MIDDLE SCHOOL
(6-8)

SCIENCE CURRICULUM

FINAL DRAFT: MARCH 2, 2016

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MIDDLE SCHOOL SCIENCE CURRICULUM

INTRODUCTION

The Fairbanks North Star Borough School District's middle school science curriculum is designed to advance students understanding of the natural world. Such understanding requires knowing science concepts, laws and theories of the physical, life, and Earth sciences, as well as ideas that are common across the natural sciences. For middle school-level students, the essence of learning science has shifted from rote memorization to an understanding of the basic themes and concepts of science. Students can begin to develop the skills of investigation and the understanding that scientific inquiry is guided by asking questions; making observations; and gathering, organizing and analyzing data as well as communicating results.

Technology will play a prominent role in learning science. The use of technology will not replace basic understanding and skills; rather it will be a tool to help develop a deeper understanding of science concepts. The use of technology will help promote and motivate students thinking and interest in science. With respect to ethical, social, and cultural issues, the middle school science curriculum will include the history, process, facts, concepts, principles, theories, and technological applications of science.

GRADE 6 SCIENCE

Overview:
Sixth grade science focuses on ecosystems, classification, Earth's systems, astronomy, and gravity. In ecosystems, students will examine and explain interdependent relationships amongst living and nonliving things, construct models illustrating the cycling of matter and energy transfer in ecosystems, and investigate empirical evidence that changes to physical or biological components of an ecosystem affect populations. In classification, students will describe organisms based on their structures, behaviors, and place organisms into their kingdoms. In Earth's systems, students will explore the history of our changing planet through impacts of water, rock, and soil cycles on Earth's surface processes, and construct weather and climate observations to explain influences on Earth's surface. In astronomy, the students will model the solar system to observe, describe, and predict the motion of various bodies in our solar system. In gravity, students will investigate Newton's Third Law of Motion and Einstein's Theory of Gravity. Throughout the year, interwoven into the curriculum content, students will design and conduct repeatable scientific investigations to continue to develop an awareness that different ways of thinking, curiosity, and the exploration of multiple paths are involved in scientific inquiry.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Scientific Process Skills	**Students who demonstrate understanding will:**	
Science process skills are best taught in context. Therefore, these performance expectations will be incorporated into each content area. Not all of these performance expectations will be incorporated into every activity, however, opportunities to learn these skills will be provided throughout the course. **GLEs**: SA1.1; SA3.1 **NGSS**: MS-LS-1; MS-ESS2.5; MS-PS1.2; MS-PS2-2, 5 LS2=Ecosystems ESS1 = Earth's Place in the Universe ESS2 = Earth's Systems ESS3 = Earth and Human Activity ETS1= Engineering Design	• Ask questions, predict, observe, describe, measure, classify, make generalizations, infer and communicate. [SA1.1] • Plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. [SA1.1; MS-LS.1; MS-ESS2.5; MS-PS1.2; MS-PS2.2, 5] • Select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, and distance) in metric units. [SA1.1] • Develop a model to describe phenomena. [SA1.1; MS-LS2.3] • Conduct research to learn how the local environment is used by a variety of competing interests (e.g., competition for habitat/resources, tourism, oil and mining companies, hunting groups). [SA3.1] • Use standard safety practices for all classroom laboratory and field investigations.	**These are explorations pulled from other units to demonstrate how science process skills are integrated:** • Dissect owl pellets and relate findings to a food web. • Use a dichotomous key to identify the bones, graph results from class totals of all organisms found, and predict/infer the diet of owls. • Inquiry Activity: Students observe number of plants, animals (insects) within a specific area, measure soil and air temperature, and develop a story of related factors that may have influenced or changed the habitat and animals living in the environment. • Design, test, and revise bottle rockets when studying Newton's Laws.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	**Students who demonstrate understanding will:**	
MS-LS2: Ecosystems: Interactions, Energy, and Dynamics A system of living and nonliving things operate to meet the needs of the organisms in an ecosystem. **Classification:** All organisms are scientifically classified by their structure. **GLEs**: SA3.1; SC1.2; SC2.1-2; SC3.1-2; SF1.1-3.1	• Compare and contrast monocotyledons and dicotyledons. [SC2.1] • Compare and contrast the characteristics and behaviors of arthropods, mollusks, echinoderms, worms, and coelenterates. [SC2.2] • Describe characteristics and behaviors of fish, amphibians, reptiles, birds, and mammals. [SC2.2] • Investigate, observe, and identify microscopic organisms. [SC2.1-2] • Use a dichotomous key to classify animals and plants into groups based on external or internal features. [SC2.1] • Explain how organisms and populations of organisms are dependent on interactions with other living and nonliving factors. [SC1.2; SC2.2; MS-LS2.1-2] • Identify sunlight as one of the major sources of energy for all ecosystems. [SC3.1] • Explain patterns of interactions between organisms in an ecosystem (competitive, predatory, and mutually beneficial, cause and effect relationships). [SC1.2, 6; SC2.2; MS-LS2.2] • Describe and construct a food web and food pyramid. [SC3.1; SC3.2; MS-LS2.3] • Classify and explain the roles of organisms within a food web as producers, consumers, or decomposers. [SC3.2; MS-LS2.3] • Ecosystems are dynamic in nature and disruptions to the physical or biological components can lead to shifts in all populations, which then influence humans' availability of resources such as food, energy, medicines, etc. [MS-LS2.5] • Examine how the local environment is used by a variety of competing interests including hunters, miners, tourists, animals, and plants. [SA3.1; SF1.1-3.1] • Explain that differences and similarities in living things are based on structure and basic behaviors (e.g., migrations, communication, adaptation, hibernation) used by organisms to meet the requirements of life. [SC2.1-2; MS-LS1.4]	• Dissect flowers and seeds to classify monocots and dicots. • Grow sprouts in baggies on the window to illustrate first seed leaves. • Research a plant or animal from the local environment; examine its internal and external structure and relate it to similar species found in other areas. • Dissect sea stars, worms, crayfish, etc. to compare internal and external characteristics. • Virtually dissect any invertebrates to compare internal and external characteristics. • Lab: Protist Identification • Dissect mushrooms to observe internal structures for classification purposes. • Create an alien dichotomous key and use a dichotomous key to classify alien relatives. • Classification Lab: students observe preserved specimens (or use pictures of microorganisms, fungi, plants and animals) and decide how to group them based on similarities. Include discussion on local Alaskan animals: subsistence hunting, and impacts of permafrost environments on animals. • Classification activities. • Develop a taxonomic key for classifying organisms. • Use taxonomic key to identify local trees by their leaves. • Classification Activity: students sort animal cards into vertebrates and invertebrates. • Create a terrestrial and aquatic biosphere using a 2-liter bottle. • Ecosystems: Food Webs. • Dissect owl pellets and relate findings to a food web. • Use a dichotomous key to identify the bones, graph results from class totals of all organisms found, and predict/infer the diet of owls. • Identify plants located around the school grounds, determine which plants are native and which plants are invasive.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
		• Create an ecosystem poster labeling parts of ecosystems and the relationship of living organisms (e.g., producers, consumers, decomposers). • Technology: Use online simulations like *Gizmo* to show relationships between organisms when populations change. • Diagram or construct a food web showing relationships of organisms (e.g., producers, consumers, decomposers). • Computer Simulation: Students choose a number of predators/prey and collect data on observations of survival and graph results. • Inquiry Activity: Students observe a number of plants and animals (insects) within a specific area; measure soil and air temperature, and develop a story of related factors that may have influenced or changed the habitat and animals living in the environment. • Place-Based Activity: Research and present information on floodplain findings and upland forest succession, through research being conducted at Bonanza Creek Long-Term Ecosystem Research site.
Physical Science Concepts	**Students who demonstrate understanding will:**	
MS-PS2: Motion and Stability: Forces and Interactions Gravity is the force that causes two particles to pull towards each other. **GLEs:** S.A.1-3, S.F.2, S.G.3-4, CS.B.2; (7) SB4.1	• Recognize that objects exert gravitational force on other objects. [SB4.2; MS-PS2.4] • Investigate Newton's Third Law of Motion. (7) [SB4.1; MS-PS2.1]	• Motion and forces. • Design, test, and revise bottle rockets. • Using components such as string, papers and balloons, design a rocket. • Design, test, and revise various styles of paper airplanes for specific purposes (e.g., distance, ability to fly in a straight line, gliding). • Observe a blanket toss to describe and explain balance of forces at each stage.
Earth & Space Concepts	**Students who demonstrate understanding will:**	
MS-ESS1: Earth's Place in the Universe **ESS1.A: The Universe and Its Stars** Earth and its solar system are part of the Milky Way galaxy, which is one of	• Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process; to include melting, crystallization, weathering, deformation, and sedimentation that act together to form minerals and rocks. [SD1.1; SD2.1; MS-ESS2.1]	• Play a game on orienteering called *Orient.* • Lab: Create an Ice Lens. • Observe and draw the moon for 30 days. • Research seasons in the Northern and Southern Hemispheres.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	**Students who demonstrate understanding will:**	
many galaxies in the universe. (MS-ESS1.2) **ESS1.B: Earth and the Solar System** The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1.2-3) **MS-ESS2: Earth's Systems** **ESS2.A: Earth's Materials and Systems** All Earth processes are the result of energy from the Sun and Earth's hot interior flowing and matter cycling within and among the Earth's systems. Earth's systems interact on a microscopic to global level in size, and operate in a fraction of a second to billions of years. **MS-ESS3: Earth and Human Activity** **ESS3.C: Human Impacts on Earth Systems** Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3.3-4) **GLEs**: S.A.1-3; S.D.1-2; S.F.1-3; S.G.1-4; C.S.E.2	• Develop and use a model of the Earth-Sun-Moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [SD3.1; SD4.1-2; MS-ESS1.1] • Describe the role of gravity in the motions within galaxies and the solar system. [SB4; SD4.4; ESS1.2] • Make connections between components of locally observable geologic environment and the rock cycle. [SD1.1] • Explain how geoscience processes have changed Earth's surface at varying time and spatial scales (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches). [SA1.1; SD2.3; MS-ESS2.2] • Apply knowledge of water cycle to explain changes in the Earth's surface. [SD1.2] • Analyze and interpret data to determine scale properties of objects in the solar system. [SD4.1-2; MS-ESS1.3] • Explain the interrelationship among the rock, water, and cycles. [SD1.1-2] • Know that sedimentary, igneous, and metamorphic rocks contain evidence of the minerals, temperatures, and the forces that created them. [SD2.2; MS-ESS1.4] • Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [MS-ESS3.3] • Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [MS-ESS3.4] • Gather information and explain how synthetic materials come from natural resources and impact society. [MS-PS1.3]	• Create a model of the solar system on the playground or in school that demonstrates an understanding of the scale of the system and the objects within it. • Use baking chips as rocks and have students demonstrate the rock cycle using chips through differing pathways. • Use rock kits for identification and classification. • Start a class rock collection. • Field trip to Brown's Hill Quarry, to Tanana River, to a road cut, or other locations to view local geologic environment and evidence of rock cycle. • USGS Materials: *Wegener's Puzzling Evidence* www.volcanoes.usgs.gov • Star lab with UAF Geophysical Institute • One page researched and written in the astronomy book project, including a Native American perspective, on constellations or stars. • Alfred Wegener: Biography kit in Library Media Services.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	**Students who demonstrate understanding will:**	
Weather/Climate Energy from the sun is transferred between systems and circulates through the ocean and atmosphere results in weather patterns. Unequal heating from the sun and the rotation of the Earth cause atmospheric and oceanic circulation that determines regional climates. **GLEs:** S.A.1-3; S.D.1, 3; S.E.1-3; S.F.1-3; CS.A.3 **NGSS:** MS-ESS2.4-6	• Describe/illustrate continual water cycle propelled by sunlight and gravity including transpiration, evaporation, condensation and crystallization, precipitation, and downhill flows on land. [SD1.2; MS-ESS2.4] • Describe the effects of the ocean and the water cycle on the weather. [SD3.1; MS-ESS2.4] • Identify and analyze movement of air masses from regions of high to low pressure (convection currents) and the effects on the weather. [SA1.2. MS-ESS2.5] • Describe how unequal heating and rotation of Earth determines regional climates. [MS-ESS2.6] • Identify that energy transfer is affected by surface conditions. [SD3.2] • Explain the interrelationship and effects of permafrost on the physical environment. [SA3.1; SE3.1] • Investigate how climate change impacts communities. [SE1.1] • Investigate and compare multiple explanations and theories related to climate change. [SA2.1; SE2.2] • Explain climate change and the effects on the physical environment. [SE3.1; SG3.1]	• Examine weather maps, diagrams, and visualizations to collect data on motion and interactions of air masses. • Explore the air currents with student-created hot air balloons. • Observe convection currents with *Convection Currents Paper Dots* lab. • Record weather observations for a length of time using UAF's Arctic Climate Modeling Project lessons. • Compare and contrast weather in Alaska to that of Hawaii with UAF's *Arctic Climate Modeling* project lessons and extend lesson to hypothesize how our Alaska communities would be affected if the two different climates suddenly flipped. • Analyze the past 90 years' worth of monthly average temperatures in Fairbanks, Alaska to show empirical evidence of climate change. • Compare and contrast current and past satellite images of various land forms. • Research steps that could be taken to reduce the causes of climate change as well as adaptations Alaskans can take to cope with climate changes. • Bill Nye video on atmosphere. • Retell a traditional story that explains a natural event and relate it to a scientific explanation. • Predict the date of ice break-up on the river based on qualitative and quantitative observations of temperature, ice thickness, rate of run-off, and wind factors. • Explore work of John Dalton.

GRADE 7 SCIENCE

<table>
<tr><td>Length: Two Semesters</td><td colspan="2">Overview:
Science 7 is an introductory course designed to expand 7th grade students understanding of natural world by focusing on the characteristics of living things, cellular organization, the diversity of life, how organisms and populations change over time in terms of biological adaptation, heredity & genetics, evolution, natural selection and changes over time in Earth's history.</td></tr>
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<tr><td>Science process skills are best taught in context. Therefore, these performance expectations will be incorporated into the units taught. Not all of these performance expectations will be incorporated into every activity, however, opportunities to learn these skills will be provided throughout the course.

GLEs: SA1.1; SA3.1

NGSS: MS-LS1-1-2, 7-8; MS-LS4.3; MS-LS3.1-2; MS-ESS2.1

LS2=Ecosystems
ESS1 = Earth's Place in the Universe
ESS2 = Earth's Systems
ESS3 = Earth and Human Activity
ETS1= Engineering Design</td><td>• Ask questions, predict, observe, describe, measure, classify, make generalizations, infer and communicate. [SA1.1]
• Plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend and communicate results. [SA1.1; MS-LS1.1; MS-LS4.3; MS-ESS2.5]
• Select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, and distance) in metric units. [SA1.1]
• Develop and use a model to describe phenomena including models that describe unobservable mechanisms. [SA1.1; MS-LS1.2, 7; MS-LS3.1-2; MS-ESS2.1]
• Read, identify and evaluate the sources used to support scientific statements. [SA2.1; MS-LS1.8; MS-LS4.5]
• Design and conduct a simple investigation about the local environment. [SA 3.1]</td><td>These are explorations pulled from other units to demonstrate how science process skills are integrated.
• Osmosis Egg Experiment: Soak raw eggs in vinegar to remove shell, and then soak in various solutions (e.g., sugar, salt water). Weigh egg between solutions to observe/demonstrate the process of osmosis in cells.
• Observation: Observe and identify single-cell and multicellular microorganisms from local pond water by making wet mount slides and observing with microscopes.
• Levels of Organization: Students sort images of cells, tissues, organs, and systems by level of organization and by system.
• Inquiry Experiment: Develop a decomposition chamber to observe and collect data on microorganisms.
• Students observe chicken bones and use skeleton diagrams of birds and humans to identify differences and similarities between homologous bones.
• Experiment with yeast cells to determine their energy needs by adding yeast culture to a test tube and placing a balloon over the tube and measuring change in size of the balloon.
• Inquiry for Natural Selection - Simulation of Peppered Moth Survival: Students color paper moths and hide from classmates. Survival rate is graphed and analyzed on reasons of survival rate of different colored moths.</td></tr>
</table>

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Engineering Concepts	**Students who demonstrate understanding will:**	
Engineering Design Engineering and design skills are best taught in context. Therefore, these core objectives will be incorporated into each of the following content areas. Not all of these objectives will be incorporated into every activity, but opportunities to learn these skills will be provided throughout the course. (MS-ETS1) **Defining the Problem:** At the middle school level, students are expected to define the problem with precision, thinking more deeply than elementary students about the problem and the goals of the design as well as the effects on the end user, broader society, and the environment. (MS-ETS1.A) **NGSS:** MS-ETS1.1-4	• Define a design problem that can be solved through the development of an object, tool, process, or system that included multiple criteria and constraints, including the scientific knowledge that may limit possible solutions. [MS-ETS1.1] • Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. [MS-ETS1.2]	• Use paired hand lenses and paper tubes to build a simple microscope; test and refine. • Using cardboard and string, build a model of how muscles work in pair to move bones. • Have students use bottles, clay, straws, and balloons to create a functioning lung.
Life Science Concepts	**Students who demonstrate understanding will:**	
Cells: Patterns of Cellular organization Understand the processes, structures and functions of living organisms that enable them to survive, reproduce and carry out the basic functions of life. **GLEs**: SA1.1; SC1.1, 3; SC2.1, SE3.1; SG.1.3	• Explain that all living things are composed of cells that carry on functions that sustain life. [SC2.1; MS-LS1.1-2] • Recognize and explain how cells of all organisms undergo similar processes, including growth, obtaining energy, getting rid of wastes, and reproducing. [SC1.1; SC2.1; SG3.1; MS-LS1.2] • Identify and label cell structure and organelles (cell membrane, cell wall, cytoplasm, nucleus, chloroplast and mitochondria). [SC2.1; MS-LS1.2] • Compare and contrast the structure and function of major organelles of plant and animal cells (cell wall, cell membrane, nucleus, cytoplasm, chloroplasts, mitochondria, and vacuoles). [SC2.1; MS-LS1.2]	**Cells and Microscopes** • Living vs. Nonliving: Arrange pictures into categories living and nonliving then group characteristics of living things by analyzing the pictures in each category. • Students create cultural stories about plants and animals. • Experiment with yeast cells to determine their energy needs by adding yeast culture to a test tube and placing a balloon over the tube and measuring change in size of the balloon. • Diagram and label the parts of cells. • Technology (online): Create a Mind Map/concept of cells and cell organelles.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
MS-LS1: From Molecules to Organisms: Structures and Processes Cells are the smallest unit of life that can function independently and perform all the necessary functions of life. **LS1.A: Structure and Function** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1.1) • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1.3) **GLEs:** SA1.1; SA2.1; SC2.1, 3	• Observe cells by using technology or constructing cell models. [SA1.1; SC2.1; SE3.1; MS-LS1.2] • Investigate and explain the components of the scientific theory of cells. [SE3.1] • Explain how producers transfer the sun's energy into chemical energy through photosynthesis. [SC3.1; MS-LS1.6] • Analyze the role of nutrients in providing energy to carry on life processes. [SA1.1; SC3.1; SD1.2; MS-LS1.7] • Differentiate between unicellular organisms and multicellular organisms and name common examples of each. [SC2.1; MS-LS1.1-2] • Explain how specialized cells perform specialized functions in multicellular organisms. [SA1.1; SA2.1; SC2.1; MS-LS1.3] • Differentiate among cells, tissues, organs, organ systems, and whole organism. [SC2.3; MS-LS1.3] • Identify and investigate the general functions of the major systems of the human body (digestive, respiratory, circulatory, skeletal, muscular, excretory, nervous, integument, immune) and describe the ways these systems interact with each other. [SC2.1, 3; MS-LS1.3] • Explain how disease can be a breakdown in structures or functions of an organism, or the result of damage by infection from other organisms or environmental factors. [SC2.1, 3]	• Develop analogies that refer to the characteristics of cell organelles. • Compare and contrast plant and animal cells using Venn Diagram or Double Bubble Thinking Map. • Develop a model of either a plant cell or animal cell. • Discuss historical significance of development of microscope. • Create a timeline of scientists and discoveries that show the history of cells. • Anton von Leeuwenhoek: Biography kit in Library Media Services. • Use paired hand lenses and paper tubes to build a simple microscope; test and refine. • Observe plant and animal cells by using microscopes or computers. • Create PowerPoint, flow chart, or Mind Map of differences between sexual and asexual reproduction of cells. • Osmosis Egg Experiment: Soak raw eggs in vinegar to remove shell, and then soak in various solutions (e.g., sugar, salt water). Weigh egg between solutions to observe/demonstrate the process of osmosis in cells. • Mitosis: Complete online *Onion Root Tip* Lab –Cell biology project. • Demonstration Activity: Place leaves of plant in water to observe carbon dioxide bubbles rising to the surface. • Diagram a structure of a plant leaf labeling parts relating to photosynthesis. • Observation: Observe and identify single cell and multicellular microorganisms from local pond water by making wet mount slides and observing with microscopes. • Technology: use resources on the Internet to observe and describe electron micrograph of single cells and single celled organisms. • Research Project: Research bacteria (single-cell organisms) and produce brochure/poster or

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
		PowerPoint, showing relationships with disease in living organisms. • Technology Computer Simulation: Observe the reproduction rate of bacteria and compare to reproduction of multicellular organisms. www.cellsalive.com • Levels of Organization: Students sort images of cells, tissues, organs, and systems by level of organization and by system. • Microscope Lab: Compare animal (check cells to plants) cells (onion) using microscope and complete drawings of each type of cell; label the cell parts. • Inquiry Experiment: Develop a decomposition chamber to observe and collect data on microorganisms. **Human Body** • Lab Activity: Observe slides of different tissue types using microscope or computer and diagram structures for each type of tissue. • Lab Activity: Students check their heart rate before, during, and after exercise and create a graph using data from lab activity to show relationship between heart rate and exercise. Include discussion on high altitude activities. • Dissection Lab: Dissect worms or other organisms and compare difference between digestive systems. • Students observe chicken bones and use skeleton diagram of birds and humans to identify differences and similarities between homologous bones. • Lab Activity: Students predict and test lung capacity and compare to classmates.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
MS-LS3: Heredity: Inheritance and Variation of Traits General overview of nature of DNA, genes, chromosomes and the important role they play in the transmission of traits between generations. **LS3.A: Inheritance of Traits** • Genes are located in the chromosome cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3.1) • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3.2)	• Explain how every organism has a set of instructions which pass characteristics from one generation to another by genes through reproduction. [SA1.1; SA2.1; SC1.1; SG1.1; SG3.1] • Explain that an inherited trait can be determined by one or many genes, and a single gene can influence more than one trait. [C1.2, SC1.1, SC2.2, MS-LS3-2] • Explain the differences between sexual and asexual reproduction. [SA1.1 SC.1.1, MS-LS3-2] • Describe possible outcomes of mutations (e.g., no effect, damage, benefit). [SC1.2, MS-LS3-1]	**Heredity and Traits** • Use Punnet square to predict the results of simple genetic traits. • Student predicts outcomes of genetic cross of aliens through Punnett square, then randomly draw alleles from paper bag parents to test prediction. • Class Activity: Class survey to determine visible genotypes of classmates. (AIMS, Prentice Hall *Science Explorer Cells & Heredity*). • Model: Use marbles to predict and collect data on results of genetic crosses. • Create paper pet model with five different traits. • Technology online —Explore Tour of Basic Genetics from *Learn Genetics*. • Design a species with 3-5 inherited traits and create chart showing Dominant/recessive traits.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
LS3.B: Variation of Traits: • In sexually reproducing organisms, each parent contributions half of the gene acquired (at random) by offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3.2) • In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutation. Though rare, mutations may result in changes to the structure and function of proteins. Some changes to the structure and function of proteins. Some changes are beneficial, others are harmful, and some are neutral to the organism. (MS-LS3.1) **AKSS**: SA1.1-2; SA2.1; SC1.1-2; SC2.2; SG1.1, 3		**Variation of Traits** • Given the genotypes of a large number of offspring, students work backwards through Punnett square to determine likely genotype and phenotype of parents. • Research Project: research genetic diseases and produce a brochure relating to effects on humans. • Computer Simulation: observe genetic simulation and determine how gender is produced in humans.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
MS-LS4: Biological Evolution: Unity and Diversity **LS4.A: Evidence of Common Ancestry and Diversity** • The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4.1) • Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4.2) • Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4.3)	• Identify living things using similarities and differences based on the current taxonomic system of classification. [SA1.1; SC2.1-2; SE2.1] • Explain how the theory of biological evolution accounts for the diversity of species through gradual changes over time. [SC1.2; SE3.1; MS-LS4.1-3, 6] • Describe natural selection and its relationship to the theory of evolution and genetic variability. [SC1.2; MS-LS4.4-5]	**Natural Selection and Evolution** • Inquiry for Natural Selection - Simulation of Peppered Moth Survival: Students color paper moths and hide from classmates. Survival rate is graphed and analyzed on reasons of survival rate of different colored moths. • Use differences in bird beaks, wings, and legs as inquiry activity. • PBS Video: *Evolution of Resistance to Malaria*.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
LS4.B: Natural Selection • Natural selection leads to the predominance of certain traits in a population and the suppression of others. (MS-LS4.4) • In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4.5) **LS4.C: Adaptation** • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4.6) **LS1.B: Growth and Development of Organisms** • Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1.4) • Plants reproduce in a variety of ways, sometimes depending on		

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	**Students who demonstrate understanding will:**	
animal behavior and specialized features for reproduction. (MS-LS1.4) **GLEs**: SA1.1-2; SC1.1-3; SC2.1-2; SE2.1, 3		
Earth Science Concepts	**Students who demonstrate understanding will:**	
MS-ESS1: Earth's Place in the Universe Alaska Geology **ESS1.C: The History of Planet Earth** The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4) **MS-ESS2: Earth's Systems** **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) **GLEs**: S.A.1-3; S.D.1-4; S.E.1-4; S.F.1-3; S.G.1-4; CS.E.2	• Know that sedimentary rocks contain evidence of the minerals, temperatures, and the forces that created them. [SD2.2; MS-ESS1.4] • Identify some basic rocks of Alaska that form fossils and tell their classification. [SA1.1; SD1.1] • Analyze how landforms are created through constructive and destructive forces caused by movement of the tectonic plates. [SD2.2; MS-ESS1.4; MS-ESS2.3] • Analyze and interpret data on distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. [MS-ESS2.3]	• Use the Alaska rock kits for identification & classification. • Create puzzles of the plates and label fossils that are found on different plates as evidence for plate movement. • *The Theory of Plate Tectonics* CD by TASA. • Use a tub with ice, hot water, & Styrofoam for convection currents & plate movement.

GRADE 8 SCIENCE

Length: Two Semesters	**Overview:** *Science 8* is designed to expand student investigation of physics and chemistry. Aspects of physics are studied through laboratory investigations including sound, light, electricity, mechanics, motion, and energy. Aspects of chemistry are studied based on the Periodic Table of the Elements and through basic chemical laboratory investigations. Laboratory work, laboratory reporting, and engineering design will be included and is an integral part of the learning process.	
CORE IDEAS	**PERFORMANCE EXPECTATIONS**	**SUGGESTED EXPLORATIONS**
Scientific Process Skills	**Students who demonstrate understanding will:**	
Science process and engineering design skills are best taught in context. Therefore, these core performance expectations will be incorporated into. Not all performance expectations will be incorporated into every activity however, opportunities to learn these skills will be provided throughout the course. **GLEs**: SA1.1; SA2.2; SA3.1; SG1.1 **NGSS**: MS-PS1.1-2, 4; MS-PS2.2-3; MS-PS3.4; MS-PS4.2; MS-ESS1.1; MS-ETS-1.1-3 PS1=Matter PS2=Motion & Force PS3=Energy PS4=Waves ETS1=Engineering	• Ask questions, predict, observe, describe, measure, classify, make generalizations, infer communicate, and when appropriate, frame a hypothesis based on observations and scientific principles. [SA1.1; MS-PS2.3] • Plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend and communicate results. [SA1.1; MS-PS1.2; MS-PS2.2; MS-PS3-4] • Recognize and analyze differing scientific explanations and develop a model to predict and/or describe phenomena including models that describe unobservable mechanisms. [SA1.2; SA2.2; MS-ESS1.1; MS-PS1.1, 4; MS-PS3.2; MS-PS4.2] • Select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, distance) in metric units. [SA1.1] • Read, identify, and evaluate the sources used to support scientific statements. [SA2.1; SG1.1; MS-PS1.3] • Use standard safety practices for all classroom laboratory and field investigations.	**These are explorations pulled from other units to demonstrate how science process skills are integrated.** • Design and conduct an experiment to test how an object's mass and/or speed affect its momentum. • Research and compare different models of atoms (i.e., Thomson, Rutherford, Bohr, Quantum Cloud models). • Design and conduct experiments with electromagnets, testing how the strength of the magnet varies with wire length, number of wraps, voltage source, size of core, current, composition of core, neatness of wraps, etc. • Students design a method to determine the salinity of water by measuring density and comparing to solutions of known salinity. • Gum Lab: Students weigh gum before and after chewing to determine if mass has changed. • Students construct atoms out of edible materials in the edible atoms lab. • Students find a current science article and write a summary in the one-pagers activity. • Lab: Speed and Motion. • Inquiry Lab: Develop an experiment with any consumer product based on the scientific method.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Engineering Design Concepts	**Students who demonstrate understanding will:**	
MS-ETS1: Engineering Design **ETS1.A: Defining and Delimiting Engineering Problems** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1.1) **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1.4) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1.2-3) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1.3) • Models of all kinds are important for testing solutions. (MS-ETS1.4)	• Define a design problem that can be solved through the development of an object, tool, process, or system that included multiple criteria and constraints, including the scientific knowledge that may limit possible solutions. [SA1.1; MS-ETS1.1] • Evaluate competing design solution based on jointly developed and agreed-upon design criteria. [SA1.1-2; MS-ETS1.2] • Students will investigate and explain that all matter is made up atoms and understand that substances have physical properties that are unique to each substance.	**Engineering** • Use the design process to build and test a capsule that safely lands an egg dropped from a designated height. • Demonstrate your knowledge of factors that affect the speed of a falling object. • Calculate speed and acceleration. • Create a device that uses an electromagnet to accomplish a real-world task (i.e., door lock, vehicle, trap). • Newton's Rollercoaster.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Engineering Design Concepts (cont.)	**Students who demonstrate understanding will:**	
ETS1.C: Optimizing the Design Solution • Although one design ay not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process – that is, some of those characteristics may be incorporated into the new design. (MS-ETS1.3) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1.4)		
Physical Science Concepts	**Students who demonstrate understanding will:**	
MS-PS1: Matter and Its Interactions **PS1.A: Structure and Properties of Matter** • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1.1)	• Develop and use models to demonstrate how atoms and elements form molecules and compounds. [SA2.1; SB1.1; SB3.2; MS-PS1.1] • Measure and use physical properties such as to compare and separate substances. [SB1.1; MS-PS1.2] • Classify everyday materials as elements, compounds, or mixtures. [SA1.1; SB1.1] • Recognize the role chemistry has in our everyday lives, including the production of synthetic materials from natural resources (e.g., soil and water testing, extraction of minerals, consumer science). [SA1.2; SE2.1-2; SG2.1; SG3.1; MS-PS1.3]	**Matter and Interactions** • Research and utilize a variety of models of atoms and molecules. • Examples of molecular level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. *(At this level, students are not expected to explain valence electrons or bonding energy.)* • Students design a method to determine the salinity of water by measuring density and comparing to solutions of known salinity.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	**Students who demonstrate understanding will:**	
PS1.B: Chemical Reactions • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1.2-3, 5) • Some chemical reactions release energy, others store energy. (MS-PS1.6) **PS3.A: Definitions of Energy** The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (Secondary to MS-PS1.4) **GLEs**: S.A.1-3; S.B.1-3; S.E 1-3; S.F.1; S.G.2-4; CS.E.2	• Investigate changes that occur in physical and chemical properties of matter using a qualitative description of changes on a molecular level including conservation of matter. • Describe the relationship between atomic mass, atomic number, and location on the periodic table with chemical properties of the elements. [SB1.1; MS-PS1.2] • Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved (grades 7-8). [SB1.1; MS-PS1.5]	• Make a periodic table using shoes, coffee cups, and ordinary objects, or a class periodic table where students each have a family, creating one wall-sized chart. **Chemical Reactions** • Lab: Experiment with rusting. • Lab: Soil and water chemistry. • Collect current events from newspapers with elements in the news from Alaskan areas (e.g., mining, water quality). • Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide and mixing zinc with hydrogen chloride. • Show elements, create/show compounds, make mixtures (e.g., lemonade, fizzy lemonade made with baking soda). • Lab from the American Chemical Society on *Energy Changes in Chemical Reactions*. • Create Ice Cream: Measure temperature changes and graph. Discuss Native ways of making ice cream. • Students use the pHet lab simulations to model various physical standards. • Lab: Density. • Lab: Elements, Compounds, and Mixtures. • Lab: Salinty.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	**Students who demonstrate understanding will:**	

MS-PS2: Motion and Stability: Forces and Interactions
 	
PS2.B: Types of Interactions
• Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2.3)
	• Identify various sources and forms of energy and classify them as potential or kinetic. [SE1.1; MS-PS3.A]
	• Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [MS-PS4.1]
	• Apply scientific principles to design, construct, and test a device that either minimized or maximized thermal energy transfer. [MS-PS3.3]
	• Investigate relationships among the amount of energy transferred, the type of matter, the mass, and the change in temperature of a sample (the average kinetic energy of the particles in the sample). [MS-PS3.4]
	• Investigate the ways that light and sound interact with matter, expanding on wavelength, color, refraction, and reflection (grades 7-9). [SB4.3; MS-PS4.2]
	• Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. [MS-PS2.3]
	• Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. [MS-PS2.5]
	• Investigate through experimentation and "real-life" examples, the relationship among (1) force, mass, acceleration, and gravity, (2) speed, distance, time and acceleration, (3) force and friction. [SB4.2; SF1.1-3]
	• Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object (balanced and unbalanced forces) and the mass of the object. [SB4.2; MS-PS2.2]
	• Demonstrate that an object's motion can be described and represented graphically according to its position, direction of motion, and speed. [SB4.1; MS-PS2.2]
		• Labs with diffraction gratings, mirrors, and spinners.
		• Design and conduct experiments with electromagnets, testing how the strength of the magnet varies with wire length, number of wraps, voltage source, size of core, current, composition of core, neatness of wraps, etc.
		• Use a compass to detect an electric field around an electrical current.
		• Inquiry Labs:
		  ○ Block cars, weights and elapse times (use variables: (a) add sandpaper to the track, (b) graphite on wheels, graph the block car lab runs and compare).
		  ○ Catapults and marshmallows.
		  ○ Balloon Races.
		  ○ Scooter Races. Skateboards and raw eggs.
		  ○ Rockets (model, Alka-Seltzer rockets).
		  ○ Build a rollercoaster for a marble.
		• Discuss riding in a car or flying in a Super Cub; include using a GPS and topographic maps for planning a hunting/fishing trip.
		• Project explaining the physics of a favorite sport or activity including forces, speed, acceleration, laws of motion and the ways that energy is converted between potential and kinetic energy.
		• Compare the potential energy of a rollercoaster car at different points on a rollercoaster, or the energy of a sled at different positions on a hill.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	**Students who demonstrate understanding will:**	
	• Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [MS-PS3.1] • Support the claim that when the kinetic energy of an object changes, the energy is transferred to or from that object. [MS-PS3.5] • Explain "real-life" examples of linear and rotational motion using Newton's Laws of Motion. [SB4.1; MS-PS2.A] • Describe gravity as an attractive force between two objects that depends on the mass of the interacting objects. Explain how the orbital motion of planets provides evidence for this force. [SB4.2; MS-PS2.4] • Explain how changes in the arrangement of objects interacting at a distance changes the amounts of potential energy stored in the system. [MS-PS3.2]	
PS3.B: Conservation of Energy and Energy Transfer • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3.5) • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3.4) **PS3.C: Relationship Between Energy and Forces** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3.2)	• Examine energy transfers, conservation of energy, and identify energy that is useful vs. energy that is unavailable (grades 7-8). [SB2.1, SD3.2, MS-PS3.B] • Differentiate between renewable and non-renewable energy resources. [SB2.1] • Demonstrate the relationship between electricity and magnetism. [SB2.1; SB2.2; SB4.2] • Explain how changes in the arrangement of objects interacting at a distance changes the amounts of potential energy stored in the system. [MS-PS3.2] • Investigate how energy is produced and used including alternative energy sources in Alaska. Evaluate the impact of energy production methods on the environment. [SB2.1; SE 3.1; MS-ESS3.3]	• Compare the potential energy of a magnet held at different positions within a magnetic field or the potential energy of a statically charged balloon at different distances from a classmate's hair. • Use kits on hydrogen cells and biofuels. • Take a field trip to Chena Hot Springs Resort to view the hydrogen fuel. Discuss clean coal for Healy or wind power in Delta Junction. • Build mini-homes with the same heat source (light bulb). • Design, build, test, and redesign a solar cooker, insulated box, house design that would be less likely to melt permafrost. • Compare the temperature change of different materials as they cool or heat the environment. Apply this to practical applications (heat reservoirs in building). • Visit the Cold Climate Housing Research Center.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	**Students who demonstrate understanding will:**	
MS-PS4: Waves and Their Applications in Technologies for Information Transfer **PS4.A: Wave Properties** • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4.1) • A sound wave needs a medium through which it is transmitted. (MS-PS4.2) **PS4.B: Electromagnetic Radiation** • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4.2) • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4.2) • However, because light can travel through space, it cannot be a matter of wave, like sound or water waves. (MS-PS4.2)	• Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. [MS-ETS1.2] • Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [MS-PS4.1] • Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [MS-PS4.2]	• Use Slinkys to demonstrate different types of waves and to explore frequency, amplitude and wavelength. • Compare movement of sound waves through solids, gases and liquids. • Explore the way that light is refracted as it moves from air into water by placing observing objects partially submerged in water or pennies beneath cups of water. • Examine inaccuracies in popular culture related to the movement of waves of sound through space. • Use mirrors and laser pointers to examine the movement of light in straight lines. • Use colored filters and colored light bulbs to investigate the absorption and transmission of different wavelengths of light.