

Science—Kindergarten

| Discipline 1: Science Processes Observations with 5 Senses | Discipline 2: Physical Science Force and Motion | Discipline 3: Life Science Organization of Living Things | Discipline 4: Earth Science Solid Earth |
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| <p><i>Inquiry Process:</i> Make purposeful observations of the natural world using appropriate senses. Generate questions based on observations using the senses. Plan/conduct simple investigations using the senses. Manipulate simple tools that aid observation and data collection. Construct simple charts from data/observations.</p> | <p><i>Position:</i> Describe the position of an object (above, below, in front of, behind, on) in relations to other objects around it. Describe the path of a moving object (away from or closer to) from different observers' views.</p> | <p><i>Life Requirements:</i> Recognize that living things have basic needs. Identify and compare living/nonliving things.</p> | <p><i>Earth Materials:</i> Identify Earth materials that occur in nature (rocks, sand, soil, water).</p> |
| <p><i>Inquiry Analysis and Communication:</i> Shares ideas about the senses through purposeful conversation. Communicate and present findings of observations. Develop strategies for information gathering (ask an expert, use a book, make observations, conduct simple investigations, watch a video).</p> | <p><i>Gravity:</i> Observe how objects fall toward the earth.</p> | | |
| <p><i>Reflection and Social Implications:</i> Demonstrate science concepts about the senses through illustrations, performances, models, exhibits, and activities.</p> | <p><i>Force:</i> Demonstrate pushes/pulls on objects that can move. Observe that objects initially at rest will move in the direction of a push or pull. Observe how pushes/pulls can change the speed or direction of moving objects. Observe how shape, size, and weight of an object can affect motion.</p> | | |
| <p><i>Literacy Integration:</i> Respond to individual/multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make meaning, and make connections. Apply significant knowledge from grade-level science, social studies, and mathematical texts. Write a brief informational piece (class book) using drawings, words, word-like clusters, and/or sentences.</p> | | | |

Science—Grade 1

| Discipline 1: Science Processes Observations with 5 Senses | Discipline 2: Physical Science Properties of Matter | Discipline 3: Life Science Organization of Living Things | Discipline 4: Earth Science Earth Systems |
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| <p><i>Inquiry Process:</i> Make purposeful observations of the natural world using appropriate senses. Generate questions based on observations using the senses. Plan/conduct simple investigations using the senses. Manipulate simple tools that aid observation and data collection (hand lens, pencil, ruler, thermometer, rain gauge, balances). Make accurate measurements with appropriate non-standard units for the measurement tool. Construct simple charts from data/observations.</p> | <p><i>Physical Properties:</i> Demonstrate the ability to sort objects according to observable attributes (color, shape, size, sink, or float).</p> | <p><i>Life Requirements:</i> Identify the needs of animals.</p> | <p><i>Solar Energy:</i> Identify the sun as the most important source of heat that warms the land, air, and water of the Earth. Demonstrate the importance of sunlight and warmth in plant growth.</p> |
| <p><i>Inquiry Analysis and Communication:</i> Shares ideas about science through purposeful conversation. Communicate and present findings of observations. Develop strategies for information gathering (ask an expert, use a book, make observations, conduct simple investigations, watch a video).</p> | <p><i>States of Matter:</i> Demonstrate that water as a solid keeps its own shape (ice). Demonstrate that water as a liquid takes on the shape of various containers.</p> | <p><i>Life Cycles:</i> Describe the life cycle of animals including the following stages: egg, young, adult egg, larva, pupa, adult</p> | <p><i>Weather:</i> Compare daily changes in weather related to temperature (cold, hot, warm, cool); cloud cover (cloudy, partly cloudy, foggy); precipitation (rain, snow, hail, freezing rain); wind (breezy, windy, calm). Describe/compare weather related to the 4 seasons in terms of temperature, cloud cover, precipitation / wind. Describe several weather characteristics. Describe precautions that should be taken for human safety during severe weather conditions (thunder, lightning, tornadoes, strong winds, heavy precipitation).</p> |
| <p><i>Reflection and Social Implications:</i> Demonstrate science concepts about the senses through illustrations, performances, models, exhibits, and activities.</p> | <p><i>Magnets:</i> Identify materials that are attracted by magnets. Observe that like poles of a magnet repel and unlike poles of a magnet attract.</p> | <p><i>Heredity:</i> Identify characteristics (body, coverings, beak shape, number of legs, body parts) that are passed on from parents to young. Classify young animals based on characteristics that are passed on from parents (e.g. dogs/puppies, cats/kittens, cows/calves, chicken/chicks).</p> | <p><i>Weather Measurement:</i> Identify the tools that might be used to measure temperature, precipitation, cloud cover, and wind. Observe/collect data of weather conditions over a period of time.</p> |

Science—Grade 2

| Discipline 1: Science Processes Observations with 5 Senses | Discipline 2: Physical Science Properties of Matter | Discipline 3: Life Science Organization of Living Things | Discipline 4: Earth Science Earth Systems |
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| <p><i>Inquiry Process:</i> Make purposeful observations of the natural world using appropriate senses. Generate questions based on observations using the senses. Plan/conduct simple investigations using the senses. Manipulate simple tools (ruler, meter stick, measuring cup, hand lens, thermometer, balance) that aid observation/data collection. Make accurate measurements with appropriate units (meter, centimeter) for the measurement tool. Construct simple charts/graphs from data/ observations.</p> | <p><i>Physical Properties:</i> Describe objects/substances according to their properties (color, shape, texture, hardness, liquid, solid, sink, float). Measure the length of objects using rulers (cm) and meter sticks (m). Measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, beakers). Compare the weight of objects using balances.</p> | <p><i>Life Requirements:</i> Identify the needs of plants.</p> | <p><i>Water:</i> Identify water sources (wells, springs, lakes, rivers, oceans). Identify household uses of water (drinking, cleaning, food preparation). Describe the properties of water as liquid (visible, flowing, shape of container). Recognize rain, dew, fog as water in its liquid state. Describe the properties of water as a solid (hard, visible, frozen, cold) . Recognize ice, snow, hail as water in its solid state.</p> |
| <p><i>Inquiry Analysis and Communication:</i> Shares ideas about science through purposeful conversation. Communicate and present findings of observations. Develop strategies for information gathering / problem solving (books, internet, ask an expert, observation, investigation, technology tools).</p> | <p><i>Material Composition:</i> Recognize that some objects are composed of a single substance (water, sugar, salt) and others are composed of more than one substance (salt/pepper, mixed dry beans).</p> | <p><i>Life Cycles:</i> Describe the life cycle of familiar flowering plants including the following stages: seed, plant, flower, fruit</p> | <p><i>Water Movement:</i> Describe how rain collects on the surface of the earth and flows downhill into bodies of water (streams, rivers, lakes, oceans) or into the ground. Describe the major bodies of water on the Earth's surface (lakes, ponds, oceans, rivers, streams).</p> |
| <p><i>Reflection and Social Implications:</i> Demonstrate science concepts about the senses through illustrations, performances, models, exhibits, and activities. Recognize when a science investigation is exactly repeated, similar results are expected. Use evidence when communicating scientific ideas. Identify technology used in everyday life.</p> | | <p><i>Heredity:</i> Identify characteristics of plants (e.g. leaf shape, flower type, color, size) that are passed on from parents to young.</p> | <p><i>Surface Changes:</i> Describe the major landforms of the surface of the Earth (mountains, plains, plateaus, valleys, hills).</p> |
| <p><i>Literacy Integration:</i> Respond to individual/multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make meaning, and make connections. Apply significant knowledge from grade-level science, social studies, and mathematical texts. Write a brief informational piece (class book) using drawings, words, word-like clusters, and/or sentences.</p> | | | |

Science—Grade 3

| Science Processes | Physical Science | Life Science | Earth Science |
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| <p><i>Inquiry Process:</i> Make purposeful observations of the natural world using appropriate senses. Generate questions based on observations. Plan/conduct simple investigations. Manipulate tools/collect data. Make accurate measurements. Construct simple charts/graphs from data/observations.</p> | <p><i>Forces and Motion:</i> Identify the force that pulls objects toward the Earth. Describe how a push or a pull is a force. Demonstrate how change in motion is related to strength and mass. Compare/Contrast motion in terms of direction. Identify changes in motion. Calculate speed based on distance/time.</p> | <p><i>Life Requirements:</i> Describe the function of the following plant parts: Flower, stem, root, leaf. Identify/compare structures in animals used for controlling body temperatures, support, movement, food-getting, and protection (e.g. fur, wings, teeth, claws). Classify plants based on physical characteristics. Classify animals based on physical characteristics.</p> | <p><i>Earth Systems:</i> Identify natural resources. Classify renewable/non-renewable resources. Describe ways humans are protecting, extending, and restoring resources. Recognize that paper, metal, glass, and some plastics can be recycled. Describe ways humans are dependent on the natural environment and constructed environments. Describe helpful or harmful effects of humans on the environment.</p> |
| <p><i>Inquiry Analysis and Communication:</i> Summarize information to answer questions. Share ideas through conversation. Communicate and present findings. Develop research, information gathering, and problem solving strategies. Compare/contrast information and explain reasons for differences.</p> | <p><i>Sound:</i> Identify sound as a form of energy. Relate sound to its source of vibration. Distinguish the effect of fast or slow vibrations as pitch.</p> | | <p><i>Solid Earth:</i> Recognize/describe different types of Earth materials (mineral, rock, clay, boulder, gravel, sand, soil) Recognize that rocks are made of minerals Identify/describe natural causes of change in the Earth's surface.</p> |
| <p><i>Reflection and Social Implications:</i> Demonstrate concepts through illustrations, models, exhibits, and activities. Use data to separate fact from opinion. Use evidence when communicating ideas. Identify everyday technology/problems that may be solved by using it. Describe the effect of humans on the natural world. Describe human contribution to science.</p> | <p><i>Force Interaction:</i> Relate a change in motion to the force that caused the change. Demonstrate when an object does not move, it's because another force is action on it.</p> | <p><i>Evolution:</i> Relate characteristics/functions of observable parts in a variety of plants that allow them to live in their environment. Relate characteristics/functions of observable body parts to the ability of animals to live in their environment.</p> | <p><i>Using Earth Materials:</i> Identify Earth materials used to construct some common objects (bricks, buildings, roads, glass) Describe how materials taken from the Earth can be used as fuels for heating and transportation.</p> |
| | <p><i>Light:</i> Identify light as a form of energy. Identify that light travels in a line and shadows are formed by placing an object in its path. Demonstrate what happens to light when it travels from water to air.</p> | | |

| Science Processes | Physical Science | Life Science | Earth Science |
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| <p><i>Inquiry Process:</i> Generate questions, conduct investigation, and develop solutions to problems through reasoning/ observation. Make purposeful observations of the natural world. Plan/conduct simple investigations. Manipulate simple tools. Make accurate measurements. Construct simple charts/graphs.</p> | <p><i>Forms of Energy:</i> Identify heat and electricity as forms of energy. <i>Electrical Circuits:</i> Explain how electrical energy is transferred and changed through the use of simple circuit. Create a simple working electromagnet and explain the conditions necessary to make the electromagnet.</p> | <p><i>Organization of Living Things:</i> Determine that plants require air, water, light, and a source of energy and building material for growth and repair. Determine that animals require air, water, and a source of energy and building material for growth and repair.</p> | <p><i>Characteristics of Objects in the Sky:</i> Identify common objects in the sky, such as the sun and moon. Compare and contrast the characteristics of the sun, moon, and earth including distances and abilities to support life.</p> |
| <p><i>Inquiry Analysis and Communication:</i> Summarize information from charts and graphs to answer questions. Share and collaborate about science ideas. Communicate and present findings. Develop research strategies and skills for information gathering and problem solving. Compare/contrast sets of data from investigation.</p> | <p><i>Energy and Temperature:</i> Describe heat as the energy produced when substances burn, materials rub against each other, and electricity flows through wire. Demonstrate how temperature can be increased in a substance by adding energy. Describe how heat is produced through electricity, rubbing and burning.</p> | <p><i>Evolution:</i> Identify individual differences in organisms of the same kind. Identify how variations in physical characteristics of individual organisms give them an advantage for survival and reproduction.</p> | <p><i>Patterns of Objects in the Sky:</i> Describe the orbit of the Earth around the sun as it defines a year. Explain that the spin of the Earth creates day and night. Describe the motion of the moon around the Earth. Explain how the visible shape of the moon follows a predictable cycle which takes approximately one month. Describe movement of the sun and moon across the sky through day/night and seasons.</p> |
| <p><i>Reflection and Social Implications:</i> Demonstrate scientific concepts through illustrations, models, exhibits, and activities. Use data/samples as evidence to separate fact from opinion. Use evidence to communicate scientific ideas. Identify current problems that may be solved through the use of technology. Describe the effect of humans/other organisms have on the balance of the natural world. Describe how people have contributed to science throughout history and across cultures.</p> | <p><i>Properties of Matter:</i> Measure the weight (spring scale) and mass (balances grams or kilograms) of objects. Measure volumes of liquids and capacities of containers in milliliters / liters. Demonstrate the use of centimeter cubes poured into a container to estimate the containers capacity. <i>States of Matter:</i> Compare/Contrast the states of matter. <i>Change in Matter:</i> Explain how matter can change from one state to another by heating/cooling. <i>Conductive and Reflective Properties:</i> Identify objects that are good conductors or poor conductors of heat and electricity.</p> | <p><i>Ecosystems:</i> Identify organisms as a part of a food chain or food web. Explain how environmental changes can produce a change in the food web.</p> | <p><i>Fossils:</i> Explain how fossils provide evidence of the history of the Earth. Compare and contrast life forms found in fossils and organisms that exist today.</p> |
| | <p><i>Magnets:</i> Demonstrate magnetic field by observing the patterns formed with iron filings using a variety of magnets. Demonstrate that non-magnetic objects are affected by the strength of the magnet and the distance away from the magnet.</p> | | |

| Science Processes | Physical Science | Life Science | Earth Science |
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| <p><i>Inquiry Process:</i> Generate questions to investigate in labs. Design/Conduct experiments. Use tools and equipment. Use metric measurement devices. Identify patterns in data. Construct charts and graphs.</p> | <p><i>Force and Motion (Force Interaction):</i> Distinguish between contact/non-contact forces. Demonstrate contact/non-contact forces to change in motion.</p> | <p><i>Organization of Living Things (Cell Functions):</i> Recognize that all organisms are composed of cells. Explain how cells make up different body tissues, organs, and organ systems. Describe how cells in all multicellular organisms are specialized to take in nutrients. Recognize that cells function in a similar way.</p> | <p><i>Earth Systems (Seasons):</i> Demonstrate using a model, seasons as a result of variations in the intensity of sunlight caused by the tilt of the Earth on its axis, and revolution around the sun. Explain how the revolution of the Earth around the sun defines a year.</p> |
| <p><i>Inquiry Analysis and Communication:</i> Analyze information from data to answer scientific questions. Evaluate data, claims, and personal knowledge. Communicate and defend findings. Draw conclusions from data over multiple trials. Use multiple sources of information to evaluate strengths and weaknesses.</p> | <p><i>Force and Motion (Force):</i> Describe what happens when two forces act on an object in same/opposing directions. Describe how constant motion is the result of balanced forces. Describe how changes in the motion of objects are caused by a non-zero force. Relate the size of change in motion to the strength of unbalanced forces and mass of the object.</p> | | <p><i>Earth in Space and Time (Solar System Motion):</i> Describe the motion of planets and moons in terms of rotation on axis and orbits due to gravity. Explain moon phases as they relate to the position of the moon in its orbit around the Earth. Recognize that nighttime objects and the sun appear to move. Explain lunar and solar eclipses. Explain the tides of the oceans.</p> |
| <p><i>Reflection and Social Implications:</i> Evaluate strengths/weaknesses of data, claims and arguments. Describe limitations in knowledge. Demonstrate scientific concepts. Identify the need for evidence. Use technology to design solutions. Describe effect of humans on the world. Describe advancement of technology and science.</p> | <p><i>Force and Motion (Speed):</i> Explain the motion of an object relative to its point of reference. Describe the motion of an object in terms of distance, time, and direction, as the object moves, and in relationship to other objects. Illustrate how motion can be measured and represented on a graph.</p> | | <p><i>Earth in Space and Time (Solar System):</i> Design a model that describes the position and relationship of the planets and other objects to the sun.</p> |

Science—Grade 6

| Science Processes | Physical Science | Life Science | Earth Science |
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| <p><i>Inquiry Process:</i> Generate scientific questions. Conduct scientific investigations. Use scientific tools and equipment. Construct charts and graphs. Identify patterns in data.</p> | <p><i>Energy:</i> Identify kinetic/potential energy. Demonstrate the transformation between kinetic and potential energy in simple mechanical systems. Explain radiation, conduction, and convection. Explain conservation of energy. Explain how light energy is transferred to chemical energy through photosynthesis. Identify examples of waves. Describe how waves transfer energy. Identify that nuclear reactions take place in the sun. Explain how only a tiny fraction of light energy from the sun is transformed to heat energy on Earth.</p> | <p><i>Organization of Living Things:</i> Identify the general purpose of selected animal systems (nervous, digestive, circulatory, respiratory, skeletal, muscular, and excretory). Explain how animal systems work together. Describe growth and development (increase of cell number or size).</p> | |
| <p><i>Inquiry Analysis and Communication:</i> Analyze information. Evaluate data, claims, and knowledge. Communicate and defend findings. Draw conclusions from data. Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments or data.</p> | <p><i>Properties of Matter:</i> Classify substances by their chemical properties. Identify the smallest component that makes up an element. Illustrate the structure of molecules using models or drawings. Describe examples of physical and chemical properties.</p> | | |
| <p><i>Reflection and Social Implications:</i> Describe limitations in knowledge. Identify the need for evidence. Demonstrate scientific concepts. Describe how science has advanced because of the contributions of many people throughout history and across cultures.</p> | <p><i>Changes in Matter:</i> Identify evidence of chemical change. Compare/contrast the chemical properties of a new substance with the original after a chemical change. Describe the physical/chemical properties of products/reactants in a chemical change. Describe/illustrate changes in state. Explain how mass is conserved as a substance changes from state to state in a closed system.</p> | | |
| <p><i>Scientific Literacy:</i> Cite specific textual evidence. Determine the central ideas of conclusions of a text. Determine the meaning of symbols and key terms. Follow a multi-step procedure. Write informative/explanatory texts.</p> | <p><i>Forces and Motion:</i> Understand forces affect the motion and speed of an object. Understand the Earth pulls down on objects with a force called gravity. Develop an understanding that some forces are in direct or indirect contact with objects.</p> | | |

Science—Grade 7
Science Processes / Life Science

| Science Processes | Life Science | |
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| <p><i>Inquiry Process:</i> Generate scientific questions. Design and conduct scientific investigations. Use scientific tools and equipment. Use metric measurement devices. Construct charts and graphs from data and observations. Identify patterns in data.</p> | <p><i>Ecology -Energy:</i> Classify producers, consumers, and decomposers based on their source of food (the source of energy/building materials). Distinguish between the ways in which consumers and decomposers obtain energy. Identify and describe examples of populations, communities, and ecosystems, including those within the Great Lakes region.</p> | <p><i>Pollution:</i> Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere (car exhaust, industrial emissions, acid rain, and natural sources), and how pollution impacts habitats, climate change, and threatens or endangers species. Explain how human activities (surface mining, deforestation, overpopulation, construction and urban development, farming, dams, landfills, and restoring natural areas) change the surface of the Earth and affect the survival of organisms.</p> |
| <p><i>Inquiry Analysis and Communication:</i> Analyze information from tables and graphs. Evaluate data, claims, and personal knowledge. Communicate and defend findings of observations. Draw conclusions from data from multiple trials. Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments or data.</p> | <p><i>Ecology-Biotic and Abiotic Factors:</i> Identify the living (biotic) and nonliving (abiotic) components of an ecosystem. Identify the factors in an ecosystem that influence changes in population size.</p> | <p><i>Plants and Photosynthesis:</i> Recognize the need for light to provide energy for the production of carbohydrates, proteins, and fats. Explain that carbon dioxide and water are used to produce carbohydrates, proteins, and fats. Explain how light energy is transferred to chemical energy through the process of photosynthesis. Describe evidence that plants make, use, and store food.</p> |
| <p><i>Reflection and Social Implications:</i> Evaluate the strengths and weaknesses of claims. Describe limitations in personal/scientific knowledge. Identify the need for evidence in making scientific decisions. Describe relationships through illustrations. Describe the effect of humans. Design solutions to problems using technology. Describe the contributions to science throughout history /across cultures.</p> | <p><i>Ecology-Environmental Impact of Organisms</i> Predict and describe possible consequences of overpopulation of organisms, including humans, (e.g. species extinction, resource depletion, climate change, pollution). Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.</p> | <p><i>Sexual and Asexual Reproduction:</i> Compare how characteristics of living things are passed on through generations, both asexually and sexually. Compare and contrast the advantages/disadvantages of sexual vs. asexual reproduction.</p> |
| | <p><i>Ecology-Relationships of Organisms</i> Describe common patterns of relationships between and among populations (competition, parasitism, symbiosis, predator/prey). Explain how two populations of organisms can be mutually beneficial and how that can lead to interdependency. Predict and describe how changes in one population might affect other populations based upon their relationships in the food web.</p> | |

Earth Science

Earth's Layers

Describe layers of the Earth as lithosphere (crust and upper mantle), convecting mantle, and a dense metallic core.
Describe the Earth as a magnet and compare/contrast the magnetic properties of the Earth to that of a natural or manufactured magnet.
Explain how a compass works using the magnetic field of the Earth, and how a compass is used for navigation on land and sea.

Plate Tectonics:

Explain plate tectonic movement and that the lithospheric plates move centimeters each year.
Demonstrate how major geological events (earthquakes, volcanic eruptions, mountain building) result from these plate movements.

The Rock Cycle:

Compare/contrast the formation of rock types (igneous, metamorphic, and sedimentary) and demonstrate the similarities and differences using the rock cycle model.

Geologic Time:

Explain how rocks and fossils are used to understand the age and geological history of the Earth (timelines and relative dating, rock layers).
Explain how Earth processes (erosion, mountain building, and glacier movement) are used for the measurement of geologic time through observing rock layers.
Describe how fossils provide important evidence of how life and environmental conditions have changed.

Weathering and Soil:

Explain how physical and chemical weathering lead to erosion and the formation of soils and sediments.
Describe how soil is a mixture, made up of weather-eroded rock and decomposed organic material, water, and air.
Compare and contrast different soil samples based on particle size.
Explain how waves, wind, water, and glacier movement shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas.

The Atmosphere:

Describe the atmosphere as a mixture of gases.
Explain how different forms of energy can be transferred from one place to another by radiation, conduction, or convection.
Describe the relationship between the warming of the atmosphere of the Earth by the sun and convection within the atmosphere and oceans.
Explain how the temperature of the oceans affects the different climates on Earth because water in the oceans holds a large amount of heat.
Compare and contrast the atmosphere at different elevations.

Watersheds and Groundwater:

Analyze the flow of water between the components of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater.

Weather:

Compare and contrast the difference and relationship between climate and weather.
Describe how different weather occurs due to the constant motion of the atmosphere from the energy of the sun reaching the surface of the Earth.
Describe weather conditions associated with frontal boundaries (cold, warm, stationary, and occluded) and the movement of major air masses and the jet stream across North America using a weather map.

The Water Cycle:

Demonstrate, using the model or drawing, the relationship between the warming by the sun of the Earth and the water cycle as it applies to the atmosphere (evaporation, water vapor, warm air rising, cooling, condensation, clouds).
Explain the water cycle and describe how evaporation, transpiration, condensation, cloud formation, precipitation, infiltration, surface runoff and ground water occur within the cycle.

Science—Grade 8
 Science Processes / Earth Systems

| Science Processes | | Earth Systems |
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| <p><i>Inquiry Process:</i> Generate new questions that can be investigated in the laboratory or field. Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design and/or the dependence on underlying assumptions. Conduct scientific investigations using appropriate tools and techniques (e.g. selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision). Identify patterns in data and relate them to theoretical models. Describe a reason for a given conclusion using evidence from an investigation. Predict what would happen if the variables, methods, or timing of an investigation were changed. Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation. Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables. Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.</p> | <p><i>Literacy Standards:</i> Reading Standards</p> <ul style="list-style-type: none"> • Key Ideas and Details • Reading Comprehension • Craft and Structure • Informational Text • Word Study • Integration of Knowledge and Ideas • Range of Reading and level of Text Complexity <p>Writing Standards</p> <ul style="list-style-type: none"> • Text Types and Purposes • Production and Distribution of Writing • Research to Build and Present Knowledge • Range of Writing | <p><i>Earth Systems Overview:</i> Explain why the Earth is essentially a closed system in terms of matter. Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth. Explain, using specific examples, how a change in one system affects other Earth systems.</p> |
| <p><i>Reflection and Social Implications:</i> Critique whether or not specific questions can be answered through scientific investigations. Identify and critique arguments about personal or societal issues based on scientific evidence. Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information. Evaluate scientific explanations in a peer review process or discussion format. Evaluate the future career and occupational prospects of science fields. Critique solutions to problems, given criteria and scientific constraints. Identify scientific trade-offs in design decisions and choose among alternative solutions. Describe the distinctions between scientific theories, laws, hypotheses, and observations. Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge. Apply science principles or scientific data to anticipate effects of technological design decisions. Analyze how science and society interact from a historical, political, economic, or social perspective.</p> | | <p><i>Energy in the Earth System:</i> Describe the Earth's principal sources of internal and external energy (e.g. radioactive decay, gravity, solar energy).</p> <p><i>Biogeochemical Cycles:</i> Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans. Explain how the nitrogen cycle is part of the Earth system . Explain how carbon moves through the Earth system (including the geosphere) and how it may benefit (e.g. improve soils for agriculture) or harm (e.g.. Act as a pollutant) society.</p> |

| The Solid Earth | | The Fluid Earth |
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| <p>Rocks, Minerals, and Advanced Rock Cycle: Identify common rock-forming minerals (quartz, feldspar, biotite, calcite, hornblende). Identify common igneous (granite, basalt, andesite, obsidian, pumice), metamorphic (schist, gneiss, marble, slate, quartzite), and sedimentary (sandstone, limestone, shale, conglomerate) rocks and describe the processes that change one kind of rock to another. Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments. Explain the origin of Michigan landforms. Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another. Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks. Explain how the size and shape of grains in a sedimentary rock indicate the environment of formation (including climate) and deposition. Explain how the crystal sizes of igneous rocks indicate the rate of cooling and whether the rock is extrusive or intrusive. Explain how the texture (foliated, nonfoliated) of metamorphic rock can indicate whether it has experienced regional or contact</p> | <p>Plate Tectonics Theory: Describe geologic, paleontologic, and paleoclimatologic evidence that indicates Africa and South America were once part of a single continent. Describe the 3 types of plate boundaries (divergent, convergent, and transform) and geographic features associated with them (e.g. continental rifts and mid-ocean ridges, volcanic and island arcs, deep-sea trenches, transform faults). Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface. Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density. Describe the motion history of geologic features (e.g. plates, Hawaii) using equations relating rate, time, and distance. Distinguish plate boundaries by the pattern of depth and magnitude of earthquakes. Predict the temperature distribution in the lithosphere as a function of distance from the mid-ocean ridge and how it relates to ocean depth. Describe how the direction and rate of movement for the North American plate has affected the local climate over the last 600 million years.</p> | <p>Hydrogeology: Describe the river and stream types, features, and process including cycles of flooding, erosion, and deposition as they occur naturally and as they are impacted by land use decisions. Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability). Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g. the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs. Explain how water quality in both groundwater and surface systems is impacted by land use decisions. Explain the types, process, and beneficial functions of wetlands. Describe how coastal features are formed by wave erosion and deposition.</p> |
| <p>Interior of the Earth: Describe the interior of the Earth (in terms of crust, mantle, and inner/outer cores) and where the magnetic field of the Earth is generated. Explain how scientists infer that the Earth has interior layers with discernible properties using patterns of primary (P) and secondary (S) seismic wave arrivals. Describe the differences between oceanic and continental crust (including density, age, composition). Explain the uncertainties associated with models of the interior of the Earth and how these models are validated</p> | <p>Earth in Space and Time</p> | <p>Oceans and Climate: Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the Earth, changes in water temperature and salinity at high latitudes, and basin shape. Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climate zones, and the ocean as a major CO2 reservoir. Explain the dynamics (including ocean-atmosphere interactions) of the El Niño-Southern Oscillation (ENSO) and its effect on continental climates. Identify factors affecting seawater density and salinity / describe how density affects oceanic layering and currents. Explain the differences between maritime and continental climates with regard to oceanic currents. Explain how the Coriolis effect controls oceanic circulation. Explain how El Niño affects economies (e.g. South America). Describe how coastal features are formed by wave erosion/ deposition.</p> |
| <p>Earthquakes and Volcanoes: Describe the 3 major types of volcanoes (shield volcano, stratovolcano, cylinder cone) and their relationship to the Ring of Fire. Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries. Describe how the sizes of earthquakes and volcanoes are measured or characterized. Describe the effects of earthquakes and volcanic eruptions on humans. Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes. Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems. Explain why fences are offset after an earthquake, using the elastic rebound theory.</p> | <p>Earth History and Geologic Time: Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them. Relate major events in the history of the Earth to the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary(K-T) and Permian extinctions, and Pleistocene ice age. Geological Dating: Determine the approximate age of a sample, when given the half-life of a radioactive substance (in graph or tabular form) along with the ratio of daughter to parent substances present in the sample. Explain why C-14 can be used to date a 40,000 year old tree but U-Pb cannot. Identify a sequence of geologic events using relative age dating principles.</p> | <p>Glaciers: Describe how glaciers have affected the Michigan landscape and how the resulting landforms impact our state economy. Explain what happens to the lithosphere when an ice sheet is removed. Explain the origin of Michigan landforms.</p> |

Science—Grade 9 Integrated Science

| General Science Topics | Chemistry Topics | Physics Topics | Earth Science Topics | Space Science Topics |
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| <p>Scientific Inquiry: Generate questions to investigate in the lab. Evaluate scientific conclusions . Conduct experiments. Use the scientific method. Identify patterns in data.</p> | <p>Forms of Energy: Describe energy changes within the atom due to photon emission and or absorptions using flame tests . Describe relative arrangements of particles in a solid, liquid, gas, and plasma as observed in a phase change experiment . Explain molecular changes using the gas laws. Illustrate how atoms change in nuclear reactions.</p> | <p>Motion of Objects: Analyze the motion of objects using formulas for speed, acceleration, and momentum. Use graphs to compare +/- accelerations. Distinguish between vector and scalar quantities. Compare the motion of an object from different frames of reference. Explain centrifugal and centripetal acceleration.</p> | <p>The Atmosphere: Describe the composition of the layers of the atmosphere. Explain the greenhouse effect and its contribution to global warming. Understand the importance of the atmosphere for u-v protection and solar wind absorption. Describe how the aurora borealis forms.</p> | <p>The Earth-Moon System: Describe the features of the moon's surface . State a theory about the formation of the moon. Illustrate how the phases of the moon occur. Illustrate how the earth, moon, and sun affect the ocean's tides.</p> |
| <p>Scientific Reflection: Contrast opinion and scientific statements. Use scientific data to predict future events. Explain historical development of scientific ideas, models, and theories. Contrast theories, laws, hypotheses.</p> | <p>Energy Transfer and Conservation: Explain the laws of conservation of energy and conservation of mass. Describe the relative strength of single, double, and triple covalent bonds. Use the terms endothermic and exothermic to classify physical and chemical changes. Explain why matter is not conserved during nuclear reactions.</p> | <p>Forces and Motion: Contrast electromagnetic, strong nuclear, weak nuclear, and gravitational forces. Perform experiments to analyze work done by the six simple machines. Classify motion events as being explained by Newton's first, second, or third law of motion. Solve problems using $F = m \times a$ Contrast weight and mass relative to gravity.</p> | <p>Weather: Explain the causes of the seasons. Interpret weather maps. Describe fog and cloud formation. Sketch the major wind patterns across the globe. Collect data using a hygrometer to determine the relative humidity within different air masses using charts and tables.</p> | <p>The Planets: Compare the terrestrial planets and describe characteristics of each. Compare the gas giants and describe the characteristics of each. Describe the formation of rings around Saturn. Contrast the planet's orbits, rotations, and revolution around the sun. Describe the origin of our solar system.</p> |
| <p>Social Implications: Critique societal arguments involving science. Explore science related careers. Predict future occupational prospects within science fields.</p> | <p>Properties of Matter: Illustrate phase and phase changes using a phase change diagram. Contrast elements, compounds, solutions, mixtures, colloids, and suspensions. Name and write formulas for simple binary compounds. Define conductivity, malleability, polarity, and chemical properties of elements and compounds.</p> | <p>Electricity and Magnetism: Explain results of Van de Graaff generator demonstrations using static electricity. Assemble and describe the operation of a generator and electric motor. Illustrate magnetic fields around a bar magnet. Design and produce a variety of parallel and series circuits.</p> | <p>Climate: Describe the major types of air masses (e.g. continental polar) and how they form. Explain the Coriolis effect. Describe the El Nino effect. Describe the relationship between solar energy and wind or ocean currents. Classify climate regions. Identify natural climate change.</p> | <p>Asteroids, Comets, and Meteoroids: Describe the Kuiper belt and identify several Kuiper belt objects. Describe the Asteroid belt. Contrast long period and short period comets and their relationship to the Oort cloud. Explain why the earth experiences meteor showers.</p> |
| <p>Measurement: Use SI units in solving problems. Convert metric and English units. Use scales, balances, graduated cylinders, metric rulers. Calculate densities. Create graphs and tables from data.</p> | <p>Atomic Structure: Identify location, mass, and charge of electrons, protons, and neutrons. Sketch electron configurations for neutral atoms, ions, and isotopes. Use the periodic table to predict properties of the elements. Describe trends in the periodic table related to size, ionization energy, and reactivity.</p> | <p>Forms of Energy: Solve problems using formulas for work, power, energy, Ohm's law, and efficiency. Contrast gravitational potential and kinetic energy. Describe waves using wavelength, amplitude, and frequency. Contrast electromagnetic and mechanical waves. Compare different forms of electromagnetic energy.</p> | <p>Severe Weather Events: Describe the atmospheric conditions associated with the formations of hurricanes and tornadoes. Describe the seasonal variations in severe weather. Identify frontal boundaries associated with severe weather. Explain and illustrate adiabatic cooling.</p> | <p>Our Sun and Other Stars: Describe how the sun produces energy. Sketch, label, and describe the interior and atmospheric structure of the sun. Define a light year and describe its use. Classify stars using the H-R diagram and describe their life cycle including supernovas.</p> |
| <p>Scientific Literacy: Write informative, explanatory texts as they relate to scientific experiments. Determine central ideas within a text passage describing scientific principles. Translate quantitative data into graphs. Cite textual evidence to support scientific explanations.</p> | <p>Changes in Matter: Predict reaction rate changes due to concentration, temperature, and pressure. Balance chemical equations. Distinguish between physical and chemical changes. Compare and contrast ionic and covalent bonding. Predict products of SR, SR, and synthesis reactions.</p> | <p>Energy Transformations: Identify energy transfers occurring in common objects (light bulb, tuning fork, a car etc.) . Explain the energy transformation as an object falls due to gravity. Perform experiments with pendulums to analyze potential and kinetic energy transfers. Predict the behavior of light waves using the concepts of refraction, reflection, and diffraction.</p> | <p>Weather's Effects: Explain the costs to society related to drought or flooding. Explore and relate the damage resulting from and the social impact of severe weather. Describe how major changes in climate and/or weather can affect the economies of various regions of the earth.</p> | <p>The Universe: Contrast black holes, pulsars, quasars, and neutron stars. Classify galaxies based on their appearance and composition. Describe Hubble's Law. Describe the Big-Bang Theory. Discuss dark matter and dark energy.</p> |

Science—Grade 10 Biology

| General Science Topics | Organization and Development of Living Systems | Independence of Living Systems | Genetics | Evolution and Biodiversity |
|--|---|---|---|---|
| <p>Scientific Inquiry: Generate science based questions. Replicate science investigations. Draw conclusions using logical reasoning. Use direct and indirect observations for support. Communicate results in reports & peer reviews.</p> | <p>Transformation of Matter / Energy in Cells: Explain how cells transform energy from one form to another through the processes of photosynthesis and cellular respiration. Explain cell division, growth and development. Explain cell differentiation.</p> | <p>Photosynthesis and Respiration: Describe how organisms acquire energy directly or indirectly from the sun. Know the equations for photosynthesis and cellular respiration. Explain how living organisms use these two chemical reactions to live.</p> | <p>Genetics and Inherited Traits: Understand information passed from parents to offspring in transmitted by genes that are coded with DNA. Differentiate between dominant, recessive, co-dominant, polygenic and sex-linked traits. Explain Mendel's laws of segregation & independent assortment. Determine genotypes & phenotypes using a Punnett Square.</p> | <p>Theory of Evolution: Summarize the major concepts of natural selection. Describe how natural selection provides a mechanism for evolution. Explain how fossil records support the theory of evolution. Illustrate how genetic variation is preserved or eliminated from a population through natural selection.</p> |
| <p>Scientific Reflection: Introduce a 'good science practice'. Stress logical reasoning during investigation, design, analysis, communication and conclusions.</p> | <p>Organic Molecules: Understand (and describe the composition of) the 4 major categories of organic molecules that make up living systems: carbohydrates, fats, proteins and amino acids. R Recognize the 6 most common elements in organic molecules: C, H, N, O, P and S R Explain cell differentiation, dehydration & hydrolysis. Understand the composition & function of protein molecules as enzymes.</p> | <p>Ecosystems: Describe energy transfer through an ecosystem. Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.</p> | <p>DNA: Show that mutations in sex cells can be passed on to offspring. Recognize that every living species has its own DNA sequence. Describe the structure and function of DNA. Propose possible effects of exposing organisms to radiation and toxic chemicals.</p> | <p>Molecular Evidence: Describe how species are classified based on molecular similarities. Explain that the degree of kinship between organisms can be estimated from the similarity of their DNA and protein sequences. Trace the relationship between environmental changes and changes in the gene pool.</p> |
| <p>Social Implications: Evaluate problems from a personal, local and global perspective. Introduce career opportunities in science. Discuss how personal choices play a role in public policy decisions.</p> | <p>Maintaining Environmental Stability: Describe how cells operate to perform life functions. Explain cell differentiation. Explain how stability is challenged (physically, chemically, environmentally, and by diseases). Explain homeostasis (stable internal environment). Identify general functions of major system of the human body.</p> | <p>Element Recombination: Use a food web to identify producers, consumers, decomposers. Explain the transfer of energy through the trophic levels. Describe environmental processes: water cycle, carbon cycle and nitrogen cycle. Explain the role of these cycles in processing matter crucial for life.</p> | <p>RNA and Protein Synthesis: Demonstrate how genetic information in DNA provides instruction on building proteins. Describe replication, transcription and translation. Recognize that genetic engineering techniques provide great potential and responsibilities in our world.</p> | <p>Natural Selection: Explain how natural selection acts on individuals, but it is populations that evolve. Describe the role of geographic isolation in speciation. Show how genetic variation and environmental factors are causes of evolution and the diversity of organisms. Explain how evolution through natural selection results in biodiversity.</p> |
| <p>Scientific Literacy: Cite specific textual evidence, determine central ideas or conclusion, follow a complex procedure, determine the meaning of symbols and key terms, analyze relationships of key terms, analyze the text's purpose, translate quantitative information to tables and charts, analyze scientific theory, compare and contrast the finding in the texts to other sources, read and comprehend the grade 9-10 textbook.</p> | <p>Cell Specialization: Explain how living things are classified based on cell structure (DNA). Explain how different organisms accomplish the same results using different cell specializations. Describe the cellular structures of bacteria and viruses.</p> | <p>Changes in Ecosystems: Describe ecosystem stability. Examine the negative impact of human activities. Describe the greenhouse effect and list possible causes. List the possible causes and consequences of global warming.</p> | <p>Cell Division—Mitosis / Meiosis: Compare and contrast the two processes of cell division (mitosis and meiosis). Explain mutations and how they are passed on to offspring. Explain that sexual reproduction results in a great variety of possible gene combinations. Explain how it is possible to identify genetic defects. Explain how uncontrolled cell division is cancer.</p> | |
| <p>Learn to write using the parameters of the scientific method.</p> | <p>Living Organism Composition: Explain macromolecules (lipids) contain high energy bonds. Relate cells, tissues, organs & systems to molecular function. Describe how energy is transferred from the sun to energy-rich molecules during photosynthesis. Describe how cells break down molecules to provide energy. Explain how energy is transferred to ATP & used by the cell.</p> | <p>Populations: Graph changes in population growth. Explain the influences that affect population growth. Predict the consequences of an invasive species on the environment. Explain the advantages and disadvantages to different reproductive strategies. Understand exponential growth.</p> | <p>Recombinant DNA: Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes. Evaluate the advantages and disadvantages of human manipulation of DNA.</p> | |

Science—Grade 11 Chemistry

| General Science Topics | Forms of Energy | Energy Transfer and Conservation | Properties of Matter | Changes in Matter |
|---|---|---|--|--|
| <p>Scientific Inquiry : Generate questions to investigate in the lab. Evaluate scientific conclusions. Conduct experiments. Use the scientific method. Identify patterns in data.</p> | <p>Chemical Potential Energy: Explain the changes in potential energy as a chemical bond forms. Describe energy changes associated with chemical reactions, intermolecular forces and physical forces.</p> | <p>Hess's Law : Calculate the ΔH for a given reaction. Draw enthalpy diagrams for exothermic and endothermic reactions. Calculate the ΔH for a chemical reaction. Calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation.</p> | <p>Molecular and Empirical Formulae : Calculate the percent by weight of each element in a compound based on the compound formula. Calculate the empirical formula of a compound based on the percent by weight Use the empirical formula and molecular weight of to determine the molecular formula.</p> | <p>Chemical Changes : Balance simple chemical equations applying the conservation of matter. Distinguish between chemical and physical changes in terms of the properties of the reactants and products.</p> |
| <p>Scientific Reflection : Contrast opinion and scientific statements. Use scientific data to predict future events. Explain historical development of scientific ideas, models, and theories. Contrast theories, laws, hypotheses.</p> | <p>Molecules in Motion: Describe conduction in terms of molecules transferring energy. Explain why there is better conduction in solids and liquids than gases. Describe the various states of matter in terms of the motion and arrangement of the molecules.</p> | <p>Enthalpy and Entropy : Describe the energy changes in the combustion of sugar in terms of bond breaking and bond making. Describe the relative strength of single, double, and triple covalent bonds. Write chemical equations including the heat term as a part of equation or using ΔH notation. (and more) Draw enthalpy diagrams for reactants and products in endothermic and exothermic reactions.</p> | <p>Nomenclature: Name simple binary compounds using their formulae. Given the name, write the formula of simple binary compounds. Given a formula, name the compound. (vice versa) Given the formula for a simple hydrocarbon, draw and name the isomers.</p> | <p>Balancing Equations : Calculate the mass of a particular compound formed from the masses of starting materials. Identify the limiting reagent when given the masses of more than one reactant. Calculate the number of atoms present in a given mass of element.</p> |
| <p>Social Implications : Critique societal arguments involving science. Explore science related careers. Predict future occupational prospects within science fields.</p> | <p>Molecular Entropy : Explain changes in P,V,T for gases using the kinetic molecular model. Explain convection and the difference in transfer of thermal energy for solids, liquids, and gases. Compare the entropy of solids, liquids, and gases. Compare the average kinetic energy of molecules.</p> | <p>Heating Impacts : Describe how heat is conducted in a solid. Describe melting on a molecular level.</p> | <p>Properties of Substances, Solids: Recognize the physical and chemical properties of substances by the arrangement. Predict whether the forces of attraction in a solid are primarily metallic, covalent, network covalent, or ionic based upon the elements' location on the periodic table.</p> | <p>Equilibrium : Describe equilibrium shifts in a chemical system caused by changing conditions and predict shifts in a chemical system caused by changing conditions (Le Chatelier's Principle). Predict the extent reactants are converted to products using the value of the equilibrium constant.</p> |
| <p>Literacy Standard: Write informative, explanatory texts as they relate Acids and Bases to scientific experiments. Determine central ideas within a text passage describing scientific principles. Cite textual evidence to support scientific explanations.</p> | <p>Breaking Chemical Bonds : Explain how the rate of a given chemical reaction is dependent on the temperature and the activation energy. Draw and analyze a diagram to show the activation energy for an exothermic reaction.</p> | <p>Bond Energy : Explain why it is necessary for a molecule to absorb energy in order to break a chemical bond.</p> | <p>Molecular Polarity: Explain why at room temperature different compounds can exist in different phases. Identify if a molecule is polar or nonpolar given a structural formula for the compound.</p> | <p>Changes of State: Explain why both the melting point and boiling points of water are significantly higher than other small molecules of comparable mass (e.g., ammonia and methane).</p> |
| <p>Measurement : Use SI units in solving problems Convert metric and English units Use scales, balances, graduated cylinders. Calculate densities.</p> | <p>Electron Movement: Describe energy changes in flame tests of common elements. Explain why an atom can absorb only certain wavelengths of light. Compare various wavelengths of light in terms of frequency and relative energy.</p> | <p>Endothermic and Exothermic Reactions : Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory. Explain why chemical reactions will either release or absorb energy.</p> | <p>Ideal Gas Laws: Provide macroscopic examples and mathematical representations for the pressure-volume relationship, pressure-temperature relationship and the temperature-volume relationship in gases.</p> | <p>Changes of State: Explain why both the melting point and boiling points for water are significantly higher than other small molecules of comparable mass (e.g., ammonia and methane).</p> |
| <p>Math Standard: Create graphs and tables from data Use Alg I and Alg II skills to solve complex stoichiometric and thermochemical problems.</p> | <p>Nuclear Stability : Determine the age of materials using the ratio of stable and unstable isotopes of a particular type. Illustrate how elements can change in nuclear reactions using balanced equations.</p> | <p>Mass Defect: Explain why matter is not conserved in nuclear reactions.</p> | <p>Moles: Calculate the number of moles of any compound or element given the mass of the substance. Calculate the number of particles of any compound or element given the mass of the substance. Atomic Structure (electron config. also) P,N,E –IDsize, location, mass, charge, and there ions.</p> | <p>Reduction/Oxidation Reactions: Balance half-reactions and describe them as oxidations or reductions. Predict single replacement reactions. Calculate the voltage for spontaneous redox reactions from the standard reduction potentials.</p> |
| | | | | <p>Acids and Bases: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II. Predict products of an acid-base neutralization.</p> |

Science—Grade 11 Chemistry

| General Science Topics | Forms of Energy | Energy Transfer and Conservation | Properties of Matter | Changes in Matter |
|--|-----------------|----------------------------------|---|--|
| <p>Draw structural formulas for up to ten carbon chains of simple hydrocarbons: Draw isomers for simple hydrocarbons. Recognize that proteins, starches, and other large biological molecules are polymers.</p> | | | <p>Electron Configuration: Write the complete electron configuration of elements in the first four rows of the periodic table. Write kernel structures for main group elements. Predict oxidation states and bonding capacity for main group elements using their electron structure. Describe the shape and orientation of s and p orbitals. Describe the fact that the electron location cannot be exactly determined at any given time.</p> | <p>Phase Change/Diagrams I: Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees. Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling.</p> |
| | | | <p>Periodic Table: Identify elements with similar chemical and physical properties using the periodic table.</p> | <p>Chemical Bonds — Trends: Predict if the bonding between two atoms of different elements will be primarily ionic or covalent. Predict the formula for binary compounds of main group elements.</p> |
| | | | <p>Electron Energy Levels: Identify metals, non-metals, and metalloids using the periodic table. Predict general trends in atomic radius, first ionization energy, and electronegativity of the elements using the periodic table.</p> | <p>Chemical Bonds: Draw Lewis structures for simple compounds. Compare the relative melting point, electrical and thermal conductivity and hardness for ionic, metallic, and covalent compounds. Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure.</p> |
| | | | <p>Neutral Atoms, Ions, and Isotopes: List the number of protons, neutrons, and electrons for any given ion or isotope. Recognize that an element always contains the same number of protons.</p> | <p>Brønsted-Lowry I: Write balanced chemical equations for reactions between acids and bases and perform calculations with balanced equations. Calculate the pH from the hydronium ion or hydroxide ion concentration. Explain why sulfur oxides and nitrogen oxides contribute to acid rain. Identify the Brønsted-Lowry conjugate acid-base pairs in an equation.</p> |
| | | | <p>Average Atomic Mass: Calculate the average atomic mass of an element given the percent abundance and mass of the individual isotopes. Predict which isotope will have the greatest abundance given the possible isotopes for an element and the average atomic mass in the periodic table. Write the symbol for an isotope, X_ZA, where Z is the atomic number, A is the mass number, and X is the symbol for the element.</p> | <p>Carbon Chemistry: Draw structural formulas for up to ten carbon chains of simple hydrocarbons. Draw isomers for simple hydrocarbons. Recognize that proteins, starches, and other large biological molecules are polymers.</p> |

Science—Physics Grade 12

| 1st Trimester | | 2nd Trimester | 3rd Trimester |
|---|--|---|--|
| <p>Introduction: Areas of Physics Language of Physics Units, SI prefixes Accuracy vs. Precision Significant Figures</p> | <p>Momentum and Collisions: Momentum Impulse Conservation of Momentum Elastic and Inelastic Collisions</p> | <p>Rotational Equilibrium & Dynamics: Torque Moment of Inertia Equilibrium Angular Momentum Rotational Kinetic Energy Simple Machines</p> | <p>Optics: Characteristics of Light Mirrors (Flat and Curved) Color and Polarization Refraction Lenses Optical Phenomenon</p> |
| <p>One-Dimensional Motion: Displacement Velocity Acceleration Freefall</p> | <p>Rotational Motion: Measuring Rotational Motion Centripetal and Tangential Acceleration Centripetal Force Newton's Law of Universal Gravitation</p> | <p>Fluids and Fluid Mechanics: Fluids Density Buoyant Force Pressure and Temperature Fluids in Motion Properties of Gases</p> | <p>Electricity: Static Electricity Electric Fields Electrical Potential, Potential Diff. Capacitance Current Circuits</p> |
| <p>Two-Dimensional Motion: Vectors Vector Operations Projectile Motion Relative Velocity</p> | <p>Project: Spaghetti Bridge</p> | <p>Heat and Thermodynamics: Temperature /Thermal Equilibrium Heat Temperature and Phase Change Heat and Work Efficiency and Cyclic Processes Entropy</p> | <p>Magnetism: Magnets Magnetic Fields Magnetic Force Electromagnets Induction Applications</p> |
| <p>Force and Newton's Laws: Forces and Change in Motion Newton's Laws of Motion Friction Weight Normal Force</p> | | <p>Waves, Vibrations and Sound: Simple Harmonic Motion Waves Wave Interactions Sound Sound Intensity Resonance</p> | <p>Projects: Trebuchet Cardboard Canoe Remote Operated Vehicle</p> |
| <p>Work and Energy: Work Kinetic and Potential Energy Conservation of Energy Power</p> | | <p>Projects: Hot Air Balloon Mousetrap Car</p> | |