

Senior 2
Specific Learning Outcomes

Specific Learning Outcomes

Organization into Clusters

This *Science Framework* presents specific learning outcomes (SLOs) for Senior 2 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 2 Science, Figure 7: Cluster Titles for Kindergarten to Grade 4, and Figure 8: Cluster Titles for Grade 5 to Senior 2 Science.)

Whereas the individual SLOs themselves comprise the compulsory learning experiences, the order in which they are addressed is not prescriptive. Consideration should be given to developing a more integrated approach to the teaching of science, and this includes crossing over the perceived divides of the content clusters. 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 2 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 will be given equal time.

The Overall Skills and Attitudes SLOs for Senior 2 are also presented in a *Senior 2 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 #80400).

Grades 5 to 8 and *Senior 1 Overall Skills and Attitudes Charts*, along with Grade-at-a-Glance posters, are also available (MTBB stock #80366 and #80367).

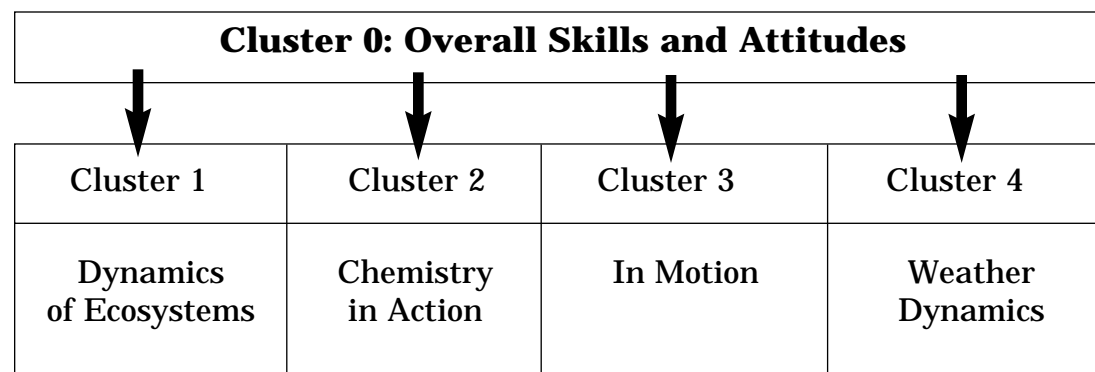
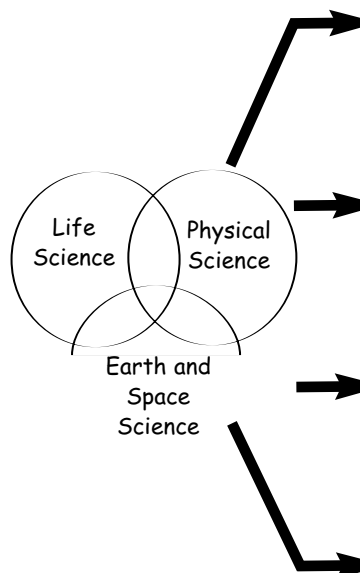


Figure 6: Cluster Titles for Senior 2 Science



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

Figure 7: Cluster Titles for Kindergarten to Grade 4 Science

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

Figure 8: Cluster Titles for Grade 5 to Senior 2 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.

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

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

Senior 2 Science
Specific Learning Outcomes

Senior 2, 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 and 2, 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 an STSE issue related to safe driving conditions in Cluster 3. To assist in planning and to facilitate curricular integration, many specific learning outcomes within this cluster are accompanied by links to specific learning outcomes in other subject areas, specifically English language arts (ELA) and mathematics (Math). There are also links to *Technology As a Foundation Skill Area (TFS)*.

Students will...

	Scientific Inquiry	STSE Issues
Initiating	S2-0-1a Propose questions that could be tested experimentally. GLO: C2 (ELA: S2: 3.1.2)	S2-0-1c Identify STSE issues which could be addressed. GLO: C4
	S2-0-1b Select and justify various methods for finding the answers to specific questions. GLO: C2 (Math: S1: A-1)	S2-0-1d Identify stakeholders and initiate research related to an STSE issue. GLO: C4 (ELA: S2: 3.1.2)

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 S1 (Senior 1 Mathematics 10F), AMA (Applied Mathematics 20S); CMA (Consumer Mathematics 20S); PMA (Pre-Calculus Mathematics 20S), ELA (English Language Arts), TFS (Technology As a Foundation Skill Area)

Indicates specific learning outcomes related to scientific inquiry

Indicates specific learning outcomes related to STSE issues

Indicates specific learning outcomes related to both scientific inquiry and STSE issues

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

Specific Learning Outcomes		Senior 2 Science			
	Scientific Inquiry	STSE Issues			
Researching	<p>S2-0-2a 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: S2: 3.1.4, 3.2.4; Math: S1-B-1, 2)</p> <p>S2-0-2b Evaluate the reliability, bias, and usefulness of information. GLO: C2, C4, C5, C8 TFS: 2.2.2, 4.3.4 (ELA: S2: 3.2.3, 3.3.3)</p> <p>S2-0-2c 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: S2: 3.3.2; MATH: S2-AMA C-1)</p>	<p>S2-0-2d Review effects of past decisions and various perspectives related to an STSE issue. Examples: environmentalist and industry group positions on fossil fuel emissions... GLO: B1, C4 TFS: 1.3.2, 4.3.4 (ELA: S2: 3.2.2)</p>	Planning	<p>S2-0-3a State a testable hypothesis or prediction based on background data or on observed events. GLO: C2</p> <p>S2-0-3b Identify probable mathematical relationships between variables. Examples: relationship between braking distance, velocity, and friction... GLO: C2 (MATH: S2-AMA H-3, CMA F-3[11], PCA H-1,2)</p> <p>S2-0-3c Plan an experiment to answer a specific scientific question. Include: materials, variables, controls, methods, safety considerations. GLO: C1, C2</p>	<p>S2-0-3d Summarize relevant data and consolidate existing arguments and positions related to an STSE issue. GLO: C4 TFS: 2.3.1, 4.3.4 (ELA: S2: 1.2.1, 3.3.1, 3.3.2)</p> <p>S2-0-3e 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>S2-0-3f Formulate and develop options which could lead to an STSE decision. GLO: C4</p>

Include:
Indicates a mandatory component of the specific learning outcome

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

Senior 2 Science	Specific Learning Outcomes
Senior 2, Cluster 2: Chemistry in Action	
<p>Overview</p> <p>This cluster provides students with the opportunity to examine the interactions among elements as they form compounds through chemical reactions. Students become familiar with the formulas and naming of binary compounds, and investigate the Law of Conservation of Mass. The recognition that mass is conserved in chemical reactions allows students to balance equations with both words and symbols, and classify them by type. The principles of acid-base chemistry are studied and extended to large-scale environmental interactions. Students investigate the use of chemistry in biological, industrial, and domestic settings, recognizing that chemical use is pervasive in modern society.</p>	<p>Students will...</p> <p>S2-2-01 Relate an element's position on the periodic table to its combining capacity (valence). Include: alkali metals, alkaline earths, chalcogens, halogens, noble gases. GLO: D3, D4, E1</p> <p>S2-2-02 Explain, using the periodic table, how and why elements combine in specific ratios to form compounds. Include: ionic bonds, covalent bonds. GLO: D3, E2</p> <p>S2-2-03 Write formulas and names of binary ionic compounds. Include: IUPAC guidelines and rationale for their use. GLO: A2, C2, D3, E1</p> <p>S2-2-04 Write formulas and names for covalent compounds using prefixes. Include: mono, di, tri, tetra. GLO: C2, D3, E1</p> <p>S2-2-05 Investigate the Law of Conservation of Mass, and recognize that mass is conserved in chemical reactions. GLO: A2, D3, D4, E3</p>
3.18	

Describes general content and emphasis of cluster

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

Cross-reference to general learning outcomes

Specific Learning Outcomes	Senior 2 Science
<p>S2-2-06 Balance chemical equations. GLO: D3</p>	<p>S2-2-12 Investigate technologies that are used to reduce emissions of potential air pollutants.</p>
<p>S2-2-07 Investigate and classify chemical reactions as synthesis, decomposition, single displacement, double displacement, or combustion. GLO: B1, D4, E4</p>	<p><i>Examples: catalytic converters in automobiles, smokestack scrubbers, regulation of vehicle emissions, disposal of PCBs from electrical transformers, elimination of CFCs from refrigerants and aerosol propellants...</i> GLO: A5, B5, C8, E2</p>
<p>S2-2-08 Experiment to classify acids and bases using their characteristic properties. Include: pH, indicators, reactivity with metals. GLO: D3, E1</p>	
<p>S2-2-09 Discuss the occurrence of acids and bases in biological systems, industrial processes, and domestic applications. Include: environmental, health, and safety issues. GLO: B2, B3, C1, C8</p>	
<p>S2-2-10 Explain how acids and bases interact to form a salt and water in the process of neutralization. GLO: D3, E2</p>	
<p>S2-2-11 Describe the formation and the environmental impact of various types of air pollution. <i>Examples: acid precipitation, ground-level ozone, airborne particulates, smog; ozone depletion, respiratory ailments, acidified lakes...</i> GLO: B5, C6, D2, D5</p>	

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

Include:
Indicates a mandatory component of the specific learning outcome