

# THE ANGLO-AMERICAN SCHOOL OF MOSCOW

## K-12 Science

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. AAS has the responsibility of preparing students for the future. We will prepare students — regardless of their future aspirations — to be scientifically literate (Aero, 2012).

### IN THE ELEMENTARY SCHOOL

Our understanding of science is constantly changing and evolving. The inclusion of science within the Primary Years Program leads learners to an appreciation and awareness of the world as it is viewed from a scientific perspective.

It is recognized that teaching and learning science as a subject, while necessary, is not sufficient. Of equal importance is the need to learn science in context, exploring content relevant to students, and transcending the boundaries of the traditional subject area. The transdisciplinary themes of the PYP provide the framework for a highly defined, focused, in-depth program of inquiry.

### IN THE MIDDLE SCHOOL

At the middle level we understand that we serve as the bridge between two divisions and we work closely with our colleagues to provide a thoughtful and personalized science experience for each student. We present to the students, and practice, with the idea that science is a way of making sense of our universe and the environment around us.

Our curriculum is integrated in sixth through eighth grades, with major science concepts building on themselves as students progress through the program. The middle school science program emphasizes understanding and relevant learning as we prepare students for not only their next level of schooling but also their present life beyond the classroom.



## IN THE HIGH SCHOOL

Through studying any of the science subjects, students should become aware of how scientists work and communicate with each other. While the “scientific method” may take on a wide variety of forms, it is the emphasis on a practical approach through experimental work that distinguishes the science subjects from other disciplines and characterizes each of the subjects.

It is in this context that all science courses aim to enable students to apply and use a body of knowledge, methods and techniques that characterize science and technology and to engender an awareness of the need for, and the value of, effective collaboration and communication, and ethical considerations during scientific activities.



# The Anglo-American School of Moscow



## Science

## Standards and Benchmarks

**THE ANGLO-AMERICAN SCHOOL OF MOSCOW**  
**Learning Outcomes (Standards and Benchmarks)**

**CONTENT AND PERFORMANCE STANDARDS**

At the Anglo-American School of Moscow, our curriculum standards represent an overview of essential school learning for all students. Standards are broad statements of what students should know and be able to do. Different types of standards address various aspects important to learning.

**CONTENT STANDARDS**

Content standards cover what students are to learn in various subject areas, such as mathematics and science. Each discipline has identified a core of learning outcomes desired for all students.

**PERFORMANCE STANDARDS OR *BENCHMARKS***

Performance standards –or *benchmarks* as they are referred to at AAS - are developmentally appropriate components of standards. They are written for each grade and state the knowledge and skills to be acquired by the end of that grade or group of grades. To provide a clearer understanding of what specific skills are taught at a grade level, certain benchmarks include descriptors or examples.

Benchmarks are the knowledge and skills that teachers can assess, and on which student learning progress can be reported. While the ultimate learning goal for students is to attain deep understandings of the issues and content they study, we recognize that understanding itself is difficult to measure and we depend on the measures of knowledge and skills combined with student reflection or ultimate performance.

## **GUARANTEED AND VIABLE CURRICULUM**

A guaranteed curriculum means that we provide the opportunity and support for all students to learn what we have identified as core learning outcomes. Viable means we have identified that which is actually able to be achieved within the time frame of students' PK-12 journey. We provide learning extension for all students ready and able to exceed the general curriculum, but we organize so that we can ensure all students make adequate progress in the guaranteed curriculum.

In order to ensure the curriculum is guaranteed, viable, and relevant to students' lives, teachers review the benchmarks on a continuous basis and use them to design instruction (and when appropriate – remediation or extension) for students.

AAS teachers develop unit plans aligned with the standards and grade level benchmarks. Unit plans are documents for teacher use that outline the specific content, skills, assessments and resources used in all AAS classrooms. We organize these standards, benchmarks, and instructional units in the resource tool of Rubicon Atlas.

The standards and benchmarks are available on the school website under *academics* at [www.aas.ru](http://www.aas.ru)

## **What is Not Covered by Standards**

**(adopted from Common Core Standards, 2011)**

The Standards should be recognized for what they are not as well as for what they are. The most important intentional design limitations are as follows:

1. The Standards define what all students are expected to know and be able to do, not how teachers should teach. For instance, the use of play with young children is not specified by the Standards, but it is welcome as a valuable activity in its own right and as a way to help students meet the expectations in this document. Furthermore, while the Standards make references to some particular forms of content, they do not—indeed, cannot—enumerate all or even most of the content that students should learn. The Standards must therefore be complemented by a well-developed, content-rich curriculum consistent with the expectations laid out in this document.

2. While the Standards focus on what is most essential, they do not describe all that can be taught. A great deal is left to the discretion of teachers and curriculum developers. The aim of the Standards is to articulate the fundamentals, not to set out an exhaustive list or a set of restrictions that limits what can be taught beyond what is specified.

3. The Standards do not define the nature of advanced work for students who meet the Standards prior to the end of high school. AAS graduates are expected to meet the IBO learning objectives for each course in which they are enrolled.

4. The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations. No set of grade-specific standards can fully reflect the great variety in abilities, needs, learning rates, and achievement levels of students in any given classroom. The Standards should also be read as allowing for the widest possible range of students to participate fully from the outset and as permitting appropriate accommodations to ensure maximum participation of students with special education needs.

5. It is also beyond the scope of the Standards to define the full range of supports appropriate for English language learners and for students with special needs. At the same time, all students must have the opportunity to learn and meet the same high standards if they are to access the knowledge and skills necessary in their post-high school lives.

Each grade will include students who are still acquiring English. For those students, it is possible to meet the standards in reading, writing, speaking, and listening without displaying native-like control of conventions and vocabulary.

6. Students require a wide-ranging, rigorous academic preparation and, particularly in the early grades, attention to such matters as social, emotional, and physical development and approaches to learning.

# **TABLE OF CONTENTS AERO K-12 SCIENCE EDUCATION FRAMEWORK**

## **Physical Science (PS)**

- PS.1 Properties of Matter
- PS.2 Changes in Matter
- PS.3 Forms of Energy
- PS.4 Energy Transfer/Cons
- PS.5 Motion at MacroLevel
- PS.6 Forces Affecting Motion

## **Earth & Space Sciences (ESS)**

- ESS.1 Objects in Space
- ESS.2 History of Earth
- ESS.3 Prop of Earth's Materials
- ESS.4 Tectonics
- ESS.5 Energy in Earth Sys
- ESS.6 Climate and Weather
- ESS.7 Biogeochemical Cycles

## **Life Sciences (LS)**

- LS.1 Organization/Development
- LS.2 Energy Transformations
- LS.3 Interdependence
- LS.4 Heredity and Reproduction
- LS.5 Evolution and Diversity

## **Scientific Inquiry and Critical Thinking Skills**

## **History and Nature of Science**

**PHYSICAL SCIENCE  
STANDARDS and PERFORMANCE INDICATORS**

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.1 Properties of Matter</b> Students will develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior.
<b>Benchmarks through grade 5</b>	A. 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).
	C. Students will be able to identify and describe the physical and chemical properties of a substance.
	D. 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.
	E. Students will use measures of weight (data) to demonstrate that the whole equals the sum of its parts.
	F. 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).



**PHYSICAL SCIENCE – 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.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai 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)</p> <p>Aii Describe objects in terms of what they are made of and their physical properties</p> <p>Aiii Compare, sort and group objects in terms of what they are made of (e.g., clay, cloth, paper, or metal)</p>	<p>Ai Describe features of the object or material that are only visible with the use of the magnifier</p> <p>Aii Use measures of weight (data) to demonstrate that the whole equals the sum of its parts</p>	
<p>Ci Identify the observable properties of different objects, such as color, size, shape, weight and texture</p> <p>Cii Use attributes of properties to state why objects are grouped together (e.g., things that roll, things that are rough)</p> <p>Ciii Identify, compare, and sort objects by similar or different physical properties (e.g., size, shape, color, texture, smell, weight)</p>	<p>Ci 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)</p> <p>Cii 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)</p>	
<p>Di Identify matter that can be a liquid or solid (e.g., water)</p> <p>Dii Identify and compare solids (e.g. have a definite shape) and liquids (e.g. take the shape of their containers)</p> <p>Diii Investigate and recognize water can change from a liquid to a solid (freeze), and</p>		

**PHYSICAL SCIENCE – 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.**

<p>back again to a liquid (melt), as the result of temperature changes</p> <p>Div 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)</p> <p>Dv 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</p>		
<p>Ei Use non-standard units of measure (e.g., string, paper clips) to compare the size and weight of non-living materials</p> <p>Eii Use simple tools (e.g. balance scale, see-saw) to explore the property of weight</p>	<p>Ei Use standard tools to measure objects or materials (e.g., ruler, meter stick, measuring tape, pan balance, thermometer, graduated cylinder)</p> <p>Eii Select the appropriate metric system tools for measuring length, width, temperature, volume, and mass</p> <p>Eiii Show that the weight of an object remains the same despite a change in its shape</p>	
	<p>Fi Observe and sort objects that are and are not attracted to magnets</p> <p>Fii Predict whether or not an object will be attracted to a magnet</p> <p>Fiii Describe what happens when like and opposite poles of a magnet are placed near each other</p> <p>Fiv Describe the physical properties of magnets</p> <p>Fv Determine the relative strength of various</p>	

**PHYSICAL SCIENCE – 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.

	magnets (e.g. size, number of paper clips attracted, etc.)	
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**PHYSICAL SCIENCE  
STANDARDS and PERFORMANCE INDICATORS**

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
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<b>Benchmarks through grade 8</b>	A. 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).
	B. Students will explain how properties of elements and the location of elements on the periodic table are related.
	C. Students will be able to use physical and chemical properties as determined through an investigation to identify a substance
	D. Students will represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter.
	E. Students will be able to investigate and explain the relationships among mass, volume and density.

**PHYSICAL SCIENCE – 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.**

Grade 6	Grade 7	Grade 8
<p>Ai 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</p>		<p>Ai 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</p> <p>Aii Use models or diagrams to show the difference between atoms and molecules</p> <p>Aiii Given graphic or written information, classify matter as an atom / molecule or element/ compound (not the structure of an atom)</p>
		<p>Bi Explain that over one hundred elements exist, and identify the periodic table as a tool for organizing the information about them</p> <p>Bii Explain that elements are organized in the periodic table according to their properties</p> <p>Biii Use the periodic table to obtain information about a given element</p> <p>Biv Predict how an atom's electron arrangement influences its ability to transfer or share electrons and is related its position on the periodic table</p> <p>Bv Describe how elements can combine to form new substances that often have different properties</p>

		<p>Bvi 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)</p> <p>Bvii 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)</p> <p>Bviii Describe the different atoms and molecules in mixtures (e.g., dissolving carbon dioxide in water produces a type of mixture [solution] of CO<sub>2</sub> and H<sub>2</sub>O molecules)</p> <p>Bix 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</p>
<p>Ci Identify substances by their physical and chemical properties, such as magnetism, conductivity, density, solubility, boiling and melting points</p>		<p>Ci Identify elements according to their common properties, such as highly reactive metals, less reactive metals, highly reactive non-metals and almost non-reactive gases.</p> <p>Cii 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 identify a molecule as the smallest part of a substance that retains its properties</p> <p>Ciii Given data about characteristic properties of matter (e.g., melting and boiling points,</p>

		density, solubility, acid or base), identify, compare, or classify different substances
<p>Di 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)</p> <p>Dii Create diagrams or models that represent the states of matter at the molecular level</p> <p>Diii Explain the effect of increased and decreased thermal energy on the motion and arrangement of molecules</p> <p>Div Predict the changes in the state of matter when adding or taking away heat (e.g., ice melting, water boiling or freezing, condensation/evaporation)</p> <p>Dv Describe how matter changes from one phase to another (e.g., condensation, evaporation)</p> <p>Dvi Describe the movement of individual particles and verify the conservation of matter during the phase changes (e.g., melting, boiling, or freezing)</p>		<p>Di 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)</p> <p>Dii Explain that states of matter depend on the arrangement of the molecules and their motion</p>
<p>Ei 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</p> <p>Eii Differentiate between weight and mass</p>		<p>Ei Explain how different substances of equal volume usually have different weights</p> <p>Eii 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)</p>

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.2 Changes in Matter</b> Students will develop an understanding that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.
<b>Benchmarks through grade 5</b>	A. Students will differentiate between physical and chemical changes.



**PHYSICAL SCIENCE –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.

<b>Kindergarten - Grade 1</b>	<b>Grade 2 - Grade 3</b>	<b>Grade 4 - Grade 5</b>
<p>Ai 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</p> <p>Aii 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)</p>		<p>Ai Investigate and explain that not all materials react the same way when an action is applied to them</p> <p>Aii Differentiate between a physical change, such as melting, and a chemical change, such as rusting</p>

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.2 Changes in Matter</b> Students will develop an understanding that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.
<b>Benchmarks through grade 8</b>	A. Students will demonstrate how substances can chemically react with each other to form new substances having properties different from those of the original substances.

**PHYSICAL SCIENCE –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.

<b>Grade 6</b>	<b>Grade 7</b>	<b>Grade 8</b>
Ai Describe how energy has the ability to create change.		

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.3 Forms of Energy</b> Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.
<b>Benchmarks through grade 5</b>	A. 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...?”).
	B. Students will experiment, observe, or predict how heat might move from one object to another.
	C. Students will experiment to identify, classify, and change different pitches and volumes of sounds produced by different objects.
	D. Students will use observations of light in relation to other objects/substances to describe the properties of light (can be reflected, refracted, or absorbed).

**PHYSICAL SCIENCE – 3. FORMS OF ENERGY:** Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Observe how energy does things (e.g., batteries, the sun, wind, electricity)</p> <p>Aii Explain that energy comes from different sources, such as electricity and water, and is utilized in many common objects</p>		<p>Ai Describe how energy produces changes (e.g., heat melts ice, gas makes car go uphill, electricity makes TV work)</p> <p>Aii 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</p> <p>Aiii 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)</p>
<p>Bi Classify objects in terms of their relative temperature (e.g., hotter and colder)</p> <p>Bii Identify some examples where heat is released (e.g., burning candles, rubbing hands, running)</p>	<p>Bi Describe that heat can be produced (e.g., burning, rubbing, mixing some substances)</p> <p>Bii Explain that thermal energy (heat) moves more rapidly in thermal conductors (e.g., metal pan) than in insulators (e.g., plastic handle)</p> <p>Biii Describe the effectiveness of different insulating and conducting materials with respect to thermal energy (heat) flow</p>	<p>Bi Classify a variety of materials on whether they conduct heat (conductors) or do not conduct heat (insulators)</p> <p>Bii Classify a variety of materials as those that can reflect or absorb light</p> <p>Biii Classify a variety of materials on whether they conduct electricity (conductors) or do not conduct electricity (insulators)</p>
<p>Ci Demonstrate and identify sounds as soft or loud</p> <p>Cii Demonstrate how sound is made in a variety of ways (e.g., singing, whispering, striking an object)</p>	<p>Ci Demonstrate how sound can change in pitch and volume</p> <p>Cii 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)</p>	<p>Ci Demonstrate that the pitch of a sound is dependent on the frequency of the vibration producing it</p>

<p>Di 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)</p> <p>Dii Observe and record shadows at different times of the day.</p> <p>Diii Describe the effects of the sun's energy on different materials.</p> <p>Div Identify the sun as the main source of the Earth's light and heat energy</p>		<p>Di Investigate the properties of transparent and opaque objects (e.g., plastic wrap and aluminum foil)</p> <p>Dii Describe how light can be reflected by a mirror, bent by a lens, or absorbed by the object</p> <p>Diii Describe ways light can interact with matter, such as transmission (which includes refraction), absorption, and scattering (which includes reflection)</p> <p>Div Compare the heating and cooling rates of air, land, and water</p> <p>Dv Analyze data to explain the heating and cooling rates of air, land, and water</p> <p>Dvi Describe how the Sun, a major energy source for the Earth, affects the planet's surface</p>
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<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.3 Forms of Energy</b> Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.
<b>Benchmarks through grade 8</b>	B. Students will use data to draw conclusions about how heat can be transferred (convection, conduction, radiation).
	C. Students will describe sound as the transfer of energy through various materials (e.g. solids, liquids, gases).
	D. Students will explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky).

**PHYSICAL SCIENCE – 3. FORMS OF ENERGY: Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.**

Grade 6	Grade 7	Grade 8
<p>Bi Describe how thermal energy (heat) is transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators</p>	<p>Bi Explain how thermal energy (heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature</p>	<p>Bi Explain how thermal energy (heat) flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions</p>
<p>Ci Describe and summarize observations of the transmission, reflection, and absorption of sound</p> <p>Cii Observe and explain that sound vibrations move at different speeds, have different wavelengths; and establish wave-like disturbances that emanate from the source</p>		
	<p>Di Demonstrate that visible light from the sun or reflected by objects may be made up of a mixture of many different colors of light</p> <p>Dii Explain the relationship between an object's color and the wavelength of light reflected or transmitted to the viewer's eyes</p> <p>Diii Describe the relationship between frequency and wavelength of any wave</p> <p>Div 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</p>	



<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.4 Energy Transfer and Conservation</b> Students will develop an understanding of the transfer, transformation, and conservation of energy.
<b>Benchmarks through grade 5</b>	A. Students will demonstrate and explain the movement of electricity in closed and open circuits.

**PHYSICAL SCIENCE – 4. ENERGY TRANSFER AND CONSERVATION:** Students will develop an understanding of the transfer, transformation, and conservation of energy.

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
		Ai Identify the use of electricity  Aii Construct and explain a simple electric circuit  Aiii Demonstrate that electricity flowing in circuits can produce light, heat, sound, and magnetic effects

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.4 Energy Transfer and Conservation</b> Students will develop an understanding of the transfer, transformation, and conservation of energy.
<b>Benchmarks through grade 8</b>	B. Students will describe electromagnetic energy from the Sun (solar radiation) as the major source of energy on Earth
	C. Students will describe electromagnetic energy from the Sun (solar radiation) as the major source of energy on Earth.
	D. 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).

**PHYSICAL SCIENCE – 4. ENERGY TRANSFER AND CONSERVATION: Students will develop an understanding of the transfer, transformation, and conservation of energy.**

Grade 6	Grade 7	Grade 8
	<p>Bi Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves)</p> <p>Bii 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</p> <p>Biii 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</p> <p>Biv 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</p>	
	<p>Di Explain that solar energy reaches Earth through radiation, mostly in the form of visible light</p> <p>Dii Describe the sun as the major source of energy for phenomena on Earth's surface, powering winds, ocean currents, the water</p>	

	cycle, and providing energy essential for life functions	
Di Explain the relationship between the mass of an object and the sum of its parts		Di Describe how mass remains constant in a closed system and provide examples relating to both physical and chemical change

<b>Standard</b>	<p><b>PS: Physical Science</b>  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.</p>
<b>Strand Standard</b>	<p><b>PS.5 Motion at the Macroscopic Level</b>  Students will understand how to describe the motion of an object.</p>
<b>Benchmarks through grade 5</b>	<p>A. Students will measure distance and time for a moving object and using those values as well as the relationship <math>s=d/t</math> to calculate speed and graphically represent the data.</p>

**PHYSICAL SCIENCE – 5. MOTION AT THE MACROSCOPIC LEVEL: Students will understand how to describe the motion of an object.**

<b>Kindergarten - Grade 1</b>	<b>Grade 2 - Grade 3</b>	<b>Grade 4 - Grade 5</b>
	<p>Ai Describe spatial relationships (i.e., above, below, next to, left, right, middle, center) of objects</p> <p>Aii 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)</p> <p>Aiii Describe an objects position by locating it relative to another object or the background</p>	<p>Ai Demonstrate a variety of ways to make things move and describe what causes them to change speed, direction and/or stop</p> <p>Aii Describe an object’s motion by tracing and measuring its position over time (measuring speed)</p>

<p><b>Standard</b></p>	<p><b>PS: Physical Science</b>  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.</p>
<p><b>Strand Standard</b></p>	<p><b>PS.5 Motion at the Macroscopic Level</b>  Students will understand how to describe the motion of an object.</p>
<p><b>Benchmarks through grade 8</b></p>	<p>A. Students will measure distance and time for a moving object and using those values as well as the relationship <math>s=d/t</math> to calculate speed and graphically represent the data.</p>



**PHYSICAL SCIENCE – 5. MOTION AT THE MACROSCOPIC LEVEL: Students will understand how to describe the motion of an object.**

Grade 6	Grade 7	Grade 8
	<p>Ai Describe variables that change an object's speed, direction, or both and identify and describe the forces that cause the change in motion</p> <p>Aii Explain motion in terms of frames of reference and analyze graphs depicting motion and predicted future motion</p> <p>Aiii Create a graph devised from measurements of moving objects and their interactions, including: position-time graphs and velocity-time graphs</p> <p>Aiv Interpret the relationships of distance versus time, speed versus time, and acceleration versus time graphs</p>	

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.6 Forces Affecting Motion</b> Students will understand that the motion of an object is affected by external forces on it.
<b>Benchmarks through grade 5</b>	A. 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).

**PHYSICAL SCIENCE – 6. FORCES AFFECTING MOTION: Students will understand that the motion of an object is affected by external forces on it.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
	<p>Ai Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets) Describe the position of an object by referencing its location in relation to another object or background</p> <p>Aii Describe and demonstrate how the position and motion of an object can be changed by applying force, such as pushing and pulling</p> <p>Aiii Compare the effects of force (pushes or pulls) on the motion of an object</p> <p>Aiv Describe the properties of magnetism and demonstrate how magnets can be used to move some things without touching them</p> <p>Av 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)</p> <p>Avi Describe the ways that different objects may balance or topple in various situations</p> <p>Avii Describe and demonstrate that things close to the Earth drop to the ground unless something supports them</p> <p>Aviii Assemble, take apart, and reassemble constructions using interlocking blocks, erector sets, etc</p> <p>Aix Manipulate hammers and nails,</p>	<p>Ai Identify contact /non-contact forces that affect motion of an object (e.g., gravity, magnetism and collision)</p> <p>Aii Explain that the strength of a force and mass of an object influence the amount of change in an object’s motion</p> <p>Aiii Explain that electrically charged material pulls on all other materials and can attract or repel other charged materials</p> <p>Aiv Describe the effect of retarding forces such as friction on the motion of objects</p> <p>Av Describe the effects of variables on an object’s motion (e.g., incline angle, friction, gravity, applied forces)</p> <p>Avi Perform experiments with simple machines to demonstrate the relationship between forces and distance</p> <p>Avii Illustrate quantitatively mechanical advantage of simple machines</p>

	<p>screwdrivers and screws, scissors, and other simple tools</p> <p>Ax Examine simple machines and the forces (pushes and pulls) involved</p>	
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<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.6 Forces Affecting Motion</b> Students will understand that the motion of an object is affected by external forces on it.
<b>Benchmarks through grade 8</b>	B. 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.

**PHYSICAL SCIENCE – 6. FORCES AFFECTING MOTION: Students will understand that the motion of an object is affected by external forces on it**

Grade 6	Grade 7	Grade 8
	<p>Bi 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)</p> <p>Bii Investigate and describe how the acceleration of a body is dependent on its mass and the net applied force (Newton’s Second Law)</p> <p>Biii Describe Newton’s Laws of Motion; identify examples, illustrate qualitatively and quantitatively drawing vector examples</p> <p>Biv 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)</p> <p>Bv Explain that just as electric currents can produce magnetic forces, magnets can cause electric currents</p> <p>Bvi 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</p> <p>Bvii 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</p> <p>Bviii Use data to determine or predict the</p>	

overall (net) effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.

Bix Explain that the Earth's gravitational force pulls any object toward it

Bx Explain the effect of gravity on falling objects (e.g.,  $g = 9.8\text{m/s}^2$ , object dropped on earth and on moon)

Bxi Explain that the force of gravity gets stronger the closer one gets to an object and decreases the further away one gets from it

Bxii 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)

<b>Standard</b>	<p><b>ESS: Earth and Space Science</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.1 Objects In The Universe</b>  Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.</p>
<b>Benchmarks through grade 5</b>	<p>A. Students will observe and identify objects and their apparent motion in the day and night sky.</p>
	<p>B. students will relate the motions of the Earth-sun-moon system to units of time (days, months, years).</p>
	<p>C. 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”.</p>



**EARTH AND SPACE SCIENCES – 1. OBJECTS IN THE UNIVERSE: Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Explain that there are more stars in the sky than anyone can easily count</p> <p>Aii Explain that stars are not scattered evenly and they are not always the same brightness and color</p> <p>Aiii Explain that the patterns in the sky remain stable but appear to move across the sky because of the Earth's motion</p> <p>Aiv Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light</p> <p>Av Identify objects in the day and night sky (e.g., moon, stars, or sun)</p> <p>Avi 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</p> <p>Avii Observe and describe the sun, moon, planets, and stars</p> <p>Aviii Identify the sun, moon, and the Earth as components of our solar system</p> <p>Aix Observe and describe properties, locations, and movements of the sun, moon, stars, and clouds</p>	<p>Ai Observe and describe properties, locations, and movements of the sun, moon, stars, and clouds</p>	

	<p>Bi Describe Earth's position and movement in the solar system</p> <p>Bii Use models to demonstrate how the rotation of the Earth on its axis every 24 hours produces the night-and-day cycle</p>	<p>Bi Use models to demonstrate how the revolution of the Earth around the sun produces the yearly cycle</p>
<p>Ci Identify that the moon and stars are usually seen at night</p> <p>Cii Observe and discuss the importance of objects in the day and night sky</p>	<p>Ci Observe and describe the changes of the moon's appearance over a month</p> <p>Cii Describe the relative movement of the Earth and moon in relation to the sun</p>	<p>Ci Demonstrate the phases of the moon by showing the alignment of the earth, moon, and sun</p>

<b>Standard</b>	<p><b>ESS: Earth and Space Science</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.1 Objects In The Universe</b>  Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.</p>
<b>Benchmarks through grade 8</b>	<p>B. Students will relate the motions of the Earth-sun-moon system to eclipses and the seasons.</p>

**EARTH AND SPACE SCIENCES – 1. OBJECTS IN THE UNIVERSE: Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.**

<b>Grade 6</b>	<b>Grade 7</b>	<b>Grade 8</b>
	<p>Ai 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</p> <p>Aii Explain that the difference in heating of the Earth’s surface produces the planet’s seasons and weather patterns</p> <p>Aiii Relate the tilt of the earth to the distribution of sunlight throughout the year and its effect on climate</p>	

<b>Standard</b>	<p><b>3.0 Earth and Space Sciences</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.2 History of the Earth</b>  Students will understand scientific theories of how the earth's surface is formed and how those theories developed.</p>
<b>Benchmarks through grade 5</b>	<p>A. Students will explain how wind, water, or ice shape and reshape the earth.</p>
	<p>B. Students will use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves).</p>

**EARTH AND SPACE SCIENCES – 2. HISTORY OF THE EARTH: Students will understand scientific theories of how the earth’s surface is formed and how those theories developed.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
	<p>Ai Identify the processes of physical weathering that break down rocks at Earth's surface (i.e., water movement, freezing, plant growth, wind)</p> <p>Aii Distinguish between weathering (i.e., wearing down and breaking of rock surfaces) and erosion (i.e., the movement of materials)</p> <p>Aiii Observe seasonal and weather changes throughout the school year</p> <p>Aiv Observe and record seasonal and weather changes throughout the school year</p> <p>Av Investigate local landforms and how wind, water, or ice have shaped and reshaped them (e.g. severe weather)</p>	<p>Ai Describe land features (including volcanoes, mountains, valleys, canyons, caverns, and islands) by using pictures, diagrams, and maps</p> <p>Aii Describe changes in Earth’s surface that are due to slow processes (including weathering, erosion, and deposition)</p> <p>Aiii Describe changes in Earth’s surface that are due to rapid processes (including landslides, volcanic eruptions, floods, and earthquakes)</p>
	<p>Bi Conduct tests on how different soils retain water (e.g., how fast does the water drain through?)</p> <p>Bii Conduct investigations and use observational data to describe how water moves rocks and soils</p>	

<b>Standard</b>	<p><b>3.0 Earth and Space Sciences</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.2 History of the Earth</b>  Students will understand scientific theories of how the earth's surface is formed and how those theories developed.</p>
<b>Benchmarks through grade 8</b>	<p>A. 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.</p>
	<p>B. 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.</p>

**EARTH AND SPACE SCIENCES – 2. HISTORY OF THE EARTH: Students will understand scientific theories of how the earth’s surface is formed and how those theories developed.**

Grade 6	Grade 7	Grade 8
<p>Ai 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</p> <p>Aii Evaluate fast processes (e.g. erosion, volcanoes and earthquakes) to determine how the earth has changed and will continue to change over time</p> <p>Aiii Investigate the effect of flowing water on landforms (e.g. stream table, local environment)</p> <p>Aiv Describe how the history of the Earth is influenced by occasional natural occurrences, such as the impact of an asteroid or comet</p> <p>Av Describe how energy from the Earth's interior causes changes to Earth's surface (i.e., earthquakes, volcanoes)</p> <p>Avi 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)</p> <p>Avii Plot location of volcanoes and earthquakes and explain the relationship between the location of these phenomena and faults Illustrate the geologic landforms of the</p>	<p>Ai Describe events and the effect they may have on climate (e.g. El Nino, deforestation, glacial melting, and an increase in greenhouse gases).</p>	



<p>ocean floor (including the continental shelf and slope, the mid-ocean ridge, rift zone, trench, and the ocean basin)</p> <p>Aviii Compare continental and oceanic landforms</p> <p>Aix 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</p> <p>Ax Identify and illustrate the geologic features of the local region through the use of topographic maps</p> <p>Axi Illustrate the creation and changing of landforms that have occurred through geologic processes (including volcanic eruptions and mountain-building forces)</p>		
<p>Bi Identify common rock forming minerals (quartz, feldspar, mica, halite, hematite, hornblende)</p> <p>Bii Classify rock samples as igneous (granite, basalt, obsidian, pumice), metamorphic (marble, slate, quartzite), and sedimentary (sandstone, limestone, shale, conglomerate)</p> <p>Biii Explain how igneous, metamorphic, and sedimentary rocks are interrelated in the rock cycle</p> <p>Biv Compare and contrast the formation of the different rock types, and demonstrate the similarities and differences using a model</p>		

<p>Bv Describe and model the processes of fossil formation</p> <p>Bvi Describe how fossils provide important evidence of how life and environmental conditions have changed</p> <p>Bvii Explain why more recently deposited rock layers are more likely to contain fossils resembling existing species than older rock layers</p> <p>Bviii Explain how rocks and fossils are used to understand the age and geological history of the earth (timelines and relative dating, rock layers)</p>		
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<b>Standard</b>	<p><b>ESS: Earth and Space Sciences</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.3 Properties of Earth's Materials</b>  Students will demonstrate an understanding materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed.</p>
<b>Benchmarks through grade 5</b>	A. Students will use physical properties to sort, classify, and describe earth materials (soils, rocks or minerals).
	B. Students will explain how their characteristics of various earth materials lend themselves to specific uses.

**EARTH AND SPACE SCIENCES– 3. PROPERTIES OF EARTH’S MATERIALS: Students will demonstrate an understanding of materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
	<p>Ai Identify the earth materials (i.e., rocks, soil, water, air) found in aquatic and terrestrial environments</p> <p>Aii Use the senses to observe and describe the properties of a variety of earth materials (i.e., rock, soil, sand, water)</p> <p>Aiii Use the senses to observe and then describe the physical properties of soil components</p> <p>Aiv Compare soil samples by sorting them according to properties (including color, texture, and the capacity to retain water)</p> <p>Av Conduct simple tests to identify the three basic components of soil (sand, clay, humus)</p> <p>Avi Describe the observable properties of water (including the fact that it takes the shape of its container, flows downhill, and feels wet)</p> <p>Avii Illustrate the locations of water on Earth by using drawings, maps, or models</p>	<p>Ai 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)</p> <p>Aii Use the physical properties of hardness, color, luster, and reaction to vinegar (weak acid) to identify common minerals (quartz, fluorite, calcite, and gypsum)</p> <p>Aiii Identify the importance of minerals, ores, and fossil fuels as Earth’s resources on the basis of their properties</p> <p>Aiv Test soils (touch and roll, smear, settling, ability to absorb and retain water) and compare and contrast the properties</p> <p>Av 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)</p> <p>Avi Illustrate Earth’s saltwater and freshwater features (including oceans, seas, rivers, lakes, ponds, streams, and glaciers)</p> <p>Avii Summarize the processes of the water cycle (including evaporation, condensation, precipitation, and runoff)</p>
<p>Bi Identify the composition of Earth (including rocks, sand, soil, and water)</p>	<p>Bi Identify which materials are best for different uses (e.g., soils for growing plants, sand for the sand box)</p>	<p>Bi 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)</p>

	Bii Identify different uses (e.g., building materials, sources of fuel) of Earth's materials based on their properties	Bii 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)
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**EARTH AND SPACE SCIENCES– 3. PROPERTIES OF EARTH’S MATERIALS: Students will demonstrate an understanding of materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed.**

<b>Standard</b>	<b>ESS: Earth and Space Sciences</b> 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.
<b>Strand Standard</b>	<b>ESS.3 Properties of Earth’s Materials</b> Students will demonstrate an understanding materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed.
<b>Benchmarks through grade 8</b>	A. Students will use physical properties to sort, classify, and describe earth materials (soils, rocks or minerals).
	C. Students will describe how matter in the atmosphere cycles through other Earth systems

**EARTH AND SPACE SCIENCES– 3. PROPERTIES OF EARTH’S MATERIALS: Students will demonstrate an understanding of materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed.**

Grade 6	Grade 7	Grade 8
		<p>Ai Investigate that soils are often found in layers and can be different from place to place</p> <p>Aii 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)</p> <p>Aiii Investigate the properties of soil (e.g., color, texture, capacity to retain water, ability to support plant growth)</p>
		<p>Ci Identify the composition and layers of the Earth’s atmosphere</p> <p>Cii Compare the composition and structure of Earth’s atmospheric layers (including the gases and differences in temperature and pressure within the layers)</p> <p>Ciii Explain the interrelationship among the dynamic processes of the water cycle (including precipitation, evaporation, transpiration, condensation, surface-water flow, and groundwater flow)</p> <p>Civ 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</p>

		<p>Cv Describe movement of a carbon atom from the atmosphere through a plant, animal, and decomposer, and back into the atmosphere</p> <p>Cvi Diagram the nitrogen cycle and provide examples of human actions that affect this cycle (e.g., fertilizers, crop rotation, fossil fuel combustion)</p> <p>Cvii 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</p> <p>Cviii 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)</p>
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<b>Standard</b>	<b>ESS Earth and Space Sciences</b> 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.
<b>Strand Standard</b>	<b>ESS.4 Tectonics</b> Students will gain an understanding of gravity, density, and convection which moves Earth's plates causing the plates to impact other Earth systems
<b>Benchmarks through grade 8</b>	A. Students will use geological evidence to support the idea that the Earth's crust/lithosphere is composed of plates that move
	B. Students will describe how the magnetic field of Earth and a magnet are similar

**EARTH AND SPACE SCIENCES– 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.**

Grade 6	Grade 7	Grade 8
		<p>Ai Describe Earth’s layers as a lithosphere (crust and upper mantle), convecting mantle, and dense metallic core</p> <p>Aii 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</p> <p>Aiii Identify the energy sources that cause material to move within Earth</p> <p>Aiv Model the movement of materials within Earth</p> <p>Av Define and describe the location of the major plates and plate boundaries</p> <p>Avi 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)</p> <p>Avii 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</p> <p>Aviii Relate plate boundary movements to their resulting landforms, including: Mountains, faults, rift valleys, trenches and</p>

		volcanoes
		<p>Bi Construct a compass and explain how it works. using Earth's magnetic field</p> <p>Bii Compare Earth's magnetic field to the magnetic field of a magnet</p> <p>Biii 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)</p> <p>Biv Explain how scientists use seismic waves —primary, secondary, and surface waves to determine the internal structure of Earth</p>

<b>Standard</b>	<p><b>ESS Earth and Space Sciences</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.5 Energy in Earth Systems</b>  Students will understand that energy from the sun provides heat and light for the Earth and is essential for plant growth.</p>
<b>Benchmarks through grade 5</b>	<p>A. Students will provide evidence showing that the sun is the source of heat and light for Earth and is essential for plant growth.</p>

**EARTH AND SPACE SCIENCES– 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.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Compare temperatures in sunny and shady places.</p> <p>Aii Investigate and report how sunlight affects plant growth</p> <p>Aiii Provide examples of how sunlight affects people and animals by providing heat and light</p> <p>Aiv Investigate and record temperature data to show the effects of heat energy on changing the states of water</p> <p>Av Identify the sun as the source of energy that evaporates water from the surface of Earth</p>	<p>Ai</p>	

<b>Standard</b>	<p><b>ESS Earth and Space Sciences</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.5 Energy in Earth Systems</b>  Students will understand that energy from the sun provides heat and light for the Earth and is essential for plant growth.</p>
<b>Benchmarks through grade 8</b>	<p>A. Students will explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water.</p>
	<p>B. Students will explain how the relationship between the tilt of Earth's axis and its yearly orbit around the sun produces the seasons.</p>

**EARTH AND SPACE SCIENCES– 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.**

Grade 6	Grade 7	Grade 8
	<p>Ai Identify the reservoirs of Earth’s water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally</p> <p>Aii 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</p> <p>Aiii Describe the processes of evaporation, condensation, and precipitation as they relate to the water cycle</p> <p>Aiv Construct a model or diagram to show how water continuously moves through the water cycle over time</p>	
	<p>Bi Use collected data to compare patterns relating to seasonal daylight changes</p> <p>Bii 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</p> <p>Biii 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</p>	

	<p>Biv Use a model to explain why the seasons are reversed in the Northern and Southern Hemispheres</p>	
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<b>Standard</b>	<p><b>ESS: Earth and Space Sciences</b>  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.</p>
<b>Strand Standard</b>	<p><b>ESS.6 Climate and Weather</b>  Students will demonstrate an understanding of the relationship between Earth’s atmospheric properties and processes and its weather and climate.</p>
<b>Benchmarks through grade 5</b>	<p>A. Students will explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate.</p> <p>B. 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).</p>

**EARTH AND SPACE SCIENCES– 6. CLIMATE AND WEATHER: Students will demonstrate an understanding of the relationship between Earth’s atmospheric properties and processes and its weather and climate.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Observe and record daily changes in weather (e.g., clouds or air temperature)</p> <p>Aii Observe, identify and record changes in weather and effects on living organisms</p> <p>Aiii Describe weather by measurable quantities such as temperature</p>		<p>Ai Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure</p> <p>Aii Graph recorded weather data to show daily and seasonal patterns in weather</p> <p>Aiii Identify and describe short- and longer-term patterns of events (including weather and seasons) that occur on the Earth and in the sky</p>
<p>Bi Describe how weather and forecasts affect people’s lives</p> <p>Bii Describe weather by measurable quantities such as temperature and precipitation</p>		<p>Bi 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)</p> <p>Bi Predict weather and justify prediction with observable evidence</p> <p>Bii 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 anemometer)</p> <p>Biii Relate weather forecast accuracy to evidence or tools used to make the forecast (e.g. feels like rain vs. barometer reading is dropping)</p> <p>Biv Describe the weather that accompanies cumulus, cumulonimbus, cirrus and stratus</p>

		<p>clouds</p> <p>Bv Predict temperature and precipitation changes associated with the passing of various fronts</p> <p>Bvi 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)</p> <p>Bvii 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</p> <p>Bviii Read a weather map to interpret local, regional and national weather</p> <p>Bix Describe how temperature and precipitation determine climatic zones (biomes) (e.g., desert, grasslands, forests, tundra and alpine)</p>
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<b>Standard</b>	<b>ESS Earth and Space Sciences</b> 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.
<b>Strand Standard</b>	<b>ESS.7 Biogeochemical Cycles</b> Students will understand that Earth systems have a variety of cycles through which energy and matter continually flow.
<b>Benchmarks through grade 8</b>	A. Students will explain the importance of Earth’s resources and identify ways in which various resources can be recycled and reused.
	B. 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.
	C. Students will explain the water cycle and identify the factors that affect the rate of evaporation, condensation, and cloud formation.

**EARTH AND SPACE SCIENCES– 7. BIOGEOCHEMICAL CYCLES: Students will understand that Earth systems have a variety of cycles through which energy and matter continually flow.**

Grade 6	Grade 7	Grade 8
<p>Ai 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</p> <p>Aii 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)</p>	<p>Ai 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)</p> <p>Aii Recognize, describe, and compare renewable energy resources (e.g., solar, wind, water, biomass) and nonrenewable energy resources (e.g., fossil fuels, nuclear energy)</p> <p>Aiii 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</p> <p>Aiv Identify ways that humans affect the atmosphere and the oceans and their limited capacity to absorb wastes and recycle materials naturally</p>	<p>Ai Describe the benefits of Earth’s resources, air, soil, and trees.</p> <p>Aii Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy</p>
		<p>Bi Define ozone and compare its effects in the lower and upper atmosphere</p> <p>Bii Describe the role of living organisms in producing the ozone layer and how the ozone layer affected the development of life on Earth</p> <p>Biii Compare the rate at which CO<sub>2</sub> is put into the atmosphere to the rate at which it is removed through the carbon cycle</p>

		<p>Biv Analyze data relating to the concentration of atmospheric CO<sub>2</sub> over the past 100 years, and describe international efforts to protect the atmosphere</p>
	<p>Ci 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)</p> <p>Cii 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</p> <p>Ciii Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration</p> <p>Civ Explain how thermal energy is transferred throughout the water cycle by the processes of convection, conduction, and radiation</p>	<p>Ci Explain how major bodies of water are important natural resources for human activity (e.g., food, recreation, habitat, irrigation, solvent, transportation)</p> <p>Cii 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</p>

## 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.

<b>Standard</b>	<p><b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.</p>
<b>Strand Standard</b>	<p><b>LS.1 Organization and Development</b> Students will understand that all life forms, at all levels of organization, use specialized structures and similar processes to meet life's needs.</p>
<b>Benchmarks through grade 5</b>	<p>A. Students will identify the basic needs of plants and animals in order to stay alive. (i.e., water, air, food, space).</p> <p>B. 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.</p>

**THE LIVING ENVIRONMENT– 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**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Distinguish between living and nonliving things</p> <p>Aii Identify the basic needs of most animals (i.e., air, water, food, shelter)</p> <p>Aiii Observe that animals need water, air, food, and shelter/space to grow and reproduce</p> <p>Aiv Identify and compare the physical structures of a variety of plants (e.g., stem, leaves, flowers, seeds, roots)</p> <p>Av Identify and compare the physical structures of a variety of animals (e.g., sensory organs, beaks, appendages, body covering)</p>	<p>Ai Identify the basic needs of most plants (i.e., air, water, light)</p> <p>Aii Predict and investigate the growth of plants when growing conditions are altered (e.g., dark vs. light, water vs. no water)</p> <p>Aiii Investigate and describe how living things grow and change</p> <p>Aiv Observe, identify, and record external features of humans and other animals</p>	<p>Ai Investigate and describe how plants and animals have features that help them live in various environments</p> <p>Aii Identify the structures in plants (leaves, roots, flowers, stem, bark, wood) that are responsible for food production, support, water transport, reproduction, growth, and protection</p> <p>Aiii 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)</p> <p>Aiv 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)</p>
<p>Bi Sort animals and plants by observable characteristics</p> <p>Bii Identify and compare the physical structures of a variety of plants (e.g., stem, leaves, flowers, seeds, roots)</p> <p>Biii Identify and compare the physical structures of a variety of animals (e.g., sensory organs, beaks, appendages, body covering)</p>		<p>Bi 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)</p> <p>Bii 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)</p>



## 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.

<b>Standard</b>	<p><b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.</p>
<b>Strand Standard</b>	<p><b>LS.1 Organization and Development</b> Students will understand that all life forms, at all levels of organization, use specialized structures and similar processes to meet life's needs.</p>
<b>Benchmarks through grade 8</b>	<p>A. 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).</p> <p>B. 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).</p> <p>C. Students will explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.</p>

**THE LIVING ENVIRONMENT– 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**

Grade 6	Grade 7	Grade 8
<p>Ai Describe the hierarchical organization of multicellular organisms from cells to tissues to organs to systems to organisms</p> <p>Aii 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</p> <p>Aiii Investigate, compare, and contrast the different structures of organisms that serve different functions for growth, reproduction, and survival</p> <p>Aiv 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)</p> <p>Av 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</p> <p>Avi 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)</p>		<p>Ai Explain how each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole</p> <p>Aii Describe structures or behaviors that help organisms survive in their environment (e.g., defense, obtaining nutrients, reproduction, and eliminating waste)</p> <p>Aiii Investigate and describe how cells, grow, divide, and take in nutrients, which they use to provide energy for cellular functions</p> <p>Aiv Describe the importance of the transport and exchange of oxygen and carbon dioxide to the survival of the organism</p> <p>Av Explain that oxygen is needed by all cells of most organisms for the release of energy from nutrient (sugar) molecules</p> <p>Avi Describe photosynthesis 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</p>

	<p>Bi Follow a taxonomic key to identify a given organism (e.g. flowering and non-flowering plants)</p> <p>Bii Sort organisms with similar characteristics into groups based on internal and external structures</p>	<p>Bi 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)</p> <p>Bii Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom</p>
<p>Ci Explore how the use of a microscope allows one to see cells in a variety of organisms</p> <p>Cii 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</p> <p>Ciii Observe and describe (e.g., drawing, labeling) individual cells as seen through a microscope targeting cell membrane, cell wall, nucleus, and chloroplasts</p>		<p>Ci Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles)</p> <p>Cii Explain the functions of the cell (e.g., growth, metabolism, reproduction, photosynthesis, response)</p> <p>Ciii 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</p> <p>Civ Explain that specialized cells perform specialized functions. (e.g., muscle cells contract, nerve cells transmit impulses, and skin cells provide protection)</p> <p>Cv Compare individual cells of tissues and recognizing the similarities of cells and how they work together to perform specific functions</p>

<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.2 Matter and Energy Transformations</b> Students will understand how living things obtain and use energy.
<b>Benchmarks through grade 5</b>	A. Students will identify the basic needs of plants and animals in order to stay alive (i.e., water, air, food, space).
	B. 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.

**THE LIVING ENVIRONMENT– 2. MATTER AND ENERGY TRANSFORMATIONS: Students will understand how living things obtain and use energy**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Identify basic needs of plants and animals: Food, water, light, air, space</p> <p>Aii 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</p> <p>Aiii Explain that all organisms require a form of energy to survive and that humans and other animals obtain energy and materials from food</p>		<p>Ai Explain that all living things have structures that provide the basic needs for survival</p> <p>Aii Associate specific structures with their functions in the survival of an organism</p>
	<p>Bi Describe how all animals depend upon plants whether or not they eat the plants directly</p> <p>Bii Differentiate between the needs of plants and those of animals</p>	

<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.2 Matter and Energy Transformations</b> Students will understand how living things obtain and use energy.
<b>Benchmarks through grade 8</b>	A. 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.
	B. Students will trace the flow of energy through an ecosystem.

**THE LIVING ENVIRONMENT– 2. MATTER AND ENERGY TRANSFORMATIONS: Students will understand how living things obtain and use energy**

Grade 6	Grade 7	Grade 8
<p>Ai 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)</p> <p>Aii Identify various specialized cells and common unicellular organisms in diagrams, photographs and/or microscopic slides</p>		<p>Ai 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)</p> <p>Aii 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).</p>
	<p>Bi Categorize organisms as predator or prey in a given ecosystem</p> <p>Bii Classify populations of unicellular and multicellular organisms as producers, consumers, and decomposers by the role they serve in the ecosystem</p> <p>Biii Differentiate between the three types of consumers (herbivore, carnivore, omnivore)</p> <p>Biv 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</p> <p>Bv Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a</p>	

	<p>food chain from producers (plants) to consumers to decomposers</p> <p>Bvi Explain how energy is transferred through food chains and food webs in an ecosystem</p> <p>Bvii Explain how the amount of useable energy available to organisms decreases as it passes through a food chain and/or food web</p> <p>Bviii 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</p> <p>Bix Compare and contrast predator/prey, parasite/host and producer/consumer/decomposer relationships</p>	
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<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.3 Interdependence</b> 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.
<b>Benchmarks through grade 5</b>	A. Students will describe ways plants and animals depend on each other (e.g., shelter, nesting, food).

**THE LIVING ENVIRONMENT– 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**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
<p>Ai Observe how the living things in an environment change with the seasons (e.g., trees lose their leaves in the winter)</p> <p>Aii Act out or construct simple diagrams (pictures or words) that shows a simple food web</p>	<p>Ai Identify different environments (i.e., pond, forest, prairie) support the life of different types of plants and animals.</p> <p>Aii Investigate and describe how animals and plants that live in different places have similarities and differences</p> <p>Aiii 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).</p> <p>Aiv Describe how people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.</p> <p>Av Use information about a simple food web to determine how basic needs (e.g. shelter and water) are met by the habitat/environment</p>	<p>Ai 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)</p> <p>Aii Investigate and describe the roles of plants as producers and animals as consumers and how living things may depend on each other</p> <p>Aiii 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)</p> <p>Aiv Observe, record, and describe changes in the health or behavior of an organism as a result of changes in its environment</p> <p>Av Demonstrate in a food web that all animals’ food begins with the sun</p> <p>Avi Explain the way that plants and animals in a habitat depend on each other</p> <p>Avii Use information about organisms to design a habitat and explain how the habitat provides for the needs of the organisms that live there</p>

<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.3 Interdependence</b> 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.
<b>Benchmarks through grade 8</b>	A. Students will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem.

**THE LIVING ENVIRONMENT– 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**

Grade 6	Grade 7	Grade 8
	<p>Ai 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</p> <p>Aii Explain the factors that affect the number and types of organisms an ecosystem can support, including available resources, abiotic and biotic factors and disease</p> <p>Aiii 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</p> <p>Aiv 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</p> <p>Av Identify ways organisms interact with one another in various ways besides providing food</p> <p>Avi Identify populations within a community that are in competition with one another for resources</p>	

	<p>Avii Predict the possible effects of removing an organism from a food chain</p> <p>Aviii 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</p> <p>Aix Identify the sun as the major source of energy for life on earth and sequence the energy flow in an ecosystem</p> <p>Ax Describe the basic processes and recognize the substances involved in photosynthesis and respiration</p> <p>Axi Explain the transfer of the sun's energy through living systems and its effect upon them</p>	
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<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.4 Heredity and Reproduction</b> Students will understand the transmission of traits in living things.
<b>Benchmarks through grade 5</b>	A. 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).

**THE LIVING ENVIRONMENT– 4. HEREDITY AND REPRODUCTION: Students will understand the transmission of traits in living things**

<b>Kindergarten - Grade 1</b>	<b>Grade 2 - Grade 3</b>	<b>Grade 4 - Grade 5</b>
<p>Ai Describe the major stages that characterize the life cycle of the frog and butterfly as they go through meta-morphosis</p> <p>Aii Sequence the life cycle of a plant or animal when given a set of pictures</p> <p>Aiii Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death</p>		<p>Ai Compare the life cycles of different animals including birth to adulthood, reproduction and death (e.g., egg-tadpole-frog, egg-caterpillar-chrysalis-butterfly)</p> <p>Aii Compare the life cycles of different plants including germination, maturity, reproduction and death</p>

<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.4 Heredity and Reproduction</b> Students will understand the transmission of traits in living things.
<b>Benchmarks through grade 8</b>	A. 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).
	B. Students will use data to provide evidence that supports the concept that genetic information is passed on from both parents to offspring.



**THE LIVING ENVIRONMENT– 4. HEREDITY AND REPRODUCTION: Students will understand the transmission of traits in living things**

Grade 6	Grade 7	Grade 8
	<p>Ai Describe how plants and animals usually resemble their parents</p> <p>Aii Investigate and describe how particular plants have seeds that produce the same kind of plant</p>	<p>Ai 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</p> <p>Aii Explain reproduction as a fundamental process by which the new individual receives genetic information from parent(s)</p> <p>Aiii Describe forms of asexual reproduction that involve the genetic contribution of only one parent (e.g., binary fission, budding, vegetative propagation, regeneration)</p> <p>Aiv Describe sexual reproduction as a process that combines genetic material of two parents to produce a new organism (e.g., sperm/egg, pollen/ova)</p>
		<p>Bi Differentiate between inherited and acquired traits</p> <p>Bii Observe, record and compare differences in inherited traits (e.g. connected earlobe, tongue rolling)</p> <p>Biii 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</p> <p>Biv Identify that genetic material (i.e. chromosomes and genes) is located in the cell's nucleus</p>

<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.5 Evolution and Diversity</b> Students will describe and analyze diversity of species, natural selection, and adaptations.
<b>Benchmarks through grade 5</b>	A. 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).

**THE LIVING ENVIRONMENT– 5. EVOLUTION AND DIVERSITY: Students will describe and analyze diversity of species, natural selection, and adaptations.**

Kindergarten - Grade 1	Grade 2 - Grade 3	Grade 4 - Grade 5
		<p>Ai Identify the specific functions of the physical structures of a plant or an animal (e.g. roots for water; webbed feet for swimming)</p> <p>Aii Identifying and explain how the physical structure/characteristic of an organism allows it to survive and defend itself</p> <p>Aiii 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/conserves/ retain water)</p> <p>Aiv 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</p>

<b>Standard</b>	<b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.
<b>Strand Standard</b>	<b>LS.5 Evolution and Diversity</b> Students will describe and analyze diversity of species, natural selection, and adaptations.
<b>Benchmarks through grade 8</b>	A. 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.

**THE LIVING ENVIRONMENT– 5. EVOLUTION AND DIVERSITY: Students will describe and analyze diversity of species, natural selection, and adaptations.**

Grade 6	Grade 7	Grade 8
		<p>Ai Explain how a population’s or species’ traits affect their ability to survive over time</p> <p>Aii Describe possible causes for the extinction of an animal or plant</p> <p>Aiii Cite evidence that demonstrates evolutionary relationships among organisms (e.g., similarities in body structure, early development, traits)</p> <p>Aiv Explain how natural selection leads to evolution (e.g., survival of the fittest)</p> <p>Av Explain that some animal behaviors are instinctive (e.g., turtles burying their eggs), and others are learned (e.g., humans building fires for warmth)</p> <p>Avi 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</p> <p>Avii 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)</p> <p>Aviii 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</p>

<b>Strand Standard</b>	<b>SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
<b>Benchmarks through grade 5</b>	A. Students will use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.

**SCIENTIFIC ENQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.**

Kindergarten - Grade 3	Grade 4 - Grade 5
<p>Ai Generate questions and predictions using observations and exploration about the natural world</p>	<p>Ai Generate questions and predictions using observations and exploration about the natural world.</p>
<p>Aii Generate and follow simple plans using systematic observations to explore questions and predictions</p>	<p>Aii Generate and follow simple plans using systematic observations to explore questions and predictions</p>
<p>Aiii 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</p>	<p>Aiii 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</p>
<p>Aiv Use nonstandard measures to estimate and compare the sizes of objects. Represent information in bar graphs</p>	<p>Aiv Use measurement tools and standard units (e.g., centimeters, meters, grams, kilograms) to describe objects and materials</p>
<p>Av 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</p>	<p>Av 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</p>
<p>Avi Share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation</p>	<p>Avi Share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation</p>
<p>Avii Use appropriate safety procedures when conducting investigations</p>	<p>Avii Use appropriate safety procedures when conducting investigations</p>

**SCIENTIFIC ENQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.**

<b>Strand Standard</b>	<b>SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
<b>Benchmarks through grade 8</b>	A. Students will use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.



**SCIENTIFIC ENQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.**

Grade 6	Grade 7 - Grade 8
Ai Generate focused questions and informed predictions about the natural world	Ai Frame and refine questions that can be investigated scientifically, and generate testable hypotheses
Aii Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested	Aii Design and conduct investigations with controlled variables to test hypotheses
Aiii 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	Aiii Accurately collect data through the selection and use of tools and techniques appropriate to the investigation
Aiv Use mathematics, reading, writing, and technology when conducting scientific inquiries	Aiv 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
Av Construct a reasonable explanation by analyzing evidence from the data.	Av Construct logical scientific explanations and present arguments that defend proposed explanations through the use of closely examined evidence
Avi Revise the explanation after comparing results with other sources or after further investigation	Avi 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
Avii Communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument	
Aviii Use appropriate safety procedures when conducting investigations	Avii Use appropriate safety procedures when conducting investigations

<b>Strand Standard</b>	<b>HISTORY AND THE NATURE OF SCIENCE: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
<b>Benchmarks through grade 5</b>	A. Students will develop an understanding of science as a human endeavor

**HISTORY AND THE NATURE OF SCIENCE: Students will demonstrate an understanding of the nature of scientific inquiry.**

Kindergarten - Grade 3	Grade 4 - Grade 5
<p>Ai Explain why anyone can be a scientist</p> <p>Aii Identify ways (e.g., create things, ask questions, make observations, figure things out) that everybody can do science.</p> <p>Aiii Identify ways scientists work together to solve problems (e.g., share results, teamwork, investigate)</p> <p>Aiv Identify safety rules for school and home.</p> <p>Av Describe ways that humans influence their environment (e.g., littering, recycling, car pooling).</p>	<p>Ai 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).</p> <p>Aii Identify a variety of careers in the field of science</p> <p>Aiii Identify scientific advances that changed popular beliefs (e.g., Earth was center of universe, world was flat, man was incapable of flight)</p> <p>Aiv Identify ways in which science and technology have greatly improved human lives (e.g., food quality and quantity, transportation, health, sanitation, communication)</p> <p>Av Identify the benefits of recycling, reusing, and reducing.</p> <p>Avi Identify consequences of natural and human-induced environmental changes (e.g., erosion, tsunami, deforestation)</p>

<b>Strand Standard</b>	<b>HISTORY AND THE NATURE OF SCIENCE: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
<b>Benchmarks through grade 8</b>	A. Students will develop an understanding of science as a human endeavor

**HISTORY AND THE NATURE OF SCIENCE: Students will demonstrate an understanding of the nature of scientific inquiry.**

Grade 6	Grade 7 - Grade 8
<p>Ai Identify various settings in which scientists may work alone or in a team (e.g., industries, laboratories, field work)</p> <p>Aii Explain why results of similar scientific investigations may turn out differently (i.e., inconsistencies in methods, materials, and observations)</p> <p>Aiii Identify scientific advances that have resulted in new ideas and further advance.</p> <p>Aiv Explain how natural hazards affect populations, resources, and the environment (e.g., floods, storms, hurricanes, volcanoes, earthquakes)</p> <p>Av Explain how recycling and conservation affect populations, resources, and the environment</p> <p>Avi Explain ways humans benefit from Earth's resources (e.g., air, water, soil, food, fuel, building materials)</p>	<p>Ai Explain how science is influenced by human qualities (e.g., reasoning, insightfulness, creativity, life-long learning).</p> <p>Aii Explain how many people from various cultures have made important contributions to the advancement of science and technology.</p> <p>Aiii 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)</p> <p>Aiv Explain the interaction of science and technology with social issues (e.g., mining, natural disasters)</p> <p>Av Explain the impact of science on food technology (e.g., preservatives, packaging, genetically modified organisms)</p> <p>Avi Explain how overpopulation affects organisms, resources, and environments (e.g., depletion of food resources, habitat availability, increased loss due to disease, parasites and predators)</p>

**BIOLOGY 1/2  
GRADE 9 – GRADE 10**

<b>Standard</b>	<p><b>ESS: Earth and Space Science</b> 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.</p>
<b>Strand Standard</b>	<p><b>ESS.2 History of the Earth</b> Students will understand scientific theories of how the earth's surface is formed and how those theories developed.</p>
Benchmarks through grade 10	A. Students will explain the methods of determining geologic time
	D. Students will explain how the evolution of life caused dramatic changes in the composition of the Earth's atmosphere.

<b>Strand Standard</b>	<p><b>ESS.7 Biogeochemical Cycles</b> Students will understand that Earth systems have a variety of cycles through which energy and matter continually flow.</p>
Benchmarks through grade 10	A. Students will understand that Earth is a system containing essentially fixed amounts of each stable chemical.
	B. Students will explain the physical and chemical changes that occur as elements and compounds flow through the Earth system.

<b>Standard</b>	<p><b>LS: The Living Environment</b> Students will understand the basic concepts and principles of life science.</p>
<b>Strand Standard</b>	<p><b>LS.1 Organization and Development</b> Students will understand that all life forms, at all levels of organization, use specialized structures and similar processes to meet life's needs.</p>
Benchmarks through grade 10	A. Students will be able to describe the four main groups of organic molecules and outline their role in the cellular processes of life.
	C. Students will be able to relate the importance of cell division and differentiation to development and organization in organisms.

<b>Strand Standard</b>	<b>LS.2 Matter and Energy Transformations</b> Students will understand how living things obtain and use energy;
Benchmarks through grade 10	A. 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.
	B. Students will explain that as energy and matter flow through ecosystems, energy is lost and matter is conserved
<b>Strand Standard</b>	<b>LS.4 Heredity and Reproduction</b> Students will understand the transmission of traits in living things.
Benchmarks through grade 10	A. Students will demonstrate an understanding of the basic relationships between genes, DNA, proteins, cells and organisms.
	A. 2. Students will be able to describe gamete production and explain its importance to diversity in populations.
	B. Students will be able to predict the traits of offspring of individuals in a population.
	B. 2. Students will be able to describe new technologies that have been developed in the field of biotechnology and their applications.
<b>Strand Standard</b>	<b>LS.5 Evolution and Diversity</b> Students will describe and analyze diversity of species, natural selection, and adaptations.
Benchmarks through grade 10	A. Students will be able to explain in writing the relationships between populations, species, their environment, natural selection and evolution.
<b>Strand Standard</b>	<b>SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
Benchmarks through grade 10	B. Students will design and conduct scientific investigation to explore new phenomena, verify previous results, test how well a theory predicts and compare opposing theories.

**BIOLOGY 1 & 2**  
**Grade 9 - Grade 10**

**EARTH AND SPACE SCIENCES– 2. HISTORY OF THE EARTH: Students will understand scientific theories of how the earth’s surface is formed and how those theories developed.**

- Ai Explain the occurrence of radioactive elements
  - Aii Explain how carbon dating tells us the age of organic materials
  - Aiii Give examples of radioactive isotopes in rocks and their use in dating
- 
- Di Describe the characteristics of Earth’s early atmosphere
  - Dii Give evidence of one-celled forms of life
  - Diii Describe changes in Earth’s atmospheric composition over time

**EARTH AND SPACE SCIENCES – 7. BIOGEOCHEMICAL CYCLES: Students will understand that Earth systems have a variety of cycles through which energy and matter continually flow.**

- Ai Explain that different chemical forms exist in Earth’s systems
  - Aii Describe the movement of elements within the Earth system
  - Aiii Justify that the Earth system has essentially fixed amounts of each stable chemical
- 
- Bi Explain how energy sources move matter through Earth’s system
  - Bii Describe the cycles of materials through the Earth’s system. i.e. carbon cycle
  - Biii Distinguish between physical and chemical changes within cycles



**BIOLOGY 1 & 2**  
**Grade 9 - Grade 10**

***LIFE SCIENCES – 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.***

- Ai Describe how the elements most common in organisms (carbon, hydrogen, oxygen, nitrogen and sulfur) interact to form complex molecules
- Aii Explain that many organic molecules are continuously constructed and deconstructed in cells
- Aiii Describe the general structure and function of the major groups of organic molecules: carbohydrates, lipids, proteins and nucleic acids
- Aiv 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
- Av Relate the concept that DNA molecules in cells serve as instructions to the cell for making proteins

- Ci Compare the daughter cells of cell division to the parent cells to include chromosome number
- Cii Diagram chromosome movement during the process of mitosis
- Ciii State that different types of cells are different from one another in multi-cellular organisms due to expression of different genes during development
- Civ Describe ways in which cellular processes are regulated by internal and external signals

***LIFE SCIENCES – 2.MATTER AND ENERGY TRANSFORMATIONS: Students will understand how living things obtain and use energy.***

- Ai Describe photosynthesis as the process of converting water and carbon dioxide into high-energy sugar molecules using energy from the sun
- Aii Display an understanding that plants, many protists and many bacteria are producers and carry out photosynthesis
- Aiii Describe aerobic cellular respiration as the process of releasing energy from organic molecules in the presence of oxygen to power cellular processes

**BIOLOGY 1 & 2**  
**Grade 9 - Grade 10**

Aiv Distinguish between those organisms that carry out aerobic and anaerobic respiration as their primary means of obtaining energy

Av Compare and contrast how photosynthesis and aerobic cellular respiration move carbon through the biosphere

Bi Demonstrate an understanding of several different ways that the products of photosynthesis are used in organisms

Bii Compare and contrast the ways in which energy and matter are transformed as they move through trophic levels in food webs

Biii Compare and contrast the ways in which energy and matter are conserved and/or lost as they move through trophic levels in food webs

**BIOLOGY 1 & 2**  
**Grade 9 - Grade 10**

**LIFE SCIENCES – 4.HEREDITY AND REPRODUCTION: Students will understand the transmission of traits in living things.**

Ai Distinguish between genes, chromosomes, and DNA

Aii State that genes code for the synthesis of polypeptides

Aiii Explain that a gene may affect one or many traits, depending on the role of the protein that it codes for

Aiv Explain why each cell in a multicellular organism contains thousands of genes

Av Explain why all cells in multicellular organisms contain the same DNA (except for gametes)

A2i Compare and contrast haploid and diploid cells

A2ii Illustrate and annotate the production of gametes through meiosis

A2iii Explain the ways in which sexual reproduction causes variation in populations

Bi Define and describe the human genome

Bii Define the term allele

Biii Explain why organisms have 2 genes for each trait

Biv Describe a human karyotype to include chromosome number and homologous pairs of chromosomes

Bv Predict alleles and traits of the offspring of 2 parents using a Punnet square

**BIOLOGY 1 & 2**  
**Grade 9 - Grade 10**

B2i Outline the production of a transgenic organism.

B2ii Describe how genetically modified organisms (GMOs) are produced and describe potential benefits and harms of the creation and use of GMOs.

B2iii Display an understanding of what gene therapy is and the challenges and potential benefits of this technology.

B2iv Describe the applications of sequencing genes or genomes of humans and other organisms.

**BIOLOGY 1 & 2**  
**Grade 9 - Grade 10**

***LIFE SCIENCES – 5.EVOLUTION AND DIVERSITY: Students will describe and analyze diversity of species, natural selection, and adaptations.***

- Ai Distinguish between organisms, species and populations
- Aii Define evolution as a change in the gene pool of a population over time
- Aiii Explain how natural selection causes changes in populations over time and can lead to the formation of new species
- Aiv Interpret, evaluate and summarize data about changes in a population over time
- Av GIVE examples showing why populations that are diverse are more able to survive changes in their environment

***SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.***

- Ai Use appropriate tools and technology to collect precise and accurate data
- Aii Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias
- Aiii Compare experimental evidence and conclusions with those drawn by others about the same testable question
- Aiv Communicate and defend scientific findings
- Av Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

**CHEMISTRY 1/2  
GRADE 9 – GRADE 10**

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.1 Properties of Matter</b> Students will develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior.
Benchmarks through grade 10	A. Students will be able to connect the arrangement of, and the strength of interactive forces between, atoms or molecules to the physical properties of solids, liquids, and gases.
	B. Students will understand the commonality and patterns of physical and chemical properties through the arrangement of atomic number within the Periodic Table.
	G. 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.
	H. Students will be able to use quantitative relationships to describe and analyze the outcomes of chemical reactions.

<b>Strand Standard</b>	<b>PS.2 Changes in Matter</b> Students will develop an understanding that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.
Benchmarks through grade 10	A. Students will understand how an atom's electronic configuration, particularly its outermost electrons determine how the atom interacts with other atoms.
	B. Students will know that changes in state require a transfer of energy.
	C. Students will understand that reactions are a result of interactions between atoms, molecules or ions.

<b>Strand Standard</b>	<b>PS.3 Forms of Energy</b> Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.
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Benchmarks through grade 10	A. Students will understand that the atoms and molecules that compose matter are in constant motion (translational, rotational, and/or vibrational).
<b>Strand Standard</b>	<b>PS.4 Energy Transfer and Conservation</b> Students will develop an understanding of the transfer, transformation, and conservation of energy.
Benchmarks through grade 10	A. Students will know that heating a material increases the rotational, translational, and vibrational energies of its atoms/molecules.
	B. Students will know that some processes can only be understood from a particulate nature of energy transfer.
<b>Strand Standard</b>	<b>SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
Benchmarks through grade 10	A. Students will design and conduct scientific investigation to explore new phenomena, verify previous results, test how well a theory predicts and compare opposing theories.

**CHEMISTRY 1 & 2**  
**Grade 9 - Grade 10**

**PHYSICAL SCIENCE– 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.**

Ai Explain how we know that atoms exist?

Aii Relate the kinetic-molecular theory to the properties of an ideal gas

Aiii Relate verbally, mathematically, or graphically the behavior of the parameters that describe the physical behavior of gases

Aiv List the conditions under which gases deviate from ideal behavior

Av Interpret a phase diagram

Bi Describe the evidence for the existence of electrons and protons and their presence in atoms

Bii Relate the properties of the main-group elements to their electron arrangements

Biii Explain why metals are good conductors of electricity and heat

Biv Relate trends in the periodic table to the atomic structures of elements

Gi Describe the composition of atom

Gii Describe the results of Thomson, Rutherford, and Bohr models of the atom

Giii Explain the differences between electrical and nuclear forces

Giv Describe how the strong nuclear force acts among nucleons

Gv Explain what as nuclei get heavier many become radioactive



**CHEMISTRY 1 & 2**  
**Grade 9 - Grade 10**

Hi Convert between moles and number of particles

Hii Convert between moles and mass of elements and formulas

Hiii Calculate the molar mass of a compound

Hiv Determine the empirical and molecular formulas for a compound from mass percent and actual mass data

Hv Calculate mass of product(s) formed when given masses of moles of reactants

**CHEMISTRY 1 & 2**  
**Grade 9 - Grade 10**

**PHYSICAL SCIENCE –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.**

Ai Explain interactions between atoms that hold them together in molecules or between oppositely charged ions are called chemical bonds

Aii Explain how the configuration of atoms determine the molecular combinations

Bi List evidence that suggest a chemical reaction might have occurred and evidence that proves a chemical reaction has occurred

Bii Describe the rearrangements of atoms involved chemical reactions

Biii Explain how non-spontaneous reactions can occur

Biv Distinguish between exothermic and endothermic reactions

Ci Describe the transfer of electrons (oxidation/reduction)

Cii Describe the transfer of hydrogen ions in acid/base reactions

Ciii Describe how bonds are created by sharing electrons

Civ Explain the origins of synthetic polymers, oils, and the large molecules essential to life

**CHEMISTRY 1 & 2**  
**Grade 9 - Grade 10**

**PHYSICAL SCIENCE – 3. FORMS OF ENERGY:** Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.

- Ai Describe the kinetic energy of a particle
- Aii Relate translational motion to average kinetic energy
- Aiii Demonstrate how energy can be transferred from one object to another during collisions
- Aiv Explain why molecule shape determines if rotational motion is significant

**PHYSICAL SCIENCE – 4. ENERGY TRANSFER AND CONSERVATION:** Students will develop an understanding of the transfer, transformation, and conservation of energy.

- Ai Explain how translational energy is related to temperature
- Aii Describe how crystalline structure breaking down results in solids melting when the vibrational energy becomes great enough
- Aiii Relate the specific heat of a substance to the distribution of its particulate energies between translational, rotational, and vibrational
- Bi Describe the how the photoelectric effect supports the particle nature of light
- Bii Justify why radiation from cell phone generated EM waves is harmless because the energy packet is too low to change chemical bonds

**CHEMISTRY 1 & 2**  
**Grade 9 - Grade 10**

**SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.**

- Ai Use appropriate tools and technology to collect precise and accurate data
- Aii Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias
- Aiii Compare experimental evidence and conclusions with those drawn by others about the same testable question
- Aiv Communicate and defend scientific findings
- Av Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

**PHYSICS 1/2  
GRADE 9 – GRADE 10**

<b>Standard</b>	<b>PS: Physical Science</b> Students will develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
<b>Strand Standard</b>	<b>PS.3 Forms of Energy</b> Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.
Benchmarks through grade 10	<p>D. 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.</p> <p>E. Students will explain that fission and fusion are reactions involving changes in the nuclei of atoms.</p>

<b>Strand Standard</b>	<b>PS.4 Energy Transfer and Conservation</b> Students will develop an understanding of the transfer, transformation, and conservation of energy.
Benchmarks through grade 10	D. By the end of Grade 10, students will understand that total mechanical energy of a closed system stays constant.

<b>Strand Standard</b>	<b>PS.5 Motion at the Macroscopic Level</b> Students will understand how to describe the motion of an object.
Benchmarks through grade 10	A. Students will know that velocity and acceleration are quantitative descriptions of the motion of objects.

<b>Strand Standard</b>	<b>PS.6 Forces Affecting Motion</b> Students will understand that the motion of an object is affected by external forces on it.
Benchmarks	A. Students will know that the motion of an object changes only when a net force is applied to that object.

through grade 10	B. Students will know that there are key quantities of motion that are constant during the interactions between objects.
	C. Students will know the relationship between the net force on an object, its mass, and the resulting acceleration.
	D. Students will understand the universality of gravitational attraction.
	E. Students will understand that electric force is a universal force between any two electrically charged objects.

<b>Strand Standard</b>	<b>ESS.1 Objects In The Universe</b> Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.
Benchmarks through grade 10	A. Students will know the origin of the universe and describe its evolution.

<b>Strand Standard</b>	<b>ESS.2 History of the Earth</b> Students will understand scientific theories of how the earth's surface is formed and how those theories developed.
Benchmarks through grade 10	B. Students will understand the sporadic and gradual events that have changed the structure of the earth.
	C. 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

<b>Standard</b>	<b>ESS Earth and Space Sciences</b> 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.
<b>Strand Standard</b>	<b>ESS.4 Tectonics</b> Students will gain an understanding of gravity, density, and convection which moves Earth's plates causing the plates to impact other Earth systems

Benchmarks through grade 10	A. Students will understand how data supports the theory of plate tectonics.
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<b>Strand Standard</b>	<b>SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
Benchmarks through grade 10	A. Students will design and conduct scientific investigation to explore new phenomena, verify previous results, test how well a theory predicts and compare opposing theories.

<b>Strand Standard</b>	<b>HISTORY AND THE NATURE OF SCIENCE: Students will demonstrate an understanding of the nature of scientific inquiry.</b>
Benchmarks through grade 10	B. Students will understand the distinction between science and engineering/technology and will develop an understanding of the societal role in the development on new technologies

**PHYSICS 1 & 2**  
**Grade 9 - Grade 10**

**PHYSICAL SCIENCE – 3. FORMS OF ENERGY: Students will develop an understanding of the characteristics of energy and the interactions between matter and energy.**

- Di Explain that moving electric charges produce magnetic fields
- Dii Describe how changing magnetic fields can produce electric fields
- Diii Explain why the energy in electromagnetic waves is proportional to the frequency of the wave
- Div Describe how changes on the electromagnetic spectrum going from high-energy gamma rays to low energy radio/television waves
- Dv Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

- Ei Describe the composition of the nucleus
- Eii Describe the nuclear processes in the Sun
- Eiii Explain why nuclei become more unstable when neutrons are added
- Eiv Explain why nuclear processes are unaffected by normal variations in temperature and pressure
- Ev Describe the relationship between mass and energy in nuclear reactions

**PHYSICAL SCIENCE – 4. ENERGY TRANSFER AND CONSERVATION: Students will develop an understanding of the transfer, transformation, and conservation of energy.**

- Di Describe potential energy
- Dii Relate changes in potential energy with distance above the Earth's surface
- Diii Describe the energy of motion, kinetic energy
- Div Relate changes in the kinetic energy of a closed system with the potential energy of the system



**PHYSICS 1 & 2**  
**Grade 9 - Grade 10**

**PHYSICAL SCIENCE – 5. MOTION AT THE MACROSCOPIC LEVEL: Students will understand how to describe the motion of an object.**

- Ai Distinguish between average speed and instantaneous speeds
- Aii Identify linear velocity and acceleration from table of data
- Aiii Deduce acceleration from a velocity versus time graph
- Aiv Demonstrate how acceleration can occur when an object changes direction but not speed

**PHYSICAL SCIENCE – 6. FORCES AFFECTING MOTION: Students will understand that the motion of an object is affected by external forces on it.**

- Ai Describe a force as a vector
- Aii Describe how unbalanced or net forces can change the motion of an object
- Aiii Predict the forces on an object from observing its motion
- Bi Describe how the force of one object on another is “mirrored” by a force on the first object
- Bii Describe momentum as a vector
- Biii Explain the conservation of momentum within a closed system
- Biv Show how the conservation of momentum allows one to know the velocities of interacting particles
- Ci Subtract two velocity vectors to get a change in velocity
- Cii Calculate the average acceleration of an object given the appropriate data
- Ciii Deduce the acceleration of an object knowing the forces on the object and its mass

**PHYSICS 1 & 2**  
**Grade 9 - Grade 10**

- Di Explain that the weight of an object is due to the attraction to the Earth
- Dii Demonstrate the connection between law of gravitational attraction and potential energy
- Diii Show that all objects fall at the same rate near the Earth's surface
- Div Explain how an apple falling on Earth is similar to the Moon orbiting Earth
- Dv Show how gravitational attraction explains the motion of planets around the Sun

- Ei Understand the inverse-square law
- Eii Use Coulomb's law to compare electrical forces on an object at different distances from another charged object
- Eiii Compare the relative strengths of gravitational forces versus electrical forces

**EARTH & SPACE SCIENCES– 1. OBJECTS IN THE UNIVERSE: Students shall demonstrate and apply knowledge of objects in the universe using the appropriate equipment and technology.**

- Ai Explain how hydrogen nuclei fuse to form Helium
- Aii Show how nuclear reactions can produce new nuclei
- Aiii Describe the formation of heavier elements via nuclear processes
- Aiv Cite evidence for the Big Bang
- Av Describe the birth-death process for stars

**PHYSICS 1 & 2**  
**Grade 9 - Grade 10**

***EARTH & SPACE SCIENCES – 2. HISTORY OF THE EARTH: Students will understand scientific theories of how the earth’s surface is formed and how those theories developed.***

Bi Describe how earthquakes and volcanoes can change the Earth’s surface features

Bii Identify the events that lead to mountain building

Ci Describe the mechanism for planet formation

Cii Explain how meteorites add to our Earth-dating abilities

***EARTH & SPACE SCIENCES – 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.***

Ai Identify mid-ocean ridges from maps

Aii Describe Earth’s magnetic characteristics

Aiii Use magnetic mapping data to support the theory of plate tectonics

***SCIENTIFIC INQUIRY AND CRITICAL THINKING SKILLS: Students will demonstrate an understanding of the nature of scientific inquiry.***

Ai Use appropriate tools and technology to collect precise and accurate data

Aii Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias

Aiii Compare experimental evidence and conclusions with those drawn by others about the same testable question

Aiv Communicate and defend scientific findings

Av Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

**PHYSICS 1 & 2**  
**Grade 9 - Grade 10**

***HISTORY AND THE NATURE OF SCIENCE: Students will demonstrate an understanding of the nature of scientific inquiry.***

- Ai Recognize that technological advances generally are in response to practical problems
- Aii Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.
- Aiii Understand design in technology generally requires taking into account social and ethical constraints in addition to scientific ones
- Aiv Understand that technology usually affects society more directly than science does because technology solves practical problems

**Reference:**

AERO Science K-8 and High School Standards, Document Version 8-2011