Grades 5 to 8
Science

Manitoba Curriculum
Framework of Outcomes

Manitoba
Education
and Training

GRADES 5 TO 8
SCIENCE

Manitoba Curriculum Framework of Outcomes

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Introduction

Background

The ***Grades 5 to 8 Science: Manitoba Curriculum Framework of Outcomes*** (2000) (hereinafter referred to as the *Science Framework*) presents student learning outcomes for Grade 5 to Grade 8 science. These learning outcomes are the same for students in English, French Immersion, and Français programs and result from a partnership involving two divisions of Manitoba Education and Training: School Programs and Bureau de l'éducation française. Manitoba's 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 learning for teachers. *Grades 5 to 8 Science: A Foundation for Implementation* (2000) will complement 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 to 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 student learning outcomes and establish performance criteria. It is important that these criteria correspond with provincial student 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 learning 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.

Notes

Grades 5 to 8
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 the 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 J. Désautels,* 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.

Scientific theories 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.

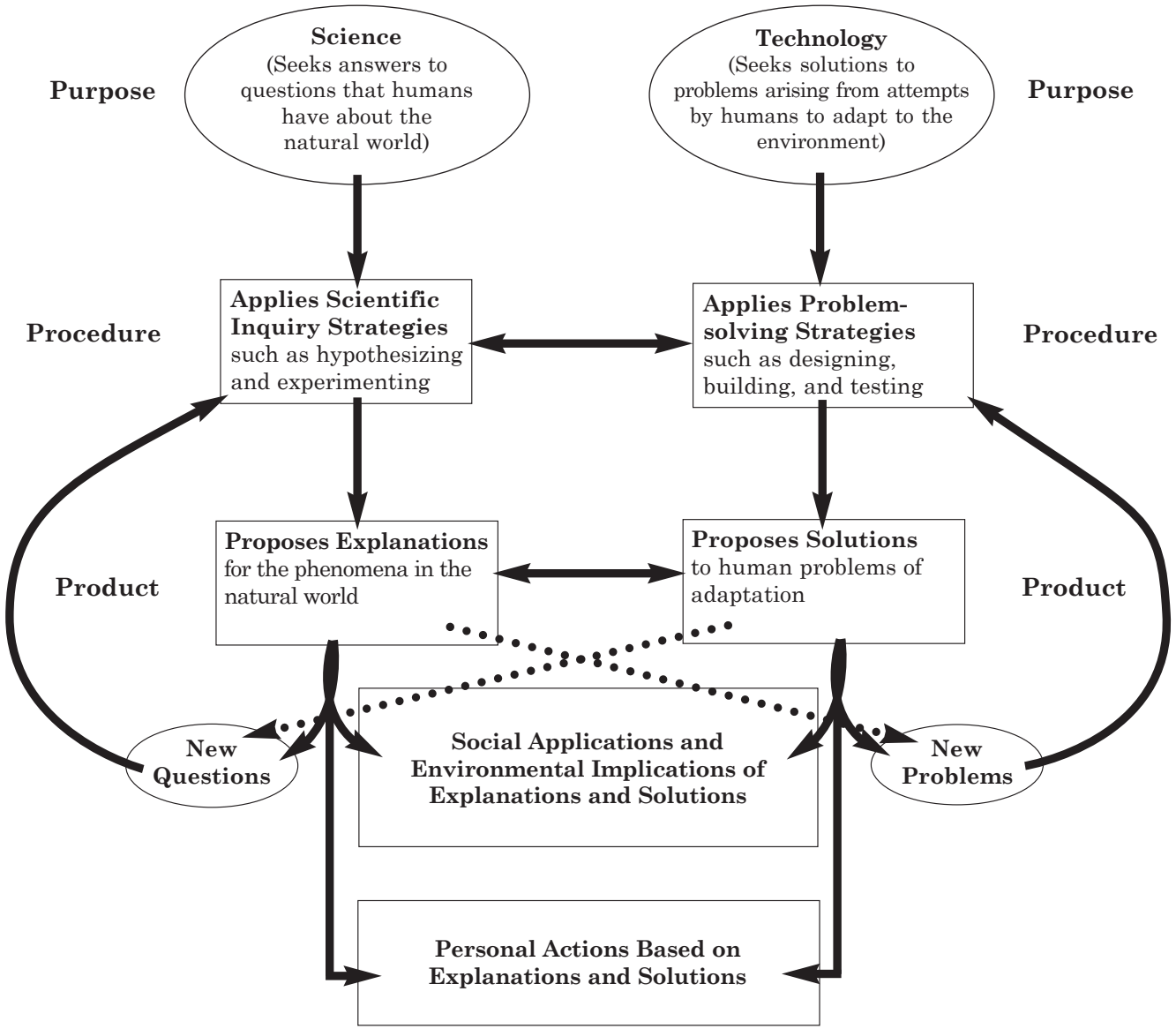


Figure 1: Science and Technology: Their Nature and Relationship

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 science GLOs, see Appendix 1.)

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, most 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).

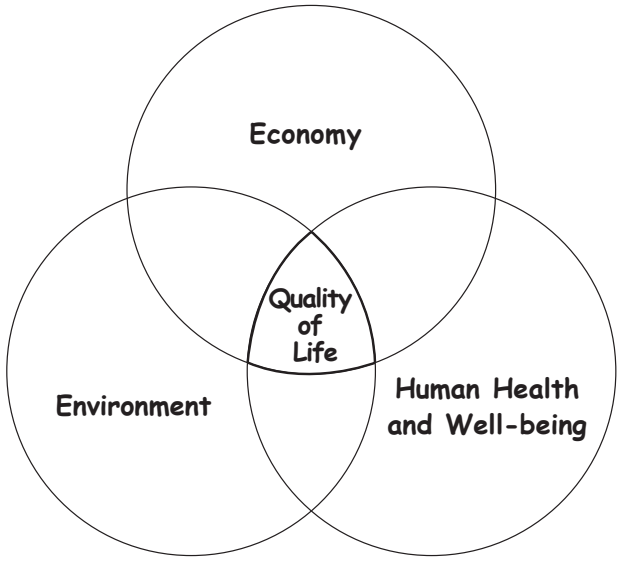


Figure 2: Sustainable Development

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 science GLOs see Appendix 1.)

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?	How can I keep my coffee hot?	Should we use styrofoam cups or ceramic mugs for our meeting?
	An Answer: Heat energy is transferred by conduction, convection, and radiation.	*A Solution:* A styrofoam cup will keep liquids warm for a long time.	*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 Learning, 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, planning experiments, collecting, analyzing, 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 analyzing 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 (Design Process)

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 proposing, creating, and testing of prototypes, and the evaluation of consumer 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 science GLOs, see Appendix 1).

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 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 the study of organisms (including humans), ecosystems, biodiversity, cells, 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 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 science GLOs, see Appendix 1.)

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

Energy, as a concept, 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 science GLOs see Appendix 1.)

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 following conceptual organizer (see Figure 4) summarizes the relationships among the Manitoba Foundations for Scientific Literacy and shows how they are translated into general and specific student learning outcomes at Kindergarten to Senior 4.

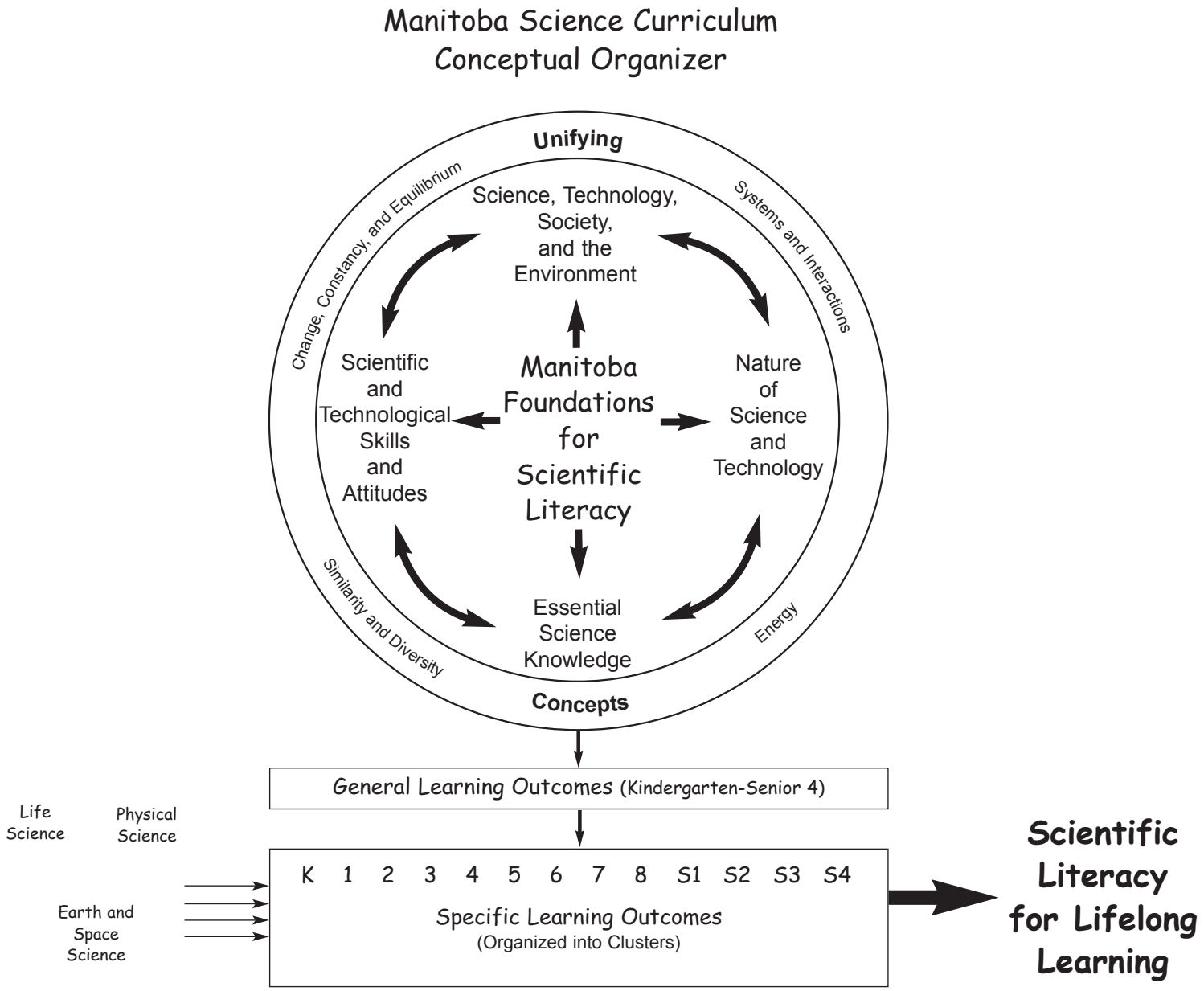


Figure 4: Manitoba Science Curriculum Conceptual Organizer

Notes

Grades 5 to 8
Specific Learning Outcomes

Specific Learning Outcomes

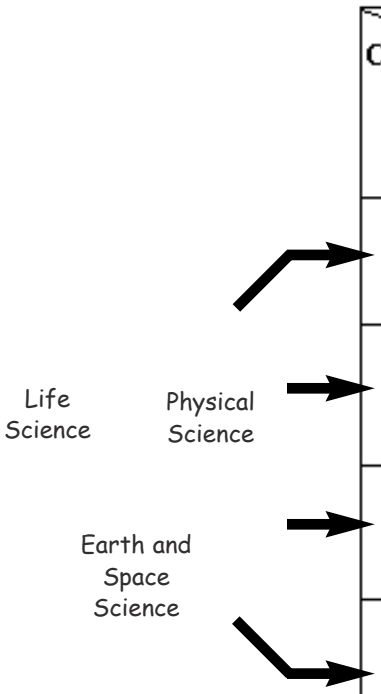
Organization into Clusters

This *Science Framework* presents specific learning outcomes (SLOs) for Grades 5 to 8 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 0 comprises Overall Skills and Attitudes. Cluster titles for Grades 5 to 8 science are presented in Figure 5. Cluster titles for Kindergarten to Grade 4 science, and for Senior 1 science are presented in Appendix 2.

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. *Grades 5 to 8 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 Grades 5 to 8 chart (separate attachment). The purpose of this chart is to assist teachers in tracking the development of skills and attitudes across several grades.

Additional copies of these posters are available from the Manitoba Text Book Bureau (MTBB stock # 80366). *Senior 1 Science at a Glance — Thematic Chart* is also available (MTBB stock # 80367).



Grades / Clusters	Grade 5	Grade 6	Grade 7	Grade 8
Cluster 0	Overall Skills and Attitudes (to be integrated into Clusters 1 to 4)			
Cluster 1	Maintaining a Healthy Body	Diversity of Living Things	Interactions within Ecosystems	Cells and Systems
Cluster 2	Properties of and Changes in Substances	Flight	Particle Theory of Matter	Optics
Cluster 3	Forces and Simple Machines	Electricity	Forces and Structures	Fluids
Cluster 4	Weather	Exploring the Solar System	Earth's Crust	Water Systems

Figure 5: Cluster Titles

Guide to Reading Science Specific Learning Outcomes

Each cluster is presented on a series of facing pages. The following pages provide examples of the Cluster 0 format and the Clusters 1 to 4 format.

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

Icon (⊂) indicates an outcome that appeared in a previous grade: students are expected to apply their learning in new contexts

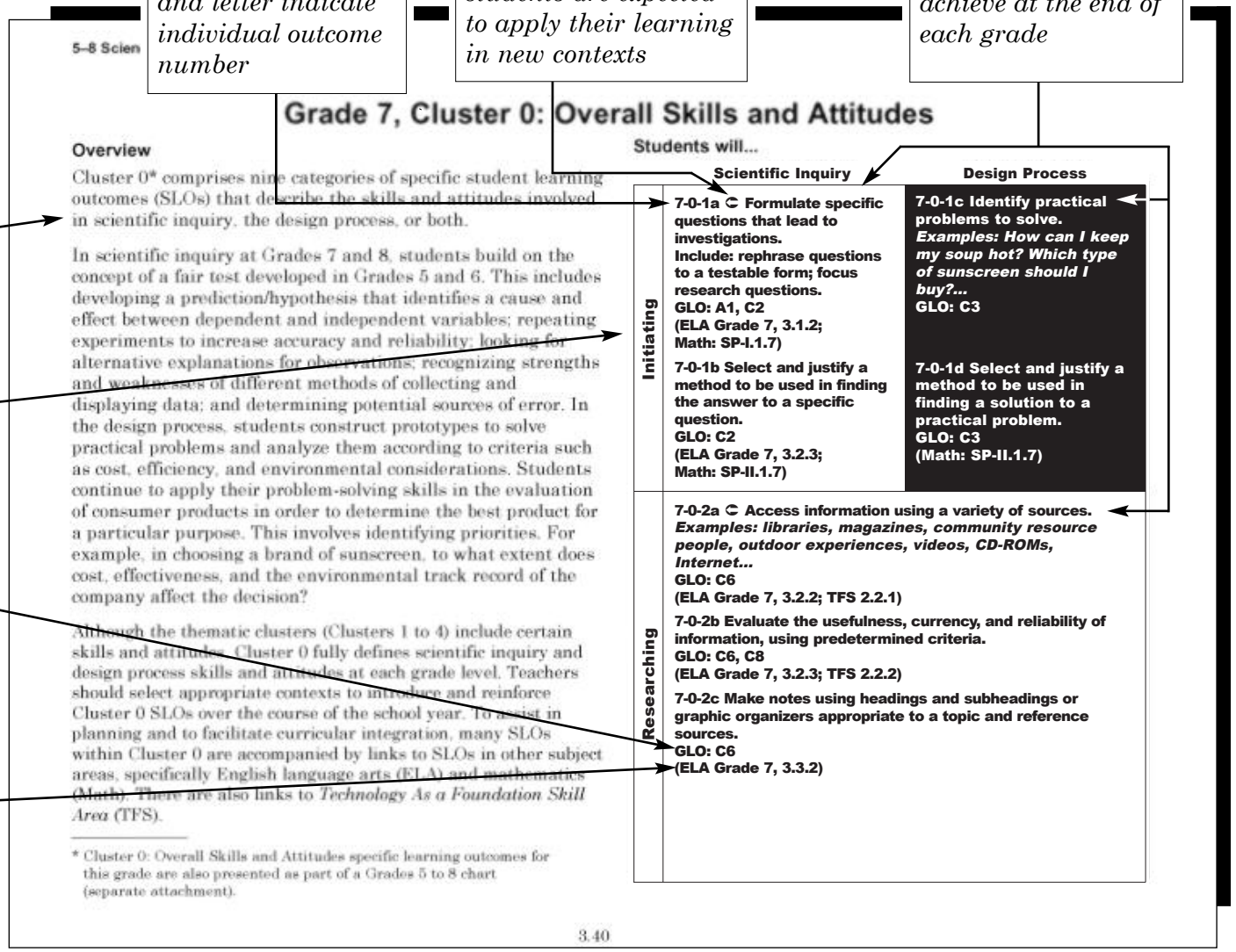
Specific learning outcome statements define what students are expected to achieve at the end of each grade

Describes general content and emphasis of cluster

Indicates organizational category of skills/attitudes

Cross-reference to general learning outcomes

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



5–8 Scien

Grade 7, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0* comprises nine categories of specific student learning outcomes (SLOs) that describe the skills and attitudes involved in scientific inquiry, the design process, or both.

In scientific inquiry at Grades 7 and 8, students build on the concept of a fair test developed in Grades 5 and 6. This includes developing a prediction/hypothesis that identifies a cause and effect between dependent and independent variables; repeating experiments to increase accuracy and reliability; looking for alternative explanations for observations; recognizing strengths and weaknesses of different methods of collecting and displaying data; and determining potential sources of error. In the design process, students construct prototypes to solve practical problems and analyze them according to criteria such as cost, efficiency, and environmental considerations. Students continue to apply their problem-solving skills in the evaluation of consumer products in order to determine the best product for a particular purpose. This involves identifying priorities. For example, in choosing a brand of sunscreen, to what extent does cost, effectiveness, and the environmental track record of the company affect the decision?

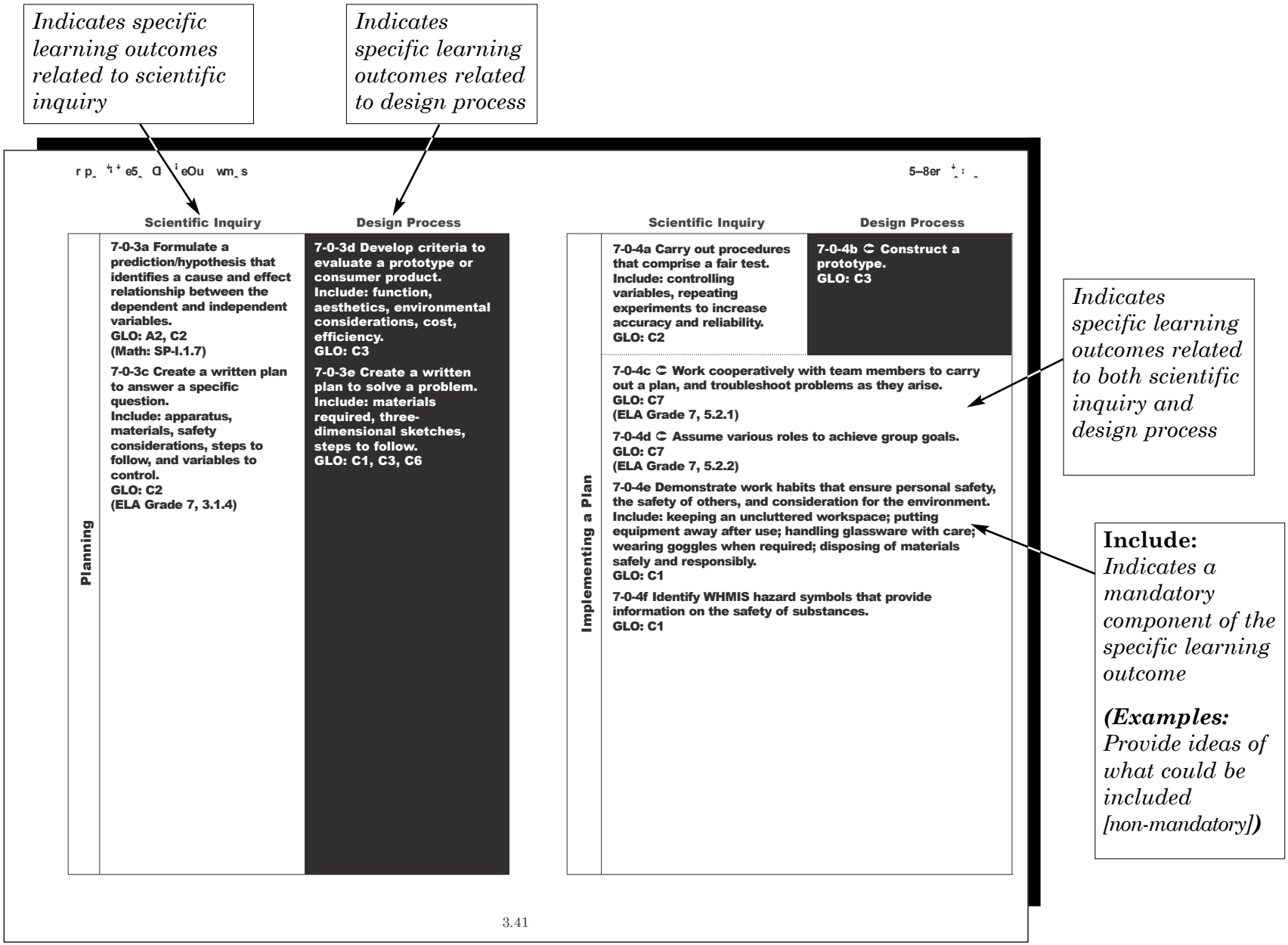
Although the thematic clusters (Clusters 1 to 4) include certain skills and attitudes, Cluster 0 fully defines scientific inquiry and design process skills and attitudes at each grade level. Teachers should select appropriate contexts to introduce and reinforce Cluster 0 SLOs over the course of the school year. To assist in planning and to facilitate curricular integration, many SLOs within Cluster 0 are accompanied by links to SLOs 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 Grades 5 to 8 chart (separate attachment).

Students will...

	Scientific Inquiry	Design Process
Initiating	7-0-1a ⊂ Formulate specific questions that lead to investigations. Include: rephrase questions to a testable form; focus research questions. GLO: A1, C2 (ELA Grade 7, 3.1.2; Math: SP-I.1.7)	7-0-1c Identify practical problems to solve. *Examples: How can I keep my soup hot? Which type of sunscreen should I buy?...* GLO: C3
	7-0-1b Select and justify a method to be used in finding the answer to a specific question. GLO: C2 (ELA Grade 7, 3.2.3; Math: SP-II.1.7)	7-0-1d Select and justify a method to be used in finding a solution to a practical problem. GLO: C3 (Math: SP-II.1.7)
Researching	7-0-2a ⊂ Access information using a variety of sources. *Examples: libraries, magazines, community resource people, outdoor experiences, videos, CD-ROMs, Internet...* GLO: C6 (ELA Grade 7, 3.2.2; TFS 2.2.1)	
	7-0-2b Evaluate the usefulness, currency, and reliability of information, using predetermined criteria. GLO: C6, C8 (ELA Grade 7, 3.2.3; TFS 2.2.2)	
	7-0-2c Make notes using headings and subheadings or graphic organizers appropriate to a topic and reference sources. GLO: C6 (ELA Grade 7, 3.3.2)	

3.40


Indicates specific learning outcomes related to scientific inquiry
Indicates specific learning outcomes related to design process
Scientific Inquiry
Design Process
Planning
7-0-3a Formulate a prediction/hypothesis that identifies a cause and effect relationship between the dependent and independent variables.
GLO: A2, C2
(Math: SP-I.1.7)
7-0-3c Create a written plan to answer a specific question.
Include: apparatus, materials, safety considerations, steps to follow, and variables to control.
GLO: C2
(ELA Grade 7, 3.1.4)
7-0-3d Develop criteria to evaluate a prototype or consumer product.
Include: function, aesthetics, environmental considerations, cost, efficiency.
GLO: C3
7-0-3e Create a written plan to solve a problem.
Include: materials required, three-dimensional sketches, steps to follow.
GLO: C1, C3, C6
Scientific Inquiry
Design Process
Implementing a Plan
7-0-4a Carry out procedures that comprise a fair test.
Include: controlling variables, repeating experiments to increase accuracy and reliability.
GLO: C2
7-0-4b ⊂ Construct a prototype.
GLO: C3
7-0-4c ⊂ Work cooperatively with team members to carry out a plan, and troubleshoot problems as they arise.
GLO: C7
(ELA Grade 7, 5.2.1)
7-0-4d ⊂ Assume various roles to achieve group goals.
GLO: C7
(ELA Grade 7, 5.2.2)
7-0-4e Demonstrate work habits that ensure personal safety, the safety of others, and consideration for the environment.
Include: keeping an uncluttered workspace; putting equipment away after use; handling glassware with care; wearing goggles when required; disposing of materials safely and responsibly.
GLO: C1
7-0-4f Identify WHMIS hazard symbols that provide information on the safety of substances.
GLO: C1
Indicates specific learning outcomes related to both scientific inquiry and design process
Include:
Indicates a mandatory component of the specific learning outcome
(Examples:
Provide ideas of what could be included [non-mandatory])
3.41

Specific learning outcome statements define what students are expected to achieve at the end of each grade

5–8 Science Specific Learning Outcomes

Grade 6, Cluster 3: Electricity

Describes general content and emphasis of cluster

Overview

In this cluster, students explore current and static electricity and compare and contrast the characteristics of each. These explorations help students identify and appreciate the importance of electricity in everyday life including the need for safe practices when using electricity. Students have the opportunity to apply their knowledge of series and parallel circuits in the construction of a prototype that performs a specific function. They demonstrate how electricity can be transformed into motion, and motion into electricity. Students also identify other types of transformations that can take place. Students discuss advantages and disadvantages of various renewable and non-renewable sources of electrical energy, and recognize the importance of energy conservation. The creation of an action plan to help reduce electrical energy consumption helps students understand the impacts they can make.

Students will

6-3-01 Use appropriate vocabulary related to their investigations of electricity.

Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.

GLO: C6, D4, E4

6-3-02 Explain the attraction and repulsion of electrostatically charged materials.

Include: negatively and positively charged materials attract one another; materials of like charge repel one another.

GLO: D4

6-3-03 Explain current electricity, and compare the characteristics of current and static electricity by using a model.

GLO: A2, D4

6-3-04 Identify dangers associated with static and current electricity, and demonstrate and describe appropriate safety precautions.

GLO: C1, D4

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

Cross-reference to general learning outcomes

3.32

Specific Learning Outcomes 5–8 Science

6-3-05 List electrical devices used at home, at school, and in the community, and identify the human needs that they fulfill.

Examples: heat, light, communication, movement...

GLO: B1, B2, D4

6-3-06 Develop a definition of an electrical circuit, based on classroom explorations.

Include: an electrical circuit is a continuous path for charges and must contain a power source and a conductor.

GLO: C2, D4

6-3-07 Experiment to classify a variety of materials as insulators or conductors.

GLO: C2, D3, D4, E1

6-3-08 Demonstrate and describe the function of switches in electrical circuits.

GLO: D4

6-3-09 Construct and diagram simple series circuits and simple parallel circuits.

GLO: C2, C6, D4, E1

6-3-10 Explore to determine factors that affect bulb brightness in simple series and parallel circuits.

Include: number of bulbs, number of batteries, placement of bulbs and batteries.

GLO: C2, D4

6-3-11 Use the design process to construct an electrical circuit that performs a useful function.

Examples: doorbell, alarm, motorized toy, game...

GLO: C3, D4

6-3-12 Demonstrate, using a simple electromagnet constructed in class, that an electric current can create a magnetic field.

GLO: C2, D4

6-3-13 Explore motors and generators to determine that electromagnets transform electricity into motion, and motion into electricity.

GLO: A5, D4, E2, E4

6-3-14 Identify forms of energy that may result from the transformation of electrical energy, and recognize that energy can only be changed from one form into another, not created or destroyed.

Include: light, heat, sound, motion.

GLO: D4, E4

6-3-15 Identify the two major sources of electrical energy, and provide examples of each.

Include: chemical sources such as batteries; electromagnetic sources such as turbine motion caused by wind, falling water, and steam.

GLO: B1, D4, E4

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

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

Grade 5, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0* comprises nine categories of specific student learning outcomes (SLOs) that describe the skills and attitudes involved in scientific inquiry, the design process, or both.

In scientific inquiry at Grades 5 and 6, students begin to develop the concept of a fair test. This includes developing a prediction/hypothesis that identifies a cause and effect relationship; controlling variables; repeating measurements to increase accuracy and reliability; and drawing conclusions that support or reject their initial predictions/hypotheses. In the design process, students continue to identify and address practical problems through the construction of a prototype. Increasingly sophisticated criteria are used to analyze a prototype, including use of recycled materials, cost, and reliability. Students begin to apply their problem-solving skills in the evaluation of consumer products based on identified criteria in order to determine the best product for a specific purpose. For example, in choosing between pre-packaged pizzas, the various factors of cost, nutritional value, and packaging may influence students' evaluation of the product.

Although the thematic clusters (Clusters 1 to 4) include certain skills and attitudes, Cluster 0 fully defines scientific inquiry and design process skills and attitudes at each grade level. Teachers should select appropriate contexts to introduce and reinforce Cluster 0 SLOs over the course of the school year. To assist in planning and to facilitate curricular integration, many SLOs within Cluster 0 are accompanied by links to SLOs in other subject areas, specifically English language arts (ELA) and mathematics (Math). There are also links to *Technology As a Foundation Skill Area* (TFS).

Students will...

	Scientific Inquiry	Design Process
Initiating	**5-0-1a Formulate, with guidance, specific questions that lead to investigations. Include: rephrase questions to a testable form, focus research questions. GLO: A1, C2 (ELA Grade 5, 3.1.1; Math: SP-I.1.5)** **5-0-1b Identify various methods for finding the answer to a specific question and, with guidance, select one to implement.** ***Examples: generating experimental data; accessing information from a variety of sources...*** **GLO: C2 (ELA Grade 5, 3.2.2; Math: SP-II.1.5)**	**5-0-1c Identify practical problems to solve.** ***Examples: How can I determine the mass of air? Which prepared pizza should I buy?...*** **GLO: C3** **5-0-1d Identify various methods to solve a practical problem, and select and justify one to implement.** ***Examples: constructing and testing a prototype; evaluating consumer products; accessing information from a variety of sources...*** **GLO: C3 (Math: SP-II.1.5)**
Researching	**5-0-2a Access information using a variety of sources.** ***Examples: libraries, magazines, community resource people, outdoor experiences, videos, CD-ROMs, Internet...*** **GLO: C6 (ELA Grade 5, 3.2.3; Math: SP-II.3.1)** **5-0-2b Review information to determine its usefulness, using predetermined criteria. GLO: C6, C8** **5-0-2c Record information in own words and reference sources appropriately. GLO: C6 (ELA Grade 5, 3.3.2)**	

* Cluster 0: Overall Skills and Attitudes are also presented as part of a Grades 5 to 8 chart (separate attachment).

	Scientific Inquiry	Design Process
Planning	**5-0-3a Formulate, with guidance, a prediction/hypothesis that identifies a cause and effect relationship.** **GLO: A2, C2 (Math: SP-I.1.5)**	
	5-0-3b Identify variables that might have an impact on their experiments and, with guidance, variables to hold constant to ensure a fair test. **GLO: A2, C2**	**5-0-3d Develop criteria to evaluate a prototype or consumer product.** **Include: function, aesthetics, use of recycled materials, cost, reliability.** **GLO: C3**
	5-0-3c Create a written plan to answer a specific question. **Include: apparatus, materials, safety considerations, steps to follow.** **GLO: C2 (ELA Grade 5, 3.1.4)**	**5-0-3e Create a written plan to solve a problem.** **Include: materials, safety considerations, labelled diagrams of top and side views, steps to follow.** **GLO: C1, C3, C6**
Implementing a Plan	**5-0-4a Carry out, with guidance, procedures that comprise a fair test.** **Include: controlling variables, repeating measurements to increase accuracy and reliability.** **GLO: C2**	**5-0-4b Construct a prototype.** **GLO: C3**
	5-0-4c Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. **GLO: C7 (ELA Grade 5, 5.2.2)**	
	5-0-4d Assume various roles and share responsibilities as group members. **GLO: C7 (ELA Grade 5, 5.2.2)**	
	5-0-4e Use tools and materials in a manner that ensures personal safety and the safety of others. **Include: keeping an uncluttered workspace; putting equipment away after its use; handling glassware with care.** **GLO: C1**	

	Scientific Inquiry	Design Process
Observing, Measuring, Recording	**5-0-5a Make observations that are relevant to a specific question.** **GLO: A1, A2, C2**	**5-0-5b Test a prototype or consumer product, using predetermined criteria.** **GLO: C3, C5**
	5-0-5c Select and use tools and instruments to observe, measure, and construct. **Include: balance, thermometer, spring scale, weather instruments.** **GLO: C2, C3, C5**	
	5-0-5d Evaluate the appropriateness of units and measuring tools in practical contexts. **GLO: C2, C5 (Math: SS-I.1.5)**	
	5-0-5e Estimate and measure mass/weight, length, volume, and temperature using SI and other standard units. **GLO: C2, C5** **(Math: SS-IV.1.5, SS-III.1.5, SS-I.1.5, SS-VIII.4.3)**	
	5-0-5f Record and organize observations in a variety of ways. ***Examples: point-form notes, sentences, labelled diagrams, charts, ordered lists of data, frequency diagrams, spread sheets...***	
Analyzing and Interpreting	**5-0-6a Construct graphs to display data, and interpret and evaluate these and other graphs.** ***Examples: bar graphs, frequency tallies, line plots, broken line graphs...*** **GLO: C2, C6 (ELA Grade 5, 3.3.1; Math: SP-II.1.5, SP-III.2.5, SP-IV.1.5; TFS: 4.2.2–4.2.6)**	**5-0-6d Identify and make improvements to a prototype, and explain the rationale for the changes.** **GLO: C3, C4**
	5-0-6c Identify and suggest explanations for patterns and discrepancies in data. **GLO: A1, A2, C2, C5**	**5-0-6e Evaluate the strengths and weaknesses of a consumer product, based on predetermined criteria.** **GLO: C3, C4**
	5-0-6f Evaluate the methods used to answer a question or solve a problem. GLO: C2, C3 (ELA Grade 5, 3.3.4)	

Students will...

Concluding and Applying

Scientific Inquiry	Design Process
5-0-7a Draw, with guidance, a conclusion that explains investigation results. Include: explaining patterns in data; supporting or rejecting a prediction/hypothesis. GLO: A1, A2, C2 (ELA Grade 5, 3.3.4)	**5-0-7d Propose and justify a solution to the initial problem. GLO: C3**
5-0-7b Base conclusions on evidence rather than pre-conceived ideas or hunches. GLO: C2, C4	
5-0-7c Identify, with guidance, a new prediction/hypothesis, based on investigation results. GLO: A1, C2 (ELA Grade 5, 3.3.4)	**5-0-7e Identify new practical problems to solve. GLO: C3**

5-0-7f Use prior knowledge and experiences selectively to make sense of new information in a variety of contexts. GLO: A2, C4 (ELA Grade 5, 1.2.1)

5-0-7g Communicate methods, results, conclusions, and new knowledge in a variety of ways. *Examples: oral, written, multimedia presentations...* GLO: C6 (ELA Grade 5, 4.4.1; TFS: 3.2.2, 3.2.3)

5-0-7h Identify, with guidance, potential applications of investigation results. GLO: C4

Reflecting on Science and Technology

Scientific Inquiry	Design Process
5-0-8a Recognize that science is a way of answering questions about the world and that there are questions that science cannot answer. GLO: A1, A3	**5-0-8c Recognize that technology is a way of solving problems in response to human needs. GLO: A3, B2**
5-0-8b Identify examples of scientific knowledge that have developed as a result of the gradual accumulation of evidence. GLO: A2	**5-0-8d Provide examples of technologies from the past and describe how they have evolved over time. GLO: B1**

5-0-8e Describe hobbies and careers related to science and technology. GLO: B4

5-0-8f Recognize that science is organized into specialized disciplines. GLO: A1, B4

5-0-8g Describe positive and negative effects of scientific and technological endeavours. Include: effects on themselves, society, the environment, and the economy. GLO: A1, B1, B3, B5

	Scientific Inquiry	Design Process
Demonstrating Scientific and Technological Attitudes	**5-0-9a Appreciate that women and men of diverse cultural backgrounds can contribute equally to science.** **GLO: A4** **5-0-9b Show interest in the activities of individuals working in scientific and technological fields.** **GLO: B4** **5-0-9c Demonstrate confidence in their ability to carry out investigations.** **GLO: C5** **5-0-9d Appreciate the importance of creativity, accuracy, honesty, and perseverance as scientific and technological habits of mind.** **GLO: C5** **5-0-9e Be sensitive to and develop a sense of responsibility for the welfare of other humans, other living things, and the environment.** **GLO: B5** **5-0-9f Frequently and thoughtfully evaluate the potential consequences of their actions.** **GLO: B5, C4**	

Grade 5, Cluster 1: Maintaining a Healthy Body

Overview

The study of the human body at Grade 5 focusses on the maintenance of good health. Students learn about the role that nutrients play, and how to plan balanced and nutritious meals using *Canada's Food Guide to Healthy Eating*. Students gain experience in interpreting nutritional information on food labels, and in evaluating images presented by the media. A study of the major body systems and their role in the healthy functioning of the human body helps students to appreciate the nature and function of each, and the interrelationships that exist between systems. Students explore how lifestyle choices and environmental factors can affect personal health.

Students will…

5-1-01 Use appropriate vocabulary related to their investigations of human health.

Include: nutrients; carbohydrates; proteins; fats; vitamins; minerals; *Canada's Food Guide to Healthy Eating*; food group; serving size; terms related to the digestive, skeletal, muscular, nervous, integumentary, respiratory, and circulatory systems.

GLO: B3, C6, D1

5-1-02 Interpret nutritional information found on food labels.

Examples: ingredient proportions, identification of potential allergens, information related to energy content and nutrients...

GLO: B3, C4, C5, C8

5-1-03 Describe the types of nutrients in foods and their function in maintaining a healthy body.

Include: carbohydrates, proteins, fats, vitamins, minerals.

GLO: B3, D1

5-1-04 Evaluate a daily menu plan and suggest changes to make it align more closely with *Canada's Food Guide to Healthy Eating*.

Include: serving size recommendations according to age for each food group.

GLO: B3, C3, C4, C8

5-1-05 Evaluate prepared food products using the design process.

Examples: frozen pizza, snack foods, beverages...

GLO: B3, C3, C4, C8

5-1-06 Identify the major components of the digestive system, and describe its role in the human body.

Include: teeth, mouth, esophagus, stomach, and intestines break down food.

GLO: D1, E2,

5-1-07 Identify the major components of the skeletal, muscular, and nervous systems, and describe the role of each system in the human body.

Include: the skeleton provides protection and support; muscles, tendons, and ligaments enable movement; brain, spinal cord, and nerves receive sensory input, process information, and send out signals.

GLO: D1, E2

5-1-08 Identify skin as the major component of the integumentary system, and describe its role in protecting and supporting the human body.

GLO: D1, E2

5-1-09 Identify components of the human body's defenses against infections, and describe their role in defending the body against infection.

Include: tears, saliva, skin, white blood cells.

GLO: D1, E2

5-1-10 Identify the major components of the respiratory and circulatory systems, and describe the role of each system in the human body.

Include: the nose, trachea, and lungs take in oxygen and expel carbon dioxide; the heart, blood vessels, and blood transport oxygen, nutrients, and waste products such as carbon dioxide.

GLO: D1, E2

5-1-11 Describe how the human body gets rid of waste.

Include: kidneys filter blood and dispose of waste as urine; lungs give off waste carbon dioxide; the rectum collects and expels undigested food matter.

GLO: D1, E2

5-1-12 Give examples of how systems of the human body work together.

Examples: the circulatory system transports nutrients from the digestive system and oxygen from the respiratory system to the muscular system...

GLO: D1, E2

5-1-13 Identify and describe factors necessary to maintain a healthy body.

Include: daily physical activity, a balanced diet, fluid replacement, adequate sleep, appropriate hygiene practices, regular check-ups.

GLO: B3, C4, D1

(continued)

Grade 5, Cluster 1: Maintaining a Healthy Body (continued)

5-1-14 Evaluate information related to body image and health from media sources for science content and bias.

Examples: glamorization of smoking in movies, promotion of unrealistic role models in magazines, trivialization of scientific information on television...

GLO: B3, C4, C5, C8

5-1-15 Explain how human health may be affected by lifestyle choices and natural- and human-caused environmental factors.

Include: smoking and poor air quality may cause respiratory disorders; unhealthy eating and physical inactivity may lead to diabetes or heart disease; prolonged exposure to the Sun can cause skin cancer.

GLO: B3, B5, C4, D1

Notes

Grade 5, Cluster 2: Properties of and Changes in Substances

Overview

In this cluster, students deepen their understanding of the characteristics and properties of substances, and the changes that occur in substances in different situations. Through their explorations, students identify the three states of matter — solids, liquids, and gases — and describe the properties of each. Students observe examples of reversible and non-reversible changes including changes of state. Students also investigate how the characteristics and properties of substances are altered during physical and chemical changes. Students identify examples of these changes in the world around them. Safety practices related to chemical products in the home are addressed. Students evaluate household products by using criteria such as efficiency, cost, and environmental impact.

Students will…

5-2-01 Use appropriate vocabulary related to their investigations of properties of, and changes in, substances.

Include: characteristic, property, substance, matter, volume, state, solid, liquid, gas, reversible and non-reversible changes, physical change, chemical change, chemical product, raw material.

GLO: C6, D3

5-2-02 Identify characteristics and properties that allow substances to be distinguished from one another.

Examples: texture, hardness, flexibility, strength, buoyancy, solubility, colour, mass/weight for the same volume...

GLO: D3, E1

5-2-03 Investigate to determine how characteristics and properties of substances may change when they interact with one other.

Examples: baking soda in vinegar produces a gas; adding flour to water produces a sticky paste...

GLO: C2, D3, E3

5-2-04 Recognize that matter is anything that has mass/weight and takes up space.

GLO: D3

5-2-05 Identify properties of the three states of matter.

Include: solids have definite volume and hold their shape; liquids have definite volume but take the shape of their container; gases have no definite volume and take the volume and shape of their container.

GLO: D3

5-2-06 Experiment to compare the mass/weight of a substance in its liquid and solid states.

Examples: compare the mass of ice cubes with the mass of the liquid that results when they melt...

GLO: C2, D3, E3

5-2-07 Demonstrate that the mass/weight of a whole object is equal to the sum of the mass/weight of its parts.

Examples: compare the mass/weight of a pencil case and its contents with that of the individual components weighed separately and added together...

GLO: C2, D3, E3

5-2-08 Demonstrate that changes of state are reversible through the addition or removal of heat.

Include: melting, freezing/solidification, condensation, evaporation.

GLO: D3, E3, E4

5-2-09 Explore to identify reversible and non-reversible changes that can be made to substances.

Examples: reversible — folding paper, mixing baking soda and marbles; non-reversible — cutting paper, mixing baking soda and vinegar...

GLO: C2, D3, E3

5-2-10 Recognize that a physical change alters the characteristics of a substance without producing a new substance, and that a chemical change produces a new substance with distinct characteristics and properties.

GLO: D3, E3

5-2-11 Observe examples of changes in substances, classify them as physical or chemical changes, and justify the designation.

Examples: physical — bending a nail, chopping wood, chewing food; chemical — rusting of a nail, burning wood, cooking food...

GLO: C2, D3, E3

5-2-12 Identify potentially harmful chemical products used at home, and describe practices to ensure personal safety.

Include: use of products with parental supervision, recognition of safety symbols, procedures to follow in case of an emergency, proper storage of chemical products.

GLO: B1, C1, D3

5-2-13 Evaluate household chemical products using the design process.

Examples: glass-cleaner, laundry soap, toothpaste...

GLO: B5, C3, C4, C8

5-2-14 Research and describe how raw materials are transformed into useful products.

Examples: food processing, oil refining, paper milling, plastic moulding, gold smelting...

GLO: B1, B4, C2, E3

Grade 5, Cluster 3: Forces and Simple Machines

Overview

In this cluster, students increase their understanding of forces through the study of simple machines. Emphasis is placed on investigating a variety of simple machines and recognizing their usefulness for moving and lifting loads. Students explore how simple machines are used in daily life, and they identify advantages and disadvantages of using simple machines for a given task. Students apply their knowledge of simple machines by designing, constructing, and evaluating a prototype.

Students will…

5-3-01 Use appropriate vocabulary related to their investigations of forces and simple machines.

Include: applied force, balanced and unbalanced forces, fulcrum, load, friction, terms related to types of simple machines.

GLO: C6, D4

5-3-02 Describe, using diagrams, the forces acting on an object and the effects of increasing or decreasing them.

Include: force arrows representing direction and relative strength of forces acting in the same plane, balanced and unbalanced forces.

GLO: C6, D4

5-3-03 Investigate a variety of levers used to accomplish particular tasks in order to compare them qualitatively with respect to fulcrum position, applied force, and load.

Include: first-class, second-class, and third-class levers.

GLO: C2, D4, E1

5-3-04 Identify objects in the school and at home that use wheels and axles, and describe the forces involved.

Examples: doorknob, manual pencil sharpener, hinge, bicycle...

GLO: B1, D4, E1

5-3-05 Recognize that a gear is a wheel and axle used to turn another wheel and axle.

GLO: D4, E2

5-3-06 Identify common devices and systems that incorporate pulleys and/or gears.

GLO: A5, B1, D4, E1

5-3-07 Explore to determine how the direction and amount of the applied force and the speed of rotation vary within a two-gear system.

GLO: C2, D4, E2

5-3-08 Compare, quantitatively, the force required to lift a load using a pulley system versus a single fixed pulley, and recognize the relationship between the force required and the distance over which the force is applied.

Include: a system of pulleys reduces the force required while increasing the distance over which the force is applied; a single fixed pulley requires a greater force but applies it over a shorter distance.

GLO: C2, D4, E2

5-3-09 Identify and make modifications to their own pulley and/or gear systems to improve how they move loads.

Include: reducing friction.

GLO: C3, D4, E2

5-3-10 Identify and describe types of simple machines.

Include: levers, wheel and axle, pulley, gear, inclined plane, screw, wedge.

GLO: D4

5-3-11 Describe the advantage of using simple machines to move or lift a given load.

Include: to decrease the force required; to increase the resulting force; to change the direction of the applied force.

GLO: D4

5-3-12 Investigate to identify advantages and disadvantages of using different simple machines to accomplish the same task.

Examples: using a pulley, inclined plane, or lever to move a piano to the second floor...

GLO: B1, C2, C4, D4

5-3-13 Compare devices that use variations of simple machines to accomplish similar tasks.

Examples: a short- or long-handled pump, a racing or mountain bicycle...

GLO: B1, C3, C4, D4

5-3-14 Use the design process to construct a prototype containing a system of two or more different simple machines that move in a controlled way to perform a specific function.

GLO: C3, D4, E2

Grade 5, Cluster 4: Weather

Overview

In this cluster, students learn that daily weather conditions are not the result of random occurrences, but of global systems that can be predicted on a short-term and a seasonal basis. Through observations and measurements, students investigate the properties of air and other aspects of daily weather. Students learn to interpret public weather reports and investigate the usefulness of various ways of predicting the weather. Understanding the meaning of severe weather forecasts and the preparations to ensure personal safety are emphasized. Students recognize the role of technology in increasing scientific understanding of weather while appreciating the limitations in accurately predicting long-term weather trends. They also investigate factors that influence climate in Manitoba and across Canada.

Students will…

5-4-01 Use appropriate vocabulary related to their investigations of weather.

Include: weather; properties; volume; pressure; air masses; fronts; weather instrument; severe weather; forecast; accuracy; water cycle; climate; terms related to public weather reports, and cloud formations.

GLO: C6, D5

5-4-02 Describe how weather conditions may affect the activities of humans and other animals.

Examples: heavy rainfall may cause roads to wash out; stormy conditions may prevent a space shuttle launching; in excessive heat cattle may produce less milk...

GLO: D5

5-4-03 Describe properties of air.

Include: has mass/weight and volume; expands to fill a space; expands and rises when heated; contracts and sinks when cooled; exerts pressure; moves from areas of high pressure to areas of low pressure.

GLO: D3

5-4-04 Recognize that warm and cold air masses are important components of weather, and describe what happens when these air masses meet along a front.

Include: in a cold front the cold air mass slides under a warm air mass, pushing the warm air upwards; in a warm front the warm moist air slides up over a cold air mass.

GLO: D5, E2

5-4-05 Use the design process to construct a weather instrument.

Examples: an instrument that measures wind direction, wind speed, rainfall...

GLO: C3, D5

5-4-06 Observe and measure local weather conditions over a period of time, using student-constructed or standard instruments, and record and analyze these data.

GLO: A2, C2, C5, D5

5-4-07 Identify and describe components of public weather reports from a variety of sources.

Include: temperature; relative humidity; wind speed and direction; wind chill; barometric pressure; humidex; cloud cover; ultraviolet index; warm and cold fronts; amount, types, and probability of precipitation.

GLO: C6, D5

5-4-08 Describe the key features of a variety of weather phenomena.

Examples: wind speed and precipitation of blizzards...

GLO: D5, E1, E2

5-4-09 Provide examples of severe weather forecasts, and describe preparations for ensuring personal safety during severe weather and related natural disasters.

Examples: tornado, thunderstorm, blizzard, extreme wind chill, flood, forest fire...

GLO: B3, C1, D5

5-4-10 Investigate various ways of predicting weather, and evaluate their usefulness.

Examples: weather-related sayings, traditional knowledge, folk knowledge, observations of the natural environment...

GLO: A2, A4, B2, C8

5-4-11 Contrast the accuracy of short- and long-term weather forecasts, and discuss possible reasons for the discrepancies.

Include: long-term forecasts may not be accurate as weather is a complex natural phenomenon that science is not yet able to predict accurately.

GLO: A1, C2

5-4-12 Describe examples of technological advances that have enabled humans to deepen their scientific understanding of weather and improve the accuracy of weather predictions.

Examples: satellites collect data that scientists analyze to increase understanding of global weather patterns; computerized models predict weather...

GLO: A2, A5, B1, D5

(continued)

Grade 5, Cluster 4: Weather (continued)

5-4-13 Explain how the transfer of energy from the Sun affects weather conditions.

Include: the Sun's energy evaporates water and warms the Earth's land, water, and air on a daily basis.

GLO: D4, D5, E4

5-4-14 Explain how clouds form, and relate cloud formation and precipitation to the water cycle.

GLO: D5, E2

5-4-15 Identify and describe common cloud formations.

Include: cumulus, cirrus, stratus.

GLO: D5, E1

5-4-16 Differentiate between weather and climate.

Include: weather includes the atmospheric conditions existing at a particular time and place; climate describes the long-term weather trend of a particular region.

GLO: D5, E1

5-4-17 Identify factors that influence weather and climate in Manitoba and across Canada, and describe their impacts.

Examples: jet stream, proximity to water, elevation, chinook...

GLO: D5, E2

5-4-18 Recognize that climates around the world are ever changing, and identify possible explanations.

Examples: volcanic eruptions, ozone depletion, greenhouse effect, El Niño, deforestation...

GLO: B5, D5, E2, E3

Notes

Grade 6, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0* comprises nine categories of specific student learning outcomes (SLOs) that describe the skills and attitudes involved in scientific inquiry, the design process, or both.

In scientific inquiry at Grades 5 and 6, students begin to develop the concept of a fair test. This includes developing a prediction/hypothesis that identifies a cause and effect relationship; controlling variables; repeating measurements to increase accuracy and reliability; and drawing conclusions that support or reject their initial predictions/hypotheses. In the design process, students continue to identify and address practical problems through the construction of a prototype. Increasingly sophisticated criteria are used to analyze a prototype, including use of recycled materials, cost, and reliability. Students begin to apply their problem-solving skills in the evaluation of consumer products based on identified criteria in order to determine the best product for a specific purpose. For example, in choosing between pre-packaged pizzas, the various factors of cost, nutritional value, and packaging may influence students' evaluation of the product.

Although the thematic clusters (Clusters 1 to 4) include certain skills and attitudes, Cluster 0 fully defines scientific inquiry and design process skills and attitudes at each grade. Teachers should select appropriate contexts to introduce and reinforce Cluster 0 SLOs over the course of the school year. To assist in planning and to facilitate curricular integration, many SLOs within Cluster 0 are accompanied by links to SLOs 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 are also presented as part of a Grades 5 to 8 chart (separate attachment).

Students will...

	Scientific Inquiry	Design Process
Initiating	**6-0-1a Formulate specific questions that lead to investigations.** **Include: rephrase questions to a testable form; focus research questions.** **GLO: A1, C2 (ELA Grade 6, 3.1.2; Math: SP-I.1.6)** **6-0-1b Identify various methods for finding the answer to a specific question and select one to implement.** ***Examples: generating experimental data; accessing information from a variety of sources...*** **GLO: C2** **(ELA Grade 6, 3.2.2; Math: SP-I.2.6, SP-II.1.6)**	**6-0-1c Identify practical problems to solve.** ***Examples: How can I make a hot-air balloon? Which type of light bulb should I buy?...*** **GLO: C3** **6-0-1d ⊂ Identify various methods to solve a practical problem, and select and justify one to implement.** ***Examples: constructing and testing a prototype; evaluating consumer products; accessing information from a variety of sources...*** **GLO: C3** **(Math: SP-I.2.6, SP-II.1.6)**
Researching	**6-0-2a ⊂ Access information using a variety of sources.** ***Examples: libraries, magazines, community resource people, outdoor experiences, videos, CD-ROMs, Internet...*** **GLO: C6** **(ELA Grade 6, 3.2.2; Math: SP-II.1.6; TFS 2.2.1)** **6-0-2b ⊂ Review information to determine its usefulness, using predetermined criteria.** **GLO: C6, C8** **(ELA Grade 6, 3.2.3)** **6-0-2c Make notes on a topic, combining information from more than one source and referencing sources appropriately.** **GLO: C6** **(ELA Grade 6, 3.3.2)**	

	Scientific Inquiry	Design Process
Planning	**6-0-3a Formulate a prediction/hypothesis that identifies a cause and effect relationship.** **GLO: A2, C2** **(Math: SP-I.1.6)**	
	6-0-3b Identify variables that might have an impact on their experiments, and variables to hold constant to ensure a fair test. **GLO: A2, C22**	**6-0-3d ⊂ Develop criteria to evaluate a prototype or consumer product.** **Include: function, aesthetics, use of recycled materials, cost, reliability.** **GLO: C3**
	6-0-3c ⊂ Create a written plan to answer a specific question. **Include: apparatus, materials, safety considerations, steps to follow.** **GLO: C1, C2** **(ELA Grade 6, 3.1.4)**	**6-0-3e ⊂ Create a written plan to solve a problem.** **Include: materials, safety considerations, labelled diagrams of top and side views, steps to follow.** **GLO: C1, C3, C6**
Implementing a Plan	**6-0-4a Carry out procedures that comprise a fair test.** **Include: controlling variables; repeating measurements to increase accuracy and reliability.** **GLO: C2**	**6-0-4b ⊂ Construct a prototype.** **GLO: C3**
	6-0-4c ⊂ Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. **GLO: C7 (ELA Grade 6, 5.2.2)**	
	6-0-4d Assume various roles to achieve group goals. **GLO: C7 (ELA Grade 6, 5.2.2)**	
	6-0-4e ⊂ Use tools and materials in a manner that ensures personal safety and the safety of others. **Include: keeping an uncluttered workspace; putting equipment away after its use; handling glassware with care.** **GLO: C1**	

	Scientific Inquiry	Design Process
Observing, Measuring, Recording	**6-0-5a ⊂ Make observations that are relevant to a specific question.** **GLO: A1, A2, C2**	**6-0-5b ⊂ Test a prototype or consumer product, using predetermined criteria.** **GLO: C3, C5**
	6-0-5c Select and use tools and instruments to observe, measure, and construct. ***Examples: hand lens, telescope, binoculars...*** **GLO: C2, C3, C5**	
	6-0-5d ⊂ Evaluate the appropriateness of units and measuring tools in practical contexts. **GLO: C2, C5** **(Math: SS-I.1.6)**	
	6-0-5e Estimate and measure accurately using SI and other standard units. **GLO: C2, C5** **(Math: SS-IV.1.6, SS-III.1.5, SS-I.1.5)**	
	6-0-5f ⊂ Record and organize observations in a variety of ways. ***Examples: point-form notes, sentences, labelled diagrams, charts, ordered lists of data, frequency diagrams, spread sheets...*** **GLO: C2, C6** **(ELA Grade 6, 3.3.1; Math: SP-III.2.6)**	

Students will...

	Scientific Inquiry	Design Process
Analyzing and Interpreting	**6-0-6a Construct graphs to display data, and interpret and evaluate these and other graphs.** ***Examples: frequency tallies, histograms, double-bar graphs, stem-and-leaf plots...*** **GLO: C2, C6** **(ELA Grade 6, 3.3.1; Math: SP-II.2.5, SP-III.2.6, SP-IV.1.6; TFS: 4.2.2—4.2.6)**	**6-0-6d ⊂ Identify and make improvements to a prototype, and explain the rationale for the changes.** **GLO: C3, C4**
	6-0-6c ⊂ Identify and suggest explanations for patterns and discrepancies in data. **GLO: A1, A2, C2, C5**	**6-0-6e ⊂ Evaluate the strengths and weaknesses of a consumer product, based on predetermined criteria.** **GLO: C3, C4**
	6-0-6f ⊂ Evaluate the methods used to answer a question or solve a problem. **GLO: C2, C3** **(ELA Grade 6, 3.3.4)**	

	Scientific Inquiry	Design Process
Concluding and Applying	**6-0-7a Draw a conclusion that explains investigation results.** **Include: explaining patterns in data; supporting or rejecting a prediction/hypothesis.** **GLO: A1, A2, C2** **(ELA Grade 6, 3.3.4)**	**6-0-7d ⊂ Propose and justify a solution to the initial problem.** **GLO: C3**
	6-0-7b ⊂ Base conclusions on evidence rather than pre-conceived ideas or hunches. **GLO: C2, C4**	
	6-0-7c Identify a new prediction/hypothesis based on investigation results. **GLO: A1, C2** **(ELA Grade 6, 3.3.4)**	**6-0-7e ⊂ Identify new practical problems to solve.** **GLO: C3**
	6-0-7f Reflect on prior knowledge and experiences to construct new understanding, and apply this new knowledge in other contexts. **GLO: A2, C4** **(ELA Grade 6, 1.2.1)**	
	6-0-7g ⊂ Communicate methods, results, conclusions, and new knowledge in a variety of ways. ***Examples: oral, written, multimedia presentations...*** **GLO: C6** **(ELA Grade 6, 4.4.1; TFS: 3.2.2, 3.2.3)**	
	6-0-7h Identify potential applications of investigation results. **GLO: C4**	

Reflecting on Science and Technology

Scientific Inquiry	Design Process
6-0-8a ⊂ Recognize that science is a way of answering questions about the world, and that there are questions that science cannot answer. **GLO: A1, A3**	**6-0-8c ⊂ Recognize that technology is a way of solving problems in response to human needs.** **GLO: A3, B2**
6-0-8b ⊂ Identify examples of scientific knowledge that have developed as a result of the gradual accumulation of evidence. **GLO: A2**	**6-0-8d ⊂ Provide examples of technologies from the past and describe how they have evolved over time.** **GLO: B1**

6-0-8e ⊂ Describe hobbies and careers related to science and technology.
GLO: B4

6-0-8f ⊂ Recognize that science is organized into specialized disciplines.
GLO: A1, B4

6-0-8g ⊂ Describe positive and negative effects of scientific and technological endeavours.
Include: effects on themselves, society, the environment, and the economy.
GLO: A1, B1, B3, B5

Demonstrating Scientific and Technological Attitudes and Habits of Mind

Scientific Inquiry	Design Process

6-0-9a ⊂ Appreciate that women and men of diverse cultural backgrounds can contribute equally to science.
GLO: A4

6-0-9b ⊂ Show interest in the activities of individuals working in scientific and technological fields.
GLO: B4

6-0-9c ⊂ Demonstrate confidence in their ability to carry out investigations.
GLO: C5

6-0-9d ⊂ Appreciate the importance of creativity, accuracy, honesty, and perseverance as scientific and technological habits of mind.
GLO: C5

6-0-9e ⊂ Be sensitive to and develop a sense of responsibility for the welfare of other humans, other living things, and the environment.
GLO: B5

6-0-9f ⊂ Frequently and thoughtfully evaluate the potential consequences of their actions.
GLO: B5, C4

Grade 6, Cluster 1: Diversity of Living Things

Overview

In this cluster, students develop an appreciation of the diversity of living things. Students study a variety of classification systems, and construct and use their own as well as those developed by others. In doing so, they recognize the advantages and disadvantages of classification systems in organizing information. The animal kingdom provides a specific focus with students investigating different types of animals to understand where they fit in the classification of living things. Students compare and contrast the adaptations of closely related vertebrates living in different habitats, and the adaptations of vertebrates living today with those that lived in the past. Students learn about the contributions of individual scientists who have increased our understanding of the diversity of living things.

Students will…

6-1-01 Use appropriate vocabulary related to their investigations of the diversity of living things.

Include: classification system, classification key, paleontologist, terms related to names of kingdoms and types of vertebrates and invertebrates.

GLO: C6, D1

6-1-02 Describe various kinds of classification systems used in everyday life, and identify related advantages and disadvantages.

Examples: organization of phone numbers in a phone book, books in a library, groceries in a supermarket...

GLO: B1, B2, E1, E2

6-1-03 Develop a system to classify common objects or living things into groups and subgroups, and explain the reasoning used in the system's development.

GLO: A1, C2, E1, E2

6-1-04 Identify living things using an existing classification key, and explain the rationale used.

Examples: identification of birds, butterflies, animal tracks, winter twigs...

GLO: A1, C2, D1, E2

6-1-05 Identify advantages and disadvantages of having a common classification system for living things, and recognize that the system changes as new evidence comes to light.

GLO: A1, A2, D1, E2

6-1-06 Identify the five kingdoms commonly used for the classification of living things, and provide examples of organisms from each to illustrate the diversity of living things.

Include: monerans, protists, fungi, plants, animals.

GLO: A1, D1, E1, E2

6-1-07 Recognize that many living things are difficult to see with the unaided eye, and observe and describe some examples.

GLO: C2, D1, E1

6-1-08 Observe and describe the diversity of living things within the local environment.

Include: fungi, plants, animals.

GLO: A1, C2, D1, E1

6-1-09 Recognize that the animal kingdom is divided into two groups, vertebrates and invertebrates, and differentiate between the two.

Include: vertebrates have backbones, invertebrates do not.

GLO: D1, E1

6-1-10 Provide examples of a variety of invertebrates to illustrate their diversity.

Include: sponges, worms, molluscs, arthropods.

GLO: D1, E1

6-1-11 Compare and contrast adaptations of common arthropods, and describe how these adaptations enable them to live in particular habitats.

GLO: D1, D2, E1

6-1-12 Classify vertebrates as fishes, amphibians, reptiles, birds, and mammals, and provide examples to illustrate the diversity within each group.

GLO: D1, E1

6-1-13 Compare and contrast the adaptations of closely related vertebrates living in different habitats, and suggest reasons that explain these adaptations.

GLO: D1, D2, E1

6-1-14 Identify, based on evidence gathered by paleontologists, similarities and differences in animals living today and those that lived in the past.

Examples: archaeopteryx and modern birds...

GLO: A1, A2, E1, E3

6-1-15 Identify and describe contributions of scientists and naturalists who have increased our understanding of the diversity of living things.

GLO: A2, A4, B4, D1

Grade 6, Cluster 2: Flight

Overview

In this cluster, a study of the properties of fluids helps students to understand how flight can be achieved. Through the testing of models, students explore how the forces of thrust, drag, lift, and gravity act on living things or devices that fly through the air. They learn how specific adaptations or modifications can alter lift or drag. Different means of propulsion are compared and the use of unbalanced forces to steer aircraft and spacecraft are described. Students apply their understanding of forces and flight through the construction of a prototype that flies and meets specific performance criteria. Students also examine the history of the development of air travel and identify its impact on the way people work and live.

Students will…

6-2-01 Use appropriate vocabulary related to their investigations of flight.

Include: fluid, pressure, lift, gravity, thrust, drag, Bernoulli's Principle, propulsion, unbalanced forces.

GLO: C6, D4

6-2-02 Describe properties of fluids using air and water as examples, and identify manifestations of these properties in daily life.

Include: air and water flow and exert pressure; objects can flow through air and water; warm air and water rise.

GLO: B1, D3, E1

6-2-03 Identify adaptations that enable living things to propel themselves through air, water, or to be transported by the wind.

Examples: the streamlined shape of dolphins and barn swallows, the helicopter-like motion of the winged fruit of maple trees, the parachute-shaped fruit of dandelions...

GLO: D1, D4, E1

6-2-04 Recognize that in order for devices or living things to fly they must have sufficient lift to overcome the downward force of gravity, and that the force of gravity increases as mass increases.

GLO: D4

6-2-05 Describe how "lighter-than-air flying devices" are able to achieve lift.

Include: hot-air balloons, helium balloons.

GLO: D4

6-2-06 Test models of aircraft to observe Bernoulli's Principle.

Include: the shape of a wing affects the speed of airflow, creating lift in a "heavier-than-air flying device."

GLO: C2, C3, D3, D4

6-2-07 Explain how Bernoulli's Principle is applied in a device other than an aircraft.

Examples: paint sprayer, perfume mister...

GLO: A5, B1, D4

6-2-08 Provide examples of design features or adaptations that enhance or reduce lift, and explain how they work.

Examples: race car spoilers reduce lift; bird wing shapes enhance lift...

GLO: A5, B1, D1, D4

6-2-09 Provide examples of design features or adaptations that enhance or reduce drag, and explain how they work.

Examples: pilots use flaps to increase drag when landing aircraft; birds tuck their wings to decrease drag when diving...

GLO: A5, B1, D1, D4

6-2-10 Identify and diagram the four forces that act on living things or devices that fly through the air.

Include: lift, gravity, thrust, drag.

GLO: C6, D4

6-2-11 Compare a variety of propulsion methods that are used to produce thrust in animals and flying devices.

Examples: rockets for spacecraft, propellers, or jet engines for aircraft, wings for flying animals...

GLO: B1, D1, D4, E4

6-2-12 Describe how unbalanced forces are used to steer aircraft and spacecraft.

GLO: A5, D4, D6

6-2-13 Explain why the design of aircraft and spacecraft differs.

GLO: B1, C3, D4, D6

6-2-14 Identify milestones in the history of air travel and describe their impacts on daily life.

GLO: A4, B1, B2, D4

6-2-15 Use the design process to construct a prototype that can fly and meet specific performance criteria.

Examples: a glider that can loop; a hot-air balloon that can stay aloft for a given time...

GLO: C3, D4

Grade 6, Cluster 3: Electricity

Overview

In this cluster, students explore current and static electricity and compare and contrast the characteristics of each. These explorations help students identify and appreciate the importance of electricity in everyday life including the need for safe practices when using electricity. Students have the opportunity to apply their knowledge of series and parallel circuits in the construction of a prototype that performs a specific function. They demonstrate how electricity can be transformed into motion, and motion into electricity. Students also identify other types of transformations that can take place. Students discuss advantages and disadvantages of various renewable and non-renewable sources of electrical energy, and recognize the importance of energy conservation. The creation of an action plan to help reduce electrical energy consumption helps students understand the impacts they can make.

Students will…

6-3-01 Use appropriate vocabulary related to their investigations of electricity.

Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.

GLO: C6, D4, E4

6-3-02 Explain the attraction and repulsion of electrostatically charged materials.

Include: negatively and positively charged materials attract one another; materials of like charge repel one another.

GLO: D4

6-3-03 Explain current electricity, and compare the characteristics of current and static electricity by using a model.

GLO: A2, D4

6-3-04 Identify dangers associated with static and current electricity, and demonstrate and describe appropriate safety precautions.

GLO: C1, D4

6-3-05 List electrical devices used at home, at school, and in the community, and identify the human needs that they fulfill.

Examples: heat, light, communication, movement...

GLO: B1, B2, D4

6-3-06 Develop a definition of an electrical circuit, based on classroom explorations.

Include: an electrical circuit is a continuous path for charges and must contain a power source and a conductor.

GLO: C2, D4

6-3-07 Experiment to classify a variety of materials as insulators or conductors.

GLO: C2, D3, D4, E1

6-3-08 Demonstrate and describe the function of switches in electrical circuits.

GLO: D4

6-3-09 Construct and diagram simple series circuits and simple parallel circuits.

GLO: C2, C6, D4, E1

6-3-10 Explore to determine factors that affect bulb brightness in simple series and parallel circuits.

Include: number of bulbs, number of batteries, placement of bulbs and batteries.

GLO: C2, D4

6-3-11 Use the design process to construct an electrical circuit that performs a useful function.

Examples: doorbell, alarm, motorized toy, game...

GLO: C3, D4

6-3-12 Demonstrate, using a simple electromagnet constructed in class, that an electric current can create a magnetic field.

GLO: C2, D4

6-3-13 Explore motors and generators to determine that electromagnets transform electricity into motion, and motion into electricity.

GLO: A5, D4, E2, E4

6-3-14 Identify forms of energy that may result from the transformation of electrical energy, and recognize that energy can only be changed from one form into another, not created or destroyed.

Include: light, heat, sound, motion.

GLO: D4, E4

6-3-15 Identify the two major sources of electrical energy, and provide examples of each.

Include: chemical sources such as batteries; electromagnetic sources such as turbine motion caused by wind, falling water, and steam.

GLO: B1, D4, E4

(continued)

Grade 6, Cluster 3: Electricity (continued)

6-3-16 Identify renewable and non-renewable sources of electrical energy, and discuss advantages and disadvantages of each.

Examples: renewable sources such as hydroelectric, wind, geothermal, solar; non-renewable sources such as fossil fuels, nuclear fission...

GLO: B5, E4

6-3-17 Evaluate an electrical device using the design process.

Examples: light bulbs, kitchen appliances...

GLO: B5, C4

6-3-18 Describe factors that affect the consumption of electrical energy, and outline an action plan to reduce electrical energy consumption at home, at school, or in the community.

GLO: B5, C4, E4

6-3-19 Describe the ways in which electricity has had an impact on daily life.

GLO: B1, B2, B5

Notes

Grade 6, Cluster 4: Exploring the Solar System

Overview

In this cluster, students develop an understanding of the Earth in space, the solar system, and the role of space research programs in increasing scientific knowledge. Positive and negative impacts arising from space research programs are addressed, and the contributions of Canadians to these programs are highlighted. Students develop an appreciation for the nature of science by examining the changing conceptions of the Earth's position in space and by differentiating between astronomy and astrology. Students investigate the causes of phenomena such as the cycle of day and night, the yearly cycle of the seasons, moon phases, eclipses, and the reasons why the apparent movements of celestial bodies in the night sky are regular and predictable. An important distinction is made between weight and mass.

Students will…

6-4-01 Use appropriate vocabulary related to their investigations of Earth and space.

Include: astronauts, communication and remote sensing satellites, solar system, inner and outer planets, asteroid belt, mass, weight, points of reference, apparent movement, celestial objects, astrology, astronomy, rotation, revolution, axis, moon phases, eclipses.

GLO: C6, D6

6-4-02 Identify technological developments that enable astronauts to meet their basic needs in space.

Examples: dehydrated foods, backpacks with an oxygen supply, hermetically sealed cabins with temperature and air controls...

GLO: B1, B2, D1, D6

6-4-03 Identify Canadians who have contributed to space science or space technology, and describe their achievements.

GLO: A4, A5, B1, B4

6-4-04 Investigate past and present space research programs involving astronauts, and explain the contributions to scientific knowledge.

Examples: Apollo, Mir, International Space Station...

GLO: A1, A2, A5, D6

6-4-05 Describe positive and negative impacts arising from space research programs.

Examples: advantages — increased knowledge about space and medicine, the development of technologies such as orange drink crystals and pocket calculators; disadvantages — space pollution and the high cost of research projects...

GLO: A1, B1, B5, D6

6-4-06 Identify technological devices placed in space that help humans learn more about the Earth and communicate more efficiently.

Include: communication and remote sensing satellites.

GLO: B1, B2, D6

6-4-07 Describe how the conception of the Earth and its position in space have been continuously questioned and how our understanding has evolved over time.

Include: from a flat Earth, to an Earth-centred system, to a Sun-centred system.

GLO: A1, A2, B2, C5

6-4-08 Recognize that the Sun is the centre of the solar system and it is the source of energy for all life on Earth.

GLO: D6, E2, E4

6-4-09 Identify the planets in the solar system and describe their size relative to the Earth and their position relative to the Sun.

GLO: D6, E1, E2

6-4-10 Classify planets as inner or outer planets, based on their position relative to the asteroid belt, and describe characteristics of each type.

Include: inner planets are small and rocky; outer planets (except Pluto) are giant balls of gas.

GLO: D6, E1

6-4-11 Recognize that mass is the amount of matter in an object, that weight is the force of gravity on the mass of an object, and that the force of gravity varies from planet to planet.

GLO: D3

6-4-12 Explain, using models and simulations, how the Earth's rotation causes the cycle of day and night, and how the Earth's tilt of axis and revolution cause the yearly cycle of seasons.

GLO: A2, D6, E2, E4

6-4-13 Use the design process to construct a prototype that tells the time of day or measures a time span.

GLO: C3, D6

6-4-14 Explain how the relative positions of the Earth, moon, and Sun are responsible for moon phases and eclipses.

GLO: D6, E2

6-4-15 Identify points of reference in the night sky and recognize that the apparent movement of celestial objects is regular, predictable, and related to the Earth's rotation and revolution.

Examples: planets, constellations...

GLO: D6, E2, E3

(continued)

Grade 6, Cluster 4: Exploring the Solar System (continued)

6-4-16 Identify and describe how people from various cultures, past and present, apply astronomy in daily life.

Examples: using celestial bodies to navigate; knowing when to plant crops...

GLO: A4, A5, B1, B2

6-4-17 Differentiate between astrology and astronomy, and explain why astrology is considered unscientific.

GLO: A1, A2, C5, C8

Notes

Grade 7, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0* comprises nine categories of specific student learning outcomes (SLOs) that describe the skills and attitudes involved in scientific inquiry, the design process, or both.

In scientific inquiry at Grades 7 and 8, students build on the concept of a fair test developed in Grades 5 and 6. This includes developing a prediction/hypothesis that identifies a cause and effect relationship between dependent and independent variables; repeating experiments to increase accuracy and reliability; looking for alternative explanations for observations; recognizing strengths and weaknesses of different methods of collecting and displaying data; and determining potential sources of error. In the design process, students construct prototypes to solve practical problems and analyze them according to criteria such as cost, efficiency, and environmental considerations. Students continue to apply their problem-solving skills in the evaluation of consumer products in order to determine the best product for a particular purpose. This involves identifying priorities. For example, in choosing a brand of sunscreen, to what extent do cost, effectiveness, and the environmental track record of the company affect the decision?

Although the thematic clusters (Clusters 1 to 4) include certain skills and attitudes, Cluster 0 fully defines scientific inquiry and design process skills and attitudes at each grade. Teachers should select appropriate contexts to introduce and reinforce Cluster 0 SLOs over the course of the school year. To assist in planning and to facilitate curricular integration, many SLOs within Cluster 0 are accompanied by links to SLOs 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 are also presented as part of a Grades 5 to 8 chart (separate attachment).

Students will...

	Scientific Inquiry	Design Process
Initiating	**7-0-1a ⊂ Formulate specific questions that lead to investigations.** **Include: rephrase questions to a testable form; focus research questions.** **GLO: A1, C2** **(ELA Grade 7, 3.1.2; Math: SP-I.1.7)**	**7-0-1c Identify practical problems to solve.** ***Examples: How can I keep my soup hot? Which type of sunscreen should I buy?...*** **GLO: C3**
	7-0-1b Select and justify a method to be used in finding the answer to a specific question. **GLO: C2** **(ELA Grade 7, 3.2.3; Math: SP-II.1.7)**	**7-0-1d Select and justify a method to be used in finding a solution to a practical problem.** **GLO: C3** **(Math: SP-II.1.7)**
Researching	**7-0-2a ⊂ Access information using a variety of sources.** ***Examples: libraries, magazines, community resource people, outdoor experiences, videos, CD-ROMs, Internet...*** **GLO: C6** **(ELA Grade 7, 3.2.2; TFS 2.2.1)**	
	7-0-2b Evaluate the usefulness, currency, and reliability of information, using predetermined criteria. **GLO: C6, C8** **(ELA Grade 7, 3.2.3; TFS 2.2.2)**	
	7-0-2c Make notes using headings and subheadings or graphic organizers appropriate to a topic and reference sources. **GLO: C6** **(ELA Grade 7, 3.3.2)**	

	Scientific Inquiry	Design Process
Planning	**7-0-3a Formulate a prediction/hypothesis that identifies a cause and effect relationship between the dependent and independent variables.** **GLO: A2, C2** **(Math: SP-I.1.7)**	**7-0-3d Develop criteria to evaluate a prototype or consumer product.** **Include: function, aesthetics, environmental considerations, cost, efficiency.** **GLO: C3**
	7-0-3b Identify with guidance the independent and dependent variables in an exeriment. **GLO: A2, C2**	
	7-0-3c Create a written plan to answer a specific question. **Include: apparatus, materials, safety considerations, steps to follow, and variables to control.** **GLO: C2** **(ELA Grade 7, 3.1.4)**	**7-0-3e Create a written plan to solve a problem.** **Include: materials required, three-dimensional sketches, steps to follow.** **GLO: C1, C3, C6**

	Scientific Inquiry	Design Process
Implementing a Plan	**7-0-4a Carry out procedures that comprise a fair test.** **Include: controlling variables, repeating experiments to increase accuracy and reliability.** **GLO: C2**	**7-0-4b ⊂ Construct a prototype.** **GLO: C3**
	7-0-4c ⊂ Work cooperatively with team members to carry out a plan, and troubleshoot problems as they arise. **GLO: C7** **(ELA Grade 7, 5.2.1)**	
	7-0-4d ⊂ Assume various roles to achieve group goals. **GLO: C7** **(ELA Grade 7, 5.2.2)**	
	7-0-4e Demonstrate work habits that ensure personal safety, the safety of others, and consideration for the environment. **Include: keeping an uncluttered workspace; putting equipment away after use; handling glassware with care; wearing goggles when required; disposing of materials safely and responsibly.** **GLO: C1**	
	7-0-4f Identify WHMIS hazard symbols that provide information on the safety of substances. **GLO: C1**	

Students will...

	Scientific Inquiry	Design Process
Observing, Measuring, Recording	7-0-5a ⊂ Make observations that are relevant to a specific question. GLO: A1, A2, C2	7-0-5b ⊂ Test a prototype or consumer product, using predetermined criteria. GLO: C3, C5
	7-0-5c Select and use tools to observe, measure, and construct. Include: microscopes, a variety of thermometers, graduated cylinders, glassware, balance. GLO: C2, C3, C5 7-0-5d Make conversions among commonly used SI units. GLO: C2, C3 (Math: SS-IV.3.6, SS-I.3.6, SS-III.3.6) 7-0-5e Estimate and measure accurately using SI and other standard units. Include: determining volume by displacement of water. GLO: C2, C5 (Math: SS-IV.1.6, SS-III.1.5, SS-III.1.6, SS-I.1.5) 7-0-5f Record, compile, and display observations and data, using an appropriate format. GLO: C2, C6 (ELA Grade 7, 3.3.1; Math: SP-III.2.7)	

	Scientific Inquiry	Design Process
Analyzing and Interpreting	7-0-6a Construct graphs to display data, and interpret and evaluate these and other graphs. *Examples: frequency tallies, histograms, double-bar graphs, stem-and-leaf plots...* GLO: C2, C6 (ELA Grade 7, 3.3.1; Math: SP-III.2.6; TFS: 4.2.2– 4.2.6) 7-0-6b Interpret patterns and trends in data, and infer and explain relationships. GLO: A1, A2, C2, C5 7-0-6c Identify strengths and weaknesses of different methods of collecting and displaying data, and potential sources of error. GLO: A1, A2, C2, C5 (ELA Grade 7, 3.3.3)	7-0-6d ⊂ Identify and make improvements to a prototype, and explain the rationale for the changes. GLO: C3, C4 7-0-6e ⊂ Evaluate the strengths and weaknesses of a consumer product, based on predetermined criteria. GLO: C3, C4
	7-0-6f Identify how the original plan evolved and justify the changes. GLO: C2, C3 (ELA Grade 7, 3.3.4)	

	Scientific Inquiry	Design Process
Concluding and Applying	**7-0-7a Draw a conclusion that explains investigation results.** **Include: explaining the cause and effect relationship between the dependent and independent variables; identifying alternative explanations for observations; supporting or rejecting a prediction/hypothesis.** **GLO: A1, A2, C2** **(ELA Grade 7, 3.3.4)** **7-0-7b Critically evaluate conclusions, basing arguments on fact rather than opinion.** **GLO: C2, C4** **7-0-7c ⊂ Identify a new prediction/hypothesis based on investigation results.** **GLO: A1, C2** **(ELA Grade 7, 3.3.4)**	**7-0-7d ⊂ Propose and justify a solution to the initial problem.** **GLO: C3** **7-0-7e ⊂ Identify new practical problems to solve.** **GLO: C3**
	7-0-7f ⊂ Reflect on prior knowledge and experiences to construct new understanding and apply this new knowledge in other contexts. **GLO: A2, C4** **(ELA Grade 7, 1.2.1)** **7-0-7g ⊂ Communicate methods, results, conclusions, and new knowledge in a variety of ways.** ***Examples: oral, written, multimedia presentations...*** **GLO: C6 (ELA Grade 7, 4.4.1)** **7-0-7h Identify and evaluate potential applications of investigation results.** **GLO: C4**	

	Scientific Inquiry	Design Process
Reflecting on Science and Technology	**7-0-8a Distinguish between science and technology.** **Include: purpose, procedures, products.** **GLO: A3** **7-0-8b Describe examples of how scientific knowledge has evolved in light of new evidence, and the role of technology in this evolution.** **GLO: A2, A5, B1** **7-0-8d Describe examples of how technologies have evolved over time in response to changing needs and scientific advances.** **GLO: A5, B1, B2** **7-0-8e Provide examples of Canadian institutions and individuals who have contributed to science and technology, and describe their contributions.** **GLO: A1, A4, B1, B4** **7-0-8f Relate personal activities in formal and informal settings to specific scientific disciplines.** **GLO: A1, B4** **7-0-8g Discuss societal, environmental, and economic impacts of scientific and technological endeavours.** **Include: local and global impacts.** **GLO: A1, B1, B3, B5**	

	Scientific Inquiry / Design Process
Demonstrating Scientific and Technological Attitudes	**7-0-9a Appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds.** **GLO: A4** **7-0-9b Express interest in a broad scope of science and technology related fields and issues.** **GLO: B4** **7-0-9c ⊂ Demonstrate confidence in their ability to carry out investigations.** **GLO: C5** **7-0-9d Value skepticism, accuracy, precision, and open-mindedness as scientific and technological habits of mind.** **GLO: C5** **7-0-9e Be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment.** **GLO: B5** **7-0-9f Consider both immediate and long-term effects of their actions.** **GLO: B5, C4, E3**

Notes

Grade 7, Cluster 1: Interactions Within Ecosystems

Overview

In this cluster, students investigate the complex interactions between organisms and their environment. Students identify biotic and abiotic components of ecosystems, and analyze the cycling of matter that takes place within them. This includes an investigation of the transfer of energy that occurs at various consumer levels, the implications of the loss of producers and consumers to the transfer of energy, and the potential for bio-accumulation within an ecosystem. Students explore ecological succession and assess the positive and negative impacts of human interventions on this natural process. Students discuss environmental, social, and economic factors that should be considered in the management and preservation of ecosystems. They propose a course of action that would help protect the habitat of a particular organism. Students observe micro-organisms with microscopes and discuss their beneficial and harmful roles. Students consider how knowledge of micro-organisms has improved food production and preservation techniques.

Students will…

7-1-01 Use appropriate vocabulary related to their investigations of interactions within ecosystems.

Include: ecosystem, biosphere, abiotic, biotic, organisms, ecological succession, photosynthesis, cellular respiration, ecological pyramid, bioaccumulation, scavengers, decomposers, micro-organisms.

GLO: C6, D2

7-1-02 Define ecosystem, and describe various examples that range from the microscopic to the entire biosphere.

Include: a place on Earth where living things interact with other living things as well as non-living things.

GLO: D2, E2

7-1-03 Identify abiotic and biotic components of ecosystems that allow particular organisms to survive.

GLO: D1, D2, E2

7-1-04 Describe ecological succession and identify signs of succession in a variety of ecosystems.

Include: the natural process whereby some species are replaced by other species in a predictable pattern.

GLO: D2, E2, E3

7-1-05 Identify and describe positive and negative examples of human interventions that have an impact on ecological succession or the makeup of ecosystems.

Examples: positive — protecting habitats, reintroducing species; negative — preventing natural fires, introducing non-indigenous species, draining wetlands for agriculture or housing...

GLO: B5, D2, E2, E3

7-1-06 Identify environmental, social, and economic factors that should be considered in the management and preservation of ecosystems.

Examples: habitat preservation, recreation, employment, industrial growth, resource development...

GLO: B1, B5, D2, E2

7-1-07 Propose a course of action to protect the habitat of a particular organism within an ecosystem.

Examples: protect the nesting habitat of a given bird in a local wetland...

GLO: B5, C3, D2, E2

7-1-08 Compare photosynthesis to cellular respiration, and explain how both are part of the cycling of matter and the transfer of energy in ecosystems.

Include: photosynthesis: water + carbon dioxide + light energy = sugar + oxygen in the presence of chlorophyll; cellular respiration: sugar + oxygen = water + carbon dioxide + energy.

GLO: A2, C6, D2, E4

7-1-09 Analyze food webs, using ecological pyramids, to show energy gained or lost at various consumer levels.

Include: producers; primary, secondary, and tertiary consumers.

GLO: C2, C8, D2, E4

7-1-10 Analyze, using ecological pyramids, the implications of the loss of producers and consumers to the transfer of energy within an ecosystem.

GLO: C2, C8, D2, E4

7-1-11 Explain, using ecological pyramids, the potential for bioaccumulation within an ecosystem.

GLO: D2, E2, E4

7-1-12 Provide examples of scavengers and decomposers, and describe their role in cycling matter in an ecosystem.

Include: micro-organisms.

GLO: D2, E1, E2, E3

7-1-13 Demonstrate proper use and care of the microscope to observe micro-organisms.

Include: preparing wet mounts beginning with the least powerful lens; focussing; drawing specimens; indicating magnification.

GLO: C1, C2, C7

(continued)

7-1-14 Identify beneficial and harmful roles played by micro-organisms.

Examples: beneficial — aid in digestion, composting, food and vaccine production; harmful — cause disease, food spoilage...

GLO: B3, C2, D2

7-1-15 Research and describe human food production or preservation techniques that apply a knowledge of micro-organisms.

Examples: bread and yogourt making, food drying, sterilization, refrigeration...

GLO: A5, B2, B3, D1

Notes

Grade 7, Cluster 2: Particle Theory of Matter

Overview

In this cluster, students explore the nature of science by examining the development of scientific theories. One theory, the particle theory of matter, is investigated in detail. Students use the particle theory to describe changes of state, to differentiate between pure substances and mixtures, and to describe characteristics of solutions. An important distinction is made between heat and temperature. Students demonstrate how heat is transmitted by way of conduction, convection, and radiation. They plan and conduct experiments to identify substances that are good insulators and conductors of heat. They apply this knowledge through the design and construction of a prototype that controls the transfer of heat energy. Students also identify different forms of energy that can be transformed into heat energy, and recognize that heat is the most common by-product of other energy transformations. Students classify substances used in daily life as pure substances, mechanical mixtures, and solutions. They demonstrate different methods of separating the components of mixtures. Students experiment to determine factors that affect solubility. They describe the concentration of solutions in qualitative and quantitative terms, and demonstrate the differences between saturated and unsaturated solutions. The potential harmful effects of some substances on the environment are discussed, and methods to ensure safe use and disposal are identified.

Students will…

7-2-01 Use appropriate vocabulary related to their investigations of the particle theory of matter.

Include: boiling and melting points, pure substance, scientific theory, particle theory of matter, temperature, heat, conduction, convection, radiation, mixture, solution, mechanical mixture, homogeneous, heterogeneous, solutes, solvents, solubility, concentration, dilute, concentrated, saturated, unsaturated, terms related to forms of energy.

GLO: C6, D3, E4

7-2-02 Evaluate different types of thermometers using the design process.

Examples: materials used, range, sensitivity, durability, scale, cost...

GLO: C1, C3

7-2-03 Demonstrate the effects of heating and cooling on the volume of solids, liquids, and gases, and give examples from daily life.

GLO: A2, C1, D3, E4

7-2-04 Compare the boiling and melting points of a variety of substances and recognize that boiling and melting points are properties of pure substances.

Include: water.

GLO: C2, D3, E3, E4

7-2-05 Explain what scientific theories are, and provide some examples.

Include: a scientific theory helps to explain an observation; when this explanation has been repeatedly tested and shown to be consistent it is generally accepted in the scientific world.

GLO: A1, A2

7-2-06 Describe the particle theory of matter and use it to explain changes of state.

GLO: A2, C6, D3, D4

7-2-07 Differentiate between the concept of temperature and the concept of heat.

GLO: D3, D4, E4

7-2-08 Demonstrate how heat can be transmitted through solids, liquids, and gases.

Include: conduction, convection, radiation.

GLO: C1, D3, D4, E4

7-2-09 Plan an experiment to identify materials that are good heat insulators and good heat conductors, and describe some uses of these materials.

GLO: B1, D3, D4

7-2-10 Use the design process to construct a prototype that controls the transfer of heat energy.

Examples: insulated lunch bag, solar oven, home insulation...

GLO: A5, B2, C3, C4

7-2-11 Recognize that heat energy is the most common by-product of energy transformations, and describe some examples.

Examples: thermal pollution, body heat, friction...

GLO: B1, D4, E4

7-2-12 Identify different forms of energy that can be transformed into heat energy.

Include: mechanical, chemical, nuclear, electrical.

GLO: D4, E4

7-2-13 Differentiate between pure substances and mixtures by using the particle theory of matter.

Include: a pure substance is made up of one type of particle; a mixture is made up of two or more types of particles.

GLO: A2, D3, E1

7-2-14 Differentiate between the two types of mixtures, solutions and mechanical mixtures.

Include: solutions — homogeneous; mechanical mixtures — heterogeneous mixtures.

GLO: D3, E1

7-2-15 Classify a variety of substances used in daily life as pure substances, solutions, or mechanical mixtures.

Examples: distilled water, paint thinner, mouthwash, peanut butter, liquid soap, medicines, sunscreens...

GLO: B1, E1

(continued)

Grade 7, Cluster 2: Particle Theory of Matter (continued)

7-2-16 Identify solutes and solvents in common solid, liquid, and gaseous solutions.

GLO: D3

7-2-17 Describe solutions by using the particle theory of matter.

Include: particles have an attraction for each other; the attraction between the particles of solute and solvent keeps them in solution.

GLO: A1, D3, E1

7-2-18 Demonstrate different methods of separating the components of both solutions and mechanical mixtures.

Examples: distillation, chromatography, evaporation, sieving, dissolving, filtration, decanting, magnetism, sedimentation...

GLO: C1, C2

7-2-19 Identify a separation technique used in industry, and explain why it is appropriate.

GLO: B1, C4

7-2-20 Experiment to determine factors that affect solubility.

Include: agitation, surface area, temperature.

GLO: C2, D3

7-2-21 Describe the concentration of a solution in qualitative and quantitative terms, and give examples from daily life when the concentration of a solution influences its usefulness.

Include: dilute, concentrated, grams of solute per 100 mL.

GLO: C6, D3

7-2-22 Demonstrate the difference between saturated and unsaturated solutions.

GLO: C2, C6, D3

7-2-23 Discuss the potential harmful effects of some substances on the environment, and identify methods to ensure their safe use and disposal.

Examples: pollution of groundwater from improper disposal of paints and solvents; pollution of the atmosphere by car exhaust...

GLO: B1, B3, B5, C1

Notes

Grade 7, Cluster 3: Forces and Structures

Overview

In this cluster, students explore a variety of natural and human-built structures, and the forces that act on them. Students investigate internal and external forces acting on structures and recognize that these forces may affect structural strength and stability. Students identify common shapes used to increase strength and stability in structures, and methods used to enhance the strength of the materials used. The efficiency of a structure is assessed by comparing its mass with the mass of the load it supports. Students apply their understanding of forces and structures by evaluating the appropriateness of a specific structure's design, and by constructing a structure of their own that supports a given load and remains standing when a particular force is applied.

Students will…

7-3-01 Use appropriate vocabulary related to their investigations of forces and structures.

Include: frame, shell, solid, centre of gravity, stability, compression, tension, shear, torsion, internal and external forces, stress, structural fatigue, structural failure, load, magnitude, point and plane of application, efficiency.

GLO: C6, D4

7-3-02 Classify natural and human-built structures found locally and around the world.

Include: frame, shell, solid.

GLO: E1

7-3-03 Identify the centre of gravity in a model structure, and demonstrate that changes in the location of a structure's centre of gravity affect its stability.

GLO: C1, D4

7-3-04 Identify internal forces acting on a structure, and describe them using diagrams.

Include: compression, tension, shear, torsion.

GLO: D4, E4

7-3-05 Identify external forces acting on a structure, and describe them using diagrams.

Examples: snow on a rooftop, wind on a tent, water against a beaver dam...

GLO: C6, D4, E4

7-3-06 Recognize that internal and external forces apply stress to structures, and describe examples in which this stress has led to structural fatigue or structural failure.

GLO: D4, E3

7-3-07 Investigate to determine that the effect of a force on a structure depends on its magnitude, direction, and point and plane of application.

GLO: D4

7-3-08 Describe, using diagrams, how common structural shapes and components can increase the strength and stability of a structure.

Examples: a triangle distributes the downward force of a load evenly between its two vertices...

GLO: C6, D3, D4

7-3-09 Describe and demonstrate methods to increase the strength of materials.

Examples: corrugation of surfaces, lamination of adjacent members, alteration of the shape of components...

GLO: C2, C3, D3, E3

7-3-10 Determine the efficiency of a structure by comparing its mass with the mass of the load it supports.

GLO: C1, C5

7-3-11 Evaluate a structure to determine the appropriateness of its design, using the design process.

Examples: jacket, foot stool, local building...

GLO: C3, C4, C8, D4

7-3-12 Use the design process to construct a structure that will withstand the application of an external force.

Examples: a tower that will remain standing during a simulated earthquake...

GLO: C3, D3, D4

Grade 7, Cluster 4: Earth's Crust

Overview

In this cluster, students investigate Earth's geology, including rock and mineral formation, changes in the landscape over time, and human use of geological resources. Students describe processes involved in the location, extraction, processing, and recycling of geological resources found in Manitoba and Canada. Students recognize that soil is an important natural resource and they discuss the importance of soil conservation. Students identify environmental, social, and economic factors that should be considered in making informed decisions about land use. They examine theories explaining the Earth's geology, and recognize the role of technology in the development of new scientific theories. Specialized careers involving the science and technology of the Earth's crust are also explored.

Students will…

7-4-01 Use appropriate vocabulary related to their investigations of the Earth's crust.

Include: crust, mantle, outer core, inner core, weathering (physical, biological, and chemical), erosion, rock cycle, fossil fuel, geothermal energy, continental drift theory, theory of plate tectonics.

GLO: C6, D5

7-4-02 Describe the Earth's structure.

Include: crust, mantle, outer core, inner core.

GLO: C6, D5

7-4-03 Describe the geological processes involved in rock and mineral formation, and classify rocks and minerals by their method of formation.

GLO: D3, D5, E3

7-4-04 Investigate and describe the processes of weathering and erosion, and recognize that they cause changes in the landscape over time.

Include: physical, biological, and chemical weathering.

GLO: D3, D5, E3

7-4-05 Explain how rocks on the Earth constantly undergo a slow process of change through the rock cycle.

GLO: D5, E3

7-4-06 Identify geological resources that are used by humans as sources of energy, and describe their method of formation.

Include: fossil fuels, geothermal energy.

GLO: D4, D5, E3

7-4-07 Identify geological resources that are present in Manitoba and Canada, and describe the processes involved in their location, extraction, processing, and recycling.

Include: fossil fuels, minerals.

GLO: A5, B5, D3, D5

7-4-08 Identify environmental impacts of geological resource extraction, and describe techniques used to address these.

GLO: B1, B5, C1, C3

7-4-09 Recognize that soil is a natural resource, and explain how the characteristics of soil determine its use.

GLO: D5, E1

7-4-10 Describe methods used to control soil erosion, and recognize the importance of soil conservation.

Examples: economically important to the agri-food industry, important for controlling the flow of water, necessary for plant growth...

GLO: A5, B2, B5, E3

7-4-11 Identify environmental, social, and economic factors that should be considered in making informed decisions about land use.

GLO: B1, B5, D5

7-4-12 Describe evidence used to support the continental drift theory, and explain why this theory was not generally accepted by scientists.

GLO: A1, A2, A4, D5

7-4-13 Describe evidence used to support the theory of plate tectonics, the role technology has played in the development of this theory, and reasons why it is generally accepted by scientists.

GLO: A1, A2, A5, D5

7-4-14 Explain geological processes and events using the theory of plate tectonics.

Include: mountain formation, earthquakes, volcanoes.

GLO: A1, A2, D5, E3

7-4-15 Identify specialized careers involving the study of the Earth's crust or the utilization of geological resources, and give examples of technologies used in each.

Examples: geophysicist, seismologist, volcanologist, farmer...

GLO: A5, B4

Grade 8, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0* comprises nine categories of specific student learning outcomes (SLOs) that describe the skills and attitudes involved in scientific inquiry, the design process, or both.

In scientific inquiry at Grades 7 and 8, students build on the concept of a fair test developed in Grades 5 and 6. This includes developing a prediction/hypothesis that identifies a cause and effect relationship between dependent and independent variables; repeating experiments to increase accuracy and reliability; looking for alternative explanations for observations; recognizing strengths and weaknesses of different methods of collecting and displaying data; and determining potential sources of error. In the design process, students construct prototypes to solve practical problems and analyze them according to criteria such as cost, efficiency, and environmental considerations. Students continue to apply their problem-solving skills in the evaluation of consumer products in order to determine the best product for a particular purpose. This involves identifying priorities. For example, in choosing a brand of sunscreen, to what extent do cost, effectiveness, and the environmental track record of the company affect the decision?

Although the thematic clusters (Clusters 1 to 4) include certain skills and attitudes, Cluster 0 fully defines scientific inquiry and design process skills and attitudes at each grade. Teachers should select appropriate contexts to introduce and reinforce Cluster 0 SLOs over the course of the school year. To assist in planning and to facilitate curricular integration, many SLOs within Cluster 0 are accompanied by links to SLOs 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 are also presented as part of a Grades 5 to 8 chart (separate attachment).

Students will...

	Scientific Inquiry	Design Process
Initiating	**8-0-1a ⊂ Formulate specific questions that lead to investigations.** **Include: rephrase questions to a testable form; focus research questions.** **GLO: A1, C2** **(ELA Grade 8, 3.1.2; Math: SP-I.1.8)** **8-0-1b ⊂ Select and justify a method to be used in finding the answer to a specific question.** **GLO: C2** **(ELA Grade 8, 3.2.3; Math: SP-II.1.8)**	**8-0-1c Identify practical problems to solve.** ***Examples: How can I make water flow uphill? Which type of bottled water should I buy?...*** **GLO: C3** **8-0-1d ⊂ Select and justify a method to be used in finding a solution to a practical problem.** **GLO: C3** **(Math: SP-II.1.8)**
Researching	**8-0-2a ⊂ Access information, using a variety of sources.** ***Examples: libraries, magazines, community resource people, outdoor experiences, videos, CD-ROMs, Internet...*** **GLO: C6** **(ELA Grade 8, 3.2.2)** **8-0-2b Develop and use criteria for evaluating information sources.** **Include: distinguish between fact and opinion.** **GLO: C6, C8** **(ELA Grade 8, 3.2.2, 3.2.3; TFS 2.2.2)** **8-0-2c Make notes in point form, summarizing major ideas and supporting details and referencing sources.** **GLO: C6** **(ELA Grade 8, 3.3.2)**	

	Scientific Inquiry	Design Process
Planning	**8-0-3a ⊂ Formulate a prediction/hypothesis that identifies a cause and effect relationship between the dependent and independent variables.** **GLO: A2, C2** **(Math: SP-I.1.8)**	**8-0-3d ⊂ Develop criteria to evaluate a prototype or consumer product.** **Include: function, aesthetics, environmental considerations, cost, efficiency.** **GLO: C3**
	8-0-3b Identify the independent and dependent variables in an experiment. **GLO: A2, C2**	
	8-0-3c ⊂ Create a written plan to answer a specific question. **Include: apparatus, materials, safety considerations, steps to follow, and variables to control.** **GLO: C2** **(ELA Grade 8, 3.1.4)**	**8-0-3e ⊂ Create a written plan to solve a problem.** **Include: materials, safety considerations, three-dimensional sketches, steps to follow.** **GLO: C3, C6**

	Scientific Inquiry	Design Process
Implementing a Plan	**8-0-4a ⊂ Carry out procedures that comprise a fair test.** **Include: controlling variables, repeating experiments to increase accuracy and reliability.** **GLO: C2**	**8-0-4b ⊂ Construct a prototype.** **GLO: C3**
	8-0-4c ⊂ Work cooperatively with team members to carry out a plan, and troubleshoot problems as they arise. **GLO: C7** **(ELA Grade 8, 5.2.2)**	
	8-0-4d Identify and assume various roles to achieve group goals. **GLO: C7** **(ELA Grade 8, 5.2.2)**	
	8-0-4e ⊂ Demonstrate work habits that ensure personal safety, the safety of others, and consideration for the environment. **Include: keeping an uncluttered workspace; putting equipment away after use; handling glassware with care; wearing goggles when required; disposing of materials safely and responsibly.** **GLO: C1**	
	8-0-4f ⊂ Identify WHMIS hazard symbols that provide information on the safety of substances. **GLO: C1**	

Students will...

Observing, Measuring, Recording

Scientific Inquiry	Design Process
8-0-5a ⊂ Make observations that are relevant to a specific question. **GLO: A1, A2, C2**	**8-0-5b ⊂ Test a prototype or consumer product, using predetermined criteria.** **GLO: C3, C5**

8-0-5c Select and use tools to observe, measure, and construct.
Include: microscope, concave and convex mirrors and lenses, chemical indicators.
GLO: C2, C3, C5

8-0-5d ⊂ Make conversions among commonly used SI units.
GLO: C2, C5
(Math: SS-IV.3.7, SS-I.3.6, SS-III.3.7)

8-0-5e ⊂ Estimate and measure accurately using SI and other standard units.
Include: determining volume by displacement of water.
GLO: C2, C5
(Math: SS-IV.1.6, SS-III.1.5, Math: SS-III.1.6, SS-I.1.5)

8-0-5f ⊂ Record, compile, and display observations and data, using an appropriate format.
GLO: C2, C6
(ELA Grade 8, 3.3.1; Math: SP-III.2.8)

Analyzing and Interpreting

Scientific Inquiry	Design Process
8-0-6a Construct graphs to display data, and interpret and evaluate these and other graphs. ***Examples: circle graphs...*** **GLO: C2, C6** **(ELA Grade 8, 3.3.1; Math: SP-III.2.7; TFS: 4.2.2–4.2.6)**	**8-0-6d ⊂ Identify and make improvements to a prototype, and explain the rationale for the changes.** **GLO: C3, C4**
8-0-6b ⊂ Interpret patterns and trends in data, and infer and explain relationships. **GLO: A1, A2, C2, C5**	
8-0-6c ⊂ Identify strengths and weaknesses of different methods of collecting and displaying data, and potential sources of error. **GLO: A1, A2, C2, C5** **(ELA Grade 8, 3.3.3)**	**8-0-6e ⊂ Evaluate the strengths and weaknesses of a consumer product, based on predetermined criteria.** **GLO: C3, C4**

8-0-6f ⊂ Identify how the original plan evolved and justify the changes.
GLO: C2, C3
(ELA Grade 8, 3.3.4)

Concluding and Applying

Scientific Inquiry	Design Process
8-0-7a ⊂ Draw a conclusion that explains investigation results. **Include: explaining the cause and effect relationship between the dependent and independent variables; identifying alternative explanations for observations; supporting or rejecting a prediction/hypothesis.** **GLO: A1, A2, C2** **(ELA Grade 8, 3.3.4)**	**8-0-7d ⊂ Propose and justify a solution to the initial problem.** **GLO: C3**
8-0-7b ⊂ Critically evaluate conclusions, basing arguments on fact rather than opinion. **GLO: C2, C4**	
8-0-7c ⊂ Identify a new prediction/hypothesis based on investigation results. **GLO: A1, C2** **(ELA Grade 8, 3.3.4)**	**8-0-7e ⊂ Identify new practical problems to solve.** **GLO: C3**

8-0-7f ⊂ Reflect on prior knowledge and experiences to construct new understanding and apply this new knowledge in other contexts.
GLO: A2, C4
(ELA Grade 8, 1.2.1)

8-0-7g ⊂ Communicate methods, results, conclusions, and new knowledge in a variety of ways.
Examples: oral, written, multimedia presentations...
GLO: C6
(ELA Grade 8, 4.4.1)

8-0-7h ⊂ Identify and evaluate potential applications of investigation results.
GLO: C4

Reflecting on Science and Technology

Scientific Inquiry	Design Process
8-0-8a ⊂ Distinguish between science and technology. **Include: purpose, procedures, products.** **GLO: A3**	
8-0-8b ⊂ Describe examples of how scientific knowledge has evolved in light of new evidence, and the role of technology in this evolution. **GLO: A2, A5, B1**	
8-0-8d ⊂ Describe examples of how technologies have evolved over time in response to changing needs and scientific advances. **GLO: A5, B1, B2**	
8-0-8e ⊂ Provide examples of Canadian institutions and individuals who have contributed to science and technology, and describe their contributions. **GLO: A1, A4, B1, B4**	
8-0-8f ⊂ Relate personal activities in formal and informal settings to specific scientific disciplines. **GLO: A1, B4**	
8-0-8g ⊂ Discuss societal, environmental, and economic impacts of scientific and technological endeavours. **Include: local and global impacts.** **GLO: A1, B1, B3, B5**	

	Scientific Inquiry / Design Process
Demonstrating Scientific and Technological Attitudes and Habits of Mind	**8-0-9a ⊂ Appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds.** **GLO: A4** **8-0-9b ⊂ Express interest in a broad scope of science- and technology-related fields and issues.** **GLO: B4** **8-0-9c ⊂ Demonstrate confidence in their ability to carry out investigations.** **GLO: C5** **8-0-9d ⊂ Value skepticism, accuracy, precision, and open-mindedness as scientific and technological habits of mind.** **GLO: C3** **8-0-9e ⊂ Be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment.** **GLO: B5** **8-0-9f ⊂ Consider both immediate and long-term effects of their actions.** **GLO: B5, C4, E3**

Notes

Grade 8, Cluster 1: Cells and Systems

Overview

In this cluster, students investigate living things through a focus on cells and systems. Cell theory provides the basis for exploring cells and unicellular and multicellular organisms. Students identify major events and technological innovations that have enabled scientists to increase our understanding of cell biology. Microscopes are used to observe and compare the general structure and function of plant and animal cells. Students examine important processes that take place within the cell, including the movement of nutrients and wastes across cell membranes. The need for specialization of cells and tissues in multicellular organisms is discussed as are the structural and functional relationships among cells, tissues, organs, and systems. Investigations of the circulatory and respiratory systems highlight their importance to the body and lead to an understanding of how body systems function interdependently. Students identify components of the body's primary and secondary defense systems. They examine medical advances that enhance the human body's defence mechanisms, and research disorders and diseases that can affect body systems.

Students will…

8-1-01 Use appropriate vocabulary related to their investigations of cells and systems.

Include: cell theory, osmosis, diffusion, selective permeability, unicellular, multicellular, specialized cells and tissues, organs, systems, arteries, veins, capillaries, terms related to cell structure, heart structure, components of blood, and primary and secondary defense systems.

GLO: C6, D1

8-1-02 Identify characteristics of living things, and describe how different living things exhibit these characteristics.

Include: composed of cells; reproduce; grow; repair themselves; require energy; respond to the environment; have a lifespan; produce wastes.

GLO: D1, E1

8-1-03 Describe cell theory.

Include: all living things are composed of one or more cells; cells are the basic unit of structure and function of any organism; all cells come from pre-existing cells; the activity of an organism as a whole depends on the total activity of all its cells.

GLO: A2, D1, E2

8-1-04 Identify major events and technological innovations that have enabled scientists to increase our understanding of cell biology.

Examples: invention of the light and electron microscopes, works of Robert Hooke, Anton van Leeuwenhoek, Matthias Schleiden and Theodor Schwann...

GLO: A2, A4, B1, B2

8-1-05 Identify and compare major structures in plants and animal cells, and explain their function.

Include: cell membrane, cytoplasm, mitochondria, nucleus, vacuoles, cell wall, chloroplasts.

GLO: D1, E1

8-1-06 Demonstrate proper use and care of the microscope to observe the general structure of plant and animal cells.

Include: preparing wet mounts beginning with the least powerful lens; focussing; drawing specimens; indicating magnification.

GLO: C1, C2, D1

8-1-07 Describe the movement of nutrients and wastes across cell membranes and explain its importance.

Include: osmosis, diffusion, selective permeability.

GLO: D1

8-1-08 Differentiate between unicellular and multicellular organisms.

GLO: D1, E1

8-1-09 Describe why cells and tissues are specialized in multicellular organisms, and observe examples.

Include: specialization is needed because all cells in a complex organism do not have access to the external environment.

GLO: C2, D1

8-1-10 Describe structural and functional relationships among cells, tissues, organs, and systems.

GLO: D1, E2

8-1-11 Describe the structure and function of the heart and the path of blood to and from the heart through its four chambers.

Include: atria, ventricles, septum, valves, aorta, pulmonary artery, pulmonary veins, superior vena cava, inferior vena cava.

GLO: D1, E1

8-1-12 Compare and contrast the structure and function of arteries, veins, and capillaries.

GLO: D1, E1

8-1-13 Identify components of blood and describe the function of each.

Include: red blood cells carry oxygen; white blood cells fight infection; platelets clot blood; plasma is the liquid part of blood that transports blood cells, dissolved material, nutrients, and waste products.

GLO: D1

(continued)

Grade 8, Cluster 1: Cells and Systems (continued)

8-1-14 Describe, using examples, how individual systems in the human body function interdependently.

GLO: D1, E2

8-1-15 Compare heart rate and respiratory rate before, during, and after various physical activities; explain the observed variations; and discuss implications for overall health.

GLO: B3, C2, D1, E3

8-1-16 Identify components of the primary and secondary defence systems of the human body, and describe their roles.

Include: primary defense system — skin, tears, ear wax, saliva, gastric juices, cilia hairs; secondary defense system — white blood cells, antibodies.

GLO: D1, E2

8-1-17 Identify medical advances that enhance the human body's defence mechanisms and describe their effects on society.

Examples: vaccines, antibiotics...

GLO: A5, B1, B2, B3

8-1-18 Research and describe disorders/diseases that affect body systems, and identify possible preventative measures.

Examples: liver disease, diabetes, multiple sclerosis, heart attack, stroke, high/low blood pressure, leukemia, anemia, high cholesterol...

GLO: B3, C6, D1

8-1-19 Describe functional similarities and differences of comparable structures and systems in different groups of living things.

Examples: movement, food intake, and digestion of a unicellular organism, an invertebrate, and a vertebrate; gas exchange in plants versus animals...

GLO: D1, E1

Notes

Grade 8, Cluster 2: Optics

Overview

In this cluster, students broaden their understanding of how light is produced, transmitted, and detected. Students identify colours as different wavelengths of light, and explore why objects appear to have colour. Various types of electromagnetic radiation are compared. The potential positive and negative impacts of technological devices that use electromagnetic radiation are discussed. Students explore the principles and properties of reflection and refraction, and their application in everyday situations. Students investigate the characteristics of concave and convex mirrors and lenses. They enhance their understanding of how these devices function in a variety of optical tools. Students also demonstrate the formation of images using lenses and compare the function of the human eye to that of a camera lens.

Students will…

8-2-01 Use appropriate vocabulary related to their investigations of optics.

Include: spectrum; additive theory; subtractive theory; frequency; wavelength; refraction; concave and convex mirrors and lenses; terms related to types of light sources, types of electromagnetic radiation, and the law of reflection.

GLO: C6, D3

8-2-02 Differentiate between incandescent and luminescent sources of light.

Include: fluorescent, phosphorescent, chemiluscent, bioluminescent.

GLO: D3, D4, E1

8-2-03 Demonstrate that light is a form of energy, that light travels in a straight line, and can be separated into the visible light spectrum.

GLO: A1, C1, C2, D4

8-2-04 Explain, using the additive theory, how colours are produced, and identify applications of this theory in daily life.

GLO: A1, A2, B1

8-2-05 Explain how the human eye detects colour, and how the ability to perceive colour may vary from person to person.

GLO: A2, E1

8-2-06 Demonstrate, using the subtractive theory, how colours are produced, and identify applications of this theory in daily life.

GLO: A2, B1

8-2-07 Compare and contrast various types of electromagnetic radiation, with respect to relative energy, frequency, wavelength, and human perception.

Include: radio waves, microwaves, infrared radiation, visible light, ultra-violet radiation, x-rays, gamma rays.

GLO: D4, E1

8-2-08 Provide examples of technologies that use electromagnetic radiation, and describe potential positive and negative impacts of their uses.

Examples: satellite dish, x-ray machine, light telescopes, motion sensors, microwave ovens...

GLO: A5, B1, D4

8-2-09 Conduct experiments to determine the law of reflection, and provide examples of the use of reflection in daily life.

Include: the angle of reflection is the same as the angle of incidence; the incident beam, the normal and the reflected beam are all on the same plane.

GLO: A2, C1, C2, D4

8-2-10 Conduct experiments to compare the refraction of light through substances of different densities.

GLO: C1, C2, D4

8-2-11 Explain how reflection and refraction produce natural phenomena.

Examples: sun dogs, rainbows, blue sky...

GLO: D4, D5

8-2-12 Investigate to determine how light interacts with concave and convex mirrors and lenses, and provide examples of their use in various optical instruments and systems.

GLO: B1, C2, D3, D4

8-2-13 Demonstrate the formation of images using a double convex lens, and predict the effects of changes in lens position on the size and location of the image.

Examples: magnify or reduce an image by altering the placement of one or more lenses...

GLO: C2, C5, D4

8-2-14 Compare the functional operation of the human eye to that of a camera in focussing an image.

GLO: A5, C4, D1, D4

Grade 8, Cluster 3: Fluids

Overview

In this cluster, students investigate the properties of fluids, including viscosity, density, and compressibility. Students identify products in which viscosity is an important characteristic, and plan and conduct experiments to determine factors that affect flow. Students illustrate effects of temperature on density, and they compare the effects of fluids with different densities on the buoyant force of an object. They use the particle theory of matter to explain the relationships among pressure, volume, and temperature. Investigations of the relative compressibility of fluids are related to the ability of liquids and gases to transmit forces in hydraulic and pneumatic devices. Students apply their understanding of fluids within a practical context through the design, construction, and testing of a prototype that utilizes a hydraulic or pneumatic system.

Students will…

8-3-01 Use appropriate vocabulary related to their investigations of fluids.

Include: fluid, viscosity, flow, density, particle theory of matter, buoyant force, pressure, compressibility, hydraulic, pneumatic.

GLO: C6, D3, E1

8-3-02 Distinguish between fluids and non-fluids.

GLO: D3, E1

8-3-03 Explore and compare the viscosity of various liquids.

Examples: time the fall of a steel ball through various liquids; time the flow rate of different liquids on an incline...

GLO: C2, D3, E1

8-3-04 Identify products in which viscosity is an important property, and evaluate different brands of the same product, using the design process.

Examples: sauces, lubricating oil, paint, hand lotion...

GLO: A5, B2, C1

8-3-05 Plan and conduct experiments to determine factors that affect flow within a given system.

Examples: temperature, pressure, tube diameter...

GLO: C1, C2, D3, E2

8-3-06 Measure, calculate, and compare densities of solids, liquids, and gases.

Include: different amounts of the same substance, regularly and irregularly shaped objects.

GLO: C2, C5, D3

8-3-07 Illustrate, using the particle theory of matter, the effects of temperature change on the density of solids, liquids, and gases.

GLO: A2, C6, D3, E4

8-3-08 Compare fluids of different densities to determine how they alter the buoyant force on an object.

GLO: C2, D3

8-3-09 Recognize that pressure is the relationship between force and area, and describe situations in which pressure can be increased or decreased by altering surface area.

Examples: wearing snowshoes instead of boots to decrease pressure, increase surface area, and stay on top of snow...

GLO: B1, B2, D4

8-3-10 Explain, using the particle theory of matter, the relationships among pressure, volume, and temperature of liquid and gaseous fluids.

GLO: A2, D4

8-3-11 Compare the relative compressibility of water and air, and relate this property to their ability to transmit force in hydraulic and pneumatic systems.

GLO: A5, C1, D4, E1

8-3-12 Identify a variety of natural and constructed hydraulic and pneumatic systems and describe how they function.

Examples: heart, lungs, eyedropper, misting bottle, fuel pump, hydraulic lift...

GLO: D4, E2

8-3-13 Compare hydraulic and pneumatic systems, and identify advantages and disadvantages of each.

GLO: B1, D4, E1, E2

8-3-14 Use the design process to construct a prototype that uses a pneumatic or hydraulic system to perform a given task.

Examples: a prototype that can lift a load a specified distance...

GLO: C3, D4

Grade 8, Cluster 4: Water Systems

Overview

In this cluster, students investigate the properties of water, its global manifestations, and its impacts. They compare and contrast fresh and salt water, describe factors that affect ocean currents, and recognize the impact of large bodies of water and ocean currents on regional climates. Features of the North American drainage system are identified, and factors that influence erosion and deposition in streams and large bodies of water examined. Students determine causes of flooding and examine methods and technologies used to contain or prevent damage from erosion and floods. Sources of drinking water are identified, methods for treating water are discussed, and waste-water disposal systems are compared. Students explore water pollution problems and identify environmental, social, and economic factors important to the management of water resources.

Students will…

8-4-01 Use appropriate vocabulary related to their investigations of water systems.

Include: heat capacity, fresh water, salt water, convection, Coriolis effect, global water cycle, drainage system, watershed, continental divide, erosion, deposition, flow rate, tides, terms related to water treatment.

GLO: C6, D5

8-4-02 Demonstrate that water, as compared to other substances, has a high heat capacity and is able to dissolve a wide variety of solutes.

GLO: C1, C2, C5, D3

8-4-03 Compare and contrast characteristics and properties of fresh water and salt water.

Examples: freezing point, density, dissolved materials, global distribution, relative amounts, biologically diverse components of each...

GLO: D3, D5, E1

8-4-04 Identify factors that can work individually or in combination to affect ocean currents.

Include: convection, Coriolis effect, prevailing winds, position of continents.

GLO: D5, E2

8-4-05 Describe how the heat capacity of large bodies of water and the movement of ocean currents influence regional climates.

Examples: Gulf Stream effects, El Niño, lake effect...

GLO: D3, D5, E2

8-4-06 Describe the components of the global water cycle and explain how it works.

GLO: D3, D5, E2

8-4-07 Describe features of the North American drainage system.

Include: local and regional watersheds, direction of water flow, continental divide.

GLO: C6, D5

8-4-08 Describe how erosion and deposition are influenced by the flow rate of a stream or river, and contrast the related characteristics of young and mature streams.

Examples: meanders, oxbows, alluvial deposits, sandbars, flood plains, deltas...

GLO: C8, D5, E3

8-4-09 Describe how wave action and ice movement in large bodies of water cause erosion and deposition.

GLO: D5, E3

8-4-10 Explain how tides are caused and describe their effects on shorelines.

GLO: D5, D6

8-4-11 Describe examples of human interventions to prevent riverbank or coastal erosion.

Examples: vegetation, reinforcement (concrete, boulders), piers, breakwaters...

GLO: B2, B5, D5

8-4-12 Identify factors that can cause flooding either individually or in combination.

Examples: heavy snow pack, quick thaw, rain in spring, lack of vegetation to remove water through transpiration, frozen ground preventing absorption, agricultural drainage systems, dams, diversions...

GLO: C8, D5

8-4-13 Provide examples of the way in which technology is used to contain or prevent damage due to flooding, and discuss related positive and negative impacts.

Examples: floodway, diversion, dike, levee...

GLO: A5, B1, D5

8-4-14 Identify sources of drinking water and describe methods for obtaining water in areas where supply is limited.

Examples: desalination, melting of ice, condensation...

GLO: B1, B2, B3, D5

8-4-15 Explain how and why water may need to be treated for use by humans.

Include: filtration, settling, chlorination, fluoridation.

GLO: B1, B3, D5

(continued)

Grade 8, Cluster 4: Water Systems (continued)

8-4-16 Compare the waste-water disposal system within their communities to one used elsewhere.

Include: process involved, environmental impact, cost.

GLO: B2, B5

8-4-17 Identify substances that may pollute water, related environmental and societal impacts of pollution, and ways to reduce or eliminate effects of pollution.

GLO: B2, B3, B5, D5

8-4-18 Identify environmental, social, and economic factors that should be considered in the management of water resources.

Examples: ecosystem preservation, employment, recreation, industrial growth, water quality...

GLO: B5, D5

8-4-19 Use the design process to develop a system to solve a water-related problem.

GLO: B2, B3, C3, D5

Notes

Appendices

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 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

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

Notes

Kindergarten to Grade 4, and Senior 1 Science Cluster Titles

Manitoba's *Science Frameworks (Kindergarten to Grade 4, Grades 5–8, Senior 1)* present specific learning outcomes (SLOs) that are arranged into groupings, referred to as clusters. The clusters are thematic and generally relate to the three science disciplines: life science, physical science, and Earth and space science.

The cluster titles for both Kindergarten to Grade 4 Science, and Senior 1 Science have been reproduced in the figure below.

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.

Grades / Clusters	Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4	Senior 1
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	Reproduction
Cluster 2	Colours	The Senses	Properties of Solids, Liquids, and Gases	Materials and Structures	Light	Atoms and Elements
Cluster 3	Paper	Characteristics of Objects and Materials	Position and Motion	Forces that Attract or Repel	Sound	Nature of Electricity
Cluster 4		Daily and Seasonal Changes	Air and Water in the Environment	Soils in the Environment	Rocks, Minerals, and Erosion	Exploring the Universe

Notes

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