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...

	Scientific Inquiry	Design Process
Observing, Measuring, Recording	**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)**	

	Scientific Inquiry	Design Process
Analyzing and Interpreting	**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)** **8-0-6b ⊂ 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)**	**8-0-6d ⊂ Identify and make improvements to a prototype, and explain the rationale for the changes.** **GLO: C3, C4** **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