a sense of personal and shared responsibility for maintaining a sustainable environment.
c. Explore ecology-related work settings and work roles in the community.

**SE3 Analyze population dynamics within an ecosystem.**

a. Construct and/or interpret graphs of natural populations within an ecosystem.

**SE4 Describe cycles, change, and stability in ecosystems.**

a. Identify and respect various cultural perspectives on the cycling of nutrients and matter throughout the environment.

**SE5 Investigate human impact on ecosystems.**

a. Explain why ecosystems with similar characteristics can exist in different geographical locations.
b. Compare a natural and a disturbed (altered) ecosystem and suggest ways of assuring their sustainability.
c. Predict the personal, social, and environmental consequences of a proposed action.

## Physical Science: Motion in Our World

**MW1 Explore motion-related technologies.**

a. Acquire additional science knowledge and skills using a variety of resources and methods, and adopt behaviours and attitudes that project a positive self image.
b. Recognize the contribution of science and technology to the progress of civilizations.
c. Relate personal activities and interests related to motion.
d. Describe examples of Canadian contributions to science and technology in motion-related fields such as transportation, sport science, or space science.

**MW2 Observe and describe the motion of everyday objects.**

a. Observe and describe the motion of everyday objects qualitatively using personal words and phrases.
b. Discuss the role of “frame of reference” in determining whether an object is in motion.

**MW3 Investigate the relationship among distance, time, and speed for objects that undergo uniform motion.**

a. Collect data about everyday objects that undergo simple linear motion.

b. Design an experiment and identify specific variables to be tested.
c. Use appropriate instruments such as ticker timers, stopwatches, photogates, or motion detectors to collect data.
d. Evaluate the relevance and reliability of the data.

**MW4 Investigate the relationship among speed, time, and acceleration for objects that undergo uniformly accelerated motion.**

a. Collect data about everyday objects that undergo uniformly accelerated motion.
b. Work collaboratively to plan and carry out investigations, as well as to generate and evaluate ideas to practice the skills, knowledge, and attitudes needed to work effectively with and for others.
c. Construct and analyze distance-time and speed-time graphs of objects that undergo uniform acceleration.

**MW5 Analyze graphically and mathematically the relationship among distance, speed, time and acceleration for objects that undergo simple linear motion or uniformly accelerated motion.**

a. Read and interpret simple graphs to develop an understanding of the relationships among numbers.
b. Describe the relationship among distance, time, speed, and acceleration for everyday objects that undergo simple linear motion.

## Physical Science: Chemical Reactions

**CR1 Observe common chemical reactions in your world.**

a. Provide examples of how science and technology are an integral part of our lives and community.
b. Observe and describe chemical reactions that are important in everyday life.
c. Perform activities to investigate chemical reactions.
d. Show concern for safety and accept the need for rules and regulations when conducting scientific investigations.
e. Demonstrate knowledge of Workplace Hazardous Materials Information System (WHMIS) standards by selecting and applying proper techniques for handling and disposing of lab materials.
f. Show concern for safety and accept the need for rules and regulations.
g. Identify and describe science and technology-based occupations related to chemistry.
h. Compare examples of how society supports and influences science and technology in Saskatchewan and Canada.

**CR2 Represent chemical reactions symbolically using models, word equations, and balanced chemical equations.**

a. Represent a chemical compound using a model.

b. Explore the periodic table.

**CR3 Identify characteristics of chemical reactions involving organic compounds.**

a. Observe and describe the combustion process.
b. Discuss a variety of natural and synthetic compounds that contain carbon.
c. Propose alternative solutions to society's reliance on fossil fuels, identify the potential strengths and weaknesses of each solution.

**CR4 Identify factors that affect the rates of chemical reactions.**

a. Discuss how factors such as temperature, concentration, and surface area can affect the rate of a chemical reaction.
b. Conduct an experiment to observe how various factors affect chemical reaction rates.
c. Discuss the data.
d. Value the processes for drawing conclusions in science.

**CR5 Investigate chemical reactions involving acids and bases.**

a. Investigate the characteristics of acids and bases.
b. Work co-operatively with team members to develop and carry out a plan.

## Earth and Space Science: Weather Dynamics

**MW1 Explore the causes and impact of severe weather in Canada.**

a. Identify and explain those characteristics that distinguish weather from climate.
b. Identify and explain the causes of Canadian severe weather events (e.g. tornadoes, hurricanes, blizzards, hailstorms, thunderstorms, flooding, ice storms, and droughts).
c. Identify tools scientists use to describe and classify severity of weather phenomenon (e.g. Beaufort wind scale, Saffir-Simpson Hurricane Scale, wind chill chart, humidex, UV index).
d. Explore careers related to weather forecasting.

**MW2 Analyze meteorological data.**

a. Identify commonly used symbols on meteorological and news weather maps.
b. Explain how to collect meteorological data.

c. Related personal collection of weather data to branches of science such as meteorology.
d. Discuss Canadian contributions to science and technology in the field of meteorology (e.g. satellite data collection, analysis/forecasting, and modelling).

**MW3 Explain the principles of weather.**

a. Identify weather-related questions that arise from practical problems and one's previous life experiences.
b. Discuss how science attempts to explain weather phenomena through observation and experiment.
c. Explore cultural and historical views on the origins and interpretations of weather.
d. Discuss the characteristics of the atmosphere, hydrosphere, and lithosphere.
e. Describe and explain heat transfer within the water cycle.
f. Describe and explain heat transfer and its effects on air and water currents.

**MW4 Forecast weather conditions.**

a. Examine the principles of weather prediction and predict local weather conditions.
b. Determine the accuracy of local weather predictions for a given period.
c. Identify the ways in which technology has improved weather forecasting.
d. Explore various cultural and historical perspectives related to weather forecasting.
e. Discuss the benefits and limitations of technological tools used to predict weather.

**MW5 Identify consequences of global climate change.**

a. Identify current issues related to global climate change.
b. Identify the most important natural and human factors that influence global climate.
c. Explain how scientific knowledge of global climate has evolved and continues to evolve, as new evidence becomes known.
d. Select and integrate information related to global climate change from various print and electronic sources.
e. Discuss potential consequences of climate change and the need to investigate climate change.
f. Identify questions or problems relating to global climate change that arise from personal research.
g. Consider some personal, social, and environmental consequences of a position or proposed course of action related to global climate change.
h. Understand the role that human values play in critical thinking.

# Life Science: Sustainability of Ecosystems

## Unit Overview

The land in Saskatchewan supports agriculture, forestry, mining and tourism. Choices made in those sectors have significant impacts on the lifestyles of all people in the province and on the health of our environment. Students should develop a greater understanding of how our personal, social, economic, and political decisions influence our environment and how these choices are rooted in cultural understandings of our relationship with the natural environment. As students develop this understanding, they are better able to make informed decisions that enhance the sustainability of our world.

Students in the Science 18 program will be encouraged to participate in the development of an action plan that they can undertake in order to enhance the sustainability of an environment at a local level.

Teachers are strongly encouraged to use case studies of local ecosystems during this unit.

## UbD Planning Document

| Good Spirit School Division UbD Unit Plan | | |
|---|---|---|
| **Teacher:** | **Subject: Science** | **Grade: Ten – Level 18** |
| **Unit Title: Life Science: Sustainability of Ecosystems** | | |
| **Context (ELA only):** | **Type of Unit (ELA only):** | |
| **Time Frame:** | | |
| **STAGE ONE: IDENTIFY THE DESIRED RESULTS** | | |
| **Outcomes Addressed in the Unit**<br>**SK curriculum outcomes can be copied and pasted, focuses highlighted.** | | |
| SE1 Explore cultural perspectives on sustainability.<br>SE2 Examine biodiversity within local ecosystems.<br>SE3 Analyze population dynamics within an ecosystem.<br>SE4 Describe cycles, change, and stability in ecosystems.<br>SE5 Investigate human impact on ecosystems. | | |

| **Big Ideas/Enduring Understandings**<br>**What do you want students to understand and be able to use several years from now?**<br>**What are the BIG ideas?** | **Essential Questions**<br>**Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.** |
|---|---|
| - There are different world views on sustainability.<br>- Natural factors affect the sustainability of ecosystems.<br>- Human activities affect the sustainability of ecosystems. | - What is sustainability?<br>- What natural factors affect the sustainability of an ecosystem?<br>- How do human activities affect the sustainability of an ecosystem?<br>- How can humans improve the sustainability of our ecosystems? |

| **Knowledge and Skills (Students will know and do…)**<br>**What key knowledge and skills will students acquire as a result of this unit?**<br>**(These may be indicators from the curriculum)** | |
|---|---|
| **Knowledge (Students will know…)**<br>**What key knowledge will students acquire as a result of this unit?** | **Skills (Students will know how to…)**<br>**What key skills will students acquire as a result of this unit?** |
| - the definition of sustainability (ability to meet the needs of the present generation without compromising the ability of future generations to meet their needs).<br>- the definition of biodiversity.<br>- how the nature of sustainability is revealed<br>- how various cultures view the relationships between living organisms and their ecosystems.<br>- the human responsibility to protect ecosystems.<br>- the various cultural perspectives on the cycling of nutrients and matter through the environment. | - demonstrate how society's needs and functions affect one's community.<br>- observe a range of organisms to illustrate the biodiversity within a local ecosystem.<br>- demonstrate a sense of personal and shared responsibility for maintaining a sustainable environment.<br>- explore ecology-related work settings and work roles in the community.<br>- construct graphs of natural populations within an ecosystem.<br>- interpret graphs of natural populations within an ecosystem.<br>- respect the various cultural perspectives on the cycling of nutrients and matter through the environment. |

| **STAGE TWO: DESIGN ASSESSMENT EVIDENCE** | |
|---|---|
| **Assessment Evidence** | |
| **Summative Assessments/Performance Tasks**<br>**Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.** | |
| **Outcomes/Objectives** | Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include: |
| SE1, SE2, SE3, SE4, SE5 | **Action Plan -** Students create and implement an action plan that promotes the sustainability of the ecosystems at the local level. Include description of plan and reasons behind choices of actions. |

| | |
|---|---|
| | **Perfect Ecosystem** - Students design a perfect ecosystem. They create their ecosystem using a medium of their choice (painting, model, diorama, etc.). Teachers then conduct oral interviews to determine student knowledge and understanding of the sustainability of ecosystems. |
| | **Sustainability of Ecosystems Brochure** - Students use their knowledge to design and write a brochure that demonstrates their understanding of the sustainability of ecosystems. |

## Formative Assessments

**Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?**
**These help guide instruction and provide feedback to students.**

**Examples of possible formative assessments include:**

**Science Journals** - Throughout the study of the ecosystems, students record their learning in Science journals using diagrams, charts, descriptions, highlights of learning, etc.

**Exit Cards** - Use daily exit cards to determine student understanding and identify concepts that students need further instruction and/or exploration opportunities.

**Open Ended Questions** - Pose open-ended questions and have students discuss with partners or small groups and report highlights to larger groups.

## Pre-Assessments

**Pre-assessments are used to determine what students know and their readiness level to inform instruction.**

**Examples of possible pre-assessments include:**

**Anticipation Guides** - Before introducing ecosystems to your students, create an anticipation guide that includes statements about the sustainability of ecosystems that require students to answer true and false and provide reasons for their choice of answer.

**Graffiti Wall** - Create a graffiti wall in the classroom and have students create visual representations of their knowledge of ecosystems.

**Placemats** - Divide students into groups and use the placemat strategy to activate students' prior knowledge about ecosystems and use this information to plan instruction.

**STAGE THREE: CREATE THE LEARNING PLAN**

## Instructional Plan

**The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.**

**Related Topics In Saskatchewan Science Curriculums**
Grade 1 - Needs and Characteristics of Living Things (LT1.1, LT1.2)
Grade 2 - Animal Growth and Changes (AN2.1, AN2.2, AN2.3)
Grade 3 - Plant Growth and Changes (PL3.1, PL3.2)
Grade 4 - Habitats and Communities (HC4.1, HC4.2, HC4.3)
Grade 6 - Diversity of Living Things (DL6.1, DL6.2, DL6.3, DL6.4, DL6.5)
Grade 7 - Interactions within Ecosystems (IE7.1, IE7.2, IE7.3, IE7.4)

**The instructional plan will depend on the unique learning needs of the students in each Science 18 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:**

**SE1 Explore cultural perspectives on sustainability.**
- Interview people from different cultures to determine the role that living things play in their lives (values, beliefs, etc.).
- Determine why it is important for people to protect our environment. Discuss what would happen if people did not accept this responsibility.

**SE2 Examine biodiversity within local ecosystems.**
- Go on a field trip and examine the living organisms in more than one local ecosystem (in a park, along a river, near a pond, in a grassland, etc.). Encourage students to determine the relationships between the living things in each ecosystem.
- Discuss how students help to protect the living organisms in local ecosystems. Brainstorm additional activities that students could take part in to preserve and protect the ecosystems.

**SE3 Analyze population dynamics within an ecosystem.**
- Provide students with data on different populations of living things within an environment and have them interpret what the data means.
- Create a survey to determine various populations in an ecosystem. After gathering the data, students construct a graph to show their findings.

**SE4 Describe cycles, change, and stability in ecosystems.**
- Study the role of the water, carbon, or oxygen cycle from the First Nations perspective. How is the First Nations perspective the same or different from your perspective.

**SE5 Investigate human impact on ecosystems.**
- Discuss how a change might affect an ecosystem. Determine if the change will have a positive or negative impact on the environment and the people who live in the environment.

## Key Resources

| **Support Materials:**<br>[Cultural Perspectives on Sustainability: Lessons to Support Science 10 by John Wright]<br>[Canadian Museum of Nature]<br>[Focused Study: Cultural Perspectives on Saskatchewan]<br>[Oil Sands: The Case for Caution]<br>[From Mission to Action: Lessons on Sustainability to Support Science 10 by Ted View] |
|---|

# Physical Science: Motion in Our World

## Unit Overview

Motion occurs throughout our physical world, from the readily observable motion of people moving throughout our society to the less easily observable motion of atoms vibrating and planets orbiting. In this unit, students will focus their study of motion on the description and analysis of simple linear motion using words, diagrams, graphs, and equations.

Students in the Science 18 program will use the context of observing and describing motion of everyday objects that undergo simple motion. Students should have varied hands-on experiences with moving objects in order to develop understandings of position, speed, and acceleration.

The theme of personal transportation devices (e.g. feet, shoes, bicycles, snowshoes, roller blades, wheelchairs, motorcycles, or passenger automobiles) is strongly suggested for this unit. Such a theme enables students to apply the descriptive language and analytic tools of kinematics to concrete examples of familiar motion. Alternatively, students must study the motion of athletes, automobiles, or objects in flight to situate their learning within a personally relevant context.

## UbD Planning Document

<table>
<tr><th colspan="3">Good Spirit School Division UbD Unit Plan</th></tr>
<tr><td>Teacher:</td><td>Subject: Science</td><td>Grade: Ten – Level 18</td></tr>
<tr><td colspan="3">Unit Title: Physical Science: Motion in Our World</td></tr>
<tr><td colspan="2">Context (ELA only):</td><td>Type of Unit (ELA only):</td></tr>
<tr><td colspan="3">Time Frame:</td></tr>
<tr><td colspan="3">STAGE ONE: IDENTIFY THE DESIRED RESULTS</td></tr>
</table>

| **Outcomes Addressed in the Unit**<br>**SK curriculum outcomes can be copied and pasted, focuses highlighted.** | |
|---|---|
| MW1: Explore motion-related technologies.<br>MW2: Observe and describe the motion of everyday objects.<br>MW3: Investigate the relationship among distance, time, and speed for objects that undergo uniform motion.<br>MW4: Investigate the relationship among speed, time, and acceleration for objects that undergo uniformly accelerated motion.<br>MW5: Analyze graphically and mathematically the relationship among distance, speed, time, and acceleration for objects that undergo simple linear motion or uniformly accelerated motion. | |
| **Big Ideas/Enduring Understandings**<br>**What do you want students to understand and be able to use several years from now?**<br>**What are the BIG ideas?** | **Essential Questions**<br>**Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.** |
| - We can describe motion and the changes in motion of everyday objects.<br>- You can determine the position, speed, and acceleration of everyday objects using a number of different methods. | - What are the characteristics of the motion?<br>- How can we describe motion and the changes in motion of everyday objects?<br>- What are some methods of determining the position, speed, and acceleration of everyday objects? |
| **Knowledge and Skills (Students will know and do…)**<br>**What key knowledge and skills will students acquire as a result of this unit?**<br>**(These may be indicators from the curriculum)** | |
| **Knowledge (Students will know…)**<br>**What key knowledge will students acquire as a result of this unit?** | **Skills (Students will know how to…)**<br>**What key skills will students acquire as a result of this unit?** |

| | |
|---|---|
| - motion can be described by its position, direction of motion, and speed.<br>- motion is relative to reference point.<br>- different motion-related technologies.<br>- the contribution of science and technology to the progress of civilizations.<br>- examples of Canadian contributions to science and technology in motion-related fields. | - relate personal activities and interests to motion.<br>- observe and describe the motion of everyday objects using personal words and phrases.<br>- discuss the role of "frame of reference" in determining whether an object is in motion.<br>- collect data on objects that display linear motion and accelerated motion.<br>- design experiments related to motion.<br>- use appropriate instruments (ticker timers, stopwatches, photogates, motion detectors, etc.) to collect data on motion.<br>- analyze data collected during experiments.<br>- read and interpret graphs that show relationships among numbers.<br>- describe the relationship of everyday objects in motion. |

**STAGE TWO: DESIGN ASSESSMENT EVIDENCE**

## Assessment Evidence

**Summative Assessments/Performance Tasks**

**Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.**

| Outcomes/Objectives | Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include: |
|---|---|
| MW1, MW2, MW3, MW4, MW5 | **Science Fair** - Ask students to create a science project that showcases their learning about linear and accelerated motion. Encourage students to be creative and follow criteria on a co-constructed rubric or on a rubric provided by the teacher. |
| | **Photo Journals** - Have students create photo journals that demonstrate understanding of linear and accelerated motion. Students can provide written or oral explanations of the pictures in their journals. |
| | **Choice Boards -** Provide students with a choice board of activities that target different learning styles. Students choose activities to demonstrate their learning. |

**Formative Assessments**

**Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?**
**These help guide instruction and provide feedback to students.**

**Examples of possible formative assessments include:**
**Drawing Journal** - Provide each student with an unlined journal. Students draw diagrams to demonstrate their learning about motion. Be sure to tell students to label their drawings and provide jot notes to support their learning.
**Fist of Five** - Use the fist of five strategy throughout lessons on motion to ensure student understanding. If students indicate they have little or incomplete understanding, plan learning opportunities to further explore these concepts.
**Three, Two, One Exit Slips** - Use three, two, one exit slips at the end of each class to assess learning. Ask students to record three new pieces of learning, two questions they still have, and one personal connection to the day's lesson. These exit slips will provide a written record of student learning and help plan instruction.

## Pre-Assessments

**Pre-assessments are used to determine what students know and their readiness level to inform instruction.**

**Examples of possible pre-assessments include:**
**Email Questions** - Before beginning a unit or series of lessons on motion, email three to five questions to students regarding motion and motion-related technologies. Use student answers to help you plan instruction.
**Pre-Assessment Quiz** - Provide each student with a pre-assessment quiz that targets motion. On one or more occasions during the study of motion, repeat this assessment to track student learning.
**Class Discussions** - Hold a class discussion to introduce students to linear and accelerated motion. Ask open-ended questions and let student responses guide the discussion. Listen carefully to student comments to determine their understanding of this topic.

**STAGE THREE: CREATE THE LEARNING PLAN**

## Instructional Plan

**The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.**

**Related Topics In Saskatchewan Science Curriculums**
Grade 1 - Using Objects and Materials (OM1.1, OM1.2)
Grade 2 - Motion and Relative Position (MP2.1, MP2.2)
Grade 3 - Structures and Materials (SM3.1, SM3.2)
Grade 4 - Light (LI4.1, LI4.2, LI4.3)
Grade 5 - Properties and Changes of Materials (MC5.1, MC5.2, MC5.3)
Grade 5 - Forces and Simple Machines (FM5.1, FM5.2, FM5.3)
Grade 6 - Principles of Flight (FL6.1, FL6.2, FL6.3)
Grade 8 - Forces, Fluids, and Density (FD8.1, FD8.2, FD8.3, FD8.4)

**The instructional plan will depend on the unique learning needs of the students in each Science 18 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:**

**MW1: Explore motion-related technologies.**
- Students could design and fly paper airplanes and record discoveries about motion.
- Research Canadian inventors who have contributed to science in areas such as transportation, sport science, or space science (hydrofoil boat, Canadarm, snowmobile, goalie mask, instant replay etc.).

**MW2: Observe and describe the motion of everyday objects.**
- Describe the motion of everyday objects.
- Define "frame of reference" for students and provides examples of the role frame of reference plays in describing the motion of objects.

**MW3: Investigate the relationship among distance, time, and speed for objects that undergo uniform motion.**
- Conduct experiments that focus on simple linear motion. Discuss student observations and findings.
- Ask students to design experiments that focuses on linear motion, gather data during experiment, and present findings to the rest of the class.

**MW4: Investigate the relationship among speed, time, and acceleration for objects that undergo uniformly accelerated motion.**
- Conduct experiments that focus on accelerated motion. Discuss student observations and findings.
- Ask students to design experiments that focuses on accelerated motion, gather data during experiment, and present findings to the rest of the class.

**MW5: Analyze graphically and mathematically the relationship among distance, speed, time, and acceleration for objects that undergo simple linear motion or uniformly accelerated motion.**
- Provide students with simple graphs that demonstrate both linear and accelerated motion. Encourage students to analyze data and report on conclusions.

## Key Resources

| **Support Materials:** |
|---|
| Exploring Motion-Related Technology Through a First Nations Game<br>Force and Motion Facts<br>Newton's Understanding of Force and Motion<br>Laws of Motion<br>Free Fall Laboratory Gizmo |

# Physical Science: Chemical Reactions

## Unit Overview

Chemistry is the science that answers questions about the composition, structure, and properties of matter and the changes matter undergoes. It has a specialized language based on chemical names, formulas, and equations that are common throughout the world.

Students in the Science 18 program will explore the relationships between science, technology, society, and the environment that are common in Saskatchewan agriculture and industry.

The study of chemical reactions should focus on chemistry in a student's daily life in Saskatchewan, which may include themes such as household chemistry, food chemistry, agriculture, pharmaceuticals, photography, arts and crafts, personal care products, home maintenance products, pesticides, potash, water resources, sodium sulphate, ethanol, ammonia and urea, mining, forestry, or high technology industries.

## UbD Planning Document

| **Good Spirit School Division UbD Unit Plan** | | |
|---|---|---|
| **Teacher:** | **Subject: Science** | **Grade: Ten – Level 18** |
| **Unit Title: Physical Science: Chemical Reactions** | | |
| **Context (ELA only):** | **Type of Unit (ELA only):** | |
| **Time Frame:** | | |
| **STAGE ONE: IDENTIFY THE DESIRED RESULTS** | | |
| **Outcomes Addressed in the Unit**<br>**SK curriculum outcomes can be copied and pasted, focuses highlighted.** | | |

| |
|---|
| CR1 Observe common chemical reactions in your world.<br>CR2 Represent chemical reactions symbolically using models, word equations, and balanced chemical equations.<br>CR3 Identify characteristics of chemical reactions involving organic compounds.<br>CR4 Identify factors that affect the rates of chemical reactions.<br>CR5 Investigate chemical reactions involving acids and bases. |

| **Big Ideas/Enduring Understandings**<br>**What do you want students to understand and be able to use several years from now?**<br>**What are the BIG ideas?** | **Essential Questions**<br>**Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.** |
|---|---|
| - Chemical reactions differ from physical changes.<br>- Chemical reactions are important in our lives and community.<br>- Energy changes take place during chemical reactions.<br>- The reliance on fossil fuels affects our society. | - What are chemical reactions and how do they differ from physical change?<br>- How are chemical reactions important in our lives and community?<br>- What energy changes take place during chemical reactions?<br>- How does the reliance on fossil fuels affect our society? |

| **Knowledge and Skills (Students will know and do…)**<br>**What key knowledge and skills will students acquire as a result of this unit?**<br>**(These may be indicators from the curriculum)** | |
|---|---|
| **Knowledge (Students will know…)**<br>**What key knowledge will students acquire as a result of this unit?** | **Skills (Students will know how to…)**<br>**What key skills will students acquire as a result of this unit?** |
| - the role science and technology plays in our lives and community.<br>- what chemical reactions are important in our everyday lives.<br>- the rules and regulations for conducting scientific investigations.<br>- know Workplace Hazardous Materials Information Systems (WHMIS).<br>- science and technology-related occupations related to chemistry.<br>- how to use the periodic table.<br>- the combustion process. | - investigate chemical reactions.<br>- select and apply proper techniques for handling and disposing of lab materials.<br>- compare examples of how society supports and influences science and technology in Saskatchewan and Canada.<br>- represent a common chemical compound using a model.<br>- propose alternative solutions to fossil fuels and the possible strengths and weaknesses of each solution.<br>- discuss how various factors (temperature, concentration, and surface area) affect the rate of a chemical reaction.<br>- conduct experiments to observe how various facts affect chemical reaction rates.<br>- discuss data collected during experiments.<br>- investigate characteristics of acids and bases. |

| STAGE TWO: DESIGN ASSESSMENT EVIDENCE | |
|---|---|
| **Assessment Evidence** | |
| **Summative Assessments/Performance Tasks**<br>**Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.** | |
| **Outcomes/Objectives** | Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include: |
| CR1, CR2, CR3, CR4, CR5 | **Dictionary** - Students create a dictionary of key terms used throughout the unit and describe how the terminology relates to their understanding of chemical reactions. |
| | **Learning Logs -** Throughout the study of chemical reactions, students can record new understandings in their learning logs. Encourage students to make personal connections to their understandings. |
| | **Science Projects** - Students design a science project to demonstrate their understanding of chemical reactions. They can present their projects to the class. |
| **Formative Assessments**<br>**Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?**<br>**These help guide instruction and provide feedback to students.** | |
| **Examples of possible formative assessments include:**<br>**List Ten Things** - Periodically throughout the study of chemical reactions, ask students to list ten things they have learned about chemical reactions. These lists will provide evidence of student learning and can be used to support findings of other summative assessment measures.<br>**Three Facts and a Fib** - Students write three things they know to be true about chemical reactions and one think they know is not true. Read out these statements to the class and have them identify the “fib” in each set of facts.<br>**Turn and Talk** - Provide students with an open-ended question about chemical reactions and ask them to “turn and talk” about the question with a partner. Circulate throughout the room to determine what students understand and what further instruction is needed. | |
| **Pre-Assessments**<br>**Pre-assessments are used to determine what students know and their readiness level to inform instruction.** | |
| **Examples of possible pre-assessments include:**<br>**Quick Writes** - Before beginning your study of chemical reactions, give students three to five minutes to quickly write what they know about chemical reactions. Use this information to help plan learning opportunities for students.<br>**Sticky Notes** - Give students a sticky note and have students write and/or draw what they know about chemical reactions. Encourage students to label their drawings. Remind students that they only have a sticky note to write on so they should only include key points.<br>**Carousel Brainstorming** - Write four or five topics or questions related to chemical reactions on chart paper. Students circulate around the room and respond to each of the topics or questions. | |
| **STAGE THREE: CREATE THE LEARNING PLAN** | |

## Instructional Plan

**The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.**

**Related Topics In Saskatchewan Science Curriculums**
Grade 2 - Liquids and Solids (LS2.1, LS2.2)
Grade 7 - Mixtures and Solutions (MS7.1, MS7.2, MS7.3)
Grade 7 - Heat and Temperature (HT7.1, HT7.2, HT7.3)
Grade 9 - Atoms and Elements (AE9.1, AE9.2, AE9.3)

**The instructional plan will depend on the unique learning needs of the students in each Science 18 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:**

**CR1 Observe common chemical reactions in your world.**
- Brainstorm a list of common chemical reactions that take place around us (rust, photosynthesis, digestion, etc.)
- Conduct simple experiments that demonstrate chemical reactions (baking soda and vinegar).

**CR2 Represent chemical reactions symbolically using models, word equations, and balanced chemical equations.**
- Construct models of common chemical compounds.
- Create a scavenger hunt to explore the periodic table.

**CR3 Identify characteristics of chemical reactions involving organic compounds.**
- Demonstrate the combustion process to students.
- Discuss possible alternatives to the use of fossil fuels. Determine the strengths and weaknesses of each alternative.

**CR4 Identify factors that affect the rates of chemical reactions.**
- Conduct experiments that show how factors such as temperature, concentration, and surface area can affect chemical reactions.
- Study data conducted during experiments to draw conclusion and make personal responses to findings.

**CR5 Investigate chemical reactions involving acids and bases.**
- Discuss the characteristics of acids and bases and introduce students to the pH scale.
- Explore acids and bases using litmus paper.

## Key Resources

| **Support Materials:** |
|---|
| [10 Examples of Chemical Reactions in Everyday Life]<br>[Science Projects for Kids: Chemical Reactions]<br>[Chemistry Lab Take Home Activities]<br>[Acids and Bases]<br>[Acids and Bases Videos] |

# Earth and Space Science: Weather Dynamics

## Unit Overview

It is difficult to imagine a day going by where someone does not talk about the weather or climate change, yet few people are able to base their discussions on a thorough understanding of scientific principles that explain the Earth's weather and climate systems. To help develop and strengthen that understanding, students will investigate the factors that govern our global climate, focusing on the role of energy and water movement through the atmosphere and hydrosphere.

Students in the Science 18 program will explore weather forecasting and its limitations, cultural perspectives on weather, the impact of severe climate and weather on our planet and the changing of the Earth's climate.

## UbD Planning Document

| **Good Spirit School Division UbD Unit Plan** | | |
|---|---|---|
| **Teacher:** | **Subject: Science** | **Grade: Ten – Level 18** |
| **Unit Title: Earth and Space Science: Weather Dynamics** | | |
| **Context (ELA only):** | **Type of Unit (ELA only):** | |
| **Time Frame:** | | |
| **STAGE ONE: IDENTIFY THE DESIRED RESULTS** | | |
| **Outcomes Addressed in the Unit**<br>**SK curriculum outcomes can be copied and pasted, focuses highlighted.** | | |

| | |
|---|---|
| WD1 Explore the causes and impact of severe weather in Canada.<br>WD2 Analyze meteorological data.<br>WD3 Explain the principles of weather.<br>WD4 Forecast local weather conditions.<br>WD5 Identify consequences of global climate change. | |
| **<u>Big Ideas/Enduring Understandings</u>**<br>**What do you want students to understand and be able to use several years from now?**<br>**What are the BIG ideas?** | **<u>Essential Questions</u>**<br>**Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings**. |
| - Severe weather makes an impact on our planet.<br>- Meteorologists collect data about our climate.<br>- Natural factors influence climate change.<br>- Human factors influence climate change.<br>- Global climate change effects our environment. | - What is the difference between weather and climate?<br>- What are the impacts of severe weather on our planet?<br>- How do meteorologists collect data?<br>- What major natural and human factors influence climate change?<br>- What are the effects of global climate change on our environment? |
| **<u>Knowledge and Skills (Students will know and do…)</u>**<br>**What key knowledge and skills will students acquire as a result of this unit?**<br>**(These <u>may</u> be indicators from the curriculum)** | |
| **Knowledge (Students will know…)**<br>**What key <u>knowledge</u> will students acquire as a result of this unit?** | **Skills (Students will know how to…)**<br>**What key <u>skills</u> will students acquire as a result of this unit?** |

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|---|---|
| - the definitions of weather and climate.<br>- the characteristics that distinguish weather and climate.<br>- the causes of Canadian severe weather storms (tornadoes, hurricanes, blizzards, hailstorms, thunderstorms, flooding, ice storms, droughts, etc.).<br>- the tools (Beaufort wind scale, Saffir-Simpson Hurricane Scale, wind chill chart, humidex, UV index, etc.) scientists use to describe and classify weather storms.<br>- principles of weather prediction.<br>- the ways in which technology has improved weather forecasting.<br>- current issues related to global climate change.<br>- the important natural and human factors that influence global climate. | - explore careers related to weather forecasting.<br>- explain how to collect meteorological data.<br>- relate personal collection of weather data to branches of science such as meteorology.<br>- discuss Canadian contributions to science and technology in the field of meteorology (e.g. satellite data collection, analysis, forecasting, modelling, etc.).<br>- predict local weather conditions.<br>- determine the accuracy of local weather predictions for a given period.<br>- explore various cultural and historical perspectives related to weather forecasting.<br>- discuss the benefits and limitations of technological tools used to predict weather.<br>- explain how scientific knowledge of global climate has evolved and continues to evolve as new evidence becomes known.<br>- select and integrate information related to global climate change from various print and electronic sources.<br>- discuss potential consequences of climate change and the need to investigate climate change.<br>- identify questions or problems related to global climate change that arises from personal research.<br>- consider some personal, social, and environmental consequences of a position or proposed course of action related to global climate change.<br>- understand the role that human values play in critical thinking. |

**STAGE TWO: DESIGN ASSESSMENT EVIDENCE**

## Assessment Evidence

**<u>Summative Assessments/Performance Tasks</u>**

**Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.**

| Outcomes/Objectives | Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include: |
|---|---|
| WD1, WD2, WD3, WD4, WD5 | **Power Point Presentation** - Students present information learned about weather in a power point presentation. The presentation should include personal connections they made with the information they learned during this unit. |
| | **Speech** - Students present information about careers related to weather in a speech they give to classmates or that they record for others to watch or listen to. |

| | |
|---|---|
| | **Newspaper Articles** - Each student writes a newspaper article that focuses on weather. Encourage students to use what they have learned during the study of weather dynamics. Be sure to discuss expectations with students to ensure key criteria is included. |

## Formative Assessments

**Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?**
**These help guide instruction and provide feedback to students.**

**Examples of possible formative assessments include:**
**Response Journals** - Encourage students to respond to what they see, hear, read, and discover as they take part in the different learning opportunities in this unit. Students write or draw their discoveries in their response journals.
**Four Corners** - Create a number of statements related to weather and the information students have been discussing in class. Ask students to go to the corner of the classroom that matches their understanding and/or opinion of each statement. Students present their reasons for the chosen response.
**One Minute Essays** - At different points during this unit, ask students to write a one-minute essay that sums up what they have learned about weather. Use these essays to track learning and determine what additional information is needed by students.

## Pre-Assessments

**Pre-assessments are used to determine what students know and their readiness level to inform instruction.**

**Examples of possible pre-assessments include:**
**Webs** - Ask students to create a web that shows their current level of understanding of weather, weather instruments and weather careers. Depending on the learning needs of your students, you may want to complete this activity in partners or small groups. Have a few students present their webs to the rest of the class.
**Brainstorming** - In small groups or as a class, brainstorm a list of weather words, weather instruments, weather facts, and weather careers. Record all information and revisit throughout the unit.
**KWL Charts** - Individually or with a partner, have students record what they know about weather. They can also make a list of what they would like to learn about weather.

**STAGE THREE: CREATE THE LEARNING PLAN**

## Instructional Plan

**The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.**

**Related Topics In Saskatchewan Science Curriculums**
Grade 1 - Daily and Seasonal Changes (DS1.1, DS1.2)
Grade 2 - Air and Water in the Environment (AW2.1, AW2.2)
Grade 3 - Exploring Soils (ES3.1, ES3.2)
Grade 4 - Rocks, Minerals, and Erosion (RM4.1, RM4.2, RM4.3)

Grade 5 - Weather (WE5.1, WE5.2, WE5.3)
Grade 6 - Our Solar System (SS6.1, SS6.2, SS6.3)
Grade 7 - Earth's Crust and Resources (EC7.1, EC7.2, EC7.3)
Grade 8 - Water Systems on Earth (WS8.1, WS8.2, WS8.3)
Grade 9 - Exploring our Universe (EU9.1, EU9.2, EU9.3, EU9.4)

**The instructional plan will depend on the unique learning needs of the students in each Science 18 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:**

**WD1 Explore the causes and impact of severe weather in Canada.**
- Explore different weather systems, their causes, and the impact they have on our daily lives.
- Build and use different weather tools that help people describe weather (thermometers, rain gauges, barometers, anemometers, etc.).

**WD2 Analyze meteorological data.**
- Watch the weather on the news and discuss what information is provided and how we use the information.
- Discuss the contributions of Canadians in the field of meteorology.

**WD3 Explain the principles of weather.**
- Interview an Elder and explore the role that weather plays in the First Nations culture.
- Explore heat transfer and the water cycle. Have students draw conclusions about their discoveries.

**WD4 Forecast local weather conditions.**
- If possible, visit a local weather station and determine how weather conditions are predicted.
- Research how people have predicted weather conditions over the years.

**WD5 Identify consequences of global climate change.**
- Conduct a WebQuest on global warming.
- Identify what factors affect global warming and whether the impact is positive or negative.

## Key Resources

**Support Materials:**
Weather Instruments for Kids
Weather Inventions and Devices
Measuring Weather with Tools
Global Weather WebQuest

# Glossary

(taken from Grade 10 Science Saskatchewan Online Curriculum)

**Acceleration**
is the rate of change of an object's speech, which may be a change in magnitude of the speed or a change of direction of the speed.

**Acids**
are substances that produce hydrogen ions when dissolved in water. They are sour-tasting, good conductors of electricity, turn blue litmus paper red, and react with bases to form salts and water.

**Anemometers**
are devices used to measure wind speed.

**Atmosphere**
is the gaseous envelope that surrounds the Earth.

**Atmospheric Pressure**
is the pressure exerted by air on it surroundings due to the weight of the air.

**Average Speed**
refers to a calculation of change in distance over a time interval for a moving object.

**Barometers**
are devices used to measure atmospheric pressure.

**Barometric Pressure**
is the pressure exerted by air on it surroundings due to the weight of the air.

**Bases**
are substances that produce hydroxide ions when dissolved in water. Bases are bitter tasting, good conductors of electricity, feel slippery, turn red litmus paper blue and react with acids to form salts and water.

**Biodiversity**
is a measure of the number and variety of species in an ecosystem.

**Biogeochemical Cycle**
is the path of a nutrient through an ecosystem.

**Biomass**
is the measure of the mass of the dry matter contained in a group of living things.

**Blizzards**
are severe storm with strong winds (greater than 40 km/h), low temperatures, and blowing snow that reduces visibility to 1 km or less that lasts for at least three hours.

**Catalysts**
are substances that increase the rate of a chemical reaction without being consumed in the reaction.

**Cellular Respiration**
is the process by which most living things generate useful energy by combining oxygen and sugars to produce carbon dioxide and water.

**Chemical Equation**
represents that reactants and products in a chemical reaction using their symbols or formulas.

**Chemical Reaction**
is a process that involves the formation of new substances with new properties.

**Climate**
is the weather conditions of an area averaged over many years.

**Climate Change**
is a change in the “average weather” that a given region experiences. Average weather includes all the features we associate with the weather such as temperature, wind patterns, and precipitation.

**Clouds**
are collections of small water or ice particles occurring above the Earth's surface. Clouds are classified according to their height of occurrence and shape.

**Cold Fronts**
are the leading edges of cold air masses.

**Combustion**
is the reaction of a substance with oxygen to produce oxides, light, and heat. Most combustion reactions involve organic compounds.

**Community**
is all the organisms in an ecosystem.

**Conduction**
is the transfer of energy through a substance by the collision of particles.

**Convention**
is the transfer of energy by the movement of particles in a fluid (liquid or gas).

**Cyclones**
are low pressure air masses that rotate inward (counter clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere).

**Dew**
is water vapour that condenses on cool surfaces near the Earth's surface, typically in the morning.

**Dew Point Temperature**
is the temperature to which air would have to be cooled to reach saturation with respect to liquid water.

**Doppler Radar**
is a device used to determine how fast an object is moving towards or away from the radar site as well as the actual speed of the object.

**Drizzle**
is falling water droplets that have a diameter between 40 μm and 0.5 mm.

**Droughts**
are periods in which the rainfall for an area is much less than average.

**Ecological Footprint**
is a measure of an individual's or a population's impact on the environment.

**Emigration**
is the movement of members from a population.

**Endangered**
is a species that is close to extinction in all parts of Canada or in a significantly large location.

**Extinct**
is a species that is no longer found on earth.

**Floods**
are excess water from rain, rivers, or oceans that cannot be absorbed by the surrounding land.

**Fog**
is water droplets, ice crystals, or smoke particles that collect near the Earth's surface and that reduce visibility to less than 1 km.

**Fronts**
are the leading edges of an air mass.

**Global Warming**
is the increase in the average Earth's temperature due to an increased concentration of greenhouse gases in the atmosphere that amplifies the Greenhouse Effect.

**Greenhouse Effect**

is a natural process by which a planet’s atmosphere traps thermal energy from the Sun, causing the temperature of the atmosphere to increase.

**Hail**
is frozen water droplets that are created by cycling through highly active thunderclouds many times.

**Heat Capacity**
is a measure of how much energy is required to raise the temperature of a substance.

**Humidity**
is the amount of water vapour in a sample of air.

**Hydrocarbons**
are organic compounds composed solely of hydrogen and carbon atoms.

**Hydrologic Cycle**
is a model that describes the storage and movement of water between the atmosphere, hydrosphere, and lithosphere.

**Hydrosphere**
is the waters of the Earth.

**Hygrometers**
are devices used to measure the atmospheric humidity.

**Hypothesizing**
is stating a tentative generalization that may explain a large number of events and that may be tested experimentally.

**Ice Storms**
are when falling rain freezes instantly when coming in contact with a surface, forming a coat of ice on the surface.

**Immigration**
is the movement of members into a population.

**Inferring**

is explaining an observation in terms of previous experience.

**Instantaneous Speed**
refers to the actual speed of an object at a particular instant in time.

**Ionic Bond**
is the bond formed by the transfer of electrons from one atom (usually a metal) to another (usually a non-metal).

**Ionic Compound**
is a neutral compound that consists of positive and negative ions held together by an ionic bond.

**Ions**
are atoms that have become charged by gaining or losing one or more electrons.

**Isobars**
are lines on weather maps that connect points of equal pressure.

**Isotherms**
are lines on weather maps that connect points of equal temperature.

**Jet Stream**
is the name for high-speed winds in the upper troposphere.

**Lithosphere**
is the solid, inorganic outer shell of the Earth.

**Models**
are simplified representations of real phenomena that facilitate a better understanding of some scientific concepts or principles.

**Molecular Compound**
is a neutral compound composed of two or more non-metallic elements held together by covalent bonds.

**Monsoons**
are seasonal winds that blow from land to sea in the winter and from sea to land in the summer. Summer monsoons usually bring heavy precipitation.

**Mortality**
is the death rate in a population.

**Natality**
is the birth rate in a population.

**Nitrogen Fixation**
is the conversion of atmospheric nitrogen gas into compounds that are usable by plants, typically nitrate ions or ammonia.

**Nutrient**
is any substance needed by an organism for proper growth, repair, and function such as nitrogen, oxygen, carbon, water, phosphorus, sulfur, hydrogen.

**Nutrient Cycle**
is the path of a nutrient through an ecosystem.

**Organic Compounds**
are molecular substances that contain carbon, excluding carbonates and oxides.

**Organism**
is a living thing or something that was once alive.

**Paradigm**
is a set of experiences, beliefs, and values that constitute a way of viewing reality.

**PH Scale**
indicates the acidity or alkalinity of a solution.

**Photosynthesis**

is the process by which green plants and other producers use energy from the sun, and carbon dioxide and water to produce sugars and oxygen.

**Population**
is all the members of a species that are living in the same habitat at a particular time.

**Precipitation**
is water that falls to the ground in liquid or solid form.

**Probability**
is the relative degree of certainty that can be assigned to certain events happening in a specified time interval or within a specific sequence of events.

**Products**
are substances that form in a chemical reaction.

**Psychrometers**
are devices used to measure the atmospheric humidity.

**Rain**
is falling water droplets that have a diameter between 0.5 mm and 5 mm.

**Rain Gauges**
are devices used to measure the amount of rainfall.

**Rate of Change**
is a measure of how fast a quantity changes per unit time.

**Rate of Chemical Reaction**
is a measure of how quickly or slowly the reaction occurs.

**Reactants**
are substances that undergo change in a chemical reaction.

**Relative Humidity**
is the percentage of water vapour that is actually in a sample of air compared with the amount of water vapour the air would contain at that temperature if it were saturated.

**Scientific Law**
is a statement that summarizes an observed pattern in nature.

**Sleet**
is ice pellets (frozen raindrops) that bounce upon impact with the ground.

**Smog**
is a generic term used to describe mixtures of pollutants in the atmosphere.

**Snow**
is frozen water crystals that form below 0°C.

**Sustainability**
is the ability to meet he needs of the present generation without compromising the ability of future generations to meet their needs.

**Temperature**
is a measure of the average speed of molecules.

**Thermometers**
are devices that are used to measure temperature.

**Thunderstorms**
are severe storms that are several kilometers in diameter. They are created by the rapid lifting of moist warm air which creates a cumulonimbus cloud and which may include lightning, thunder, heavy rain, or hail.

**Tornadoes**
are vortexes of rapidly moving air associated with a thunderstorm.

**Uniform Motion**

is motion that is at a constant speed in a straight line.

**Warm Fronts**
are the leading edges of warm air masses.

**Water Cycle**
is a model that describes the storage and movement of water between the atmosphere, hydrosphere, and lithosphere.

**Weather Balloons**
are helium-filled balloons that carry weather instruments aloft.

**Weather Radar**
is a ground-based system that emits microwaves that in turn are reflected back when they hit a solid or liquid object such as precipitation.

**Weather Satellites**
are orbiting crafts that detect light and infrared radiation from the Earth and then relay that data to ground stations.

**Wind Direction**
is the direction from which the wind blows.

**Wind Speed**
is a measure of the rate that air is moving.

**Wind Vanes**
are devices used to indicate the direction from which the wind is blowing.

**Word Equation**
identifies the reactants and products in a chemical reaction using only the names of the elements and compounds.

# References


Science 9 Curriculum

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