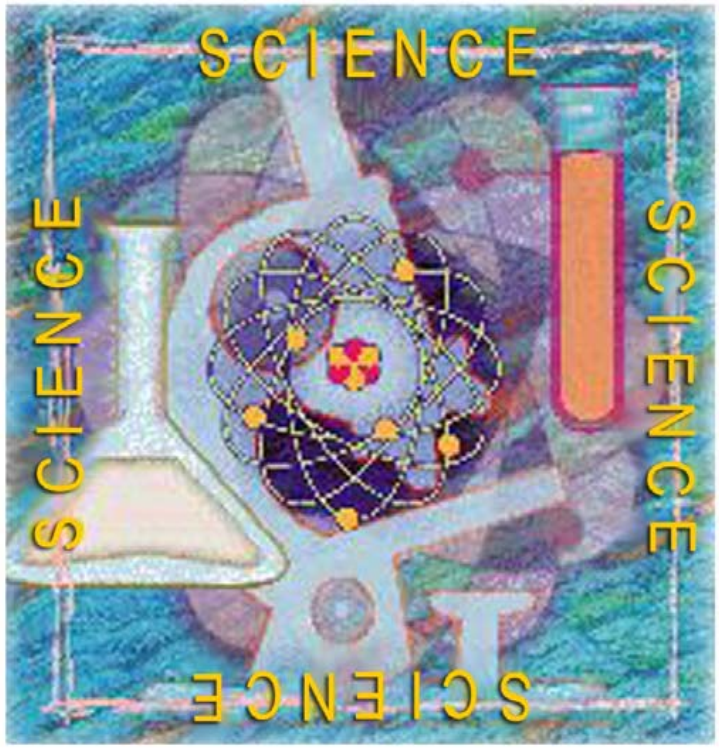
AERO SCIENCE
K-8 and High School STANDARDS
with Progression/Performance Indicators

DOCUMENT VERSION 8-2012



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AERO K-12
SCIENCE EDUCATION FRAMEWORK

A SPECIAL NOTE ABOUT THE NEXT GENERATION SCIENCE STANDARDS (NGSS) … AUGUST 2012

The NGSS is in production. A public draft was shared in May 2012 and a second draft is due around November 2012. The developers hope to release the final version in the first quarter of 2013. It will be quite a while before we know many of the details of this initiative but we plan to watch the process carefully. For now, the best advice we can offer is that if your school is interested in matching to these AERO science standards, you should continue as planned. With the emergence of NGSS we'll help you make the "cross-walk" between the current and the new standards.

VISION FOR SCIENCE EDUCATION

Science is a way of making sense of the natural world. Scientists seek to describe its complexity, to explain its systems and events, and to find the patterns that allow for predictions and understandings. Science is the basis for the design of technologies that solve real-world problems. Not all students will become scientists or engineers. But science and technology occupy ever-expanding places in our everyday lives. As citizens, we are asked to make decisions about social issues that involve science and technology. As workers, we have occupations that increasingly involve science and technology. In the 21st century, adults will need to be comfortable and competent in a complex, scientific and technological world. Schools have the responsibility of preparing students for the future. Schools must prepare all students — regardless of their future aspirations — to be scientifically literate.

Therefore, all graduates of a school science program should be:

- knowledgeable about the important concepts and theories of the three major branches of scientific study: earth, life, and physical sciences;
- able to think scientifically and use scientific knowledge to make decisions about real–world problems; able to construct new knowledge for themselves through research, reading, and discussion;
- familiar with the natural world, and respectful of its unity, diversity, and fragility; able to make informed judgments on statements and debates claiming to have a scientific basis; and, able to reflect in an informed way on the role of science in human affairs.

To make this happen, the science curriculum needs to:

- emphasize understanding, not content coverage;

- promote learning that is useful and relevant;
- emphasize scientific literacy for **ALL** students; and,
- promote interdisciplinary learning.

Goals of Science Education

1. Students will use inquiry strategies to investigate and understand the natural world.

2. Students will demonstrate an understanding of key concepts and principles central to the life, physical, and earth sciences, and engineering, while recognizing the interrelationship of all the sciences.

3. Students will demonstrate an understanding of the basic laws which govern and explain phenomena observed in the natural world

4. Students will demonstrate an understanding of, and be able to practice, the basic processes that scientists use to obtain and continually revise knowledge about the natural world.

5. Students will perceive that scientific and technological knowledge is the result of the cumulative efforts of people, past and present, who have attempted to explain the world through an objective, peer-tested, rational approach to understanding natural phenomena and occurrences.

6. Students will display a sense of curiosity and wonder about the natural world, and demonstrate an increasing awareness of the interdependence between all living things and the environment.

7. Students will demonstrate their abilities to identify human needs and concerns and to engage in problem-solving processes to define the problem, research and generate solutions, and develop simulations and prototypes to test their ideas before implementation.

8. Students will be able to apply rational, creative-thinking, and investigative skills and use scientific and technical knowledge in their roles as citizens, workers, family members, and consumers in an increasingly technological society.

9. Students will use oral and written communication, mathematical representation, and physical and conceptual models to describe and explain scientific concepts and ideas, and will be able to apply scientific and technical knowledge.

10. Students will know and employ safe practices and techniques in the laboratory, in fieldwork or any other scientific investigation, and when using scientific or technological materials at home or work.

Performance Indicators

The diagram below illustrates how content and practices are combined ("crossed") to generate the performance indicators. The columns contain the science content (defined by content statements in three broad areas), and the rows contain the four science practices. The cells at the intersection of content (columns) and practices (rows) contain student performance indicators. The content and practice categories are not distinct; and therefore, some overlap in the resultant performance indicators is to be expected. (NAEP 2009)

	SCIENCE CONTENT			
Science Practices		**EARTH AND SPACE SCIENCE (Content statements)**	**PHYSICAL SCIENCE (Content statements)**	**LIFE SCIENCE (Content statements)**
	Identifying Science Principles	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**
	Using Scientific Principles	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**
	Using Scientific Inquiry	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**
	Using Technological Design	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**

Progression of General Performance Indicators for Science Practices

Communicate accurately and effectively	**Identifying Scientific Principles**	Describe, measure, or classify observations	State or recognize correct science principles	Demonstrate relationships among closely related science principles	Demonstrate relationships among different representations of principles
	Using Science Principles	Explain observations of phenomena	Predict observations of phenomena	Suggest examples of observations that illustrate a science principle	Propose, analyze, and evaluate alternative explanations or predictions
	Using Scientific Inquiry	Design and critique aspects of scientific investigations	Conduct scientific investigations using appropriate tools and techniques	I identify patterns in data and/or relate patterns in data to theoretical models	Use empirical evidence to validate or criticize conclusions about explanations and predictions
	Using Technological Design	Propose or critique solutions to problems given criteria and scientific constraints	Identify scientific tradeoffs in design decisions and choose among alternative solutions	Apply science principles or data to anticipate effects of technological design decisions	NA

2009 NAEP FRAMEWORK

PHYSICAL SCIENCE

Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems. Familiar changes—an ice cube melting, a baseball changing direction after being struck by a bat, the appearance of a bolt of lightning, the formation and erosion of mountains, and the growth of a plant—can be explained using these fundamental ideas.

Energy is the constant in an ever-changing world. Energy from the sun fuels electrical storms, hurricanes, tornados, and photosynthesis. In turn, the products of photosynthesis (carbohydrates and oxygen) react during respiration to fuel the life processes, such as growth and reproduction, of plants and animals. Consequently, it is important for students to develop an understanding of physical science principles early and to appreciate their usefulness across Physical Science, Life Science, and Earth and Space Science. (NAEP, 2009 Framework)

PHYSICAL SCIENCE STANDARDS and PERFORMANCE INDICATORS	
Standard	**PS: Physical Science** Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
Strand Standard	**PS.1 Properties of Matter** Students will develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior.
Rationale	**Properties of Matter** Everyone has experience with matter in a variety of forms. Such experiences help build students' understanding of similarities and differences in the properties of matter. Their personal experiences help students understand common properties such as hardness, strength, color, shape, and states of matter (solid, liquid, and gaseous). Knowledge of observable properties of matter and its structure and composition is helpful in considering matter's varied uses, availability, and limitations in our world.
Enduring Understanding	All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).
Essential Question	How do the properties of materials determine their use?

Benchmarks		**PS.1.4A:** By the end of Grade 4, students will be able to collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their characteristic properties (e.g., temperature, color, size, shape, weight, texture, flexibility).					**PS.1.8A:** By the end of Grade 8, students when given graphic or written information will be able to classify matter as atom/molecule or element/compound (Not the structure of an atom).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Composition of Matter	**Describing Matter**	Identify the materials that make up an object. (e.g., desk is made up of wood and metal, bike is made up of metal, rubber, and plastic)	Describe objects in terms of what they are made of and their physical properties	Compare, sort and group objects in terms of what they are made of (e.g., clay, cloth, paper, or metal)	Describe features of the object or material that are only visible with the use of the magnifier.	Use measures of weight (data) to demonstrate that the whole equals the sum of its parts.	Explain that all matter is composed of minute particles called atoms; and explain that all substances are composed of atoms, each arranged into different groupings	Identify elements as substances that contain only one kind of atom and explain that elements do not break down by normal laboratory reactions, such as heating, exposure to electric current, and reaction to acid.	Use models or diagrams to show the difference between atoms and molecules.	Given graphic or written information, classify matter as an atom / molecule or element/ compound (not the structure of an atom).

Benchmark		PS.1.4B: Not addressed at this level					PS.1.8B: By the end of Grade 8, students will explain how properties of elements and the location of elements on the periodic table are related.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Composition of Matter	**Periodic Table**						Explain that over one hundred elements exist, and identify the periodic table as a tool for organizing the information about them.	Explain that elements are organized in the periodic table according to their properties.	Use the periodic table to obtain information about a given element.	Predict how an atom's electron arrangement influences its ability to transfer or share electrons and is related its position on the periodic table.

							PS.1.8B: By the end of Grade 8, students will explain how properties of elements and the location of elements on the periodic table are related.		
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Composition of Matter	**Compounds**							Describe how elements can combine to form new substances that often have different properties.	Demonstrate with atomic models (e.g., ball and stick) how atoms can combine in a large number of ways to form a molecule or formula unit (crystal).	Use data to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter).

							PS.1.8B: By the end of Grade 8, students will explain how properties of elements and the location of elements on the periodic table are related.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Composition of Matter	**Mixtures**							Differentiate between a mixture and a pure substance.	Describe the different atoms and molecules in mixtures (e.g., dissolving carbon dioxide in water produces a type of mixture [solution] of CO_2 and H_20 molecules).	Demonstrate how mixtures can be separated by using the properties of the substances from which they are made, such as particle size, density, solubility and boiling point.

Benchmark		**PS.1.4C:** By the end of Grade 4, students will be able to identify and describe the physical and chemical properties of a substance.					**PS.1.8C:** By the end of Grade 8, students will be able to use physical and chemical properties as determined through an investigation to identify a substance.			
Progression Level s		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Properties of Matter	**Describing Matter**	Identify the observable properties of different objects, such as color, size, shape, weight and texture.	Use attributes of properties to state why objects are grouped together (e.g., things that roll, things that are rough).	Identify, compare, and sort objects by similar or different physical properties (e.g., size, shape, color, texture, smell, weight).	Identify, compare, and sort objects by similar or different physical properties (e.g., size, shape, color, texture, smell, weight, temperature, flexibility, odor, elasticity, length, mass, area, volume, perimeter).	Collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their characteristic properties (e.g., temperature, color, size, shape, weight, texture, flexibility).	Identify substances by their physical and chemical properties, such as magnetism, conductivity, density, solubility, boiling and melting points.	Identify elements according to their common properties, such as highly reactive metals, less reactive metals, highly reactive non-metals and almost non-reactive gases.	Separate substances based on their physical properties (e.g., density, magnetism, light transmission, density, luster, malleability, solubility, ductility, boiling point, freezing point, conductivity, flammability) and **i**dentify a molecule as the smallest part of a substance that retains its properties.	Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility, acid or base), identify, compare, or classify different substances.

Benchmark		PS.1.4D: By the end of Grade 4, Students will make a prediction about what might happen to the state of common materials when heated or cooled and categorize materials as a solid, liquid, or gas					PS.1.8D: By the end of Grade 8, students will represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Properties of Matter	**States of Matter**	Identify matter that can be a liquid or solid (e.g., water).	Identify and compare solids (e.g. have a definite shape) and liquids (e.g. take the shape of their containers).	Investigate and recognize water can change from a liquid to a solid (freeze), and back again to a liquid (melt), as the result of temperature changes.	Compare the observable physical properties of solids, liquids, or gases (air) (i.e., visible vs. invisible, changes in shape, changes in the amount of space occupied).	Make a prediction about what might happen to the state of common materials when heated or cooled; or categorize materials as solid, liquid, or gas.	Predict the effect of thermal energy on the physical properties of water as it changes to and from a solid, liquid, or gas (i.e., freezing/melting, evaporation/condensation).	Create diagrams or models that represent the states of matter at the molecular level.	Explain the effect of increased and decreased thermal energy on the motion and arrangement of molecules.	Observe the physical processes of evaporation and condensation, or freezing and melting, and describe these changes in terms of molecular motion and conservation of mass**.**

							PS.1.8D: By the end of Grade 8, students will represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Properties of Matter Properties in Matter	**Changes of State**						Predict the changes in the state of matter when adding or taking away heat (e.g., ice melting, water boiling or freezing, condensation/ evaporation).	Describe how matter changes from one phase to another (e.g., condensation, evaporation).	Describe the movement of individual particles and verify the conservation of matter during the phase changes (e.g., melting, boiling, or freezing).	Explain that states of matter depend on the arrangement of the molecules and their motion.

Benchmark		PS.1.4E: By the end of Grade 4, Students will use measures of weight (data) to demonstrate that the whole equals the sum of its parts.					PS.1.8E: By the end of Grade 8, students will be able to investigate and explain the relationships among mass, volume and density.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Properties of Matter	**Measuring Matter**	Use non-standard units of measure (e.g., string, paper clips) to compare the size and weight of non-living materials.	Use simple tools (e.g. balance scale, see-saw) to explore the property of weight.	Use standard tools to measure objects or materials (e.g., ruler, meter stick, measuring tape, pan balance, thermometer, graduated cylinder).	Select the appropriate metric system tools for measuring length, width, temperature, volume, and mass.	Show that the weight of an object remains the same despite a change in its shape.	Demonstrate that regardless of how parts of an object are arranged, the mass of the whole is always the same as the sum of the masses of its parts.	Differentiate between weight and mass.	Explain how different substances of equal volume usually have different weights.	Differentiate between volume and mass and calculate the density of large and small quantities of a variety of substances (e.g., aluminum foil, water, copper, clay, rock).

Benchmark		PS.1.4F: By the end of Grade 4, Students will use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect)					PS.1. 8F: Not Addressed at this level			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Properties of Matter	**Magnetic Properties**	Observe and sort objects that are and are not attracted to magnets.	Predict whether or not an object will be attracted to a magnet.	Describe what happens when like and opposite poles of a magnet are placed near each other.	Describe the physical properties of magnets.	Determine the relative strength of various magnets (e.g. size, number of paper clips attracted, etc.)				

Benchmarks >>	**PS.1.4A:** By the end of Grade 4, students will be able to collect and organize data about physical properties in order to classify objects or draw conclusion about objects and their characteristic properties (e.g. temperature, color, size, shape, weight, texture, flexibility).	**PS.1.8A:** By the end of Grade 8, students when given graphic or written information will be able to classify matter as atom/molecule or element/compound (not the structure of an atom).	**PS.1.12A:** By the end of Grade 12, students will be able connect the arrangement of, and the strength of interactive forces between, atoms or molecules to the physical properties of solids, liquids, and gases.				
			1	2	3	4	5
			Explain how we know that atoms exist?	Relate the kinetic-molecular theory to the properties of an ideal gas.	Relate verbally, mathematically, or graphically the behavior of the parameters that describe the physical behavior of gases.	List the conditions under which gases deviate from ideal behavior.	Interpret a phase diagram.

Benchmarks >>	**PS.1.4B:** Not addressed at this level. AND **PS.1.4C:** By the end of Grade 4, students will be able to identify and describe the physical and chemical properties of a substance.	**PS.1.8B:** By the end of Grade 8, students will explain how properties of elements and the location of elements on the Periodic Table are related. AND **PS.1.8C:** By the end of Grade 8, students will be able to use physical and chemical properties as determined through an investigation to identify a substance.	**PS.1.12B:** By the end of Grade 12, students understand the commonality and patterns of physical and chemical properties through the arrangement of atomic number within the Periodic Table.				
			1	2	3	4	5
			Describe the evidence for the existence of electrons and protons and their presence in atoms.	Relate the properties of the main-group elements to their electron arrangements.	Explain why metals are good conductors of electricity and heat.	Relate trends in the periodic table to the atomic structures of elements.	

Benchmarks >>	**PS.1.4D:** By the end of Grade 4, students will make a prediction about what might happen to the state of common materials when heated or cooled and categorize materials as a solid, liquid, or gas.	**PS.1.8D:** By the end of Grade 8, students will represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter.	**PS.1.12D:** Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	**PS.1.4E:** By the end of Grade 4, students will use measures of weight (data) to demonstrate that the whole equals the sum of its parts.	**PS.1.8E:** By the end of Grade 8, students will be able to investigate and explain the relationships among mass, volume and density.	**PS.1.12E:** Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	**PS.1.4F:** By the end of Grade 4, students will use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect).	**PS.1.4F:** Not addressed at this level.	**PS.1.12F:** Not addressed at this level …				
			1	2	3	4	5

Benchmarks >>	**PS.1.4G:** Not addressed at this level.	**PS.1.4G:** Not addressed at this level.	**PS.1.12G:** **By the end of Grade 12,** students will understand the composition of atoms and their characteristics (mass, charge, and electric/nuclear forces) and know that a neutral atom has equal numbers of protons and electrons and that isotopes of an element have different numbers of neutrons.				
			1	2	3	4	5
			Describe the composition of atom.	Describe the results of Thomson, Rutherford, and Bohr models of the atom	Explain the differences between electrical and nuclear forces.	Describe how the strong nuclear force acts among nucleons.	Explain what as nuclei get heavier many become radioactive.

Standard	**PS: Physical Science** Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
Strand Standard	**PS.2 Changes in Matter** Students will develop an understanding that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.
Rationale	**Changes in Matter** Interactions between matter and energy account for changes observed in everyday events. Understanding how matter and energy interact extends students' knowledge of the physical world and allows them to monitor and explain a wide variety of changes and to predict future physical and chemical changes. Students gain both a practical and conceptual understanding of the laws of conservation of matter and energy.
Enduring Knowledge	Energy is necessary for change to occur in matter.
Essential Question	How does conservation of mass apply to the interaction of materials in a closed system?

Benchmark		PS.2.4A: By the end of Grade 4, students will differentiate between physical and chemical changes.					PS.2.8A: By the end of Grade 8, students will demonstrate how substances can chemically react with each other to form new substances having properties different from those of the original substances.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Changes in Matter	**Physical and Chemical Changes**		Describe how the properties of certain materials can change when specific actions are applied to them, such as freezing, mixing, heating, cutting, dissolving and bending.	Demonstrate that when some substances combine, they may retain their individual properties (e.g. salt and pepper) and that some may lose their individual properties (e.g. powdered drink in water).	Investigate and explain that not all materials react the same way when an action is applied to them.	Differentiate between a physical change, such as melting, and a chemical change, such as rusting.	Describe how energy has the ability to create change.	Explain that oxidation involves combining oxygen with another substance, as in burning or rusting.	Identify characteristics of chemical changes: (e.g. burning, production of a new substance, production of light, color change, endothermic and exothermic reactions, reactivity).	Demonstrate how substances can react chemically with other substances to form new substances, known as compounds, and that in such re-combinations the properties of the new substances may be very different from those of the old.

							PS.2.8A: By the end of Grade 8, students will demonstrate how substances can chemically react with each other to form new substances having properties different from those of the original substances.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Changes in Matter	**Chemical Reactions**						Identify the reactants and/or products in a chemical reaction.	Classify chemical reactions by energy type (e.g., endothermic and exothermic).	Identify factors that affect reaction rates, such as temperature, concentration and surface area, and explain that dissolving substances in liquids often accelerates reaction rates.	Determine the effect of various factors on reaction rate (e.g., temperature, surface area, concentration, agitation).

Benchmarks >>	PS.2.4A: By the end of Grade 4, students will differentiate between physical and chemical changes.	PS.2.8A: By the end of Grade 8, students will demonstrate how substances can chemically react with each other to form new substances having properties different from those of the original substances.	PS.2.12A: By the end of Grade 12, students will understand how an atom's electronic configuration, particularly its outermost electrons determine how the atom interacts with other atoms.				
			1	2	3	4	5
			Explain interactions between atoms that hold them together in molecules or between oppositely charged ions are called chemical bonds	Explain how the configuration of atoms determine the molecular combinations.			

Benchmarks >>	PS.2.4A: By the end of Grade 4, students will differentiate between physical and chemical changes.	PS.2.8A: By the end of Grade 8, students will demonstrate how substances can chemically react with each other to form new substances having properties different from those of the original substances.	PS.2.12A: By the end of Grade 12, students will know that changes in state require a transfer of energy.				
			1	2	3	4	5
			List evidence that suggest a chemical reaction might have occurred and evidence that proves a chemical reaction has occurred.	Describe the rearrangements of atoms involved chemical reactions.	Explain how non-spontaneous reactions can occur.	Distinguish between exothermic and endothermic reactions.	

Benchmarks >>	PS.2.4A: By the end of Grade 4, students will differentiate between physical and chemical changes.	PS.2.8A: By the end of Grade 8, students will demonstrate how substances can chemically react with each other to form new substances having properties different from those of the original substances.	PS.2.12A: By the end of Grade 12, students understand that reactions are a result of interactions between atoms, molecules or ions.				
			1	2	3	4	5
			Describe the transfer of electrons (oxidation/reduction.	Describe the transfer of hydrogen ions in acid/base reactions.	Describe how bonds are created by sharing electrons.	Explain the origins of synthetic polymers, oils, and the large molecules essential to life.	

Standard	**PS: Physical Science** Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
Strand Standard	**PS.3 Forms of Energy** Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.
Rationale	**Forms of Energy** Energy is a central concept in science because all physical interactions involve changes in energy. Students need to understand that all physical events involve transferring energy or changing one form of energy into another. When a transformation of energy takes place, some of it is likely to appear as heat. Knowledge of forms of energy, its transfer and transformation, is essential to interpreting, explaining, predicting, and influencing change in our world.
Enduring Knowledge	Energy exists in many different forms and is necessary for change to occur.
Essential Question ?	How do we know that things have energy?

Benchmark		**PS.3.4A:** By the end of Grade 4, students will predict the observable effects of energy (i.e., light bulb lights, a bell rings, hands warm up) when given a specific example or illustration (e.g., simple closed circuit, rubbing hands together), (e.g., a test item might ask, "what will happen when…?").					**PS.3.8A:** Not addressed at this level			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy	**Forms of Energy**	Observe how energy does things (e.g., batteries, the sun, wind, electricity).	Explain that energy comes from different sources, such as electricity and water, and is utilized in many common objects.	Describe how energy produces changes (e.g., heat melts ice, gas makes car go uphill, electricity makes TV work).	Identify the various forms of energy, such as electrical, light, heat, sound and explain that these forms of energy can affect common objects and are involved in common events.	Describe the usefulness of some forms of energy (e.g., electricity, sunlight, wind, sound) and how energy (e.g., heat, light,) can affect common objects (e.g., sunlight warms dark objects, heat melts candles).				

Benchmark		**PS.3.4B:** By the end of Grade 4**,** students will experiment, observe, or predict how heat might move from one object to another.					**PS.3.8B:** By the end of Grade 8**,** students will use data to draw conclusions about how heat can be transferred (convection, conduction, radiation).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy	**Heat Energy**	Classify objects in terms of their relative temperature (e.g., hotter and colder).	Identify some examples where heat is released (e.g., burning candles, rubbing hands, running).	Describe that heat can be produced (e.g., burning, rubbing, mixing some substances).	Explain that thermal energy (heat) moves more rapidly in thermal conductors (e.g., metal pan) than in insulators (e.g., plastic handle).	Describe the effectiveness of different insulating and conducting materials with respect to thermal energy (heat) flow.	Explain that energy, in the form of heat, is usually a by-product when one form of energy is changed to another, such as when machines convert stored energy to motion.	Describe how thermal energy (heat) is transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators.	Explain how thermal energy (heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature.	Explain how thermal energy (heat) flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions.

		PS.3.4B: By the end of Grade 4, students will experiment, observe, or predict how heat might move from one object to another.								
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Properties of Matter	**Interactions of Matter**			Classify a variety of materials on whether they conduct heat (conductors) or do not conduct heat (insulators).	Classify a variety of materials as those that can reflect or absorb light.	Classify a variety of materials on whether they conduct electricity (conductors) or do not conduct electricity (insulators).				

Benchmark		**PS.3.4C:** By the end of Grade 4, students will experiment to identify, classify, and change different pitches and volumes of sounds produced by different objects.					**PS.3.8C:** By the end of Grade 8**,** students will describe sound as the transfer of energy through various materials (e.g. solids, liquids, gases).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy	**Sound Energy**	Demonstrate and identify sounds as soft or loud.	Demonstrate how sound is made in a variety of ways (e.g., singing, whispering, striking an object).	Demonstrate how sound can change in pitch and volume.	Compare and contrast the change in length, tension, or thickness of a vibrating object on the frequency of vibration (e.g., string, wire, or rubber band).	Demonstrate that the pitch of a sound is dependent on the frequency of the vibration producing it.	Describe and summarize observations of the transmission, reflection, and absorption of sound.	Observe and explain that sound vibrations move at different speeds, have different wavelengths; and establish wave-like disturbances that emanate from the source.		

Benchmark		**PS.3.4D: By the end of Grade 4,** Students will use observations of light in relation to other objects/substances to describe the properties of light (can be reflected, refracted, or absorbed).					**PS.3.8D:** By the end of Grade 8, students will explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy	**Light Energy**	Identify natural sources of light (e.g., sun, fireflies, deep sea creatures, fire, lightning) and artificial sources of light (e.g., light bulbs, matches, candles).	Observe and record shadows at different times of the day.	Investigate the properties of transparent and opaque objects (e.g., plastic wrap and aluminum foil).	Describe how light can be reflected by a mirror, bent by a lens, or absorbed by the object.	Describe ways light can interact with matter, such as transmission (which includes refraction), absorption, and scattering (which includes reflection).	Demonstrate that visible light from the sun or reflected by objects may be made up of a mixture of many different colors of light.	Explain the relationship between an object's color and the wavelength of light reflected or transmitted to the viewer's eyes.	Describe the relationship between frequency and wavelength of any wave.	Explain that the human eye can only detect wavelengths of electromagnetic radiation within a narrow range; and explain that the differences of wavelength within that range of visible light are perceived as differences in color.

		PS.3.4D: By the end of Grade 4, Students will use observations of light in relation to other objects/substances to describe the properties of light (can be reflected, refracted, or absorbed).								
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy	**Solar Energy**	Describe the effects of the sun's energy on different materials.	Identify the sun as the main source of the Earth's light and heat energy.	Compare the heating and cooling rates of air, land, and water.	Analyze data to explain the heating and cooling rates of air, land, and water.	Describe how the Sun, a major energy source for the Earth, affects the planet's surface.				

Benchmarks >>	PS.3.4A: By the end of Grade 4, students will predict the observable effects of energy (i.e., light bulb lights, a bell rings, hands warm up) when given a specific example or illustration (e.g., simple closed circuit, rubbing hands together), (e.g., a test item might ask, "what will happen when…?").	PS.3.8A: Not addressed at this level	PS.3.12A: By the end of Grade 12, students will understand that the atoms and molecules that compose matter are in constant motion (translational, rotational, and/or vibrational).				
			1	2	3	4	5
			Describe the kinetic energy of a particle.	Relate translational motion to average kinetic energy.	Demonstrate how energy can be transferred from one object to another during collisions.	Explain why molecule shape determines if rotational motion is significant.	

Benchmarks >>	PS.3.4B: By the end of Grade 4, students will experiment, observe, or predict how heat might move from one object to another.	PS.3.8B: By the end of Grade 8, students will use data to draw conclusions about how heat can be transferred (convection, conduction, radiation).	PS.3.12B: Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	PS.3.4C: By the end of Grade 4, students will experiment to identify, classify, and change different pitches and volumes of sounds produced by different objects.	PS.3.8C: By the end of Grade 8, students will describe sound as the transfer of energy through various materials (e.g. solids, liquids, gases).	PS.3.12C: Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	PS.3.4D: By the end of Grade 4, Students will use observations of light in relation to other objects/substances to describe the properties of light (can be reflected, refracted, or absorbed).	PS.3.8D: By the end of Grade 8, students will explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky).	PS.3.12D: By the end of Grade 12, students will explain how electromagnetic waves are produced by changing the motion of electric charges or by changing the magnetic field and how the energy of these EM waves change with frequency.				
			1	2	3	4	5
			Explain that moving electric charges produce magnetic fields.	Describe how changing magnetic fields can produce electric fields.	Explain why the energy in electromagnetic waves is proportional to the frequency of the wave.	Describe how changes on the electromagnetic spectrum going from high-energy gamma rays to low energy radio/television waves.	

Benchmarks >>	PS.3.4E: Not addressed at this level.	PS.3.8E: Not addressed at this level.	PS.3.12E: By the end of Grade 12, students will explain that fission and fusion are reactions involving changes in the nuclei of atoms.				
			1	2	3	4	5
			Describe the composition of the nucleus.	Describe the nuclear processes in the Sun.	Explain why nuclei become more unstable when neutrons are added.	Explain why nuclear processes are unaffected by normal variations in temperature and pressure.	Describe the relationship between mass and energy in nuclear reactions.

Standard	**PS: Physical Science** **Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.**
Strand Standard	**PS.4 Energy Transfer and Conservation** Students will develop an understanding of the transfer, transformation, and conservation of energy.
Rationale	Interactions between matter and energy account for changes observed in everyday events. Understanding how matter and energy interact extends students' knowledge of the physical world and allows them to monitor and explain a wide variety of changes and to predict future physical and chemical changes. Students gain both a practical and conceptual understanding of the laws of conservation of matter and energy.
Enduring Knowledge Statement	Energy can be stored, transferred and transformed, but cannot be destroyed.
Essential Questions	How can energy be transferred from one material to another? What happens to a material when energy is transferred to it?

Benchmark		**PS.4.4A:** By the end of Grade 4, students will demonstrate and explain the movement of electricity in closed and open circuits					**PS.4.8A:** By the end of Grade 8, students will show, given a real-world example, that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Transformation, Transfer, Conservation Energy	**Electricity and Transformation of Energy**			Identify the use of electricity.	Construct and explain a simple electric circuit.	Demonstrate that electricity flowing in circuits can produce light, heat, sound, and magnetic effects.	Compare the following ways in which energy may be transformed: mechanical to electrical; electrical to thermal.	Trace energy transformation in a simple closed system (e.g., a flashlight).	Construct a model to explain the transformation of energy from one form to another. (e.g. an electrical circuit changing electrical energy to light energy in a light bulb, electrical energy to sound,, etc).	Identify various ways in which electrical energy is generated using renewable and nonrenewable resources (e.g., wind, dams, fossil fuels, nuclear reactions).

							PS.4.8A: By the end of Grade 8, students will show, given a real-world example, that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Transformation, Transfer, Conservation Energy	**Potential and Kinetic Energy**						Describe how an object can have potential energy due to its position or chemical composition.	Differentiate between kinetic energy, which is the energy of motion and potential energy, which depends on relative position.	Compare the potential and kinetic energy within a system at various locations or times.	Explain that chemical energy is produced by chemical reactions and is dependent upon the arrangements of atoms.

Benchmark		PS.4.4B: Not Addressed at this level					PS.4.8B: By the end of Grade 8, students will investigate, observe, and predict how energy might be transferred by means of waves.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Transformation, Transfer, Conservation Energy	**Transmission of Energy**						Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves.	Explain that energy can be carried from one place to another by waves (e.g., water waves, sound waves), by electric currents, and by moving objects.	Explain that some energy travels as waves (e.g., seismic, light, sound), including: the sun as source of energy for many processes on Earth, different wavelengths of sunlight (e.g., visible, ultraviolet, infrared), vibrations of matter (e.g., sound, earthquakes), different speeds through different materials.	Differentiate between electromagnetic and mechanical waves and represent in diagrams, or other models the visible spectrum as a part of the electromagnetic spectrum (consisting of visible light, infrared, and ultraviolet radiation) and composed of all colors of light.

Benchmark		PS.4.4C: Not addressed at this level					PS.4.8C: By the end of Grade 8, students will describe electromagnetic energy from the Sun (solar radiation) as the major source of energy on Earth			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Transformation, Transfer, Conservation of Energy	**Nuclear Energy**						Explain that solar energy reaches Earth through radiation, mostly in the form of visible light.	Explain that stars produce energy from nuclear reactions and that processes in stars have led to the formation of all elements beyond hydrogen and helium.	Describe the sun as the major source of energy for phenomena on Earth's surface, powering winds, ocean currents, the water cycle, and providing energy essential for life functions.	Explain that photosynthetic cells convert solar energy into chemical energy that is used to carry on life functions or is transferred to consumers and used to carry on their life functions.

Benchmark		PS.4.4D: Not Addressed at this level					PS.4.8 D: By the end of Grade 8, students will collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Transformation, Transfer, Conservation of Energy	**Conservation**						Explain the relationship between the mass of an object and the sum of its parts.	Describe how mass remains constant in a closed system and provide examples relating to both physical and chemical change.	Explain that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and that energy is conserved in these changes.	Explain the law of conservation of matter and energy.

Benchmarks >>	PS.4.4A: By the end of Grade 4, students will demonstrate and explain the movement of electricity in closed and open circuits.	PS.4.8A: By the end of Grade 8, students will show, given a real-world example, that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical).	PS.4.12A: By the end of Grade 12, students know that heating a material increases the rotational, translational, and vibrational energies of its atoms/molecules.				
			1	2	3	4	5
			Explain how translational energy is related to temperature.	Describe how crystalline structure breaking down results in solids melting when the vibrational energy becomes great enough.	Relate the specific heat of a substance to the distribution of its particulate energies between translational, rotational, and vibrational.		

Benchmarks >>	PS.4.4B: Not Addressed at this level.	PS.4.8B: By the end of Grade 8, students will investigate, observe, and predict how energy might be transferred by means of waves.	PS.4.12B: By the end of Grade 12, students know that some processes can only be understood from a particulate nature of energy transfer.				
			1	2	3	4	5
						Describe the how the photoelectric effect supports the particle nature of light.	Justify why radiation from cell phone generated EM waves is harmless because the energy packet is too low to change chemical bonds.

Benchmarks >>	PS.4.4C: Not addressed at this level	PS.4.8C: By the end of Grade 8, students will describe electromagnetic energy from the Sun (solar radiation) as the major source of energy on Earth.	PS.4.12C: Not Addressed at this level				
			1	2	3	4	5

Benchmarks >>	PS.4.4D: Not Addressed at this level.	PS.4.8D: By the end of Grade 8, students will collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter).	PS.4.12D: By the end of Grade 12, students understand that total mechanical energy of a closed system stays constant				
			1	2	3	4	5
			Describe potential energy.	Relate changes in potential energy with distance above the Earth's surface.	Describe the energy of motion, kinetic energy.	Relate changes in the kinetic energy of a closed system with the potential energy of the system.	

Standard	**PS: Physical Science** Students will develop a knowledge of the physical properties common to all objects and substances and physical properties common to solids, liquids and gases, the chemical properties, particulate nature of matter, and the Periodic Table of Elements, and of the characteristics of sub-atomic particles and atomic structure.
Strand Standard	**PS.5 Motion at the Macroscopic Level** Students will understand how to describe the motion of an object.
Rationale	Movement can be quantified and used to see how it involves one form of energy being transformed into another form. Waves transfer energy such as sound, heat, light, and earthquakes through different mediums. Sound and light waves allow organisms to "hear" and "see" the world around them. Energy is classified as either kinetic or potential energy.
Enduring Knowledge	Everything is constantly moving; motion is relative, but the motion of an object can be described and predicted by tracing and measuring its position over time.
Essential Question	How can motion be measured?

Benchmark		**PS.5.4A:** By the end of Grade 4, students will describe an object's change in position relative to other objects or background.					**PS.5.8A:** By the end of Grade 8, students will measure distance and time for a moving object and using those values as well as the relationship s=d/t to calculate speed and graphically represent the data.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Motion (macroscopic)	**Motion**	Describe spatial relationships (i.e., above, below, next to, left, right, middle, center) of objects.	Describe the ways things can be made to move (e.g. straight, zigzag, up and down, round and round, back and forth, or fast and slow).	Describe an objects position by locating it relative to another object or the background.	Demonstrate a variety of ways to make things move and describe what causes them to change speed, direction and/or stop.	Describe an objects motion by tracing and measuring its position over time. (measuring speed).	Describe variables that change an object's speed, direction, or both and identify and describe the forces that cause the change in motion.	Explain motion in terms of frames of reference and analyze graphs depicting motion and predicted future motion.	Create a graph devised from measurements of moving objects and their interactions, including: position-time graphs and velocity-time graphs.	Interpret the relationships of distance versus time, speed versus time, and acceleration versus time graphs.

Benchmarks >>	PS.5.4A: By the end of Grade 4, students will describe an objects change in position relative to other objects or background.	PS.5.8A: By the end of Grade 8 students will measure distance and time for a moving object and using those values as well as the relationship s=d/t to calculate speed and graphically represent the data.	PS.5.12A: By the end of Grade 12, students know that velocity and acceleration are quantitative descriptions of the motion of objects.				
			1	2	3	4	5
			Distinguish between average speed and instantaneous speeds.	Identify linear velocity and acceleration from table of data.	Deduce acceleration from a velocity versus time graph.	Demonstrate how acceleration can occur when an object changes direction but not speed.	

Standard	**PS: Physical Science** Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
Strand Standard	**PS.6 Forces Affecting Motion** Students will understand that the motion of an object is affected by external forces on it.
Rationale	Movement involves one form of energy being transformed into another form. Waves transfer energy such as sound, heat, light, and earthquakes through different mediums. Sound and light waves allow organisms to "hear" and "see" the world around them. Energy is classified as either kinetic or potential energy. Every object exerts a gravitational force on every other object. The distance between objects and mass of the objects determine the force of gravity between them. This force is difficult to measure unless one of the objects has a very large mass. Unbalanced forces cause change in the motion of objects, while balanced forces do not.
Enduring Knowledge	Motions are affected by the presence or absence of forces, some of which are not directly observable.
Essential Question	How does force affect motion?

Benchmark		**PS.6.4A:** By the end of Grade 4, students will use data to predict how a change in force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls).					**PS.6.8A:** By the end of Grade 8, students will use data to determine or predict the overall (net effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Forces Affecting Motion	**Effect of Forces**	Describe the position of an object by referencing its location in relation to another object or background.	Describe and demonstrate how the position and motion of an object can be changed by applying force, such as pushing and pulling.	Compare the effects of force (pushes or pulls) on the motion of an object.	Identify contact /non-contact forces that affect motion of an object (e.g., gravity, magnetism and collision).	Explain that the strength of a force and mass of an object influence the amount of change in an object's motion.	Use data to predict how a change in force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls).	Investigate and describe how the acceleration of a body is dependent on its mass and the net applied force (Newton's Second Law).	Describe Newton's Laws of Motion; identify examples, illustrate qualitatively and quantitatively drawing vector examples.	Demonstrate that an object in motion that is unaffected by a force will continue to move at a constant speed and in a straight line. (Newton's First Law).

Progression Levels		1	2	3	4	5	6	7	8	9
Forces Affecting Motion	Effects of Forces		Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets).	Describe the properties of magnetism and demonstrate how magnets can be used to move some things without touching them.	Use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect).	Explain that electrically charged material pulls on all other materials and can attract or repel other charged materials.	Explain that just as electric currents can produce magnetic forces, magnets can cause electric currents.	Explain that when a force is applied to an object, it reacts in one of three ways: the object either speeds up, slows down, or goes in a different direction.	Describe the relationship between the strength of a force on an object and the resulting effect, such as the greater the force, the greater the change in motion.	Use data to determine or predict the overall (net) effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.

Progression Levels		1	2	3	4	5	6	7	8	9
Forces Affecting Motion	Gravity and Friction		Describe the ways that different objects may balance or topple in various situations.	Describe and demonstrate that things close to the Earth drop to the ground unless something supports them.	Describe the effect of retarding forces such as friction on the motion of objects.	Describe the effects of variables on an object's motion (e.g., incline angle, friction, gravity, applied forces).	Explain that the Earth's gravitational force pulls any object toward it.	Explain the effect of gravity on falling objects (e.g., $g= 9.8m/s^2$, object dropped on earth and on moon).	Explain that the force of gravity gets stronger the closer one gets to an object and decreases the further away one gets from it.	Predict the effect of gravitational forces between pairs of objects (i.e., earth and object's on the surface, earth and moon, Earth and sun).
Forces Affecting Motion	Simple Machines	Assemble, take apart, and reassemble constructions using interlocking blocks, erector sets, etc.	Manipulate hammers and nails, screwdrivers and screws, scissors, and other simple tools.	Examine simple machines and the forces (pushes and pulls) involved.	Perform experiments with simple machines to demonstrate the relationship between forces and distance.	Illustrate quantitatively mechanical advantage of simple machines.				

Benchmarks >>	PS.6.4A: By the end of Grade 4, students will use data to predict how a change in a force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls).	PS.6.8A: By the end of Grade 8, students will use data to determine or predict the overall (net effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.	**PS.6.12A:** By the end of Grade 12, students know that the motion of an object changes only when a net force is applied to that object.				
			1	2	3	4	5
			Describe a force as a vector.	Describe how unbalanced or net forces can change the motion of an object	Predict the forces on an object from observing its motion.		

Benchmarks >>	PS.6.4B: Not Addressed at This Level	PS.6.8B: Not Addressed at This Level	PS.6.12B: By the end of Grade 12, students know that there are key quantities of motion that are constant during the interactions between objects.				
			1	2	3	4	5
				Describe how the force of one object on another is "mirrored" by a force on the first object	Describe momentum as a vector.	Explain the conservation of momentum within a closed system.	Show how the conservation of momentum allows one to know the velocities of interacting particles.

Benchmarks >>	PS.6.4C: Not Addressed at This Level	PS.6.8C: Not Addressed at This Level	**PS.6.12C:** By the end of Grade 12, students will know the relationship between the net force on an object, its mass, and the resulting acceleration.				
			1	2	3	4	5
			Subtract two velocity vectors to get a change in velocity.	Calculate the average acceleration of an object given the appropriate data.	Deduce the acceleration of an object knowing the forces on the object and its mass.		

Benchmarks >>	PS.6.4D: Not Addressed at This Level	PS.6.8D: Not Addressed at This Level	PS.6.12D: By the end of Grade 12, students understand the universality of gravitational attraction.				
			1	2	3	4	5
			Explain that the weight of an object is due to the attraction to the Earth.	Demonstrate the connection between law of gravitational attraction and potential energy	Show that all objects fall at the same rate near the Earth's surface.	Explain how an apple falling on Earth is similar to the Moon orbiting Earth.	Show how gravitational attraction explains the motion of planets around the Sun.

Benchmarks >>	PS.6.4E: Not Addressed at This Level	PS.6.8E: By the end of Grade 8, students will use data to determine or predict the overall (net effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.	PS.6.12E: By the end of Grade 12, students understand that electric force is a universal force between any two electrically charged objects.				
			1	2	3	4	5
			Understand the inverse-square law.	Use Coulomb's law to compare electrical forces on an object at different distances from another charged object.	Compare the relative strengths of gravitational forces versus electrical forces.		

The Earth and Space Sciences

The Earth system is part of the Solar System that exists within a vast Universe. The Earth's motion and position relative to the Sun and the Moon are unique among planets of the Solar System that allows diverse forms of life to be supported on the Earth. Students will learn that even though the distributions and types of materials differ from planet to planet, the chemical composition of materials is identical and the same laws of science apply across the universe. It is important students understand how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. In addition, an understanding of the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe are important. . An understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and space sciences opens the doors of space science and provides students an understanding of the relationship of their planet to the solar system and to the universe beyond.

Standard	**ESS: Earth and Space Science** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	**ESS.1 Objects In The Universe** Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.

Rationale	A study of the universe opens the doors of space science so that students may come to understand the relationship of their planet to the solar system and to the universe beyond. For this standard to be meaningful, students are introduced to **current** the structure, and evolution of the universe. The inclusion of this standard acknowledges the subjective and affective meaning that can be drawn from a scientific explanation of the Earth and universe. The role of scientific method and the importance of good data become critical in developing understanding relative to events that predate the existence of the Earth and span scales of distance larger than the Earth itself.
Enduring Knowledge Statement	The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time
Essential Question	Is there an order to the Universe?

Benchmark		**ESS.1.4A** By the end of Grade 4, students will observe and identify objects and their apparent motion in the day and night sky.					**ESS.1.8A** By the end of Grade 8, students will describe the universe as containing many billions of galaxies, and each galaxy contains many billions of stars.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Objects in the Universe	**Stars and Galaxies**	Explain that there are more stars in the sky than anyone can easily count.	Explain that stars are not scattered evenly and they are not always the same brightness and color.	Explain that the patterns in the sky remain stable but appear to move across the sky because of the Earth's motion.	Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light.	Investigate and describe how distance affects the brightness of any light source.	Describe how different stars can be seen at different times of the year and planets change their positions against the background of stars over time	Explain that the Sun is a star located within a galaxy of many other stars, "The Milky Way."	Describe the position of the solar system in the Milky Way galaxy and the universe.	Explain that billions of galaxies form most of the visible mass in the universe.

Progression Levels		1	2	3	4	5	6	7	8	9
Objects in the Universe	The Solar System	Identify objects in the day and night sky (e.g., moon, stars, or sun).	Observe that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day.	Observe and describe the sun, moon, planets, and stars.	Identify the sun, moon, and the Earth as components of our solar system.	Observe and describe properties, locations, and movements of the sun, moon, stars, and clouds.	Investigate and describe the basic components of our solar system (e.g., planets, moons, asteroids, comets, and the sun).	Give evidence for objects that orbit within the Solar System that impact Earth (e.g. asteroids, comets).	Explain that the sun's gravitational pull holds the Earth and other planets in their orbits, just as the planets' gravitational pull keeps their moons in orbit around them gravity is the force that governs the motion in the solar system.	Explain through words, charts, diagrams, and models the effects of distance and the amount of mass on the gravitational force between objects.
Objects in the Universe	Theories Origin of Universe								Provide an example of how technology has helped scientists investigate the universe.	Investigate and report how science has changed the accepted ideas regarding the nature of the universe throughout history.

Benchmark		**ESS.1.4 B:** By the end of Grade 4, students will relate the motions of the Earth-sun-moon system to units of time (days, months, years).					**ESS.1.8 B:** By the end of Grade 8, students will relate the motions of the Earth-sun-moon system to eclipses and the seasons.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Objects in the Universe	**The Earth**			Describe Earth's position and movement in the solar system.	Use models to demonstrate how the rotation of the Earth on its axis every 24 hours produces the night-and-day cycle.	Use models to demonstrate how the revolution of the Earth around the sun produces the yearly cycle.	Explain the alignment of the earth, moon, and sun during solar and lunar eclipses.	Use a model to demonstrate and explain that because the Earth is tilted relative to the plane of the Earth's yearly orbit around the sun, sunlight falls more intensely on different parts of the Earth during the year.	Explain that the difference in heating of the Earth's surface produces the planet's seasons and weather patterns.	Relate the tilt of the earth to the distribution of sunlight throughout the year and its effect on climate.

Benchmark		ESS.1.4C: By the end of Grade 4, students will describe the moon's orbit around the Earth as once in about 28 days and our changing views of the moon allow us to see a changing portion of the lighted side of the moon, which we call "phases".					ESS.1.8 C: Not addressed at this level.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Objects in the Universe	**The Moon**	Identify that the moon and stars are usually seen at night	Observe and discuss the importance of objects in the day and night sky	Observe and describe the changes of the moon's appearance over a month.	Describe the relative movement of the Earth and moon in relation to the sun	Demonstrate the phases of the moon by showing the alignment of the earth, moon, and sun.				

Benchmark		ESS.1.4D: Not addressed at this level					ESS.1.8 D: By the end of Grade 8, students will compare and contrast planets based on data provided about size, composition, location, orbital movement, atmosphere, or surface features (includes moons).			
Progression Levels		1	2	3	4	5	6	7	8	9
Objects in the Universe	The Planets						Explain that the Earth is one of several planets that orbit the sun, and the moon orbits around the Earth.	Observe that different stars can be seen at different times of the year and planets change their positions against the background of stars over time.	Explain that nine planets of varied size, composition, and surface features move around the sun in elliptical orbits.	Compare and contrast the planets in terms of size relative to the earth's surface and atmospheric features, relative distance from the sun, and ability to support life.

Benchmarks >>	ESS.1.4A: By the end of Grade 4, students will observe and identify objects and their apparent motion in the day and night sky.	ESS.1.8A: By the end of Grade 8, students will describe the universe as containing many billions of galaxies, and each galaxy contains many billions of stars.	ESS.1.12A: By the end of Grade 12, students know the origin of the universe and describe its evolution.				
			1	2	3	4	5
			Explain how hydrogen nuclei fuse to form Helium	Show how nuclear reactions can produce new nuclei.	Describe the formation of heavier elements via nuclear processes.	Cite evidence for the Big Bang.	Describe the birth-death process for stars.

Benchmarks >>	ESS.1.4B: By the end of Grade 4, students will relate the motions of the Earth-sun-moon system to units of time (days, months, years).	ESS.1.8B: By the end of Grade 8, students will relate the motions of the Earth-sun-moon system to eclipses and the seasons.	ESS.1.12B: Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	ESS.1.4C: By the end of Grade 4, students will describe the moon's orbit around the Earth as once in about 28 days and our changing views of the moon allow us to see a changing portion of the lighted side of the moon, which we call "phases."	ESS.1.8C: Not addressed at this level.	ESS.1.12C: Not addressed at this level.				
			1	2	3	4	5

Benchmarks >>	**ESS.1.4D:** Not addressed at this level.	**ESS.1.8D:** By the end of Grade 8, students will compare and contrast planets based on data provided about size, composition, location, orbital movement, atmosphere, or surface features (includes moons).	**ESS.1.12D:** Not addressed at this level.				
			1	2	3	4	5

Standard	**3.0 Earth and Space Sciences** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	**ESS.2 History of the Earth** Students will understand scientific theories of how the earth's surface is formed and how those theories developed.
Rationale	Earth is a dynamic planet. Processes that change Earth's surface operated in the past much as they do today. Evidence of past surface and climatic changes are indicated in the rock and fossil records. Rocks are composed of minerals. Rocks and minerals cycle through processes that change their form. Several processes contribute to changing Earth's surface. Earth's surface is changed by heat flowing from Earth's hot interior toward the cooler surface and by atmospheric processes. Earth's surface can change abruptly through volcanoes and earthquakes. Earth's surface can change gradually through mountain building, weathering, erosion, and deposition. Small changes that repeatedly occur over very long time periods can add up to major changes in Earth's surface.
Enduring Knowledge Statement	Earth's systems continually interact at different rates of time, affecting the Earth locally and globally
Essential Question	How do changes in one part of the Earth system affect other parts of the system?

Benchmark		**ESS.2.4A:** By the end of Grade 4, students will explain how wind, water, or ice shape and reshape the earth.					**ESS.2.8A:** By the end of Grade 8, students will explain how earth events (abruptly and over time) can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**Erosion and Weathering**		Identify the processes of physical weathering that break down rocks at Earth's surface (i.e., water movement, freezing, plant growth, wind).	Distinguish between weathering (i.e., wearing down and breaking of rock surfaces) and erosion (i.e., the movement of materials).	Model erosion of Earth materials and collection of these materials as part of the process that leads to soil (e.g., water moving sand in a playground area and depositing this sand in another area).	Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments.	Describe events and the effect they may have on climate (e.g. El Nino, deforestation, glacial melting, and an increase in greenhouse gases).	Evaluate slow processes (e.g. weathering, erosion, mountain building, sea floor spreading) to determine how the earth has changed and will continue to change over time.	Evaluate fast processes (e.g. erosion, volcanoes and earthquakes) to determine how the earth has changed and will continue to change over time.	Investigate the effect of flowing water on landforms (e.g. stream table, local environment).

		ESS.2.4A: By the end of Grade 4, students will explain how wind, water, or ice shape and reshape the earth.					**ESS.2.8A:** By the end of Grade 8, students will explain how earth events (abruptly and over time) can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**Results of the Processes**	Observe seasonal and weather changes throughout the school year.	Observe and record seasonal and weather changes throughout the school year.	Investigate local landforms and how wind, water, or ice have shaped and reshaped them (e.g. severe weather).	Use or build models to simulate the effects of how wind and water shape and reshape the land (e.g., erosion, sedimentation, deposition, glaciation).	Identify sudden and gradual changes that affect the Earth (e.g. sudden change = flood; gradual change = erosion caused by oceans).	Describe how the history of the Earth is influenced by occasional natural occurrences, such as the impact of an asteroid or comet.	Describe how energy from the Earth's interior causes changes to Earth's surface (i.e., earthquakes, volcanoes).	Describe how earthquakes and volcanoes transfer energy from Earth's interior to the surface (e.g., seismic waves transfer mechanical energy, flowing magma transfers heat and mechanical energy).	Plot location of volcanoes and earthquakes and explain the relationship between the location of these phenomena and faults.

		ESS.2.4A: By the end of Grade 4, students will explain how wind, water, or ice shape and reshape the earth.					**ESS.2.8A:** By the end of Grade 8, students will explain how earth events (abruptly and over time) can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**Earth's Features**			Describe land features (including volcanoes, mountains, valleys, canyons, caverns, and islands) by using pictures, diagrams, and maps.	Describe changes in Earth's surface that are due to slow processes (including weathering, erosion, and deposition).	Describe changes in Earth's surface that are due to rapid processes (including landslides, volcanic eruptions, floods, and earthquakes).	Illustrate the geologic landforms of the ocean floor (including the continental shelf and slope, the mid-ocean ridge, rift zone, trench, and the ocean basin.	Compare continental and oceanic landforms.	Explain how natural processes (including weathering, erosion, deposition, landslides, volcanic eruptions, earthquakes, and floods) affect Earth's oceans and land in constructive and destructive ways.	Explain how waves, currents, tides, and storms affect the geologic features of the ocean shore zone (including beaches, barrier islands, estuaries, and inlets).

							ESS.2.8A: By the end of Grade 8, students will explain how earth events (abruptly and over time) can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**Changes in Landforms**							Identify and illustrate the geologic features of the local region through the use of topographic maps.	Identify and illustrate the geologic features of other regions of the world through the use of imagery (including aerial photography and satellite imagery) and topographic maps.	Illustrate the creation and changing of landforms that have occurred through geologic processes (including volcanic eruptions and mountain-building forces).

Benchmark		ESS.2.4B: By the end of Grade 4, students will use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves).					ESS.2.8B: By the end of Grade 8, students will use data about a rock's physical characteristics make and support an inference about the rock's history and connection to rock cycle.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**Interaction of Water with Earth Materials**		Conduct tests on how different soils retain water (e.g., how fast does the water drain through?).	Conduct investigations and use observational data to describe how water moves rocks and soils.	Examine materials that compose soil (i.e., sand, clay, humus, gravel, water) and describe these on the basis of their properties (i.e., color, luster, granularity, texture, mass relative to size, particle size, ability to absorb water, pore space, ability to compact).	Explain how waves, wind, water, glacier movement, and ice, shape and reshape the Earth's land surface by eroding rock and sand in some areas, and depositing them in other areas.	See below	See below	See below	See below

							ESS.2.8B: By the end of Grade 8, students will use data about a rock's physical characteristics make and support an inference about the rock's history and connection to rock cycle.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**The Rock Cycle**						Identify common rock forming minerals (quartz, feldspar, mica, halite, hematite, hornblende).	Classify rock samples as igneous (granite, basalt, obsidian, pumice), metamorphic (marble, slate, quartzite), and sedimentary (sandstone, limestone, shale, conglomerate).	Explain how igneous, metamorphic, and sedimentary rocks are interrelated in the rock cycle	Compare and contrast the formation of the different rock types, and demonstrate the similarities and differences using a model.

		ESS.2.4B: By the end of Grade 4, students will use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves).					**ESS.2.8B:** By the end of Grade 8, students will use data about a rock's physical characteristics make and support an inference about the rock's history and connection to rock cycle.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
History of the Earth	**Fossils**		Identify types of fossils (including molds, casts, and preserved parts of plants and animals).	Identify features of fossils that can be used to compare them to living organisms that are familiar (e.g., shape, size and structure of skeleton, patterns of leaves).	Explain how fossils can be used to make inferences about past life, climate, geology, and environments.	Cite two scientific explanations for the extinction of dinosaurs and other prehistoric organisms.	Describe and model the processes of fossil formation.	Describe how fossils provide important evidence of how life and environmental conditions have changed.	Explain why more recently deposited rock layers are more likely to contain fossils resembling existing species than older rock layers.	Explain how rocks and fossils are used to understand the age and geological history of the earth (timelines and relative dating, rock layers).

Benchmarks >>	**ESS.2.4A:** By the end of Grade 4, students will explain how wind, water, or ice shape and reshape the earth.	**ESS.2.8A:** By the end of Grade 8, students will explain how earth events (abruptly and over time) can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.	**ESS.2.12A:** By the end of Grade 12, students will explain the methods of determining geologic time.				
			1	2	3	4	5
			Demonstrate example of index fossils and stratigraphic sequencing	Explain the occurrence of radioactive elements.	Explain how carbon dating tells us the age of organic materials.	Give examples of radioactive isotopes in rocks and their use in dating.	

Benchmarks >>	**ESS.2.4B:** By the end of Grade 4, students will use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves).	**ESS.2.8B:** By the end of Grade 8, students will use data about a rock's physical characteristics make and support an inference about the rock's history and connection to rock cycle.	**ESS.2.12B:** By the end of Grade 12, students understand the sporadic and gradual events that have changed the structure of the earth				
			1	2	3	4	5
			Describe how earthquakes and volcanoes can change the Earth's surface features.	Identify the events that lead to mountain building.	Identify mid-ocean ridges from maps.	Use the mapping data to show that sea floor is spreading.	Give evidence supporting the occurrence of plate tectonics.

Benchmarks >>	ESS.2.4C: Not addressed at this level.	ESS.2.8C: Not addressed at this level.	ESS.2.12C: By the end of Grade 12, students will know the evidence for believing the solar system was formed from a nebular cloud of dust and gas about 4.6 billion years ago.				
			1	2	3	4	5
			Describe the mechanism for planet formation.	Explain how meteorites add to our Earth-dating abilities.			

Benchmarks >>	ESS.2.4D: Not addressed at this level.	ESS.2.8D: Not addressed at this level.	ESS.2.12D: By the end of Grade 12, students will explain how the evolution of life caused dramatic changes in the composition of the Earth's atmosphere.				
			1	2	3	4	5
			Describe the characteristics of Earth's early atmosphere.	Give evidence of one-celled forms of life.	Describe changes in Earth's atmospheric composition over time.		

Standard	**ESS: Earth and Space Sciences** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	**ESS.3 Properties of Earth's Materials** Students will demonstrate an understanding materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed.
Rationale	Earth materials include rocks, soils, water, and gases. Rock is composed of minerals. Earth materials change over time from one form to another. These changes require energy. Erosion is the movement of materials and weathering is the breakage of bedrock and larger rocks into smaller rocks and soil materials. Soil is continually being formed from weathered rock and plant remains. Soil contains many living organisms. Plants generally get water and minerals from soil
Enduring Knowledge Statement	Earth's systems can be broken down into individual components that have observable measurable properties.
Essential Question	How does understanding the properties of Earth materials and the physical laws that govern their behavior lead to prediction of Earth events?

Benchmark		**ESS.3.4A** By the end of Grade 4, Students will use physical properties to sort, classify, and describe earth materials (soils, rocks or minerals).					**ESS.3.8A** Not addressed at this level			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Earth's Materials	**Rocks and minerals**	Identify the earth materials (i.e., rocks, soil, water, air) found in aquatic and terrestrial environments.	Use the senses to observe and describe the properties of a variety of earth materials (i.e., rock, soil, sand, water).	Describe, compare, and sort rocks, soils, and minerals by similar or different physical properties (e.g., size, shape, color, texture, smell, weight, temperature, hardness, composition, reaction to vinegar).	Use the physical properties of hardness, color, luster, and reaction to vinegar (weak acid). to identify common minerals (quartz, fluorite, calcite, and gypsum).	Identify the importance of minerals, ores, and fossil fuels as Earth's resources on the basis of their properties.				

Progression Levels		1	2	3	4	5	6	7	8	9
Earth's Materials	Soils	Use the senses to observe and then describe the physical properties of soil components.	Compare soil samples by sorting them according to properties (including color, texture, and the capacity to retain water).	Conduct simple tests to identify the three basic components of soil (sand, clay, humus).	Test soils (touch and roll, smear, settling, ability to absorb and retain water) and compare and contrast the properties.	Explain and give examples of the ways in which soil is formed (the weathering of rock by water and wind and from the decomposition of plant and animal remains).	Investigate that soils are often found in layers and can be different from place to place.	Observe and describe the composition of soil (e.g., small pieces of rock and decomposed pieces of plants and animals, and products of plants and animals).	Investigate the properties of soil (e.g., color, texture, capacity to retain water, ability to support plant growth).	

Earth's Materials	Water		Describe the observable properties of water (including the fact that it takes the shape of its container, flows downhill, and feels wet).	Illustrate the locations of water on Earth by using drawings, maps, or models.	Illustrate Earth's saltwater and freshwater features (including oceans, seas, rivers, lakes, ponds, streams, and glaciers).	Summarize the processes of the water cycle (including evaporation, condensation, precipitation, and runoff).				

Benchmark		ESS.3.4B By the end of Grade 4, students will explain how their characteristics of various earth materials lend themselves to specific uses					3.2.8B Not addressed at this level			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Earth's Materials	**Uses of Earth's Materials**	Identify the composition of Earth (including rocks, sand, soil, and water).	Identify which materials are best for different uses (e.g., soils for growing plants, sand for the sand box.)	Identify different uses (e.g., building materials, sources of fuel) of Earth's materials based on their properties.	Identify Earth's materials that are used as fuel, and other ways that humans use these materials to meet needs and wants (i.e., fluorite for toothpaste, marble for statues).	Determine and support explanations of the uses of Earth's materials (e.g., best soils to grow plants, best building material for a specific purpose, determining which rock size will best prevent erosion).				

Benchmark		ESS.3.4C: Not addressed at this level					ESS.3.8C: By the end of Grade 8, students will describe how matter in the atmosphere cycles through other Earth systems.			
Progression Levels		1	2	3	4	5	6	7	8	9
Earth's Materials	The Atmosphere						Identify the composition and layers of the Earth's atmosphere.	Compare the composition and structure of Earth's atmospheric layers (including the gases and differences in temperature and pressure within the layers).	Explain the interrelations hip among the dynamic processes of the water cycle (including precipitation, evaporation, transpiration, condensation, surface-water flow, and groundwater flow).	Summarize the relationship of the movement of air masses, high and low pressure systems, and frontal boundaries to storms (including thunderstorms , hurricanes, and tornadoes) and other weather conditions.

							ESS.3.8C: By the end of Grade 8, students will describe how matter in the atmosphere cycles through other Earth systems.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Earth's Materials	**Cycles in Earth's Systems**						Describe movement of a carbon atom from the atmosphere through a plant, animal, and decomposer, and back into the atmosphere.	Diagram the nitrogen cycle and provide examples of human actions that affect this cycle (e.g., fertilizers, crop rotation, fossil fuel combustion).	Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	Describe ways the biosphere, hydrosphere, and lithosphere interact with the atmosphere (e.g., volcanic eruptions putting ash and gases into the atmosphere, hurricanes, changes in vegetation).

Benchmarks >>	ESS.3.4A: By the end of Grade 4, Students will use physical properties to sort, classify, and describe earth materials (soils, rocks or minerals).	ESS.3.8A: Not addressed at this level.	ESS.3.12A: Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	ESS.3.4B: By the end of Grade 4, students will explain how their characteristics of various earth materials lend themselves to specific uses.	ESS.3.8B: Not addressed at this level.	ESS.3.12B: Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	ESS.3.4C: Not addressed at this level.	ESS.3.8C: By the end of Grade 8, students will describe how matter in the atmosphere cycles through other Earth systems.	ESS.3.12C: Not addressed at this level				
			1	2	3	4	5

Standard	**ESS Earth and Space Sciences** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	**ESS.4 Tectonics** Students will gain an understanding of gravity, density, and convection which moves Earth's plates causing the plates to impact other Earth systems
Rationale	The theory of plate tectonics explains the features of Earth's surface, earthquakes and volcanoes. Plates move very slowly, pressing against one another, sliding past one another, and pulling apart. The internal energy of the Earth drives the movement of the plates. The slow movement of materials within Earth results from heat flowing out from the deep interior and the action of gravity on regions of different density. Evidence for plate tectonics includes the spreading of the seafloor, the fossil record, and patterns and distribution of earthquakes and volcanoes
Enduring Knowledge Statement	Processes in Earth affect the atmosphere, biosphere, and hydrosphere. Processes occurring in these spheres affect the geosphere.
Essential Question	In what ways can Earth processes be explained as interactions among spheres?

Benchmark		ESS.4.4A: Not Addressed at this level					ESS.4.8A: By the end of Grade 8, students will use geological evidence to support the idea that the Earth's crust/lithosphere is composed of plates that move.			
Progression Levels		1	2	3	4	5	6	7	8	9
Tectonics	Earth's Structure						Describe Earth's layers as a lithosphere (crust and upper mantle), convecting mantle, and dense metallic core.	Describe, on the basis of relative position, density, and composition., Earth's layers as a lithosphere (crust and upper mantle), convecting mantle, and dense metallic core.	Identify the energy sources that cause material to move within Earth.	Model the movement of materials within Earth.

							ESS.4.8A: By the end of Grade 8, students will use geological evidence to support the idea that the Earth's crust/lithosphere is composed of plates that move**.**			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Tectonics	**The Theory of Tectonics**						Define and describe the location of the major plates and plate boundaries.	Describe the three types of plate boundaries (convergent, divergent, transform) and geographic features associated with them (continental rifts and mid-ocean ridges, volcanic and island arcs, deep sea trenches).	Explain how the theory of plate tectonics accounts for the motion of the lithospheric plates, the geologic activities at the plate boundaries, and the changes in landform areas over geologic time.	Relate plate boundary movements to their resulting landforms, including: Mountains, faults, rift valleys, trenches and volcanoes.

Benchmark		ESS.4.4B: Not Addressed at this level					ESS.4.8B: By the end of Grade 8, students will describe how the magnetic field of Earth and a magnet are similar.			
Progression Levels		1	2	3	4	5	6	7	8	9
Tectonics	Earth's Magnetic Field						Construct a compass and explain how it works. using Earth's magnetic field.	Compare Earth's magnetic field to the magnetic field of a magnet.	Investigate the effects of magnets on the needle of a compass and compare this to the effects of Earth's magnetic field on the needle of a compass (e.g., magnets effect the needle only at close distances, Earth's magnetic field affects the needle at great distances).	Explain how scientists use seismic waves — primary, secondary, and surface waves to determine the internal structure of Earth.

Benchmarks >>	**ESS.4.4A:** Not Addressed at this level. **ESS.4.4B:** Not Addressed at this level.	**ESS.4.8A**: By the end of Grade 8, students will use geological evidence to support the idea that the Earth's crust/lithosphere is composed of plates that move**.** **And** **ESS.4.8B:** By the end of Grade 8, students will describe how the magnetic field of Earth and a magnet are similar.	**ESS.4.12A:** By the end of Grade 12, students understand how data supports the theory of plate tectonics				
			1	2	3	4	5
			Identify mid-ocean ridges from maps.	Describe Earth's magna's magnetic characteristics.	Use magnetic mapping data to support the theory of plate tectonics.		

Standard	**ESS Earth and Space Sciences** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	**ESS.5 Energy in Earth Systems** Students will understand that energy from the sun provides heat and light for the Earth and is essential for plant growth.
Rationale	Matter on Earth cycles from one form to another. The cycling of matter on Earth requires energy. The cycling of water is an example of this process. The sun is the source of energy for the water cycle. Water changes state as it cycles between the atmosphere, land, and bodies of water on Earth.
Enduring Knowledge Statement	The sun is the major source of energy for phenomena on Earth's surface.
Essential Question	How does the sun's energy impact our lives?

Benchmark		**ESS.5.4A:** By the end of Grade 4, students will provide evidence showing that the sun is the source of heat and light for Earth and is essential for plant growth.					**ESS.5. 8A:** By the end of Grade 8, students will explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy in the Earth's Systems	**What Drives the Water Cycle**	Compare temperatures in sunny and shady places.	Investigate and report how sunlight affects plant growth.	Provide examples of how sunlight affects people and animals by providing heat and light.	Investigate and record temperature data to show the effects of heat energy on changing the states of water.	Identify the sun as the source of energy that evaporates water from the surface of Earth.	Identify the reservoirs of Earth's water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally,	Illustrate the movement of water on Earth and describe how the processes that move water (e.g., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.	Describe the processes of evaporation, condensation, and precipitation as they relate to the water cycle.	Construct a model or diagram to show how water continuously moves through the water cycle over time.

Benchmark		ESS.5.4B: Not Addressed at this level					ESS.5.8B: By the end of Grade 8, students will explain how the relationship between the tilt of Earth's axis and its yearly orbit around the sun produces the seasons.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Energy in the Earth's Systems	**Cause of Seasons**						Use collected data to compare patterns relating to seasonal daylight changes.	Use a drawing and/or model to explain that changes in the angle at which light from the sun strikes Earth, and the length of daylight, determine seasonal differences in the amount of energy received.	Compare the hours of daylight and illustrate the angle that the sun's rays strikes the surface of Earth during summer, fall, winter, and spring in the Northern Hemisphere.	Use a model to explain why the seasons are reversed in the Northern and Southern Hemispheres.

Standard	**ESS: Earth and Space Sciences** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	**ESS.6 Climate and Weather** Students will demonstrate an understanding of the relationship between Earth's atmospheric properties and processes and its weather and climate.
Rationale	Weather describes conditions in the atmosphere at a certain place and time. Water, energy from the sun, and wind create a cycle of changing weather. The sun's energy warms the oceans and lands at Earth's surface, creating changes in the atmosphere that cause the weather. The temperature and movement of air can be observed and measured to determine the effect on cloud formation and precipitation. Recording weather observations provides data that can be used to predict future weather conditions and establish patterns over time. Weather affects many aspects of people's lives.
Enduring Knowledge Statement	Water, energy from the sun, and wind are the main drivers of changing weather.
Essential Question	How does the sun interact with the earth to produce weather and climate?

Benchmark		**ESS.6.4A:** By the end of Grade 4, students will collect daily weather observation and describe weather changes or weather pattern based on data collected.					**ESS.6.8A:** By the end of Grade 8**,** students will explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Climate and Weather	**Weather**	Observe and record daily changes in weather (e.g., clouds or air temperature) .	Observe, identify and record changes in weather and effects on living organisms.	Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure.	Graph recorded weather data to show daily and seasonal patterns in weather.	Identify and describe short- and longer-term patterns of events (including weather and seasons) that occur on the Earth and in the sky.	Predict weather conditions and patterns based on weather data collected from direct observations and measurements, weather maps, satellites, and radar.	Explain how solar energy affects Earth's atmosphere and surface (land and water).	Explain how convection affects weather patterns and climate.	Explain the influence of global winds and the jet stream on weather and climatic conditions.

							ESS.6.8A: By the end of Grade 8**,** students will explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Climate ans Weather	**Factors Affecting Weather**						Explain how differential heating and convection affect Earth's weather patterns.	Describe how differential heating of the oceans affects ocean currents that in turn influence weather and climate. .	Explain the relationship between differential heating/ convection and the production of winds.	Analyze global patterns of atmospheric movements to explain effects on weather.

Benchmark		**ESS.6.4B:** By the end of Grade 4, students will explain how the use of scientific tools helps to extend senses and gather data about weather. (i.e., weather/wind vane: direction; wind sock: wind intensity; anemometer: speed; thermometer: temperature; meter sticks/rulers: snow depth; rain gauges: rain amount in inches).					**ESS.6.8B:** Not addressed at this level			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Climate and Weather	**Using Tools to Gather Data About Weather**	Describe how weather and forecasts affect people's lives.	Describe weather by measurable quantities such as temperature and precipitation.	Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).	Identify and use the tools of a meteorologist (e.g., measure rainfall using rain gauge, measure air pressure using barometer, measure temperature using a thermometer, measure wind speed using an aneometer).	Relate weather forecast accuracy to evidence or tools used to make the forecast (e.g. feels like rain vs. barometer reading is dropping).				

		ESS.6.4B: By the end of Grade 4, students will explain how the use of scientific tools helps to extend senses and gather data about weather. (i.e., weather/wind vane: direction; wind sock: wind intensity; anemometer: speed; thermometer: temperature; meter sticks/rulers: snow depth; rain gauges: rain amount in inches).								
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Climate and Weather	**Predicting the Weather**		Predict weather and justify prediction with observable evidence.	Describe the weather that accompanies cumulus, cumulonimbus, cirrus and stratus clouds.	Predict temperature and precipitation changes associated with the passing of various fronts.	Record local weather information on a calendar or map and describe changes over a period of time (e.g., barometric pressure, temperature, precipitation symbols and cloud conditions).				

		ESS.6.4B: By the end of Grade 4, students will explain how the use of scientific tools helps to extend senses and gather data about weather. (i.e., weather/wind vane: direction; wind sock: wind intensity; anemometer: speed; thermometer: temperature; meter sticks/rulers: snow depth; rain gauges: rain amount in inches).								
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Climate and Weather	**Weather Maps**			Determine how weather observations and measurements are combined to produce weather maps and that data for a specific location at one point in time can be displayed in a station model.	Read a weather map to interpret local, regional and national weather.	Describe how temperature and precipitation determine climatic zones (biomes) (e.g., desert, grasslands, forests, tundra and alpine).				

Benchmarks >>	**ESS.6.4A:** By the end of Grade 4, students will collect daily weather observation and describe weather changes or weather pattern based on data collected.	**ESS.6.8A**: By the end of Grade 8, students will explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate.	**ESS.6.12A:** By the end of Grade 12, students know that climate is determined by energy transfers from the sun to the Earth's surface is influenced by dynamic processes and static features.				
			1	2	3	4	5
			Identify static processes that influence climate.	Identify dynamic processes that influence climate.	Show how tracking cloud cover adds to our knowledge of climatic changes.	Show how landscape characteristics influence our climate.	

Benchmarks >>	**ESS.6.4B:** By the end of Grade 4, students will explain how the use of scientific tools helps to extend senses and gather data about weather. (i.e., weather/wind vane: direction; wind sock: wind intensity; anemometer: speed; thermometer: temperature; meter sticks/rulers: snow depth; rain gauges: rain amount in inches).	**ESS.6.8B:** Not addressed at this level	**ESS.6.12B:** Not addressed at this level				
			1	2	3	4	5

Standard	**ESS Earth and Space Sciences** All students will gain an understanding of the origin, evolution, and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.
Strand Standard	ESS.7 **Biogeochemical Cycles** Students will understand that Earth systems have a variety of cycles through which energy and matter continually flow.
Rationale	Biogeochemical cycles are the continuous transport and transformation of materials in the environment. Materials are transported through the atmosphere, hydrosphere, lithosphere, and biosphere in a series of cycles. These cycles include the circulation of elements and nutrients upon which life and the earth's climate depend. The most important biogeochemical cycles are those of water, carbon, nitrogen and certain other trace gases.
Enduring Knowledge Statement	Biogeochemical cycles involve biotic factors (living things) as well as abiotic factors.
Essential Question	Why Are biogeochemical cycles essential to long-term life on Earth?

Benchmark		**ESS.7.4A:** By the end of Grade 4, students will explain that the supply of many resources is limited, and that resources can be extended through recycling and decreased use.					**ESS.7.8A:** By the end of Grade 8, students will explain the importance of Earth's resources and identify ways in which various resources can be recycled and reused.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Biogeochemical Cycles	**Earth's Resources**	Describe various resources that provide the necessary things that are used by people in their daily lives.	Identify resources we get from the living (e.g., forests) and nonliving (e.g., minerals, water) environment and that resources are necessary to meet the needs and wants of a population.	Observe and describe ways water, both as a solid and liquid, is used in every day activities at different times of the year (e.g., bathe, drink, make ice cubes, build snowmen, cook, swim).	Observe and describe ways humans use Earth's materials (e.g., soil, rocks) in daily life.	Distinguish between and provide examples of materials that can be recycled/reused and those that cannot.	Identify the properties of water that make it an essential component of the Earth system (e.g., its ability to act as a solvent, its ability to remain as a liquid at most Earth temperatures).	Recognize, describe, and compare renewable energy resources (e.g., solar, wind, water, biomass) and nonrenewable energy resources (e.g., fossil fuels, nuclear energy).	Describe the benefits of Earth's resources, air, soil, and trees.	Describe the role atmosphere (e.g., clouds, ozone) plays in precipitation, reflecting and filtering light from the Sun, and trapping heat energy emitted from the Earth's surface.

		ESS.7.4A: By the end of Grade 4, students will explain that the supply of many resources is limited, and that resources can be extended through recycling and decreased use.					**ESS.7. 8A:** By the end of Grade 8, students will explain the importance of Earth's resources and identify ways in which various resources can be recycled and reused.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Biogeochemical Cycles	**Caring for Earth's Resources**	Describe how some resources can be used and reused.	Explain that the supply of many resources is limited but the supply can be extended through careful use, decreased use, reusing and/or recycling.	Explain that the supply of many non-renewable resources is limited and can be extended through reducing, reusing and recycling but cannot be extended indefinitely.	Describe ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained.	Identify examples where human activity has had a beneficial or harmful effect on other organisms (e.g., feeding birds, littering vs. picking up trash, hunting/conservation of species, paving/restoring greenspace).	Describe how human needs and activities (e.g., irrigation, damming of rivers, waste treatment, sources of drinking water) have affected the quantity and quality of major bodies of fresh water.	Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy.	Identify the ways humans affect the erosion and deposition of Earth's materials (e.g., clearing of land, planting vegetation, paving land, construction of new buildings).	Identify ways that humans affect the atmosphere and the oceans and their limited capacity to absorb wastes and recycle materials naturally.

Benchmark		ESS.7.4B: Not addressed at this level					ESS.7.8B: By the end of Grade 8, students will identify ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.			
Progression Levels		1	2	3	4	5	6	7	8	9
Biogeochemical Cycles	The Atmosphere					.	Define ozone and compare its effects in the lower and upper atmosphere.	Describe the role of living organisms in producing the ozone layer and how the ozone layer affected the development of life on Earth.	Compare the rate at which CO_2 is put into the atmosphere to the rate at which it is removed through the carbon cycle.	Analyze data relating to the concentration of atmospheric CO_2 over the past 100 years, and describe international efforts to protect the atmosphere.

Benchmark		ESS.7.4C: Not addressed at this level					ESS.7.8C: By the end of Grade 8, students will explain the water cycle and identify the factors that affect the rate of evaporation, condensation, and cloud formation.			
Progression Levels		1	2	3	4	5	6	7	8	9
Biogeochemical Cycles	The Hydrosphere						Describe the composition, circulation, and distribution of the world's oceans, estuaries, and marine environments.	Explain how major bodies of water are important natural resources for human activity (e.g., food, recreation, habitat, irrigation, solvent, transportation).	Relate the comparative amounts of fresh water and salt water on the Earth to the availability of water as a resource for living organisms and human activity.	

							ESS.7.8C: By the end of Grade 8, students will explain the water cycle and identify the factors that affect the rate of evaporation, condensation, and cloud formation.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Biogeochemical Cycles	**Water Cycle**						Explain and trace the possible paths of water through the hydrosphere, geosphere, and atmosphere (i.e., the water cycle: evaporation, condensation, precipitation, surface run-off/ groundwater flow).	Relate the different forms water can take (i.e., snow, rain, sleet, fog, clouds, dew, humidity) as it moves through the water cycle to atmospheric conditions (i.e., temperature, pressure, wind direction and speed, humidity) at a given geographic location.	Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.	Explain how thermal energy is transferred throughout the water cycle by the processes of convection, conduction, and radiation.

Benchmarks >>	**ESS.7.4A:** By the end of Grade 4, students will explain that the supply of many resources is limited, and that resources can be extended through recycling and decreased use.	**ESS.7.8A:** By the end of Grade 8, students will explain the importance of Earth's resources and identify ways in which various resources can be recycled and reused.	**ESS.7.12A:** By the end of Grade 12, students will understand that Earth is a system containing essentially fixed amounts of each stable chemical.				
			1	2	3	4	5
			Explain that different chemical forms exist in Earth's systems.	Describe the movement of elements within the Earth system.	Justify that the Earth system has essentially fixed amounts of each stable chemical.		

Benchmarks >>	**ESS.7.4B:** Not addressed at this level.	**ESS.7.8 B:** By the end of Grade 8, students will identify ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	**ESS.7.12B:** By the end of Grade 12, students will explain the physical and chemical changes that occur as elements and compounds flow through the Earth system.				
			1	2	3	4	5
			Explain how energy sources move matter through Earth's systems.	Describe the cycles of materials through the Earth's system. i.e. carbon cycle.	Distinguish between physical and chemical changes within cycles.		

Benchmarks >>	**ESS.7.4C:** Not addressed at this level	**ESS.7.8C:** By the end of Grade 8, students will explain the water cycle and identify the factors that affect the rate of evaporation, condensation, and cloud formation.	**ESS.7.12C:** Not addressed at this level				
			1	2	3	4	5

The Living Environment
Students gain a better understanding of the world around them if they study a variety of organisms, both microscopic and macroscopic. Through the study of similarities and differences of organisms, students learn the importance of classification and the diversity of living organisms. The understanding of diversity helps students understand biological evolution and life's natural processes (e.g., cycles, growth, and reproduction). Structure, function, body organization, growth and development, health and disease are important aspects to the study of life. The study of living systems provides students important information about how humans critically impact Earth's biomes.

Standard	**LS: The Living Environment** Students will understand the basic concepts and principles of life science.
Strand Standard	**LS.1 Organization and Development** Students will understand that all life forms, at all levels of organization, use specialized structures and similar processes to meet life's needs.
Rationale	The functions performed by organelles (specialized structures found in cells) within individual cells are also carried out by the organ system in multi-cellular organisms. This standard requires that students be conversant with magnifying devices, cell structure and function, body systems, and disease causes and the body's defense against them.
Enduring Knowledge Statement	Living things have different structures that serve similar functions necessary for the survival of the organism
Essential Question	How does structure relate to function in living systems?

Benchmark		**LS.1.4A:** By the end of Grade 4**,** students will identify the basic needs of plants and animals in order to stay alive. (i.e., water, air, food, space).					**LS.1.8A:** By the end of Grade 8**,** students will describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Structure and Function	**Basic Needs of Living Things**	Distinguish between living and nonliving things.	Identify the basic needs of most animals (i.e., air, water, food, shelter). .	Observe that animals need water, air, food, and shelter/space to grow and reproduce.	Identify the basic needs of most plants (i.e., air, water, light).	Predict and investigate the growth of plants when growing conditions are altered (e.g., dark vs. light, water vs. no water).	Describe the hierarchical organization of multicellular organisms from cells to tissues to organs to systems to organisms.	Recognize and illustrate (e.g. flow chart) the structural organization of an organism from a cell to tissue to organs to organ systems to organisms.	Explain how each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.	Describe structures or behaviors that help organisms survive in their environment (e.g., defense, obtaining nutrients, reproduction, and eliminating waste).

		LS.1.4A: By the end of Grade 4, students will identify the basic needs of plants and animals in order to stay alive. (i.e., water, air, food, space).					**LS.1.8A:** By the end of Grade 8, students will describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Structure and Function	**Structure and Function of Organisms**		Investigate and describe how living things grow and change.	Observe, identify, and record external features of humans and other animals.	Investigate and describe how plants and animals have features that help them live in various environments.	Identify the structures in plants (leaves, roots, flowers, stem, bark, wood) that are responsible for food production, support, water transport, reproduction, growth, and protection.	Investigate, compare, and contrast the different structures of organisms that serve different functions for growth, reproduction, and survival.	Explain how the cell, as the basic unit of life, has the same survival needs as an organism (i.e., obtain energy, grow, eliminate waste, reproduce, provide for defense).	Investigate and describe how cells, grow, divide, and take in nutrients, which they use to provide energy for cellular functions.	Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.

		LS.1.4A: By the end of Grade 4, students will identify the basic needs of plants and animals in order to stay alive. (i.e., water, air, food, space).					LS.1.8A: By the end of Grade 8, students will describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Structure and Function	**Structure and Function of Things**		Identify and compare the physical structures of a variety of plants (e.g., stem, leaves, flowers, seeds, roots).	Identify and compare the physical structures of a variety of animals (e.g., sensory organs, beaks, appendages, body covering).	Identify the relationships between the physical structures of plants and the function of those structures (e.g., absorption of water, absorption of light energy, support, reproduction) .	Identify the relationships between the physical structures of animals and the function of those structures (e.g., taking in water, support, movement, obtaining food, reproduction) .	Identify and contrast the structures of plants and animals that serve similar functions (e.g., taking in water and oxygen, support, response to stimuli, obtaining energy, circulation, digestion, excretion, reproduction) .	Describe the importance of the transport and exchange of oxygen and carbon dioxide to the survival of the organism.	Explain that oxygen is needed by all cells of most organisms for the release of energy from nutrient (sugar) molecules.	Describe photosynthes is as a chemical change with reactants (water and carbon dioxide) and products (energy-rich sugar molecules and oxygen) that takes place in the presence of light and chlorophyll.

Benchmark		**LS.1.4B:** By the end of Grade 4**,** students will sort/classify different living things using similar and different characteristics. Describe why organisms belong to each group or cite evidence about how they are alike or not alike.					**LS.1.8B:** By the end of Grade 8**,** students will use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features).			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Structure and Function	**Classification of Living Things**	Sort animals and plants by observable characteristics.	Identify and compare the physical structures of a variety of plants (e.g., stem, leaves, flowers, seeds, roots)>	Identify and compare the physical structures of a variety of animals (e.g., sensory organs, beaks, appendages, body covering)	Identify the relationships between the physical structures of animals and the function of those structures (e.g., taking in water, support, movement, obtaining food, reproduction).	Identify the relationships between the physical structures of plants and the function of those structures (e.g., absorption of water, absorption of light energy, support, reproduction).	Follow a taxonomic key to identify a given organism (e.g. flowering and non-flowering plants).	Sort organisms with similar characteristics into groups based on internal and external structures.	Explain how species with similar evolutionary histories/characteristics are classified more closely together with some organisms than others (e.g., a fish and human have more common with each other than a fish and jelly fish).	Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.

Benchmark		LS.1.4C: Not addressed at this level					LS.1.8C: By the end of Grade 8, students will explain relation ships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.			
Progression Levels		1	2	3	4	5	6	7	8	9
Structure and Function	Cells			Demonstrate that living things are made up of different parts.	Explore magnifying devices and how they allow one to see in more detail.	Identify cells as the building blocks of organisms.	Explore how the use of a microscope allows one to see cells in a variety of organisms.	Explain that all organisms are composed of cells, and that many organisms are single-celled (unicellular), (e.g., bacteria, yeast). In these single-celled organisms, one cell must carry out all of the basic functions of life.	Observe and describe (e.g., drawing, labeling) individual cells as seen through a microscope targeting cell membrane, cell wall, nucleus, and chloroplasts.	Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).

							LS.1.8C: By the end of Grade 8, students will explain relation ships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Structure and Function	**Function of Cells**						Explain the functions of the cell (e.g., growth, metabolism, reproduction, photosynthesis, response).	Explain that within cells, many of the basic functions of organisms (e.g., extracting energy from food and getting rid of waste) are carried out. The way in which cells function is similar in all living organisms.	Explain that specialized cells perform specialized functions. (e.g., muscle cells contract, nerve cells transmit impulses, and skin cells provide protection).	Compare individual cells of tissues and recognizing the similarities of cells and how they work together to perform specific functions.

Benchmarks >>	LS.1.4A: By the end of Grade 4, students will identify the basic needs of plants and animals in order to stay alive. (i.e. water, air, food, space).	LS.1.8A: By the end of Grade 8, students will describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).	**LS.1.12A:** By the end of Grade 12, students will be able to describe the four main groups of organic molecules and outline their role in the cellular processes of life.				
			1	2	3	4	5
			Describe how the elements most common in organisms (carbon, hydrogen, oxygen, nitrogen and sulfur) interact to form complex molecules.	Explain that many organic molecules are continuously constructed and deconstructed in cells.	Describe the general structure and function of the major groups of organic molecules: carbohydrates, lipids, proteins and nucleic acids.	Describe proteins as complex organic molecules that carry out most cellular functions and explain that the function that proteins serve is determined by their structure.	Relate the concept that DNA molecules in cells serve as instructions to the cell for making proteins.

Benchmarks >>	LS.1.4B: By the end of Grade 4, students will sort/classify different living things using similar and different characteristics. Describe why organisms belong to each group or cite evidence about how they are alike or not alike.	LS.1.8B: By the end of Grade 8, students will use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features).	**LS.1.12B:** Not addressed at this level				
			1	2	3	4	5

Benchmarks >>	**LS.1.4C:** Not addressed at this level.	**LS.1.8C:** By the end of Grade 8, students will explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.	**LS.1.12C:** By the end of Grade 12, students will be able to relate the importance of cell division and differentiation to development and organization in organisms.				
			1	2	3	4	5
			Compare the daughter cells of cell division to the parent cells to include chromosome number.	Diagram chromosome movement during the process of mitosis.	State that different types of cells are different from one another in multi-cellular organisms due to expression of different genes during development.	Describe ways in which cellular processes are regulated by internal and external signals.	

Standard	**LS: The Living Environment** Students will understand the basic concepts and principles of life science.
Strand Standard	**LS.2 Matter and Energy Transformations** Students will understand how living things obtain and use energy;
Rationale	From experience, students know that they must eat food to live. As a result of their study of energy movement (transfer) and change (transformation) in living organisms, students understand that the Sun is the primary and ultimate source of energy for living organisms. They learn why a constant input of matter and energy is critical for life. Photosynthetic organisms are critical to all organisms and need to be maintained. If one or more components are altered in an ecosystem, all other components are affected. Through studying the interrelationships of organisms, students learn that they can have a critical impact on other organisms.
Enduring Knowledge Statement	All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
Essential Questio	How is matter transferred and energy transferred/transformed in living systems?

Benchmark		**LS.2.4A:** By the end of Grade 4, students will identify the basic needs of plants and animals in order to stay alive (i.e., water, air, food, space).					**LS.2.8A:** By the end of Grade 8**,** students will use data and observations to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Matter and Energy Transformations	**Needs and Survival of Living things**	Identify basic needs of plants and animals: Food, water, light, air, space.	Investigate and explain that plants need light energy from the sun to make food, while animals need to eat plants and/or other animals as their food.	Explain that all organisms require a form of energy to survive and that humans and other animals obtain energy and materials from food.	Explain that all living things have structures that provide the basic needs for survival.	Associate specific structures with their functions in the survival of an organism.	Explain that most multicellular organisms have specialized cells to survive, while unicellular organisms perform all survival functions. (e.g. nerve cells communicate with other cells, muscle cells contract, unicellular are not specialized).	Identify various specialized cells and common unicellular organisms in diagrams, photographs and/or microscopic slides.	Describe the common life processes necessary to the survival of organisms (i.e., growth, reproduction, life span, response to stimuli, energy use, exchange of gases, use of water, elimination of waste).	Explain the relationships between and amongst the specialized structures of the cell and their functions (e.g. transport of materials, energy transfer, waste disposal, information feedback, and even movement**).**

Benchmark		**LS.2.4B:** By the end of Grade 4, students will explain that energy is needed for all organisms to stay alive and grow and identify where a plant or animal gets its energy.					**LS.2.8B:** By the End of Grade 8, students will trace the flow of energy through an ecosystem.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Matter and Energy Transformations	**Source of Energy for Living Things**		Describe how all animals depend upon plants whether or not they eat the plants directly.	Differentiate between the needs of plants and those of animals.	Explain that all organisms require a form of energy to survive and that humans and other animals obtain energy and materials from food.	Categorize organisms as predator or prey in a given ecosystem.	Classify populations of unicellular and multicellular organisms as producers, consumers, and decomposers by the role they serve in the ecosystem.	Differentiate between the three types of consumers (herbivore, carnivore, omnivore).	Diagram and describe the transfer of energy in an aquatic food web and a land food web with reference to producers, consumers, decomposers, scavengers, and predator/prey relationships.	Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.

							LS.2.8B: By the End of Grade 8, students will trace the flow of energy through an ecosystem.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Matter and Energy Transformations	**Flow of Energy In An Ecosystem**						Explain how energy is transferred through food chains and food webs in an ecosystem.	Explain how the amount of useable energy available to organisms decreases as it passes through a food chain and/or food web.	Explain that the total amount of matter in a closed system remains the same as it is transferred between organisms and the physical environment even though its location or form changes.	Compare and contrast predator/prey, parasite/host and producer/consumer/decomposer relationships.

Benchmarks >>	LS.2.4A: By the end of Grade 4, students will identify the basic needs of plants and animals in order to stay alive (i.e. water, air, food, space). *This benchmark is restated here.	LS.2.8A: By the end of Grade 8, students will use data and observations to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival.	LS.2.12A: By the end of Grade 12, students will be able to describe the processes of photosynthesis and aerobic cellular respiration, the types of organisms that carry out these processes and the role these processes play in the biosphere.				
			1	2	3	4	5
			Describe photosynthesis as the process of converting water and carbon dioxide into high-energy sugar molecules using energy from the sun.	Display an understanding that plants, many protists and many bacteria are producers and carry out photosynthesis	Describe aerobic cellular respiration as the process of releasing energy from organic molecules in the presence of oxygen to power cellular processes.	Distinguish between those organisms that carry out aerobic and anaerobic respiration as their primary means of obtaining energy.	Compare and contrast how photosynthesis and aerobic cellular respiration move carbon through the biosphere.

Benchmarks >>	LS.2.4B: By the end of Grade 4, students will explain that energy is needed for all organisms to stay alive and grow and identify where a plant or animal gets its energy.	LS.2.8B By the End of Grade 8, students will trace the flow of energy through an ecosystem.	LS.2.12B: By the end of Grade 12, students will explain that as energy and matter flow through ecosystems, energy is lost and matter is conserved.				
			1	2	3	4	5
			Demonstrate an understanding of several different ways that the products of photosynthesis are used in organisms.	Compare and contrast the ways in which energy and matter are transformed as they move through trophic levels in food webs.	Compare and contrast the ways in which energy and matter are conserved and/or lost as they move through trophic levels in food webs.		

Standard	**LS: The Living Environment** Students will understand the basic concepts and principles of life science.
Strand Standard	**LS.3 Interdependence** Students will demonstrate an understanding that ecosystems display patterns of organization, change, and stability as a result of the interactions and interdependencies among the life forms and the physical components of the Earth.
Rationale	Ecosystems can be reasonably stable over hundreds or thousands of years. As any population of organisms grows, it is held in check by one or more environmental factors: depletion of food or nesting sites, increased loss to increased numbers of predators, or parasites. If a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages that eventually result in a system similar to the original one.
Enduring Knowledge Statement	Organisms respond to internal and external cues, which allow them to survive
Essential Question	How do responses to internal and external cues aid in an organism's survival?

Benchmark		LS.3.4A: By the end of Grade 4, students will describe ways plants and animals depend on each other (e.g., shelter, nesting, food).					LS.3.8A: By the end of Grade 8, students will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interdependence of Living Things	**Interactions among Organisms and their Environment**		Identify different environments (i.e., pond, forest, prairie) support the life of different types of plants and animals.	Investigate and describe how animals and plants that live in different places have similarities and differences.	Identify the ways a specific organism may interact with other organisms or with the environment (e.g., pollination, shelter, seed dispersal, camouflage, migration, hibernation, defensive mechanism).	Investigate and describe the roles of plants as producers and animals as consumers and how living things may depend on each other.	Identify the biotic factors (populations of organisms) and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition) that make up an ecosystem.	Explain the factors that affect the number and types of organisms an ecosystem can support, including available resources, abiotic and biotic factors and disease.	Describe the factors related to matter and energy in an ecosystem that both influence fluctuations in population size and determine the carrying capacity of a population.	Predict and analyze how a change in an ecosystem, resulting from natural causes, changes in climate, human activity or introduction of invasive species, can affect both the number of organisms in a population and the biodiversity of species in the ecosystem.

		LS.3.4A: By the end of Grade 4, students will describe ways plants and animals depend on each other (e.g., shelter, nesting, food).					**LS.3.8A: By the end of Grade 8,** students will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interdependence of Living Things	**Effects of Changing Environmenr on Living Things**	Observe how the living things in an environment change with the seasons (e.g., trees lose their leaves in the winter).	Identify the ways in which an organism's habitat provides for its basic needs (plants require air, water, nutrients, and light; animals require food, water, air, and shelter).	Describe how people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.	Identify examples where human activity has had a beneficial or harmful effect on other organisms (e.g., feeding birds, littering vs. picking up trash, hunting/conservation of species, paving/restoring greenspace).	Observe, record, and describe changes in the health or behavior of an organism as a result of changes in its environment.	Identify ways organisms interact with one another in various ways besides providing food.	Identify populations within a community that are in competition with one another for resources.	Predict the possible effects of removing an organism from a food chain.	Predict the possible effects of changes in the number and types of organisms in an ecosystem on the populations of other organisms within that ecosystem.

		LS.3.4A: By the end of Grade 4, students will describe ways plants and animals depend on each other (e.g., shelter, nesting, food).					**LS.3.8A: By the end of Grade 8,** students will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interdependence of Living Things	**Food Webs**	Act out or construct simple diagrams (pictures or words) that shows a simple food web.	Use information about a simple food web to determine how basic needs (e.g. shelter and water) are met by the habitat/environment.	Demonstrate in a food web that all animals' food begins with the sun.	Explain the way that plants and animals in a habitat depend on each other.	Use information about organisms to design a habitat and explain how the habitat provides for the needs of the organisms that live there.	Identify the sun as the major source of energy for life on earth and sequence the energy flow in an ecosystem.	Describe the basic processes and recognize the substances involved in photo-synthesis and respiration.	Explain the transfer of the sun's energy through living systems and its effect upon them.	Describe the basic processes and recognize the names and chemical formulas of the substances involved in photo-synthesis and respiration.

Benchmarks >>	**LS.3.4A:** By the end of Grade 4, students will describe ways plants and animals depend on each other (e.g., shelter, nesting, food).	**LS.3.8A:** By the end of Grade 8, students will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem.	**LS.3.12A:** By the end of Grade 12, students will display an understanding of ways in which humans have a significant impact on other species.				
			1	2	3	4	5
			Investigate and relate what impacts rapid climate change might have on an ecosystem.	Display an understanding of the relationship between climate change and evolution using specific examples.	Interpret and evaluate data to determine the impact of humans on ecosystems (i.e. overfishing, deforestation).	Investigate the relationship between human population growth and habitat loss and make predictions about the future.	Propose and evaluate measures to lessen human impact on the environment.

Standard	**LS: The Living Environment** Students will understand the basic concepts and principles of life science.
Strand Standard	**LS.4 Heredity and Reproduction** Students will understand the transmission of traits in living things.
Rationale	The natural world consists of a diversity of organisms that transmit their characteristics to future generations. Living things reproduce, develop, and transmit traits, and theories of evolution explain the unity and diversity of species found on Earth. Knowledge of genetics, reproduction, and development is applied to improve agriculture and human health.
Enduring Knowledge Statement	Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.
Essential Question	How are organisms of the same kind different from each other? How does this help them reproduce and survive?

Benchmark		**LS.4.4A:** By the end of Grade 4, students will predict, sequence or compare the life stages of organisms – plants and animals (e.g., put images of life stages of an organism in order, predict the next stage in sequence, compare two organisms).					**LS.4.8A:** By the end of Grade 8, students will compare and contrast sexual reproduction with asexual reproduction.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Heredity and Reproduction	**Life Cycles/Reproduction**	Describe the major stages that characterize the life cycle of the frog and butterfly as they go through meta-morphosis.	Sequence the life cycle of a plant or animal when given a set of pictures.	Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.	Compare the life cycles of different animals including birth to adulthood, reproduction and death (e.g., egg-tadpole-frog, egg-caterpillar-chrysalis-butterfly).	Compare the life cycles of different plants including germination, maturity, reproduction and death.	Explain that an individual organism does not live forever; therefore reproduction is necessary for the continuation of every species and traits are passed on to the next generation through reproduction.	Explain reproduction as a fundamental process by which the new individual receives genetic information from parent(s).	Describe forms of asexual reproduction that involve the genetic contribution of only one parent (e.g., binary fission, budding, vegetative propagation, regeneration) .	Describe sexual reproduction as a process that combines genetic material of two parents to produce a new organism (e.g., sperm/egg, pollen/ova).

		LS.4.4A: By the end of Grade 4, students will predict, sequence or compare the life stages of organisms – plants and animals (e.g., put images of life stages of an organism in order, predict the next stage in sequence, compare two organisms).								
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Heredity and Reproduction	**Meta,morphsis**	Describe plant development and growth.	Illustrate complete metamorphosis (e.g., butterfly, frog).	Illustrate incomplete metamorphosis (e.g., grasshopper).	Compare and contrast complete metamorphosis and incomplete meta-morphosis.	Differentiate among complete metamorphosis, incomplete metamorphosis, and embryonic development.				
Heredity and Reproduction	**Embroynic Development**			Illustrate embryonic development (e.g., chicken).	Compare and contrast embryonic development and incomplete meta-morphosis					

Benchmark		**LS.4.4B:** By the end of Grade 4, students will distinguish between characteristics of humans that are inherited from parents (i.e., hair color, height, skin color, eye color) and others that are learned (e.g., riding a bike, singing a song, playing a game, reading).					**LS4.8B:** By the end of Grade 8, Students will using data to provide evidence that supports the concept that genetic information is passed on from both parents to offspring.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Heredity	**Inheritance**	Describe how plants and animals usually resemble their parents.	Investigate and describe how particular plants have seeds that produce the same kind of plant.	Investigate and describe how particular animals have offspring that are the same kind of animal.	Identify likenesses between parents and offspring (e.g., eye color, flower color) that are inherited. Explain that others likenesses, such as table manners are learned. .	Explain that every organism requires a set of instructions that specifies its traits. Heredity is the passage of these instructions from one generation to another.	Differentiate between inherited and acquired traits.	Observe, record and compare differences in inherited traits (e.g. connected earlobe, tongue rolling).	Explain that characteristics of an organism result from inherited traits of one or more genes from the parents and others result from interactions with the environment.	Identify that genetic material (i.e. chromosomes and genes) is located in the cell's nucleus.

Benchmarks >>	LS.4.4A By the end of Grade 4, students will predict, sequence or compare the life stages of organisms – plants and animals (e.g., put images of life stages of an organism in order, predict the next stage in sequence, compare two organisms).	LS.4.8A By the end of Grade 8, students will compare and contrast sexual reproduction with asexual reproduction.	**LS.4.12A** By the end of Grade 12, students will demonstrate an understanding of the basic relationships between genes, DNA, proteins, cells and organisms.				
			1	2	3	4	5
			Distinguish between genes, chromosomes, and DNA.	State that genes code for the synthesis of polypeptides.	Explain that a gene may affect one or many traits, depending on the role of the protein that it codes for.	Explain why each cell in a multicellular organism contains thousands of genes.	Explain why all cells in multicellular organisms contain the same DNA (except for gametes).

Benchmarks >>	LS.4.4A: See abov.	LS.4.8A: See above.	**LS.4.12A-2:** By the end of Grade 12, students will be able to describe gamete production and explain its importance to diversity in populations.				
			1	2	3	4	5
			Compare and contrast haploid and diploid cells.	Illustrate and annotate the production of gametes through meiosis.	Explain the ways in which sexual reproduction causes variation in populations.		

Benchmarks >>	LS.4.4B: By the end of Grade 4, students will distinguish between characteristics of humans that are inherited from parents (i.e., hair color, height, skin color, eye color) and others that are learned (e.g., riding a bike, singing a song, playing a game, reading).	LS.4.8B: By the end of Grade 8, Students will be using data to provide evidence that supports the concept that genetic information is passed on from both parents to offspring.	LS.4.12B: By the end of Grade 12, students will be able to predict the traits of offspring of individuals in a population.				
			1	2	3	4	5
			Define and describe the human genome.	Define the term allele.	Explain why organisms have 2 genes for each trait.	Describe a human karyotype to include chromosome number and homologous pairs of chromosomes.	Predict alleles and traits of the offspring of 2 parents using a Punnet square.

Benchmarks >>	LS.4.4B See above.	LS.4.8B See above.	LS.4.12B-2 By the end of Grade 12, students will be able to describe new technologies that have been developed in the field of biotechnology and their applications.				
			1	2	3	4	5
			Outline the production of a transgenic organism.	Describe how genetically modified organisms (GMOs) are produced and describe potential benefits and harms of the creation and use of GMOs.	Display an understanding of what gene therapy is and the challenges and potential benefits of this technology.	Describe the applications of sequencing genes or genomes of humans and other organisms.	

Standard	**LS: The Living Environment** Students will understand the basic concepts and principles of life science.
Strand Standard	**LS.5 Evolution and Diversity** Students will describe and analyze diversity of species, natural selection, and adaptations.
Rationale	Students study the scientific concept of biological evolution--the changes in populations of organisms through time--in order to understand diversity and relatedness within the living world. Inquiries into evolution explain the ways in which natural processes produce life's diversity. These studies help students understand that evolution is the major unifying concept in the biological sciences and that it explains a wide variety of observations that can be made about the living world. In particular, students see that the study of evolution initiates questions about biodiversity, adaptation, genetics, mutations, the geological record, and the observed unity at molecular and whole-organism levels.
Enduring Knowledge Statement	The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive.
Essential Question	How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?

Benchmark		**LS.5.4A:** By the End of Grade 4, students will identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire).					**LS.5.8A:** By the end of Grade 8, students will cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Heredity	**Natural Selection**		Identify the specific functions of the physical structures of a plant or an animal (e.g. roots for water; webbed feet for swimming).	Identifying and explain how the physical structure/characteristic of an organism allows it to survive and defend itself.	Analyze the structures needed for survival of populations of plants and animals in a particular habitat/environment (e.g. populations of desert plants and animals require structures that enable them to obtain/conserve/ retain water).	Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g., shape of beak or feet, placement of eyes on head, length of neck, shape of teeth, color.	Explain how a population's or species' traits affect their ability to survive over time.	Describe possible causes for the extinction of an animal or plant.	Cite evidence that demonstrates evolutionary relationships among organisms (e.g., similarities in body structure, early development, traits).	Explain how natural selection leads to evolution (e.g., survival of the fittest).

		LS.5.4A: By the End of Grade 4, students will identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire).					**LS.5.8A:** By the end of Grade 8, students will cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring.			
Progression Levels		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Heredity	**Effect of Environment on Behaviors**				Describe plant behaviors, such as the way seedlings' stems grow toward light and their roots grow downward in response to gravity.	Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).	Explain that some animal behaviors are instinctive (e.g., turtles burying their eggs), and others are learned (e.g., humans building fires for warmth).	Explain that many plants and animals can survive harsh environments because of seasonal behaviors, e.g., in winter, some trees shed leaves, some animals hibernate, and other animals migrate.	Differentiate between observed characteristics of plants and animals that are fully inherited (e.g., color of flower, shape of leaves,) and characteristics that are affected by the climate or environment (e.g., browning of leaves).	Give examples of how organisms can cause changes in their environment to ensure survival and explain how some of these changes may affect the ecosystem.

Benchmarks >>	**LS.5.4A:** By the End of Grade 4, students will identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire).	**LS.5.8A:** By the end of Grade 8, students will cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring.	**LS.5.12A:** By the end of Grade 12, students will be able to explain in writing the relationships between populations, species, their environment, natural selection and evolution.				
			1	2	3	4	5
			Distinguish between organisms, species and populations.	Define evolution as a change in the gene pool of a population over time.	Explain how natural selection causes changes in populations over time and can lead to the formation of new species.	Interpret, evaluate and summarize data about changes in a population over time.	GIVE examples showing why populations that are diverse are more able to survive changes in their environment.

SI: Scientific Inquiry and Critical Thinking Skills

Students will demonstrate an understanding of the nature of scientific inquiry.

Progression Levels		1	2	3	4	5	6	7	8	9
Benchmark		**SI.1A:** By the end of Grade 4, students will use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.					**SI.1.A:** By the end of Grade 8, students will use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.			
Grade Span		By the end of Grade 2, students will			By the end of Grade 4, students will		By the end of Grade 6, students will		By the end of Grade 8, students will	
Scientific Inquiry	Asking questions	Generate questions and predictions using observations and exploration about the natural world.			Generate questions and predictions using observations and exploration about the natural world.		Generate focused questions and informed predictions about the natural world.		Frame and refine questions that can be investigated scientifically, and generate testable hypotheses.	
	Investigating	Generate and follow simple plans using systematic observations to explore questions and predictions.			Generate and follow simple plans using systematic observations to explore questions and predictions.		Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested.		Design and conduct investigations with controlled variables to test hypotheses.	
	Using tools	Collect data using observations, simple tools such as thermometers, balances, watches, and magnifiers. . Record data in tables, charts, and bar graphs. Compare data with others to examine and question results.			Collect data using observations, simple tools such as thermometers, balances, watches, and magnifiers. . Record data in tables, charts, and bar graphs. Compare data with others to examine and question results.		Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time Compare and question results with and from others.		Accurately collect data through the selection and use of tools and techniques appropriate to the investigation.	

		SI.1A: By the end of Grade 4, students will use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.		**SI.1.A:** By the end of Grade 8, students will use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.	
		By the end of Grade 2, students will	By the end of Grade 4, students will	By the end of Grade 6, students will	By the end of Grade 8, students will
Scientific Inquiry	**Using Mathematics**	Use nonstandard measures to estimate and compare the sizes of objects. Represent information in bar graphs.	Use measurement tools and standard units (e.g., centimeters, meters, grams, kilograms) to describe objects and materials.	Use mathematics, reading, writing, and technology when conducting scientific inquiries.	Construct tables, diagrams and graphs, showing relationships between two variables, to display and facilitate analysis of data. Compare and question results with and from other students
	Explaining	Construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation.	Construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation.	Construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation.	Construct logical scientific explanations and present arguments that defend proposed explanations through the use of closely examined evidence.

		SI.1A: By the end of Grade 4, students will use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.		**SI.1.A:** By the end of Grade 8, students will use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.	
		By the end of Grade 2, students will	By the end of Grade 4, students will	By the end of Grade 6, students will	By the end of Grade 8, students will
Scientific Inquiry	**Communication**	Share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation.	Share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation.	Communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument.	Evaluating the explanations proposed by others involves examining and comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Conflicting data or conflicting interpretations of the same data suggest the need for further investigation. Continued investigation can lead to greater understanding and resolution of the conflict.
	Safety	Use appropriate safety procedures when conducting investigations.	Use appropriate safety procedures when conducting investigations.	Use appropriate safety procedures when conducting investigations.	Use appropriate safety procedures when conducting investigations.

Benchmarks >>	**SI.1.4A:** By the end of Grade 4, students will use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.	**SI.1.8A:** By the end of Grade 8, students will use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.	**SI.1.12A:** By the end of Grade 12, students design and conduct scientific investigation to explore new phenomena, verify previous results, test how well a theory predicts and compare opposing theories.				
			1	2	3	4	5
			Use appropriate tools and technology to collect precise and accurate data.	Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias.	Compare experimental evidence and conclusions with those drawn by others about the same testable question.	Communicate and defend scientific findings.	Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

History and the Nature of Science

The study of science as a human endeavor provides for the acquisition of ideas leading toward the current knowledge base that represents science content. The nature of science encompasses the basic values and beliefs that make up the scientific worldview, how scientists go about their work and the general culture of scientific enterprise. Studying historical and current discoveries of scientists and scientific milestones provides students with information about how discoveries have influenced current scientific thought and advancements. Students should understand that the continuous development of scientific knowledge shapes history. The study of the history and nature of science clarifies scientific inquiry and the role of science in the development of world cultures

HS: History and the Nature of Science Students will demonstrate an understanding of the history of science and the evolvement of scientific knowledge
Enduring Understandings: The development of technology and advancement in science influence each other and drive each other forward. Understanding past processes and contributions is essential in building scientific knowledge.
Essential Questions: How do science and technology influence each other? How have past scientific contributions influenced current scientific understanding of the world? What do we mean in science when we say that we stand on the shoulders of giants?

Progression Levels	1	2	3	4	5	6	7	8	9
Benchmark	**HS.1.4A:** By the end of Grade 4, students will develop an understanding of science as a human endeavor					HS.1.8A: By the end of Grade 8, students will develop an understanding of that science has been practiced by different individuals in different cultures and how often ideas we now accept were slow to be accepted at the time of their discovery.			

Grade Span		By the end of Grade 2, students will	By the end of Grade 4, students will	By the end of Grade 6, students will	By the end of Grade 8, students will
History and Nature of Science	People in Science	Explain why anyone can be a scientist Identify ways (e.g., create things, ask questions, make observations, figure things out) that everybody can do science. Identify ways scientists work together to solve problems (e.g., share results, teamwork, investigate).	Identify ways people of all ages, genders, and backgrounds use science in their careers and in daily life (e.g., children check temperature conditions to decide what to wear, farmer uses genetic grains, hikers use GPS, depth-finder in boat, hearing-aides for disabilities). Identify a variety of careers in the field of science.	Identify various settings in which scientists may work alone or in a team (e.g., industries, laboratories, field work).	Explain how science is influenced by human qualities (e.g., reasoning, insightfulness, creativity, life-long learning). Explain how many people from various cultures have made important contributions to the advancement of science and technology.
	Scientific Knowledge		Identify scientific advances that changed popular beliefs (e.g., Earth was center of universe, world was flat, man was incapable of flight).	Explain why results of similar scientific investigations may turn out differently (i.e., inconsistencies in methods, materials, and observations) Identify scientific advances that have resulted in new ideas and further-advance.	Explain the importance of keeping clear and accurate records of scientific investigations (e.g., Darwin's research, DaVinci's notebooks, Galileo's notes, Goodall's observations).

		HS.1.4A: By the end of Grade 4, students will develop an understanding of science as a human endeavor		HS.1.8A: By the end of Grade 8, students will develop an understanding of that science has been practiced by different individuals in different cultures and how often ideas we now accept were slow to be accepted at the time of their discovery.	
		By the end of Grade 2, students will	By the end of Grade 4, students will	By the end of Grade 6, students will	By the end of Grade 8, students will
Science and Technology	**Science and Social Issues**	Identify safety rules for school and home.	Identify ways in which science and technology have greatly improved human lives (e.g., food quality and quantity, transportation, health, sanitation, communication) Identify the benefits of recycling, reusing, and reducing.		Explain the interaction of science and technology with social issues (e.g., mining, natural disasters) Explain the impact of science on food technology (e.g., preservatives, packaging, genetically modified organisms).

		By the end of Grade 2, students will	By the end of Grade 4, students will	By the end of Grade 6, students will	By the end of Grade 8, students will
Science and Technology	**Science and Environmental Issues**	Describe ways that humans influence their environment (e.g., littering, recycling, car pooling)	Identify consequences of natural and human-induced environmental changes (e.g., erosion, tsunami, deforestation)	Explain how natural hazards affect populations, resources, and the environment (e.g., floods, storms, hurricanes, volcanoes, earthquakes) Explain how recycling and conservation affect populations, resources, and the environment Explain ways humans benefit from Earth's resources (e.g., air, water, soil, food, fuel, building materials)	Explain how overpopulation affects organisms, resources, and environments (e.g., depletion of food resources, habitat availability, increased loss due to disease, parasites and predators

Benchmarks >>	**HS.1.4A:** Not Addressed at This Level	**HS.1.8A:** Not Addressed at This Level,.	**HS.1.12A:** By the end of Grade 12, students understand the distinction between science and engineering/technology and will develop an understanding of the societal role in the development on new technologies.				
			1	2	3	4	5
			Recognize that technological advances generally are in response to practical problems.	Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.	Understand design in technology generally requires taking into account social and ethical constraints in addition to scientific ones.	Understand that technology usually affects society more directly than science does because technology solves practical problems	