Kenilworth Public Schools
Curriculum Guide

Content Area	Biology
Grade	Tenth
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Biology- Grade 10 Scope and Sequence Part I

Unit 1- The Process of Science	Unit 2- Basic Chemistry	Unit 3- Biochemistry	Unit 4- Cell Structures and Functions	Unit 5- Cellular Transports and Homeostasis	Unit 6- Cellular Communications
Week 1	Weeks 2-4	Weeks 5-8	Weeks 9-11	Weeks 12-14	Weeks 15-16
Unit Description: The scientific method involves making observations, asking questions, forming hypothesis, designing experiments, analyzing data, and drawing conclusions. Trying to answer questions about observations helps scientists form hypotheses. A controlled experiment has a control and experimental group, and tests independent and dependent variables. Scientists analyze data to draw conclusions about the experiment performed. A theory is a set of related hypotheses confirmed to be true many times. Communication between scientists about their methods and results helps prevent dishonesty and bias in science. Scientists use the metric system to take scientific measurements. Lab safety is a good laboratory	*Unit Description:* Matter is anything that occupies space and has mass. Elements are made of a single kind of atom and cannot be broken down by chemical means into simpler substances. Atoms are composed of protons, neutrons, and electrons. Protons and neutrons make up the nucleus of the atom. Electrons move about the nucleus in orbitals. Compounds consist of atoms of two or more elements that are joined by chemical bonds in a fixed proportion. Most elements react to form chemical bonds so that their atoms become stable. An atom achieves stability when the orbitals that correspond to its highest energy level are filled with the maximum number of electrons. A covalent bond is formed when two atoms share	*Unit Description:* Organic compounds contain carbon atoms and are found in living things. Most inorganic compounds do not contain carbon atoms. Carbon atoms can readily form four covalent bonds with other atoms including other carbon atoms. The carbon bonds allow the carbon atoms to form a wide variety of simple and complex organic compounds. Functional groups are groups of atoms that influence the properties of molecules and the chemical reactions in which the molecules participate. Condensation reactions join monomers (small simple molecules) to form polymers. A condensation reaction releases water as a by-product. In a hydrolysis reaction, water is used to split polymers into monomers. Adenosine	*Unit Description:* All living things are made up of one or more cells. Robert Hooke discovered cells. Anton van Leeuwenhoek was the first to observe living cells. The cell theory states all living organisms are made of one or more cells, cells are the basic units of structure and function, and cells come only from pre-existing cells. All living things are made of organized parts, obtain energy from their surroundings, perform chemical reactions, change with time, respond to their environment, and reproduce. A cell's shape reflects its function. Cell size is limited by a cell's surface area–to-volume ratio. The three basic parts of a cell are the plasma membrane, the cytoplasm, and the nucleus. Prokaryotes are organisms that lack a nucleus or	*Unit Description:* Passive transport involves the movement of molecules across the cell membrane without an input of energy by the cell. Diffusion is the movement of molecules from an area of higher concentration to an area of lower concentration, driven by the molecules' kinetic energy until equilibrium is reached. Molecules can diffuse across a cell membrane by dissolving in the phospholipid bilayer or by passing through pores in the membrane. Osmosis is the diffusion of water across a membrane. The net direction of osmosis is determined by the relative solute concentrations on the two sides of the membrane. When the solute concentration outside the cell is lower than that in the cytosol, the solution outside is	*Unit Description:* Cells signal one another with chemicals. Receptor proteins are located on or within the cell and have three-dimensional shapes that fit the shape of specific signal molecules. Binding of the signal molecule with the receptor protein induces a change in the protein's shape and produces a cellular response. Immunochemistry and molecular genetics are being used to locate and characteristize receptor proteins. Types of cell signaling – cells can communicate through any of four basic mechanisms: direct contact, paracrine signaling, endocrine signaling, or synaptic signaling. Proteins in

practice.	electrons. An ionic bond is formed when one atom gives up an electron to another. The positive ion is then attracted to a negative ion to form the ionic bond. Addition of energy to a substance can cause its state to change from a solid to a liquid and from a liquid to a gas. Reactants are substances that enter chemical reactions. Products are substances produced by chemical reactions. Enzymes lower the amount of activation energy necessary for a reaction to begin in living systems. A chemical reaction in which electrons are exchanged between atoms is called an oxidation-reduction reaction. The two hydrogen atoms and one oxygen atom that make up a water molecule are arranged at an angle to one another. Water is a polar molecule. The electrons in the molecule are shared unevenly between hydrogen and oxygen. This polarity makes water effective at dissolving other polar substances. Hydrogen bonding accounts for most	triphosphate (ATP) stores and releases energy during cell processes enabling organisms to function. There are four main classes of organic compounds: carbohydrates, proteins, lipids, and nucleic acids. Carbohydrates are made up of monomers called monosaccharides. Two monosaccharides join to form a double sugar called a disaccharide. A complex sugar, or polysaccharide, is made of three or more monosaccharides. Carbohydrates such as glucose are a source of energy and are used as structural materials in organisms. Proteins have many functions including structural, defensive, and catalytic. Proteins are made up of monomers called amino acids. The sequence of amino acids determines a protein's shape and function. A long chain of amino acids is called a polypeptide, which is made up of amino acids joined by peptide bonds. Enzymes speed up chemical reactions and bind to specific substrates. The	membrane-bound organelles. In multicellular eukaryotes, cells organize into tissues, organs, organ systems, and finally organisms. Cell membranes are made of two phospholipid layers and proteins. The nucleus directs the cell's activities and stores DNA. Mitochondria harvest energy from organic compounds and transfer it to ATP. Ribosomes are either free or attached to the rough ER and play a role in protein synthesis. The rough ER prepares proteins for export or insertion into the cell membrane. The smooth ER builds lipids and participates in detoxification of toxins. The Golgi processes and packages proteins. Vesicles are classified by their contents. The cytoskeleton is made of protein fibers that help cells move and maintain their shape. Plant cells have cell walls, central vacuoles, and plastids. In plant cells, a rigid cell wall covers the cell membrane and provides support and protection. Large central vacuoles	hypotonic to the cytosol, and water will diffuse into the cell. When the solute concentration outside the cell is higher than that in the cytosol, the solution outside is hypertonic to the cytosol, and water will diffuse out of the cell. When the solute concentrations outside and inside the cell are equal, the solution outside is isotonic, and there will be no net movement of water. To remain alive, cells must compensate for the water that enters the cell in hypotonic environments and leaves the cell in hypertonic environments. In facilitated diffusion, a molecule binds to a carrier protein on one side of the cell membrane. The carrier protein then changes its shape and transports the molecule down its concentration gradient to the other side of the membrane. Ion channels are proteins, or groups of proteins, that provide small passageways across the cell membrane through which specific ions can diffuse. Active transport moves molecules across	the cell and on its surface receive signals from other cells. All cell-signaling pathways share certain common elements, including a chemical signal that passes from one cell to another and a receptor that receives the signal in or on the target cell. Intracellular receptors may trigger a variety of responses in the cell, dependent on the receptor. Cell surface receptors convert the extracellular signal to an intercellular one, responding to the binding of the signal molecule to the cell's outside by producing a change inside the cell. Many cell surface receptors either act as enzymes or are directly linked to enzymes. G-protein-linked receptors activate an intermediary protein, which then effects the intercellular change. Second messengers, such as cAMP and calcium ions, relay messages

	of the unique properties of water. The unique properties of water include the ability to dissolve many substances, cohesion and adhesion, the ability to absorb a relatively large amount of energy as heat, the ability to cool surfaces through evaporation, and the low density of ice. A solution consists of a solute dissolved in a solvent. Water ionizes into hydronium ions and hydroxide ions. Acidic solutions contain more hydronium ions than hydroxide ions. Basic solutions contain more hydroxide ions than hydronium ions. Buffers are chemicals that neutralize the effects of adding small amounts of either an acid or a base to a solution.	binding of a substrate with an enzyme causes a change in the enzyme's shape and reduces the activation energy of the reaction. Lipids are nonpolar molecules that store energy and are an important part of cell membranes. Most lipids contain fatty acids, molecules that have a hydrophilic end and a hydrophobic end. There are three kinds of lipids: triglycerides consist of three fatty acids and one molecule of glycerol. Phospholipids, which make up cell membranes, consist of two fatty acids and one glycerol molecule. A wax is made of one long fatty acid chain joined to one long alcohol. The nucleic acid, deoxyribonucleic acid (DNA), contains all the genetic information for cell activities. Ribonucleic acid (RNA) molecules play many key roles in building of proteins and can act as enzymes.	store water, enzymes, and waste products and provide support for plant tissue. Plastids store starch and pigments. The chloroplast converts light energy into chemical energy by photosynthesis. Prokaryotes, animal cells, and plant cells can be distinguished from each other by their unique features.	the cell membrane from an area of lower concentration to an area of higher concentration. Unlike passive transport, active transport requires cells to expend energy. Some types of active transport are performed by carrier proteins called cell membrane pumps. One example of a cell membrane pump is the sodium potassium pump. It moves three Na^+ ions into the cell's external environment for every two K^+ ions it moves into the cytosol. ATP supplies the energy that drives the pump. Endocytosis and exocytosis are active transport mechanisms in which large substances enter or leave cells inside vesicles. In endocytosis, the cell membrane folds around something in the external environment and forms a pouch. The pouch then pinches off and becomes a vesicle in the cytoplasm. Endocytosis includes pinocytosis, in which the vesicle contains solutes or fluids, and phagocytosis, in which the vesicle contains large particles or cells. In exocytosis, vesicles made	from receptors to target proteins. Some surface receptors generate large intracellular responses because each stage of the pathway amplifies the next, causing a cascading effect. As an organism develops, its cells acquire their specific identies by controlling gene expression, turning on the specific set of genes that encode the particular functions of each cell type. Every cell contains surface marker proteins that uniquely identify each cell type. Cells attach to one another using cell junctions. Tight junctions connect to the plasma membranes of adjacent cells in a sheet. Anchoring junctions mechanically attach to the cytoskeleton of a cell to the cytoskeletons of other cells or to the extracellular matrix. Communication junctions allow communication with adjacent cells through

				by the cell fuse with the cell membrane, releasing their contents into the external environment.	direct connections.
Unit Targets: • Outline the main steps in the scientific method. • Summarize how observations are used to form hypotheses. • List elements of a controlled experiment. • Describe how scientists use data to draw conclusions. • Compare a scientific hypothesis and a scientific theory. • State how communication in science helps prevent dishonesty and bias. • Describe the importance of having the SI system of measurement. • State some examples of good laboratory practice.	*Unit Targets:* • Define the term mater. • Explain the relationship between elements and atoms. • Draw and label a model of the structure of an atom; Use atomic models to predict the behaviors of atoms in interactions. • Explain how compounds affect an atom's stability; explain how the properties of isotopes, including half-lives, decay modes, and nuclear resonances, lead to useful applications of isotopes. • Contrast covalent and ionic bonds; Model how the outermost electrons determine the reactivity of elements and the nature of the chemical bonds they tend to form. • Describe the physical properties of each state of matter; Account for the differences in the physical properties of solids, liquids, and gases. • Describe the role of reactants and products in chemical reactions. • Explain the relationship between enzymes and activation energy;	*Unit Targets:* • Model the four major categories of organic molecules (carbohydrates, fats, proteins, and nucleic acids). • Represent and explain the relationship between the structure and function of each class of complex molecules using a variety of models. • Identify the six elements most common to biological organisms: Carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur. • Recognize DNA as a molecule having different components (sugars, nitrogen bases, and phosphate groups). • Explain how the arrangement of the nitrogen bases within the DNA double helix forms a chemical code. • Chemistry of Life. • Food and Nutrition. • Use mathematical formulas to justify the concept of an efficient diet. • Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions	*Unit Targets:* • Predict a cell's response in a given set of environmental conditions. • Describe how a disease is the result of a malfunctioning system, organ, and cell, and relate this to possible treatment interventions (e.g., diabetes, cystic fibrosis, lactose intolerance). • Summarize the research that led to the development of the cell theory. • State the three principles of the cell theory. • Explain why the cell is considered to be the basic unit of life. • Explain the relationship between cell shape and cell function. • Identify the factor	*Unit Targets:* • Explain how equilibrium is established as a result of diffusion. • Explain how substances cross the cell membrane through facilitated diffusion. • Explain how ion channels assist the diffusion of ions across the cell membrane. • Distinguish between passive transport and active transport. • Explain how the sodium-potassium pump operates. • Compare endocytosis and exocytosis.	*Unit Targets:* • Identify the types of cell signaling • Discuss how receptor proteins embedded in the plasma membrane change shape when they bind specific signal molecules. • Compare and contrast intracellular and cell surface receptors in terms of their functions. • Describe the transfer of information through an intracellular signal pathway. • Discuss the role of secondary messengers in an intracellular signal pathway. • Explain how cell surface proteins play a role in the expression of a cell's identity. • List and define the functions of the types of intercellular

	demonstrate the properties and functions of enzymes by designing and carrying out an experiment. Model the change in rate of a reaction by changing a factor. • Explain how oxidation and reduction reactions are linked; Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions impact the environment, such as corrosion and the burning of fuel. • Describe the structure of a water molecule. • Explain how water's polar nature affects its ability to dissolve substances. • Outline the relationship between hydrogen bonding and the different properties of water. • Identify the roles of solutes and solvents in solutions. • Differentiate between acids and bases; relate the pH scale to the concentrations of various acids and bases. • Balance chemical equations by applying the law of conservation of mass. • Describe the potential commercial applications of exothermic and endothermic reactions.	that have an impact on the environment, such as corrosion and the burning of fuel. • Demonstrate the properties and functions of enzymes by designing and carrying out an experiment. • Balance chemical equations by applying the law of conservation of mass. • Describe the potential commercial applications of exothermic and endothermic reactions. • Model the change in rate of a reaction by changing a factor. • Describe how a disease is the result of a malfunctioning system, organ, and cell; and relate this to possible treatment interventions (e.g., diabetes, cystic fibrosis, lactose intolerance).	that limits cell size. • Compare prokaryotic cells and eukaryotic cells. • Analyze the relationship among cells, tissues, organs, organ systems, and organisms. • Describe the structure and function of a cell's plasma membrane. • Summarize the role of the nucleus. • Identify the characteristics of mitochondria. • Describe the structure and function of the cytoskeleton. • Describe the roles of plastids in the life of a plant. • Identify features that distinguish prokaryotes, eukaryotes, plant cells, and animal cells.		adhesion categories.

Biology- Grade 10 Scope and Sequence Part II

Unit 7- Cellular Metabolism	Unit 8- Cellular Reproduction	Unit 9- DNA Protein and Synthesis	Unit 10- Gene Expression	Unit 11- Mendelian Genetics	Unit 12- Inheritance Patterns
Weeks 17-18	Week 19	Weeks 20-22	Week 23	Week 24	Weeks 25-26
Unit Description: Photosynthesis converts light energy into chemical energy through series of reactions known as biochemical pathways. Almost all life depends on photosynthesis. Autotrophs use photosynthesis to make organic compounds from carbon dioxide and water. Heterotrophs cannot make their own organic compounds from inorganic compounds and therefore depend on autotrophs. White light from the sun is composed of an array of colors called the visible spectrum. Pigments absorb certain colors of light and reflect or transmit the other colors. The light reactions of photosynthesis begin with the absorption of light by chlorophyll a and accessory pigments in the thylakoids. Excited electrons that leave chlorophyll a travel along two electron transport chains, resulting in the production of NADPH. The electrons are replaced when water is split into electrons, protons, and oxygen in the thylakoid. Oxygen is released as a	*Unit Description:* Chromosomes are tightly coiled DNA molecules. In eukaryotes, proteins called histones help maintain the compact structure of chromosomes. Chromosomes in prokaryotes are simpler than chromosomes in eukaryotes. Each species has a characteristic number of chromosomes in each cell. Sex chromosomes are chromosomes that determine the sex of an organism. All of the other chromosomes in an organism are autosomes. Cells having two sets of chromosomes are diploid (2n). Haploid cells (1n) have half the numbCell division is the process by which	*Unit Description:* Griffith's experiments showed that hereditary material can pass from one bacterial cell to another. This is called transformation. Avery's work showed that DNA is the hereditary material that transfers information between bacterial cells. Hershey and Chase confirmed that DNA, and not protein, is the hereditary material. Watson and Crick created a model of DNA by using Franklin's and Wilkins's DNA diffraction X-rays. DNA is made of two nucleotide strands that wrap around each other in the shape of a double helix. A DNA nucleotide is made of a deoxyribose sugar, a	*Unit Description:* Gene expression is the activation of a gene that results in transcription and the production of mRNA. Only a fraction of any cell's genes are expressed at any one time. A promoter and an operator regulate the transcription of structural genes. In prokaryotes, the structural genes, the promoter, and the operator collectively form an operon. A promoter is the segment of DNA that is recognized by the enzyme RNA polymerase, which then initiates transcription. An operator is the segment of DNA that acts as a "switch" by controlling the access of RNA polymerase to the promoter. A repressor	*Unit Description:* The study of how characteristics are transmitted from parents to offspring is called genetics. Mendel observed seven characteristics of pea plants. Each characteristic occurred in two contrasting traits. Mendel concluded that inherited characteristics are controlled by factors that occur in pairs. The law of segregation states that a pair of factors is segregated, or separated, during the formation of gametes. Two factors for a characteristic are then combined when fertilization occurs and a new offspring is produced. The law of independent assortment states that factors for individual	*Unit Description:* Complete dominance occurs when heterozygous individuals and dominant homozygous individuals are indistinguishable in phenotype. Incomplete dominance occurs when two or more alleles influence the phenotype and results in a phenotype intermediate between the dominant trait and the recessive trait. Co dominance occurs when both alleles for a gene are expressed in a heterozygous offspring. A cross in which two characteristics are tracked is a dihybrid cross. The offspring of a dihybrid cross are called dihybrids. Genes reside on chromosomes. Sex chromosomes

byproduct of photosynthesis. As electrons travel along the electron transport chains, protons move into the thylakoid and build up a concentration gradient. The movements of protons down this gradient of protons and through ATP synthase results in the synthesis of ATP through chemiosmosis. The ATP and NADPH produced in the light reactions drive the second stage of photosynthesis, the Calvin cycle. In the Calvin cycle, CO2 is incorporated into organic compounds, a process called carbon fixation. The Calvin cycle produces a compound called G3P. Most G3P molecules are converted into RuBP to keep the Calvin cycle operating. However, some G3P molecules are used to make other organic compounds, including amino acids, lipids, and carbohydrates. Plants that fix carbon using only the Calvin cycle are known as C3 plants. Some plants that evolved in hot, dry climates fix carbon through alternative pathways—the C4 and CAM pathways. These plants carry out carbon fixation and the Calvin cycle either in different cells or at different times. Photosynthesis occurs in two stages. In the light reactions, energy is absorbed from sunlight and converted into chemical energy; in the	cells reproduce themselves. Binary fission is the process of cell division in prokaryotes.er of chromosomes that are present in diploid cells. The cell cycle is the repeating set of events in the life of a cell. The cell cycle consists of cell division and interphase. Cell division in eukaryotes includes nuclear division (mitosis) and the division of cytoplasm (cytokinesis). Interphase consists of growth (G1), DNA replication (S), and preparation for cell division (G2). Mitosis is divided into prophase, metaphase, anaphase, and telophase. Mitosis results in two offspring cells that are genetically identical to the original cell. During cytokinesis in animal cells, a cleavage furrow pinches in and eventually separates the	phosphate group, and one of four nitrogenous bases: adenine (A), guanine (G), cytosine (C), or thymine (T). Nucleotides along each DNA strand are linked by covalent bonds. Complementary nitrogenous bases are bonded by hydrogen bonds. Hydrogen bonding between the complementary base pairs, G-C and A-T, holds the two strands of a DNA molecule together. DNA replication is the process by which DNA is copied in a cell before a cell divides. Replication begins with the separation of the DNA strands by helicases. Then, DNA polymerases form new strands by adding complementary nucleotides to each of the original strands. Each new DNA molecule is made of one strand of nucleotides from the original DNA molecule	protein can inhibit genes from being expressed. Repressor proteins are coded for by regulator genes. A repressor protein attaches to the operator, physically blocking the advancement of RNA polymerase. An inducer is a molecule that initiates gene expression. In E. coli, lactose serves as an inducer. An inducer binds to the repressor protein. As a result, the shape of the repressor protein changes and the repressor protein detaches from the operator. RNA polymerase can then advance to the structural genes. Eukaryotes do not have operons. The genomes of eukaryotes are larger and more complex than those of prokaryotes. Eukaryotic genes are organized into noncoding sections, called introns, and coding sections, called exons. In eukaryotes,	characteristics are distributed to gametes independently. The law of independent assortment is observed only for genes that are located on separate chromosomes or are far apart on the same chromosome. One allele for each trait is passed from each parent to the offspring. The genotype is the genetic makeup of an organism. The phenotype is the appearance of an organism. Probability is the likelihood that a specific event will occur. A Punnett square can be used to predict the outcome of genetic crosses. A cross in which one characteristic is tracked is a monohybrid cross. A testcross, in which an individual of unknown genotype is crossed with a homozygous recessive individual, can be used to determine the genotype of an individual whose phenotype expresses the	contain genes that determine an organism's sex. The remaining chromosomes that are not directly involved in determining the sex of an individual are called autosomes. Genes found on the X chromosome are X-linked genes. A sex-linked trait is a trait whose allele is located on a sex chromosome. Because males have only one X chromosome, a male who carries a recessive allele on the X or Y chromosome will exhibit the sex-linked condition. Pairs of genes that tend to be inherited together are called linked genes. Researchers use recombinant percentages to construct chromosome maps showing relative gene positions. Germ-cell mutations occur in gametes and can be passed on to offspring. Somatic-cell mutations

Calvin cycle, carbon dioxide and chemical energy are used to form organic compounds. The rate of photosynthesis increases and then reaches a plateau as light intensity or CO2 concentration increases. Below a certain temperature, the rate of photosynthesis increases as temperature increases. Above that temperature, the rate of photosynthesis decreases as temperature increases. Cellular respiration is the process by which cells break down organic compounds to produce ATP. Cellular respiration begins with glycolysis, which takes place in the cytosol of cells. During glycolysis, one glucose molecule is oxidized to form two pyruvic acid molecules. Glycolysis results in a net production of two ATP molecules and two NADH molecules. If oxygen is not present, glycolysis may lead to anaerobic pathways in which pyruvic acid is converted into other organic molecules in the cytosol. Glycolysis combined with these anaerobic pathways is called fermentation. Fermentation does not produce ATP, but it does regenerate NAD_, which helps keep glycolysis operating. In lactic acid fermentation, an enzyme converts pyruvic acid into lactic acid. In alcoholic fermentation, other enzymes	dividing cell into two cells. In plant cells, a cell plate separates the dividing cell into two cells. Cell division in eukaryotes is controlled by many proteins. Control occurs at three main checkpoints. Cancer may result if cells do not respond to control mechanisms. Meiosis is a process of nuclear division that reduces the number of chromosomes in new cells to half the number in the original cell. Meiosis produces gametes. Cells undergoing meiosis divide twice. Diploid cells that divide meiotically result in four haploid cells rather than two diploid cells as in mitosis. Meiosis I includes prophase I, metaphase I, anaphase I, and telophase I. Crossing-over during prophase I results in genetic recombination. Meiosis II includes prophase II, metaphase II, anaphase II, and	and one new strand. Changes in DNA are called mutations. Proofreading and repair prevent many replication errors. The flow of genetic information can be symbolized as DNA RNA protein. RNA has the sugar ribose instead of deoxyribose and uracil in place of thymine. RNA is single stranded and is shorter than DNA. During transcription, DNA acts as a template for directing the synthesis of RNA. The genetic code identifies the specific amino acids coded for by each mRNA codon. The RNA called mRNA carries the genetic "message" from the nucleus to the cytosol; rRNA is the major component of ribosomes; tRNA carries specific amino acids, helping to form polypeptides.	gene expression can be controlled after transcription—through the removal of introns from pre-mRNA—or at the onset of transcription—through the action of transcription factors. The development of specialized cells is called cell differentiation. The development of form in an organism is called morphogenesis. Both cell differentiation and morphogenesis are governed by gene expression. Homeotic genes are regulatory genes that determine where anatomical structures will be placed during development. Within each homeotic gene, a specific DNA sequence known as the homeobox regulates patterns of development. The homeoboxes of many eukaryotic organisms appear to be very similar. Mutations of proto-oncogenes or	dominant trait.	occur in body cells and affect only the individual organism. Chromosome mutations are changes in the structure of a chromosome or the loss or gain of an entire chromosome. Gene mutations are changes in one or more of the nucleotides in a gene. Geneticists use pedigrees to trace diseases or traits through families. Pedigrees reveal inheritance patterns of genes. Polygenic characters, such as skin color, are controlled by two or more genes. Complex characters, such as height, are influenced by both genes and environment. Multiple-allele characters, such as ABO blood groups, are controlled by three or more alleles of a gene. A sex-influenced trait, such as pattern baldness, is expressed differently in men than in women even if it is

convert pyruvic acid into ethyl alcohol and CO_2. Through glycolysis, only about 2 percent of the energy available from the oxidation of glucose is captured as ATP. In eukaryotic cells, the processes of aerobic respiration occur inside the mitochondria. The Krebs cycle occurs in the mitochondrial matrix. The electron transport chain is embedded in the inner mitochondrial membrane. In the mitochondrial matrix, pyruvic acid produced in glycolysis is converted into acetyl CoA. Then, acetyl CoA enters the Krebs cycle. Each turn of the Krebs cycle generates three NADH, one $FADH_2$, one ATP, and two CO_2 molecules. NADH and $FADH_2$ donate electrons to the electron transport chain in the inner mitochondrial membrane. These electrons are passed from molecule to molecule in the transport chain. As electrons pass along the electron transport chain, protons donated by NADH and $FADH_2$ are pumped into the space between the inner and outer mitochondrial membranes. This pumping creates a concentration gradient of protons and a charge gradient across the inner mitochondrial membrane. As protons move through ATP synthase, down their concentration and charge	telophase II. Four new haploid cells result. Spermatogenesis is the process by which sperm cells are produced. Oogenesis is the process that produces egg cells. Sexual reproduction is the formation of offspring through the union of a sperm and an egg. Offspring produced by sexual reproduction are genetically different from the parents.		tumor-suppressor genes may lead to cancer. Cancer is the uncontrolled growth of abnormal cells. A carcinogen is any substance that can induce or promote cancer. Most carcinogens are mutagens, substances that cause mutations. Unlike normal cells, cancer cells continue to divide indefinitely, even if they become densely packed. Cancer cells will also continue dividing even if they are no longer attached to other cells.		on an autosome and both sexes have the same genotype. Genetic screening examines a person's genetic makeup and potential risks of passing disorders to offspring. Amniocentesis and chorionic villi sampling help physicians test a fetus for the presence of genetic disorders. Genetic counseling informs screened individuals about problems that might affect their offspring.

gradients, and back into the mitochondrial matrix, ATP is produced. During aerobic respiration, oxygen accepts both protons and electrons from the electron transport chain. As a result, oxygen is converted to water. Cellular respiration can produce up to 38 ATP molecules from the oxidation of a single molecule of glucose. Thus, up to 39 percent of the energy released by the oxidation of glucose can be transferred to ATP. However, most eukaryotic cells produce only about 36 ATP molecules per molecule of glucose. Cellular respiration uses the processes of glycolysis and aerobic respiration to obtain energy from organic compounds.					
Unit Targets: • Explain why almost all organisms depend on photosynthesis. • Summarize the main events of the light reactions. • Explain how ATP is made during the light reactions. • Summarize the main events of the Calvin cycle. • Describe what happens to the compounds that	*Unit Targets:* • Describe the structure of a chromosome. • Identify the differences in structure between prokaryotic chromosomes and eukaryotic chromosomes. • Compare the number of chromosomes in different species. • Explain the	*Unit Targets:* • Relate how Griffith's bacterial experiments showed that a hereditary factor was involved in transformation. • Summarize how Avery's experiments led his group to conclude that DNA is responsible for transformation in bacteria.	*Unit Targets:* • Explain why cells regulate gene expression. • Discuss the role of operons in prokaryotic gene expression. • Determine how repressor proteins and inducers affect transcription in prokaryotes. • Describe the structure	*Unit Targets:* • Describe how Mendel was able to control how his pea plants were pollinated. • Describe the steps in Mendel's experiments on true-breeding garden peas. • Distinguish between dominant and recessive traits. • State two laws of heredity that were	*Unit Targets:* • Distinguish between sex chromosomes and autosomes. • Explain the role of sex chromosomes in sex determination. • Describe how an X- or Y-linked gene affects the inheritance of traits. • Explain the effect of crossing-over on the inheritance of genes

are made in the Calvin cycle. • Summarize how the light reactions and the Calvin cycle work together to create the continuous cycle of photosynthesis. • Explain how environmental factors influence photosynthesis. • Identify the two main steps of cellular respiration. • Describe the major events in glycolysis. • Compare lactic acid fermentation with alcoholic fermentation. • Calculate the efficiency of glycolysis. • Relate aerobic respiration to the structure of a mitochondrion. • Summarize the events of the Krebs cycle. • Summarize the events of the electron transport chain and chemiosmosis. • Calculate the efficiency of aerobic respiration. • Contrast the roles of glycolysis and aerobic respiration in cellular respiration.	differences between sex chromosomes and autosomes. • Distinguish between diploid and haploid cells. • Describe the events of cell division in prokaryotes. • Name the two parts of the cell that are equally divided during cell division in eukaryotes. • Summarize the events of interphase. • Describe the stages of mitosis. • Compare cytokinesis in animal cells with cytokinesis in plant cells. • Explain how cell division is controlled. • Compare the end products of meiosis with those of mitosis. • Summarize the events of meiosis I. • Explain crossing-over and how it contributes to the production of unique individuals. • Summarize the events of meiosis II. • Compare	• Describe how Hershey and Chase's experiment led to the conclusion that DNA, not protein, is the hereditary molecule in viruses. • Evaluate the contributions of Franklin and Wilkins in helping Watson and Crick discover DNA's double helix structure. • Describe the three parts of a nucleotide. • Summarize the role of covalent and hydrogen bonds in the structure of DNA. • Relate the role of base-pairing rules to the structure of DNA. • Summarize the process of DNA replication. • Identify the role of enzymes in the replication of DNA. • Describe how complementary base pairing guides DNA replication. • Compare the number of replication forks in prokaryotic and	of a eukaryotic gene. • Compare the two ways gene expression is controlled in eukaryotes. • Summarize the role of gene expression in an organism's development. • Describe the influence of homeotic genes in eukaryotic development. • State the role of the homeobox in eukaryotic development. • Summarize the effects of mutations in causing cancer. • Compare the characteristics of cancer cells with those of normal cells.	developed from Mendel's work. • Describe how Mendel's results can be explained by scientific knowledge of genes and chromosomes. • Differentiate between the genotype and the phenotype of an organism. • Explain how probability is used to predict the results of genetic crosses. • Use a Punnett square to predict the results of monohybrid and dihybrid genetic crosses. • Explain how a testcross is used to show the genotype of an individual whose phenotype expresses the dominant trait. • Differentiate a monohybrid cross from a dihybrid cross.	in linkage groups. • Distinguish between chromosome mutations and gene mutations. • Analyze pedigrees to determine how genetic traits and genetic disorders are inherited. • Summarize the different patterns of inheritance seen in genetic traits and genetic disorders. • Explain the inheritance of ABO blood groups. • Compare sex-linked traits with sex-influenced traits. • Explain how geneticists can detect and treat genetic disorders.

	spermatogenesis and oogenesis. • Define sexual reproduction.	eukaryotic cells during DNA replication. • Describe how errors are corrected during DNA replication. • Outline the flow of genetic information in cells from DNA to protein. • Compare the structure of RNA with that of DNA. • Summarize the process of transcription. • Describe the importance of the genetic code. • Compare the role of mRNA, rRNA, and tRNA in translation. • Identify the importance of learning about the human genome.			

Biology- Grade 10 Scope and Sequence Part III

Unit 13- Gene Technologies	Unit 14- Evolution	Unit 15- Population Genetics	Unit 16- Intro to Ecology / Ecosystems	Unit 17- Community Ecology	Unit 18- Humans and the Environment
Weeks 27-28	Week 29	Weeks 30-31	Week 32	Week 33	Week 34
Unit Description: DNA technology provides the tools to manipulate DNA molecules for practical purposes. The repeating sequences in noncoding DNA vary between individuals and thus can be used to identify an individual. To identify a DNA sample, scientists isolate the DNA and copy it using the polymerase chain reaction (PCR). The DNA is then cut into fragments using restriction enzymes. The fragments are separated by size using gel electrophoresis. The resulting pattern is compared to the pattern from a known sample of DNA treated in the same way. Restriction enzymes recognize and cut specific nucleotide sequences. This process creates single chains called sticky ends on the ends of each piece of DNA. The	*Unit Description:* Evolution is the process of change in the inherited characteristics within populations over generations such that new types of organisms develop from preexisting types. After making many observations and considering ideas of other scientists, both Darwin and Wallace proposed the theory of natural selection to explain evolution. Darwin wrote On the Origin of Species, in which he argued that descent with modification occurs, that all species descended from common ancestors, and that natural selection is the mechanism for evolution. Organisms	*Unit Description:* Populations can be measured in terms of size, density, dispersion, growth rate, age structure, and survivorship. A population's size is the number of individuals that the population contains. Density is a measure of how crowded the population is. Dispersion describes the distribution of individuals within the population and may be random, uniform, or clumped. A population's age structure indicates the percentage of individuals at each age. Populations show three patterns of mortality: Type I (low mortality until late in life), Type	*Unit Description:* Species interact with both other species and their nonliving environment. Interdependence is a theme in ecology, and states that one change can affect all species in an ecosystem. Ecological models help to explain the environment. Ecology is usually organized into five levels: organism, population, community, ecosystem, and biosphere. Both biotic, or living, factors and abiotic, or nonliving, factors influence organisms. Examples of nonliving things are climate, sunlight, and pH. A niche is a way of life, or a role in an ecosystem. Some species survive	*Unit Description:* Ecologists recognize five major kinds of species interactions in communities: predation, parasitism, competition, mutualism, and commensalism. Predation is an interaction in which one organism (the predator) captures and eats another organism (the prey). Predators have adaptations to efficiently capture prey, whereas prey species have adaptations to avoid capture. Mimicry is an adaptation in which a species gains an advantage by resembling another species or object. Competition may cause competitive exclusion, the elimination of one	*Unit Description:* Earth's geosphere, hydrosphere, and atmosphere are interconnected in many ways. Life exists in parts of each sphere. Together, these parts make up the biosphere. Important parts of the atmosphere are greenhouse gases, which trap heat on Earth, and the ozone layer, which shields Earth from UV radiation. A very small portion of the hydrosphere is fresh water, and much of this fresh water is not easily usable. Biodiversity refers to the variety of life found in an area and can be measured in different ways, including by species richness, species evenness, and genetic diversity. Biodiversity is valued for various reasons. Over a short time period, human activities have affected global

enzyme DNA ligase can rejoin sticky ends and connect DNA fragments. Researchers use restriction enzymes to insert DNA fragments into vectors. The resulting DNA from two different organisms is called recombinant DNA. The goals of the Human Genome Project were to determine the nucleotide sequence of the entire human genome and map the location of every gene on each chromosome. This information will advance the diagnosis, treatment, and prevention of human genetic disorders. The Human Genome Project yielded important information about human genes and proteins. For example, there are far fewer protein-encoding human genes than once believed but far more proteins because of the complex way they are encoded. The Human Genome Project included sequencing the genes of many model species to provide insights into gene function. Information from the Human Genome Project has been applied	in a population adapt to their environment as the proportion of individuals with genes for favorable traits increases. Those individuals that pass on more genes are considered to have greater fitness. Evidence of evolution can be found by comparing several kinds of data, including the fossil record, biogeography, anatomy and development, and biological molecules. Evolutionary theories are supported when several kinds of evidence support similar conclusions. Geologic evidence supports theories about the age and development of Earth. In organisms, analogous structures are similar in function but have different evolutionary origins. Homologous structures have a common evolutionary origin. A species with a vestigial	II (constant mortality throughout life), and Type III (high mortality early in life followed by low mortality for the remaining life span). The exponential model describes perpetual growth at a steady rate in a population. The model assumes constant birth and death rates and no immigration or emigration. In the logistic model, birth rates fall and death rates climb as the population grows. When the carrying capacity is reached, the population becomes stable. Population-limiting factors are density-dependent if the effect on each individual depends on the number of other individuals present in the same area. Small populations have low genetic diversity and are subject to inbreeding, so they are less likely to adapt to environmental changes. About 10,000 to 12,000	unfavorable environmental conditions by becoming dormant or by migrating. Most producers are photosynthetic and make carbohydrates by using energy from the sun. Consumers obtain energy by eating other organisms and include herbivores, omnivores, carnivores, detritivores, and decomposers. Decomposers feed on dead organisms and wastes, which releases the nutrients back into the environment. A single pathway of energy transfer is a food chain. A network showing all paths of energy transfer is a food web. Ecosystems contain only a few trophic levels because there is a low rate of energy transfer between each level. Key processes in the water cycle are evaporation, transpiration, and precipitation. Photosynthesis and	species in a community. Competition may also drive the evolution of niche differences among competitors. In parasitism, one species (the parasite) feeds on, but does not always kill, another species (the host). In mutualism, both interacting species benefit. In commensalism, one species benefits, and the other is not affected. Species richness is the number of species in a community. Species evenness is the relative abundance of each species. In general, species richness is greatest near the equator, and larger areas support more species. Species interactions such as predation can promote species richness. Disturbances can alter a community by eliminating or removing organisms or altering resource	ecosystems in ways that harm humans and other species. Human impacts range from local pollution to global change in ecosystems. Industrial chemicals called chlorofluorocarbons (CFCs) act as catalysts in chemical reactions that break down O3 molecules in the ozone layer. Most countries have banned CFCs, and the ozone layer seems to be recovering. The correlation of increasing atmospheric CO2 and rising global temperature suggests a cause-and-effect relationship. Considering several types of evidence, many scientists have concluded that increased CO2 levels have caused warmer surface temperatures on Earth. Certain air pollutants cause acid precipitation, which harms or kills many organisms. The release of toxic chemicals, such as DDT, into the biosphere can impact ecosystems in many ways, especially when chemicals undergo biological magnification. Human impacts on the environment are causing

to medical, commercial, and scientific purposes. Bioinformatics uses computers to catalog and analyze genomes. Microarrays, two-dimensional arrangements of cloned genes, allow researchers to compare specific genes such as those that cause cancer. Proteomics studies the identities, structures, interactions, and abundances of an organism's proteins. Genetic engineering is being used to provide therapies for certain genetic diseases. Gene therapy refers to treating genetic disorders by correcting a defect in a gene or by providing a normal form of a gene. Researchers hope that gene therapy can be used to cure genetic disorders in the future. In cloning by nuclear transfer, a nucleus from a body cell of one individual is introduced into an egg cell (without its nucleus) from another individual. An organism identical to the nucleus donor results. Genetic engineering is used to produce disease-resistant, pest-resistant,	structure probably shares ancestry with a species that has a functional form of the structure. Related species show similarities in embryological development. Similarity in the subunit sequences of biological molecules such as RNA, DNA, and proteins indicates a common evolutionary history. Modern scientists integrate Darwin's theory with other advances in biological knowledge. Theories and hypotheses about evolution continue to be proposed and investigated. Ongoing examples of evolution among living organisms can be observed, recorded, and tested. In divergent evolution, related populations become less similar as they respond to different environments. Adaptive radiation is the divergent evolution	years ago, the development of agriculture increased the growth rate of the human population. Around 1650, improvements in hygiene, diet, and economic conditions further accelerated population growth. After World War II, the human population grew at the fastest rate in history, largely because of better sanitation and medical care in poorer countries. Today, developing countries have faster human population growth and lower standards of living than developed countries do.	cellular respiration are the two main steps in the carbon cycle. Nitrogen-fixing bacteria are important in the nitrogen cycle because they change nitrogen gas into a usable form of nitrogen for plants. Phosphorus moves from phosphate deposited in rock, to the soil, to living organisms, and finally to the ocean.	availability. Species richness may improve a community's stability. Areas of low species richness may be less stable in the event of an ecological disturbance. Ecological succession is a change in the species composition of a community over time. Primary succession is the assembly of a community on newly created habitat. Secondary succession is the change in an existing community following a disturbance. Primary succession occurs in areas that have been recently exposed to the elements and lack soil. Primary succession typically proceeds from lichens and mosses to a climax community. Secondary succession occurs in areas where the original ecosystem has been cleared by a disturbance. Secondary succession typically proceeds from weeds to a climax community.	an increasing number of extinctions. Important causes of extinctions are habitat destruction, the transfer of invasive species to new habitats, and overharvesting or hunting. This loss of species has both known and unknown effects on ecosystems. Current levels of human resource use are probably not sustainable. Conservation biologists are concerned with identifying and maintaining ecosystems, while restoration biologists are usually involved with repairing badly damaged ecosystems. Populations of many migratory birds, such as the whooping crane, are in decline because of human activities. However, some populations are recovering as a result of legal protection, breeding programs, habitat restoration, and international partnerships. International and cooperative efforts to preserve habitat and prevent extinctions include identifying biodiversity hotspots, making debt-for-nature

and herbicide-resistant crops in an effort to improve the yields and nutrition of the human food supply. Some people fear that the release of genetically modified organisms would pose a separate environmental risk. Many safety, environmental, and ethical issues involved in genetic engineering have not been resolved. Genetic disorders are treated in various ways. Among the treatments are symptom-relieving treatments and symptom-prevention measures, such as insulin injections for diabetes. Gene therapy is a type of treatment under development. In gene therapy, a defective gene is replaced with a copy of a healthy gene. Somatic cell gene therapy alters only body cells. Germ cell gene therapy attempts to alter eggs or sperm.	of a single group of organisms in a new environment. In convergent evolution, organisms that are not closely related resemble each other because they have responded to similar environments.				swaps, and promoting ecotourism. Environmental problems can be addressed through the combined efforts of governments, scientists, businesses, and individuals. The Everglades restoration project is the most ambitious ecosystem-wide restoration project attempted in the United States.
Unit Targets: • Living systems, from the organismal to the cellular level, demonstrate the complementary	*Unit Targets:* • Compare the principle of biogenesis with the idea of spontaneous generation.	*Unit Targets:* • Identify traits that vary in populations and that may be studied. • Explain the	*Unit Targets:* • Identify a key theme in ecology. • Describe an example showing the effects of interdependence	*Unit Targets:* • Identify two types of predator adaptations and two types of prey adaptations. • Identify possible	*Unit Targets:* • Explain the importance of the study of environmental science.

nature of structure and function. • All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • The diversity and changing of life forms over many generations is the result of natural selection in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. • Gene therapy is a treatment or cure for diseases caused by defective genes. • Gene therapy, like all new genetic	• Summarize the results of experiments by Redi and by Spallanzani that tested the hypothesis of spontaneous generation. • Describe how Pasteur's experiment disproved the hypothesis of spontaneous generation. • Outline the modern scientific understanding of the formation of Earth. • Summarize the concept of half-life. • Describe the production of organic compounds in the Miller-Urey apparatus. • Summarize the possible importance of cell-like structures produced in the laboratory. • Explain the importance of the chemistry of RNA in relation to the origin of life. • List three inferred characteristics that	importance of the bell curve to population genetics. • Compare three causes of genotypic variation in a population. • Calculate allele frequency and phenotype frequency. • Explain Hardy-Weinberg genetic equilibrium. • List five conditions under which evolution may take place. • Explain how migration can affect the genetics of populations. • Explain how genetic drift can affect populations of different sizes. • Contrast the effects of stabilizing selection, directional selection, and disruptive selection on populations over time. • Identify examples of nonrandom mating. • Relate the biological species concept to the modern definition of	upon organisms in their environment. • Identify the importance of models to ecology. • State the five different levels of organization at which ecology can be studied. • Compare abiotic factors with biotic factors, and list two examples of each. • Describe two mechanisms that allow organisms to survive in a changing environment. • Explain the concept of the niche. • Summarize the role of producers in an ecosystem. • Identify several kinds of consumers in an ecosystem. • Explain the important role of decomposers in an ecosystem. • Compare the concept of a food chain with that of a food web. • Explain why ecosystems usually contain only a few	causes and results of inter-specific competition. • Compare parasitism, mutualism, and commensalism, and give one example of each. • Describe the factors that affect species richness in a community. • Explain how disturbances affect community stability. • Distinguish between types of succession, and explain why succession might not be predictable.	• Describe Earth's major layers. • Explain the natural functions of the ozone layer and greenhouse effect. • Summarize the ways in which biologists measure biodiversity. • Discuss the value of biodiversity. • Describe major consequences of air pollution. • Relate air pollution to effects on global climate. • Describe how chemical pollutants may undergo the process of biological magnification. • Identify the primary causes of modern extinctions. • Explain why extinctions and ecosystem disruption are of concern to humans. • Relate human resource use to its impacts on ecosystems. • State the goals of conservation and

technologies, raises ethical and social issues about how it should be used.	describe the first forms of cellular life on Earth. • Compare the two types of autotrophy used by early cells. • Relate the development of photosynthesis to the development of aerobic respiration in early cells. • Explain the theory of endosymbiosis. • Define the biological process of evolution. • Summarize the history of scientific ideas about evolution. • Describe Charles Darwin's contributions to scientific thinking about evolution. • Analyze the reasoning in Darwin's theory of evolution by natural selection. • Relate the concepts of adaptation and fitness to the theory of natural selection.	species. • Explain how the isolation of populations can lead to speciation. • Compare two kinds of isolation and the pattern of speciation associated with each. • Contrast the model of punctuated equilibrium with the model of gradual change.	trophic levels. • List four major biogeochemical cycles. • Summarize three important processes in the water cycle. • Outline the major steps in the carbon cycle. • Describe the role of decomposers in the nitrogen cycle. • Summarize the major steps of the phosphorus cycle.		restoration biology. • Describe examples of efforts to protect species and their habitats. • Summarize international strategies for protecting entire ecosystems. • Discuss the roles of governments and laws in addressing environmental problems. • List several things that individuals can do to help solve environmental problems.

Biology- Grade 10 Framework

Unit One: The Process of Science	
Big Idea: Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world. Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims. Scientific knowledge builds on itself over time. The growth of scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.	
Unit Essential Questions • How do we build and refine models that describe and explain the natural and designed world? • What constitutes useful scientific evidence? • How is scientific knowledge constructed? • How does scientific knowledge benefit – deepen and broaden – from scientists sharing and debating ideas and information with peers?	**Unit Enduring Understandings** • Measurement and observation tools are used to categorize, represent and interpret the natural world. • Evidence is used for building, refining, and/or critiquing scientific explanations. • Scientific knowledge builds upon itself over time. • The growth of scientific knowledge involves critique and communication – social practices that are governed by a core set of values.

Biology- Grade 10 Unit of Study

Unit title: The Process of Science

Unit summary: The scientific method involves making observations, asking questions, forming hypothesis, designing experiments, analyzing data, and drawing conclusions. Trying to answer questions about observations helps scientists form hypotheses. A controlled experiment has a control and experimental group, and tests independent and dependent variables. Scientists analyze data to draw conclusions about the experiment performed. A theory is a set of related hypotheses confirmed to be true many times. Communication between scientists about their methods and results helps prevent dishonesty and bias in science. Scientists use the metric system to take scientific measurements. Lab safety is a good laboratory practice.

Primary interdisciplinary connections: History, Mathematics

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: : 5.1.12.A.3, 5.1.12.B.3-4, 5.1.12.C.1-3, 5.1.12.D.3

Content Statements:

1	Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.
2	Empirical evidence is used to construct and defend arguments.
3	Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.
4	Refinement of understandings, explanations, and models occurs as new evidence is incorporated.
5	Data and refined models are used to revise predictions and explanations.
6	Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges.
7	Ensure that instruments and specimens are properly cared for and that animals, when used, are treated humanely, responsibly, and ethically.

Unit Essential Questions

- How do we build and refine models that describe and explain the natural and designed world?
- What constitutes useful scientific evidence?
- How is scientific knowledge constructed?
- How does scientific knowledge benefit – deepen and broaden – from scientists sharing and debating ideas and information with peers?

Unit Enduring Understandings

- Measurement and observation tools are used to categorize, represent and interpret the natural world.
- Evidence is used for building, refining, and/or critiquing scientific explanations.
- Scientific knowledge builds upon itself over time.
- The growth of scientific knowledge involves critique and communication – social practices that are governed by a core set of values norms.

Unit Learning Targets

Students will…

- Outline the main steps in the scientific method.
- Summarize how observations are used to form hypotheses.
- List elements of a controlled experiment.
- Describe how scientists use data to draw conclusions.
- Compare a scientific hypothesis and a scientific theory.
- State how communication in science helps prevent dishonesty and bias.
- Describe the importance of having the SI system of measurement.
- State some examples of good laboratory practice.

Evidence of Learning

Summative Assessment: N/A

Formative Assessments:

• This topic is addressed throughout the course • Lab Reports

Lesson Plans	
Activities	*Timeframe*
• Lab on scientific method	Week 1
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	This topic is addressed throughout the course.

Biology- Grade 10 Framework

Unit Two: Basic Chemistry	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carryout biological functions. All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia. Substances can undergo physical or chemical changes to form new substances. Each change involves energy. The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • What elements make up the majority of living things? • What happens during a chemical reaction? • How do enzymes regulate chemical reactions? • How do the unique properties of water support life on Earth?	**Unit Enduring Understandings** • Cellular units are composed of molecules that also carry out biological functions. • Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure. • Experimental conditions can influence the amount of a substance produced in an equilibrium reaction. • Oxidation and reduction are opposite reactions and always occur together. • The types of bonds a substance has influences its chemical and physical properties. • Electron arrangement in a molecule can be used to predict molecular shapes. • Energy is transferred in chemical and physical reactions. • Some reactions can occur both forward and backward, at the same rate of speed. • An equilibrium system will respond to stress, shift and find a new balance. • Experimental conditions can influence the amount of a substance produced in an equilibrium reaction.

Biology- Grade 10 Unit of Study

Unit title: Basic Chemistry

Unit summary: Matter is anything that occupies space and has mass. Elements are made of a single kind of atom and cannot be broken down by chemical means into simpler substances. Atoms are composed of protons, neutrons, and electrons. Protons and neutrons make up the nucleus of the atom. Electrons move about the nucleus in orbitals. Compounds consist of atoms of two or more elements that are joined by chemical bonds in a fixed proportion. Most elements react to form chemical bonds so that their atoms become stable. An atom achieves stability when the orbitals that correspond to its highest energy level are filled with the maximum number of electrons. A covalent bond is formed when two atoms share electrons. An ionic bond is formed when one atom gives up an electron to another. The positive ion is then attracted to a negative ion to form the ionic bond. Addition of energy to a substance can cause its state to change from a solid to a liquid and from a liquid to a gas. Reactants are substances that enter chemical reactions. Products are substances produced by chemical reactions. Enzymes lower the amount of activation energy necessary for a reaction to begin in living systems. A chemical reaction in which electrons are exchanged between atoms is called an oxidation-reduction reaction. The two hydrogen atoms and one oxygen atom that make up a water molecule are arranged at an angle to one another. Water is a polar molecule. The electrons in the molecule are shared unevenly between hydrogen and oxygen. This polarity makes water effective at dissolving other polar substances. Hydrogen bonding accounts for most of the unique properties of water. The unique properties of water include the ability to dissolve many substances, cohesion and adhesion, the ability to absorb a relatively large amount of energy as heat, the ability to cool surfaces through evaporation, and the low density of ice. A solution consists of a solute dissolved in a solvent. Water ionizes into hydronium ions and hydroxide ions. Acidic solutions contain more hydronium ions than hydroxide ions. Basic solutions contain more hydroxide ions than hydronium ions. Buffers are chemicals that neutralize the effects of adding small amounts of either an acid or a base to a solution.

Primary interdisciplinary connections: History, Mathematics, Chemistry

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1&3, 5.1.12.B.1,2, & 4, 5.1.12.C.1-3, 5.1.12.D.1-3), 5.2.12.A.1,2,4,6, 5.2.12.B.1-3, 5.2.12.D.2 &5, 5.3.12.A.1-2

Content Statements:

1	Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.
2	Differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules.
3	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.

4	Acids and bases are important in numerous chemical processes that occur around us, from industrial to biological processes, from the laboratory to the environment.
5	An atom's electron configuration, particularly of the outermost electrons, determines how the atom interacts with other atoms. Chemical bonds are the interactions between atoms that hold them together in molecules or between oppositely charged ions.
6	A large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. In other chemical reactions, atoms interact with one another by sharing electrons to create a bond.
7	The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept.
8	The driving forces of chemical reactions are energy and entropy. Chemical reactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).
9	Chemical equilibrium is a dynamic process that is significant in many systems, including biological, ecological, environmental, and geological systems. Chemical reactions occur at different rates. Factors such as temperature, mixing, concentration, particle size, and surface area affect the rates of chemical reactions.
10	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
11	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.

Unit Essential Questions

- How does structure relate to function in living systems from the organismal to the cellular level?
- What elements make up the majority of living things?
- What happens during a chemical reaction?
- How do enzymes regulate chemical reactions?
- How do the unique properties of water support life on Earth?

Unit Enduring Understandings

- Cellular units are composed of molecules that also carry out biological functions.
- Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure.
- Experimental conditions can influence the amount of a substance produced in an equilibrium reaction.
- Oxidation and reduction are opposite reactions and always occur together.
- The types of bonds a substance has influences its chemical and physical properties.
- Electron arrangement in a molecule can be used to predict molecular shapes.
- Energy is transferred in chemical and physical reactions.
- Some reactions can occur both forward and backward, at the same rate of speed.
- An equilibrium system will respond to stress, shift and find a new balance.

	• Experimental conditions can influence the amount of a substance produced in an equilibrium reaction.

Unit Learning Targets
Students will…

- Define the term mater.
- Explain the relationship between elements and atoms.
- Draw and label a model of the structure of an atom; Use atomic models to predict the behaviors of atoms in interactions.
- Explain how compounds affect an atom's stability; explain how the properties of isotopes, including half-lives, decay modes, and nuclear resonances, lead to useful applications of isotopes.
- Contrast covalent and ionic bonds; Model how the outermost electrons determine the reactivity of elements and the nature of the chemical bonds they tend to form.
- Describe the physical properties of each state of matter; Account for the differences in the physical properties of solids, liquids, and gases.
- Describe the role of reactants and products in chemical reactions.
- Explain the relationship between enzymes and activation energy; demonstrate the properties and functions of enzymes by designing and carrying out an experiment. Model the change in rate of a reaction by changing a factor.
- Explain how oxidation and reduction reactions are linked; Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions that have an impact on the environment, such as corrosion and the burning of fuel.
- Describe the structure of a water molecule.
- Explain how water's polar nature affects its ability to dissolve substances.
- Outline the relationship between hydrogen bonding and the different properties of water.
- Identify the roles of solutes and solvents in solutions.
- Differentiate between acids and bases; relate the pH scale to the concentrations of various acids and bases.
- Balance chemical equations by applying the law of conservation of mass.
- Describe the potential commercial applications of exothermic and endothermic reactions.

Evidence of Learning

Summative Assessment: Topic Test

Formative Assessments:

- Vocabulary Quiz
- Questioning Techniques
- Atoms Quiz
- Lab Report

Lesson Plans	
Activities	*Timeframe*
• Teacher lead discussion on topic • Bio Book Project – students create homepages for a chemistry character	Weeks 2-4
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Three: Biochemistry	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia. Substances can undergo physical or chemical changes to form new substances. Each change involves energy. The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • What are the four main types of carbon-based molecules found in living things? • How carbon is uniquely suited to form biological macromolecules? • How are biological macromolecules synthesized and disassembled? • What are the structures and functions of the biological macromolecules? • How do enzymes catalyze chemical reactions? • How do factors such as pH, temperature, and chemicals affect enzyme function?	**Unit Enduring Understandings** • Cellular units are composed of molecules that also carry out biological functions. • Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure. • Organic compounds contain one or more of the following elements: O, H, N, S, P. • Isomers are differing arrangements of the same atoms. • Functional groups determine chemical properties of organic substances. • One set of naming rules are used for a vast number of organic molecules. • Functional groups present can be used to predict products of an organic reaction. • Properties of food can be explained by understanding chemical structure. • Food molecules have a unique naming system needed for spatial isomers.

Biology- Grade 10 Unit of Study

Unit title: Biochemistry
Unit summary: Organic compounds contain carbon atoms and are found in living things. Most inorganic compounds do not contain carbon atoms. Carbon atoms can readily form four covalent

bonds with other atoms including other carbon atoms. The carbon bonds allow the carbon atoms to form a wide variety of simple and complex organic compounds. Functional groups are groups of atoms that influence the properties of molecules and the chemical reactions in which the molecules participate. Condensation reactions join monomers (small simple molecules) to form polymers. A condensation reaction releases water as a by-product. In a hydrolysis reaction, water is used to split polymers into monomers. Adenosine triphosphate (ATP) stores and releases energy during cell processes enabling organisms to function. There are four main classes of organic compounds: carbohydrates, proteins, lipids, and nucleic acids. Carbohydrates are made up of monomers called monosaccharides. Two monosaccharides join to form a double sugar called a disaccharide. A complex sugar, or polysaccharide, is made of three or more monosaccharides. Carbohydrates such as glucose are a source of energy and are used as structural materials in organisms. Proteins have many functions including structural, defensive, and catalytic. Proteins are made up of monomers called amino acids. The sequence of amino acids determines a protein's shape and function. A long chain of amino acids is called a polypeptide, which is made up of amino acids joined by peptide bonds. Enzymes speed up chemical reactions and bind to specific substrates. The binding of a substrate with an enzyme causes a change in the enzyme's shape and reduces the activation energy of the reaction. Lipids are nonpolar molecules that store energy and are an important part of cell membranes. Most lipids contain fatty acids, molecules that have a hydrophilic end and a hydrophobic end. There are three kinds of lipids: triglycerides consist of three fatty acids and one molecule of glycerol. Phospholipids, which make up cell membranes, consist of two fatty acids and one glycerol molecule. A wax is made of one long fatty acid chain joined to one long alcohol. The nucleic acid, deoxyribonucleic acid (DNA), contains all the genetic information for cell activities. Ribonucleic acid (RNA) molecules play many key roles in building of proteins and can act as enzymes.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1 & 3, 5.1.12.B.1-3, 5.1.12.C.1 & 3, 5.1.12.D.1-3), 5.2.12.A.1,2,4,6, 5.2.12.B.1-3, 5.2.12.D.2 &5, 5.3.12.A.1,2 & 6, 5.3.12.B.2

Content Statements:

1	Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.
2	Differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules.
3	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.

4	Acids and bases are important in numerous chemical processes that occur around us, from industrial to biological processes, from the laboratory to the environment.
5	An atom's electron configuration, particularly of the outermost electrons, determines how the atom interacts with other atoms. Chemical bonds are the interactions between atoms that hold them together in molecules or between oppositely charged ions.
6	A large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. In other chemical reactions, atoms interact with one another by sharing electrons to create a bond.
7	The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept.
8	The driving forces of chemical reactions are energy and entropy. Chemical reactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).
9	Chemical equilibrium is a dynamic process that is significant in many systems, including biological, ecological, environmental, and geological systems. Chemical reactions occur at different rates. Factors such as temperature, mixing, concentration, particle size, and surface area affect the rates of chemical reactions.
10	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
11	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
12	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
13	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.

Unit Essential Questions

- How does structure relate to function in living systems from the organismal to the cellular level?
- What are the four main types of carbon-based molecules found in living things?
- How carbon is uniquely suited to form biological macromolecules?
- How are biological macromolecules synthesized and disassembled?
- What are the structures and functions of the biological macromolecules?
- How do enzymes catalyze chemical reactions?
- How do factors such as pH, temperature, and chemicals affect enzyme function?

Unit Enduring Understandings

- Cellular units are composed of molecules that also carry out biological functions.
- Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure.
- Organic compounds contain one or more of the following elements: O, H, N, S, P.
- Isomers are differing arrangements of the same atoms.
- Functional groups determine chemical properties of organic substances.
- One set of naming rules are used for a vast number of organic molecules.
- Functional groups present can be used to predict products of an organic reaction.

	• Properties of food can be explained by understanding chemical structure. • Food molecules have a unique naming system needed for spatial isomers.

Unit Learning Targets
Students will…

- Model the four major categories of organic molecules (carbohydrates, fats, proteins, and nucleic acids).
- Represent and explain the relationship between the structure and function of each class of complex molecules using a variety of models.
- Identify the six elements most common to biological organisms: Carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur.
- Recognize DNA as a molecule having different components (sugars, nitrogen bases, and phosphate groups).
- Explain how the arrangement of the nitrogen bases within the DNA double helix forms a chemical code.
- Chemistry of Life.
- Food and Nutrition.
- Use mathematical formulas to justify the concept of an efficient diet.
- Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions that have an impact on the environment, such as corrosion and the burning of fuel.
- Demonstrate the properties and functions of enzymes by designing and carrying out an experiment.
- Balance chemical equations by applying the law of conservation of mass.
- Describe the potential commercial applications of exothermic and endothermic reactions.
- Model the change in rate of a reaction by changing a factor.
- Describe how a disease is the result of a malfunctioning system, organ, and cell; and relate this to possible treatment interventions (e.g., diabetes, cystic fibrosis, lactose intolerance).

Evidence of Learning

Summative Assessment: **T**opic Test

Formative Assessments:

- Vocabulary Quiz
- Lab Report
- Basic Organic Functional Groups Quiz

Lesson Plans

Activities	*Timeframe*
• Teacher lead discussion	

• Enzyme Activity Lab • Manipulative activities for reinforcement of reactions	Weeks 5-8
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Four: Cell Structures and Functions	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • How do multi-cellular organisms develop based on how cells grow and reproduce? • How do organisms maintain internal stability with ever changing internal and external stimuli? • How do individual cell structures relate to their functions? • How do energy and matter flow during cell function? • What are the sub-structures of cells and how do they function?	**Unit Enduring Understandings** • Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • Organisms composed of cells carry on the many functions needed to sustain life. Specialized attributes of cells work together to form larger systems (tissues and organs). • In living organisms, a connection exists between structure and function. • Know that cells come preexisting cells and that are a variety of cell types. Compare structure, function and interrelatedness of cell organelles. • Explain the characteristics of life as indicated by cellular processes, and describe the process of cell division and development. • Understand the development of life on Earth from single-celled organisms to increasingly complex, multicellular organisms.

Biology- Grade 10 Unit of Study

Unit title: Cell Structures and Functions

Unit summary: All living things are made up of one or more cells. Robert Hooke discovered cells. Anton van Leeuwenhoek was the first to observe living cells. The cell theory states all living organisms are made of one or more cells, cells are the basic units of structure and function, and cells come only from pre-existing cells. All living things are made of organized parts, obtain energy from their surroundings, perform chemical reactions, change with time, respond to their environment, and reproduce. A cell's shape reflects its function. Cell size is limited by a cell's surface area–to-volume ratio. The three basic parts of a cell are the plasma membrane, the cytoplasm, and the nucleus. Prokaryotes are organisms that lack a nucleus or membrane-bound organelles. In multicellular eukaryotes, cells organize into tissues, organs, organ systems, and finally organisms. Cell membranes are made of two phospholipid layers and proteins. The

nucleus directs the cell's activities and stores DNA. Mitochondria harvest energy from organic compounds and transfer it to ATP. Ribosomes are either free or attached to the rough ER and play a role in protein synthesis. The rough ER prepares proteins for export or insertion into the cell membrane. The smooth ER builds lipids and participates in detoxification of toxins. The Golgi processes and packages proteins. Vesicles are classified by their contents. The cytoskeleton is made of protein fibers that help cells move and maintain their shape. Plant cells have cell walls, central vacuoles, and plastids. In plant cells, a rigid cell wall covers the cell membrane and provides support and protection. Large central vacuoles store water, enzymes, and waste products and provide support for plant tissue. Plastids store starch and pigments. The chloroplast converts light energy into chemical energy by photosynthesis. Prokaryotes, animal cells, and plant cells can be distinguished from each other by their unique features.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1, 5.1.12.B.3, 5.1.12.C.1, 5.1.12.D.3), 5.3.12.A.3 & 6

Content Statements:

1	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
2	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.

Unit Essential Questions

- How does structure relate to function in living systems from the organismal to the cellular level?
- How do multi-cellular organisms develop based on how cells grow and reproduce?
- How do organisms maintain internal stability with ever changing internal and external stimuli?
- How do individual cell structures relate to their functions?
- How do energy and matter flow during cell function?
- What are the sub-structures of cells and how do they function?

Unit Enduring Understandings

- Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function.
- Organisms composed of cells carry on the many functions needed to sustain life. Specialized attributes of cells work together to form larger systems (tissues and organs).
- In living organisms, a connection exists between structure and function.
- Know that cells come preexisting cells and that are a variety of cell types. Compare structure, function and interrelatedness of cell organelles.
- Explain the characteristics of life as indicated by cellular processes, and describe the process of cell division and development.
- Understand the development of life on Earth from single-celled organisms to increasingly complex, multicellular organisms.

Unit Learning Targets
Students will…

- Predict a cell's response in a given set of environmental conditions.
- Describe how a disease is the result of a malfunctioning system, organ, and cell, and relate this to possible treatment interventions (e.g., diabetes, cystic fibrosis, lactose intolerance).
- Summarize the research that led to the development of the cell theory.
- State the three principles of the cell theory.
- Explain why the cell is considered to be the basic unit of life.
- Explain the relationship between cell shape and cell function.
- Identify the factor that limits cell size.
- Compare prokaryotic cells and eukaryotic cells.
- Analyze the relationship among cells, tissues, organs, organ systems, and organisms.
- Describe the structure and function of a cell's plasma membrane.
- Summarize the role of the nucleus.
- Identify the characteristics of mitochondria.
- Describe the structure and function of the cytoskeleton.
- Describe the roles of plastids in the life of a plant.
- Identify features that distinguish prokaryotes, eukaryotes, plant cells, and animal cells.

Evidence of Learning

Summative Assessment: Topic Test

Formative Assessments:

- Vocabulary Quiz
- Cell Structure and Function Review Quiz

Lesson Plans

Activities	*Timeframe*
• Teacher Lead Discussion of Cellular Structure and Function • Student Lab Investigation Cell Survey • Cell relationship project	Weeks 9-11
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Five: Cellular Transports and Homeostasis	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. All animals and most plants depend on both other organisms and their environment to meet their basic needs.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • How are organisms dependent on each other? • How do materials get into and out of cells? • How does photosynthesis compare with cellular respiration? • How do cells use energy?	**Unit Enduring Understandings** • Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • The survival of organisms is affected by interactions with each other and their environment, and can be altered by human manipulation. • Define homeostasis and disease as disruption of homeostasis. • Describe the movement of molecules across the membrane in order to achieve equilibrium. • Differentiate between diffusion and osmosis; explain the importance of osmosis for living cells. • Distinguish between active and passive transport through the membrane and give examples of active transport instances in organisms.

Biology- Grade 10 Unit of Study

Unit title: Cellular Transports and Homeostasis
Unit summary: Passive transport involves the movement of molecules across the cell membrane without an input of energy by the cell. Diffusion is the movement of molecules from an area of higher concentration to an area of lower concentration, driven by the molecules' kinetic energy until equilibrium is reached. Molecules can diffuse across a cell membrane by dissolving in the phospholipid bilayer or by passing through pores in the membrane. Osmosis is the diffusion of water across a membrane. The net direction of osmosis is determined by the relative solute concentrations on the two sides of the membrane. When the solute concentration outside the cell is lower than that in the cytosol, the solution outside is hypotonic to the cytosol, and water will diffuse into the cell. When the solute concentration outside the cell is higher than that in the cytosol, the solution outside is hypertonic to the cytosol, and water will diffuse out of the cell.

When the solute concentrations outside and inside the cell are equal, the solution outside is isotonic, and there will be no net movement of water. To remain alive, cells must compensate for the water that enters the cell in hypotonic environments and leaves the cell in hypertonic environments. In facilitated diffusion, a molecule binds to a carrier protein on one side of the cell membrane. The carrier protein then changes its shape and transports the molecule down its concentration gradient to the other side of the membrane. Ion channels are proteins, or groups of proteins, that provide small passageways across the cell membrane through which specific ions can diffuse. Active transport moves molecules across the cell membrane from an area of lower concentration to an area of higher concentration. Unlike passive transport, active transport requires cells to expend energy. Some types of active transport are performed by carrier proteins called cell membrane pumps. One example of a cell membrane pump is the sodium potassium pump. It moves three Na^+ ions into the cell's external environment for every two K^+ ions it moves into the cytosol. ATP supplies the energy that drives the pump. Endocytosis and exocytosis are active transport mechanisms in which large substances enter or leave cells inside vesicles. In endocytosis, the cell membrane folds around something in the external environment and forms a pouch. The pouch then pinches off and becomes a vesicle in the cytoplasm. Endocytosis includes pinocytosis, in which the vesicle contains solutes or fluids, and phagocytosis, in which the vesicle contains large particles or cells. In exocytosis, vesicles made by the cell fuse with the cell membrane, releasing their contents into the external environment.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: : (5.1.12.A.1 & 3, 5.1.12.B.3, 5.1.12.C.1-3), 5.3.12.A.1-3 & 6, 5.3.12.C.2

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
5	Stability in an ecosystem can be disrupted by natural or human interactions.

Unit Essential Questions	Unit Enduring Understandings
• How does structure relate to function in living systems from the organismal to the cellular level? • How are organisms dependent on each other?	• Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • The survival of organisms is affected by interactions with each other and their environment, and can be altered by human

• How do materials get into and out of cells? • How does photosynthesis compare with cellular respiration? • How do cells use energy?	manipulation. • Define homeostasis and disease as disruption of homeostasis. • Describe the movement of molecules across the membrane in order to achieve equilibrium. • Differentiate between diffusion and osmosis; explain the importance of osmosis for living cells. • Distinguish between active and passive transport through the membrane and give examples of active transport instances in organisms.

Unit Learning Targets
Students will…

- Explain how equilibrium is established as a result of diffusion.
- Explain how substances cross the cell membrane through facilitated diffusion.
- Explain how ion channels assist the diffusion of ions across the cell membrane.
- Distinguish between passive transport and active transport.
- Explain how the sodium-potassium pump operates.
- Compare endocytosis and exocytosis.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Quizzes
- Lab Reports

Lesson Plans

Activities	*Timeframe*
• Discussion • Osmosis and Diffusion Design a Lab	Weeks 12-14
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Six: Cellular Communications	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. All animals and most plants depend on both other organisms and their environment to meet their basic needs.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • How are organisms dependent on each other?	**Unit Enduring Understandings** • Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • The survival of organisms is affected by interactions with each other and their environment, and can be altered by human manipulation.

Biology- Grade 10 Unit of Study

Unit title: Cellular Communications

Unit summary: Cells signal one another with chemicals. Receptor proteins are located on or within the cell and have three-dimensional shapes that fit the shape of specific signal molecules. Binding of the signal molecule with the receptor protein induces a change in the protein's shape and produces a cellular response. Immunochemistry and molecular genetics are being used to locate and characteristize receptor proteins. Types of cell signaling – cells can communicate through any of four basic mechanisms: direct contact, paracrine signaling, endocrine signaling, or synaptic signaling. Proteins in the cell and on its surface receive signals from other cells. All cell-signaling pathways share certain common elements, including a chemical signal that passes from one cell to another and a receptor that receives the signal in or on the target cell. Intracellular receptors may trigger a variety of responses in the cell, dependent on the receptor. Cell surface receptors convert the extracellular signal to an intercellular one, responding to the binding of the signal molecule to the cell's outside by producing a change inside the cell. Many cell surface receptors either act as enzymes or are directly linked to enzymes. G-protein-linked receptors activate an intermediary protein, which then effects the intercellular change. Second messengers, such as cAMP and calcium ions, relay messages from receptors to target proteins. Some surface receptors generate large intracellular responses because each stage of the pathway amplifies the next, causing a cascading effect. As an organism develops, its cells acquire their specific identities by controlling gene expression, turning on the specific set of genes that encode the particular functions of each cell type. Every cell contains surface marker proteins that uniquely identify each cell type. Cells attach to one another using cell junctions. Tight junctions connect to the plasma membranes of adjacent cells in a sheet. Anchoring junctions

mechanically attach to the cytoskeleton of a cell to the cytoskeletons of other cells or to the extracellular matrix. Communication junctions allow communication with adjacent cells through direct connections.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1 & 3, 5.1.12.B.3, 5.1.12.C.1-3), 5.3.12.A.1-3 & 6, 5.3.12.C.2

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
5	Stability in an ecosystem can be disrupted by natural or human interactions.

Unit Essential Questions

- How does structure relate to function in living systems from the organismal to the cellular level?
- How are organisms dependent on each other?

Unit Enduring Understandings

- Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function.
- The survival of organisms is affected by interactions with each other and their environment, and can be altered by human manipulation.

Unit Learning Targets

Students will…

- Identify the types of cell signaling.
- Discuss how receptor proteins embedded in the plasma membrane change shape when they bind specific signal molecules.
- Compare and contrast intracellular and cell surface receptors in terms of their functions.
- Describe the transfer of information through an intracellular signal pathway.
- Discuss the role of secondary messengers in an intracellular signal pathway.
- Explain how cell surface proteins play a role in the expression of a cell's identity.
- List and define the functions of the types of intercellular adhesion categories.

Evidence of Learning	
Summative Assessment: Unit Test	
Formative Assessments: • Vocabulary quiz • Mini research project on cell signal pathways	
Lesson Plans	
Activities	*Timeframe*
• Video for cell signaling pathways • Teacher led discussion	Weeks 15-16
Teacher Resources	*Teacher Note*
• Textbook – Raven, Peter, et al. Biology 7th Edition. New York: McGraw Hill, 2002 • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Seven: Cellular Metabolism

Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. Substances can undergo physical or chemical changes to form new substances. Each change involves energy. From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes. The biogeochemical cycles in the Earth systems include the flow of microscopic and macroscopic resources from one reservoir in the hydrosphere, geosphere, atmosphere, or biosphere to another, are driven by Earth's internal and external sources of energy, and are impacted by human activity.

Unit Essential Questions

- How is matter transferred and energy transferred/ transformed in living systems?
- What are the equations of photosynthesis and respiration?
- Where do photosynthesis and respiration occur?
- How do photosynthesis and respiration relate to the oxygen-carbon dioxide cycle?
- What occurs in each of the processes of photosynthesis and respiration?
- Why can't humans survive without oxygen? Specifically, why can't we depend on fermentation instead of cellular respiration?
- What are redox reactions? Why are they important to cellular respiration?

Unit Enduring Understandings

- All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
- Distinguish between autotrophic and heterotrophic modes of energy acquisition.
- Explain the importance of photosynthesis for life on earth.
- Define materials and products of photosynthesis and describe major biochemical events in the process of photosynthesis.
- Define cellular respiration, identify materials and products of respiration, and compare it to photosynthesis.
- Distinguish between major respiration pathways in terms of energy outcomes and reactants.
- Describe the applications of fermentation process in food production.
- Identify factors that affect the rate of photosynthesis and cellular respiration.

Biology- Grade 10 Unit of Study

Unit title: Cellular Metabolism

Unit summary: Photosynthesis converts light energy into chemical energy through series of reactions known as biochemical pathways. Almost all life depends on photosynthesis. Autotrophs use photosynthesis to make organic compounds from carbon dioxide and water. Heterotrophs cannot make their own organic compounds from inorganic compounds and therefore depend on autotrophs. White light from the sun is composed of an array of colors called the visible spectrum. Pigments absorb certain colors of light and reflect or transmit the other colors. The light reactions of photosynthesis begin with the absorption of light by chlorophyll a and accessory pigments in the thylakoids. Excited electrons that leave chlorophyll a travel along two electron transport chains, resulting in the production of NADPH. The electrons are replaced when water is split into electrons, protons, and oxygen in the thylakoid. Oxygen is released as a byproduct of photosynthesis. As electrons travel along the electron transport chains, protons move into the thylakoid and build up a concentration gradient. The movements of protons down this gradient of protons and through ATP synthase results in the synthesis of ATP through chemiosmosis. The ATP and NADPH produced in the light reactions drive the second stage of photosynthesis, the Calvin cycle. In the Calvin cycle, CO2 is incorporated into organic compounds, a process called carbon fixation. The Calvin cycle produces a compound called G3P. Most G3P molecules are converted into RuBP to keep the Calvin cycle operating. However, some G3P molecules are used to make other organic compounds, including amino acids, lipids, and carbohydrates. Plants that fix carbon using only the Calvin cycle are known as C3 plants. Some plants that evolved in hot, dry climates fix carbon through alternative pathways—the C4 and CAM pathways. These plants carry out carbon fixation and the Calvin cycle either in different cells or at different times. Photosynthesis occurs in two stages. In the light reactions, energy is absorbed from sunlight and converted into chemical energy; in the Calvin cycle, carbon dioxide and chemical energy are used to form organic compounds. The rate of photosynthesis increases and then reaches a plateau as light intensity or CO2 concentration increases. Below a certain temperature, the rate of photosynthesis increases as temperature increases. Above that temperature, the rate of photosynthesis decreases as temperature increases. Cellular respiration is the process by which cells break down organic compounds to produce ATP. Cellular respiration begins with glycolysis, which takes place in the cytosol of cells. During glycolysis, one glucose molecule is oxidized to form two pyruvic acid molecules. Glycolysis results in a net production of two ATP molecules and two NADH molecules. If oxygen is not present, glycolysis may lead to anaerobic pathways in which pyruvic acid is converted into other organic molecules in the cytosol. Glycolysis combined with these anaerobic pathways is called fermentation. Fermentation does not produce ATP, but it does regenerate NAD_, which helps keep glycolysis operating. In lactic acid fermentation, an enzyme converts pyruvic acid into lactic acid. In alcoholic fermentation, other enzymes convert pyruvic acid into ethyl alcohol and CO2. Through glycolysis, only about 2 percent of the energy available from the oxidation of glucose is captured as ATP. In eukaryotic cells, the processes of aerobic respiration occur inside the mitochondria. The Krebs cycle occurs in the mitochondrial matrix. The electron transport chain is embedded in the inner mitochondrial membrane. In the mitochondrial matrix, pyruvic acid produced in glycolysis is converted into acetyl CoA. Then, acetyl CoA enters the Krebs cycle. Each turn of the Krebs cycle generates three NADH, one FADH2, one ATP, and two CO2 molecules. NADH and FADH2 donate electrons to the electron transport chain in the inner mitochondrial membrane. These electrons are passed from molecule to molecule in the transport chain. As

electrons pass along the electron transport chain, protons donated by NADH and FADH2 are pumped into the space between the inner and outer mitochondrial membranes. This pumping creates a concentration gradient of protons and a charge gradient across the inner mitochondrial membrane. As protons move through ATP synthase, down their concentration and charge gradients, and back into the mitochondrial matrix, ATP is produced. During aerobic respiration, oxygen accepts both protons and electrons from the electron transport chain. As a result, oxygen is converted to water. Cellular respiration can produce up to 38 ATP molecules from the oxidation of a single molecule of glucose. Thus, up to 39 percent of the energy released by the oxidation of glucose can be transferred to ATP. However, most eukaryotic cells produce only about 36 ATP molecules per molecule of glucose. Cellular respiration uses the processes of glycolysis and aerobic respiration to obtain energy from organic compounds.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: : (5.1.12.A.1-3, 5.1.12.B.2-4, 5.1.12.D.2 & 3), 5.3.12.A.1-3, 5.3.12.B.1-6, 5.2.12.B.3, 5.4.12.B.1, 5.4.12.G.2

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	As matter cycles and energy flows through different levels of organization within living systems (cells, organs, organisms, communities), and between living systems and the physical environment, chemical elements are recombined into different products.
5	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.
6	Continual input of energy from sunlight keeps matter and energy flowing through ecosystems.
7	Plants have the capability to take energy from light to form sugar molecules containing carbon, hydrogen, and oxygen.
8	In both plant and animal cells, sugar is a source of energy and can be used to make other carbon-containing (organic) molecules.
9	All organisms must break the high-energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes.
10	The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept.
11	The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen gas.
12	Natural ecosystems provide an array of basic functions that affect humans. These functions

	include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.

Unit Essential Questions

- How is matter transferred and energy transferred/ transformed in living systems?
- What are the equations of photosynthesis and respiration?
- Where do photosynthesis and respiration occur?
- How do photosynthesis and respiration relate to the oxygen-carbon dioxide cycle?
- What occurs in each of the processes of photosynthesis and respiration?
- Why can't humans survive without oxygen? Specifically, why can't we depend on fermentation instead of cellular respiration?
- What are redox reactions? Why are they important to cellular respiration?

Unit Enduring Understandings

- All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
- Distinguish between autotrophic and heterotrophic modes of energy acquisition.
- Explain the importance of photosynthesis for life on earth.
- Define materials and products of photosynthesis and describe major biochemical events in the process of photosynthesis.
- Define cellular respiration, identify materials and products of respiration, and compare it to photosynthesis.
- Distinguish between major respiration pathways in terms of energy outcomes and reactants.
- Describe the applications of fermentation process in food production.
- Identify factors that affect the rate of photosynthesis and cellular respiration.

Unit Learning Targets

Students will…

- Explain why almost all organisms depend on photosynthesis.
- Summarize the main events of the light reactions.
- Explain how ATP is made during the light reactions.
- Summarize the main events of the Calvin cycle.
- Describe what happens to the compounds that are made in the Calvin cycle.
- Summarize how the light reactions and the Calvin cycle work together to create the continuous cycle of photosynthesis.
- Explain how environmental factors influence photosynthesis.
- Identify the two main steps of cellular respiration.
- Describe the major events in glycolysis.
- Compare lactic acid fermentation with alcoholic fermentation.
- Calculate the efficiency of glycolysis.
- Relate aerobic respiration to the structure of a mitochondrion.
- Summarize the events of the Krebs cycle.

- Summarize the events of the electron transport chain and chemiosmosis.
- Calculate the efficiency of aerobic respiration.
- Contrast the roles of glycolysis and aerobic respiration in cellular respiration.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Quizzes
- Lab Reports

Lesson Plans

Activities	*Timeframe*
• Video series for photosynthesis • Teacher led discussion • Pigment isolation lab • Factors affecting rate of photosynthesis design a lab • Sauerkraut fermentation lab	Weeks 17-18
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Eight: Cell Reproduction	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • How is genetic information passed through generations? • What are the differences between asexual and sexual reproduction? • What is the evidence for the biotic origin of life? • What are the stages of the cell cycle? • What is the role of the cell cycle in organisms?	**Unit Enduring Understandings** • Living systems from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • Identify the structures of chromosomes. • Distinguish between a diploid and a haploid cell. • Describe the events of cell cycle. • Identify phases of mitosis and explain major events in each phase. • Identify phases of meiosis and explain purpose of two divisions. • Compare egg and sperm production in animals. • Compare and contrast mitotic and meiotic divisions. • Compare sexual and asexual reproduction; identify advantages of sexual reproduction in terms of evolutionary fitness. • Analyze consequences of mistakes in the cell cycle and cell divisions (e.g. tumors, Down syndrome). • Explain how chromosomal abnormalities can be detected. • Demonstrate the ability to use karyotypes for detecting gender and chromosomal abnormalities in humans.

Biology- Grade 10 Unit of Study

Unit title: Cell Reproduction

Unit summary: Chromosomes are tightly coiled DNA molecules. In eukaryotes, proteins called histones help maintain the compact structure of chromosomes. Chromosomes in prokaryotes are simpler than chromosomes in eukaryotes. Each species has a characteristic number of chromosomes in each cell. Sex chromosomes are chromosomes that determine the sex of an organism. All of the other chromosomes in an organism are autosomes. Cells having two sets of chromosomes are diploid (2n). Haploid cells (1n) have half the numbCell division is the process by which cells reproduce themselves. Binary fission is the process of cell division in prokaryotes.er of chromosomes that are present in diploid cells. The cell cycle is the repeating set of events in the life of a cell. The cell cycle consists of cell division and interphase. Cell division in eukaryotes includes nuclear division (mitosis) and the division of cytoplasm (cytokinesis). Interphase consists of growth (G1), DNA replication (S), and preparation for cell division (G2). Mitosis is divided into prophase, metaphase, anaphase, and telophase. Mitosis results in two offspring cells that are genetically identical to the original cell. During cytokinesis in animal cells, a cleavage furrow pinches in and eventually separates the dividing cell into two cells. In plant cells, a cell plate separates the dividing cell into two cells. Cell division in eukaryotes is controlled by many proteins. Control occurs at three main checkpoints. Cancer may result if cells do not respond to control mechanisms. Meiosis is a process of nuclear division that reduces the number of chromosomes in new cells to half the number in the original cell. Meiosis produces gametes. Cells undergoing meiosis divide twice. Diploid cells that divide meiotically result in four haploid cells rather than two diploid cells as in mitosis. Meiosis I includes prophase I, metaphase I, anaphase I, and telophase I. Crossing-over during prophase I results in genetic recombination. Meiosis II includes prophase II, metaphase II, anaphase II, and telophase II. Four new haploid cells result. Spermatogenesis is the process by which sperm cells are produced. Oogenesis is the process that produces egg cells. Sexual reproduction is the formation of offspring through the union of a sperm and an egg. Offspring produced by sexual reproduction are genetically different from the parents.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1, 5.1.12.B.1 & 3, 5.1.12.C.2 & 3, 5.1.12.D.2), 5.3.12.A.1-6, 5.3.12.D.1-3

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.

5	Cell differentiation is regulated through the expression of different genes during the development of complex multicellular organisms.
6	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
7	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.
8	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
9	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.

Unit Essential Questions	**Unit Enduring Understandings**
• How does structure relate to function in living systems from the organismal to the cellular level? • How is genetic information passed through generations? • What are the differences between asexual and sexual reproduction? • What is the evidence for the biotic origin of life? • What are the stages of the cell cycle? • What is the role of the cell cycle in organisms?	• Living systems from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • Identify the structures of chromosomes. • Distinguish between a diploid and a haploid cell. • Describe the events of cell cycle. • Identify phases of mitosis and explain major events in each phase. • Identify phases of meiosis and explain purpose of two divisions. • Compare egg and sperm production in animals. • Compare and contrast mitotic and meiotic divisions. • Compare sexual and asexual reproduction; identify advantages of sexual reproduction in terms of evolutionary fitness. • Analyze consequences of mistakes in the cell cycle and cell divisions (e.g. tumors, Down syndrome). • Explain how chromosomal abnormalities can be detected. • Demonstrate the ability to use karyotypes for detecting gender and chromosomal

	abnormalities in humans.

Unit Learning Targets
Students will…

- Describe the structure of a chromosome.
- Identify the differences in structure between prokaryotic chromosomes and eukaryotic chromosomes.
- Compare the number of chromosomes in different species.
- Explain the differences between sex chromosomes and autosomes.
- Distinguish between diploid and haploid cells.
- Describe the events of cell division in prokaryotes.
- Name the two parts of the cell that are equally divided during cell division in eukaryotes.
- Summarize the events of interphase.
- Describe the stages of mitosis.
- Compare cytokinesis in animal cells with cytokinesis in plant cells.
- Explain how cell division is controlled.
- Compare the end products of meiosis with those of mitosis.
- Summarize the events of meiosis I.
- Explain crossing-over and how it contributes to the production of unique individuals.
- Summarize the events of meiosis II.
- Compare spermatogenesis and oogenesis.
- Define sexual reproduction.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Quizzes
- Lab Reports
- Homework

Lesson Plans

Activities	*Timeframe*
• Teacher led discussion • M & M Comparison activity (Mitosis/Meiosis) • M & M phase recognition lab	Week 19
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Nine: DNA and Protein Synthesis

Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction. All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.

Unit Essential Questions

- How does structure relate to function in living systems from the organismal to the cellular level?
- How are matter and energy transferred/transformed in living systems?
- How is genetic information passed through generations?
- What happens in replication, transcription, and translation?
- What is the chemical basis of life?
- How do genes code for proteins?
- What is the relationship between DNA and proteins?
- What is the structure of DNA?
- How is DNA replicated?
- What are different types of mutations and how can they affect organisms?

Unit Enduring Understandings

- Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function.
- All organisms transfer matter and convert energy from one from to another. Both matter and energy are necessary to build and maintain structures within the organism.
- There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual).
- Examine the history of discovery of DNA's role and structure.
- Describe the molecular structure of DNA and relate it to the function.
- Summarize the process of DNA replication.
- Compare and contrast the structure and functions of DNA and RNA.
- Summarize the process of protein synthesis; define the purpose and steps of transcription and translation.
- Explain how genetic code works and decode short DNA and RNA strands into amino acid sequence.
- Explain how changes in codons may or may not lead to changes in proteins.
- Describe major types, causes, and effects of mutations.

Biology- Grade 10 Unit of Study

Unit title: DNA and Protein Synthesis

Unit summary: Griffith's experiments showed that hereditary material can pass from one bacterial cell to another. This is called transformation. Avery's work showed that DNA is the hereditary material that transfers information between bacterial cells. Hershey and Chase confirmed that DNA, and not protein, is the hereditary material. Watson and Crick created a model of DNA by using Franklin's and Wilkins's DNA diffraction X-rays. DNA is made of two nucleotide strands that wrap around each other in the shape of a double helix. A DNA nucleotide is made of a deoxyribose sugar, a phosphate group, and one of four nitrogenous bases: adenine (A), guanine (G), cytosine (C), or thymine (T). Nucleotides along each DNA strand are linked by covalent bonds. Complementary nitrogenous bases are bonded by hydrogen bonds. Hydrogen bonding between the complementary base pairs, G-C and A-T, holds the two strands of a DNA molecule together. DNA replication is the process by which DNA is copied in a cell before a cell divides. Replication begins with the separation of the DNA strands by helicases. Then, DNA polymerases form new strands by adding complementary nucleotides to each of the original strands. Each new DNA molecule is made of one strand of nucleotides from the original DNA molecule and one new strand. Changes in DNA are called mutations. Proofreading and repair prevent many replication errors. The flow of genetic information can be symbolized as DNA RNA protein. RNA has the sugar ribose instead of deoxyribose and uracil in place of thymine. RNA is single stranded and is shorter than DNA. During transcription, DNA acts as a template for directing the synthesis of RNA. The genetic code identifies the specific amino acids coded for by each mRNA codon. The RNA called mRNA carries the genetic "message" from the nucleus to the cytosol; rRNA is the major component of ribosomes; tRNA carries specific amino acids, helping to form polypeptides.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1-3), 5.3.12.A.1-6, 5.3.12.B.2, 5.3.12.D.1-3, 5.2.12.A.4

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.

5	Cell differentiation is regulated through the expression of different genes during the development of complex multicellular organisms.
6	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
7	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.
8	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
9	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.
10	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.
11	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.

Unit Essential Questions	**Unit Enduring Understandings**
• How does structure relate to function in living systems from the organismal to the cellular level? • How are matter and energy transferred/transformed in living systems? • How is genetic information passed through generations? • What happens in replication, transcription, and translation? • What is the chemical basis of life? • How do genes code for proteins? • What is the relationship between DNA and proteins? • What is the structure of DNA? • How is DNA replicated? • What are different types of mutations and how can they affect organisms?	• Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • All organisms transfer matter and convert energy from one from to another. Both matter and energy are necessary to build and maintain structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • Examine the history of discovery of DNA's role and structure. • Describe the molecular structure of DNA and relate it to the function. • Summarize the process of DNA replication. • Compare and contrast the structure and functions of DNA and RNA. • Summarize the process of protein synthesis; define the purpose and steps of transcription and translation. • Explain how genetic code works and decode short DNA and RNA strands into amino acid

	sequence. • Explain how changes in codons may or may not lead to changes in proteins. • Describe major types, causes, and effects of mutations.

Unit Learning Targets
Students will…

- Relate how Griffith's bacterial experiments showed that a hereditary factor was involved in transformation.
- Summarize how Avery's experiments led his group to conclude that DNA is responsible for transformation in bacteria.
- Describe how Hershey and Chase's experiment led to the conclusion that DNA, not protein, is the hereditary molecule in viruses.
- Evaluate the contributions of Franklin and Wilkins in helping Watson and Crick discover DNA's double helix structure.
- Describe the three parts of a nucleotide.
- Summarize the role of covalent and hydrogen bonds in the structure of DNA.
- Relate the role of base-pairing rules to the structure of DNA.
- Summarize the process of DNA replication.
- Identify the role of enzymes in the replication of DNA.
- Describe how complementary base pairing guides DNA replication.
- Compare the number of replication forks in prokaryotic and eukaryotic cells during DNA replication.
- Describe how errors are corrected during DNA replication.
- Outline the flow of genetic information in cells from DNA to protein.
- Compare the structure of RNA with that of DNA.
- Summarize the process of transcription.
- Describe the importance of the genetic code.
- Compare the role of mRNA, rRNA, and tRNA in translation.
- Identify the importance of learning about the human genome.

Evidence of Learning

Summative Assessment: Unit Test/DNA Timeline Project

Formative Assessments:

- Quizzes
- Lab Reports

Lesson Plans

Activities	*Timeframe*

• Teacher led discussion • Isolation of DNA Lab • Associated DNA video clips • Chromosome/Genome Database Project	Weeks 20-22
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Ten: Gene Expression

Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time. All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.

Unit Essential Questions	**Unit Enduring Understandings**
• How does structure relate to function in living systems from the organismal to the cellular level? • How is matter transferred and energy transferred/transformed in living systems? • How is genetic information passed through generations? • How does natural selection encourage inter and intra-specific diversity over time? • How do cells modify RNA after transcription? • How do point mutations change the amino acid sequence of a protein? • What is the function of the operon? • How do repressor genes affect the operon? • What role does the environment play on gene expression (transcription and translation)? • What are the similarities and differences in chromosomal structure, gene expression, and regulation of gene expression in prokaryotes and eukaryotes? • What are some applications of recombinant DNA technology, including	• Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • The diversity and changing of life forms over many generations is the result of natural selection in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. • Explain how the environment can affect gene expression. • Explain the mechanism of gene expression in prokaryotes (lac-operon). • Describe the connection between gene expression and cancer. • Evaluate the significance of Human Genome Project. • Summarize the gene manipulating techniques (e.g. recombinant DNA) and give an example of practical use (e.g. using bacteria to produce human insulin).

cloning?	• Describe the steps and use of PCR (polymerase chain reaction). • Summarize methods and uses of DNA fingerprinting. • Discuss the ethical issues in genetic engineering. • Describe the applications and critically evaluate the use of biotechnology in forensics, medicine, agriculture, and evolutionary biology.

Biology- Grade 10 Unit of Study

Unit title: Gene Expression

Unit summary: Gene expression is the activation of a gene that results in transcription and the production of mRNA. Only a fraction of any cell's genes are expressed at any one time. A promoter and an operator regulate the transcription of structural genes. In prokaryotes, the structural genes, the promoter, and the operator collectively form an operon. A promoter is the segment of DNA that is recognized by the enzyme RNA polymerase, which then initiates transcription. An operator is the segment of DNA that acts as a "switch" by controlling the access of RNA polymerase to the promoter. A repressor protein can inhibit genes from being expressed. Repressor proteins are coded for by regulator genes. A repressor protein attaches to the operator, physically blocking the advancement of RNA polymerase. An inducer is a molecule that initiates gene expression. In E. coli, lactose serves as an inducer. An inducer binds to the repressor protein. As a result, the shape of the repressor protein changes and the repressor protein detaches from the operator. RNA polymerase can then advance to the structural genes. Eukaryotes do not have operons. The genomes of eukaryotes are larger and more complex than those of prokaryotes. Eukaryotic genes are organized into noncoding sections, called introns, and coding sections, called exons. In eukaryotes, gene expression can be controlled after transcription—through the removal of introns from pre-mRNA—or at the onset of transcription—through the action of transcription factors. The development of specialized cells is called cell differentiation. The development of form in an organism is called morphogenesis. Both cell differentiation and morphogenesis are governed by gene expression. Homeotic genes are regulatory genes that determine where anatomical structures will be placed during development. Within each homeotic gene, a specific DNA sequence known as the homeobox regulates patterns of development. The homeoboxes of many eukaryotic organisms appear to be very similar. Mutations of proto-oncogenes or tumor-suppressor genes may lead to cancer. Cancer is the uncontrolled growth of abnormal cells. A carcinogen is any substance that can induce or promote cancer. Most carcinogens are mutagens, substances that cause mutations. Unlike normal cells, cancer cells continue to divide indefinitely, even if they become densely packed. Cancer cells will also continue dividing even if they are no longer attached to other cells.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1-3), 5.3.12.A.1-6, 5.3.12.B.2, 5.3.12.D.1-3, 5.3.12.E.1 & 2, 5.2.12.A.4

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.
5	Cell differentiation is regulated through the expression of different genes during the development of complex multicellular organisms.
6	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
7	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.
8	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
9	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.
10	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.
11	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.
12	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.

Unit Essential Questions	**Unit Enduring Understandings**
• How does structure relate to function in living systems from the organismal to the cellular level? • How is matter transferred and energy transferred/transformed in living systems? • How is genetic information passed through	• Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain

generations? • How does natural selection encourage inter and intra-specific diversity over time? • How do cells modify RNA after transcription? • How do point mutations change the amino acid sequence of a protein? • What is the function of the operon? • How do repressor genes affect the operon? • What role does the environment play on gene expression (transcription and translation)? • What are the similarities and differences in chromosomal structure, gene expression, and regulation of gene expression in prokaryotes and eukaryotes? • What are some applications of recombinant DNA technology, including cloning?	structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • The diversity and changing of life forms over many generations is the result of natural selection in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. • Explain how the environment can affect gene expression. • Explain the mechanism of gene expression in prokaryotes (lac-operon). • Describe the connection between gene expression and cancer. • Evaluate the significance of Human Genome Project. • Summarize the gene manipulating techniques (e.g. recombinant DNA) and give an example of practical use (e.g. using bacteria to produce human insulin). • Describe the steps and use of PCR (polymerase chain reaction). • Summarize methods and uses of DNA fingerprinting. • Discuss the ethical issues in genetic engineering. • Describe the applications and critically evaluate the use of biotechnology in forensics, medicine, agriculture, and evolutionary biology.

Unit Learning Targets
Students will…

- Explain why cells regulate gene expression.
- Discuss the role of operons in prokaryotic gene expression.
- Determine how repressor proteins and inducers affect transcription in prokaryotes.
- Describe the structure of a eukaryotic gene.
- Compare the two ways gene expression is controlled in eukaryotes.
- Summarize the role of gene expression in an organism's development.
- Describe the influence of homeotic genes in eukaryotic development.
- State the role of the homeobox in eukaryotic development.

- Summarize the effects of mutations in causing cancer.
- Compare the characteristics of cancer cells with those of normal cells.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Quizzes
- Class Activities

Lesson Plans

Activities	*Timeframe*
• Teacher led discussions • Homework for reinforcement • Glo-Green Bacterial transformation Lab	Week 23
Teacher Resources	*Teacher Note*
•Textbook • Lab materials •PowerPoint presentations	

Biology- Grade 10 Framework

Unit Eleven: Mendelian Genetics	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • How are matter and energy transferred/transformed in living systems? • How is genetic information passed through generations? • How does genotype affect phenotype?	**Unit Enduring Understandings** • Living systems from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • Describe Mendel's experiments and explain the results. • State, explain, and apply three Mendel's principles. • Correctly use and demonstrate understanding of genetics vocabulary. • Use probability and simple statistics to explain and predict the results of genetic crosses. • Use Punnett square to predict the results of monohybrid and dihybrid crosses. • Explain results of genetic crosses using knowledge of meiotic division.

Biology- Grade 10 Unit of Study

Unit title: Mendelian Genetics

Unit summary: The study of how characteristics are transmitted from parents to offspring is called genetics. Mendel observed seven characteristics of pea plants. Each characteristic occurred in two contrasting traits. Mendel concluded that inherited characteristics are controlled by factors that occur in pairs. The law of segregation states that a pair of factors is segregated, or separated, during the formation of gametes. Two factors for a characteristic are then combined when fertilization occurs and a new offspring is produced. The law of independent assortment states that factors for individual characteristics are distributed to gametes independently. The law of independent assortment is observed only for genes that are located on separate chromosomes or are far apart on the same chromosome. One allele for each trait is passed from each parent to the offspring. The genotype is the genetic makeup of an organism. The phenotype is the appearance of an organism. Probability is the likelihood that a specific event will occur. A Punnett square can be used to predict the outcome of genetic crosses. A cross in which one characteristic is tracked is a monohybrid cross. A testcross, in which an individual of unknown genotype is crossed with a homozygous recessive individual, can be used to determine the genotype of an individual whose phenotype expresses the dominant trait.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1-3), 5.3.12.A.1-6, 5.3.12.B.2, 5.3.12.D.1-3, 5.2.12.A.4

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.
5	Cell differentiation is regulated through the expression of different genes during the development of complex multi-cellular organisms.
6	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
7	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.
8	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.
9	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.

10	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.
11	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.

Unit Essential Questions

- How does structure relate to function in living systems from the organismal to the cellular level?
- How are matter and energy transferred/transformed in living systems?
- How is genetic information passed through generations?
- How does genotype affect phenotype?

Unit Enduring Understandings

- Living systems from the organismal to the cellular level, demonstrate the complementary nature of structure and function.
- All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
- There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual).
- Describe Mendel's experiments and explain the results.
- State, explain, and apply three Mendel's principles.
- Correctly use and demonstrate understanding of genetics vocabulary.
- Use probability and simple statistics to explain and predict the results of genetic crosses.
- Use Punnett square to predict the results of monohybrid and dihybrid crosses.
- Explain results of genetic crosses using knowledge of meiotic division.

Unit Learning Targets

Students will…

- Describe how Mendel was able to control how his pea plants were pollinated.
- Describe the steps in Mendel's experiments on true-breeding garden peas.
- Distinguish between dominant and recessive traits.
- State two laws of heredity that were developed from Mendel's work.
- Describe how Mendel's results can be explained by scientific knowledge of genes and chromosomes.
- Differentiate between the genotype and the phenotype of an organism.
- Explain how probability is used to predict the results of genetic crosses.
- Use a Punnett square to predict the results of monohybrid and dihybrid genetic crosses.

- Explain how a testcross is used to show the genotype of an individual whose phenotype expresses the dominant trait.
- Differentiate a monohybrid cross from a dihybrid cross.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Vocabulary Quiz
- Genetic Problem Worksheets
- Lab Reports

Lesson Plans

Activities	*Timeframe*
• Sponge Bob Lab Activity • Teacher Discussion • Virtual Genetics Activity	Week 24
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations • Computer Lab	

Biology- Grade 10 Framework

Unit Twelve: Inheritance Patterns	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time.	
Unit Essential Questions • What are the different patterns of inheritance? • How can the probability of inheritance be predicted?	**Unit Enduring Understandings** • Define sex-linked inheritance and give examples of sex-linked traits in humans. • Distinguish between cases of inheritance by complete dominance, co-dominance, incomplete dominance, and sex-linked. • Determine the mode of inheritance of a trait using a pedigree chart. • Distinguish between polygenic traits and traits determined by multiple alleles. • List and explain the pattern of inheritance of four traits in humans, including at least four genetic diseases (e.g. – hemophilia, cystic fibrosis).

Biology- Grade 10 Unit of Study

Unit title: Inheritance Patterns

Unit summary: Complete dominance occurs when heterozygous individuals and dominant homozygous individuals are indistinguishable in phenotype. Incomplete dominance occurs when two or more alleles influence the phenotype and results in a phenotype intermediate between the dominant trait and the recessive trait. Co dominance occurs when both alleles for a gene are expressed in a heterozygous offspring. A cross in which two characteristics are tracked is a dihybrid cross. The offspring of a dihybrid cross are called dihybrids. Genes reside on chromosomes. Sex chromosomes contain genes that determine an organism's sex. The remaining chromosomes that are not directly involved in determining the sex of an individual are called autosomes. Genes found on the X chromosome are X-linked genes. A sex-linked trait is a trait

whose allele is located on a sex chromosome. Because males have only one X chromosome, a male who carries a recessive allele on the X or Y chromosome will exhibit the sex-linked condition. Pairs of genes that tend to be inherited together are called linked genes. Researchers use recombinant percentages to construct chromosome maps showing relative gene positions. Germ-cell mutations occur in gametes and can be passed on to offspring. Somatic-cell mutations occur in body cells and affect only the individual organism. Chromosome mutations are changes in the structure of a chromosome or the loss or gain of an entire chromosome. Gene mutations are changes in one or more of the nucleotides in a gene. Geneticists use pedigrees to trace diseases or traits through families. Pedigrees reveal inheritance patterns of genes. Polygenic characters, such as skin color, are controlled by two or more genes. Complex characters, such as height, are influenced by both genes and environment. Multiple-allele characters, such as ABO blood groups, are controlled by three or more alleles of a gene. A sex-influenced trait, such as pattern baldness, is expressed differently in men than in women even if it is on an autosome and both sexes have the same genotype. Genetic screening examines a person's genetic makeup and potential risks of passing disorders to offspring. Amniocentesis and chorionic villi sampling help physicians test a fetus for the presence of genetic disorders. Genetic counseling informs screened individuals about problems that might affect their offspring.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1-3), 5.3.12.A.1-6, 5.3.12.B.2, 5.3.12.D.1-3, 5.3.12.E.1 & 2, 5.2.12.A.4

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.
5	Cell differentiation is regulated through the expression of different genes during the development of complex multi-cellular organisms.
6	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
7	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.
8	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.
9	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered

	gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
10	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.
11	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.
12	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
13	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.

Unit Essential Questions

- What are the different patterns of inheritance?
- How can the probability of inheritance be predicted?

Unit Enduring Understandings

- Define sex-linked inheritance and give examples of sex-linked traits in humans.
- Distinguish between cases of inheritance by complete dominance, co-dominance, incomplete dominance, and sex-linked.
- Determine the mode of inheritance of a trait using a pedigree chart.
- Distinguish between polygenic traits and traits determined by multiple alleles.
- List and explain the pattern of inheritance of four traits in humans, including at least four genetic diseases (e.g. – hemophilia, cystic fibrosis).

Unit Learning Targets

Students will…

- Distinguish between sex chromosomes and autosomes.
- Explain the role of sex chromosomes in sex determination.
- Describe how an X- or Y-linked gene affects the inheritance of traits.
- Explain the effect of crossing-over on the inheritance of genes in linkage groups.
- Distinguish between chromosome mutations and gene mutations.
- Analyze pedigrees to determine how genetic traits and genetic disorders are inherited.
- Summarize the different patterns of inheritance seen in genetic traits and genetic disorders.
- Explain the inheritance of ABO blood groups.
- Compare sex-linked traits with sex-influenced traits.
- Explain how geneticists can detect and treat genetic disorders.

Evidence of Learning

Summative Assessment: Unit Test
Formative Assessments: • Vocabulary Quiz • Genetic Problem Worksheets • Lab Reports

Lesson Plans	
Activities	*Timeframe*
• Teacher Discussion • Virtual Genetics Activity	Weeks 25-26
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Thirteen: Gene Technologies	
Big Idea: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions. Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms. Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time. All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.	
Unit Essential Questions • How does structure relate to function in living systems from the organismal to the cellular level? • How are matter and energy transferred/transformed in living systems? • How is genetic information passed through generations? • How does natural selection encourage inter and intra-specific diversity over time? • What is gene therapy? • How is gene therapy done? • Are there ethical, legal and social implications of gene therapy?	**Unit Enduring Understandings** • Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function. • All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • The diversity and changing of life forms over many generations is the result of natural selection in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. • Gene therapy is a treatment or cure for diseases caused by defective genes. • Gene therapy, like all new genetic technologies, raises ethical and social issues about how it should be used.

Biology- Grade 10 Unit of Study

Unit title: Gene Technologies

Unit summary: DNA technology provides the tools to manipulate DNA molecules for practical purposes. The repeating sequences in noncoding DNA vary between individuals and thus can be used to identify an individual. To identify a DNA sample, scientists isolate the DNA and copy it using the polymerase chain reaction (PCR). The DNA is then cut into fragments using restriction enzymes. The fragments are separated by size using gel electrophoresis. The resulting pattern is compared to the pattern from a known sample of DNA treated in the same way. Restriction enzymes recognize and cut specific nucleotide sequences. This process creates single chains called sticky ends on the ends of each piece of DNA. The enzyme DNA ligase can rejoin sticky ends and connect DNA fragments. Researchers use restriction enzymes to insert DNA fragments into vectors. The resulting DNA from two different organisms is called recombinant DNA. The goals of the Human Genome Project were to determine the nucleotide sequence of the entire human genome and map the location of every gene on each chromosome. This information will advance the diagnosis, treatment, and prevention of human genetic disorders. The Human Genome Project yielded important information about human genes and proteins. For example, there are far fewer protein-encoding human genes than once believed but far more proteins because of the complex way they are encoded. The Human Genome Project included sequencing the genes of many model species to provide insights into gene function. Information from the Human Genome Project has been applied to medical, commercial, and scientific purposes. Bioinformatics uses computers to catalog and analyze genomes. Microarrays, two-dimensional arrangements of cloned genes, allow researchers to compare specific genes such as those that cause cancer. Proteomics studies the identities, structures, interactions, and abundances of an organism's proteins. Genetic engineering is being used to provide therapies for certain genetic diseases. Gene therapy refers to treating genetic disorders by correcting a defect in a gene or by providing a normal form of a gene. Researchers hope that gene therapy can be used to cure genetic disorders in the future. In cloning by nuclear transfer, a nucleus from a body cell of one individual is introduced into an egg cell (without its nucleus) from another individual. An organism identical to the nucleus donor results. Genetic engineering is used to produce disease-resistant, pest-resistant, and herbicide-resistant crops in an effort to improve the yields and nutrition of the human food supply. Some people fear that the release of genetically modified organisms would pose a separate environmental risk. Many safety, environmental, and ethical issues involved in genetic engineering have not been resolved. Genetic disorders are treated in various ways. Among the treatments are symptom-relieving treatments and symptom-prevention measures, such as insulin injections for diabetes. Gene therapy is a type of treatment under development. In gene therapy, a defective gene is replaced with a copy of a healthy gene. Somatic cell gene therapy alters only body cells. Germ cell gene therapy attempts to alter eggs or sperm.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1-3), 5.3.12.A.1-6, 5.3.12.B.2, 5.3.12.C.2, 5.3.12.D.1-3, 5.3.12.E.1-4, 5.2.12.A.4

Content Statements:

1	Cells are made of complex molecules that consist mostly of a few elements. Each class of

	molecules has its own building blocks and specific functions.
2	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.
3	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.
4	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.
5	Cell differentiation is regulated through the expression of different genes during the development of complex multi-cellular organisms.
6	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.
7	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.
8	Stability in an ecosystem can be disrupted by natural or human interactions.
9	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.
10	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
11	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.
12	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
13	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.
14	The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.
15	Evolution occurs as a result of a combination of the following factors: Ability of a species to reproduce; Genetic variability of offspring due to mutation and recombination of genes; Finite supply of the resources required for life; Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring.
16	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.

Unit Essential Questions	**Unit Enduring Understandings**
• How does structure relate to function in living systems from the organismal to the cellular level?	• Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function.

• How are matter and energy transferred/transformed in living systems? • How is genetic information passed through generations? • How does natural selection encourage inter and intra-specific diversity over time? • What is gene therapy? • How is gene therapy done? • Are there ethical, legal and social implications of gene therapy?	• All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. • There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual). • The diversity and changing of life forms over many generations is the result of natural selection in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. • Gene therapy is a treatment or cure for diseases caused by defective genes. • Gene therapy, like all new genetic technologies, raises ethical and social issues about how it should be used.

Unit Learning Targets
Students will…

- Living systems, from the organismal to the cellular level, demonstrate the complementary nature of structure and function.
- All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
- There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (sexual or asexual).
- The diversity and changing of life forms over many generations is the result of natural selection in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring.
- Gene therapy is a treatment or cure for diseases caused by defective genes.
- Gene therapy, like all new genetic technologies, raises ethical and social issues about how it should be used.

Evidence of Learning

Summative Assessment: Gene Technologies Research project

Formative Assessments:

- Vocabulary Quiz
- Virtual Lab Activity

Lesson Plans	
Activities	*Timeframe*
• Teacher lecture and discussion • Virtual Lab Activity for DNA recombination, Blotting, Sequencing, and Assays	Weeks 27-28
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Fourteen: Evolution	
Big Idea: All animals and most plants depend on both other organisms and their environment to meet their basic needs. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time.	
Unit Essential Questions • What are the major points of Darwin's Theory of Natural Selection? • What evidence is used to explain biological evolution? • How are natural selection and species adaptations related? • What are examples of environmental changes that can cause the formation or extinction of species?	**Unit Enduring Understandings** • Outline modern scientific understanding of the formation of Earth. • Outline the major events and timing of history of life on Earth. • Explain how the fossil record can help us to study history of life and how the age of fossils can be determined. • Describe the evidence that species have changed over time (geological, anatomical, embryological, and molecular). • Explain the major statements of Darwin's evolutionary theory. • Explain the mechanism of natural selection. • Explain the role of adaptations and give examples of adaptations in organisms. • Demonstrate understanding of genetic causes of changes in species. • Explain how biotechnology can be used to determine relationships between species. • Discuss how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process. • Predict possible evolutionary implications for a population due to environmental change over time (e.g., volcanic eruption, pollution). • Compare and contrast the theory of punctuated equilibrium and gradualism. • Describe the current scientific understanding of human evolution and relationship to other species.

Unit title: Evolution

Unit summary: Evolution is the process of change in the inherited characteristics within populations over generations such that new types of organisms develop from preexisting types. After making many observations and considering ideas of other scientists, both Darwin and Wallace proposed the theory of natural selection to explain evolution. Darwin wrote On the Origin of Species, in which he argued that descent with modification occurs, that all species descended from common ancestors, and that natural selection is the mechanism for evolution. Organisms in a population adapt to their environment as the proportion of individuals with genes for favorable traits increases. Those individuals that pass on more genes are considered to have greater fitness. Evidence of evolution can be found by comparing several kinds of data, including the fossil record, biogeography, anatomy and development, and biological molecules. Evolutionary theories are supported when several kinds of evidence support similar conclusions. Geologic evidence supports theories about the age and development of Earth. In organisms, analogous structures are similar in function but have different evolutionary origins. Homologous structures have a common evolutionary origin. A species with a vestigial structure probably shares ancestry with a species that has a functional form of the structure. Related species show similarities in embryological development. Similarity in the subunit sequences of biological molecules such as RNA, DNA, and proteins indicates a common evolutionary history. Modern scientists integrate Darwin's theory with other advances in biological knowledge. Theories and hypotheses about evolution continue to be proposed and investigated. Ongoing examples of evolution among living organisms can be observed, recorded, and tested. In divergent evolution, related populations become less similar as they respond to different environments. Adaptive radiation is the divergent evolution of a single group of organisms in a new environment. In convergent evolution, organisms that are not closely related resemble each other because they have responded to similar environments.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1 & 2), 5.3.12.C.1-2, 5.3.12.E.1-4, 5.4.12.B.1 & 3

Content Statements:

1	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.
2	Stability in an ecosystem can be disrupted by natural or human interactions.
3	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
4	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various

	lines of descent branched.
5	The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.
6	Evolution occurs as a result of a combination of the following factors: Ability of a species to reproduce; Genetic variability of offspring due to mutation and recombination of genes; Finite supply of the resources required for life; Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring.
7	The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen gas.
8	Absolute dating, using radioactive isotopes in rocks, makes it possible to determine how many years ago a given rock sample formed.

Unit Essential Questions	**Unit Enduring Understandings**
• What are the major points of Darwin's Theory of Natural Selection? • What evidence is used to explain biological evolution? • How are natural selection and species adaptations related? • What are examples of environmental changes that can cause the formation or extinction of species?	• Outline modern scientific understanding of the formation of Earth. • Outline the major events and timing of history of life on Earth. • Explain how the fossil record can help us to study history of life and how the age of fossils can be determined. • Describe the evidence that species have changed over time (geological, anatomical, embryological, and molecular). • Explain the major statements of Darwin's evolutionary theory. • Explain the mechanism of natural selection. • Explain the role of adaptations and give examples of adaptations in organisms. • Demonstrate understanding of genetic causes of changes in species. • Explain how biotechnology can be used to determine relationships between species. • Discuss how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process. • Predict possible evolutionary implications for a population due to environmental change over time (e.g., volcanic eruption, pollution). • Compare and contrast the theory of punctuated equilibrium and gradualism. • Describe the current scientific understanding of human evolution and relationship to other

	species.

Unit Learning Targets
Students will…

- Compare the principle of biogenesis with the idea of spontaneous generation.
- Summarize the results of experiments by Redi and by Spallanzani that tested the hypothesis of spontaneous generation.
- Describe how Pasteur's experiment disproved the hypothesis of spontaneous generation.
- Outline the modern scientific understanding of the formation of Earth.
- Summarize the concept of half-life.
- Describe the production of organic compounds in the Miller-Urey apparatus.
- Summarize the possible importance of cell-like structures produced in the laboratory.
- Explain the importance of the chemistry of RNA in relation to the origin of life.
- List three inferred characteristics that describe the first forms of cellular life on Earth.
- Compare the two types of autotrophy used by early cells.
- Relate the development of photosynthesis to the development of aerobic respiration in early cells.
- Explain the theory of endosymbiosis.
- Define the biological process of evolution.
- Summarize the history of scientific ideas about evolution.
- Describe Charles Darwin's contributions to scientific thinking about evolution.
- Analyze the reasoning in Darwin's theory of evolution by natural selection.
- Relate the concepts of adaptation and fitness to the theory of natural selection.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Vocabulary Quiz
- Galapagos Beyond Darwin Video
- Lab Reports

Lesson Plans

Activities	*Timeframe*
• Teacher Discussion • Virtual Evolution Activity	Week 29
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Fifteen: Population Genetics	
Big Idea: All animals and most plants depend on both other organisms and their environment to meet their basic needs. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time. From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes.	
Unit Essential Questions • What factors contribute to the diversity of a population? • What is the Hardy-Weinberg principle?	**Unit Enduring Understandings** • Change in the genetic makeup of a population over time is evolution. • Organisms are linked by lines of descent from common ancestry. • Competition and cooperation are important aspects of biological systems. • Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Biology- Grade 10 Unit of Study

Unit title: Population Genetics

Unit summary: Populations can be measured in terms of size, density, dispersion, growth rate, age structure, and survivorship. A population's size is the number of individuals that the population contains. Density is a measure of how crowded the population is. Dispersion describes the distribution of individuals within the population and may be random, uniform, or clumped. A population's age structure indicates the percentage of individuals at each age. Populations show three patterns of mortality: Type I (low mortality until late in life), Type II (constant mortality throughout life), and Type III (high mortality early in life followed by low mortality for the remaining life span). The exponential model describes perpetual growth at a steady rate in a population. The model assumes constant birth and death rates and no immigration or emigration. In the logistic model, birth rates fall and death rates climb as the population grows. When the carrying capacity is reached, the population becomes stable. Population-limiting factors are density-dependent if the effect on each individual depends on the number of other individuals present in the same area. Small populations have low genetic diversity and are subject to inbreeding, so they are less likely to adapt to environmental changes. About 10,000 to 12,000 years ago, the development of agriculture increased the growth rate of the human population. Around 1650, improvements in hygiene, diet, and economic conditions further accelerated population growth. After World War II, the human population grew at the

fastest rate in history, largely because of better sanitation and medical care in poorer countries. Today, developing countries have faster human population growth and lower standards of living than developed countries do.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: : (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1 & 2), 5.3.12.C.1-2, 5.3.12.E.1-4, 5.4.12.B.1 & 3

Content Statements:

1	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.
2	Stability in an ecosystem can be disrupted by natural or human interactions.
3	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
4	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.
5	The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.
6	Evolution occurs as a result of a combination of the following factors: Ability of a species to reproduce; Genetic variability of offspring due to mutation and recombination of genes; Finite supply of the resources required for life; Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring.
7	The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen gas.
8	Absolute dating, using radioactive isotopes in rocks, makes it possible to determine how many years ago a given rock sample formed.

Unit Essential Questions

- What factors contribute to the diversity of a population?
- What is the Hardy-Weinberg principle?

Unit Enduring Understandings

- Change in the genetic makeup of a population over time is evolution.
- Organisms are linked by lines of descent from common ancestry.
- Competition and cooperation are important aspects of biological systems.
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Unit Learning Targets
Students will…

- Identify traits that vary in populations and that may be studied.
- Explain the importance of the bell curve to population genetics.
- Compare three causes of genotypic variation in a population.
- Calculate allele frequency and phenotype frequency.
- Explain Hardy-Weinberg genetic equilibrium.
- List five conditions under which evolution may take place.
- Explain how migration can affect the genetics of populations.
- Explain how genetic drift can affect populations of different sizes.
- Contrast the effects of stabilizing selection, directional selection, and disruptive selection on populations over time.
- Identify examples of nonrandom mating.
- Relate the biological species concept to the modern definition of species.
- Explain how the isolation of populations can lead to speciation.
- Compare two kinds of isolation and the pattern of speciation associated with each.
- Contrast the model of punctuated equilibrium with the model of gradual change.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Vocabulary Quiz
- Population Genetics Study
- Homework Worksheets

Lesson Plans

Activities	*Timeframe*
• Vocabulary Quiz • Population Genetics Study	Weeks 30-31
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Sixteen: Introduction to Ecology & Ecosystems	
Big Idea: All animals and most plants depend on both other organisms and their environment to meet their basic needs. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time. From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes. Earth's composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life. Internal and external sources of energy drive Earth systems. The biogeochemical cycles in the Earth systems include the flow of microscopic and macroscopic resources from one reservoir in the hydrosphere, geosphere, atmosphere, or biosphere to another, are driven by Earth's internal and external sources of energy, and are impacted by human activity.	
Unit Essential Questions • How can change in one part of an ecosystem affect change in other parts of the ecosystem? • How does matter and energy link organisms to each other and their environments? Why is sunlight essential to life on Earth? • What is ecology and how is it studied? • How does natural selection drive evolution and behavior? • What behaviors are important to animal survival?	**Unit Enduring Understandings** • Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system. • Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the sun flows irreversibly through ecosystems and is conserved as organisms use and transform it. • Ecology is the study of plants, animals, and non-living factors in the environment. • Animal behaviors help organisms survive and are the result of genetic and environmental influences.

Biology- Grade 10 Unit of Study

Unit title: Introduction to Ecology & Ecosystems

Unit summary: Species interact with both other species and their nonliving environment. Interdependence is a theme in ecology, and states that one change can affect all species in an ecosystem. Ecological models help to explain the environment. Ecology is usually organized into five levels: organism, population, community, ecosystem, and biosphere. Both biotic, or living, factors and abiotic, or nonliving, factors influence organisms. Examples of nonliving things are climate, sunlight, and pH. A niche is a way of life, or a role in an ecosystem. Some

species survive unfavorable environmental conditions by becoming dormant or by migrating. Most producers are photosynthetic and make carbohydrates by using energy from the sun. Consumers obtain energy by eating other organisms and include herbivores, omnivores, carnivores, detritivores, and decomposers. Decomposers feed on dead organisms and wastes, which releases the nutrients back into the environment. A single pathway of energy transfer is a food chain. A network showing all paths of energy transfer is a food web. Ecosystems contain only a few trophic levels because there is a low rate of energy transfer between each level. Key processes in the water cycle are evaporation, transpiration, and precipitation. Photosynthesis and cellular respiration are the two main steps in the carbon cycle. Nitrogen-fixing bacteria are important in the nitrogen cycle because they change nitrogen gas into a usable form of nitrogen for plants. Phosphorus moves from phosphate deposited in rock, to the soil, to living organisms, and finally to the ocean.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1 & 2), 5.3.12.C.1-2, 5.3.12.E.1-4, 5.4.12.B.1 & 3, 5.4.12.C.2, 5.4.12.E.2, 5.4.12.G.2-4 & 6

Content Statements:

1	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.
2	Stability in an ecosystem can be disrupted by natural or human interactions.
3	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
4	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.
5	The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.
6	Evolution occurs as a result of a combination of the following factors: Ability of a species to reproduce; Genetic variability of offspring due to mutation and recombination of genes; Finite supply of the resources required for life; Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring.
7	The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen gas.
8	Absolute dating, using radioactive isotopes in rocks, makes it possible to determine how many years ago a given rock sample formed.
9	The chemical and physical properties of the vertical structure of the atmosphere support life on Earth.
10	Earth systems have internal and external sources of energy, both of which create heat.
11	Natural ecosystems provide an array of basic functions that affect humans. These functions

	include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.
12	Movement of matter through Earth's system is driven by Earth's internal and external sources of energy and results in changes in the physical and chemical properties of the matter.
13	Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.
14	Scientific, economic, and other data can assist in assessing environmental risks and benefits associated with societal activity.

Unit Essential Questions

- How can change in one part of an ecosystem affect change in other parts of the ecosystem?
- How does matter and energy link organisms to each other and their environments? Why is sunlight essential to life on Earth?
- What is ecology and how is it studied?
- How does natural selection drive evolution and behavior?
- What behaviors are important to animal survival?

Unit Enduring Understandings

- Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system.
- Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the sun flows irreversibly through ecosystems and is conserved as organisms use and transform it.
- Ecology is the study of plants, animals, and non-living factors in the environment.
- Animal behaviors help organisms survive and are the result of genetic and environmental influences.

Unit Learning Targets

Students will…

- Identify a key theme in ecology.
- Describe an example showing the effects of interdependence upon organisms in their environment.
- Identify the importance of models to ecology.
- State the five different levels of organization at which ecology can be studied.
- Compare abiotic factors with biotic factors, and list two examples of each.
- Describe two mechanisms that allow organisms to survive in a changing environment.
- Explain the concept of the niche.
- Summarize the role of producers in an ecosystem.
- Identify several kinds of consumers in an ecosystem.
- Explain the important role of decomposers in an ecosystem.
- Compare the concept of a food chain with that of a food web.
- Explain why ecosystems usually contain only a few trophic levels.
- List four major biogeochemical cycles.
- Summarize three important processes in the water cycle.

- Outline the major steps in the carbon cycle.
- Describe the role of decomposers in the nitrogen cycle.
- Summarize the major steps of the phosphorus cycle.

Evidence of Learning

Summative Assessment: Unit Test or Culminating Project

Formative Assessments:

- Vocabulary Quiz
- Homework Quiz
- Homework assignments

Lesson Plans

Activities	*Timeframe*
• Teacher Discussion • Research project for ecosystems • Bio-dome Video	Week 32
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Seventeen: Community Ecology	
Big Idea: All animals and most plants depend on both other organisms and their environment to meet their basic needs. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time. From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes. Earth's composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life. Internal and external sources of energy drive Earth systems. The biogeochemical cycles in the Earth systems include the flow of microscopic and macroscopic resources from one reservoir in the hydrosphere, geosphere, atmosphere, or biosphere to another, are driven by Earth's internal and external sources of energy, and are impacted by human activity.	
Unit Essential Questions • What are the important characteristics of populations and communities? • What factors help to create a community?	**Unit Enduring Understandings** • A community exists due to complex interactions amongst plants, animals, and the environment. Ecologists learn about communities through various sampling techniques.

Biology- Grade 10 Unit of Study

Unit title: Community Ecology

Unit summary: Ecologists recognize five major kinds of species interactions in communities: predation, parasitism, competition, mutualism, and commensalism. Predation is an interaction in which one organism (the predator) captures and eats another organism (the prey). Predators have adaptations to efficiently capture prey, whereas prey species have adaptations to avoid capture. Mimicry is an adaptation in which a species gains an advantage by resembling another species or object. Competition may cause competitive exclusion, the elimination of one species in a community. Competition may also drive the evolution of niche differences among competitors. In parasitism, one species (the parasite) feeds on, but does not always kill, another species (the host). In mutualism, both interacting species benefit. In commensalism, one species benefits, and the other is not affected. Species richness is the number of species in a community. Species evenness is the relative abundance of each species. In general, species richness is greatest near the equator, and larger areas support more species. Species interactions such as predation can promote species richness. Disturbances can alter a community by eliminating or removing organisms or altering resource availability. Species richness may improve a community's stability. Areas of low species richness may be less stable in the event of an ecological

disturbance. Ecological succession is a change in the species composition of a community over time. Primary succession is the assembly of a community on newly created habitat. Secondary succession is the change in an existing community following a disturbance. Primary succession occurs in areas that have been recently exposed to the elements and lack soil. Primary succession typically proceeds from lichens and mosses to a climax community. Secondary succession occurs in areas where the original ecosystem has been cleared by a disturbance. Secondary succession typically proceeds from weeds to a climax community.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy, Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1 & 2), 5.3.12.C.1-2, 5.3.12.E.1-4, 5.4.12.B.1 & 3, 5.4.12.C.2, 5.4.12.E.2, 5.4.12.G.2-4 & 6

Content Statements:

1	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.
2	Stability in an ecosystem can be disrupted by natural or human interactions.
3	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
4	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.
5	The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.
6	Evolution occurs as a result of a combination of the following factors: Ability of a species to reproduce; Genetic variability of offspring due to mutation and recombination of genes; Finite supply of the resources required for life; Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring.
7	The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen gas.
8	Absolute dating, using radioactive isotopes in rocks, makes it possible to determine how many years ago a given rock sample formed.
9	The chemical and physical properties of the vertical structure of the atmosphere support life on Earth.
10	Earth systems have internal and external sources of energy, both of which create heat.
11	Natural ecosystems provide an array of basic functions that affect humans. These functions include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.
12	Movement of matter through Earth's system is driven by Earth's internal and external sources of energy and results in changes in the physical and chemical properties of the matter.

13	Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.
14	Scientific, economic, and other data can assist in assessing environmental risks and benefits associated with societal activity.

Unit Essential Questions	**Unit Enduring Understandings**
• What are the important characteristics of populations and communities? • What factors help to create a community?	• A community exists due to complex interactions amongst plants, animals, and the environment. Ecologists learn about communities through various sampling techniques.

Unit Learning Targets
Students will…

- Identify two types of predator adaptations and two types of prey adaptations.
- Identify possible causes and results of inter-specific competition.
- Compare parasitism, mutualism, and commensalism, and give one example of each.
- Describe the factors that affect species richness in a community.
- Explain how disturbances affect community stability.
- Distinguish between types of succession, and explain why succession might not be predictable.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Vocabulary Quiz
- Homework Worksheets
- Homework Quiz

Lesson Plans

Activities	*Timeframe*
• Teacher Lead Discussion	Week 33
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	

Biology- Grade 10 Framework

Unit Eighteen: Humans and the Environment	
Big Idea: All animals and most plants depend on both other organisms and their environment to meet their basic needs. Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time. From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes. Earth's composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life. Internal and external sources of energy drive Earth systems. The biogeochemical cycles in the Earth systems include the flow of microscopic and macroscopic resources from one reservoir in the hydrosphere, geosphere, atmosphere, or biosphere to another, are driven by Earth's internal and external sources of energy, and are impacted by human activity.	
Unit Essential Questions • How do humans have an impact on the diversity and stability of ecosystems? • Why should people consider the risks and benefits before the production of new materials and/or the implementation of a new process?	**Unit Enduring Understandings** • Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system. • People develop new materials as a response to the needs of society and the pursuit of knowledge. This development may have risks and benefits to humans and the environment.

Biology- Grade 10 Unit of Study

Unit title: Humans and the Environment
Unit summary: Earth's geosphere, hydrosphere, and atmosphere are interconnected in many ways. Life exists in parts of each sphere. Together, these parts make up the biosphere. Important parts of the atmosphere are greenhouse gases, which trap heat on Earth, and the ozone layer, which shields Earth from UV radiation. A very small portion of the hydrosphere is fresh water, and much of this fresh water is not easily usable. Biodiversity refers to the variety of life found in an area and can be measured in different ways, including by species richness, species evenness, and genetic diversity. Biodiversity is valued for various reasons. Over a short time period, human activities have affected global ecosystems in ways that harm humans and other species. Human impacts range from local pollution to global change in ecosystems. Industrial chemicals called chlorofluorocarbons (CFCs) act as catalysts in chemical reactions that break down O3 molecules in the ozone layer. Most countries have banned CFCs, and the ozone layer seems to be recovering. The correlation of increasing atmospheric CO2 and rising global temperature suggests a cause-and-effect relationship. Considering several types of evidence,

many scientists have concluded that increased CO2 levels have caused warmer surface temperatures on Earth. Certain air pollutants cause acid precipitation, which harms or kills many organisms. The release of toxic chemicals, such as DDT, into the biosphere can impact ecosystems in many ways, especially when chemicals undergo biological magnification. Human impacts on the environment are causing an increasing number of extinctions. Important causes of extinctions are habitat destruction, the transfer of invasive species to new habitats, and overharvesting or hunting. This loss of species has both known and unknown effects on ecosystems. Current levels of human resource use are probably not sustainable. Conservation biologists are concerned with identifying and maintaining ecosystems, while restoration biologists are usually involved with repairing badly damaged ecosystems. Populations of many migratory birds, such as the whooping crane, are in decline because of human activities. However, some populations are recovering as a result of legal protection, breeding programs, habitat restoration, and international partnerships. International and cooperative efforts to preserve habitat and prevent extinctions include identifying biodiversity hotspots, making debt-for-nature swaps, and promoting ecotourism. Environmental problems can be addressed through the combined efforts of governments, scientists, businesses, and individuals. The Everglades restoration project is the most ambitious ecosystem-wide restoration project attempted in the United States.

Primary interdisciplinary connections: History, Mathematics, Science

21st Century Themes: Global Awareness, Health Literacy**,** Financial, Economic, Business and Entrepreneurial Literacy

Learning Targets

Standards: (5.1.12.A.1-3, 5.1.12.B.1- 3, 5.1.12.C.1-3, 5.1.12.D.1 & 2), 5.3.12.C.1-2, 5.3.12.E.1-4, 5.4.12.B.1 & 3, 5.4.12.C.2, 5.4.12.E.2, 5.4.12.G.2-6

Content Statements:

1	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.
2	Stability in an ecosystem can be disrupted by natural or human interactions.
3	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.
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	many years ago a given rock sample formed.
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11	Natural ecosystems provide an array of basic functions that affect humans. These functions include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.
12	Movement of matter through Earth's system is driven by Earth's internal and external sources of energy and results in changes in the physical and chemical properties of the matter.
13	Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.
14	Human activities have changed Earth's land, oceans, and atmosphere, as well as its populations of plant and animal species.
15	Scientific, economic, and other data can assist in assessing environmental risks and benefits associated with societal activity.

Unit Essential Questions	**Unit Enduring Understandings**
• How do humans have an impact on the diversity and stability of ecosystems? • Why should people consider the risks and benefits before the production of new materials and/or the implementation of a new process?	• Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system. • People develop new materials as a response to the needs of society and the pursuit of knowledge. This development may have risks and benefits to humans and the environment.

Unit Learning Targets

Students will…

- Explain the importance of the study of environmental science.
- Describe Earth's major layers.
- Explain the natural functions of the ozone layer and greenhouse effect.
- Summarize the ways in which biologists measure biodiversity.
- Discuss the value of biodiversity.
- Describe major consequences of air pollution.
- Relate air pollution to effects on global climate.
- Describe how chemical pollutants may undergo the process of biological magnification.
- Identify the primary causes of modern extinctions.
- Explain why extinctions and ecosystem disruption are of concern to humans.
- Relate human resource use to its impacts on ecosystems.
- State the goals of conservation and restoration biology.
- Describe examples of efforts to protect species and their habitats.
- Summarize international strategies for protecting entire ecosystems.

- Discuss the roles of governments and laws in addressing environmental problems.
- List several things that individuals can do to help solve environmental problems.

Evidence of Learning

Summative Assessment: Unit Test

Formative Assessments:

- Vocabulary Quiz
- "An Inconvenient Truth" Video
- Homework Worksheets

Lesson Plans

Activities	*Timeframe*
• Teacher Lead Discussion • Video • Research assignments	Week 34
Teacher Resources	*Teacher Note*
• Textbook • Lab materials • PowerPoint presentations	