

Senior 1
Specific Learning Outcomes

Specific Learning Outcomes

Organization into Clusters

This *Science Framework* presents specific learning outcomes (SLOs) for Senior 1 science. SLOs are arranged into groupings, referred to as clusters. Clusters 1 to 4 are thematic and generally relate to the three science disciplines (Life, Physical, Earth and Space) discussed earlier in the *Science Framework*. Cluster 0 comprises Overall Skills and Attitudes which are to be integrated into Clusters 1 to 4. (See Figure 6: Cluster Titles for Senior 1 Science and Figure 7: Cluster Titles for Grades 5 to Senior 1 Science.)

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 into new groupings and a new order. *Senior 1 Science: A Foundation for Implementation* will provide planning tools, as well as suggestions for instruction and assessment. It is expected that each of the clusters (1–4) presented in this framework be given equal time.

The Overall Skills and Attitudes SLOs for Senior 1 are also presented in a *Senior 1 Science at a Glance* poster (separate attachment). The purpose of this poster is to provide teachers with a grade view of skills and attitudes outcomes that need to be achieved. Additional copies of this poster are available from the Manitoba Text Book Bureau (MTBB stock #80367).

A *Grades 5 to 8 Overall Skills and Attitudes Chart*, along with Grade-at-a-Glance posters, are also available (MTBB stock #80366).

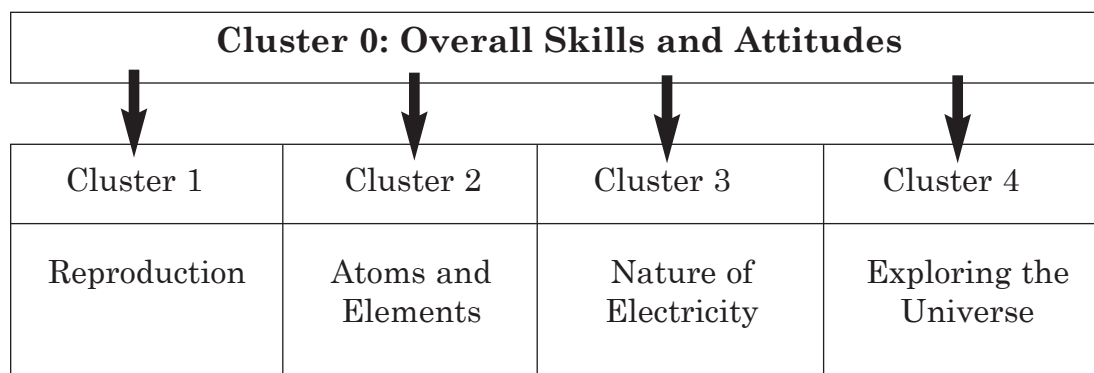


Figure 6: Cluster Titles for Senior 1 Science

Grades Clusters	Grade 5	Grade 6	Grade 7	Grade 8	Senior 1
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	Reproduction
Cluster 2	Properties of and Changes in Substances	Flight	Particle Theory of Matter	Optics	Atoms and Elements
Cluster 3	Forces and Simple Machines	Electricity	Forces and Structures	Fluids	Nature of Electricity
Cluster 4	Weather	Exploring the Solar System	Earth's Crust	Water Systems	Exploring the Universe

Figure 7: Cluster Titles for Grades 5 to Senior 1 Science

Guide to Reading Science Specific Learning Outcomes

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

Senior 1 Science
Specific Learning Outcomes

Senior 1, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0 comprises nine categories of specific learning outcomes that describe the skills and attitudes* involved in scientific inquiry and the decision-making process for STSE issues. In Grades 5 to 8, students develop scientific inquiry through the development of an hypothesis/prediction, the identification and treatment of variables, and the formation of conclusions. Students begin to make decisions based on their own research and the decision-making skills they have developed in previous grades, gradually but also acquire key attitudes such as the nature of science, a respect for the work of others, communication, the cooperative learning process, and the use of technology.

In Senior 1, students continue to use scientific inquiry as an important process in their science learning, but also recognize that STSE issues require a more sophisticated treatment through the decision-making process. This process has been delineated in the Cluster 0 specific learning outcomes.

Teachers should select appropriate contexts to introduce and reinforce scientific inquiry, the decision-making process, and positive attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students will use the decision-making process as they examine a current biotechnology issue in the news.

	Scientific Inquiry	STSE Issues
Initiating	<p>S1-0-1a Propose questions that could be tested experimentally. GLO: C2 (ELA: S1: 3.1.2)</p> <p>S1-0-1b Select and justify various methods for finding the answers to specific questions. GLO: C2 (Math: S1: A-1)</p>	<p>S1-0-1c Identify STSE issues which could be addressed. GLO: C4</p> <p>S1-0-1d Identify stakeholders and initiate research related to an STSE issue. GLO: C4 (ELA: S1: 3.1.4, 4.4.1)</p>

* Cluster 0, Overall Skills and Attitudes for this grade are presented for the purpose of this chart is to provide a visual representation of the skills and attitudes that need to be achieved by students at the end of each grade.

Describes general content and emphasis of cluster

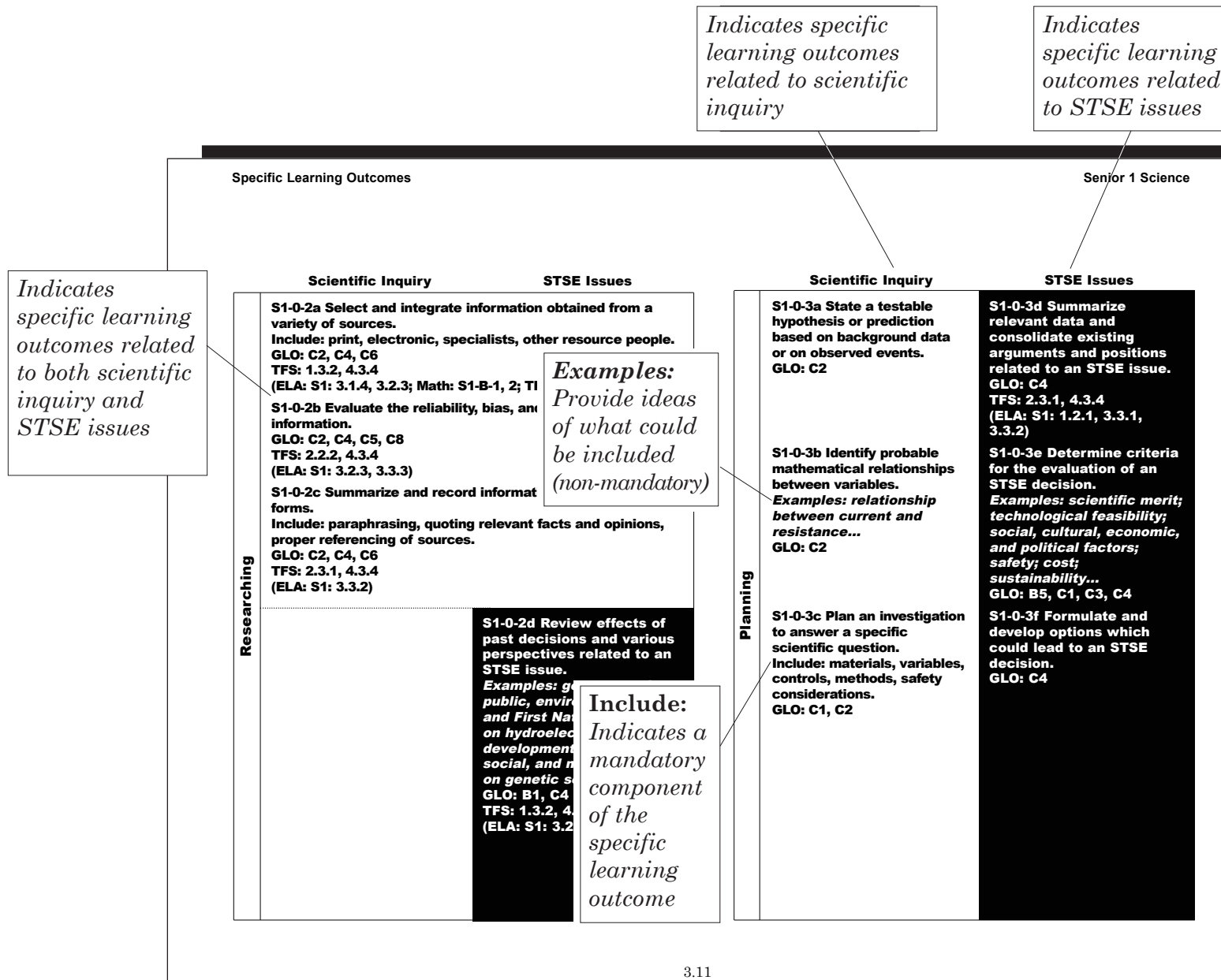
Indicates organizational category of skills/attitudes

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

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

Cross-reference to general learning outcomes

Cross-reference to other areas: mathematics, ELA (English language arts), TFS (Technology As a Foundation Skill Area)



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

Describes general content and emphasis of cluster

Senior 1 Science	Specific Learning Outcomes
<h3>Senior 1, Cluster 1: Reproduction</h3>	
<p>Overview</p> <p>Reproduction is an essential biological mechanism for the continuity and diversity of species. Students compare sexual and asexual methods of reproduction in this cluster. They learn how the human reproductive system functions and describe the major stages of human development from conception to birth. Students recognize that the nucleus of a cell contains genetic information and is responsible for the transmission of traits from one generation to the next. They also discuss factors that may change a cell's genetic information, including environmental factors. Using the knowledge they have gained, students also address a current biotechnology issue.</p>	<p>S1-1-03 Describe various types of asexual reproduction that occur in plant and animal species. <i>Examples: fission, budding, sporulation, vegetative propagation, regeneration...</i> GLO: D1, E1</p>
<p>Students</p> <p>S1-1-01 Illustrate and explain the process of mitotic cell division in plants and animals. Include: chromosom cell cycle. GLO: D1, E1, E2</p>	<p>S1-1-04 Investigate and describe agricultural applications of asexual reproduction. <i>Examples: cloning, cuttings, grafting, bulbs...</i> GLO: A5, B1, B2, D1</p>
<p>S1-1-02 Observe and explain division. GLO: C2, D1, E3</p>	<p>S1-1-05 Illustrate and explain the production of male and female gametes by meiosis. GLO: D1, E1, E2</p>
<p>S1-1-03 Investigate and explain adaptations of plant and animal species which enhance reproductive success. <i>Examples: appearance, behaviour, number of gametes or offspring, chemical cues...</i> GLO: D2, E1, E2</p>	<p>S1-1-06 Compare and contrast the function of mitosis to that of meiosis. Include: diploid cells, haploid cells. GLO: D1, E1</p>
<p>S1-1-04 Compare sexual and asexual reproduction in terms of their advantages and disadvantages for plant and animal species. GLO: D1, E1</p>	<p>S1-1-07 Investigate and explain adaptations of plant and animal species which enhance reproductive success. <i>Examples: appearance, behaviour, number of gametes or offspring, chemical cues...</i> GLO: D2, E1, E2</p>
<p>3.16</p>	

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

Cross-reference to general learning outcomes

Specific Learning Outcomes	Senior 1 Science	
<p>S1-1-09 Describe the structure and function of the male and female human reproductive systems. Include: role of hormones. GLO: D1, E1, E2</p>	<p>S1-1-15 Investigate and describe environmental factors and personal choices that may lead to a genetic mutation or changes in an organism's development. <i>Examples: fetal exposure to alcohol, overexposure to sunlight, toxins, hormone mimics, food additives, radiation...</i> GLO: B1, B3, D1, D2</p>	<p>Examples: <i>Provides ideas of what could be included (non-mandatory)</i></p>
<p>S1-1-10 Outline human development from conception through birth. Include: X and Y chromosomes, zygote, embryo, fetus. GLO: D1, E1, E2, E3</p>	<p>S1-1-16 Investigate Canadian and international contributions to research and technological development in the field of genetics and reproduction. <i>Example: Human Genome Project...</i> GLO: A3, A4, B1, B2</p>	
<p>S1-1-11 Observe, collect, and analyze class data of single trait inheritance. <i>Examples: hand clasping, earlobe attachment, tongue rolling...</i> GLO: C2, D1</p>	<p>S1-1-17 Discuss current and potential applications and implications of biotechnologies including their effects upon personal and public decision making. Include: genetic engineering, genetic screening, cloning, DNA fingerprinting. GLO: B1, B2, C4, C8</p>	<p>Include: <i>Indicates a mandatory component of the specific learning outcome</i></p>
<p>S1-1-12 Differentiate between dominant and recessive genes. Include: genotype, phenotype. GLO: D1, E1, E2</p>	<p>S1-1-18 Use the decision-making process to address a current biotechnology issue. GLO: C4, C6, C7, C8</p>	
<p>S1-1-13 Describe the relationships among DNA, chromosomes, genes, and the expression of traits. Include: genetic similarity among all humans. GLO: A2, D1, E1, E2</p>		
<p>S1-1-14 Explain the inheritance of sex-linked traits in humans and use a pedigree to track the inheritance of a single trait. <i>Examples: colour blindness, hemophilia...</i> GLO: D1, E1, E2</p>		

Notes

Senior 1, Cluster 0: Overall Skills and Attitudes

Overview

Cluster 0 comprises nine categories of specific learning outcomes that describe the skills and attitudes* involved in scientific inquiry and the decision-making process for STSE issues. In Grades 5 to 8, students develop scientific inquiry through the development of an hypothesis/prediction, the identification and treatment of variables, and the formation of conclusions. Students begin to make decisions based on scientific facts and refine their decision-making skills as they progress through the grades, gradually becoming more independent. Students also acquire key attitudes, an initial awareness of the nature of science, and other skills related to research, communication, the use of information technology, and cooperative learning.

In Senior 1, students continue to use scientific inquiry as an important process in their science learning, but also recognize that STSE issues require a more sophisticated treatment through the decision-making process. This process has been delineated in the Cluster 0 specific learning outcomes.

* Cluster 0, Overall Skills and Attitudes, specific learning outcomes for this grade are presented as a chart (separate attachment). The purpose of this chart is to provide a full grade overview of skills and attitudes that need to be achieved.

Teachers should select appropriate contexts to introduce and reinforce scientific inquiry, the decision-making process, and positive attitudes within the thematic clusters (Clusters 1 to 4) over the course of the school year. For example, students will use the decision-making process as they examine a current biotechnology issue in Cluster 1. To assist in planning and to facilitate curricular integration, many specific learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English language arts (ELA) and mathematics (Math). There are also links to *Technology As a Foundation Skill Area* (TFS).

Students will...

	Scientific Inquiry	STSE Issues
Initiating	<p>S1-0-1a Propose questions that could be tested experimentally. GLO: C2 (ELA: S1: 3.1.2)</p> <p>S1-0-1b Select and justify various methods for finding the answers to specific questions. GLO: C2 (Math: S1: A-1)</p>	<p>S1-0-1c Identify STSE issues which could be addressed. GLO: C4</p> <p>S1-0-1d Identify stakeholders and initiate research related to an STSE issue. GLO: C4 (ELA: S1: 3.1.4, 4.4.1)</p>

	Scientific Inquiry	STSE Issues
Researching	<p>S1-0-2a Select and integrate information obtained from a variety of sources. Include: print, electronic, specialists, other resource people. GLO: C2, C4, C6 TFS: 1.3.2, 4.3.4 (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1)</p> <p>S1-0-2b Evaluate the reliability, bias, and usefulness of information. GLO: C2, C4, C5, C8 TFS: 2.2.2, 4.3.4 (ELA: S1: 3.2.3, 3.3.3)</p> <p>S1-0-2c Summarize and record information in a variety of forms. Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources. GLO: C2, C4, C6 TFS: 2.3.1, 4.3.4 (ELA: S1: 3.3.2)</p>	
		<p>S1-0-2d Review effects of past decisions and various perspectives related to an STSE issue. Examples: government's, public, environmentalists', and First Nations' positions on hydroelectric development; religious, social, and medical views on genetic screening... GLO: B1, C4 TFS: 1.3.2, 4.3.4 (ELA: S1: 3.2.2)</p>

	Scientific Inquiry	STSE Issues
Planning	<p>S1-0-3a State a testable hypothesis or prediction based on background data or on observed events. GLO: C2</p>	<p>S1-0-3d Summarize relevant data and consolidate existing arguments and positions related to an STSE issue. GLO: C4 TFS: 2.3.1, 4.3.4 (ELA: S1: 1.2.1, 3.3.1, 3.3.2)</p>
	<p>S1-0-3b Identify probable mathematical relationships between variables. Examples: relationship between current and resistance... GLO: C2</p>	<p>S1-0-3e Determine criteria for the evaluation of an STSE decision. Examples: scientific merit; technological feasibility; social, cultural, economic, and political factors; safety; cost; sustainability... GLO: B5, C1, C3, C4</p>
	<p>S1-0-3c Plan an investigation to answer a specific scientific question. Include: materials, variables, controls, methods, safety considerations. GLO: C1, C2</p>	<p>S1-0-3f Formulate and develop options which could lead to an STSE decision. GLO: C4</p>

	Scientific Inquiry	STSE Issues
Implementing a Plan	<p>S1-0-4a Carry out procedures that comprise a fair test. Include: controlling variables, repeating experiments to increase accuracy and reliability of results. GLO: C1, C2 TFS: 1.3.1</p> <p>S1-0-4b Demonstrate work habits that ensure personal safety, the safety of others, as well as consideration for the environment. Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment. GLO: B3, B5, C1, C2</p> <p>S1-0-4c Interpret relevant WHMIS regulations. Include: symbols, labels, Material Safety Data Sheets (MSDS). GLO: C1, C2</p>	<p>S1-0-4d Use various methods for anticipating the impacts of different options. Examples: test run, partial implementation, simulation, debate... GLO: C4, C5, C6, C7</p>
	<p>S1-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S1: 3.1.3, 5.2.2)</p> <p>S1-0-4f Assume the responsibilities of various roles within a group and evaluate which roles are most appropriate for given tasks. GLO: C2, C4, C7 (ELA: S1: 5.2.2)</p>	

	Scientific Inquiry	STSE Issues
Observing, Measuring, Recording	<p>S1-0-5a Select and use appropriate methods and tools for collecting data or information. GLO: C2 TFS: 1.3.1</p> <p>S1-0-5b Estimate and measure accurately using Système International (SI) and other standard units. Include: SI conversions. GLO: C2</p> <p>S1-0-5c Record, organize, and display data using an appropriate format. Include: labelled diagrams, graphs, multimedia. GLO: C2, C5 TFS: 1.3.1, 3.2.2 (ELA: S1: 4.1.1, 4.1.2)</p>	<p>S1-0-5d Evaluate, using pre-determined criteria, different STSE options leading to a possible decision. Include: scientific merit; technological feasibility; social, cultural, economic, and political factors; safety; cost; sustainability. GLO: B5, C1, C3, C4 TFS: 1.3.2, 3.2.3 (ELA: S1: 3.3.3)</p>

	Scientific Inquiry	STSE Issues	Scientific Inquiry	STSE Issues	
Analyzing and Interpreting	<p>S1-0-6a Interpret patterns and trends in data, and infer and explain relationships. GLO: C2, C5 TFS: 1.3.1, 3.3.1 (ELA: S1: 3.3.1)</p> <p>S1-0-6b Identify and suggest explanations for discrepancies in data. <i>Examples: sources of error...</i> GLO: C2 (ELA: S1: 3.3.3)</p> <p>S1-0-6c Evaluate the original plan for an investigation and suggest improvements. <i>Examples: identify strengths and weaknesses of data collection methods used...</i> GLO: C2, C5</p>	<p>S1-0-6d Adjust STSE options as required once their potential effects become evident. GLO: C3, C4, C5, C8</p>	Concluding and Applying	<p>S1-0-7a Draw a conclusion that explains the results of an investigation. Include: cause and effect relationships, alternative explanations, supporting or rejecting the hypothesis or prediction. GLO: C2, C5, C8 (ELA: S1: 3.3.4)</p>	<p>S1-0-7b Select the best option and determine a course of action to implement an STSE decision. GLO: B5, C4</p> <p>S1-0-7c Implement an STSE decision and evaluate its effects. GLO: B5, C4, C5, C8</p> <p>S1-0-7d Reflect on the process used to arrive at or to implement an STSE decision, and suggest improvements. GLO: C4, C5 (ELA: S1: 5.2.4)</p>
				<p>S1-0-7e Reflect on prior knowledge and experiences to develop new understanding. GLO: C2, C3, C4 (ELA: S1: 4.2.1)</p>	

	Scientific Inquiry	STSE Issues		Scientific Inquiry	STSE Issues
Reflecting on Science and Technology	<p>S1-0-8a Distinguish between science and technology. Include: purpose, procedures, products. GLO: A3</p> <p>S1-0-8b Explain the importance of using precise language in science and technology. GLO: A2, A3, C2, C3 (ELA: S1: 4.4.2)</p> <p>S1-0-8c Describe examples of how scientific knowledge has evolved in light of new evidence, and the role of technology in this evolution. GLO: A2, A5</p> <p>S1-0-8d Describe examples of how technologies have evolved in response to changing needs and scientific advances. GLO: A5</p> <p>S1-0-8e Discuss how peoples of various cultures have contributed to the development of science and technology. GLO: A4, A5</p> <p>S1-0-8f Relate personal activities and possible career choices to specific science disciplines. GLO: B4</p> <p>S1-0-8g Discuss social and environmental effects of past scientific and technological endeavours. Include: major shifts in scientific world views, unintended consequences. GLO: B1</p>		Demonstrating Scientific and Technological Attitudes and Habits of Mind	<p>S1-0-9a Appreciate and respect that science and technology have evolved from different views held by women and men from a variety of societies and cultural backgrounds. GLO: A4</p> <p>S1-0-9b Express interest in a broad scope of science- and technology-related fields and issues. GLO: B4</p> <p>S1-0-9c Demonstrate confidence in their ability to carry out investigations in science and to address STSE issues. GLO: C2, C4, C5</p> <p>S1-0-9d Value skepticism, honesty, accuracy, precision, perseverance, and open-mindedness as scientific and technological habits of mind. GLO: C2, C3, C4, C5</p> <p>S1-0-9e Be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment. GLO: B5, C4</p> <p>S1-0-9f Demonstrate personal involvement and be proactive with respect to STSE issues. GLO: B5, C4</p>	

Notes

Senior 1, Cluster 1: Reproduction

Overview

Reproduction is an essential biological mechanism for the continuity and diversity of species. Students compare sexual and asexual methods of reproduction in this cluster. They learn how the human reproductive system functions and describe the major stages of human development from conception to birth. Students recognize that the nucleus of a cell contains genetic information and is responsible for the transmission of traits from one generation to the next. They also discuss factors that may change a cell's genetic information, including environmental factors. Using the knowledge they have gained, students also address a current biotechnology issue.

Students will...

- S1-1-01 Illustrate and explain the process of mitotic cell division in plants and animals.
 Include: chromosomes, mitosis, cytoplasmic division, cell cycle.
 GLO: D1, E1, E2
- S1-1-02 Observe and explain the dynamic nature of cell division.
 GLO: C2, D1, E3

- S1-1-03 Describe various types of asexual reproduction that occur in plant and animal species.
Examples: fission, budding, sporulation, vegetative propagation, regeneration...
 GLO: D1, E1
- S1-1-04 Investigate and describe agricultural applications of asexual reproduction.
Examples: cloning, cuttings, grafting, bulbs...
 GLO: A5, B1, B2, D1
- S1-1-05 Illustrate and explain the production of male and female gametes by meiosis.
 GLO: D1, E1, E2
- S1-1-06 Compare and contrast the function of mitosis to that of meiosis.
 Include: diploid cells, haploid cells.
 GLO: D1, E1
- S1-1-07 Compare sexual and asexual reproduction in terms of their advantages and disadvantages for plant and animal species.
 GLO: D1, E1
- S1-1-08 Investigate and explain adaptations of plant and animal species which enhance reproductive success.
Examples: appearance, behaviour, number of gametes or offspring, chemical cues...
 GLO: D2, E1, E2

- S1-1-09 Describe the structure and function of the male and female human reproductive systems.
Include: role of hormones.
GLO: D1, E1, E2
- S1-1-10 Outline human development from conception through birth.
Include: X and Y chromosomes, zygote, embryo, fetus.
GLO: D1, E1, E2, E3
- S1-1-11 Observe, collect, and analyze class data of single trait inheritance.
Examples: hand clasping, earlobe attachment, tongue rolling...
GLO: C2, D1
- S1-1-12 Differentiate between dominant and recessive genes.
Include: genotype, phenotype.
GLO: D1, E1, E2
- S1-1-13 Describe the relationships among DNA, chromosomes, genes, and the expression of traits.
Include: genetic similarity among all humans.
GLO: A2, D1, E1, E2
- S1-1-14 Explain the inheritance of sex-linked traits in humans and use a pedigree to track the inheritance of a single trait.
Examples: colour blindness, hemophilia...
GLO: D1, E1, E2
- S1-1-15 Investigate and describe environmental factors and personal choices that may lead to a genetic mutation or changes in an organism's development.
Examples: fetal exposure to alcohol, overexposure to sunlight, toxins, hormone mimics, food additives, radiation...
GLO: B1, B3, D1, D2
- S1-1-16 Investigate Canadian and international contributions to research and technological development in the field of genetics and reproduction.
Example: Human Genome Project...
GLO: A3, A4, B1, B2
- S1-1-17 Discuss current and potential applications and implications of biotechnologies including their effects upon personal and public decision making.
Include: genetic engineering, genetic screening, cloning, DNA fingerprinting.
GLO: B1, B2, C4, C8
- S1-1-18 Use the decision-making process to address a current biotechnology issue.
GLO: C4, C6, C7, C8

Senior 1, Cluster 2: Atoms and Elements

Overview

This cluster builds on the particle theory of matter learned in previous grades. Students become familiar with the basic constituents of matter by learning about the historical development of the atomic model and the periodic table. Various investigations of the properties of elements and compounds will acquaint students with chemical symbols and families, as well as with natural phenomena and everyday technologies that demonstrate chemical change.

Students will...

- S1-2-01 Describe how historical ideas and models furthered our understanding of the nature of matter.
Include: Greek ideas, alchemy, Lavoisier.
GLO: A1, A2, A4
- S1-2-02 Investigate the historical progression of the atomic model.
Include: Dalton, Thompson, Rutherford, Bohr, quantum model.
GLO: A1, A2, A4, D3
- S1-2-03 Define element and identify symbols of some common elements.
Include: the first 18 elements and K, Ca, Fe, Ni, Cu, Zn, I, Ag, Sn, Au, W, Hg, Pb, U.
GLO: C2, D3
- S1-2-04 Explain the atomic structure of an atom in terms of the number of protons, electrons, and neutrons and explain how these numbers define atomic number and atomic mass.
GLO: D3, E2
- S1-2-05 Assemble or draw Bohr atomic models for the first 18 elements and group them according to the number of outer shell electrons.
GLO: A2, C2, D3

- S1-2-06 Investigate the development of the periodic table as a method of organizing elements.
Include: periods, families (groups).
GLO: A2, A4, B2, E1
- S1-2-07 Investigate the characteristic properties of metals, non-metals, and metalloids and classify elements according to these properties.
Examples: ductility, conductivity of heat and electricity, lustre, reactivity...
GLO: D3, E1
- S1-2-08 Relate the reactivity and stability of different families of elements to their atomic structure.
Include: alkali metals, alkaline earths, chalcogens, halogens, noble gases.
GLO: D3, D4, E1, E3
- S1-2-09 Compare elements to compounds.
Include: atoms, molecules.
GLO: D3, E1, E2
- S1-2-10 Interpret chemical formulas of elements and compounds in terms of the number of atoms of each element.
Examples: He, H₂, O₂, H₂O, CO₂, NH₃...
GLO: C2, D3
- S1-2-11 Investigate properties of substances and explain the importance of knowing these properties.
Examples: usefulness, durability, safety...
GLO: A5, B2, D3, E1
- S1-2-12 Differentiate between physical and chemical changes.
GLO: D3, E1, E3
- S1-2-13 Experiment to determine indicators of chemical change.
Examples: colour change, production of heat and/or light, production of a gas or precipitate or new substance...
GLO: C2, D3, E3
- S1-2-14 Investigate technologies and natural phenomena that demonstrate chemical change in everyday situations.
Examples: photography, rusting, photosynthesis, combustion, baking...
GLO: A3, A5, B1, B2

Senior 1, Cluster 3: Nature of Electricity

Overview

The conceptual development of the particle model of electricity underlies an understanding of electrostatics and current electricity. To develop and test this model, students construct simple devices like an electrophorous and investigate electrostatic phenomena. A transition from static to current electricity enables the learner to investigate circuits and make connections to daily applications like the cost of electrical energy and the safety and efficiency of electrical appliances. Additionally, students investigate hydroelectric power and address sustainability issues associated with the generation and transmission of electricity in Manitoba.

Students will...

- S1-3-01 Demonstrate evidence for the existence of two types of charge.
GLO: A1, C2, C5
- S1-3-02 Discuss early models of electricity to support the premise that models in science change.
Include: one-fluid model, two-fluid model, particle model.
GLO: A1, A2, A5, C8
- S1-3-03 Explain how a discrepant event can be used to evaluate the particle model of electricity.
Include: the attraction of neutral objects to charged objects.
GLO: A1, A2, A3, C8
- S1-3-04 Relate the particle model of electricity to atomic structure.
GLO: A1, A2, D3
- S1-3-05 Investigate and explain electrostatic phenomena using the particle model of electricity.
Include: conservation of charge, conduction, grounding, attraction of a neutral insulator, induction.
GLO: A2, D3, D4, E4

- S1-3-06 Investigate common electrostatic technologies and phenomena and describe measures which reduce dangers associated with electrostatics.
Examples: photocopying, static straps to reduce charge buildup, lightning, electrostatic spray-painting, electrostatic precipitator...
GLO: A5, B1, C1, D4
- S1-3-07 Construct one or more electrostatic apparatus and explain how they function using the particle model of electricity.
Include: pie-plate electrophorus.
GLO: A2, C3, D3, D4
- S1-3-08 Demonstrate and explain the like nature of electrostatics and current electricity.
Include: discharge an electrophorus through a neon bulb.
GLO: C3, D4, E4
- S1-3-09 Define electric current as charge per unit time and solve related problems.
Include: $I = \frac{Q}{t}$.
GLO: C2, C3, D4
- S1-3-10 Define voltage (electric potential difference) as the energy per unit charge between two points along a conductor and solve related problems.
Include: $V = \frac{E}{Q}$.
GLO: C2, C3, D4
- S1-3-11 Identify the five sources of electrical energy and some associated technologies.
Include: chemical, photo, thermo, electromagnetic, piezo.
GLO: B1, D4, E4
- S1-3-12 Describe resistance in terms of the particle model of electricity.
GLO: A2, D3, E2
- S1-3-13 Construct electric circuits using schematic diagrams.
Include: series, parallel.
GLO: C3, D4, E4
- S1-3-14 Use appropriate instruments and units to measure voltage (electric potential difference), current, and resistance.
GLO: C2, C3, D4
- S1-3-15 Compare and contrast voltage (electric potential difference) and current in series and parallel circuits.
Include: cells, resistance.
GLO: C3, D4
- S1-3-16 Investigate and describe qualitatively the relationship among current, voltage (electric potential difference), and resistance in a simple electric circuit.
GLO: C2, D4, E4
- S1-3-17 Relate the energy dissipated in a circuit to the resistance, current, and brightness of bulbs.
GLO: D4

Senior 1, Cluster 3: Nature of Electricity (continued)

S1-3-18 Explain the parallel circuits, the components, and the safety aspects of household wiring.

Include: switches, fuses, circuit breakers, outlets.

GLO: A5, B1, B2, C1

S1-3-19 Explain safety considerations of some common household electrical appliances.

Examples: kettle, heater, toaster...

GLO: A5, B1, C1, D4

S1-3-20 Define electrical power as energy per unit time, and solve related problems.

Include: $P = \frac{E}{t}$.

GLO: C2, C3, D4

S1-3-21 Develop a formula for domestic power consumption costs, and solve related problems.

Include: $\text{Cost} = \frac{\text{Power} \times \text{time} \times \text{unit price}}{\text{kWh}}$.

GLO: B2, C2, C3, D4

S1-3-22 Analyze the electrical energy consumption of a household appliance.

Include: calculate consumption using Energuide labels, read hydro meter, interpret monthly hydro bill.

GLO: B5, C4, C5, C8

S1-3-23 Recognize and explain the importance of incorporating principles of electrical energy conservation into the decision-making process.

GLO: B2, B5, C4, C8

S1-3-24 Use the decision-making process to address an issue associated with the generation and transmission of electricity in Manitoba.

Include: hydroelectric power, sustainability.

GLO: B2, B5, C4, C8

Notes

Senior 1, Cluster 4: Exploring the Universe

Overview

This cluster leads students through an exploration of the universe starting with some basic hands-on astronomy and ending with a critical look at issues surrounding space science and technology. Students observe and locate visible celestial objects. This knowledge provides them with an appreciation for the relevance of astronomy to various peoples. Students develop an understanding of the origin, evolution, and components of the universe. They concurrently research and study Canada's involvement in international space exploration and evaluate the impact of space science and technologies in terms of their benefits and risks to the human race.

Students will...

- S1-4-01 Use a coordinate system to locate visible celestial objects, and construct an astrolabe to determine the position of these objects.
Include: altitude, azimuth.
GLO: C2, C3, D6
- S1-4-02 Observe the motion of visible celestial objects and organize collected data.
Examples: graph sunrise and sunset data, track the position of the Moon and planets over time, maintain a log of changes in the night sky...
GLO: C2, C5, C6, D6
- S1-4-03 Investigate how various cultures used knowledge of the position and motion of visible celestial objects for navigation.
GLO: A4, B1, B2, D6
- S1-4-04 Compare and contrast historical perspectives on the relationship between Earth and space.
Include: geocentric model, heliocentric model.
GLO: A2, A4, B2, E2
- S1-4-05 Explain the apparent motion of the Sun, stars, planets, and the Moon as seen from Earth.
Include: daily rising and setting, seasonal constellations, retrograde motion.
GLO: D4, D6, E2

S1-4-06 Differentiate between units of measure used for astronomical distances, and perform simple calculations using these units.

Include: astronomical unit, light year.

GLO: C2, D6

S1-4-07 Compare and contrast scientific and cultural perspectives on the origin and evolution of the universe.

GLO: A1, A2, A4, D6

S1-4-08 Differentiate between the major components of the universe.

Include: planets, moons, comets and asteroids, nebulae, stars, galaxies, black holes.

GLO: D6, E1, E2

S1-4-09 Explain how various technologies have extended our ability to explore and understand space.

Examples: robotics, Canadarm, Hubble telescope, Lunar Rover, shuttle, space station, Sojourner Rover, Pathfinder and Galileo space probes...

GLO: A5, B1, B2, D6

S1-4-10 Investigate ways in which Canada participates in space research and in international space programs, and then use the decision-making process to address a related issue.

Examples: International Space Station, Canadarm...

GLO: A3, A4, B2, C4

S1-4-11 Evaluate the impact of space science and technologies in terms of their benefits and risks to humans.

Examples: search for extraterrestrial life and habitat, remote sensing, predictions of potentially catastrophic impacts, colonization of space by only a few countries...

GLO: A3, B1, B2, B5

