Kindergarten to Grade 4 Science

Manitoba Curriculum Framework of Outcomes

Renewing Education:
New Directions

Manitoba Education and Training
James C. McCrae, Minister

KINDERGARTEN TO GRADE 4 SCIENCE

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Introduction

Background

The ***Kindergarten to Grade 4 Science: Manitoba Curriculum Framework of Outcomes*** (1999) (hereinafter referred to as the *Science Framework*) presents student learning outcomes for Kindergarten to Grade 4 science. These learning outcomes are the same for students in English, French Immersion, and Franco-Manitoban programs and result from a partnership involving two divisions of Manitoba Education and Training: School Programs and Bureau de l'éducation française. The Manitoba science student learning outcomes are based on those found within the *Common Framework of Science Learning Outcomes K to 12* (Council of Ministers of Education, Canada, 1997). The latter, commonly referred to as the *Pan-Canadian Science Framework*, was initiated under the Pan-Canadian Protocol for Collaboration on School Curriculum (1995), and was developed by educators from Manitoba, Saskatchewan, Alberta, British Columbia, the Northwest Territories, the Yukon Territory, Ontario, and the Atlantic Provinces.

> Student learning outcomes are concise descriptions of the knowledge and skills [and attitudes] that students are expected to learn in a course or grade level in a subject area. *(A Foundation for Excellence,* 1995)

This *Science Framework* provides the basis for teaching, learning, and assessing science, and is mandated for use in all schools (*A Foundation For Excellence*, 1995). In addition, this *Science Framework* serves as a starting point for future development of curriculum documents, support materials, learning resources, assessment tools, and professional development for teachers. *Kindergarten to Grade 4 Science: A Foundation for Implementation* (1999) complements this *Science Framework*, providing support for its implementation, including suggestions for instruction and assessment.

This *Science Framework* is organized into three sections:

- **Introduction** – describes the background, vision, goals, and beliefs upon which this *Science Framework* is based.
- **Manitoba Foundations for Scientific Literacy** – describes Manitoba foundations for scientific literacy, presents the conceptual organizer for Manitoba science education, and states the general learning outcomes that are broad descriptors of what Manitoba students are expected to know and be able to do as a result of their Early, Middle, and Senior Years science education.
- **Specific Learning Outcomes** – presents specific learning outcomes that describe the knowledge, skills, and attitudes that students are expected to demonstrate with increasing competence and confidence in science by the end of each grade.

Vision for Scientific Literacy

Global interdependence; rapid scientific and technological innovation; the need for a sustainable environment, economy, and society; and the pervasiveness of science and technology in daily life reinforce the importance of scientific literacy. Scientifically literate individuals can more effectively interpret information, solve problems, make informed decisions, accommodate change, and create new knowledge. Science education is a key element in developing **scientific literacy** and in building a strong future for Canada's young people.

This *Science Framework* is designed to support and promote the vision for **scientific literacy** as articulated in the *Pan-Canadian Science Framework*.

> The [Pan-Canadian Science] Framework is guided by the vision that all Canadian students, regardless of gender or cultural background, will have an opportunity to develop scientific literacy. Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge. Students need to develop inquiry, problem-solving, and decision-making abilities, to become lifelong learners, and to maintain a sense of wonder about the world around them.
>
> Diverse learning experiences based on the [Pan-Canadian Science] Framework will provide students with many opportunities to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, careers, and their future.
> (*Common Framework of Science Learning Outcomes K–12*, 1997)

Goals for Canadian Science Education

To promote scientific literacy, the following goals for Canadian science education were developed as part of the *Pan-Canadian Science Framework* and are addressed through Manitoba science curricula.

Science education will...

- encourage students at all grades to develop a critical sense of wonder and curiosity about scientific and technological endeavours
- enable students to use science and technology to acquire new knowledge and solve problems, so that they may improve the quality of their own lives and the lives of others
- prepare students to critically address science-related societal, economic, ethical, and environmental issues
- provide students with a proficiency in science that creates opportunities for them to pursue progressively higher levels of study, prepares them for science-related occupations, and engages them in science-related hobbies appropriate to their interests and abilities
- develop in students of varying aptitudes and interests a knowledge of the wide variety of careers related to science, technology, and the environment

Beliefs about Learning, Teaching, and Assessing Science

To promote scientific literacy among future citizens, it is crucial to recognize how students learn, how science can best be taught, and how learning can be assessed. Students are curious, active learners who have individual interests, abilities, and needs. They come to school with various personal and cultural experiences and prior knowledge that generate a range of attitudes and beliefs about science and life.

Students learn most effectively when their study of science is rooted in concrete learning experiences, related to a particular context or situation, and applied to their world where appropriate. Ideas and understandings that students develop should be progressively extended and reconstructed as students grow in their experiences and in their ability to conceptualize. Learning involves the process of linking newly constructed understandings with prior knowledge and adding new contexts and experiences to current understandings.

Development of scientific literacy is supported by instructional environments that engage students in the following processes:

- **scientific inquiry:** students address questions about natural phenomena, involving broad explorations as well as focussed investigations
- **technological problem solving (design process):** students seek answers to practical problems requiring the application of their science knowledge in various ways
- **decision making:** students identify issues and pursue science knowledge that will inform the issues

It is through these processes that students discover the significance of science in their lives and come to appreciate the interrelatedness of science, technology, society, and the environment.

Each of these processes is a potential starting point for approaching science learning. These processes may encompass a variety of learning approaches for exploring new ideas, for developing specific investigations, and for applying the ideas that are learned.

To achieve the vision of scientific literacy, students must increasingly become engaged in the planning, development, and evaluation of their own learning experiences. They should have the opportunity to work cooperatively with other students, to initiate investigations, to communicate their findings, and to complete projects that demonstrate their learning. To assist teachers in planning for instruction, assessment, evaluation, and reporting, Manitoba Education and Training recommends the following:

> At the beginning of a block of instruction, teachers and students identify expected learning outcomes and establish performance criteria. It is important that these criteria correspond with provincial [learning] outcomes.… This communication between students and teachers helps to identify clearly what needs to be accomplished, thereby assisting in the learning process.
>
> When students are aware of expected outcomes, they will be more focussed on the learning and more likely to assess their own progress. Furthermore, they can participate in creating appropriate assessment and evaluation criteria. Assessment methods must be valid, reliable, and fair to students. (*Reporting on Student Progress and Achievement: A Policy Handbook for Teachers, Administrators, and Parents,* 1997)

Kindergarten to Grade 4 Manitoba Foundations for Scientific Literacy

Manitoba Foundations for Scientific Literacy

The Five Foundations

To develop scientifically literate students, science learning experiences must incorporate the essential aspects of science and related applications. These essential aspects, the foundations for scientific literacy, have been adapted from the *Pan-Canadian Science Framework* to address the needs of Manitoba students. Manitoba science curricula are built upon the following five foundations for scientific literacy:

A. Nature of Science and Technology

B. Science, Technology, Society, and Environment (STSE)

C. Scientific and Technological Skills and Attitudes

D. Essential Science Knowledge

E. Unifying Concepts

> Producing science knowledge is an intrinsically collective endeavour. There is no such thing as stand-alone science. Scientists submit models and solutions to the assessment of their peers who judge their logical and experimental soundness by reference to the body of existing knowledge. (*Larochelle, M. and Désautels, J,* 1992)

In the following pages each foundation is described and accompanied by general learning outcomes, which further define expectations for student learning. These general learning outcomes constitute a global picture of science learning from Kindergarten to Senior 4.

A. Nature of Science and Technology

Students must learn that science and technology are creative human activities with long histories in all cultures of the world.

Science is a way of learning about the universe. This learning stems from curiosity, creativity, imagination, intuition, exploration, observation, replication of experiments, interpretation of evidence, and debate over the evidence and its interpretations. Scientific activity involves predicting, interpreting, and explaining natural and human-made phenomena. Many historians, sociologists, and philosophers of science argue that there is no set procedure for conducting a scientific investigation. Rather, they see science as driven by a combination of theories, knowledge, experiments, and processes anchored in the physical world.

Theories of science are being tested, modified, and refined continuously as new knowledge and theories supersede existing ones. Scientific debate on new observations and hypotheses that challenge accepted knowledge involves many participants with diverse backgrounds. This highly complex interplay, which has occurred throughout history, is fuelled by theoretical discussions, experimentation, social, cultural, economic, and political influences, personal biases, and the need for peer recognition and acceptance. Students will realize that while some of our understandings about how the world works are due to revolutionary scientific developments, many of our understandings result from the steady and gradual accumulation of knowledge.

Technology is concerned mainly with proposing solutions to problems arising from attempts by humans to adapt to the environment. Technology may be regarded as "... a tool or machine; a process, system, environment, epistemology, and ethic; the systematic application of knowledge, materials, tools, and skills to extend human capabilities..." (*Technology as a Foundation Skill Area: A Journey Toward Information Technology Literacy*, 1998). Technology includes much more than the knowledge and skills related to computers and their applications. Technology is both a form of knowledge that uses concepts and skills from other disciplines (including science) and the application of this knowledge to meet an identified need or solve a problem using materials, energy, and tools (including computers). Technology also has an impact on processes and systems, on society, and on the ways people think, perceive, and define their world.

This *Science Framework* is designed to emphasize both the distinctions and relationships between science and technology. Figure 1 illustrates how science and technology differ in purpose, procedure, and product, while, at the same time, interacting with each other.

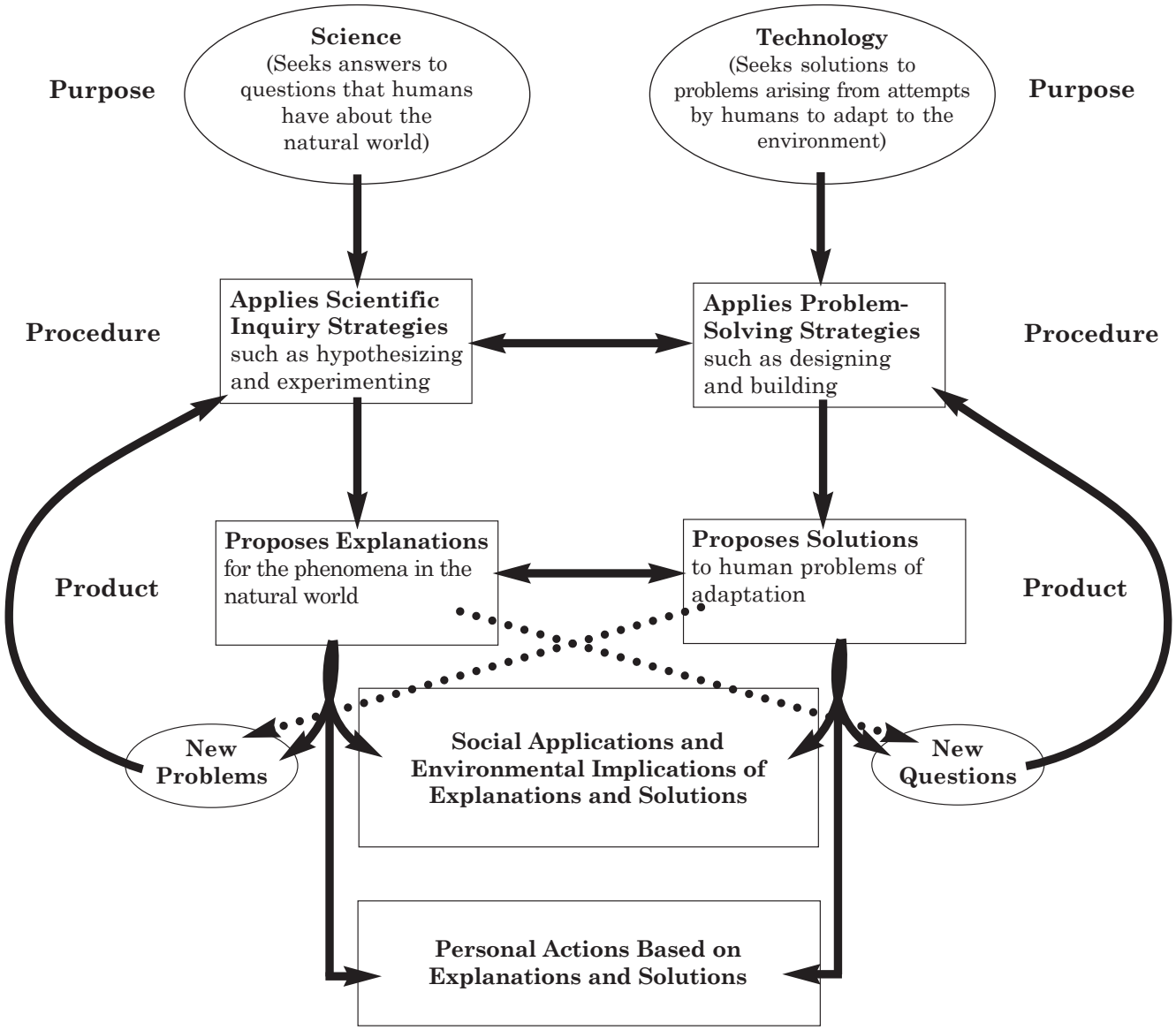


Figure 1: Science and Technology: Their Nature and Relationship

Adapted with permission from *Bybee, Rodger W. Science and Technology Education for the Elementary Years: Frameworks for Curriculum and Instruction.* ©The NETWORK, Inc.

The following general learning outcomes (GLOs) have been developed to further define expectations related to this foundation area. (For a complete listing of GLOs, see Appendix.)

Nature of Science and Technology General Learning Outcomes

As a result of their Early, Middle, and Senior Years science education, students will...

A1. recognize both the power and limitations of science as a way of answering questions about the world and explaining natural phenomena

A2. recognize that scientific knowledge is based on evidence, models, and explanations, and evolves as new evidence appears and new conceptualizations develop

A3. distinguish critically between science and technology in terms of their respective contexts, goals, methods, products, and values

A4. identify and appreciate contributions made by women and men from many societies and cultural backgrounds towards increasing our understanding of the world and in bringing about technological innovations

A5. recognize that science and technology interact with and advance one another

B. Science, Technology, Society, and the Environment (STSE)

STSE understandings are an essential component of scientific literacy. By studying the historical context, students come to appreciate ways in which cultural and intellectual traditions have influenced the questions and methodologies of science, and how science, in turn, has influenced the wider world of ideas.

Today, a majority of scientists work in industry, where projects are more often driven by societal and environmental needs than by pure research. Many technological solutions have evoked complex social and environmental issues. Students, as future citizens, must recognize the potential of scientific literacy to inform and empower decision making of individuals, communities, and democratic society as a whole.

> There can be no greater contribution or more essential element to long-term environmental strategies leading to sustainable development that respects the environment… than the education of future generations in matters relating to the environment. (*UNESCO,* 1988)

Scientific knowledge is necessary, but is not in itself sufficient for understanding the relationships among science, technology, society, and the environment. To understand these relationships, it is essential that students understand the values related to science, technology, society, and the environment.

To achieve scientific literacy, students must develop an appreciation for the importance of sustainable development. To this end, this *Science Framework* integrates the Sustainable Development Strategy developed by the Province of Manitoba (see Figure 2).

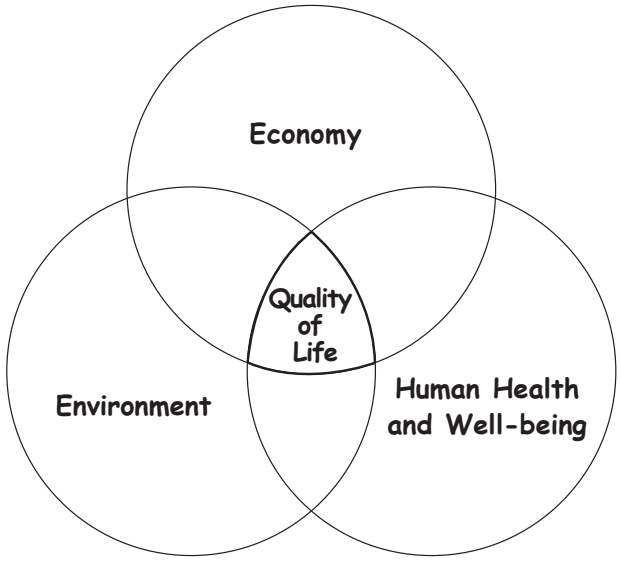


Figure 2: Sustainable Development

Sustainable development is a decision-making model that considers the needs of both present and future generations, and integrates and balances the **impact of economic activities**, the **environment**, and the **health and well-being of the community**.

> Public awareness and understanding of the concept of sustainable development and its practices are essential. If we are to change our way of life we must equip present and future generations with the knowledge and training to put sustainable development into effect. (*Sustainable Development Strategy for Manitoba,* 1994)

As students advance from grade to grade, they identify STSE interrelationships and apply decision-making skills in increasingly demanding contexts, as shown below:

- **complexity of understanding** — from simple, concrete ideas to abstract ideas; from limited knowledge of science to more in-depth and broader knowledge of science and the world
- **applications in context** — from contexts that are local and personal to those that are societal and global
- **consideration of variables and perspectives** — from one or two that are simple to many that are complex
- **critical judgement** — from simple right or wrong assessments to complex evaluations
- **decision making** — from decisions based on limited knowledge, made with the teacher's guidance, to decisions based on extensive research, involving personal judgement and made independently

The following general learning outcomes (GLOs) have been developed to further define expectations related to this foundation area. (For a complete listing of Manitoba's GLOs see Appendix)

Science, Technology, Society, and the Environment (STSE) General Learning Outcomes

As a result of their Early, Middle, and Senior Years science education, students will...

B1. describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies, and the environment, both locally and globally

B2. recognize that scientific and technological endeavours have been and continue to be influenced by human needs and the societal context of the time

B3. identify the factors that affect health, and explain the relationships among personal habits, lifestyle choices, and human health, both individual and social

B4. demonstrate a knowledge of and personal consideration for a range of possible science- and technology-related interests, hobbies, and careers

B5. identify and demonstrate actions that promote a sustainable environment, society, and economy, both locally and globally

C. Scientific and Technological Skills and Attitudes

A science education that strives for scientific literacy must engage students in answering questions, solving problems, and making decisions. These processes are referred to as Scientific Inquiry, Technological Problem Solving (Design Process), and Decision Making (see Figure 3: Processes for Science Education). While the skills and attitudes involved in these processes are not unique to science, they play an important role in the development of scientific understandings and in the application of science and technology to new situations.

Each of these processes is described on the following page. Attitudes, an important element of each process, are also examined.

	Scientific Inquiry	**Technological Problem-Solving (Design Process)**	**Decision-Making**
Purpose:	Satisfying curiosity about events and phenomena in the natural world.	Coping with everyday life, practices, and human needs.	Identifying different views or perspectives based on different or the same information.
Procedure:	What do we know? What do we want to know?	How can we do it? Will it work?	What alternatives or consequences are there? Which choice is best at this time?
Product:	Knowledge about events and phenomena in the natural world.	An effective and efficient way to accomplish a task or meet a need.	A defensible decision in the particular circumstances.

	Scientific Question	**Technological Problem**	**STSE Issue**
Example:	Why does my coffee cool so quickly? *An Answer:* Heat energy is transferred by conduction, convection, and radiation.	How can I keep my coffee hot? *An Answer:* A Solution: A styrofoam cup will keep liquids warm for a long time.	Should we use styrofoam cups or ceramic mugs for our meeting? *A Decision:* Personal health, the environment, cost, and availability must be considered along with science and technology information.

Figure 3: Processes for Science Education

Adapted with permission of the Minister of Education, Province of Alberta, Canada, 1999.

Scientific Inquiry

Scientific inquiry is a way of learning about the universe. It involves posing questions and searching for explanations of phenomena. Although no single "scientific method" exists, students require certain skills to participate in science-related experiences.

Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting, analysing, and interpreting data are fundamental to scientific inquiry; as are attitudes such as curiosity, skepticism, and creativity. These skills are often represented as a cycle. This cycle involves posing questions, generating possible explanations, and collecting and analysing evidence to determine which of these explanations is most useful and accurate in accounting for the phenomena under investigation. New questions may arise to re-ignite the cycle. It must be noted, however, that many scientific inquiries, past and present, do not necessarily follow a set sequence of steps nor do they always start at the "beginning" of the cycle: scientists can be creative and responsive to scientific challenges as they arise.

Technological Problem Solving

Technological problem solving seeks solutions to problems arising from attempts by humans to adapt to the environment. Related skills and attitudes are often represented as a cycle, referred to as the **design process**. The design process includes the proposing, creating, and testing of prototypes, products, and techniques in an attempt to reach an optimal solution to a given problem. Feedback and evaluation are built into this cycle, which like scientific inquiry, can be an ongoing set of revisited steps. However, technological problem solving and scientific inquiry differ in purpose, procedure, and product (see Figure 1: Science and Technology: Their Nature and Relationship, p. 2.5).

Decision Making

Students, as individuals and global citizens, are required to make decisions, and increasingly, the types of issues they face demand an ability to apply scientific and technological processes and products. The decision-making process involves identifying the issue, gathering data, generating possible courses of action, evaluating alternatives, and making a thoughtful decision based on the information available. Students should be actively involved in decision-making situations as they progress through their science education. Not only are decision-making situations important in their own right, but they also provide a relevant context for engaging in scientific inquiry, problem solving, and the study of STSE relationships.

Attitudes

Attitudes refer to generalized aspects of behaviour that are modelled for students and reinforced by selective approval. Attitudes are not acquired in the same way as skills and knowledge. They cannot be observed at any particular moment, but are evidenced by regular, unprompted manifestations over time. Development of attitudes is a lifelong process that involves the home, the school, the community, and society at large. The development of positive attitudes plays an important role in students' growth by interacting with their intellectual development and by creating a readiness for responsible application of what they learn.

The following General Learning Outcomes (GLOs) have been developed to further define expectations related to this foundation area. (For a complete listing of Manitoba's GLOs, see Appendix.)

Scientific and Technological Skills and Attitudes General Learning Outcomes

As a result of their Early, Middle, and Senior Years science education, students will...

C1. recognize safety symbols and practices related to scientific and technological activities and to their daily lives, and apply this knowledge in appropriate situations

C2. demonstrate appropriate scientific inquiry skills when seeking answers to questions

C3. demonstrate appropriate problem-solving skills while seeking solutions to technological challenges

C4. demonstrate appropriate critical thinking and decision-making skills when choosing a course of action based on scientific and technological information

C5. demonstrate curiosity, skepticism, creativity, open-mindedness, accuracy, precision, honesty, and persistence, and appreciate their importance as scientific and technological habits of mind

C6. employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data

C7. work cooperatively and value the ideas and contributions of others while carrying out scientific and technological activities

C8. evaluate, from a scientific perspective, information and ideas encountered during investigations and in daily life

D. Essential Science Knowledge

The subject matter of science includes theories, models, concepts, and principles that are essential to an understanding of each of life science, physical science, and Earth and space science. While this *Science Framework* is not strictly aligned with these disciplines, the learning outcomes are intended to help develop important concepts from each of these areas.

Life science deals with the growth and interactions of life forms within their environment in ways that reflect their uniqueness, diversity, genetic continuity, and changing nature. Life science includes fields of study such as the study of organisms (including humans), ecosystems, biodiversity, and the study of the cell, biochemistry, and biotechnology.

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

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

The following General Learning Outcomes (GLOs) have been developed to further define expectations related to this foundation area. (For a complete listing of Manitoba's GLOs, see Appendix.)

Essential Science Knowledge General Learning Outcomes

As a result of their Early, Middle, and Senior Years science education, students will...

D1. understand essential life structures and processes pertaining to a wide variety of organisms, including humans

D2. understand various biotic and abiotic components of ecosystems, as well as their interaction and interdependence within ecosystems and within the biosphere as a whole

D3. understand the properties and structures of matter as well as various common manifestations and applications of the actions and interactions of matter

D4. understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts

D5. understand the composition of the Earth's atmosphere, hydrosphere, and lithosphere, as well as the processes involved within and among them

D6. understand the composition of the universe, the interactions within it, and the impacts of humankind's continued attempts to understand and explore it

E. Unifying Concepts

An effective way to create linkages within and among science disciplines is to use unifying concepts; these are key ideas that underlie and integrate all science knowledge and extend into areas such as mathematics and social studies. Consequently, unifying concepts help students to construct a holistic understanding of science and its role in society. The following four unifying concepts were used in the development of this *Science Framework*.

Similarity and Diversity

The concepts of similarity and diversity provide tools for organizing our experiences with the world. Beginning with informal experiences, students learn to recognize attributes of materials, organisms, and events that help to make useful distinctions between and among them. Over time, students adopt accepted procedures and protocols for describing and classifying objects, organisms, and events they encounter, thus enabling them to share ideas with others and to reflect on their own experiences.

Systems and Interactions

An important part of understanding and interpreting the world is the ability to think about the whole in terms of its parts and, alternately, about parts in terms of how they relate to one another and to the whole. A system is a collection of components that interact with one another so that the overall effect is often greater than that of the individual parts, even when these are considered together. Students will study both natural and technological systems.

Change, Constancy, and Equilibrium

The concepts of constancy and change underlie most understandings of the natural and technological world. Through observations, students learn that some characteristics of living things, materials, and systems remain constant over time, whereas others change. Through formal and informal studies, students develop an understanding of the processes and conditions in which change, constancy, and equilibrium take place.

Energy

The concept of energy provides a conceptual tool that brings together many understandings about natural phenomena, materials, and the processes of change. Energy, whether transmitted or transformed, is the driving force of both movement and change. Students learn to describe energy in terms of its effects and, over time, develop a concept of energy as something inherent within the interactions of materials, the processes of life, and the functioning of systems.

The following General Learning Outcomes (GLOs) have been developed to further define expectations related to this foundation area. (For a complete listing of Manitoba's GLOs see Appendix.)

Unifying Concepts General Learning Outcomes

As a result of their Early, Middle, and Senior Years science education, students will...

E1. describe and appreciate the similarity and diversity of forms, functions, and patterns within the natural and constructed world

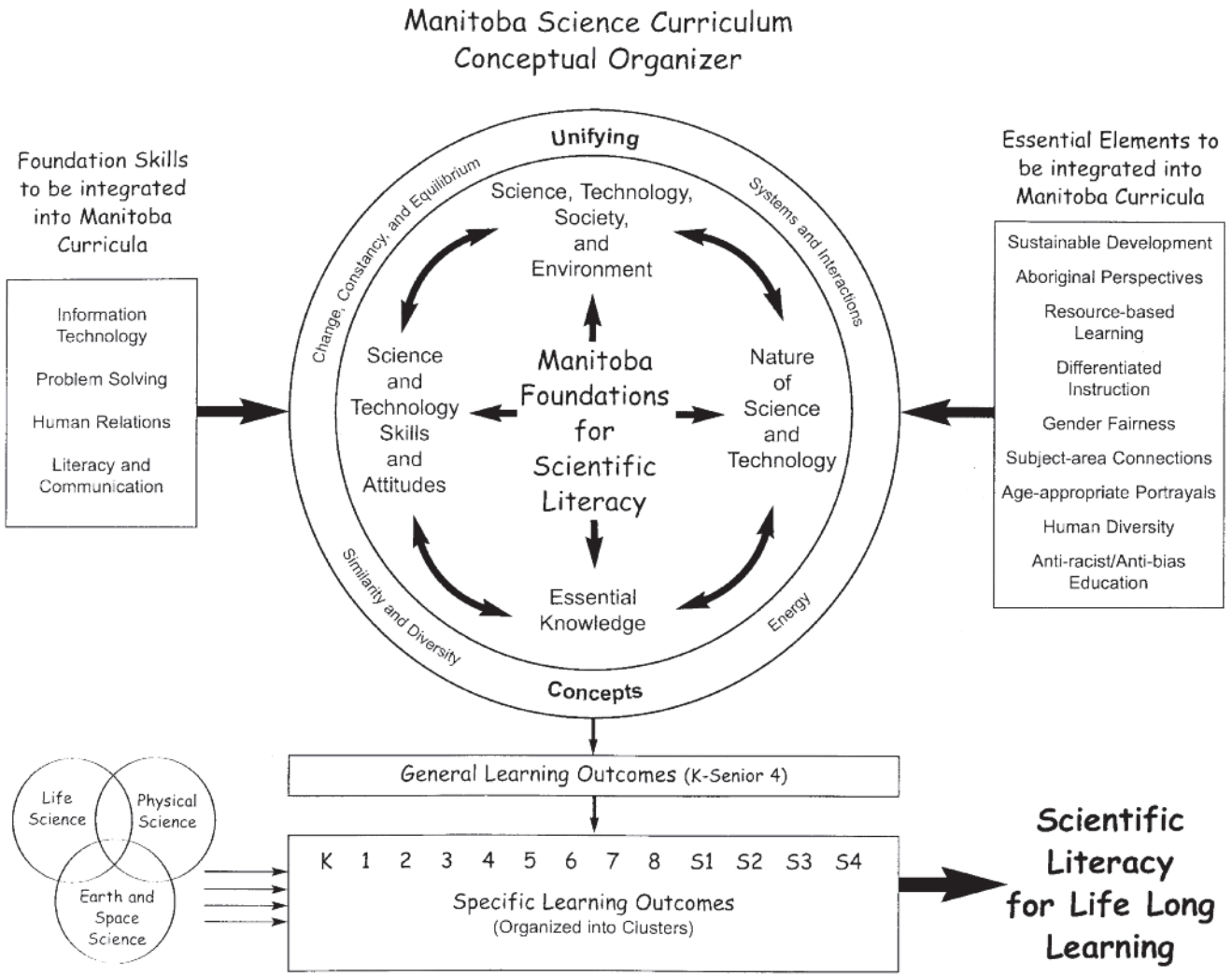
E2. describe and appreciate how the natural and constructed world is made up of systems and how interactions take place within and among these systems

E3. recognize that characteristics of materials and systems can remain constant or change over time, and describe the conditions and processes involved

E4. recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them

Conceptual Organizer

The learning outcomes presented in this *Science Framework* address the Foundation Skill Areas and other essential elements common to all Manitoba curricula (*A Foundation for Excellence*, 1995). The following conceptual organizer (Figure 4) illustrates these and other key components upon which Manitoba science curricula are based.



e 4: Manitoba Science Curriculum Conceptual Organizer

Figure 4: Manitoba Science Curriculum Conceptual Organizer

Kindergarten to Grade 4
Specific Learning Outcomes

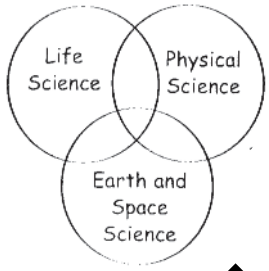
Specific Learning Outcomes

Organization into Clusters

This *Science Framework* presents specific learning outcomes (SLOs) for Kindergarten to Grade 4 science. Within each grade, SLOs are arranged into groupings, referred to as clusters. Clusters 1 to 4 are thematic and generally relate to the three science disciplines discussed earlier in the *Science Framework*. Cluster O includes Overall Skills and Attitudes. (See Figure 5: Cluster Titles.)

Whereas the SLOs themselves are mandatory, the order in which they are addressed is not. Teachers are encouraged to plan their instruction based on student needs, individual contexts, learning resources, and other pertinent considerations. This may involve organizing the SLOs from a particular grade into new groupings and a new order. *Kindergarten to Grade 4 Science: A Foundation for Implementation* provides planning tools, as well as suggestions for instruction and assessment.

The Overall Skills and Attitudes SLOs for each grade are also presented as part of a Kindergarten to Grade 4 chart (separate attachment). The purpose of this chart is to provide support related to the tracking of the development of skills and attitudes across several grades



Grades / Clusters	Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
Cluster 0	Overall Skills and Attitudes (to be integrated into Clusters 1 to 4)				
Cluster 1	Trees	Characteristics and Needs of Living Things	Growth and Changes in Animals	Growth and Changes in Plants	Habitats and Communities
Cluster 2	Colours	The Senses	Properties of Solids, Liquids, and Gases	Materials and Structures	Light
Cluster 3	Paper	Characteristics of Objects and Materials	Position and Motion	Forces that Attract or Repel	Sound
Cluster 4		Daily and Seasonal Changes	Air and Water in the Environment	Soils in the Environment	Rocks, Minerals, and Erosion

Figure 5: Cluster Titles

Guide to Reading Science Specific Learning Outcomes

Each cluster is presented on two facing pages. The following pages provide examples of the Cluster O format and the Clusters 1 to 4 format.

Indicates organizational category of skills/attitudes

First digit indicates grade; second digit indicates cluster number; third digit and letter indicate individual outcome number

Specific Learning Outcomes statements define what students are expected to achieve at the end of each guide

Describes general content and emphasis of cluster

Cross-reference to other areas: Math, ELA (English Language Arts), TFS (Technology as a Foundation Skill Area)

Cross-reference to General Learning Outcomes

K–4 Science

Grade 3, Cluster 0: Overall Skills and Attitudes

Overview

Cluster "0" comprises nine categories of specific learning outcomes related to skills and attitudes* involved in scientific inquiry, the design process, or both. In Grades 3 and 4 students develop scientific inquiry skills and attitudes as they plan and conduct simple experiments. They refine their design process skills as they progress through the grades, gradually behaving more independently in designing, constructing, and testing objects, and devices. Students also acquire key attitudes, an increased awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

Teachers should select appropriate contexts to introduce and reinforce the scientific inquiry and design process skills and attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students in one Grade 4 class may be introduced to graphing skills during a study of deer populations, and develop them further whi… contrast, students in anot… opportunities to acquire a… clusters. To assist in plan… integration, many learnin… are accompanied by links … other subject areas, specif… (ELA) and Mathematics (… Technology as a Foundati…

* Cluster "0," Overall Skills and Attitudes spe… for this grade are also presented as part of a … 4 chart (separate attachment). The purpose … support related to the tracking of the develo… attitudes across several grades.

Students Will...

	Scientific Inquiry	Design Process
Initiating	3-0-1a. Ask questions that lead to investigation of living things, objects, and events in the local environment. (ELA 1.2.4) GLO: A1, C2, C5	3-0-1c. Identify practical problems to solve in the local environment. GLO: C3
	3-0-1b. Make predictions based on observed patterns, collected data, or data provided from other sources. (ELA 1.1.1; Math SP-IV.2.3) GLO: A1, C2	
Researching	3-0-2a. Access information using a variety of sources. *Examples: children's magazines, local farmers, CD-ROMs, Internet...* (ELA 1.1.2, 3.2.2; Math SP-I.1.2.3; TFS 2.1.1) GLO: C6	
	3-0-2b. Review information to determine its usefulness to research needs. (ELA 3.2.3, 3.3.3) GLO: C6, C8	
Planning	3-0-3a. Brainstorm, with the class, one or more methods of finding the answer to a given question and reach consensus on which method to implement. GLO: C2, C7	3-0-3d. Brainstorm, in small groups, possible solutions to a practical problem, and reach consensus on which solution to implement. GLO: C3, C7
	3-0-3b. Identify, with the class, variables that have an impact on an investigation. GLO: A1, A2, C2, C7	3-0-3e. Create, in small groups, a written plan to solve a problem or meet a need. Include: identify steps to follow, prepare a simple diagram. (ELA 1.2.3) GLO: C3, C7
	3-0-3c. Create, with the class, a plan to answer a given question. (ELA 3.1.4) GLO: C2, C7	3-0-3f. Develop, in small groups, limited criteria to evaluate an object or device based on its function and aesthetics. GLO: C3, C7
Implementing a Plan	3-0-4a. Carry out a plan, and describe the steps followed. (Math SP-V.2.3) GLO: C2	3-0-4b. Construct an object or device to solve a problem or meet a need. GLO: C3
		3-0-4c. Test an object or device with respect to pre-determined criteria. GLO: C3, C5
		3-0-4d. Identify and make improvements to an object or device, and explain the rationale for the changes. GLO: C3

3.36

Indicates specific learning outcomes related to scientific inquiry

Indicates specific learning outcomes related to design process

Include: *Indicates a mandatory component of the specific learning outcome*

Examples: *Provide ideas of what could be included (non-mandatory)*

Indicates specific learning outcomes related to both scientific inquiry and design process

Specific Learning Outcomes — K–4 Science

	Scientific Inquiry	Design Process
Implementing a Plan (cont'd)	3-0-4e. Respect fully to the ideas and actions of others, and recognize their ideas and contributions. (ELA 1.1.2, 5.2.2) GLO: C5, C7 3-0-4f. Assume roles, and share responsibilities as group members. (ELA 5.2.1) GLO: C7 3-0-4g. Verbalize questions, ideas, and intentions during classroom learning experiences. GLO: C6 3-0-4h. Follow given safety procedures and rules, and explain why they are needed. GLO: C1	
Measuring, Recording	3-0-5a. Make observations that are relevant to a specific question. GLO: A1, A2, C2	
	3-0-5b. Use tools to observe, measure, and construct. Include: ruler, meter stick, pan balance, magnifying glass, bathroom scale, thermometer, magnet. (Math SS-I.1.3, SS-III.1.3, SS-IV.1.3, SS-VII.4.3) GLO: C2, C3, C5 3-0-5c. Estimate and measure mass/weight, length, volume, and temperature using standard units. (Math SS-IV.1.3, SS-I.1.3, SS-III.1.3, SS-VIII.4.3) GLO: C2, C3, C5 3-0-5d. Estimate and measure the passage of time using standard units. Include: seconds, minutes, hours. (Math SS-VI.1.3) GLO: C2, C3, C5 3-0-5e. Record observations in a variety of ways. *Examples: point form notes, sentences, simple diagrams, charts...* (ELA 3.2.1, 3.3.2, 4.1.3; Math SP-II.2.1, SP-V.2.3) GLO: C2, C6	
Analysing and Interpret	3-0-6a. Display data using more than one way to represent the same data. (Math SP-III.2.3) GLO: C2, C6 3-0-6b. Discuss data and generate new questions from displayed data. (Math SP-IV.1.2) GLO: A1, A2, C2, C5	
	3-0-6c. Place materials and objects in a sequence or in groups using two or more attributes, and describe the system used. (Math PR-I.1.3) GLO: C2, C3, C5	

	Scientific Inquiry	Design Process
Concluding and Applying	3-0-7a. Draw a simple conclusion based on their observations. GLO: A1, A2, C2 3-0-7b. Explain why conclusions related to classroom experiments should be based on multiple trials or classroom data, rather than on an individual result. GLO: A1, A2, C2	3-0-7c. Identify new problems that arise. GLO: C3
	3-0-7d. Examine how new experience, ideas, and information connect to prior knowledge and experiences, and record these connections. (ELA 1.2.1, 2.1.2, 3.3.3) GLO: A2, C6 3-0-7e. Communicate results and conclusions in a variety of ways. *Examples: point-form lists, sentences, simple diagrams, charts, demonstrations...* (ELA 2.3.5, 3.3.2, 4.1.3; Math SP-III.2.3; TFS 2.1.4) GLO: C6	
Reflecting on Science and Technology	3-0-8a. Recognize that valid experiments normally have reproducible results, which may vary slightly. GLO: A1, A2, C2 3-0-8b. Recognize that scientists develop explanations from observations and what they already know about the world, and that good explanations are based on evidence. GLO: A1, A2, C2	3-0-8c. Recognize that designing a solution to a simple problem may have considerations, such as cost, materials, time, and space. GLO: B2, C3
Demonstrating Scientific and Technological Attitudes	3-0-9a. Listen to and consider differing opinions. (ELA 5.2.3) GLO: C5, C7 3-0-9b. Express enjoyment when sharing and discussing science-related experiences from daily life. (ELA 4.4.3) GLO: C5 3-0-9c. Take the time to repeat a measurement or observation for greater precision or detail. GLO: C5	

3.37

Specific Learning Outcome statements define what students are expected to achieve at the end of each grade

Grade 2, Cluster 2: Properties of Solids, Liquids, and Gases

Describes general content and emphasis of cluster

Overview

When students examine materials in the world around them, they become aware of the similarities and differences in their characteristics, such as the ways materials look, feel, sound, or change. In Grade 2, students begin to develop an understanding of matter by investigating properties of solids and liquids. Gases are also introduced through an examination of the properties of air. Students investigate ways in which solids and liquids interact, and identify how the properties of solids and liquids determine their uses. Students observe how water can be made to change from one state to another and back again. Students also encounter changes of state in the study of the water cycle in *Grade 2, Cluster 4, Air and Water in the Environment*. Teachers are encouraged to help students make connections between these learning experiences.

Students will

2-2-01 Use appropriate vocabulary related to their investigations of solids, liquids, and gases.
Include: solid, liquid, substance, property, mass/weight, dissolve, gas, changes of state, water vapour, freeze, melt, condense, evaporate, boil, float, sink, buoyancy.
GLO: C6, D3, D4

2-2-02 Identify substances, materials, and objects as solids or liquids.
GLO: D3

2-2-03 Investigate and compare properties of familiar solids.
Include: have mass/weight, take up space, maintain their shape.
GLO: C2, D3, E1

2-2-04 Investigate and compare properties of familiar liquids.
Include: have mass/weight, take up space, have no definite shape.
GLO: C2, D3

2-2-05 Identify similarities and differences among properties of familiar solids and liquids.
GLO: D3, E1

2-2-06 Distinguish between solids that dissolve in water and those that do not.
Examples: sugar dissolves in water, whereas sand does not...
GLO: D3, E1

First digit indicates grade; second digit indicates cluster number; third 2-digits indicate individual specific learning outcome number

Cross-reference to General Learning Outcomes

3.30

2-2-07 Explore interactions of familiar liquids with different surfaces, powdered solids, and other liquids, and describe how these interactions determine their uses.
GLO: A5, B1, C1, C2

2-2-08 Identify liquids used in the home, and describe how they are used.
Examples: milk for drinking and cooking, detergent for cleaning...
GLO: B1

2-2-09 Compare different materials with respect to their capacity to absorb liquids, and describe how this capacity determines their uses.
GLO: B1, C2, D3

2-2-10 Describe useful materials that are made by combining solids and liquids.
Examples: a drink made from crystals and water, a cake made from cake mix and water, glue made from flour and water...
GLO: B1, D3

2-2-11 Explore to determine that there is a substance around us called air.
GLO: A2, C2, D3, D5

2-2-12 Recognize that air is composed of several gases
Examples: carbon dioxide, oxygen, nitrogen, water vapour...
GLO: D3

2-2-13 Identify properties of gases.
Include: occupy the space not taken up by solids and liquids, have no definite shape.
GLO: D3

2-2-14 Explore to determine how water can be made to change from one state to another and back again.
Include: addition or removal of heat.
GLO: C2, D3, D4, E3

2-2-15 Recognize that the states of solids and liquids remain constant in some circumstances, but may change in other circumstances.
Examples: liquids may freeze when temperature drops, solids may melt when heated, solids remain solid when broken...
GLO: D3, E3

2-2-16 Describe ways humans dispose of solids and liquids to maintain a clean and healthy environment.
Examples: take used car oil and old paints to collection sites, recycle newspapers...
GLO: B5

2-2-17 Predict and test to determine whether a variety of materials float or sink in water.
GLO: C2, D3

2-2-18 Demonstrate ways to make sinking materials float and floating materials sink.
GLO: B1, C3

2-2-19 Use the design process to construct an object that is buoyant and able to support a given mass/weight.
GLO: C3

3.31

Include: *Indicates a mandatory component of the specific learning outcome*

Examples: *Provides ideas of what could be included (non-mandatory)*

Kindergarten, Cluster 0: Overall Skills and Attitudes

Overview

Cluster "0" comprises nine categories of specific learning outcomes related to skills and attitudes* involved in scientific inquiry, the design process, or both. In Kindergarten to Grade 2, students are introduced to scientific inquiry through observing and measuring. Students refine their design-process skills as they progress through the grades, gradually behaving more independently in designing, constructing, and testing objects and devices. Students also acquire key attitudes, an initial awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

Teachers should select appropriate contexts to introduce and reinforce the scientific inquiry and design process skills and attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students in one Grade 1 class may focus on the development of cooperative group skills while using their senses to sort and classify objects in Cluster 2, while another class may focus on these skills while testing and evaluating the suitability of materials for a particular purpose as part of Cluster 3. To assist in planning and to facilitate curricular integration, many specific learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English Language Arts (ELA) and Mathematics (Math). There are also links to Technology as a Foundation Skill Area (TFS).

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* Cluster 0, Overall Skills and Attitudes specific learning outcomes for this grade are also presented as part of a Kindergarten to Grade 4 chart (separate attachment). The purpose of this chart is to provide support related to the tracking of the development of skills and attitudes across several grades.

Students will...

	Scientific Inquiry	Design Process
Initiating	**K-0-1a. Ask questions that demonstrate a curiousity about living things, objects, and events in the immediate environment.** **(ELA 1.2.4, 3.1.2, 3.1.3)** **GLO: A1, C2, C5** **K-0-1b. Make predictions as to what might happen during explorations.** **(ELA 1.2.1)** **GLO: A1, C2**	**K-0-1c. Recognize a practical problem in a given context.** **GLO: C3**
Researching	**K-0-2a. Seek information from others.** ***Examples: people at school, at home, in the community...*** **(ELA 3.2.2, 3.2.4; Math SP-II.1.0)** **GLO: C6** **K-0-2b. Compare gathered ideas and information to personal knowledge.** **(ELA 3.2.3, 3.3.3; Math SP-IV.1.0)** **GLO: C6, C8**	
Planning		**K-0-3a. Brainstorm, with the class, possible solutions to a practical problem, and reach consensus on a solution to implement.** **(ELA 1.2.3, 3.1.3)** **GLO: C3, C7** **K-0-3b. Develop, as a class, limited criteria to evaluate an object based on its function.** **GLO: C3, C7**
	K-0-3c. Select materials to be used. **GLO: C2, C3**	
Implementing a Plan	**K-0-4a. Manipulate materials purposefully.** **GLO: C1, C2**	**K-0-4b. Construct an object to solve a problem or meet a need.** **GLO: C3** **K-0-4c. Identify, with guidance, improvements to an object with respect to pre-determined criteria.** **GLO: C3**

	Scientific Inquiry	Design Process
Implementing a Plan (cont'd)	**K-0-4d. Respond to the ideas and actions of others.** **(ELA 1.1.2)** **GLO: C5, C7** **K-0-4e. Participate in cooperative group learning experiences.** **(ELA 5.2.1)** **GLO: C7** **K-0-4f. Verbalize questions during classroom learning experiences.** **GLO: C6** **K-0-4g. Follow given safety procedures and rules.** **(ELA 2.1.2)** **GLO: C1**	
Observing, Measuring, Recording	**K-0-5a. Observe using one or a combination of senses.** **GLO: C2**	
	K-0-5b. Describe the duration of events. ***Examples: long time, short time...*** **(Math SS-VI.0.1)** **GLO: C2, C3** **K-0-5c. Record observations using drawings.** **(ELA 4.1.2, 4.2.5)** **GLO: C6**	
Analysing and Interpreting	**K-0-6a. Construct, with guidance, concrete-object graphs using 1:1 correspondence.** **(Math SP-III.2.0)** **GLO: C2, C6** **K-0-6b. Compare data using appropriate terms.** ***Examples: more, less, same...*** **(Math SP-IV.1.0)** **GLO: A1, A2, C2, C5**	
	K-0-6c. Place materials and objects in a sequence or in groups using a single, self-determined attribute. **(Math PR-I.1.0)** **GLO: C2, C3, C5**	

	Scientific Inquiry	Design Process
Concluding and Applying	**K-0-7a. Recognize connections between new experiences and prior knowledge.** **(ELA 1.2.1)** **GLO: A2** **K-0-7b. Describe, in a variety of ways, what was done and what was observed.** ***Examples: concrete materials, drawings, oral language....*** **(ELA 4.1.2, 4.1.3)** **GLO: C6**	
Reflecting on Science and Technology	**K-0-8a. Recognize that learning can come from careful observations and investigations.** **(ELA 3.3.4)** **GLO: A1, A2, C2**	
Demonstrating Scientific and Technological Attitudes	**K-0-9a. Be open minded while exploring.** **GLO: C5** **K-0-9b. Willingly observe, question, and explore.** **GLO: C5** **K-0-9c. Express enjoyment of science-related classroom activities.** **GLO: C5**	

Kindergarten, Cluster 1: Trees

Overview

In Kindergarten, an investigation of trees capitalizes on students' curiosity about the world around them. Students' observations of trees, including their seasonal changes, are complemented by a study of basic parts and uses of trees.

Students will…

K-1-01 Use appropriate vocabulary related to their investigations of trees.

Include: tree, trunk, crown, branch, leaf, needle, bark, root, seed, winter, spring, fall, summer.

GLO: C5, D1, D5

K-1-02 Identify ways in which humans and other animals use trees.

Examples: humans eat apples and walnuts; birds make their homes in trees; deer eat leaves, bark, and tender twigs...

GLO: B1

K-1-03 Identify and describe basic parts of a tree.

Include: trunk, crown, branch, leaf, bark, root, seed.

GLO: D1, E2

K-1-04 Explore, sort, and classify leaves, using their own classification system.

Examples: size, colour, pattern, length, shape...

GLO: C2, D1, E1

K-1-05 Name and describe each of the four seasons.

GLO: D6

K-1-06 Recognize that some trees lose their leaves in the fall, while others do not.

GLO: D1

K-1-07 Describe seasonal changes in the life of a tree.

Examples: leaves of some trees change colour and drop off in the fall...

GLO: D1

K-1-08 Investigate to determine that many trees produce seeds which are dispersed and may grow into new trees.

GLO: C2, D1

Kindergarten, Cluster 2: Colours

Overview

Colour is an important part of the world around us. Through observations and the use of specific vocabulary, students develop their ability to describe their world in terms of colour. They also explore how to create colours by mixing them and where colours are found in the environment.

Students will…

K-2-01 Use appropriate vocabulary related to their investigations of colours.

Include: red, yellow, blue, orange, brown, black, white, purple, green, gray, pink, mix, light, dark, match, primary colour.

GLO: C6, D3

K-2-03 Compare and contrast colours using appropriate terms.

Examples: lighter than, darker than, brighter than...

GLO: C2, D3

K-2-02 Sort and classify objects by colour.

GLO: C2, D3

K-2-04 Order a group of objects based on a given colour criterion.

Examples: order objects of the same colour range from lightest to darkest...

GLO: C2, D3

K-2-05 Predict and describe changes in colour that result from the mixing of primary colours and from mixing a primary colour with white or black.

GLO: C2, D3

K-2-06 Create a colour to match a given sample by mixing the appropriate amounts of two primary colours.

GLO: C3, D3

K-2-07 Explore to identify and describe colours found in their environment.

Examples: rocks, flowers, shells, blocks, crayons...

GLO: C2, D3

Kindergarten, Cluster 3: Paper

Overview

By identifying, describing, and manipulating different kinds of paper and paper products found in the classroom, students are introduced to the concept of characteristics of materials. Hands-on investigations allow students to determine how well different kinds of paper can be cut, torn, and folded, and how these characteristics help to determine their uses. This study of paper culminates in students developing their design-process skills by constructing a paper product for a particular use.

Students will…

K-3-01 Use appropriate vocabulary related to their investigations of paper.

Include: characteristic, thick, thin, hard, soft, smooth, rough, absorbent, pliable.

GLO: C6, D3

K-3-02 Identify kinds of paper that can be found in the classroom.

Examples: drawing paper, paper towels, paper plates, books, newspaper, cardboard, tissue paper...

GLO: B1

K-3-03 Recognize that paper is most often made from trees.

GLO: D3

K-3-04 Observe and compare characteristics of different kinds of paper.

Examples: compare colour, thickness, stiffness, texture...

GLO: C2, D3

K-3-05 Compare characteristics of different kinds of paper that make them easy or difficult to cut, tear, or fold.

Examples: cardboard is thicker than newsprint and harder to fold...

GLO: D3, E1

K-3-06 Explore to determine an appropriate kind of paper for a particular task.

Examples: paper towels are useful for soaking up spills...

GLO: B1, C3

K-3-07 Use the design process to construct a paper product for a particular use.

Examples: paper cup, envelope, paper mat, box...

GLO: C3

Grade 1, Cluster 0: Overall Skills and Attitudes

Overview

Cluster "0" comprises nine categories of specific learning outcomes related to skills and attitudes* involved in scientific inquiry, the design process, or both. In Kindergarten to Grade 2, students are introduced to scientific inquiry through observing and measuring. Students refine their design-process skills as they progress through the grades, gradually behaving more independently in planning, constructing, and testing objects and devices. Students also acquire key attitudes, an initial awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

Teachers should select appropriate contexts to introduce and reinforce the scientific inquiry and design process skills and attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students in one Grade 1 class may focus on the development of cooperative group skills while using their senses to sort and classify objects in Cluster 2, while another class may focus on these skills while testing and evaluating the suitability of materials for a particular purpose as part of Cluster 3. To assist in planning and to facilitate curricular integration, many specific learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English Language Arts (ELA) and Mathematics (Math). There are also links to Technology as a Foundation Skill Area (TFS).

* Cluster 0, Overall Skills and Attitudes specific learning outcomes for this grade are also presented as part of a Kindergarten to Grade 4 chart (separate attachment). The purpose of this chart is to provide support related to the tracking of the development of skills and attitudes across several grades.

Students will...

	Scientific Inquiry	Design Process
Initiating	**1-0-1a. Ask questions that lead to explorations of living things, objects, and events in the immediate environment.** **(ELA 3.1.2, 3.1.3)** **GLO: A1, C2, C5** **1-0-1b. Make predictions based on classroom experiences.** **GLO: A1, C2**	**1-0-1c. Recognize a practical problem in a given context.** **GLO: C3**
Researching	**1-0-2a. Access information using a variety of sources.** ***Examples: picture and concept books, people, excursions, camps, CD-ROMs…*** **(ELA 3.2.2, Math SP-II.1.1, TFS 2.1.1)** **GLO: C6** **1-0-2b. Recognize when information answers the questions asked.** **(ELA 3.2.3, 3.2.5)** **GLO: C6, C8**	
Planning		**1-0-3a. Brainstorm, with the class, possible solutions to a practical problem, and reach consensus on a solution to implement.** **(ELA 1.1.3, 3.1.3)** **GLO: C3, C7** **1-0-3b. Create, with the class, a plan to solve a problem or meet a need. Include: identify simple steps to follow.** **(ELA 1.2.3)** **GLO: C3, C7** **1-0-3c. Develop, as a class, limited criteria to evaluate an object or device based on its function.** **GLO: C3, C7**
	1-0-3d. Identify materials to be used, and explain their choices. **GLO: C2, C3, C4**	
Implementing a Plan	**1-0-4a. Follow simple directions while undertaking explorations.** **GLO: C2**	**1-0-4b. Construct an object or device to solve a problem or meet a need.** **GLO: C3** **1-0-4c. Test, with guidance, an object or device with respect to pre-determined criteria.** **GLO: C3, C5** **1-0-4d. Identify and make improvements to an object or device with respect to pre-determined criteria.** **GLO: C3**

	Scientific Inquiry	Design Process
Implementing a Plan (cont'd)	**1-0-4e. Respond to the ideas and actions of others in building their own understandings.** **(ELA 1.1.2)** **GLO: C5, C7** **1-0-4f. Work in cooperative partnerships and groups.** **(ELA 5.2.1)** **GLO: C7** **1-0-4g. Verbalize questions and ideas during classroom learning experiences.** **GLO: C6** **1-0-4h. Follow given safety procedures and rules.** **GLO: C1** **1-0-4i. Recognize safety symbols in their surroundings.** **GLO: C1**	
Observing, Measuring, Recording	**1-0-5a. Observe using a combination of the senses.** **GLO: C2**	
	1-0-5b. Use, with guidance, appropriate materials and tools to measure and construct. ***Examples: use paper clips to measure the width of a desk...*** **(Math SS-IV.1.1)** **GLO: C2, C3, C5** **1-0-5c. Estimate and measure the passage of time using non-standard units, and compare the duration of activities.** **(Math SS-VI.1.1)** **GLO: C2, C3, C5** **1-0-5d. Select an appropriate non-standard unit, and estimate and measure length.** **(Math SS-I.1.1)** **GLO: C2, C3, C5** **1-0-5e. Record observations using drawings and tally charts.** **(ELA 4.1.2., 4.2.5; Math SP-II.1.1)** **GLO: C2, C6**	
Analysing and Interpreting	**1-0-6a. Construct, with guidance, concrete-object graphs and pictographs using 1:1 correspondence.** **(Math SP-III.2.1)** **GLO: C2, C6** **1-0-6b. Compare data using quantitative terms, and ask questions about the data gathered.** **(Math SP-IV.1.1)** **GLO: A1, A2, C2, C5**	
	1-0-6c. Place materials and objects in a sequence or in groups using a single, given attribute or a single, self-determined attribute. **(Math SP-IV.2.1)** **GLO: C2, C3, C5**	

	Scientific Inquiry	Design Process
Concluding and Applying	**1-0-7a. Propose an answer to the initial question based on their observations.** **GLO: A1, A2, C2**	**1-0-7b. Propose a solution to the initial problem.** **GLO: C3** **1-0-7c. Identify new problems that arise.** **GLO: C3**
	1-0-7d. Connect new experiences and information with prior knowledge. **(ELA 1.2.1)** **GLO: A2** **1-0-7e. Describe, in a variety of ways, what was done and what was observed.** ***Examples: concrete materials, drawings, oral language...*** **(ELA 4.1.2, 4.1.3)** **GLO: C6**	
Reflecting on Science and Technology	**1-0-8a. Recognize that learning can come from careful observations and investigations.** **(ELA 3.3.4)** **GLO: A1, A2, C2**	**1-0-8b. Recognize that tools are developed in response to human needs.** **GLO: A3**
Demonstrating Scientific and Technological Attitudes	**1-0-9a. Willingly consider other people's views.** **GLO: C5, C7** **1-0-9b. Willingly observe, question, and explore.** **GLO: C5** **1-0-9c. Express enjoyment of science-related classroom activities.** **GLO: C5** **1-0-9d. Take the time to measure with care.** **GLO: C5**	

Grade 1, Cluster 1: Characteristics and Needs of Living Things

Overview

Students in Grade 1 are interested in a wide variety of living things found in their local environments as well as in those from afar. In this cluster, a study of living things provides opportunities for students to discover the many different forms life takes. Students observe similarities and differences among living things and develop an understanding of their general characteristics. As a result, students become aware that all living things, including themselves, have needs. They discover that living things can often have similar needs, but that particular needs may be unique to individual living things. While the emphasis is on shared characteristics and needs among living things, diversity is also recognized, including the variations that make each human unique.

Students will…

1-1-01 Use appropriate vocabulary related to their investigations of characteristics and needs of living things.

Include: characteristic, human, animal, plant, living things, needs, as well as descriptive words relating to life processes.

GLO: C6, D1

1-1-02 Identify major parts of the human body and describe their functions.

Examples: arms and legs for movement...

GLO: D1, E2

1-1-03 Identify and describe common characteristics of humans and other animals they have observed.

Examples: number of limbs, eyes, ears, skin...

GLO: D1, E1

1-1-04 Identify and appreciate variations that make each human unique.

Examples: eye colour, hair colour, body type...

GLO: C5, E1

1-1-05 Recognize that plants, as living things, come in different forms.

Examples: grass, trees, shrubs...

GLO: D1, E1

1-1-06 Observe and identify similarities in life processes between themselves and other living things.

Examples: they eat, sleep, grow, and breathe, and so do other living things...

GLO: D1, E1

1-1-07 Recognize that plants, animals, and humans, as living things, have particular needs.

Examples: plants need sunlight and water...

GLO: D1

1-1-08 Describe what is needed to care for a pet, a farm animal, or an indoor plant.

Examples: provide fresh water for their hamster daily, feed and bed calves regularly...

GLO: B4, B5

1-1-09 Compare ways in which humans and other animals meet their needs.

Examples: senses, locomotion, tools...

GLO: C2, D1, E1

1-1-10 Describe how humans and other living things depend on their environment to meet their needs.

Examples: the environment provides humans and other living things with food...

GLO: D2, E2

1-1-11 Design a representation of an environment that meets the needs of a Manitoba animal.

Examples: a model, a diagram

GLO: C3, D1

1-1-12 Identify hobbies and jobs that require knowledge of the needs of living things.

Examples: gardeners, nurses, zookeepers...

GLO: B4, B5

1-1-13 Develop, implement, and evaluate personal and group action plans that contribute to a healthy environment for themselves and for other living things.

Examples: wash hands before eating, reduce amount of waste produced by the class...

GLO: B3, B5, C4, C7

1-1-14 Show respect for living things in their immediate environment.

Examples: handling the class gerbil with care...

GLO: B5

1-1-15 Recognize that some information they receive about living things is not scientific in nature.

Examples: movie animals talking, Jack's beanstalk growing to the sky...

GLO: A1, C5, C8

Grade 1, Cluster 2: The Senses

Overview

Our awareness of the environment and the many materials that are found within it is based on our sensory experiences. Through our senses, we can detect items that may be good to eat, pose danger, or be useful. Our senses are immediate and automatic. But the ability to use our senses safely and effectively involves focus, discernment, awareness, and judgement. In this cluster, students learn more about what the senses are, how they operate, and how they must be protected. Students also refine their observation skills. These skills are critical to science (see *Grade 1, Cluster 3: Characteristics of Objects and Materials*) and can be applied to other subject areas.

Students will…

1-2-01 Use appropriate vocabulary related to their investigations of the senses.

Include: senses, sight, smell, hearing, taste, touch, eye, nose, ear, tongue, skin, eyelash, eyebrow, eyelid, nostril, cartilage, nose hair, as well as descriptive words related to shape, colour, lustre, wetness, temperature, taste, odour, size, texture, pitch.

GLO: C6, D1, D3

1-2-02 Identify the five senses and describe the main body parts with which they are associated.

Include: sight and eyes; smell and nose; hearing and ears; taste and tongue; touch and skin.

GLO: D1

1-2-03 Use their senses to sort and classify objects.

Examples: *sort according to texture, sound, taste, or smell...*

GLO: C2, D1, E1

1-2-04 Identify and describe parts of the eye that help to protect it.

Include: eyelash, eyebrow, eyelid.

GLO: D1

1-2-05 Recognize that their fingertips are especially sensitive to touch.

GLO: D1

1-2-06 Identify the external part of the ear, and explore to determine its function.

GLO: D1

1-2-07 Use smell to identify familiar substances, following safe procedures.

Examples: vinegar, cinnamon, lemon, shampoo...

GLO: C1, C2, D3

1-2-08 Identify parts of the nose and describe their functions.

Include: nostril, cartilage, hairs.

GLO: D1

1-2-09 Identify parts of the body that are involved directly and indirectly in tasting.

Include: the tongue is involved directly, the nose is involved indirectly.

GLO: D1

1-2-10 Identify objects and procedures that protect the body and preserve each of the senses in explorations and in daily life.

Examples: sunglasses and safety goggles for eyes, gloves and tongs for hands, plugs for ears, washing hands regularly to avoid getting a cold or pinkeye...

GLO: B3, C1

1-2-11 Explore to determine ways that the appearance, texture, sound, smell, and taste of objects can be altered.

Examples: sanding, cooking, painting, tuning instruments, shaping clay...

GLO: D3, E3

1-2-12 Describe ways in which the senses can both protect and mislead.

Examples: seeing enables us to avoid obstacles, smell of smoke tells us something is burning, smell is not reliable when we have a cold, skin may not immediately tell us when we are getting sunburned or frostbitten...

GLO: B3, C1, D1

1-2-13 Recognize and appreciate that humans have different capabilities for sensing the environment and can use aids to assist them.

Examples: glasses and guide dogs are used to assist people with visual impairment...

GLO: B1, C5, E1

1-2-14 Recognize and appreciate that humans may have different interpretations of similar sensory observations.

Examples: one student likes the taste broccoli, another does not...

GLO: C5, E1

1-2-15 Give examples of how the senses are important in various activities, hobbies, and jobs.

Examples: smell is important to a chef, sight is important to a baseball player...

GLO: B4

Grade 1, Cluster 3: Characteristics of Objects and Materials

Overview

In Grade 1, students are introduced to the concept of materials by exploring various objects in their immediate surroundings. Through these observations, students distinguish between objects and materials, learning that objects are made from materials with specific characteristics. They are also able to describe these characteristics clearly and precisely. By making objects from various materials, they begin to understand the connection between a material's characteristics and the specific purpose(s) for which the material is used.

Students will…

1-3-01 Use appropriate vocabulary related to their investigations of objects and materials.

Include: characteristic, wood, metal, plastic, cloth, waterproof, absorbent, rigid, pliable, join, recycle.

GLO: C6, D3

1-3-02 Explore and describe characteristics of materials using their sensory observations.

Examples: steel is hard, shiny, and cold, and makes a ringing noise when tapped...

GLO: C2, D3

1-3-03 Distinguish between an object and the materials used to construct it.

Examples: chairs can be made of wood, metal, plastic, cloth, leather, wicker, or a combination of these materials...

GLO: D3, E2

1-3-04 Identify materials that make up familiar objects.

Examples: a desk can be made up of wood, metal, and plastic...

GLO: D3, E2

1-3-05 Explore to identify characteristics of common materials.

Examples: waterproof/absorbent, rigid/pliable...

GLO: D3

1-3-06 Give examples that show how the same material can serve a similar function in different objects.

Examples: in gloves and boots, rubber is used to keep out water...

GLO: D3, E1

1-3-07 Test and evaluate the suitability of materials for a particular function.

Examples: test mitts made of different materials to evaluate their ability to keep hands warm and dry...

GLO: C3, D3

1-3-08 Evaluate and describe the usefulness of common objects for a specific task.

Examples: compare usefulness of a toothbrush, hairbrush, toilet brush, or paintbrush for cleaning a sink...

GLO: B1, C3, C4, D3

1-3-09 Describe ways that materials can be joined.

Examples: gluing, stapling, taping, interlocking, buttoning...

GLO: C3, D3

1-3-10 Use the design process to construct a useful object by selecting, combining, joining, and shaping materials.

Examples: pencil holder, crayon box, desk organizer...

GLO: C3, D3

1-3-11 Demonstrate ways to reduce, reuse, and recycle materials during classroom learning experiences.

GLO: B5, D3

Grade 1, Cluster 4: Daily and Seasonal Changes

Overview

By observing their environment, students become aware of changes that can occur within it, such as changes in temperature, wind, and light, and in plant and animal life. Through observations and investigations, students learn that changes often occur in cycles, including the relatively short cycle of day and night and the longer cycle of the seasons. Recognizing these cyclical patterns prepares students to deal with daily and seasonal changes. Particular attention is given to studying ways in which humans are able to live comfortably throughout the seasons.

Students will…

1-4-01 Use appropriate vocabulary related to changes over time.

Include: Sun, light, heat, day, day time, night time, morning, afternoon, days of the week, yesterday, today, tomorrow, seasons, shadow, characteristic, behaviour, living things, cycle.

GLO: C6, D4, D6

1-4-02 Recognize that the Sun is a source of light and heat.

GLO: D4, E4

1-4-03 Recognize that a day is divided into day time and night time based on the presence or absence of sunlight.

GLO: D6

1-4-04 Sequence and record events and activities that occur over the course of a day, a week, or a year.

GLO: C2

1-4-05 Recognize that shadows are caused by blocking light.

GLO: D4, D6

1-4-06 Observe and describe how the Sun appears to change position over the course of a day.

Examples: track the location of the Sun using shadows...

GLO: C2, D6

1-4-07 Record, describe, and compare changes in temperature at different times of the day.
GLO: C2, D4, E3

1-4-08 Investigate and describe changes that occur in characteristics and behaviours of living things throughout a day.
Examples: some flowers open in the morning, some animals are active at night...
GLO: D1, E3

1-4-09 Compare characteristics of the four seasons.
Examples: length of day, type of precipitation, temperature...
GLO: E1, E3

1-4-10 Describe how humans prepare for seasonal changes.
Examples: put up snow fences, take out winter clothes...
GLO: B1, C1

1-4-11 Identify people who help us prepare for and deal with seasonal changes.
Examples: meteorologists, snow plough operators, reporters...
GLO: B4

1-4-12 Identify features of buildings that help keep humans sheltered and comfortable throughout daily and seasonal cycles.
Examples: furnace, lights, air conditioners, fans, windows, blinds, walls, roof...
GLO: B1

1-4-13 Sort clothing to suit each season, and justify their decisions.
GLO: B1, B3, C3, C4

1-4-14 Describe safety precautions related to daily weather, the changing of the seasons, and weather extremes.
Examples: wearing a raincoat if rain is expected, staying indoors during a blizzard, staying off thin ice in the spring and fall...
GLO: B3, C1

1-4-15 Describe how humans are able to participate in non-seasonal activities.
Examples: use indoor sport centres to swim in the winter and skate in the summer...
GLO: B1, B3

1-4-16 Identify physical and behavioural changes that occur seasonally among Manitoba plants and animals, and discuss possible reasons for these changes.
Examples: thicker fur, migration, dormancy...
GLO: D1, E3

1-4-17 Use the design process to construct a device or structure that helps a Manitoba animal adjust to seasonal changes.
Examples: winter birdfeeder, dog house, dog "booties" for winter...
GLO: B5, C3

Grade 2, Cluster 0: Overall Skills and Attitudes

Overview

Cluster "0" comprises nine categories of specific learning outcomes related to skills and attitudes* involved in scientific inquiry, the design process, or both. In Kindergarten to Grade 2, students are introduced to scientific inquiry through observing and measuring. Students refine their design-process skills as they progress through the grades, gradually behaving more independently in planning, constructing, and testing objects and devices. Students also acquire key attitudes, an initial awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

Teachers should select appropriate contexts to introduce and reinforce the scientific inquiry and design process skills and attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students in one Grade 1 class may focus on the development of cooperative group skills while using their senses to sort and classify objects in Cluster 2, while another class may focus on these skills while testing and evaluating the suitability of materials for a particular purpose as part of Cluster 3. To assist in planning and to facilitate curricular integration, many specific learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English Language Arts (ELA) and Mathematics (Math). There are also links to Technology as a Foundation Skill Area (TFS).

* Cluster 0, Overall Skills and Attitudes specific learning outcomes for this grade are also presented as part of a Kindergarten to Grade 4 chart (separate attachment). The purpose of this chart is to provide support related to the tracking of the development of skills and attitudes across several grades.

Students will...

	Scientific Inquiry	Design Process
Initiating	**2-0-1a. Ask questions that lead to investigations of living things, objects, and events in the immediate environment.** **(ELA 1.2.4, 3.1.2, 3.1.3; Math SP-I.1.2)** **GLO: A1, C2, C5** **2-0-1b. Make predictions based on observed patterns or on collected data.** **(ELA 1.1.1, 1.2.1)** **GLO: A1, C2**	**2-0-1c. Identify practical problems to solve in the immediate environment.** **GLO: C3**
Researching	**2-0-2a. Access information using a variety of sources.** ***Examples: elders, simple chapter books, concept books, CD-ROMs, Internet...*** **(ELA 1.1.2, 3.2.2 Math SP-II.1.2; TFS 2.1.1)** **GLO: C6** **2-0-2b. Match information to research needs.** **(ELA 3.2.3, 3.3.3)**	
Planning		**2-0-3a. Brainstorm, with the class, possible solutions to a practical problem; and in small groups, reach consensus on a solution to implement.** **(ELA 1.2.3, 2.2.2)** **GLO: C3, C7** **2-0-3b. Create, with the class, a plan to solve a problem or meet a need.** ***Examples: identify simple steps to follow, prepare a drawing of the object to be constructed...*** **(ELA 1.2.3)** **GLO: C3, C7** **2-0-3c. Develop, as a class, limited criteria to evaluate an object or device based on its function and aesthetics.** **GLO: C3, C7**
	2-0-3d. Identify tools and materials to be used, and explain their choices. **GLO: C2, C3, C4**	

	Scientific Inquiry	Design Process
Implementing a Plan (cont'd)	2-0-4a. Follow simple directions, and describe the purpose of steps followed. GLO: C2	2-0-4b. Construct an object or device to solve a problem or meet a need. GLO: C3 2-0-4c. Test an object or device with respect to pre-determined criteria. GLO: C3
	2-0-4e. Respond to the ideas and actions of others in building their own understandings. (ELA 1.1.2) GLO: C5, C7 2-0-4f. Work in a variety of cooperative partnerships and groups. (ELA 5.2.1) GLO: C7 2-0-4g. Verbalize questions, ideas, and intentions during classroom activities. GLO: C6 2-0-4h. Follow given safety procedures and rules. GLO: C1 2-0-4i. Recognize international symbols and the Canadian Safety Association signage, which provide information on the safety of substances. Include: flammable, explosive, corrosive, poisonous. GLO: C1	
Observing, Measuring, Recording	2-0-5a. Make, with guidance, observations that are relevant to a specific question. GLO: A1, A2, C2	
	2-0-5b. Use, with guidance, tools to observe, measure, and construct. *Examples: ruler, meter stick, pan balance, magnifying glass, bathroom scale, thermometer....* (Math SS-VIII.1.2) GLO: C2, C3, C5 2-0-5c. Estimate and measure the passage of time related to minutes and hours. (Math SS-VI.1.2) GLO: C2, C3, C5 5d. Estimate and measure length using standard units. (Math SS-I.1.2) GLO: C2, C3, C5 2-0-5e. Record observations using written language, drawings, and, with guidance, charts. (ELA 4.1.2, 4.2.5) GLO: C2, C6	

	Scientific Inquiry	Design Process
Analysing and Interpreting	2-0-6a. Construct and label concrete-object graphs, pictographs, and bar graphs using 1:1 correspondence. (Math SP-III.2.2) GLO: C2, C6 2-0-6b. Discuss data and generate new questions from dispayed data. (Math SP IV.1.2) GLO: A1, A2, C2, C5	
	2-0-6c. Place materials and objects in a sequence or in groups using one or two attributes, and describe the system used. (Math SP-III.0.2) GLO: C2, C3, C5	
Concluding and Applying	2-0-7a. Propose an answer to the initial question based on their observations. (Math SP-IV.2.2) GLO: A1, A2, C2	2-0-7b. Propose a solution to the initial problem. GLO: C3 2-0-7c. Identify new problems that arise. GLO: C3
	2-0-7d. Connect new experiences, ideas, and information with prior knowledge and experiences. (ELA 1.2.1, 2.1.2) GLO: A2 2-0-7e. Describe, in a variety of ways, what was done and what was observed. *Examples: concrete materials, captioned drawings, oral language...* (ELA 4.1.2, 4.2.5) GLO: C6	
Reflecting on Science and Technology	2-0-8a. Recognize that learning can come from careful observations and investigations. (ELA 3.3.4) GLO: A1, A2, C2	2-0-8b. Recognize that tools are developed in response to human needs. GLO: A3, B2
Demonstrating Scientific and Technological Attitudes	2-0-9a. Willingly consider other people's views. GLO: C5, C7 2-0-9b. Express enjoyment when sharing and discussing science-related experiences from daily life. GLO: C5 2-0-9c. Take the time to repeat a measurement or observation for greater precision or detail. GLO: C5	

Grade 2, Cluster 1: Growth and Changes in Animals

Overview

In Grade 2, students focus on animals to build upon their knowledge of living things (see *Grade 1, Cluster 1: Characteristics and Needs of Living Things*). All animals grow and change from birth until adulthood. Because children are interested in the changes that take place over the lifetime of different animals, observing these changes becomes a powerful learning experience for them. In their explorations of growth, students compare their own growth with the growth patterns of various animals, and they learn about the conditions needed to support healthy development. Particular attention is given to the nutritional requirements of humans.

Students will…

2-1-01 Use appropriate vocabulary related to their investigations of growth and changes in animals.

Include: food groups, Canada's Food Guide to Healthy Eating, offspring, adult, behaviour, life cycle, stage, life processes, as well as terms relating to life cycles studied.

GLO: B3, C6, D1

2-1-02 Identify and describe constant and changing characteristics of humans as they grow and develop.

Examples: eye colour remains constant, height changes...

GLO: D1, E3

2-1-03 Recognize that all humans do not grow and develop at the same rate.

GLO: B3, D1, E1, E3

2-1-04 Recognize that food is a form of energy and that healthy eating is essential for growth and development.

GLO: B3, D1, D4, E4

2-1-05 Identify the four food groups of Canada's Food Guide to Healthy Eating and give examples of foods from each group.

GLO: B3, E1

2-1-06 Plan a menu for one day based on the four food groups outlined in Canada's Food Guide to Healthy Eating.

GLO: B3, C4, D1

2-1-07 Recognize that foods humans eat come from plants and animals, and classify foods accordingly.

GLO: B1, B3

2-1-08 Recognize that all animals can have offspring, and that offspring generally resemble their parents.

GLO: D1, E1

2-1-09 Compare the appearance of young and mature animals of the same type.

GLO: D1, E1, E3

2-1-10 Compare the length of time from birth to adulthood for humans and other animals.

GLO: D1, E1

2-1-11 Identify and describe constant and changing characteristics of an animal as it grows and develops.

GLO: D1, E3

2-1-12 Describe and classify a wide range of animals according to various characteristics and behaviours.

Examples: skin covering, where they live, food they eat, day or night activity, how they move...

GLO: C2, D1, E1

2-1-13 Describe and compare ways in which different animals care for their offspring.

Examples: Canada geese, bears, alligators, bees...

GLO: D1, E1

2-1-14 Describe changes in the appearance and activity of various animals as they go through a complete life cycle.

Include: an insect, a bird, an amphibian.

GLO: D1, E3

2-1-15 Compare the life cycles of animals that have similar life cycles and those that have different life cycles.

Examples: bee and butterfly, gerbil and butterfly...

GLO: E1, E3

2-1-16 Observe and describe an animal's life processes.

Include: eating habits, movement, rest patterns, breathing.

GLO: E3

2-1-17 Identify and describe ways in which humans help other animals.

Examples: protecting endangered animals, feeding birds...

GLO: B1, B5

Grade 2, Cluster 2: Properties of Solids, Liquids, and Gases

Overview

When students examine materials in the world around them, they become aware of the similarities and differences in their characteristics, such as the ways materials look, feel, sound, or change. In Grade 2, students begin to develop an understanding of matter by investigating properties of solids and liquids. Gases are also introduced through an examination of the properties of air. Students investigate ways in which solids and liquids interact, and identify how the properties of solids and liquids determine their uses. Students observe how water can be made to change from one state to another and back again. Students also encounter changes of state in the study of the water cycle in *Grade 2, Cluster 4, Air and Water in the Environment*. Teachers are encouraged to help students make connections between these learning experiences.

Students will…

2-2-01 Use appropriate vocabulary related to their investigations of solids, liquids, and gases.

Include: solid, liquid, substance, property, mass/weight, dissolve, gas, changes of state, water vapour, freeze, melt, condense, evaporate, boil, float, sink, buoyancy.

GLO: C6, D3, D4

2-2-02 Identify substances, materials, and objects as solids or liquids.

GLO: D3

2-2-03 Investigate and compare properties of familiar solids.

Include: have mass/weight, take up space, maintain their shape.

GLO: C2, D3, E1

2-2-04 Investigate and compare properties of familiar liquids.

Include: have mass/weight, take up space, have no definite shape.

GLO: C2, D3

2-2-05 Identify similarities and differences among properties of familiar solids and liquids.

GLO: D3, E1

2-2-06 Distinguish between solids that dissolve in water and those that do not.

Examples: sugar dissolves in water, whereas sand does not...

GLO: D3, E1

2-2-07 Explore interactions of familiar liquids with different surfaces, powdered solids, and other liquids, and describe how these interactions determine their uses.

GLO: A5, B1, C1, C2

2-2-08 Identify liquids used in the home, and describe how they are used.

Examples: milk for drinking and cooking, detergent for cleaning...

GLO: B1

2-2-09 Compare different materials with respect to their capacity to absorb liquids, and describe how this capacity determines their uses.

GLO: B1, C2, D3

2-2-10 Describe useful materials that are made by combining solids and liquids.

Examples: a drink made from crystals and water, a cake made from cake mix and water, glue made from flour and water...

GLO: B1, D3

2-2-11 Explore to determine that there is a substance around us called air.

GLO: A2, C2, D3, D5

2-2-12 Recognize that air is composed of several gases

Examples: carbon dioxide, oxygen, nitrogen, water vapour...

GLO: D3

2-2-13 Identify properties of gases.

Include: occupy the space not taken up by solids and liquids, have no definite shape.

GLO: D3

2-2-14 Explore to determine how water can be made to change from one state to another and back again.

Include: addition or removal of heat.

GLO: C2, D3, D4, E3

2-2-15 Recognize that the states of solids and liquids remain constant in some circumstances, but may change in other circumstances.

Examples: liquids may freeze when temperature drops, solids may melt when heated, solids remain solid when broken...

GLO: D3, E3

2-2-16 Describe ways humans dispose of solids and liquids to maintain a clean and healthy environment.

Examples: take used car oil and old paints to collection sites, recycle newspapers...

GLO: B5

2-2-17 Predict and test to determine whether a variety of materials float or sink in water.

GLO: C2, D3

2-2-18 Demonstrate ways to make sinking materials float and floating materials sink.

GLO: B1, C3

2-2-19 Use the design process to construct an object that is buoyant and able to support a given mass/weight.

GLO: C3

Grade 2, Cluster 3: Position and Motion

Overview

The study of position and motion helps children develop a sense of space as well as an understanding of the relationship between stationary and moving objects, including themselves. Through observations and the use of specific vocabulary, students develop their ability to describe the position and motion of objects and recognize the effects of pushes and pulls on the motion of an object. In exploring motion, students investigate inclined planes, and wheels and axles as types of simple machines. They determine how these simple machines make it easier to move things and how friction affects the motion of objects.

Students will…

2-3-01 Use appropriate vocabulary related to their investigations of position and motion.

Include: position, stationary, above, between, near, far from, next to, below, in front of, behind, to the right/left, perspective, motion, push, pull, friction, slope, inclined plane, wheel, axle, rotate, clockwise, counterclockwise.

GLO: C6, D4

2-3-02 Explore and describe the position of a stationary object with reference to themselves, to other objects, or to a specific area.

Include: above, between, near, far from, next to, below, in front of, behind, to the right/left.

GLO: D4

2-3-03 Explore and describe changes in the position of an object in relation to its original position, themselves, or another object.

GLO: D4

2-3-04 Explore and describe the position of an object viewed from a perspective different from one's own.

GLO: D4

2-3-05 Explore and describe how changing the position of one's own body affects perspective with reference to a stationary object.

GLO: D4, E3

2-3-06 Describe the motion of various objects and living things.

Examples: spinning, swinging, bouncing, sliding, rolling, jumping...

GLO: D1, D4

2-3-07 Recognize that the position and motion of an object can be changed by a push or a pull and the size of the change is related to the strength of the push or pull.

GLO: D4

2-3-08 Compare and describe the effects of friction on the motion of objects and humans when travelling across different surfaces.

Examples: wheels of a toy on tile, sandpaper, or foam rubber; shoes on carpet, tile, or ice...

GLO: C2, D4

2-3-09 Explore and describe the effects of changing the slope of an inclined plane on the downward motion of an object and the effort needed to push or pull an object upward.

GLO: C2, D4

2-3-10 Identify how humans use inclined planes to make motion easier.

Examples: staircase, playground slide, wheelchair ramp, ramp on a moving van...

GLO: B1, D4

2-3-11 Explore toys to determine how wheels and axles interact and move.

GLO: C2, D4

2-3-12 Recognize that the wheels of a vehicle rotate clockwise or counterclockwise depending on the direction of motion of the vehicle.

GLO: D4

2-3-13 Identify how humans use the wheel and axle to make movement easier.

Examples: moving dolly, wheelbarrow, cart, wagon...

GLO: B1, D4

2-3-14 Use the design process to construct a vehicle with wheels and axles that meets given criteria.

GLO: C3, D4

Grade 2, Cluster 4: Air and Water in the Environment

Overview

Air and water are major parts of our physical environment and are essential for life. Yet, our awareness of them is often limited largely because we identify them only in their most obvious and observable forms. Through investigations, students learn about the characteristics of air, and the various forms of water in the environment. Students continue to build their understanding of the nature of science by describing evidence of the water cycle (see *Grade 2, Cluster 2: Properties of Solids, Liquids, and Gases*) and of moving air in indoor and outdoor environments. In the process, students discover the many ways in which air and water contribute to the health and survival of living things, including themselves.

Students will…

2-4-01 Use appropriate vocabulary related to their investigations of air and water.

Include: wind, air current, temperature, changes of state, water cycle, freeze, melt, condense, evaporate, sources of drinking water, pollution.

GLO: C6, D4, D5

2-4-02 Recognize that air can move.

Include: wind, air current.

GLO: D5

2-4-03 Observe and identify evidence of moving air in indoor and outdoor environments.

Examples: leaves blowing, drapes moving...

GLO: B1, C2, D5

2-4-04 Identify positive and negative effects of changes in air temperature and air movement in indoor and outdoor environments.

GLO: B1, E3

2-4-05 Use the design process to construct and test a device that shows evidence of air movement.

Examples: windsock, wind chime, pinwheel, sailboat, kite...

GLO: C3

2-4-06 Observe and identify examples of water in the environment.

Examples: dew, frost, snow, rain, lakes, puddles, clouds, fog, perspiration...

GLO: C2, D5

2-4-07 Describe evidence of water changing state, and recognize that these changes are part of the water cycle.

Examples: puddles evaporating after a rainstorm, snow melting...

GLO: D4, D5, E2, E3

2-4-08 Investigate to determine factors that cause things to dry quickly or slowly.

Examples: air temperature, amount of moisture in the air, amount of wind...

GLO: C2, D5, E3

2-4-09 Identify sources of drinking water, and explain how this water is distributed in one's own and in other communities.

Examples: wells, springs, lakes, rivers are sources; pumps, pipes, aqueducts and water trucks help distribute water...

GLO: B1, D5, E2

2-4-10 Describe different uses of water by humans.

Examples: drinking, washing, cooking, canoeing, irrigating...

GLO: B1

2-4-11 Explain and appreciate the importance of clean air and water for humans, plants, and animals.

GLO: B5, D2

2-4-12 Identify substances that pollute air and water, and describe ways of reducing such pollution.

Examples: car exhaust, smoke, carbon monoxide, oil, house paints, and sewage...

GLO: B3, B5, D3, D5

2-4-13 Recognize that clean water is an increasingly scarce resource in many parts of the world, and describe consequences of a shortage of clean water.

GLO: B1, B3, B5

2-4-14 Record personal use of water, and identify ways in which they can reduce water usage.

Examples: rather than leaving water running while brushing teeth, turn off tap to reduce usage...

GLO: B5, C2, C5

Grade 3, Cluster 0: Overall Skills and Attitudes

Overview

Cluster "0" comprises nine categories of specific learning outcomes related to skills and attitudes* involved in scientific inquiry, the design process, or both. In Grades 3 and 4 students develop scientific inquiry skills and attitudes as they plan and conduct simple experiments. They refine their design-process skills as they progress through the grades, gradually behaving more independently in designing, constructing, and testing objects, and devices. Students also acquire key attitudes, an increased awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

Teachers should select appropriate contexts to introduce and reinforce the scientific inquiry and design process skills and attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students in one Grade 4 class may be introduced to graphing skills during a study of deer populations, and develop them further while graphing sound frequency. In contrast, students in another Grade 4 class may have opportunities to acquire and practise these skills in other clusters. To assist in planning and to facilitate curricular integration, many learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English Language Arts (ELA) and Mathematics (Math). There are also links to Technology as a Foundation Skill Area (TFS).

* Cluster 0, Overall Skills and Attitudes specific learning outcomes for this grade are also presented as part of a Kindergarten to Grade 4 chart (separate attachment). The purpose of this chart is to provide support related to the tracking of the development of skills and attitudes across several grades.

Students will...

	Scientific Inquiry	Design Process
Initiating	**3-0-1a. Ask questions that lead to investigations of living things, objects, and events in the local environment.** **(ELA 1.2.4)** **GLO: A1, C2, C5** **3-0-1b. Make predictions based on observed patterns, collected data, or data provided from other sources.** **(ELA 1.1.1; Math SP-IV.2.3)** **GLO: A1, C2**	**3-0-1c. Identify practical problems to solve in the local environment.** **GLO: C3**
Researching	**3-0-2a. Access information using a variety of sources.** ***Examples: children's magazines, local farmers, CD-ROMs, Internet...*** **(ELA 1.1.2, 3.2.2; Math SP-I.1.2.3; TFS 2.1.1)** **GLO: C6** **3-0-2b. Review information to determine its usefulness to research needs.** **(ELA 3.2.3, 3.3.3)** **GLO: C6, C8**	
Planning	**3-0-3a. Brainstorm, with the class, one or more methods of finding the answer to a given question and reach consensus on which method to implement.** **GLO: C2, C7** **3-0-3b. Identify, with the class, variables that have an impact on an investigation.** **GLO: A1, A2, C2, C7** **3-0-3c. Create, with the class, a plan to answer a given question.** **(ELA 3.1.4)** **GLO: C2, C7**	**3-0-3d. Brainstorm, in small groups, possible solutions to a practical problem, and reach consensus on which solution to implement.** **GLO: C3, C7** **3-0-3e. Create, in small groups, a written plan to solve a problem or meet a need.** **Include: identify steps to follow, prepare a simple diagram.** **(ELA 1.2.3) GLO: C3, C7** **3-0-3f. Develop, in small groups, limited criteria to evaluate an object or device based on its function and aesthetics.** **GLO: C3, C7**
Implementing a Plan	**3-0-4a. Carry out a plan, and describe the steps followed.** **(Math SP-V.2.3)** **GLO: C2**	**3-0-4b. Construct an object or device to solve a problem or meet a need.** **GLO: C3** **3-0-4c. Test an object or device with respect to pre-determined criteria. GLO: C3, C5** **3-0-4d. Identify and make improvements to an object or device, and explain the rationale for the changes.** **GLO: C3**

	Scientific Inquiry	Design Process
Implementing a Plan (cont'd)	**3-0-4e. Respond respectfully to the ideas and actions of others, and recognize their ideas and contributions.** **(ELA 1.1.2, 5.2.2)** **GLO: C5, C7** **3-0-4f. Assume roles and share responsibilities as group members.** **(ELA 5.2.1)** **GLO: C7** **3-0-4g. Verbalize questions, ideas, and intentions during classroom-learning experiences.** **GLO: C6** **3-0-4h. Follow given safety procedures and rules, and explain why they are needed.** **GLO: C1**	
Observing, Measuring, Recording	**3-0-5a. Make observations that are relevant to a specific question.** **GLO: A1, A2, C2**	
	3-0-5b. Use tools to observe, measure, and construct. **Include: ruler, meter stick, pan balance, magnifying glass, bathroom scale, thermometer, magnet.** **(Math SS-I.1.3, SS-III.1.3, SS-IV.1.3, SS-VII.4.3)** **GLO: C2, C3, C5** **3-0-5c. Estimate and measure mass/weight, length, volume, and temperature using standard units.** **(Math SS-IV.1.3, SS-I.1.3, SS-III.1.3, SS-VIII.4.3)** **GLO: C2, C3, C5** **3-0-5d. Estimate and measure the passage of time using standard units.** **Include: seconds, minutes, hours.** **(Math SS-VI.1.3)** **GLO: C2, C3, C5** **3-0-5e. Record observations in a variety of ways.** ***Examples: point-form notes, sentences, simple diagrams, charts...*** **(ELA 3.2.1, 3.3.2, 4.1.3; Math SP-II.2.1, SP-V.2.3)** **GLO: C2, C6**	
Analysing and Interpreting	**3-0-6a. Display data using more than one way to represent the same data.** **(Math SP-III.2.3)** **GLO: C2, C6** **3-0-6b. Discuss data and generate new questions from displayed data.** **(Math SP-IV.1.2)** **GLO: A1, A2, C2, C5**	
	3-0-6c. Place materials and objects in a sequence or in groups using two or more attributes, and describe the system used. **(Math PR-I.1.3)** **GLO: C2, C3, C5**	

	Scientific Inquiry	Design Process
Concluding and Applying	**3-0-7a. Draw a simple conclusion based on their observations.** **GLO: A1, A2, C2** **3-0-7b. Explain why conclusions related to classroom experiments should be based on multiple trials or classroom data rather than on an individual result.** **GLO: A1, A2, C2**	**3-0-7c. Identify new problems that arise.** **GLO: C3**
	3-0-7d. Examine how new experiences, ideas, and information connect to prior knowledge and experiences, and record these connections. **(ELA 1.2.1, 2.1.2, 3.3.3)** **GLO: A2, C6** **3-0-7e. Communicate results and conclusions in a variety of ways.** ***Examples: point-form lists, sentences, simple diagrams, charts, demonstrations...*** **(ELA 2.3.5, 3.3.2, 4.1.3; Math SP-III.2.3; TFS 2.1.4)** **GLO: C6**	
Reflecting on Science and Technology	**3-0-8a. Recognize that valid experiments normally have reproducible results, which may vary slightly.** **GLO: A1, A2, C2** **3-0-8b. Recognize that scientists develop explanations from observations and what they already know about the world, and that good explanations are based on evidence.** **GLO: A1, A2, C2**	**3-0-8c. Recognize that designing a solution to a simple problem may have considerations, such as cost, materials, time, and space.** **GLO: B2, C3**
Demonstrating Scientific and Technological Attitudes	**3-0-9a. Listen to and consider differing opinions.** **(ELA 5.2.3)** **GLO: C5, C7** **3-0-9b. Express enjoyment when sharing and discussing science-related experiences from daily life.** **(ELA 4.4.3)** **GLO: C5** **3-0-9c. Take the time to repeat a measurement or observation for greater precision or detail.** **GLO: C5**	

Grade 3, Cluster 1: Growth and Changes in Plants

Overview

In Grade 3, the study of living things focuses on the characteristics and needs of plants and their growth patterns. Students observe and investigate local plants, but a deeper understanding and appreciation is developed through planting, nurturing, and observing individual plants over time. Connections are made to students' prior knowledge of animal needs (see *Grade 2, Cluster 1: Growth and Changes in Animals*) by identifying needs that are similar between plants and animals and how those needs are met. This cluster addresses the importance of plants to the environment as well as the significance of food, shelter, medicine, and other plant products to humans. Emphasizing the connection between this cluster and *Grade 3, Cluster 4: Soils in the Environment* develops the relationship between plants and the soils in which they are grown.

Students will…

3-1-01 Use appropriate vocabulary related to their investigations of growth and changes in plants.

Include: growing medium, nutrient, energy, root, stem, leaf, flowers, pistil, stamen, ovule, pollen, seed, fruit, adaptation, life cycle.

GLO: C6, D1

3-1-02 Observe, compare, and contrast the structure and appearance of several types of plants.

Examples: plants with different types of roots, trees with needles and trees with leaves...

GLO: C2, D1, E1

3-1-03 Show respect for plants as living things.

GLO: B5

3-1-04 Conduct experiments to determine conditions needed for healthy plant growth.

Include: light, water, air, space, warmth, growing medium, nutrients.

GLO: A1, C2, C5, D1

3-1-05 Recognize that a plant uses the Sun's energy to make its own food.

GLO: D1, D2, D4, E4

3-1-06 Use the design process to construct an environment that enhances plant growth.

Examples: window sill garden, terrarium, cold frames...

GLO: A5, C3, C5, D1

3-1-07 Identify the basic parts of plants and describe their functions.

Include: roots, stems, leaves, flowers, pistil, stamen, ovule, pollen, seeds, fruit.

GLO: D1, E2

3-1-08 Explain how different adaptations of plants help them survive in particular environments.

Examples: cacti have fleshy stems that store water, allowing them to survive in a dry environment; plants with tap roots can grow well in heavily compacted soil...

GLO: D1, D2, E1

3-1-09 Identify plant adaptations that can be harmful to humans, and describe their effects.

Examples: rose thorns cause painful punctures, poison in rhubarb leaves can cause sickness and death...

GLO: B3, C1, D1

3-1-10 Care for a flowering plant throughout its life cycle, tracking its growth and its changes over time.

GLO: B5, C5, D1, E3

3-1-11 Identify characteristics that remain constant and those that change throughout the life cycle of a flowering plant.

Examples: generally, for a given plant, the leaf shape and flower colour stay the same, whereas the leaf size and number of leaves change...

GLO: D1, E3

3-1-12 Identify needs common to plants and animals, and contrast how they meet those needs.

GLO: D1, E1

3-1-13 Describe ways that plants and animals depend on each other.

Examples: plants provide food and shelter for some animals, animals help distribute pollen and seeds...

GLO: D2, E2

3-1-14 Describe ways plants are important to the environment.

Examples: improve soil, air, and water quality; reduce erosion...

GLO: B5, D2

3-1-15 Identify and describe hobbies and jobs involving plants.

GLO: B4

3-1-16 Identify how humans from various cultures use plant parts for food and medicine.

Examples: use of roots for food (carrots) and medicine (ginseng)...

GLO: A4, B1, C5, E1

3-1-17 Investigate to determine how humans from various cultures make useful products from plant materials.

Examples: lumber milling, paper making, rope making, fabric making...

GLO: A3, A4, B1

3-1-18 Explain how humans replenish the plants they use and the consequences if plants are not replenished.

Examples: after loggers harvest trees, new ones should be planted to ensure a future lumber supply...

GLO: B1, B5, E3

Grade 3, Cluster 2: Materials and Structures

Overview

Students learn about the nature of materials not just by observing them but, more importantly, by using them. In this cluster, students experience the design process as they manipulate and test materials, build structures, and select and use materials suitable to the task at hand. Students find that the strength and stability of structures in their community, as well as those they build themselves, are linked to the properties of the materials used and to the particular way the materials are configured and joined. This cluster further develops the concept of materials introduced in *Kindergarten, Cluster 3: Paper* and built upon in *Grade 1, Cluster 3: Characteristics of Objects and Materials.*

Students will…

3-2-01 Use appropriate vocabulary related to their investigations of materials and structures.

Include: strength, balance, stability, structure, frame structure, natural structure, human-built structure, force.

GLO: C6, D3

3-2-02 Conduct experiments to compare the strength of common materials.

Examples: wooden toothpicks, plastic straws, paper, cardboard, polystyrene foam...

GLO: A1, A2, C2, D3

3-2-03 Explore to determine ways to strengthen a material used for building.

Include: changing shape, bulk, and number of layers.

GLO: B1, C2, D3

3-2-04 Explore to determine an appropriate method for joining two materials for a specific use.

GLO: C2, D3

3-2-05 Recognize that balance affects the stability of a structure.

Examples: a domino tower that leans to one side is more likely to tip over than one that stands straight...

GLO: D4

3-2-06 Explore to determine ways to improve the strength and stability of a frame structure.

Examples: use of triangulation or a cross member...

GLO: C2, D4, E2

3-2-07 Identify shapes that are part of natural and human-built structures from various cultures and describe how these shapes help to provide strength and stability.

Examples: cylinders, triangles, hexagons in outdoor playstructure, hexagons in a honeycomb...

GLO: A4, D4, E2

3-2-08 Identify characteristics of materials that need to be considered when choosing materials for building structures.

Examples: strength, flexibility, durability, surface texture...

GLO: D3

3-2-09 Use the design process to build a structure that meets given criteria related to strength, stability, and function.

GLO: A3, C3

3-2-10 Describe the effects of various forces on different structures.

Examples: bookshelf sagging under the mass/weight of books, tent blowing over in a storm...

GLO: D4, E2

3-2-11 Evaluate simple structures to determine if they are safe and appropriate to the user.

Examples: classroom furniture...

GLO: C1, C3, C4, D4

3-2-12 Investigate to identify hobbies and jobs related to construction, engineering, and architecture.

GLO: B4

3-2-13 Identify various materials used in the construction of buildings in their community and in communities around the world.

GLO: A4, B1, D3, E1

Grade 3, Cluster 3: Forces That Attract or Repel

Overview

In Grade 3, students build on their initial awareness of forces as pushes or pulls, (see *Grade 2, Cluster 3: Position and Motion*). In this cluster, the focus is on forces that act without direct contact: gravity, magnetism, and static electricity. Students describe evidence that shows that objects and living things on or near Earth are affected by a force called gravity, enhancing their understanding of the nature of science. Through their investigations, they determine that magnets have two poles and are surrounded by a magnetic field. They describe interactions of like and unlike poles, and compare Earth to a giant magnet. In addition, they identify ways of producing electrostatic charges using everyday materials. Students show how the strength of magnetic and electrostatic forces varies under different conditions. New understandings of gravity, magnetism, and static electricity are further refined as students identify and construct devices that use these forces.

Students will…

3-3-01 Use appropriate vocabulary related to their investigations of forces.

Include: force, attract, repel, gravity, magnet, magnetize, magnetism, north pole, south pole, magnetic field, compass, electrostatic charge, static electricity, electrostatic force.

GLO: C6, D4

3-3-02 Recognize that force is a push or pull and that attraction and repulsion are types of pushes and pulls.

GLO: D4

3-3-03 Describe evidence showing that objects and living things on or near Earth are pulled toward it by a force called gravity.

GLO: A2, D4

3-3-04 Predict and test to identify materials that are attracted by magnets and those that can be magnetized.

GLO: C2,, C5 D3

3-3-05 Investigate to determine how to magnetize a given object.

Include: contact with another magnet, proximity to a magnet.

GLO: C2, D4

3-3-06 Investigate to determine the location of poles on a magnet, and the shape of the magnetic field around a magnet.

GLO: A1, C2, D4

3-3-07 Demonstrate that opposite poles attract and like poles repel.

GLO: C2, D4

3-3-08 Explain why Earth can be compared to a giant magnet.

Include: Earth has a magnetic field with poles adjacent to the geographic poles.

GLO: D4, E1, E2

3-3-09 Demonstrate and explain how a compass operates by magnetism.

Include: Earth's magnetic pole attracts the magnetic needle of a compass.

GLO: B1, D4

3-3-10 Describe potentially harmful effects of magnets on magnetized materials.

Examples: computers, videos, credit cards...

GLO: B1, C1, D4

3-3-11 Describe and demonstrate ways to use everyday materials to produce electrostatic charges.

Examples: rubbing feet on carpet, brushing hair, rubbing a balloon on clothes...

GLO: D4

3-3-12 Investigate to determine how electrostatically charged materials interact with each other and with uncharged materials.

Include: charged materials attract or repel each other, charged materials attract uncharged materials.

GLO: A2, C2, D4

3-3-13 Identify ways in which problems associated with static electricity can be avoided or eliminated.

Examples: staying indoors when there is a lightning storm, grounding yourself before using computers, avoiding shuffling your feet on carpets...

GLO: B1, C1, D4

3-3-14 Investigate to determine the change in magnetic and electrostatic forces at different distances.

GLO: C2, D4

3-3-15 Predict and test to determine the effect of placing materials between a magnet and an attracted object and between charged objects.

Examples: different thicknesses of paper, glass, water, metal...

GLO: C2, C5, D4

3-3-16 Recognize that gravitational, magnetic, and electrostatic forces can move certain objects without touching them directly.

GLO: D4

3-3-17 Distinguish between motion that is caused without contact and that which is caused by contact.

GLO: D4

3-3-18 Identify devices that use gravitational, magnetic, or electrostatic forces.

Examples: balances, magnetic cupboard latches, dust mops...

GLO: B1, D4

3-3-19 Use the design process to construct a game, toy, or useful device that uses gravitational, magnetic, or electrostatic forces.

GLO: C3, C5

Grade 3, Cluster 4: Soils in the Environment

Overview

Soil provides a base for gardens, forests, fields, and farms, supporting plant and animal life, and human activities. By examining soils, students discover that soil composition and characteristics vary. Students also experiment to determine the impact of different soils on plant growth, thus improving their understanding of scientific inquiry processes. Students also learn the importance of animals and nutrient recycling to soil quality. Teachers are encouraged to help students develop the strong connection between soils and plants (see *Grade 3, Cluster 1: Growth and Changes in Plants*).

Students will…

3-4-01 Use appropriate vocabulary related to their investigations of soils in the environment.

Include: soil, soil component, loam, clay, sand, pebbles, organic matter, humus, rocks, sedimentation, sieving, water-holding capacity.

GLO: C6, D5

3-4-02 Identify and describe various components within a sample of soil from the local environment.

Examples: clay, loam, sand, pebbles, organic matter, humus, rocks...

GLO: D5

3-4-03 Explore to determine ways to separate soil components.

Include: sedimentation and sieving techniques.

GLO: C2, D5

3-4-04 Describe and compare components of soil samples collected at different locations and depths.

GLO: D5, E1

3-4-05 Compare the water-holding capacity of different soils.

Examples: sandy soil retains far less water than loamy soil...

GLO: D3, D5, E1

3-4-06 Describe the effect of water on different soils.

Examples: texture, cohesion, ability to hold shape...

GLO: D3, D5

3-4-07 Conduct experiments to determine how different soils affect the growth of plants.

Examples: compare the same type of plant grown in sand versus potting soil...

GLO: A1, A2, C2, D2

3-4-08 Explain the importance of understanding the characteristics of different soils.

Examples: enables farmers to determine which crops can be grown in a particular area, enables gardeners to improve plant growth, enables engineers to know what types of foundations to set for structures...

GLO: A5, B1, B5, E2

3-4-09 Identify animals found in soil and explain their importance to soil quality.

Examples: worms, insects, and mammals help to aerate the soil or increase nutrients...

GLO: B5, D2

3-4-10 Describe ways to return organic matter to the soil.

Examples: composting, spreading manure on fields...

GLO: B1, B5, D2, D5

3-4-11 Use the design process to construct a simple composter that returns organic matter to the soil.

Examples: classroom composter for left-over food, school composter for grass clippings and leaves...

GLO: B1, B5, C3, D2

3-4-12 Investigate how humans from various cultures use earth materials to make objects.

Examples: clay pots, sod houses, adobe bricks, glass...

GLO: A4, B1, B4

Grade 4, Cluster 0: Overall Skills and Attitudes

Overview

Cluster "0" comprises nine categories of specific learning outcomes related to skills and attitudes* involved in scientific inquiry, the design process, or both. In Grades 3 and 4 students develop scientific inquiry skills and attitudes as they plan and conduct simple experiments. They refine their design process skills as they progress through the grades, gradually behaving more independently in designing, constructing, and testing objects, and devices. Students also acquire key attitudes, an increased awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

Teachers should select appropriate contexts to introduce and reinforce the scientific inquiry and design-process skills and attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students in one Grade 4 class may be introduced to graphing skills during a study of deer populations, and develop them further while graphing sound frequency. In contrast, students in another Grade 4 class may have opportunities to acquire and practise these skills in other clusters. To assist in planning and to facilitate curricular integration, many learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English Language Arts (ELA) and Mathematics (Math). There are also links to Technology as a Foundation Skill Area (TFS).

* Cluster 0, Overall Skills and Attitudes specific learning outcomes for this grade are also presented as part of a Kindergarten to Grade 4 chart (separate attachment). The purpose of this chart is to provide support related to the tracking of the development of skills and attitudes across several grades.

Students will...

	Scientific Inquiry	Design Process
Initiating	**4-0-1a. Ask questions that lead to investigations of living things, objects, and events in the local environment.** **(ELA 1.2.4, 3.1.2)** **GLO: A1, C2, C5** **4-0-1b. Make and justify predictions based on observed patterns, collected data, or data provided from other sources.** ***Examples: graph, chart...*** **(ELA 1.1.1, 1.2.1; Math PR-III.1.4)** **GLO: A1, C2**	**4-0-1c. Identify practical problems to solve in the local environment.** **GLO: C3**
Researching	**4-0-2a. Access information using a variety of sources.** ***Examples: school libraries, videos, traditional knowledge, CD-ROMs, Internet...*** **(ELA 3.2.2, 3.2.4, TFS 2.1.1)** **GLO: C6** **4-0-2b. Review information to determine its usefulness to inquiry or research needs.** **(ELA 3.2.3, 3.3.3)** **GLO: C6, C8**	
Planning	**4-0-3a. Brainstorm, in small groups, one or more methods of finding the answer to a given question, and reach consensus on which method to implement.** **GLO: C2, C7** **4-0-3b. Identify, in small groups, variables that have an impact on an investigation.** **GLO: A1, A2, C2, C7** **4-0-3c. Create, in small groups, a plan to answer a given question.** **(ELA 3.1.4; Math SP-V.2.4)** **GLO: C2**	**4-0-3d. Brainstorm possible solutions to a practical problem, and identify and justify which solution to implement.** **(ELA 1.2.3)** **GLO: C3** **4-0-3e. Create a written plan to solve a problem or meet a need. Include: identify steps to follow, prepare a labelled diagram.** **GLO: C3** **4-0-3f. Develop criteria to evaluate an object, device, or system based on its function, aesthetics, and other considerations such as materials, and cost. GLO: C3**
Implementing a Plan	**4-0-4a. Carry out a plan, and describe the purpose of the steps followed.** **(Math SP-V.2.4)** **GLO: C2**	**4-0-4b. Construct an object, device, or system to solve a problem or meet a need. GLO: C3** **4-0-4c. Test an object, device, or system with respect to pre-determined criteria. GLO: C3, C5** **4-0-4d. Identify and make improvements to an object, device, or system, and explain the rationale for the changes.** **GLO: C3**

	Scientific Inquiry	Design Process
Implementing a Plan (cont'd)	**4-0-4e. Identify problems as they arise, and work with others to find solutions.** **GLO: C3, C7** **4-0-4f. Assume roles, and share responsibilities as group members. (ELA 5.2.2)** **GLO: C7** **4-0-4g. Communicate questions, ideas and intentions, and listen effectively to others during classroom-learning experiences.** **GLO: C6** **4-0-4h. Use tools and apparatus in a manner that ensures personal safety and the safety of others.** **GLO: C1**	
Observing, Measuring, Recording	**4-0-5a. Select and use tools to observe, measure, and construct.** ***Examples: tuning fork, prism, binoculars, measuring tape...*** **GLO: C2, C3, C5** **4-0-5b. Estimate and measure mass/weight, length, volume, area, and temperature using standard units. (Math SS-IV.1.4, SS-I.1.4, SS-III.1.4, SS-II.1.4)** **GLO: C2, C3, C5** **4-0-5c. Record observations in a variety of ways.** ***Examples: point-form notes, sentences, labelled diagrams, charts...*** **(ELA 2.1.1, 3.3.1, 4.1.1, 4.1.2; Math SP-1.2.4, SP-II.2.4)** **GLO: C2, C6**	
Analysing and Interpreting	**4-0-6a. Construct bar graphs and pictographs using many to one correspondence, and interpret these as well as graphs from other sources. (Math SP-III.2.4)** **GLO: C2, C6** **4-0-6b. Identify and suggest explanations for patterns and discrepancies in data.** **GLO: A1, A2, C2, C5**	
	4-0-6c. Choose and identify relevant attributes for use in a classification system, and create a chart or diagram that shows the method of classifying. (Math PR-II.2.4) **GLO: C2, C3, C5** **4-0-6d. Sort and classify according to an established classification system. (Math PR-II.2.4)** **GLO: C2, C3** **4-0-6e. Evaluate, with guidance, the methods used to answer a question or solve a problem.** **GLO: C2, C3**	

	Scientific Inquiry	Design Process
Concluding and Applying	**4-0-7a. Draw a conclusion based on evidence gathered through research and observation.** **GLO: A1, A2, C2** **7b. Identify new questions that arise from what was learned. (ELA 3.3.4)** **GLO: A1, C2, C3**	**4-0-7b. Propose a solution to the initial problem.** **GLO: C3** **4-0-7c. Identify new problems that arise.** **GLO: C3**
	4-0-7d. Construct meaning in different contexts by connecting new experiences and information to prior experiences and knowledge. (ELA 1.2.1, 2.1.2) **GLO: A2, C6** **4-0-7e. Communicate results and conclusions in a variety of ways.** ***Examples: point-form lists, sentences, graphs, labelled diagrams, charts...*** **(ELA 2.3.5, 4.2.5; Math SP-III.1.4, SP-III.2.4; TFS 2.1.4)** **GLO: C6**	
Reflecting on Science and Technology	**4-0-8a. Recognize that experimental results may vary slightly when carried out by different persons, or at different times or places; but that if the results of repeated experiments are very different, something must must be wrong with the design of the experiment.** **GLO: A1, A2, C2** **4-0-8b. Recognize that scientists must support their explanations using evidence and scientific knowledge.** **GLO: A1, A2, C2**	**4-0-8c. Recognize that designing a solution to a simple problem may have considerations, such as cost, materials, time, and space.** **GLO: B2, C3**
Demonstrating Scientific and Technological Attitudes	**4-0-9a. Respect alternative views of the world. (ELA 5.1.1)** **GLO: C5, C7** **4-0-9b. Demonstrate confidence in their ability to do science.** **GLO: C5** **4-0-9c. Report and record what is observed, not what they think they ought to observe, nor what they believe the teacher expects.** **GLO: C5**	

Grade 4, Cluster 1: Habitats and Communities

Overview

As students in Grade 4 are familiar with the basic needs of plants and animals (see *Grade 2, Cluster 1: Growth and Changes in Animals*, and *Grade 3, Cluster 1, Growth and Changes in Plants*), they can begin to explore and compare ways in which plant and animal communities satisfy their needs in particular habitats. They begin to recognize the complex interactions that take place between plant and animal populations within a community. Through investigations, students study influences, both naturally occurring and human-caused, that can alter habitats and affect plant and animal populations. The cluster also addresses the role traditional knowledge and technology play in learning more about and caring for plant and animal populations.

Students will…

4-1-01 Use appropriate vocabulary related to their investigations of habitats and communities.

Include: habitat, physical adaptation, behavioural adaptation, traditional knowledge, technological development, population, community, food chain, food web, organism, producer, consumer, herbivore, omnivore, carnivore, predator, prey, scavenger, endangerment, extinction, conservation.

GLO: C6, D2

4-1-02 Recognize that each plant and animal depends on a specific habitat to meet its needs.

GLO: D2

4-1-03 Identify the components of an animal habitat.

Include: food, water, living space, cover/shelter.

GLO: D2, E2

4-1-04 Identify physical and behavioural adaptations of animals and plants, and infer how these adaptations help them to survive in a specific habitat.

Examples: ducks' webbed feet and waterproof feathers help them dive for food in the marsh...

GLO: D1, D2

4-1-05 Investigate alternate explanations of plant or animal adaptations based on traditional knowledge from a variety of cultures.

GLO: A1, A4, C8

4-1-06 Investigate how technological developments often mirror physical adaptations.

Examples: fishnet — spider web, diving fins — webbed feet...

GLO: A5, E1

4-1-07 Investigate and describe a variety of local and regional habitats and their associated populations of plants and animals.

GLO: D2, E2

4-1-08 Predict and test to determine an appropriate method for measuring a plant population within a given habitat.

GLO: A2, C2, C3, C5

4-1-09 Recognize that plant and animal populations interact within a community.

GLO: D2

4-1-10 Recognize that the food chain is a system in which some of the energy from the Sun is transferred eventually to animals.

GLO: D2, D4, E2

4-1-11 Construct food chains and food webs, and classify organisms according to their roles.

Include: producer, consumer, herbivore, omnivore, carnivore, predator, prey, scavenger.

GLO: D2, E2

4-1-12 Use the design process to construct a model of a local or regional habitat and its associated populations of plants and animals

GLO: C3, D4

4-1-13 Predict, based on their investigations, how the removal of a plant or animal population may affect the rest of the community.

Examples: if the wolves were removed from a community, the deer population may increase rapidly...

GLO: D2, E2, E3

4-1-14 Investigate natural and human-caused changes to habitats, and identify resulting effects on plant and animal populations.

Include: endangerment, extinction.

GLO: B1, B5, D2, E3

4-1-15 Describe how their actions can help conserve plant and animal populations and their habitats.

Examples: clean up a local stream to improve fish and bird habitat...

GLO: B5

4-1-16 Describe how specific technological developments have enabled humans to increase their knowledge about plant and animal populations.

Examples: radio collar tracking, timelapse photography...

GLO: A2, A3, A5

4-1-17 Recognize and appreciate how traditional knowledge contributes to our understanding of plant and animal populations and interactions.

GLO: A1, A2, A4, C8

Grade 4, Cluster 2: Light

Overview

In previous grades, students had an informal introduction to energy. In this cluster, students begin to examine in more depth one form of energy they encounter on a daily basis — light. In *Grade 4, Cluster 3: Sound*, students study another aspect of energy — sound. Whether these clusters are addressed separately or as part of a combined unit, the emphasis is on building an understanding of energy. Students become familiar with the properties of light by investigating and observing how light interacts with various objects in the environment. From these observations, students come to recognize that light travels in a straight line, knowledge which they will apply, along with their design-process skills, to the construction of simple optical devices.

Students will…

4-2-01 Use appropriate vocabulary related to their investigations of light.

Include: energy, reflect, absorb, transmit, artificial, light beam, transparent, translucent, opaque, technological development, science, brightness.

GLO: A5, B1, C6, D4

4-2-02 Give examples of various forms of energy.

Include: light, heat, food, sound.

GLO: D4, E4

4-2-03 Recognize that energy is an integral part of daily life.

GLO: B1, D4, E4

4-2-04 Demonstrate that white light can be separated into colours.

GLO: C2, D4

4-2-05 Distinguish between objects that produce their own light and those that reflect light from another source.

Examples: the Sun emits its own light, the Moon reflects light from the Sun...

GLO: A1, A2, D4

4-2-06 Identify a variety of natural and artificial light sources.

Examples: Sun, candle, light bulb, firefly, lightning, aurora borealis, lasers...

GLO: D4

4-2-07 Observe and describe properties of light.

Include: travels in a straight path, bends as it passes from one medium to another, can be reflected, can be different colours.

GLO: C2, D4

4-2-08 Explore to determine effects different materials and objects have on a light beam.

Examples: prisms and water bend light; some lenses intensify light, whereas others disperse light...

GLO: C2, D3, D4

4-2-09 Recognize that most objects that produce light also give off heat, and identify objects that produce light but give off little or no heat.

GLO: D4

4-2-10 Classify materials as transparent, translucent, or opaque.

GLO: D3, E1

4-2-11 Evaluate the usefulness of a material for a particular task based on its ability to transmit, reflect, or absorb light.

Examples: usefulness of coloured glass to preserve food and drink by protecting them from light...

GLO: A5, B1, D3

4-2-12 Predict the location, shape, and size of a shadow based on the position of a light source relative to an object.

GLO: C2, D4

4-2-13 Identify technological developments that extend our ability to see, and recognize their impact on science.

Examples: the telescope allows astronomers to obtain new information...

GLO: A5, B1

4-2-14 Use the design process to construct a device that transmits and reflects light.

Examples: periscope, kaleidoscope...

GLO: B1, C3

4-2-15 Describe practices that help ensure protection of eyes and sight.

Examples: direct mirrors away from the eyes when reflecting intense light sources...

GLO: B3, C1

4-2-16 Identify different uses of light at home, at school, and in the community, and explain how the brightness and colour of the light are appropriate for each use.

Examples: vivid neon lights for advertising, blue lights for snow removal vehicles...

GLO: B1, B3, C1

Grade 4, Cluster 3: Sound

Overview

In this cluster, students expand their concept of energy by examining sound. This cluster complements the study of another common form of energy – light, which is addressed in *Grade 4, Cluster 2: Light*. Sound is a phenomenon that can be observed, measured, and controlled in various ways. Understanding that sound is caused by vibrations helps students when they explore how sound travels, how the human ear is designed to detect sound, and how certain factors can modify the sound produced. The varying abilities of humans and other animals to detect sound is also examined, which, in turn, leads to discussions about the necessity of protecting one's sense of hearing. By investigating materials to ascertain whether they transmit, absorb, or reflect sound, students learn how these characteristics influence a material's function. Students also explore the role of technology in extending one's ability to produce, transmit, and detect sound.

Students will…

4-3-01 Use appropriate vocabulary related to their investigations of sound.

Include: energy, sound, vibration, vocal cords, pitch, loudness, sound waves, outer ear, middle ear, inner ear, brain, transmit, absorb, reflect, detect.

GLO: B1, C6, D4

4-3-02 Recognize that sound is a form of energy.

GLO: D4, E4

4-3-03 Recognize that energy makes things happen and can be found all around us.

GLO: D4, E4

4-3-04 Identify and classify various sounds using student-generated criteria.

GLO: C2, D4

4-3-05 Recognize that sounds are caused by vibrations.

Include: the human voice relies on the vibrations of vocal cords.

GLO: D3, D4

4-3-06 Use the design process to create a musical instrument.

GLO: C3, C5, D4, E2

4-3-07 Demonstrate how the pitch and loudness of sounds can be modified.

Examples: differences in sound when plucking a loose rubber band vs. a stretched rubber band...

GLO: C2, D3, D4, E3

4-3-08 Observe and describe properties of sound.

Include: travels in waves in all directions.

GLO: C2, D4

4-3-09 Describe how the human ear is designed to detect sound vibrations.

Include: sound is transmitted from the outer ear to the middle ear and the inner ear, which relays messages to the brain.

GLO: D1, D4

4-3-10 Recognize that there is a range of sounds that humans can and cannot hear.

GLO: D1

4-3-11 Describe practices that help ensure protection of the ears and hearing.

Examples: use of ear plugs in situations involving excessive noise...

GLO: B3, C1

4-3-12 Describe harmful effects of high or sustained sound levels and identify potential sound hazards at home or in the community.

Examples: leaf blowing machines, snowblower, stereo, drone of machinery...

GLO: B1, B3, C1

4-3-13 Investigate to compare how vibrations travel differently through solids, liquids, and gases.

GLO: C2, D3, E1

4-3-14 Explore to determine the ability of materials to transmit or absorb sound.

GLO: C2, D3, E1

4-3-15 Describe how materials that absorb or reflect sound are used in different situations.

Examples: concrete sound barriers are placed beside highways to absorb sound...

GLO: B1, C1, D3

4-3-16 Describe devices that extend our ability to produce, transmit, and detect sound.

Examples: amplifier, hearing aids, megaphone, ear trumpet...

GLO: B1

4-3-17 Investigate to identify inventions related to sound, and describe their impacts on society.

Examples: radio, telephone, microphone...

GLO: A4, B1, B2

4-3-18 Describe the role of sound in different jobs and hobbies.

Examples: physician listens to a patient's heartbeat during a check-up, birders identify birds by their calls...

GLO: B4

Grade 4, Cluster 4: Rocks, Minerals, and Erosion

Overview

The study of rocks and minerals introduces students to geology. By examining various rocks and minerals found in the Earth's crust, students learn about their characteristics and properties. These characteristics and properties determine how these rocks and minerals are used by humans. Students discover the role rocks play in forming soil (see *Grade 3, Cluster 4: Soils in the Environment*) and in providing us with information about Earth's history. Students advance their understanding of the changing landscape by becoming aware of how wind, water, and ice continue to reshape it through erosion. This leads students to explore ways in which humans can adapt to and prevent or make changes in the landscape.

Students will…

4-4-01 Use appropriate vocabulary related to their investigations of rocks, minerals, and erosion.

Include: rock, mineral, characteristic, property, scratch test, streak test, igneous, sedimentary, metamorphic, fossil, organism, extinct, soil formation, erosion, natural phenomena.

GLO: C6, D5

4-4-02 Classify rocks and minerals according to student-generated criteria.

GLO: C2, D3, D5

4-4-03 Test to determine characteristics of rocks and properties of minerals, and classify accordingly.

Include: scratch test for hardness, streak test for colour.

GLO: A1, C2, D3, D5

4-4-04 Differentiate between minerals and rocks.

Include: minerals are composed of the same substance throughout, rocks are composed of two or more minerals..

GLO: D5

4-4-05 Compare rocks and minerals from the local environment with each other and with those from other geological areas.

GLO: C2, D5, E1

4-4-06 Give examples of products derived from rocks and minerals.

Examples: china, chalk, jewellery, pumice stone, drywall, talcum powder...

GLO: B1

4-4-07 Describe how characteristics of rocks and properties of minerals determine their uses.

Examples: soft soapstone is used for carving...

GLO: B1, D3, D5

4-4-08 Recognize that there are three types of rock, and describe how each is formed.

Include: igneous, sedimentary, metamorphic.

GLO: D5

4-4-09 Explain how fossils are formed.

GLO: D1, D5, E3

4-4-10 Describe how fossils help humans gain a better understanding of Earth's history, including identifying organisms that are now extinct.

GLO: A1, A2, D1, D5

4-4-11 Investigate and describe ways in which rock contributes to soil formation.

GLO: D5, E2, E3

4-4-12 Investigate and describe ways in which soil erosion is controlled or minimized in their community and in communities around the world.

Examples: windbreaks, retaining walls, terracing, cover crops, reforestation...

GLO: A5, B1, B5

4-4-13 Use the design process to determine an appropriate system for controlling soil erosion in a given situation.

GLO: B1, B5, C3, E3

4-4-14 Describe effects of wind, water, and ice on the landscape.

Examples: ice breaking rocks into soil, wind shaping sand dunes, waves polishing rocks on the shoreline...

GLO: D5, E3

4-4-15 Identify natural phenomena and human activities that cause significant changes in the landscape.

Examples: floods, avalanches, mud slides, hydroelectric dams, clearing land for agriculture, clear-cut forestry, forest fires...

GLO: B5, D5, E3

Appendix

General Learning Outcomes

The purpose of Manitoba science curricula is to impart to students a measure of scientific literacy that will assist them in becoming informed, productive, and fulfilled members of society. As a result of their Early, Middle, and Senior Years science education Manitoba students will be able to:

Nature of Science and Technology

A1. recognize both the power and limitations of science as a way of answering questions about the world and explaining natural phenomena

A2. recognize that scientific knowledge is based on evidence, models and explanations, and evolves as new evidence appears and new conceptualizations develop

A3. distinguish critically between science and technology in terms of their respective contexts, goals, methods, products, and values

A4. identify and appreciate contributions made by women and men from many societies and cultural backgrounds towards increasing our understanding of the world and in bringing about technological innovations

A5. recognize that science and technology interact with and advance one another

Science, Technology, Society, and the Environment (STSE)

B1. describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies, and the environment, both locally and globally.

B2. recognize that scientific and technological endeavors have been and continue to be influenced by human needs and the societal context of the time

B3. identify the factors that affect health and explain the relationships among personal habits, lifestyle choices, and human health, both individual and social

B4. demonstrate a knowledge of, and personal consideration for, a range of possible science- and technology-related interests, hobbies, and careers

B5. identify and demonstrate actions that promote a sustainable environment, society, and economy, both locally and globally

Scientific and Technological Skills and Attitudes

C1. recognize safety symbols and practices related to scientific and technological activities and to their daily lives, and apply this knowledge in appropriate situations

C2. demonstrate appropriate scientific inquiry skills when seeking answers to questions

C3. demonstrate appropriate problem-solving skills while seeking solutions to technological challenges

C4. demonstrate appropriate critical thinking and decision-making skills when choosing a course of action based on scientific and technological information

C5. demonstrate curiosity, skepticism, creativity, open-mindedness, accuracy, precision, honesty, and persistence, and appreciate their importance as scientific and technological habits of mind

C6. employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data

C7. work cooperatively and value the ideas and contributions of others while carrying out scientific and technological activities

C8. evaluate, from a scientific perspective, information and ideas encountered during investigations and in daily life

Essential Science Knowledge

D1. understand essential life structures and processes pertaining to a wide variety of organisms, including humans

D2. understand various biotic and abiotic components of ecosystems, as well as their interaction and interdependence within ecosystems and within the biosphere as a whole

D3. understand the properties and structures of matter as well as various common manifestations and applications of the actions and interactions of matter

D4. understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts

D5. understand the composition of the Earth's atmosphere, hydrosphere, and lithosphere, as well as the processes involved within and among them

D6. understand the composition of the universe, the interactions within it, and the impacts of humankind's continued attempts to understand and explore it

Unifying Concepts

E1. describe and appreciate the similarity and diversity of forms, functions, and patterns within the natural and constructed world

E2. describe and appreciate how the natural and constructed world is made up of systems and how interactions take place within and among these systems

E3. recognize that characteristics of materials and systems can remain constant or change over time, and describe the conditions and processes involved

E4. recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them

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