



Standards Overview

Shanghai American School

Science



Grade 6

Define Scientific Facts, Concepts

Standard I Define scientific facts, concepts, and terminology Electricity and Magnetism

- 6EM-1.1 Identify the names, locations, and charges of the major subatomic particles (protons, neutrons, and electrons) [11]
- 6EM-1.2 Identify the interaction of like and unlike charges (magnetic poles, subatomic particles, static electric charges) [9]
- 6EM-1.3 Demonstrate ways in which charges can be transferred (friction, induction, conduction) [9]
- 6EM-1.4 Demonstrate an understanding of the relationship among current, resistance, and voltage [4]
- 6EM-1.5 Identify the parts of an electrical circuit (energy source, conductor, and load) [9]
- 6EM-1.6 Identify practical uses of transferring electrical energy into other forms of energy (to

Grade 7

Define Scientific Facts, Concepts

Standard I Define scientific facts, concepts, and terminology Human Body

- 7HB-1.1 Describe the main functions of the following systems: skeletal, muscular, digestive, circulatory, respiratory, and nervous [25]
- 7HB-1.2 Identify the locations and functions of the major organs of the skeletal, muscular, digestive, circulatory, respiratory, and nervous systems [25]

Cells

- 7CE-1.1 Recognize that organisms are made of cells working together as tissues, tissues working together as organs, organs working together as systems, and systems working together as organisms [7]
- 7CE-1.2 State the cell theory and describe its development [7]
- 7CE-1.3 Describe the function of the cell's organelles including the cell membrane, nucleus, cytoplasm, and chloroplast [9]

Grade 8

Define Scientific Facts, Concepts

Standard I Define scientific facts, concepts, and terminology

Astronomy

- 8AS-1.1 Describe the relationships between Earth, Moon and Sun such as seasons, eclipses, lunar phases, tides and Earth's calendar. [9]
- 8AS-1.2 Identify and describe the different structures in the universe such as stars, planets, comets and meteors [8]
- 8AS-1.3 Describe the scientific evidence for the existence of the universe as we know it (Big Bang Theory) [10]
- 8AS-1.4 Describe how different lenses and mirrors are used in telescopes [9]
- 8AS-1.5 Describe man's efforts to explore space (Sputnik, Apollo, unmanned probes, the space shuttle) [4]

Genetics and Heredity

- 8GH-1.1 Describe how information is passed from cell to cell, and from organism to organism using mitosis, meiosis, DNA, chromosomes and sex cells [10]
- 8GH-1.2 Describe the cell cycle and describe how mitosis is a part of it [10]
- 8GH-1.3 Illustrate and describe the events in mitosis using the following terms: chromatid and chromosome [9]
- 8GH-1.4 Describe meiosis in simple terms of meiosis I and meiosis II [6]
- 8GH-1.5 Describe the role of genetics in natural selection, evolution and

Grade 9

HS Biology

Standard I Defines scientific facts, concepts, and terminology

- 1. Describe the basic functions and uses of the compound light microscope and electron microscope [3]
- 2. Identify the basic structure of the cell wall, cell membrane, nucleus, ribosome, cytoplasm, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, vacuole, chloroplasts, cilia, and flagella using diagrams [8]
- 3. Describe the basic function of the cell wall, cell membrane, nucleus, ribosome, cytoplasm, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, vacuole, chloroplasts, cilia, and flagella [7]
- 4. Discuss the differences of specialized cells (skin cell vs. muscle cell vs. nerve cell) and how these specialized cells function together to make up tissues, organs, organ systems, and complex organisms [9]
- 5. Identify the structures of basic organic molecules (e.g., lipids, proteins, carbohydrates, nucleic acids) [8]

Grade 10

HS Biology

Standard I Define scientific facts, concepts, and terminology DNA Structure and Replication

- 1. Recognize the historical contributions that scientists have made to the discovery of the structure and function of DNA [7]
- 2. Describe the structure of DNA using the following terms: sugarphosphate backbone, nitrogenous base, nucleotide, antiparallel [9]
- 3. Describe the nitrogenous base pairing of DNA and RNA using the following terms: hydrogen bonds, purines, pyrimidines, complementary base pairs, adenine, guanine, cytosine, thymine and uracil [9]
- 4. Order the steps of DNA replication [6]

Protein Synthesis

- 5. Examine the roles of proteins in organisms [6]
- 6. Describe the process of transcription in protein synthesis using the following terms: RNA nucleotides (uracil), RNA polymerase, introns, exons, DNA triplet code, mRNA, codons, 5 cap, poly-A tail [6]
- 7. Describe the process of translation in protein synthesis using the following terms: ribosome, mRNA, rRNA, tRNA, codon, anticodon, peptide bond, dehydration synthesis (condensation), amino acid, and protein [6]
- 8. Differentiate

Grades 11-12

HS Biology

Standard I Define scientific facts, concepts, and terminology

- Explain the characteristics of life as indicated by cellular processes
- Describe how cells and organisms acquire and release energy
- Explain the flow of energy and the cycling of matter through biological and ecological systems

Standard II Applies analyzes and evaluates scientific facts and concepts

- All matter tends toward more disorganized states. Living systems require a continuous input of energy to maintain their chemical and physical organizations. With death, and the cessation of energy input, living systems rapidly disintegrate.
- The energy for life primarily derives from the sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. These molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars, and fats). In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes.
- The chemical

<ul style="list-style-type: none"> produce heat, light, sound, and motion [9] 6EM-1.7 Summarize the relationship between electricity and magnetism (flowing electricity creates a magnetic field; moving magnets create electrical flow) [9] 6EM-1.8 Identify characteristics of insulators and conductors (sample materials, degree to which electrons are bound to the atoms of those materials) [5] 	<ul style="list-style-type: none"> 7CE-1.4 Describe the movement of particles in and out of cells using the processes of diffusion and osmosis [7] 7CE-1.5 Describe the basic processes of photosynthesis and cellular respiration and their importance to life [7] 	<ul style="list-style-type: none"> extinction [9] 8GH-1.6 Describe recent advances in genetics such as cloning, stem cells, and genetic engineering [6] 	<ul style="list-style-type: none"> 6. Describe how the body breaks down organic polymers through enzymes in the digestive system and describe how cells are able to synthesize organic polymers from monomers (dehydration synthesis and hydrolysis) [10] 7. Describe the structure and function of the cells, tissues, and organs of the digestive system, respiratory system and circulatory system [14] 	<ul style="list-style-type: none"> 8. Differentiate between the roles of mRNA, tRNA, and rRNA in protein synthesis [6] 9. Identify the nature of each of the four levels of protein structure and describe how various intermolecular interactions (e.g. disulfide bridges, hydrogen bonds, polar/non-polar interactions, ionic bonds) contribute to the folding of the polypeptide chain [5] 10. Identify the roles of the endoplasmic reticulum and the Golgi apparatus in protein synthesis [4] 	<ul style="list-style-type: none"> The chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Cells usually store this energy temporarily in phosphate bonds of a small high-energy compound called ATP.
Forces and Motion	Microorganisms and Diseases	Chemistry	Standard II Applies, analyzes and evaluates scientific facts and concepts	Mitosis/Meiosis	Ecology: Standard I Define scientific facts, concepts, and terminology of diversity and interdependence of life & characteristics and structure of life
<ul style="list-style-type: none"> 6FM-1.1 Define the terms force, motion, friction, inertia, speed, and velocity [12] 6FM-1.2 Calculate average speed by taking measurements of distance and time [8] 6FM-1.3 Identify the points at which an object has the most potential and/or kinetic energy [6] 	<ul style="list-style-type: none"> 7MD-1.1 Describe the basic characteristics of bacteria, viruses and protists [11] 7MD-1.2 Describe and give examples of infectious diseases and how they can be prevented and treated [5] 7MD-1.3 Discuss how infectious diseases are transmitted and describe the precautions that should be taken to prevent their spread [7] 	<ul style="list-style-type: none"> 8CH-1.1 Describe the current model of the atom in terms of the nucleus, protons, neutrons, electrons and energy levels. 8CH-1.2 Be able to identify, place and write the chemical symbols of all atoms 1-20 and some common compounds. 8CH-1.3 Be able to draw and write the electronic configuration of atoms of elements 1-20 using the basic energy levels (excluding s, p, d, f orbitals) 8CH-1.4 Identify acids and bases using different methods such as pH scale and chemical reactions. 	<ul style="list-style-type: none"> 1. Compare and contrast the characteristics of living and non-living things [5] 2. Examine the differences (shape, color, organelles, size) between plant and animal cells with a microscope [5] 3. Explain how the structure of the cell membrane is related to the selectively permeable nature of the transportation of certain materials across the cell membrane using diffusion, osmosis, facilitated diffusion, passive transport, active transport, endocytosis, and exocytosis [11] 4. Explain how chloroplasts and mitochondria contribute in metabolism 	<ul style="list-style-type: none"> 11. Differentiate between the roles of mitosis and meiosis in organisms [7] 12. Arrange the mitotic phases in the order in which they occur [8] 13. Illustrate and describe the events in each phase of mitosis using the following terms: somatic cell, spindle, kinetochore, kinetochore/nonkinetochore fibers, sister chromatids, centrosome, centrioles, centromere, aster, and cell plate/cleavage furrow [8] 14. Differentiate between chromatin, chromosomes (single and doublestranded), chromatids, and homologous chromosomes; and identify where each can be found in the phases of mitosis and meiosis [8] 15. Arrange the meiotic phases in the order in which they occur [8] 16. Describe the major events in each meiotic phase using the following terms: germ cell, diploid, haploid, synapsis, tetrad/bivalent, crossing over, interkinesis. 	<ul style="list-style-type: none"> The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere All matter tends toward more disorganized states The energy for life primarily derives from the sun Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers The chemical bonds of food molecules contain energy Organisms both cooperate and compete in ecosystems Like other aspects of an organism's biology, behaviors have evolved through natural selection The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystems to recycle matter. Living organisms have the capacity to produce populations of infinite size, but environments and
Plants and Animals	Waves and Sound	Environmental Science			
<ul style="list-style-type: none"> 6PA-1.1 List the characteristics of living things: they are made of cells, are made of similar chemicals, use energy, grow and develop, respond to stimuli, and reproduce [15] 6PA-1.2 Differentiate 	<ul style="list-style-type: none"> 7WS-1.1 Demonstrate (e.g., using probes) that there are variations in sound among instruments and voices 7WS-1.2 Identify the parts of the ear and describe how the brain perceives sound 	<ul style="list-style-type: none"> 8ES-1.1 Describe the way an ecosystem is able to perpetuate itself (energy flow, recycling of matter) [9] 8ES-1.2 Explain how biotic and abiotic factors influence the size of a population using words such as competition, disease, limiting factors [10] 8ES-1.3 Describe the different levels of organization within an ecosystem: organism, species, population, community, ecosystem Describe causes and effects of global environmental issues such as endangered species, exotic species, extinction, pollution and global warming [9] 8ES-1.4 Identify renewable and non-renewable resources such as fossil fuels, metals, solar energy, wind energy and geothermal energy [7] 			
	Dynamic Earth	Genetics and Evolution			
	<ul style="list-style-type: none"> 7DE-1.1 Identify the existence of tectonic plates and investigate the forces that cause their movement 	<ul style="list-style-type: none"> 8GE-1.1 Describe how information is passed from cell to cell, and from organism to organism using mitosis, meiosis, DNA, 			

<p>Differentiate between plants and animals on the basis of cellular structure (cell membrane, chloroplasts) and means of obtaining food (internal production vs. external consumption) [9]</p> <ul style="list-style-type: none"> 6PA-1.3 Identify the anatomy and function of various parts of vascular plants (root, stem, leaf, and flower) [13] 6PA-1.4 Discover the various stages in the life cycle of a flowering plant (seed, germination, emergence of cotyledon, growth spurt, pollination, and seed production) [11] 6PA-1.5 Identify major taxonomic groups (5 vertebrate classes, 9 invertebrate phyla, monocots, dicots, angiosperms, gymnosperms) [23] 	<p>[9]</p> <ul style="list-style-type: none"> 7DE-1.2 Describe the effects of volcanic and earthquake activity on the surface of the earth [9] 7DE-1.3 Identify and describe transverse, longitudinal and surface waves 7DE-1.4 Define wavelength, frequency, amplitude, and velocity of waves 	<p>chromosomes and sex cells</p> <ul style="list-style-type: none"> 8GE-1.2 Describe the cell cycle and describe how mitosis is a part of it 8GE-1.3 Describe meiosis in simple terms of meiosis I and meiosis II 8GE-1.4 Describe the role of genetics in natural selection, evolution and extinction 8GE-1.5 Describe recent advances in genetics such as cloning, stem cells, and genetic engineering 	<p>producing chemical energy for the cell through the processes of cellular respiration and photosynthesis (use balanced equations in describing the processes of cellular respiration and photosynthesis and identify the reactants and products in the equations) [9]</p> <ul style="list-style-type: none"> 5. Compare and contrast the processes of cellular respiration and photosynthesis [8] 6. Explain how the nucleus, cytoplasm, ribosome, endoplasmic reticulum, and Golgi apparatus contribute to the process of protein synthesis (show how these organelles work together in making and transporting a protein within the cell without covering the structure of DNA, codons, anticodons, etc.) [7] 7. Investigate and compare the properties of acids, bases, and indicators [3] 8. Discover how pH affects the effectiveness of an enzyme [6] 9. Explain how diffusion plays a major role in the transportation of substances through the cell membrane and in the digestive system, respiratory system, and circulatory system [14] 10. Examine how the digestive system, respiratory system, and circulatory 	<p>over, meiosis, gametes [7]</p> <p>Human Genetics</p> <ul style="list-style-type: none"> 17. Describe Mendel's experimental work which led to defining his laws of dominance, segregation, and independent assortment [8] 18. Describe the effects that genes have on the physical characteristics of an organism using the following terms: homozygous, heterozygous, allele, dominant allele, recessive allele, phenotype and genotype [9] 19. Differentiate between codominance and incomplete dominance and state examples of each [6] 20. Describe ABO blood groups as an example of codominance and multiple alleles [6] 21. Differentiate between sex-linked traits and sex-influenced traits and state examples of each [6] 22. Describe the following chromosome mutations and their effects: deletion, inversion, translocation, addition, and non-disjunction [6] 23. Describe gene mutations and their effects using the following terms: point mutation, frameshift mutation, insertion, deletion, and substitution [6] 24. Construct Punnett grids for monohybrid and dihybrid crosses [9] 25. Identify chromosome mutations and the sex of individuals using karyotypes [8] 26. Construct a pedigree based on anecdotal information [7] 	<p>environmental resources are finite.</p> <ul style="list-style-type: none"> Human beings live within the world's ecosystems. Behavioral biology has implications for humans, as it provides links to psychology, sociology, and anthropology <p>Standard II Applies, analyzes and evaluates scientific facts on concepts diversity and interdependence of life & characteristics and structure of life</p> <ul style="list-style-type: none"> Explain how energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers. As matter and energy flows through different levels of organization of living systems-- cells, organs, organisms, communities-- and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change. Explain how living things interact with biotic and abiotic components of the environment; Relate how distribution and abundance of organisms and populations in ecosystems are limited by the ability of the ecosystem to recycle materials and the availability of matter, space and energy; Conclude that ecosystems tend to have cyclic fluctuations around a state of approximate equilibrium that can change when climate changes.
<p>Matter</p> <ul style="list-style-type: none"> 7MA-1.1 Describe, compare, and measure objects based on common physical and chemical properties including: states of matter, mass, volume, density, temperature, boiling point, and melting point [46] 7MA-1.2 Describe and measure properties of matter such as temperature, mass, and volume before and after a physical or chemical change [31] 7MA-1.3 Identify and describe the phases of matter [19] 		<p>Forces and Motion</p> <ul style="list-style-type: none"> 8FE-1.1 Calculate and describe different types of motion (velocity and acceleration) [10] 8FE-1.2 Describe the effects of balanced and unbalanced forces on an object's motion [10] 8FE-1.3 Recognize and manipulate simple machines [6] 8FE-1.4 Describe how Newton's laws influence everyday life [7] 			
<p>Weather and Climate</p> <ul style="list-style-type: none"> 6WC-1.1 Describe the components and interactions of the water cycle (evaporation, condensation, precipitation, transpiration, and runoff) [27] 6WC-1.2 Describe the basic composition, properties, and structure of the atmosphere (the range and distribution of temperature and pressure in the troposphere and 					

- 6WC-1.3 Observe, measure, and record changes in weather conditions (humidity, temperature, air pressure, cloud type, wind, precipitation) [10]
- 6WC-1.4 Explain how atmospheric circulation is driven by the sun (transfer of energy by radiation, convection, conduction) [13]

system function **Evolution**

- 11. Examine how the respiratory system and circulatory system function together in order to get rid of carbon dioxide waste [13]
- 27. Explain how the processes of meiosis and mutation enhance genetic variability in a population [6]
- 28. Explain how the processes of genetic mutation, natural selection, and adaptation leads to organisms well suited for survival in a particular environment [7]
- 29. Describe how Darwin's findings from his voyage supports the current body of evidence for evolution: fossil record, biogeography, anatomy (i.e., homologous structures, embryology) and molecular biology [5]

Standard III Constructs research questions, hypotheses, and plans experimental procedures

- 1. Identify questions for investigation [11]
- 2. Develop predictions based on background knowledge and/or research and can be addressed through scientific investigations [8]
- 3. Design and conducts scientific investigations [6]
- 4. Select appropriate tools, technologies and techniques for gathering, analyzing and interpreting data [7]

Standard IV Collects, records and organizes data

- 1. Record the appropriate qualitative and/or quantitative raw data [8]
- 2. Record raw data clearly [10]
- 3. Use appropriate numerical representation in data (for

Standard II Applies analyzes and evaluates scientific facts and concepts DNA Structure and Replication

- 1. Demonstrate the molecular interactions that define the primary structure of DNA by creating a model [9]
- 2. Compare and contrast DNA and RNA [5]
- 3. Explain both the polarity and antiparallel nature of DNA as a molecule and how these impact the replication of DNA [6]
- 4. Explain the role of the enzymes; helicase, primase, DNA polymerase, and ligase in the process of DNA replication [7]

Protein Synthesis

- 5. Predict what will happen to a protein if various point mutations occur during transcription [4]
- 6. Summarize the events that occur in protein synthesis from transcription to secretion of proteins from the cell [5]
- 7. Given any

when one or more new species appear as a result of immigration or when one or more species disappear.

- Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.
- Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms. Populations grow or decline through the combined effects of births and deaths, and through emigration and immigration. Populations can increase through linear or exponential growth, with effects on resource use and environmental pollution.
- Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected. Various factors influence birth rates and fertility rates, such as average levels of affluence and education, importance of

example making tables using Word and Excel)
[6]

Standard V Analyzes and interprets collected data

- 1. Use appropriate tools and techniques to analyze data (for example plotting graphs using Excel)
[7]
- 2. Determine direct and indirect relationships among data using best fit lines
[6]
- 3. Communicate analyzed data such as constructing graphs using Excel, charts and mathematical calculations appropriately
[6]

Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draw conclusions from analyzed data and as appropriate compares with hypothesis
[9]
- 2. Evaluate the procedure by identifying strengths and weakness
[7]
- 3. Recognize alternative explanations and develops questions for further investigation
[7]

Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrate the use of equipment and materials appropriately
[9]
- 2. Use materials and equipment safely
[8]

nucleotide sequence (DNA or RNA), order the proper sequence of amino acids in a protein using a codon chart
[5]

- 8. Evaluate the role of DNA in protein synthesis, cell reproduction, genetics, and evolution
[6]

Mitosis/Meiosis

- 10. Analyze the role that meiosis plays in maintaining organisms' genetic variability
[7]
- 11. Evaluate the process of crossing over and its implications in terms of genetic variability
[6]
- 12. Compare and contrast the phases of mitosis and meiosis
[6]
- 13. Examine cells undergoing mitosis on microscope slides and identify the phases of each cell based the orientation of the structures observed
[6]

Human Genetics

- 14. Explain how Mendel's laws of segregation and independent assortment relate to meiosis
[7]
- 15. Calculate and predict the phenotypic and genotypic ratios of offspring of monohybrid and dihybrid crosses involving unlinked autosomal genes, sex-linked genes, codominant alleles, and alleles that display incomplete dominance
[10]
- 16. Deduce the pattern of inheritance (sex-linked/autosomal, dominant/recessive), as well as the genotypes and phenotypes of individuals in pedigree charts
[9]
- 17. Discover the cause of various human genetic disorders in terms of the specific

children in the labor force, education and employment of women, infant mortality rates, costs of raising children, availability and reliability of birth control methods, and religious beliefs and cultural norms that influence personal decisions about family size.

Evolution: Standard I Define scientific facts, concepts and terminology

- Relate diversity and adaptation to structures and their functions in living organisms
- Explain that natural selection provides the following mechanism for evolution; undirected variation in inherited characteristics exist within every species
- Describe historical scientific developments that occurred in evolutionary thought
- Describe advances in life sciences that have important long-lasting effects on science and society
- Explain how natural selection and other evolutionary mechanisms account for the unity and diversity of past and present life forms
- Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences

Evolution: Standard II Applies analyzes and evaluates scientific facts and concepts

- Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory

<ul style="list-style-type: none">3. Use technology tools to enhance learning, increase productivity and promote creativity [10]	<p>chromosomal or point mutations responsible for the resulting symptoms [8]</p> <p>Evolution</p> <ul style="list-style-type: none">18. Discover how adaptations may occur as the result of an allele frequency increasing in a population's gene pool over a number of generations [8]19. Explore how natural selection leads to the increased reproduction of individuals with favorable inheritable variations [7]	<ul style="list-style-type: none">Analyze how natural selection and other evolutionary mechanisms and their consequences provide a scientific explanation for the diversity and unity of past life forms, as depicted in the fossil record, and present life formsUse historical examples to explain how new ideas are limited by the context in which they are conceived. These ideas are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators
	<p>Standard III Collects, records and organizes data</p> <ul style="list-style-type: none">1. Records the appropriate qualitative and/or quantitative raw data [11]2. Records raw data clearly [9]3. Uses appropriate numerical representation in data (for example units, significant figures, tallies, uncertainties in data) [11] <p>Standard IV Analyzes and interprets collected data</p> <ul style="list-style-type: none">1. Uses appropriate tools and techniques to analyze data [10]2. Determine the connections and relationships among data [10]3. Communicates analyzed data such as graphs, charts and mathematical calculations appropriately [11] <p>Standard V Draws conclusions and evaluates procedures and hypotheses</p> <ul style="list-style-type: none">1. Draws conclusions from analyzed data and as appropriate compares with hypothesis [11]2. Evaluates the procedure by identifying strengths	<p>Biodiversity & Classification</p> <p>Standard I Define scientific facts, concepts, and terminology</p> <ul style="list-style-type: none">Cells have particular structures that underlie their functionsMost cell functions involve chemical reactionPlant cells contain chloroplasts, the site of photosynthesisCells can differentiate and form complete multicellular organismsThe great diversity of organisms is the result of more than 3.5 billion years of evolutionNatural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms as well as for the striking molecular similarities observed among the diverse species of living organismsThe millions of different species of plants, animals, and microorganisms that live on earth

and weakness
[11]

- 3. Recognizes alternative explanations and develops questions for further investigation [7]

Standard VI Effectively manipulates equipment and utilizes technology

- 1. Demonstrates the use of equipment and materials appropriately [8]
- 2. Uses materials and equipment safely [8]
- 3. Uses technology tools to enhance learning, increase productivity and promote creativity [8]

today are related by descent from common ancestors

- Biological classifications are based on how organisms are related
- The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism
- Organisms both cooperate and compete in ecosystems
- Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships. Species is the most fundamental unit of classification
- Explain that the basic functions of organisms are carried out in cells and groups of specialized cells form tissues and organs; the combination of these cells make up multicellular organisms that have a variety of body plans and internal structures
- Describe the characteristics of an organism in terms of a combination of inherited traits and recognize reproduction as a characteristic of living organisms essential to the continuation of the species

Plants
Standard I Define scientific facts, concepts, and terminology

- Compare the structure, function and interrelatedness of cell organelles in eukaryotic cells and prokaryotic

cells

- Explain that living organisms use matter and energy to synthesize a variety of organic molecules and to drive life processes
- Relate diversity and adaptation to structures and their functions in living organisms.
- Describe that biological classification represents how organisms are related with species being the most fundamental unit of the classification system

Plants

Standard II Applies analyzes and evaluates scientific facts and concepts

- Summarize the general processes of cell division and differentiation, and explain why specialized cells are useful to organisms and explain that complex multicellular organisms are formed as highly organized arrangements of differentiated cells
- Relate how biologists arrange organisms into a hierarchy of groups and subgroups based on similarities and differences that reflect their evolutionary relationships.

Animals

Standard I Define scientific facts, concepts, and terminology

- Compare the structure, function and interrelatedness of cell organelles in eukaryotic cells and prokaryotic cells
- Explain that living organisms use matter and energy to synthesize a variety of organic molecules and to drive life processes
- Relate diversity and adaptation to

structures and their functions in living organisms

- Describe that biological classification represents how organisms are related with species being the most fundamental unit of the classification system

Animals
Standard II Applies
analyzes and evaluates
scientific facts and
concepts

- Analyze and investigate emerging scientific issues
- Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences
- Explain that life on Earth is thought to have begun as simple, one celled organisms approximately 4 billion years ago. During most of the history of Earth only single celled microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved
- Summarize the general processes of cell division and differentiation, and explain why specialized cells are useful to organisms and explain that complex multicellular organisms are formed as highly organized arrangements of differentiated cells
- Use historical examples to explain how new ideas are limited by the context in which they are conceived. These ideas are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through

contributions from many different investigators

Standard III Collects, records and organizes data

- Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps and available technology

Standard IV Analyzes and interprets collected data

- Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations

Standard V Draws conclusions and evaluates procedures and hypotheses

- Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations

Standard VI Effectively manipulates equipment and utilizes technology

- Research and apply appropriate safety precautions when designing and conducting scientific investigations

Applies, Analyze, Evaluate
Standard II Applies, analyzes, and evaluates scientific facts and concepts
Electricity and Magnetism

- 6EM-2.1 Identify element names, symbols, atomic mass, and atomic number using the periodic table
- 6EM-2.2

Applies, Analyze, Evaluate
Standard II Applies, analyzes and evaluates scientific facts and concepts
Human Body

- 7HB-2.1 Demonstrate the interdependent nature of the skeletal, muscular, digestive, circulatory, respiratory and nervous systems

Applies, Analyze, Evaluate
Standard II Applies analyzes and evaluates scientific facts and concepts

Astronomy

- 8AS-2.1Identify how relationships between Earth, Moon and Sun affect human life [6]
- 8AS-2.2Compare the temperature and composition of stars during their life-cycle [4]
- 8AS-2.3Explain and demonstrate how the light behaves in the equipment used to

HS Chemistry
Standard I Defines scientific facts, concepts, and terminology
Atomic Theory

- 1. Describe how elements are characterized by the nature of their particles [7]
- 2. Identify materials as elements, molecules, compounds or mixtures and how they are represented in chemical equations

HS Chemistry
Standard I Defines scientific facts, concepts, and terminology
Atomic Theory

- 1. Describe the arrangement of elements in the periodic table in order of increasing atomic number, groups (valence electrons) and periods (energy levels) [2]
- 2. Identify and give the historical names of the elements in groups in 1 to 8 [2]
- 3. Describe the

HS Chemistry
Standard I Defines scientific facts, concepts, and terminology

- 1. Identify metals, semimetals, nonmetals, and halogens using the periodic table.
- 2. Identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of atoms using the periodic table.
- 3. Descrihe

<p>Analyze the impact of the factors that affect the resistance to electrical current (material, temperature, length, thickness) [11]</p> <p>6EM-2.3 Design a combination circuit using both parallel and series circuits in order to accomplish a wiring task [10]</p> <p>6EM-2.4 Compare magnetic and non-magnetic materials with respect to their domain alignment [8]</p> <p>6EM-2.5 Apply Ohm's Law to find current, voltage, and resistance in an electrical circuit [5]</p> <p>6EM-2.6 Analyze the impact of the removal of a load (e.g., light bulb) on other loads in a combination circuit [5]</p>	<p>Cells</p> <ul style="list-style-type: none"> 7CE-2.1 Explain that the cell is the basic unit of life and carries out all of life's functions 7CE-2.2 Describe the relationship between breathing and respiration 7CE-2.3 Make connections between organelles and basic life processes such as photosynthesis, respiration, diffusion and osmosis 7CE-2.4 Compare the structure and function of plant cells and animal cells 	<p>study the universe [6]</p> <ul style="list-style-type: none"> 8AS-2.4Design, construct and modify a balloon rocket [6] 	<p>Chemistry</p> <ul style="list-style-type: none"> 8CH-2.1Classify (Demonstrate?) matter in terms of atoms, elements, molecules, compounds and mixtures 8CH-2.2Use the periodic table as a resource to identify basic physical and chemical properties of the elements including valence electrons, non-metal, metal, metalloid, and family characteristics 8CH-2.3Test the pH of substances and identify them as acid, base or neutral 	<p>Environmental Science</p> <ul style="list-style-type: none"> 8ES-2.1Analyze the interactions of organisms in food chains and food webs (producer/consumer, predator/prey, parasite/host, symbiosis, scavenger, herbivore, carnivore, omnivore, decomposer) [11] 8ES-2.2Evaluate the effect of unsustainable exploitation at any level of an ecosystem (fishing, forestry, poaching)Analyze the impact of the human population on Earth (renewable and non-renewable resources, pollution) [9] 8ES-2.3Analyze the impact of the human population on Earth (renewable and non-renewable resources, pollution) 	<p>Bonding and Reactions</p> <ul style="list-style-type: none"> 6. Identify compounds as ionic or covalent via their constituent parts or physical properties [7] 7. Describe the importance of the Law of Conservation of Mass and its relationship to balancing chemical reactions [7] 8. Identify upon inspection of the chemical equation: synthesis, decomposition, single and double displacement, and combustion of hydrocarbons reactions [1] 9. Define the term aqueous and describe the nature of the ions in an aqueous solution [5] 10. Insert acid-base benchmarks here.....these are attempting to become part of the grade 9 course to remove pressure on the grade 9 biology 	<p>Measurement</p> <ul style="list-style-type: none"> 10. Distinguish between precision and accuracy [4] 	<p>Mole Concept</p> <ul style="list-style-type: none"> 11. Define Avogadro's number, molar mass, relative atomic mass, relative molecular mass 	<p>Bonding</p> <ul style="list-style-type: none"> 12. Describe the ionic bond as the result of electron transfer leading to the attraction between oppositely charged ions [2] 13. Describe the covalent bond as the result of electron sharing [2] 14. Identify the functional groups of common biological molecules [2] 15. Define and describe periodic trends (periods and groups) in electro negativity [2] 	<p>Standard II Applies, analyzes and evaluates scientific facts and concepts</p> <ul style="list-style-type: none"> 1. State the relationship of the position of an element in the periodic table to its atomic number and atomic mass. 2. Determine the number of electrons available
<p>Forces and Motion</p> <ul style="list-style-type: none"> 6FM-2.1 Predict the motion of an object exposed to forces from multiple directions [4] 	<p>Microorganisms and Diseases</p> <ul style="list-style-type: none"> 7MD-2.1 Compare and contrast bacteria and viruses 7MD-2.2 Compare the effectiveness of various chemical agents such as antiseptics, disinfectants and antibiotics in controlling the growth of bacteria 7MD-2.3 Evaluate the impact of pathogens on the human population 								
<p>Plants and Animals</p> <ul style="list-style-type: none"> 6PA-2.1 Classify organisms into taxonomic groups on the basis of selected characteristics (body plans, external features, digestive structures, vascular systems in plants, specialized internal structures) 	<p>Waves and Sound</p> <ul style="list-style-type: none"> 7WS-2.1 Relate the wave properties of amplitude and frequency to our perception of sound 7WS-2.2 Explain why there are variations in sound among instruments and voice 	<p>Genetics and Evolution</p> <ul style="list-style-type: none"> 8GE-2.1Compare and contrast mitosis and meiosis using the following terms: purpose, number of divisions, number of cells produced number of chromosomes, genetic variability [9] 8GE-2.2Examine cells undergoing mitosis on microscope slides the phases of each cell. [6] 8GE-2.3Analyze (e.g. through debates) high-profile/current/disputed issues in genetics/science [3] 							
	<p>Dynamic Earth</p> <ul style="list-style-type: none"> 7DE-2.1 Explain how earth's internal structure 								

<p>structures) [17]</p> <p>Weather and Climate</p> <ul style="list-style-type: none"> 6WC-2.1 Predict weather based on recent data (reports of humidity, temperature, air pressure, cloud type, wind, and precipitation) [8] 	<p>causes the dynamic nature of the surface of the earth</p> <ul style="list-style-type: none"> 7DE-2.2 Explain the distribution and causes of earthquakes and volcanoes. 7DE-2.3 Explain the relationships among earthquakes, volcanoes, mid-ocean ridges, and deep sea trenches using the theory of plate tectonics 7DE-2.4 Locate the epicenter of an earthquake using knowledge of P waves and S waves 7DE-2.5 Compare and contrast the damage caused by P, S and Surface waves on man-made structures 7DE-2.6 Relate the density of a material with the waves speed as it passes through the material 	<p>[9]</p> <p>Forces and Motion</p> <ul style="list-style-type: none"> 8FM-2.1 Draw, interpret and analyze motion graphs [4] 8FM-2.2 Solve problems involving simple machines (force, work, power, distance, mechanical advantage) [10] 8FM-2.3 Compare, contrast, builds and modifies simple machines [4] 	<p>- Definitions of: broned-lowry? Arrhenius? - pH scale basics: relative hydronium and hydroxide concentrations [5]</p> <p>Gases</p> <ul style="list-style-type: none"> 11. Describe using the molecular kinetic theory, the structure and properties of various states of matter and how they are represented in chemical equations [5] 12. Describe the relationship between temperature, volume and pressure in terms of the gas laws: Boyles, Charles, Gay Lussac and Combined Gas Law and predict the change in one variable given a change in another [3] 	<p>analyzes and evaluates scientific facts and concepts. Atomic Theory</p> <ul style="list-style-type: none"> 1. Predict the pattern in the arrangement of elements on the periodic table and their chemical reactivity from their electron configuration [2] 2. Calculate non integer atomic masses from the relative abundance of isotopes [2] 3. Calculate the number of protons, electrons and neutrons in atoms and ions form the mass number, atomic number and charge [2] 4. Infer the name of an element and its group number from Bohr- Rutherford diagrams [2] <p>Mole Concept</p> <ul style="list-style-type: none"> 5. Calculate the mass of one mole of a species [1] 6. Calculate the number of atoms, ions and molecules in a species using Avogadro's number [2] 7. Solve calculations involving: a) Amount of a substance, mass and molar mass ($n = m \div M$) b) Amount of a substance, concentration and volume ($c = n \div v$) c) dilutions ($c_i \times v_i = c_f \times v_f$) [3] 8. Identify the mole ratios of any two species in a balanced chemical equation; use balanced chemical equations to obtain information about the amount of reactants and products [2] <p>Bonding</p> <ul style="list-style-type: none"> 9. Predict whether a compound will or ionic or covalent from its position on the periodic table and why inert gases generally do not form compounds [2] 	<p>for bonding using the periodic table.</p> <ul style="list-style-type: none"> 3. Compare the position of elements in the periodic table to their quantum electron configurations and their reactivities, with other elements in the table. 4. Explain the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom. 5. State that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E = hv$). 6. Explain how atoms combine to form molecules by sharing electrons to form covalent or metallic bonds 7. Identify an ionic bond as the attraction between oppositely charged ions. 8. Identify chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, N_2, Cl_2, and many large biological molecules are covalent. 9. Identify salt crystals, such as $NaCl$, as repeating patterns of positive and negative ions held together by electrostatic attraction. 10. Draw Lewis dot structures. 11. Identify solids and liquids held together by van der Waals forces or hydrogen bonding and compare these forces to volatility and boiling/ melting point temperatures.
	<p>Matter</p> <ul style="list-style-type: none"> 7MA-2.1 Classify objects based on common physical and chemical properties, including: phases of matter, mass, volume, density, boiling point, melting point 7MA-2.2 Compare and contrast the observable properties of matter including their phases, masses, volumes and densities. 7MA-2.3 Investigate and compare the properties and behavior of matter in its solid, liquid and gaseous states 7MA-2.4 Explain the increase in the atomic mass 		<p>Standard II Applies, analyzes and evaluates scientific facts and concepts Atomic Theory</p> <ul style="list-style-type: none"> 1. Write the symbol formulae for ionic and covalent compounds including polyatomic containing ionic compounds (Q – do we want to include ionic compound naming beyond the 20 element limit and introduce the use of roman numerals for ambiguous naming? Or leave to the grade 10 course where it is more clear to students WHY.....) [5] 2. Predict oxidation states of elements based on their position in the periodic table, 		

- and atomic number of elements across the periods in the periodic table (e.g., as one moves across the periods, the atomic number and mass increase because of the addition of protons and neutrons)
- 7MA-2.5 Use the periodic table as a resource to identify the phases of matter of elements at room temperature.

- difference in the number of protons and electrons and how they behave in chemical reactions [7]
- 3. Deduce the formula and name of compounds involving monatomic and polyatomic ions (cross reference to grade 10) [5]

Bonding and Reactions

- 4. Balance chemical equations using the correct coefficients [3]
- 5. Predict compound formula for the products of: single and double displacement reactions, synthesis and decomposition and combustion of hydrocarbons [1]
- 6. Translate a balanced chemical reaction into a balanced ionic and/or net ionic equation (where applicable) [1]
- 7. Insert acid-base benchmarks here.....these are attempting to become part of the grade 9 course to remove pressure on the grade 9 biology - Definitions of: bronsted-lowry? Arrhenius? - pH scale basics: relative hydronium and hydroxide concentrations [5]

Gases

- 8. Apply the following gas laws: Boyle's; Charles' and Gay-Lussac to various situations involving the

- 10. Deduce the Lewis structures for simple molecules and polyatomic ions [2]
- 11. Distinguish between polar and non-polar molecules using water and chlorine as examples [2]
- 12. Explain how the polarity of water relates to the solubility of some solutes [2]
- 13. Describe the intermolecular force (hydrogen bond) between two water molecules and its affect on the physical properties of boiling point and density [2]
- 14. Explain the difference between adhesion and cohesion with respect to water [1]

Standard III Constructs research questions, hypotheses and plans experimental procedures

- 1. Identifies questions for investigation
- 2. Develops predictions based on background knowledge and/or research and can be addressed through scientific Investigations
- 3. Designs and conducts scientific investigations
- 4. Selects appropriate tools, technologies and techniques for gathering, analyzing and interpreting data

Standard IV Collects, records and organizes data

- 1. Records the appropriate qualitative and/or quantitative raw data [3]
- 2. Records raw data clearly [3]
- 3. Uses appropriate numerical representation in data; this includes: a) Fundamental units b) Accepted SI format c) Scientific notation d) Correct number of significant figures e)

- 12. Describe how temperature, pressure, and surface area affect the dissolving process.
- 13. Outline how energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.
- 14. Describe how reaction rates depend on such factors as concentration, temperature, surface area and pressure.
- 15. Describe the role a catalyst plays in increasing the reaction rate.
- 16. Explain the role of activation energy in a chemical reaction.
- 17. Calculate an equilibrium constant expression for a reaction.
- 18. Distinguish between acids as hydrogen-ion-donating and bases as hydrogen-ion-accepting substances.
- 19. Apply the pH scale to characterize acid and base solutions.
- 20. Identify oxidation-reduction reactions.
- 21. Predict oxidation states.
- 22. Identify oxidizing and reducing agents.

Standard III Constructs research questions, hypotheses, and plans experimental procedures

- 1. Identifies questions for investigation
- 2. Develops predictions based on background knowledge and/or research and can be addressed through scientific investigations
- 3. Designs and conducts scientific investigations
- 4. Selects appropriate tools, technologies and techniques for gathering, analyzing and

- variables of temperature, pressure and volume [5]
- 9. Calculate pressure, volume or temperature from data provided using the gas laws (No $PV=nRT$ absence of moles concept) [5]

Standard III Constructs research questions, hypotheses, and plans experimental procedures

- 1. Identifies questions for investigation [5]
- 2. Develops predictions based on background knowledge and/or research and can be addressed through scientific investigations [7]
- 3. Designs and conducts scientific investigations [3]
- 4. Selects appropriate tools, technologies and techniques for gathering, analyzing and interpreting data [3]

Standard IV Constructs research questions, hypotheses, and plans experimental procedures

- 1. Records the appropriate qualitative and/or quantitative raw data [17]
- 2. Records raw data clearly [11]
- 3. Uses appropriate numerical representation in data; calculate values from measurements using the correct number of significant

Uncertainty inherent in measuring devices used in laboratory work f) Units conversions (for example mL to L) [4]

Standard V Analyzes and interprets collected data

- 1. Uses appropriate tools and techniques to analyze data [3]
- 2. Determine the connections and relationships among data [4]
- 3. Communicates analyzed data such as graphs, charts and mathematical calculations appropriately [6]

Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draws conclusions from analyzed data and as appropriate compares with hypothesis [1]
- 2. Evaluates the procedure by identifying strengths and weakness
- 3. Recognizes alternative explanations and develops questions for further investigation

Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrates the use of equipment and materials appropriately [2]
- 2. Uses materials and equipment safely [2]
- 3. Uses technology tools to enhance learning, increase productivity and promote creativity [4]

interpreting data

Standard IV Constructs research questions, hypotheses, and plans experimental procedures

- 1. Records the appropriate qualitative and/or quantitative raw data
- 2. Records raw data clearly
- 3. Uses appropriate numerical representation in data; calculate values from measurements using the correct number of significant figures

Standard V Analyzes and interprets collected data

- 1. Uses appropriate tools and techniques to analyze data
- 2. Determine the connections and relationships among data
- 3. Communicates analyzed data such as graphs, charts and mathematical calculations appropriately
- 4. Determine the molar mass of a molecule from its chemical formula and the periodic table and calculate the mass of a molecular substance in moles, number of particles, or volume of gas at standard temperature and pressure.
- 5. Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.
- 6. Calculate percent yield in a chemical reaction.
- 7. Determine the limiting reactant and the reactant in excess when quantities of reacting substances are given.
- 8. Calculate the concentration of a solute in terms of moles per liter, molarity.

figures
[15]

Standard V Analyzes and interprets collected data

- 1. Uses appropriate tools and techniques to analyze data [11]
- 2. Determine the connections and relationships among data [13]
- 3. Communicates analyzed data such as graphs, charts and mathematical calculations appropriately [5]

Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draws conclusions from analyzed data and as appropriate compares with hypothesis [9]
- 2. Evaluates the procedure by identifying strengths and weakness [5]
- 3. Recognizes alternative explanations and develops questions for further investigation [9]

Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrates the use of equipment and materials appropriately [11]
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- 3. Uses technology tools to enhance learning, increase productivity and promote creativity [5]

- 9. Apply the dilution equation $c_i V_i = c_f V_f$ to carry out simple dilutions.
- 10. Solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.
- 11. Apply Hess's law to calculate enthalpy change in a reaction.
- 12. Solve calorimetry problems using $q = mc\Delta T$.
- 13. Analyze experimental data from rate experiments.
- 14. Apply Le Chatelier's principle to predict the effect of changes in concentration, temperature, and pressure.
- 15. Calculate pH from the hydrogen-ion concentration.

Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draws conclusions from analyzed data and as appropriate compares with hypothesis
- 2. Evaluates the procedure by identifying strengths and weakness
- 3. Recognizes alternative explanations and develops questions for further investigation
- 4. Predict the shape of simple molecules and their polarity from Lewis dot structures.
- 5. Explain how electronegativity and ionization energy relate to bond formation.
- 6. Predict the geometry of molecules using the VSEPR model

Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrates the use of equipment and

- materials appropriately
- 2. Uses materials and equipment safely
 - 3. Uses technology tools to enhance learning, increase productivity and promote creativity

Constructs research questions Standard III Constructs research questions, hypotheses, and plans experimental procedures <ul style="list-style-type: none">• 1. Identify questions for investigation [4]• 2. Develop predictions based on background knowledge and/or research and can be addressed through scientific investigations [2]• 3. Design and conducts scientific investigations [2]• 4. Select appropriate tools, technologies and techniques for gathering, analyzing and interpreting data [6]	Constructs research questions Standard III Constructs research questions, hypotheses, and plans experimental procedures <ul style="list-style-type: none">• 1. Identify questions for investigation [13]• 2. Develop predictions based on background knowledge and/or research and can be addressed through scientific investigations [15]• 3. Design and conducts scientific investigations [8]• 4. Select appropriate tools, technologies and techniques for gathering, analyzing and interpreting data [6]	Constructs research questions Standard III Constructs research questions, hypotheses, and plans experimental procedures <ul style="list-style-type: none">• 1. Identify questions for investigation [7]• 2. Develop predictions based on background knowledge and/or research and can be addressed through scientific investigations [15]• 3. Design and conducts scientific investigations [11]• 4. Select appropriate tools, technologies and techniques for gathering, analyzing and interpreting data [10]	HS Physics Standard I Defines scientific facts, concepts, and terminology Waves <ul style="list-style-type: none">• 1. Identify the characteristics of the electromagnetic (E&M) spectrum [3]• 2. Identify how waves transfer energy without transferring matter [5]• 3. Define wavelength, frequency, amplitude and velocity [5]• 4. Illustrate the application of the Doppler Effect to wave phenomena [1] Sound <ul style="list-style-type: none">• 5. Identify the parts of the ear and describe how the brain perceives sound [3]• 6. Illustrate the application of the Doppler Effect to sound [3] Light <ul style="list-style-type: none">• 7. Describe how diffraction demonstrates that light is wave [2]• 8. Illustrate the application of the Doppler Effect to light [2]• 9. Identify different techniques used in determining the speed of light, for example Galileo, Roemer and Michelson [1]• 10. Distinguish between specular and diffuse reflection	HS Physics Standard I Defines scientific facts, concepts, and terminology Vectors and Scalars <ul style="list-style-type: none">• 1. Distinguish between vector and scalar quantities; give examples of each [6]• 2. Draw arrows of appropriate length and direction to represent vector quantities [8]• 3. State vector quantities in terms of magnitude and direction or by the components along chosen axis [6] Mechanics <ul style="list-style-type: none">• 4. Define displacement, velocity, speed and acceleration (quantities should be identified as scalar or vector quantities) [10]• 5. Describe the effects of air resistance on falling objects, including "terminal velocity" [6] Forces Dynamics <ul style="list-style-type: none">• 6. State Newton's 1st, 2nd and 3rd Law of motion [4]• 7. State the conditions for translational equilibrium [6]• 8. Describe examples of Newton's 1st Law [4]• 9. Discuss examples of Newton's 3rd Law [4] Electricity <ul style="list-style-type: none">• 10. Define work and energy in relation to the moving electron [2]• 11. State that there are two types of electric charge [2]• 12. State and apply
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- Reflection
[2]
- 11. Locate the images formed by plane mirrors
[2]
 - 12. Describe the properties and uses of spherical mirrors
[2]
 - 13. Determine the locations and sizes of spherical mirror images
[2]
 - 14. Describe how real and virtual images are formed by single convex and concave lenses
[4]
 - 15. Locate images formed by concave and convex lenses using ray tracing
[4]
 - 16. Describe how the eye focuses light to form an image
[4]
 - 17. Describe the optical systems in some common optical instruments
[2]
- the concept of conservation of charge
[2]
- 13. Describe and explain the properties of conductors and insulators
[2]
 - 14. Describe the use of a gold leaf electroscope
[2]
 - 15. State Coulomb's Law qualitatively
[2]
 - 16. Define electric potential energy difference
[2]
 - 17. Define electric potential difference
[2]
 - 18. Describe a simple model of electrical conduction in a metal
[2]
 - 19. Define electric current
[4]
 - 20. Define the concept of resistance and state the variable that influences its magnitude
[4]
 - 21. State Ohm's Law
[4]
 - 22. Draw simple circuit diagrams
[4]
 - 23. Describe the use of ammeters and voltmeters (including the ability to describe and draw the correct positioning of ideal ammeters and voltmeters in a circuit)
[4]

Standard II Applies, analyzes and evaluates scientific facts and concepts
Waves

- 1. Distinguish between the different types of the electromagnetic radiation and their uses
[3]
- 2. Compare simple harmonic motion and the motion of a pendulum
[2]
- 3. Contrast transverse and longitudinal waves
[4]
- 4. Relate wave speed, wavelength and frequency
[4]
- 5. Apply the principles of superposition, diffraction, interference refraction and

Magnetism (if time permits)

- 24. Draw patterns of magnetic field lines of an isolated bar magnet
[4]
- 25. Draw the magnetic field pattern of the earth
[4]

Standard II Applies, analyzes and evaluates scientific facts and concepts
Vectors and Scalars

- 1. Add vector quantities by the graphical method
[6]
- 2. Resolve vectors into perpendicular components along chosen axis
[6]

reflection to waves
[4]

Sound

- 6. Demonstrate the properties that sound shares with other waves [5]
- 7. Relate the physical properties of sound waves to hear and our perception of sound [4]
- 8. Demonstrate an understanding of forces vibration and resonance, especially as applied to air columns and strings [4]
- 9. Explain why there are variations in sound among instruments and voices [5]

- 3. Interpret the physical meaning of vector components (force components along and perpendicular to inclined plane and along suspended cables) [6]
- 4. Add two or more vectors by the method of components [6]

Mechanics

- 5. Draw and analyze displacement-time graphs and velocity-time graphs [8]
- 6. Analyze and calculate the slopes of displacement-time and velocity-time graphs and the areas under the velocity versus time graph [10]
- 7. Determine the acceleration due to gravity using a ticker timer [6]

Light

- 10. Compare and contrast the ray and the wave model of light [4]
- 11. Solve problems involving the speed of light [4]
- 12. Predict the effects of combining colors of light and mixing pigments [2]
- 13. Explain the phenomenon of the polarization of light [2]
- 14. Explain the Law of Reflection [2]
- 15. Explain how concave and convex mirrors form images [2]
- 16. Explain the Law of Refraction [4]
- 17. Explain the phenomena of total internal reflection [3]
- 18. Solve problems using

Forces Dynamics

- 8. Identify the forces acting on an object and draw free-body diagrams representing the forces acting on both stationary and moving objects (both at constant velocities and accelerations) [4]
- 9. Resolve force vectors into perpendicular components along chosen axis [4]
- 10. Determine the resultant force indifferent situations [4]
- 11. Solve problems involving translational equilibrium [4]
- 12. Solve problems using Newton's 2nd Law [4]

Electricity

- 13. Compare Ohmic and non-Ohmic behavior [4]
- 14. Derive and apply expressions for electrical power dissipation in resistors [4]

- the lens equation
[2]

 - 19. Explain nearsightedness and farsightedness and how eyeglass lenses correct these defects
[4]
- 15. Derive and apply the equations for equivalent resistance of resistors in series and parallel
[4]
 - 16. Solve problems involving series and parallel circuits (including the calculation of voltage and current across resistors in both parallel and series circuits)
[4]

**Standard III
Constructs research questions, hypotheses, and plans experimental procedures**

- 1. Identifies questions for investigation
[4]
- 2. Develops predictions based on background knowledge and/or research and can be addressed through scientific investigations
[4]
- 3. Designs and conducts scientific investigations
[2]
- 4. Selects appropriate tools, technologies, and techniques for gathering, analyzing and interpreting data
[3]

Standard III Constructs research questions, hypotheses and plans experimental procedures

- 1. Identifies questions for investigation
[6]
- 2. Develops predictions based on background knowledge and/or research and can be addressed through scientific investigations
[10]
- 3. Designs and conducts scientific investigations
[6]
- 4. Selects appropriate tools, technologies and techniques for gathering, analyzing and interpreting data
[10]

Standard IV Collects, records and organizes data

- 1. Records the appropriate qualitative and/or quantitative raw data
[4]
- 2. Records raw data clearly
[4]
- 3. Uses appropriate numerical representation in data (for example, units, significant figures, tallies, uncertainties in data)
[4]

Standard IV Collects, records and organizes data

- 1. Records the appropriate qualitative and/or quantitative raw data
[10]
- 2. Records raw data clearly
[10]
- 3. Uses appropriate numerical representation in data; for example units, significant figures, tallies, uncertainties in data
[10]

Standard V Analyzes and interprets collected data

- 1. Uses appropriate

Standard V Analyzes and interprets collected data

- 1. Uses appropriate tools and techniques to analyze data
[10]
- 2. Determine the connections and relationships among data
[10]
- 3. Communicates analyzed data such

- tools and techniques to analyze data [5]
- 2. Determine the connections and relationships among data [7]
 - 3. Communicates analyzed data such as graphs, charts and mathematical calculations appropriately [6]
- as graphs, charts and mathematical calculations appropriately [10]

Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draws conclusions from analyzed data and as appropriate compares with hypothesis [5]
- 2. Evaluates the procedure by identifying strengths and weakness [4]
- 3. Recognizes alternative explanations and develops questions for further investigation [3]

Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draws conclusions from analyzed data and as appropriate compares with hypothesis [10]
- 2. Evaluates the procedure by identifying strengths and weakness [10]
- 3. Recognizes alternative explanations and develops questions for further investigation [10]

Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrates the use of equipment and materials appropriately [10]
- 2. Uses materials and equipment safely [10]
- 3. Uses technology tools to enhance learning, increase productivity and promote creativity [10]

Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrates the use of equipment and materials appropriately [7]
- 2. Uses materials and equipment safely [7]
- 3. Uses technology tools to enhance learning, increase productivity and promote creativity [7]

Collects, records & organizes data

Standard IV Collects, records and organizes data

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Standard IV Collects, records and organizes data

Collects, records & organizes data

Standard IV Collects, records and organizes data

- 1. Record the

organizes data

- 1. Record the appropriate qualitative and/or quantitative raw data [6]
- 2. Record raw data clearly [6]
- 3. Use appropriate numerical representation in data [6]

organizes data

- 1. Record the appropriate qualitative and/or quantitative raw data [21]
- 2. Record raw data clearly [21]
- 3. Use appropriate numerical representation in data [21]

- appropriate qualitative and/or quantitative raw data [13]
- 2. Record raw data clearly [10]
- 3. Use appropriate numerical representation in data [7]

Analyzes &interprets collected data
Standard V Analyzes and interprets collected data

- 1. Use appropriate tools and techniques to analyze data [4]
- 2. Determine direct and indirect relationships among [2]
- 3. Communicate analyzed data [4]

Analyzes &interprets collected data
Standard V Analyzes and interprets collected data

- 1. Use appropriate tools and techniques to analyze data [19]
- 2. Determine direct and indirect relationships among data [9]
- 3. Communicate analyzed data such as constructing graphs using Excel, charts and mathematical calculations appropriately [15]

Analyzes &interprets collected data
Standard V Analyzes and interprets collected data

- 1. Use appropriate tools and techniques to analyze data [12]
- 2. Determine direct and indirect relationships among data [17]
- 3. Communicate analyzed data such as constructing graphs using Excel, charts and mathematical calculations appropriately [10]

Draws conclusions/ Evaluates
Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draw conclusions from analyzed data and as appropriate compares with hypothesis [4]
- 2. Evaluate the procedure by identifying strengths and weakness [2]
- 3. Recognize alternative explanations and develops questions for further investigation [4]

Draws conclusions/ Evaluates
Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draw conclusions from analyzed data and as appropriate compares with hypothesis [19]
- 2. Evaluate the procedure by identifying strengths and weakness [12]
- 3. Recognize alternative explanations and develops questions for further investigation [7]

Draws conclusions/ Evaluates
Standard VI Draws conclusions and evaluates procedures and hypotheses

- 1. Draw conclusions from analyzed data and as appropriate compares with hypothesis [17]
- 2. Evaluate the procedure by identifying strengths and weakness [11]
- 3. Recognize alternative explanations and develops questions for further investigation [11]

Utilizes Technology
Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrate the use of equipment and materials appropriately [10]
- 2. Use materials and equipment safely [10]
- 3. Use technology tools to enhance learning, increase productivity and promote creativity [6]

Utilizes Technology
Standard VII Effectively manipulates equipment and utilizes technology

- 1. Demonstrate the use of equipment and materials appropriately [16]
- 2. Use materials and equipment safely [16]
- 3. Use technology tools to enhance learning, increase productivity and promote creativity [18]

Utilizes Technology
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- 1. Demonstrate the use of equipment and materials appropriately [11]
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