Science Curriculum

Explanation of Terms

Alaska Science Standards
Science Standards were adopted by the State Board of Education in 2019. These are general statements of what Alaskans want students to know and be able to do as a result of their public school experience. https://education.alaska.gov/standards

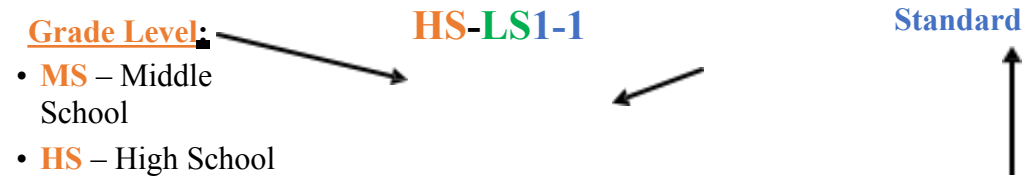
Alaska Cultural Standards
Standards endorsed by the State Board of Education that serve to encourage enrichment of the content standards. They are used as a guide to ensure that schools are aware of and sensitive to their surrounding physical and cultural environments.
https://education.alaska.gov/akstandards/#c3gtabs-cultural

Objectives
Statements that document specific, essential tasks students are expected to accomplish in a given grade level or course.

Guaranteed and Viable Curriculum (GVC)
A guaranteed and viable curriculum is one that guarantees equal opportunity for learning for all students. Similarly, it guarantees adequate time for teachers to teach content and for students to learn it. A guaranteed and viable curriculum is one that ensures that the curriculum being taught is the curriculum being assessed. It is viable when adequate time is ensured to teach all determined essential content.

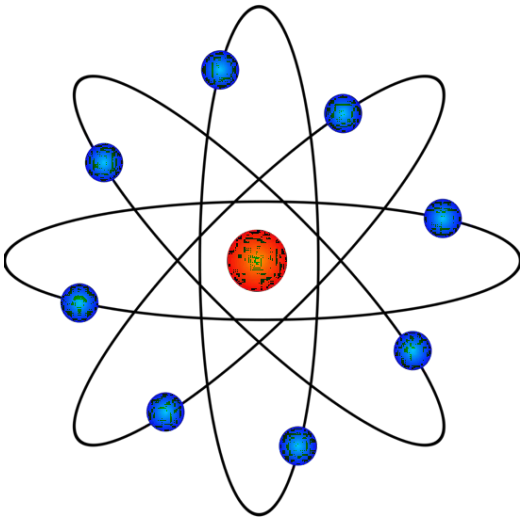
Standards Alignment Coding

This Science Curriculum is aligned to the Alaska Science Standards adopted in 2019, which are largely the same as the national Next Generation Science Standards (NGSS). The Alaska Science Standards provide a foundation for defining what students should know and be able to do in terms of scientific knowledge and skills.
(https://education.alaska.gov/akstandards/science/science-standards-for-alaska.pdf)



Science Standards for Alaska Disciplinary Core Ideas	
Physical Sciences PS1: Matter and its interactions PS2: Motion and stability: Forcesand interactions PS3: Energy PS4: Waves and their applications in technologies for informationtransfer	**Life Sciences** LS1: From molecules to organisms: Structures and processes LS2: Ecosystems: Interactions, energy, and dynamics LS3: Heredity: Inheritance and variationof traits LS4: Biological evolution: Unity and diversity
Earth and Space Sciences ESS1: Earth's place in the universe ESS2: Earth's systems ESS3: Earth and human activity	**Engineering, Technology, Applications of Science** ETS1: Engineering design

High School Science Courses



Grades 9-12

Science Graduation Requirements

The student must complete a total of three credits (six semesters) of high school science courses to include:

- 1.0 credits of Life Science
- 1.0 credits of Physical Science
- 1.0 credits of Science electives

Life Science Options	Physical Science Options	Science Electives
• *Alaska Zoology: Fish and Birds* • *Alaska Zoology: Mammals* • *AP Biology* • *AP Environmental Science (semester 1)* • *Biology or Honors Biology* • *Environmental Science (semester 1)* • *Human Anatomy and Physiology* • *Marine Science* • *Wildlife Biology*	• *AP Chemistry* • *AP Environmental Science (semester 2)* • *AP Physics 1* • *AP Physics 2* • *AP Physics C: Mechanics* • *Chemistry* • *Earth & Space Science* • *Environmental Science (semester 2)* • *Geology* • *Physical Science* • *Physics*	• *Astronomy* • *Forensic Science 1* • *Forensic Science 2* • *Introduction to Basic Pathophysiology* • *Paleontology* • *Any course from the Life Science and Physical Science lists.* • *CTE Courses:* o *Advanced Automotive Technology 1B (second semester)* o *Engineering Design and Development B* o *Introduction to Exercise Science and Sports Medicine 1B* o *Medical Terminology* o *Pharmacy Technician 1B* o *Principles of Engineering A/B*

Life Science

Introduction to Environmental Science

Grade(s): 11-12 **Length**: two semesters **Credit**: 1.0 (4.0 college credits)* **Prerequisites**: Teacher recommendation or *Biology,* and *Chemistry* **Textbook:** Pearson *Environmental Science* This course can be taught as a high school science course or for college credit. College credit is incumbent on the incorporation of a lab section that requires students to complete 10 lab-based activities over the course of the school year. In the past, this course has used online-lab resources purchased though ScienceInteractive: **https://https://www.scienceinteractive.com/www.scienceinteractive.com/**	**Course Overview**: Introduction to Environmental Studies is designed to be equivalent to a one-semester, introductory college course, through which students engage with the scientific principles, concepts and methodologies required to understand the interrelationships of the natural world. Environmental science is an interdisciplinary subject that embraces various topics including geology, biology, ecology, hydrogeology as well as earth and atmospheric science. The course requires that students identify and analyze natural and human made environmental problems at the local level, evaluate the relative risks associated with these problems and examine alternative solutions for resolving or preventing these issues. This can be taught as a lab based course where each lab is designed to help reinforce concepts and skills that are addressed in class. Students will complete up to 10 labs throughout the school year and will be asked to work independently as well as collaboratively in groups. This course integrates two significant activities each semester. The Strait Science Lecture Review will engage students in primary resources as they analyze and discuss Strait Science lectures on a variety of environmental topics. Strait Science is a local lecture series organized by Northwest Campus that invites researchers to discuss local projects ongoing in the region with community members. Strait Science lectures viewed in class will be relevant to course content and encourage students to reflect on the scientific process as they identify the research objective and hypotheses, discuss project methods as well as analyze the significance of the results presented in the lecture. Students will discuss the significance of the research to their community and region, delineate questions that they would like answered on the topic and note any biases that may be present in the research. In addition, students will work collaboratively with classmates to research local environmental issues for the Stewards of Our Land project. The objective of this project is to familiarize students with local issues related to renewable energy sources and mining operations so that students may brainstorm ways to inform the community on complex issues as well as provide strategies to ameliorate negative impacts on the environment. Projects may include discussions of environmental topics through the local radio station, publish articles in the school and local newspaper, and/or construct project proposals that may be discussed with local leaders in order to discuss possible solutions that may resolve issues we currently face in Nome. .

Units(Recommended Order)	
Semester 1	**Semester 2**
Traditional Teaching Method: • Introduction to Environmental Science • Biosphere • Atmosphere	Traditional Teaching Method: • Atmosphere (continued) • Geosphere • Hydrosphere

	Unit 1: Introduction To Environmental Science			
	Suggested Pacing: 4 weeks			
Standards	**Knowledge and Skills (Key Objectives)**	**Essential Question(s)**	**Objectives**	**Suggested Activities & Resources**
	Investigation One **1.Introduction to Environmental Science (pp 4-11 and 228-241)** **Vocabulary:** Environment, environmental science, ecology, environmental activism, natural resource, renewable natural resource, nonrenewable natural resource, sustainable, fossil fuel, ecological footprint • **Environmental scientists study how the natural world works, and how humans and the environment affect each other.** • **In the last several hundred years, both human population and resource consumption have increased dramatically.**	1.How does environmental science help us understand the natural world?	• Explain the focus of environmental science • Describe the recent trends in human population and resource consumption	Core Activities • Ecological Footprint Activity and bookmark (Suburban Science) • Communal Resource Activity (Suburban Science) **OR** • Tragedy of the Commons (hands-on activity)- *Science Interactive Lab* • **Carbon Footprint and Sustainable Living-** ScienceInteractive Inc. **Quiz: Google Form Link** **https://forms.gle/fC7Ah4TVmQ5X5vfM6**
	Investigation Two **1.Nature of Science** **Vocabulary:** hypothesis, prediction, independent variable, dependent variable, controlled study, data **2.The Community of Science** **3. Strait Science Lecture Review: Spectacular Shorebird Migration** **4.Evaluating Energy Facts** **Vocabulary:** Claim of fact, expert, credible source, lateral reading • Facts support informed decision-making by leading to more accurate predictions about the likely outcomes of different choices.	1.What is science? 2.What is peer review? 3. What scientific research is being done in our region? 4. How can we determine if the sources we use are credible?	• Explain what science is. • Describe the major roles of the scientific community in the process of science. • Identify the different steps of the scientific process while viewing a Strait Science lecture. • Distinguish Facts from Claim of facts by applying lateral reading strategies	Core Activities • Evaluating Energy Facts Investigation-Teacher Edition • Evaluating Energy Facts investigation-Student Edition • Strait Science Lecture Review: Spectacular Shorebird Migration worksheet (worksheet in activities folder) • Lecture Found here: https://www.youtube.com/watch?v=vqkqNXmNjVk&list=PLuuqkhFcq8ifdnRxDaKYiRiewrQSvzcA6&index=18 Optional Activities • Environmental Scientist Research (Suburban Science) • Create Your Own Environmental Lab

	• Values affect people's behaviors, opinions, and decisions. There can be disagreement within a community when people hold a variety of values. • When gathering facts, first determine whether the source is credible before looking at the information or evidence provided by the source in more depth.			(Suburban Science) • Environmental Careers flyer (Suburban Science) **Quiz: Google Form Link** **https://forms.gle/E4qhVULjPS9oob5o7**
	Investigation Two **Economics and Policy** **1.Economics (textbook pages)** **Vocabulary:** Economics, supply, demand, cost-benefit analysis, ecological economics, environmental economics, non-market value, market failure, ecolabelling • Supply and demand and cost-benefit analysis are two economic concepts that greatly contribute to decision making. • All economies depend on the environment for resources and for management of wastes, but these connections are often overlooked. • A new trend in economics is the recognition that supplies of goods and services need to consider how to conserve resources and reduce harm to the environment. **2. Environmental Policies** •Environmental policies are rules and regulations to help conserve common resources. They can be categorized into regulations or incentives. The cap-and-trade policies are a combination of both types.	**1.**How is sustainability affected by economics**?**	• Describe two basic concepts of economics. • Explain the relationship between economics and the environment • Describe the ways that economies are working toward sustainability	Core Activities • Environmental Policy Timeline Activity-Suburban Science (Optional: Student Presentation Review sheets attached to Cornell Notes) **Quiz: Google Form Link** https://forms.gle/uBn6vuBPGeDqKoVh9

	Unit 1 Project ***(Optional) Straight Science Lecture Review: Seabirds and the Changing Northern Bering Sea** ***COASST (Coastal Observation and Seabird Survey Team(: Citizen Science**	How does COASST and citizen science contribute to the monitoring of our local seabird populations?	• Identify beached birds using the COASST Beached Birds field guide • Analyze data from COASST from around the region and lectures presented in class to explain recent seabird deaths with previous die-off events • Define key terms discussed in the readings with peers COASST Project	• **Strait Science Lecture Review_Searbirds and the Changing Northern Bering Sea7** • **Strait Science Presentation:** https://www.youtube.com/watch?v=vqkqNXmNjVk&list=PLuuqkhFcq8ifdnRxDaKYiRiewrQSvzcA6&index=17 ● COASST Seabird Monitoring Project - About: https://coasst.org/about/ Watch following videos related to COASST Bird Survey (Project) - Link to COASST data sheets: https://coasst.org/toolbox/beached-birds/ -Link to COASST bird measuring video: https://vimeo.com/211755589 -Link to COASST beach measuring video https://vimeo.com/181084689 -Link to COASST paces per meter video: https://vimeo.com/181084699
	Standards List:			

	Unit 2: Biosphere			
	Suggested Pacing: 6-8 weeks			
Standards	**Knowledge and Skills (Key Objectives)**	**Essential Question(s)**	**Objective(s)**	**Suggested Activities & Resources**
	Investigation One- Basics of Ecology **Spheres of the Earth (pp72-82 in text)** **Vocabulary:** erosion, geosphere, lithosphere, biosphere, atmosphere, hydrosphere, crust, mantle, core, tectonic plate, landform, deposition, evaporation, transpiration, precipitation, condensation, aquifer, groundwater, • Describe two major ways the Earth's systems interact • Define Earth's geosphere, lithosphere, biosphere, atmosphere and hydrosphere • Describe the parts of the Earth's geosphere • Describe Earth's biosphere and atmosphere. • Discuss the water cycle.	1. What types of systems play roles in environmental science? 2.What are the characteristics of Earth's geosphere, biosphere, atmosphere and hydrosphere?	• Describe two major ways the Earth's systems interact • Define Earth's geosphere, lithosphere, biosphere, atmosphere and hydrosphere • Describe the parts of the Earth's geosphere • Describe Earth's biosphere and atmosphere. • Discuss the water cycle.	**Core Activities** • Spheres of Earth's Outdoor Activity- (Suburban Science) **Optional Activities** • Biome Poster Project (Suburban Science) • Ecology Reading (in Pearson Environmental Science textbook)
	***Studying Ecology (pp. 100-103) (pp. 164-180)** **Vocabulary:** ecology, species, population, community, ecosystem, biosphere, biotic factors, biosphere, biotic factor, abiotic factor, habitat, resource, biome, climate, weather, climatograph, net primary production, • Describe the different levels of organization studied by ecologists • Explain the difference between biotic and abiotic factors • Discuss how an organism's habitat relates to its survival	1.How do ecologists organize and study life? 2. What abiotic and biotic factors are used to classify biomes? 3.What conditions and organisms characterize the world's biomes?	• Describe the different levels of organization studied by ecologists • Explain the difference between biotic and abiotic factors • Discuss how an organism's habitat relates to its survival • Explain how biomes are characterized • Describe how net primary production varies among biomes	**Core Activities** • Data Analysis: Climatograms (Suburban Science) • Digging Deeper: Vegetation and Climate (Suburban Science) • AAB Biome Activity worksheet • Activity utilizes the following website: askabiologist.asu.edu/explore/biomes • Digging Deeper: Speciation (suburban science) • Interspecific Competition (suburban science) • Digging Deeper: Keystone Species

	• Explain how biomes are characterized • Describe how net primary production varies among biomes • Explain how organisms are adapted to the conditions of their biomes *Note: This will not address Aquatic Biomes (see Hydrosphere Unit)		• Explain how organisms are adapted to the conditions of their biomes • Explain how biotic and abiotic factors influence an ecosystem • Compare habitat and niche • Explain how variation in niche can impact survival and prevent competition for resources between organisms • Identify different trophic levels in a food chain/web • Compare bioaccumulation and biomagnification • • Define *species, speciation*, *gene pool* and *interspecific competition* • Explain the difference between an endangered vs threatened species • List factors that can lead to the extinction of a species • Compare the four factors that cause speciation • Explain the principle of competitive exclusion	(Suburban Science) • Data Analysis: Indicator species (suburban science) **Optional Activities** • Biome Poster Project (Suburban Science) • Ecology Reading (in Pearson Environmental Science textbook) **Quiz: Google Form Link** https://forms.gle/Kw7KSmQtshHKQkeR9

	Investigation Four-Populations **1.Describing Populations (pp. 104-109)** **Vocabulary:** population size, population density, population distribution, age structure, age structure diagram, sex ratio • Explain the usefulness of tracking population size • Describe the three ways populations can be distributed • Explain what age structure diagrams tell you about a population 2.**Population Growth (pp. 110-117)** • Describe the factors that influence a population's growth rate • Explain exponential growth and logistic growth • Explain how limiting factors and biotic potential affect population growth	1. What are the important characteristics of populations? 2.What factors determine whether, and how, a population's size changes?	• Define *population density* • Explain the usefulness of tracking population size • Describe the three ways populations can be distributed • Explain what age structure diagrams tell you about a population • Describe the factors that influence a population's growth rate • Explain exponential growth and logistic growth • Explain how limiting factors and biotic potential affect population growth BIODIVERSITY	**Core Activities** • Describing Populations (in Pearson Environmental Science textbook) • Data Analysis: Age Structure Diagram (suburban science) • Data Analysis: Barnacle Geese Population (suburban science) • Real Life Scenario: Ozark Collard Lizzards (suburban science) • Deer Ecology Analysis (Suburban Science) • Digging Deeper: Invasive Species **Optional Activities** • Biodiversity Lab (suburban science) • Data Analysis: Biodiversity analysis (suburban science) • Population Growth Concept Map (suburban science) • R v K Strategist Card Sort
	Standards List:		**GLEs: S.A.1-**, Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, Using Mathematics and Computational Thinking, Engaging in Argument from Evidence, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Obtaining, Evaluating, and Communicating Information	

	Unit 3: Atmosphere			
Suggested Pacing: 5 weeks Note: Stewards of Our Land Project will begin at the conclusion of Unit 6 and before S2 Final Exam. This will add approximately 2 weeks to the pacing guide.				
Standard	**Knowledge and Skills (Key Objectives)**	**Essential Question(s)**	**Objectives**	**Suggested Activities & Resources**
	Investigation One: Composition and Layers of the Atmosphere **Earth's Atmosphere (pp 452- 459)** **Vocabulary:** atmosphere, relative humidity, air pressure, troposphere, stratosphere, ozone layer, mesosphere, thermosphere, radiation, conduction, convection, convection current, air mass, front • Describe the properties of the atmosphere • Identify the four main layers of the atmosphere • Explain heat transfer and the interaction of air masses in the troposphere **Pollution of the Atmosphere (pp. 461-468)** **Vocabulary:** air pollution, emission, fossil fuel, primary air pollutant, secondary air pollutant, smog, temperature inversion, acid deposition • Explain how both natural processes and human activities can cause air pollution • Describe how air pollutants affect human health • Explain what causes smog and how temperature inversions affect it and other forms of air pollution • Explain how acid deposition occurs and describe its effects **Controlling Air Pollution (pp. 469-473)** **Vocabulary:** Clean Air Act, catalytic converter, scrubber, ozone hole, chlolofluorocarbon (CFC), Montreal Protocol • Explain how the provisions of the Clean Air Act have reduced air pollution in the United States • Describe the international efforts to reduce	1.How can we describe the Earth's Atmosphere? 2.What are the sources of air pollution? 3. What measures can limit and prevent pollution of the atmosphere?		• Composition of the Atmosphere Lab- (Suburban Science) • Layers of the Atmosphere Graphing Activity (Suburban Science) • Local Weather Independent Exploration (Suburban Science) • Meteorology Video Report group activity (Suburban Science) • Whats Your Weather? Independent Exploration (Suburban Science) • **Lab:** Weather and the Atmosphere (Science Interactive Inc) • **Lab:** Ultraviolet Radiation and Sunscreen (Science Interactive Inc)

	the ozone hole			
	Investigation Two: Global Climate Change **1.Our Dynamic Climate (pp. 484-490)** **Vocabulary:** greenhouse effect, greenhouse gas, thermohaline circulation, El Nino, topography • Describe factors that affect how the sun warms Earth • Discuss the role of wind patterns in determining climate • Explain how the oceans affect Climate • Describe how climate is affected by topography, volcanoes, regional vegetation, and periodic changes in Earth's orbit **2. Climate Change (pp. 491- 496)** **Vocabulary:** global climate change, global warming, proxy indicator, climate model, fossil fuel • Identify evidence of global warming • Explain three methods used to study climate change • State the probably cause of global climate change **3.Effects of Climate Change (pp. 497-501)** **Vocabulary:** coral bleaching • State ways in which the warming atmosphere affects ecosystems and organisms • Explain how climate change is affecting people now • Predict future effects of Climate Change on people **4.Responding to Climate Change (pp. 502- 507)** **Vocabulary:** carbon footprint, carbon tax, carbon offset, carbon sequestration, Kyoto Protocol • List ways to reduce greenhouse gases related to the use and generation of electricity • Describe some of the ways of reducing greenhouse gases related to transportation • Describe other strategies for reducing greenhouse gases • Explain how nations are working together to try to address Climate Change	**1.**What factors determine Earth's Climate? 2. What evidence shows that global climate change is occurring and why it is happening? 3. What are the effects of Climate Change? 4. How can we respond to Climate Change		• Exploring the Coriolis Effect Partner Activity (Suburban Science) • **Lab:** The Greenhouse Effect (Science Interactive Inc) •

	Investigation Three: Nonrenewable Energy **1.Energy an Overview (pp. 516-521)** **Vocabulary:** • **2.Fossil Fuels (pp. 522- 528)** **Vocabulary** • **3.Consequences of Fossil Fuels (pp. 529-535)** **Vocabulary** • **4.Nuclear Power (pp. 536-541)** **Vocabulary** •	**1.**What is energy and how is it used? 2. How did fossil fuels form and how are they obtained and used? 3.What problems are associated with fossil fuel use? 4.What are the advantages and disadvantages of nuclear energy?		• **Lab:** Alternative Energies (Science Interactive Inc) • **Lab:** Energy Comparison of Fuels (Science Interactive Inc)
	Investigation Four: Renewable Energy **1.Biomass and Geothermal (pp. 550-555)** **Vocabulary:** • **2.Hydropower and Ocean Energy (pp. 556-560)** **Vocabulary** • **3.Solar and Wind (pp. 561-569)** **Vocabulary** • **4.Energy from Hydrogen (pp. 570-573)** **Vocabulary** •	**1**.How can we use biomass energy and geothermal energy? 2. How can water be used to address energy needs? 3. How can we rely on the sun and wind for power? 4.How can we use hydrogen as a source of energy?		• **Lab:** Energy Comparison of Fuels (Science Interactive Inc) • **Lab:** Renewable Solar Energy (Science Interactive Inc)
	Stewards of Our Land Project ***Harnessing the Power of Renewable Energy*** At the conclusion of the Atmosphere Unit, Develop a proposal for a wind and solar microgrid that can generate electricity for the (75-100%) of the community - Conduct interviews with local utility company to learn energy output at community level and logistics of integrating renewable technologies into grid	**1.**How much electricity does the community of Nome consume in a Month? Year? 2.How much does the average household pay for electricity on a		• Guest Speakers

	- Contact wind turbine and solar panel manufacturers to learn the cost to ship and install technology and maintain structures over 20 years period - Blueprint of how and where technology would be installed in town - Describe how structures will be maintained over time - Communicate results of project to the community at large…either a town hall meeting/over the radio/article write-up etc.	monthly basis? k 3.How does a power plant work? How has the price of fuel fluctuated over the last 20 years? 4.How do wind turbines function? -What is the history of wind turbines in Nome? -How much power do our current wind turbines generate? -What is the feasibility of installing more wind turbines in Nome and what is the maximum output of energy that we could feasibly generate from full-scale wind turbine farm? -What is the upkeep/maintenance of these turbines and how much do those cost? -How long do wind turbines last? 5.How many solar panels could be installed on the average home in Nome?		

Unit 3: Geosphere			
Suggested Pacing: 4 weeks Note: Stewards of Our Land Project will begin after S1 Midterm Exam. This will add approximately 2 weeks to the pacing guide.			
Standards	**Knowledge and Skills (Key Objectives)**	**Essential Question(s)**	**Suggested Activities & Resources**
	Investigation One- Soil Composition + Conservation **Soil (pp 352-357 in text)** **Vocabulary:** soil, parent material, bedrock, weathering, soil horizon, soil profile, clay, silt, sand, loam • Explain three processes by which soil forms • Describe the horizons that make up a soil profile • List the four characteristics used to classify soil **Soil Degradation and Conservation (pp. 358-364)** **Vocabulary:** soil degradation, intercropping, crop rotation, cover crop, shelterbelt, tilling, terracing, contour farming overgrazing, desertification, irrigation, salinization, pesticide • Describe some practices that can lead to soil erosion and some that can prevent it • Identify the causes and effects of desertification • Discuss the activities of U.S. and international agricultural organizations • Explain how irrigation and pesticide use can cause soil pollution	1. What is soil? 2. How do erosion, desertification and soil pollution affect the productivity of soil?	• Mineral social media profile-Suburban Science • Mineral identification lab- Suburban Science • Edible Mining Simulation Lab- Suburban Science • Types of Rocks Jigsaw activity-Suburban Science • Mining Impact-Research Activity-Suburban Science • Soil Analysis Lab- Suburban Science • Global Soils Profiles Research Project-Suburban Science • Soil Erosion STEM Activity- Suburban Science • **Lab:** Properties of Soils- Interactive Science Inc.
	Investigation Two- Minerals, Rocks and Mining **1.Minerals and Rocks (pp 392-397)** **Vocabulary:** mineral, precipitation, polymorph, rock and rock cycle • Explain what a mineral is • Describe how minerals form • Identify types of rocks and the stages of the rock cycle **2.Mining (pp 398- 404)** **Vocabulary:** ore, strip mining, subsurface mining, open pit mining, mountaintop removal, placer mining, tailings, smelting • Identify the types of resources that are mined • Describe different methods used for mining	1. Where do minerals come from? 2. How are mineral resources accessed? 3. How can we reduce the negative impacts of mining and manage mined resources?	• Mineral social media profile-Suburban Science • Mineral identification lab- Suburban Science • Edible Mining Simulation Lab- Suburban Science • Types of Rocks Jigsaw activity-Suburban Science • Mining Impact-Research Activity-Suburban Science • **LAB:** Mining Lab (Liben's EScience Resource)

	• Explain how metals are processed **3.Mining Impacts and Regulation (pp. 405-411)** **Vocabulary:** acid drainage • Describe the negative impacts of mining on the environment and society • Explain how mining is regulated • Describe ways that mineral use can become more responsible		
	<u>Stewards of Our Land Project</u> ***Local Mining Research and Communication*** At the conclusion of the Mineral Resources and Mining Unit, students will apply their learning to a capstone research project that investigates a local mining operation in Nome, Alaska. Working independently or collaboratively, students will: - **Identify the resource(s)** being mined at the chosen operation. - **Describe the mining method(s)** used to extract the resource. - **Explain how the resource is processed** after extraction. - **Analyze the impacts** of mining on both the environment and the Nome community, including both positive and negative effects. Students will first submit a **formal written report** of their research findings. Following this, they will craft a **community-focused communication piece** designed to share their message about the mining process with a wider audience. Students may choose the medium that best fits their message, such as a radio broadcast, newspaper article, letter to a policymaker, or educational content for social media. This project is designed to connect course concepts to real-world issues in our region, promote critical thinking about natural resource use, and empower students to communicate responsibly about environmental topics that affect their community.	1.What specific resources are being mined in Nome, and why are they important locally, nationally, or globally? 2.How is this resource extracted and processed, and what technologies or methods are used? 3.What are the environmental impacts of this mining operation, both immediate and long-term? 4.How does this mining activity affect the Nome community economically, socially, and culturally? 5.In what ways can mining practices and resource use become more sustainable and responsible for future generations	• Guest speakers

	Standards List:		**GLEs: S.A.1**-, Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, Using Mathematics and Computational Thinking, Engaging in Argument from Evidence, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Obtaining, Evaluating, and Communicating Information

Land use and Sustainability Unit (additional Content)		
Suggested Pacing: 3 weeks		
Knowledge and Skills (Key Objectives)	**Essential Question(s)**	**Suggested Activities & Resources**
Investigation One: Urbanization **Land Use and Urbanization (pp 292 and 298)** **Vocabulary:** land cover, land use, urban area, rural area, urbanization, infrastructure, heat island • Differentiate between land cover and land use and describe how people affect both • Explain how and where urbanization occurs • Describe the environmental impacts of urbanization **Sprawl (pp. 299-304)** **Vocabulary:** sprawl • Describe the contributors to sprawl and its patterns • Explain the impacts sprawl has on its area **Sustainable Cities (pp. 305-313)** **Vocabulary:** city planning, geographic information system (GIS), zoning, urban growth boundary (UGB), smart growth, ecological restoration, greenway • Describe four different components of city planning • Explain the importance of mass transit options to city and its residents • Explain the importance of open space to a livable city • Differentiate green buildings from conventional buildings • Discuss the progress toward sustainability some cities have made and its importance to the world	1.How do we use the land we live on? 2. How can the effects of urbanization lead to sprawl? 3. What are the characteristics of a sustainable city?	• Heat Islands Online Research -Suburban Science • Impacts of Urbanization Poster- Suburban Science • Urban Sprawl Drawing Activity- Suburban Science • Urban Issues in Developing and Develop Countries Research Project- Suburban Science • Be a City Planner Group Activity- Suburban Science • **Lab: Carbon Footprint and Sustainable Living-** ScienceInteractive Inc. • **Strait Science Presentation Review:** Arctic Vessel Traffic Management https://www.youtube.com/watch?v=L1Qss0r2a3A&list=PLuuqkhFcq8ifdnRxDaKYiRiewrQSvzcA6&index=4
Investigation Two: Sustainable Agriculture **1.Agriculture (pp. 365-372)** **Vocabulary:** traditional agriculture, yield, industrial agriculture, green revolution, biological pest control, integrated pest management • Discuss the beginnings of agriculture • Explain the importance of industrial agriculture and the green revolution • Identify different types of pest control • Explain the importance of pollinators to agriculture **2.Food Production (pp. 373- 383)** **Vocabulary:** arable land, food security, malnutrition, genetic engineering,	**1.**How has agriculture evolved? **2.**How can we produce enough food for a rapidly growing population while sustaining our ability to produce it?	• GMO Class Debate- Suburban Science • Perplexed by Protein graph interpretation activity - Suburban Science • Informational Flyer on Protein Sources- Suburban Science • **Lab:** Salinization of Soils - Interactive Science Inc.

genetically modified organism (GMO), biotechnology, feedlot, aquaculture, seed bank, sustainable agriculture, organic agriculture • Explain why the world needs to grow more food and to grow it sustainably • Discuss genetically modified food • Describe the advantages and disadvantages of industrial food production • Discuss sustainable agriculture		

Hydrosphere Unit (additional Content)		
Suggested Pacing: 3 weeks		
Knowledge and Skills (Key Objectives)	**Essential Question(s)**	**Suggested Activities & Resources**
Investigation One: Introduction to Water **Earth: The Water Planet (pp 420- 425)** **Vocabulary:** fresh water, surface water, runoff, river system, watershed, groundwater, permeable, impermeable, aquifer, water table, recharge zone, well • Discuss how fresh water can be both renewable and limited • Explain the significance of a watershed • Explain how most groundwater is accessed **Uses of Freshwater (pp. 426-434)** **Vocabulary:** water diversion, dam, reservoir, salinization, desalination, xeriscaping • List the three primary categories of freshwater use • Relate the causes of surface water depletion to their effects • Explain the major causes and effects of groundwater depletion • Describe strategies for addressing water depletion **Water Pollution (pp. 435-443)** **Vocabulary:** point-source pollution, nonpoint source- pollution, cultural eutrophication, wastewater, algal bloom, pathogen, red tide, septic system • Discuss the main categories of water pollution • Explain why groundwater pollution is difficult to clean up • Discuss the sources and effects of major pollutants found in the ocean • Describe how water is regulated and treated	1.Where is all of our water? 2. How can we change the way we use water? 3. How does water pollution affect humans and ecosystems?	• Properties of Water Stations Lab- Suburban Science • Personal Water Audit- Suburban Science • Watershed Mapping Activity- Suburban Science • Building an Aquifer STEM Model - Suburban Science • Irrigation Jigsaw Group Research Activity- Suburban Science • Salination Investigation Lab- Suburban Science • **Lab-** Water Quality (Interactive Science Inc) • **Lab-** Determination of Water Hardness Using a Titrator (Interactive Science Inc.)

Investigation Two: Aquatic Ecosystems **1.Agriculture (pp. 181-191)** **Vocabulary:** salinity, photic zone, aphotic zone, benthic zone, littoral zone, limnetic zone, wetland, flood plain, estuary, upwelling • Describe the criteria ecologists use to classify aquatic ecosystems • List the major categories of freshwater ecosystems • Explain the ecological importance of estuaries • List the three major zones of the Ocean	**1.**What conditions and organisms characterize the world's aquatic ecosystems?	• Group Discussion-Commercial Fishing and Aquaculture: Suburban Science • Research a Fish Project- Suburban Science • Oil Spill Clean-up Simulation Lab: Suburban Science • Effects of Oil on Marine Life Research Activity: Suburban Science • Sources of Water Pollution Card Sorting Activity: Suburban Science • **Strait Science Presentation Review:** Point Lay Walrus **https://www.youtube.com/watch?v=MWtd1ciF-lo&list=PLuuqkhFcq8ifdnRxDaKYiRiewrQSvzcA6&index=18**

Biology

Grade(s): 9-12 **Length**: two semesters **Credit**: 1 **Prerequisites**: Teacher recommendation, Freshman entry- level class	**Course Overview**: *Biology* is a one-year course (1 credit) designed to meet the Biological Science Requirements for graduation. Students will engage in the practices of science to help them understand how scientific knowledge develops as well as gain an appreciation for the wide range of approaches used to investigate, model and explain the world. Such practices will include learning how to develop and use models, planning and carrying out investigations, analyzing and interpreting data as well as engaging in argument from evidence. Academic content will focus on core ideas that will help students develop a broader and deeper understanding of content so that it can be used to make sense of new information and resolve authentic problems. First semester will begin with the Nature of Science, transition into the Cells: Structure and Function concluding with Ecosystem Dynamics. Second semester will focus on Chemistry of Life, Genetics: Inheritance and Variation of traits and will conclude with Evolution and Natural Selection. **Adopted Textbook**: *Biology*, Miller and Levine

Units (Recommended Order)	
Semester 1	**Semester 2**
Traditional Teaching Method: • The Nature of Science • Strutcure of Life: From Cells to Organisms • Ecosystem Dynamics* *This unit can be taught in the fall or spring to allow for place-based lessons.	Traditional Teaching Method: • Chemistry of Life • Genetics: Inheritance and Variation • Evolution and Natural Selection *This unit can be taught in the fall or spring to allow for place-based lessons.

Unit 1: Nature of Science	
Suggested Pacing: Intermixed through other units	**Textbook Chapter(s)/Lessons**: Africa Storyline and Homeostasis Storyline
Key Objectives	**Suggested Activities & Resources**
• Be able to define: Science, scientific theory, evidence, data, hypothesis, independent variable, dependent variable • Be able to develop a model by labeling various parts of a compound light microscope • Be able to	• Macromolecules in Food Lab • Ocean Acidification Lab • Elephant Poop Lab
• Use graphical techniques to describe data. • Use mathematical and/or computational representations of phenomena or design solutions to support explanations. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	• Labs that incorporate quantitative data • Examples: Pendulum Lab, Zookeeper Nutrition Lab, Elephants Population Lab, Calculating Evolution Lab
• Critically review current literature about scientific topics. • Practice formulating logical conclusions. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	• Practice writing Claim Evidence Reasoning (CER) reports
Standards List:	**GLEs: S.A.1-**, Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, Using Mathematics and Computational Thinking, Engaging in Argument from Evidence, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Obtaining, Evaluating, and Communicating Information

UNIT 2: Ecology- Ecosystem D This unit can be taught in the fall or spring to allow for place-based lessons.	
Suggested Pacing: 4-6 weeks	**Textbook Chapter(s)/Lessons**: Africa Storyline, Homeostasis Storyline, and Melanin Storyline
Key Objectives	**Suggested Activities & Resources**
• Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem (e.g., carbon, energy, water). • Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. • Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	• Model ecosystem energy transfers. • Make posters of food webs/chains from local habitats. • Describe specific ways in which indigenous people use local species. • Individual research projects on local plants and animal species. • Arctic Ecosystems Lab • Africa Storyline, Homeostasis Storyline, and Melanin Storyline
• Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales, specifically in Alaskan ecosystems. • Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. • Describe symbiotic interactions between organisms in a community.	• What Happened to the Otters Lab • Carrying Capacity Lab • Africa Storyline, Homeostasis Storyline, and Melanin Storyline
• Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. • Use food webs of local plant and animal species that show ecological relationships • evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. • evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	• Use web-based data to graph the extent of sea ice in the Arctic Ocean since 1970. • Explore the causes of that change and its consequences on the organisms of the Arctic. • Invasive plant studies. • Discussions of current ecological issues. • Ocean Acidification Lab • Africa Storyline, Homeostasis Storyline, and Melanin Storyline
Standards List:	**HS-LS2: Ecosystems: Interactions, Energy, and Dynamics,** LS2.A: Interdependent Relationships in Ecosystems, LS2.B: Cycles of Matter and Energy Transfer in Ecosystems, LS2.C: Ecosystem Dynamics, Functioning, and Resilience, **HS-LS4: Biological Evolution: Unity and Diversity,** LS4.D: Biodiversity and Humans, **GLEs**: SC.2-3

UNIT 2: CHEMISTRY OF LIFE	
Suggested Pacing: 4-6 weeks	**Textbook Chapter(s)/Lessons**: Africa Storyline and Homeostasis Storyline
Key Objectives	**Suggested Activities & Resources**
• Describe and model the basic atomic structure.	• PhET Digital Lab on Atoms Elements & Compounds • Animal Digestion Lab
• Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	• Flow chart-type drawings of cellular respiration. • Cellular Respiration Lab • Africa Storyline and Homeostasis Storyline
• Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	• Flow chart-type drawings of photosynthesis. • Understanding Photosynthesis Activity • Africa Storyline and Homeostasis Storyline

UNIT 3: CYTOLOGY	
Suggested Pacing: 4-6 weeks	**Textbook Chapter(s)/Lessons**: Africa Storyline, Homeostasis Storyline, and Melanin Storyline
Key Objectives	**Suggested Activities & Resources**
• Describe cell organelles and their functions. Systems of specialized cells within organisms help them perform the essential functions of life.	• Models of plant and animal cells. • Microscope skills labs including wet mounts of plant and animal cells and cell drawings. • Africa Storyline, Homeostasis Storyline, Melanin Storyline
• Describe diffusion and osmosis and the importance of these processes for cells.	• Predictions and tests of the behavior of cells in salt solutions and distilled water. • 3D molecular models of diffusion and osmosis. • Computer animations of diffusion and osmosis. • Student-built models of DNA. • Labs examining the diffusion of materials into different sized objects. • Ocean Acidification Lab • Africa Storyline, Homeostasis Storyline, Melanin Storyline
• Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. • Describe the process of cell division and its role in reproduction and multicellular organisms (mitosis and meiosis).	• Use a cell model to work through all the steps of mitosis and meiosis. • Africa Storyline, Homeostasis Storyline, Melanin Storyline
Standards List:	**HS-LS1**: From Molecules to Organisms: Structures and Processes, LS1.A: Structure and Function, LS1.B: Growth and Development of Organisms

UNIT 4: GENETICS AND HEREDITY	
Suggested Pacing: 3-5 weeks	**Textbook Chapter(s)/Lessons**: Africa Storyline, Melanin Storyline, and Disease Storyline
Key Objectives	**Suggested Activities & Resources**
• Recognize that cells use DNA to store information and manage cellular functions. • Describe the role of chromosomes in sex determination.	• Student-built models of DNA. • Africa Storyline, Melanin Storyline, and Disease Storyline
• Make and defend a claim based on evidence that inheritable genetic variations may result from: (a) new genetic combinations through meiosis, (b) viable errors occurring during replication, and/or (c) mutations caused by environmental factors. • Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	• Human traits activity. • Punnett squares activity. • Lulu the Lioness Lab • Albinism & Pedigrees Lab • Africa Storyline, Melanin Storyline, and Disease Storyline
• Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. • Explain how cell functions are regulated through changes in protein activity. • Model and interpret basic Mendelian patterns of genetics using Punnett squares, and non-Mendelian patterns (e.g., incomplete, codominance, sex-linked traits).	• Melanin Lab • Central Dogma of Biology Activity • Africa Storyline, Melanin Storyline, and Disease Storyline
Standards List:	**HS-LS1**: From Molecules to Organisms: Structures and Processes, **HS-LS3: Heredity: Inheritance and Variation of Traits,** LS3.A: Inheritance of Trai ts, LS3.B: Variation of Traits, **GLEs**: SC.1-2

UNIT 5: BIOTECHNOLOGY	
Suggested Pacing: 4-6 weeks	**Textbook Chapter(s)/Lessons**: Africa Storyline, Melanin Storyline, and Disease Storyline
Key Objectives	**Suggested Activities & Resources**
• Recognize that cells use DNA to store information and manage cellular functions. • Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	• Restriction Enzyme Lab • Strawberry Electrophoresis • CRISPR Activity • Africa Storyline, Melanin Storyline, and Disease Storyline
• Critically review current literature about scientific topics.	• Research project on current advances in biotechnology • Bioethics Research • Africa Storyline, Melanin Storyline, and Disease Storyline
Standards List:	Engaging in Argument from Evidence, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Obtaining, Evaluating, and Communicating Information, **HS-LS1**: From Molecules to Organisms: Structures and Processes, **LS4.D**: Biodiversity and Humans

UNIT 6: EVOLUTION	
Suggested Pacing: 6-8 weeks	**Textbook Chapter(s)/Lessons**: Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
Key Objectives	**Suggested Activities & Resources**
• Utilize tools to categorize organisms (i.e., taxonomic keys, cladograms). • Describe the characteristics of domains and kingdoms of organisms. • Within each kingdom, describe how the anatomical characteristics can affect an organism's survival. • Explain the relationship between structure and function in major phyla. • Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. • Describe classification based on evolutionary relationships.	• UC Berkeley Evolution website: http://evolution.berkeley.edu. • Natural selection simulations. • Build a bird. • Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
• Describe the changes that have occurred over geologic time. • Chronicle the development of evolutionary theory by natural selection. • Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence (homologous structures, embryology, DNA, adaptive radiation, fossil record). • Construct an explanation based on evidence for how natural selection leads to adaptation of populations. • Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) the change in allele frequency within the population, (2) the emergence of new species over time, and (3) the extinction of other species. • Explain how variation within a species and natural selection could result in speciation or extinction. • Create or revise a simulation to test a solution to mitigate adverse impacts on human activity on biodiversity.	• Fossil building simulations. • Interpretation of fossil exercises. • Geological Time activities • Elephant Forensics Lab • Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
• Explain how the diversity of life has arisen through evolutionary processes. • Describe how variation within species is maintained over time through recombination and mutations of genes. • Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. • Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.	• Peppered Moth activity. • Rock Pocket Mice activity. (HHMI) • Toothpick Fish. • What Happened to the Elephants Lab • Melanin Lab • Evidence for Skin Selection Lab • Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
Standards List:	**HS-LS4**: Biological Evolution: Unity and Diversity, LS4.A Evidence of Common Ancestry and Diversity, **LS4.B**: Natural Selection, **LS4.C:** Adaptation, **LS4.D**: Biodiversity and Humans, **HS-LS1:** From Molecules to Organisms: Structures and Processes, **LS1.A**: Structure and Function, **GLEs:** S.A.1; SC.1-2; SG.1-3

Foundations of Life Science

Grade(s): 9-11 **Length**: two semesters **Credit**: 1 **Prerequisites**: Teacher recommendation	**Course Overview**: *Foundations of Life Science* is a one-year course (1-credit) that meets a core-science requirement for graduation. This class is designed with interactive investigations that dive into the topics related to fisheries and arctic gardening practices. During the first semester, students will learn how to raise pacific salmon (Coho) in a classroom incubator from the egg to fry stage under the supervision of the Norton Sound Economic Development Corporation (NSEDC) fisheries biologists and technicians. Through hands-ons projects and activities, students will study topics about the life cycle, habitat requirements, and behavior/ physical adaptations of salmon before releasing their fry in Moonlight Springs at the end of the school year. Second semester, the class will switch gears and focus on plants and arctic gardening through the development of an indoor vegetable garden. Cheryl Thompson will help supervise indoor garden activities and assist students as they transfer their knowledge through activities at the Community Garden. Throughout Semester 2, students will learn about the diversity, reproductive strategies and physiology of plants. Over the course of the year, students will also discuss local employment opportunities in fisheries available to them after high school as well as discuss and implement a business plan that utilizes the resources from their school vegetable garden. . **Adopted Textbook** To be Determined. (Used to develop this curriculum: *Environmental Science.* National Geographic, 2022)

Units (Recommended Order)	
Semester 1	**Semester 2**
• Introduction: Nature of Science • Fisheries Management • Classroom Gardening	• Classroom Gardening/Fisheries Management (ongoing)* • Wildlife Management *Place-based Projects: Raising Salmon in the Classroom and Gardening will continue until the end of S2

UNIT 1: INTRODUCTION TO ENVIRONMENTAL SCIENCE	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 1 and 18
Key Objectives	**Suggested Activities & Resources**
• Explain What Science Is & the focus of Environmental Science • Describe The Process Of Science • Describe the major roles of the scientific community the process of science	• Oasis Earth: Planet in Peril (free textbook)
• Describe the recent trends human population and resource consumption • Explain the relationship between economics and the environment	
• Describe ways that economics are working towards sustainability • Explain the purpose of environmental policy	
Standards List:	**GLEs: S.A.1-,** Asking Questions and Defining Problems, Obtaining, Evaluating and Communicating Information, **LS2.A:**Interdependent Relationships in Ecosystems

UNIT 2: ECOLOGY	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Describe the different levels of organization studied by ecologists • Explain the difference between biotic and abiotic factors • Explain how limiting factors and biotic potential affect population growth	• Case Study: Caribou Conservation Conundrum • Case Study: Mystery in Alaska • Case Study: The Moose, The Wolf, and the Fir Tree • ESRI Geoinquiries • Treehugger
• Compare and contrast predation, parasitism,and herbivory • Describe mutualism and commensalism • Explain the difference between a producer and a consumer	
• Explain what a biogeochemical cycle is and recognize that nutrients cycle through the environment endlessly • Summarize the roles of producers and consumers in carbon cycle Including chemical formulas for photosynthesis and cellular respiration	

Standards List:	**GLEs: S.A.1**-, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, **LS2.A**:Interdependent Relationships in Ecosystems, **LS2.B:**Cycl es of Matter and Energy Transfer in Ecosystems, **LS2.C**:Ecosystem Dynamics, Functioning and Resilience

UNIT 3: BIODIVERSITY	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 4, 5, 6, 7, and 8
Key Objectives	**Suggested Activities & Resources**
• Explain how biomes are characterized • Describe how net primary production varies among biomes • Describe the four primary mechanisms of biological evolution	• HHMI Biointeractive Biome Viewer • HHMI Biointeractive short film "From Ants to Grizzlies: A General Rule for Saving Biodiversity" • HHMI Biointeractive: "Mystery of the Missing Tusks" • Case Study: Complexity in Conservation • ESRI Geoinquiries
• Describe how speciation and extinction affect the diversity life on Earth • Differentiate the components of biodiversity • Explain two ways in which biodiversity varies across groups or geography • Describe how biodiversity is monitored and explain current biodiversity trends	
• List the major causes of biodiversity loss • Explain legal actions nations can take to protect biodiversity • Explain the conditions necessary for a species to become invasive	
Standards List:	**GLEs: S.A.1-,** Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, **LS4.B**: Na tural Selection, **LS4.C**: Adaptation, **LS4.D**:Biodiversity and Humans, ESS3.C: Human Impacts on Earth Systems, **ETS1.B**: Developing Possible Solutions

UNIT 4: HUMAN POPULATIONS	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Describe how technological advances have contributed to human population growth • Explain recent trends in population growth • Describe total fertility rates and replacement fertility • Explain how the age structure and sex ratio of a population define its potential for growth	• ESRI Geoinquiries
• Identify characteristics of human population that are studied by demographers • Describe the demographic transition • Discuss social factors that affect population • List the types of environmental health hazards	
• Describe how humans impact their environments • Compare and contrast epidemiology and toxicology • Discuss risk assessment • Describe how infectious diseases spread • Explain why emerging diseases are important to monitor and control • Differentiate between social hazards that are lifestyle choices and those that cannot controlled	
• **Standards List:**	**GLEs: S.A.1-,** Using Ma thematics and Computational Thinking, Constructing Explanation and Designing Solutions, **LS2.A:** Interdependent Relationships in Ecosystems, **LS2.C:** Ecosystem Dynamics, Functioning and Resilience, **ESS3.A**: Na tural Resources

UNIT 5: PHYSICAL SYSTEMS IN ENVIRONMENTAL SCIENCE	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**: Chapter 3
Key Objectives	**Suggested Activities & Resources**
• State the definition of an environmental system and give examples • Explain that the geosphere, biosphere, atmosphere, and hydrosphere are defined according to their functions Earth's systems • Explain the importance of the cycling of nutrients, both macro and micro to all life on Earth	• Selected chapters and data-based activities from the "Earth Exploration Toolbook" • HHMI Biointeractive: "Understanding Global Change" Interactive
• Identify the layers of the atmosphere in the correct order • Explain how the ozone layer protects us from harmful ultraviolet radiation	
• Connect plate tectonics to environmental science concepts such as biogeochemical cycles, volcanoes and air pollution, geothermal energy, earthquakes, and risk assessment	
Standards List:	**GLEs: S.A.1-,** Developing and Using Models, Using Mathematics and Computational Thinking, **LS2.B:** Cycles of Matter and Energy Transfer in Ecosystems, **LS2.C:** Ecosystem Dynamics, Functioning and Resilience, **ESS2.A**: Earth's Materials and Systems, **ESS2.B:** Plate Tectonics and Large Scale System Interactions

UNIT 6: CLIMATE SCIENCE	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Distinguish between weather and climate and list the factors that affect them • Use conduction, convection, and radiation to explain how heat is transferred in the environment • Explain the reason for the seasons	• Selected chapters and data-based activities from the "Earth Exploration Toolbook" • HHMI BioInteractive lesson: "Trends in Atmospheric Carbon Dioxide" • PBS Lab: "Seasons on Earth" • Earth Labs: "Greenhouse Gas Lab" • Data Nuggets lab on tree ring analysis: "A Window Into a Tree's World" • SPRINTT Climate Change Curriculum • Project Learning Tree Unit: "Southeastern Forests and Climate Change" • Documentary Film *Cosmos* Episode 12: "The World Set Free"
• Identify greenhouse gasses and their sources • Explain how scientists study changes in climate • Describe the evidence indicating that global warming has been caused largely by the increase in greenhouse in the atmosphere	
• Describe how global climate change is affecting aspects of human life such farming,forestry, the economy, livingspace, health,and biodiversity • List ways of reducing the production of greenhouse gasses and explain why this is important	

Standards List:	**GLEs: S.A.1-** Planning and Carrying Out Investigations, Asking Questions and Defining Problems, Analyzing and Interpreting Data, **ESS2.D**: Wea ther and Cl imate, **ESS3.D**: Global Cl imate Change

UNIT 7: NATURAL RESOURCES	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapters 11, 12, and 13
Key Objectives	**Suggested Activities & Resources**
• Explain why agricultural lands can lose productivity over time as nutrients are consumed and what are current soil conservation methods • Describe human practices that may lead to soil erosion and techniques that can mitigate it	• Selected chapters and data-based activities from the "Earth Exploration Toolbook" • *Alaska Resource Education* Curriculum: "The Story of Alaska's Mineral and Energy Resources" • Virtual Tour of Copper Mine • *Project Wet* Activities - see website to access guides and resources • Documentary Film: *The Last Mountain* • Case Study: The Poopin Composting • CaseStudy: "The Wealth of Water"
• Describe the most common methods of mining and their environmental consequences • Describe how different minerals are formed and are cycled through the Earth • Identify mineral resources available in Alaska and how their mining affects humans and the environment, including mining regulations	
• Identify how water is used in society and how water use affects ecosystems.(agricultural, industrial, residential, recreational) • Explain what a watershed is and give an example local to Fairbanks • Identify the distribution of water on Earth. (surface, groundwater, icecaps, ocean)	
Standards List:	**GLEs: S.A.1**- Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, **ESS3.A:** Na tural Resources, **ESS2.E:** Biogeology, **ESS3.C**: Human Impacts on Earth Systems

UNIT 8: POLLUTION AND WASTE MANAGEMENT	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapters 9, 10, 16, and 17
Key Objectives	**Suggested Activities & Resources**
• Describe different types of water pollution, its sources and treatment • Describe different types of air pollution caused by human activity and natural processes, its sources and treatment • List different ways environmental policies have reduced pollution in the US and globally	• Selected chapters and data-based activities from the "Earth Exploration Toolbook" • Air Actions Curriculum (background reading, labs, video labs on air quality)
• Describe the conventional methods of waste disposal; landfills, incinerators and recycling • Discuss the importance of waste reduction and what we as consumers can do about it (the 3 R's reduce, reuse, recycle)	
• Discuss hazardous waste, identify common everyday items that are hazardous waste and associated problems with its disposal. (e-waste, cfl's, batteries etc.)	
Standards List:	**GLEs: S.A.1**- Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, **ESS2.C:** The Roles of Water in Earth's Surface Processes, **ESS3.A**: Na tural Resources, **ESS3.C:** Human Impacts on Earth Systems

UNIT 9: CONCEPTS OF ENERGY	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 2
Key Objectives	**Suggested Activities & Resources**
• Describe the different forms of energy and how they can be harnessed for human use • Describe how although energy cannot be created or destroyed it can be converted to less useful forms such as thermal energy in the environment	• Email Renewable Energy Alaska Project (REAP) at education@realaska.org to request a guest speaker to lead an energy activity using Kill-A-Watt Meters • "Renewable Energy Atlas of Alaska" - information about renewable energy resources in Alaska • Documentary Movie: *Who Killed the Electric Car* • *National Energy Education Development (NEED)* project curriculum guides • Case Study: "A Green Light for CFLs?"
• Make connections between types of renewable and nonrenewable energy and the sun as the initial source energy • Identify the pros and cons of using fossil fuels and other nonrenewable sources of energy • Describe types of fossil fuels used, how they have formed, and are extracted	
• Describe alternative energy resources and how they may be harnessed and used • Identify the pros and cons of using different renewable resources (solar, wind, hydro, geothermal)	

Standards List:	**GLEs: S.A.1**- Engaging in Argument from Evidence, Obtaining, Evaluating, and Communicating Information**, PS3.A**: Definitions of Energy, **PS3.B:** Conservation of Energy and Energy Transfer, **ESS3.A:** Na tural Resources, ESS3.C: Human Impacts on Earth Systems, **ESS3.D**: Global Cl imate Change

Human Anatomy & Physiology

Grade(s): 11-12 **Length**: two semester **Credit**: 1 **Prerequisites**: Teacher recommendation or *Biology*	**Course Overview**: *Human Anatomy & Physiology* is a course that advanced students will learn about the major organ systems of the human body and how they work together to sustain life and maintain health. Academic skills will focus on independent reading and analysis. Content focus will be on the relationship between the structure (anatomy) of organs and organ systems and the functions (physiology) of those systems. Students will have the opportunity to study how healthy life choices can help to enhance the functioning of those systems; they will also be introduced to the many careers available in the modern health care system. **Adopted Textbook**: *Body Structures and Functions*. National Geographic/Cengage, 2022.

Units (Recommended Order)	
Semester 1	**Semester 2**
• Basis of Anatomy and Physiology • Integumentary System • Skeletal System • Muscular System • Nervous System *Components of the Endocrine system will be studies as appropriate to other systems (i.e pituitary gland with the nervous system).	• Circulatory and Respiratory Systems – Macro: Lungs, Heart, and Vessels • Circulatory Systems – Micro: Cells, Proteins, Lymph, and Immunity • Digestive System • Renal System • Reproductive System *Components of the Endocrine system will be studies as appropriate to other systems (i.e. pancreas with the digestive system).

UNIT 1: BASIS OF ANATOMY AND PHYSIOLOGY	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 2, 3, 4 and 5.
Key Objectives	**Suggested Activities & Resources**
Identify and discuss the different branches of anatomy and the eleven body systems.	• View and discuss Deadly Ascent; a Nova film about the challenges of high altitude. • Make drawings/watercolors examples of the four tissue types. • Dissect celery using anatomical terms. • View Thai Cave Rescue to apply homeostasis. • Lab simulation "Homeostasis" to maintain homeostasis of model.
Learn basic anatomical vocabulary including directional planes, directional terms, and body cavities.	
Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	
Describe the structure and function of the major types of cells.	
Describe levels of organization in the human body.	
Define the function and location of tissues.	
Explain the structure of an atom, an element, and a compound.	
Describe the four main groups of organic compounds: carbohydrates, fats, proteins, and nucleic acids.	
Explain the difference between an acid, a base, and salt and the acid-base balance.	
Demonstrate understanding of homeostasis and how it is maintained by the body.	
Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	

Standards List:	**LS1.A: Structure & Function:** HS-LS1.1, HS-LS1.3, HS-LS3.1

UNIT 2: INTEGUMENTARY SYSTEM	
Suggested Pacing: 3-4 weeks	**Textbook Chapter(s)/Lessons**: Chapter 6
Key Objectives	**Suggested Activities & Resources**
Describe the functions of the skin.	• Lab: Microscopic examination of the skin • Tissue box model of the skin • Exploration of why tattoos are permanent • Biology of skin color (HHMI) • Wound lab • Medical highlights – hazards of the sun
Describe the structures found in the three skin layers.	
Explain how the skin serves as a channel of excretion.	
Understand the physiology of skin color	
Describe common skin (cancer), hair, and nail disorders. Describe wounds to the skin and how the skin heals, including scarring.	
Standards List:	**LS1.A: Structure & Function**: HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 3: SKELETAL SYSTEM	
Suggested Pacing: 4-5 weeks	**Textbook Chapter(s)/Lessons**: Chapter 7
Key Objectives	**Suggested Activities & Resources**
Identify the main functions of the skeletal system.	• Label a life size skeleton, or assemble bones into a skeleton. • Bone strength lab.
Explain how bones can grow in length and diameter over the lifetime of the person.	• Identify bone fractures in X-rays, labeling affected bones and type of fractures.
Name and locate the bones of the skeleton, including the types of joints.	• Demonstrate joint types through active pictures
Be familiar with some disorders caused by malfunctions within this system (i.e. osteoporosis).	
Give examples of how the skeletal system maintains homeostasis by controlling the level of calcium in the blood.	• Bone calcium and parathyroid POGIL
Standards List:	**LS3.B: Variation of Traits:** HS-LS3.2, HS-LS3.3

UNIT 4: MUSCULAR SYSTEM	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 8
Key Objectives	**Suggested Activities & Resources**
Identify the three types of muscle cells and their functional differences. Explain the molecular mechanism for muscular contraction through the sliding filament theory. Describe systems of opposing muscle, including how muscles attach to bones and function to make joints work. List the major groups of skeletal muscles. Become familiar with the scientific literature regarding various performance enhancing drugs used by athletes. Demonstrate an understanding of the acute and chronic effects, and the special risks of anabolic steroids in teens. Be familiar with some disorders caused by malfunctions within this system.	• Invite a physical therapist to demonstrate the skills required for successful therapy. • Identify muscular systems and how they control movement. • Draw and label muscles on a life-sized model. • Muscle contraction POGIL • Clay build of muscles. • Muscle art – label and name muscles of famous statues. • Dissect a chicken wing to view muscles, ligaments, and tendons. • Discuss body dysmorphia – Project Hope
Standards List:	**LS1.A: Structure & Function:** HS-LS1.1, HS-LS1.2, HS-LS3.1

UNIT 5: NERVOUS SYSTEM	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapters 9, 10, and 12.
Key Objectives	**Suggested Activities & Resources**
Explain the role of nervous system in coordinating the functions of the whole organism.	• Class visit from community experts on steroid abuse and traumatic brain injuries. • Labs testing the sensory neurons of skin, reaction times, blind spots, color blindness, etc. • Visit from pathologist with brain tissue. • Dissect a cow's eye. • Clay build of the brain and spinal cord, including innervation of a muscle. • Drug addiction nerve pathways. • View "Human the World Within- React or Senses."
Explain how a nervous impulse travels through an action potential, including neurotransmitters.	
Describe the major parts of the brain and their functions.	
Explain the role of sensory organs.	
Explain how muscles are innervated through the peripheral nervous system.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	**LS1.A: Structure & Function:** HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 6: CIRCULATORY AND RESPIRATORY SYSTEMS – MACRO: LUNGS, HEART AND VESSELS	
Suggested Pacing: 3-4 weeks	**Textbook Chapter(s)/Lessons**: Chapters 13, 14, 15, and 18.
Key Objectives	**Suggested Activities & Resources**
Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	• Examine and draw a pig heart. • Learn to measure blood pressure. Examine the effects of exercise on pulse and blood pressure. • Coloring models of the four-chambered heart. • Dissect the major arteries and veins of the fetal pig. Look at the fetal circulation through the umbilical cord. • Life size sketch with major vessels drawn and labeled. • Clay build of heart and lungs • Stop motion video of how blood moves through heart, to lungs, back to heart and out to body • Build a model of the lungs in a plastic bottle, simulate pressure required to inflate lungs
Explain the role of alveoli oxygenating blood.	
Give examples of how negative feedback loops in the circulatory system maintain homeostasis.	
Give examples of how positive feedback loops decrease homeostatic stability.	
Label the major vessels of the body.	
Explain the structure of the heart and how its form follows its function.	
Describe the structure of the body's vessels.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	**LS1.C: Organization for Matter and Energy Flow in Organisms:** HS-LS1.6, HS-LS1.7

UNIT 7: CIRCULATORY SYSTEMS – MICRO: CELLS, PROTEINS, LYMPH, AND IMMUNITY	
Suggested Pacing 4-5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 4 and 16
Key Objectives	**Suggested Activities & Resources**
Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	• Blood type testing with a school nurse or simulated blood typing. • Use Punnett Squares to determine the genetics of blood typing. • Immune system comic.
Describe the role of hemoglobin in oxygenating tissues.	
Describe the ABO and RH proteins on red blood cells and the genetics.	
Describe the cellular makeup of blood.	
Describe the function of each of the blood cells. Differentiate between red and white blood cells.	
List the different types of white blood cells and explain how they function in immunity.	
Describe immunity and the defense mechanisms of the body.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	**LS1.C: Organization for Matter and Energy Flow in Organisms:** HS-LS1.6, HS-LS1.7

UNIT 8: DIGESTIVE SYSTEM	
Suggested Pacing: 3-4 weeks	**Textbook Chapter(s)/Lessons**: Chapters 19 and 20.
Key Objectives	**Suggested Activities & Resources**
List the functions of the digestive system.	• Measure the calories in various easily burned foods. • Use Biuret solution, Benedicts solution and iodine to test various foods. • Dissect the digestive system of a fetal pig. • Class visit from diabetes prevention specialist. • Digestion in a bag. • Build a model of the digestive system to size, using craft material like yarn. • Clay build of the digestive system and accessory organs. • Blue frosting lab.
Name and describe the functions of the organs of the digestive tract and accessory organs.	
Describe metabolism. Recognize that food is chemical energy that is measured in calories.	
List the major types of nutrients, where they are absorbed, and how they are used by the body.	
Understand the production and excretion of fees in the microbiome of the gut.	
Explain the role of insulin in metabolism and the effects of diabetes.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	**LS1.A: Structure & Function:** HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 9: RENAL SYSTEM	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 21
Key Objectives	**Suggested Activities & Resources**
Explain the function of the urinary system.	• Urinalysis lab • Dissect a pig kidney. • Draw or model the functional unit of the kidney - the nephron. • Trace blood flow into, through, and out of the kidney.
Describe the structure and function of the organs in the urinary system.	
Explain how kidneys regulate water balance and remove nitrogenous wastes from the blood.	
Understand how the urinary system and circulatory system work together to clean the blood and create urine.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	**LS1.A: Structure & Function**: HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 10: REPRODUCTIVE SYSTEM	
Suggested Pacing: 3-4 weeks	**Textbook Chapter(s)/Lessons**: Chapter 22
Key Objectives	**Suggested Activities & Resources**
Describe the organs and glands of the male and female reproductive systems.	• Finish dissecting the reproductive system of the fetal pig. • Invite medical professionals to show students how to suture their pigs closed. • Invite medical professionals to talk to students about anabolic steroids. • Lab: Birth Control. • View "The 9 Months that Made You" (PBS) • Clay build of the reproductive systems • Public Health
Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	
List the major hormones of the male and female reproductive system.	
Explain the relative effects of estrogen and progesterone during the female menstrual cycle.	
Explain the importance of the placenta to healthy prenatal development.	
Explain why a fetus is particularly vulnerable to damage by drugs, alcohol, or environmental contaminants.	
Describe the trimesters of pregnancy and the fetal development that is occurring during each one.	
Describe the structure of the lactating breast. Summarize the process of lactation. Explain how the composition of breast milk changes during the first days of lactation and in the course of a single feeding.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	**HS-LS1: Growth & Development of Organisms:** HS-LS1.4

Marine Science

Grade(s): 10-12 **Length**: one semester **Credit**: 0.5 **Prerequisites**: Teacher recommendation or *Biology*	**Course Overview**: *Marine Science* explores the adaptation of marine organisms, ecological concepts, and physical processes that structure the marine environment. The course is a study of the environmental impacts of chemistry, geology, and other abiotic conditions and the organisms that live in marine environments. The course also examines human interactions with marine ecosystems and the many careers associated with it. Special attention will be given to students' knowledge of Alaska's marine environment, its importance to indigenous people, local economies, food production, and career possibilities. **Adopted Textbook**: New textbook to be determined. *Introduction to Marine Biology*. Brooks Cole/ Cengage, 2010.

Units (Recommended Order)
Semester 1
• Physical and Chemical Oceanography • Organisms and Their Effects on Ecosystems • Biochemical Cycles • Interdependence Between Organisms • Evolution of Marine Species • Marine Sciences and Culture

UNIT 1: PHYSICAL AND CHEMICAL OCEANOGRAPHY	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: TBD
Key Objectives	**Suggested Activities & Resources**
Use the properties of water, salinity, and temperature to explain water stratification.	• Use a 10-gallon aquarium to demonstrate the effects of different densities and temperatures on stratification. • Label and color code a world map with sea/ocean names and locations of currents. • Read The Perfect Storm and use it for small group discussions of weather patterns and environmental impacts of the fishing industry. • Explain the impact of atmospheric CO2 on ocean acidification.
Describe and explain periodic variations in the marine ecosystem such as tides, currents, and seasons.	
Explain how the surface of the Earth changes through plate tectonics, earthquakes, volcanoes, erosion, and deposition.	
Give examples of interactions between marine and terrestrial ecosystems.	
Describe how weather is affected by the oceans.	
Develop a model to i **l**ustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	
Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	
Standards List:	**ESS2.A: Earth Materials & Systems:** HS-ESS2.1, HS-ESS2.2, **ESS2.B: Plate Tectonics & Large-Scale System Interactions:** HS-ESS2.3, **ESS2.C: The Roles of Water in Earth's Surface Processes:** HS-ESS2.5

UNIT 2: ORGANISMS AND THEIR EFFECTS ON ECOSYSTEMS	
Suggested Pacing: 6 weeks	**Textbook Chapter(s)/Lessons**: TBD
Key Objectives	**Suggested Activities & Resources**
Describe the major abiotic and biotic characteristics of the important ecological zones within the marine biome.	• Build a bulletin board showing benthic habitats. • Use the characteristics of preserved invertebrates to develop a classification system. • Student reports on the major phyla. • Discussions of the abiotic challenges of various marine habitats and the physiological and behavioral responses of organisms.
Describe how biochemical and anatomical characteristics define an organism's anatomy and physiology, its behavior, survival and reproductive capabilities.	
Explain how taxonomy is used to describe the diversity of phyla and classes.	
List the characteristics of major chordate and invertebrate phyla that allow them to survive in a marine environment.	
Compare environmental characteristics and the adaptations organisms have to adapt and survive.	
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	
Standards List:	**LS2.A: Interdependent Relationships in Ecosystems:** HS-LS2.1, HS-LS2.2, **LS2.C: Ecosystem Dynamics, Functioning, & Resilience:** HS-LS2.6

<table>
<tr><th colspan="3">UNIT 3: BIOCHEMICAL CYCLES</th></tr>
<tr><td colspan="2">Suggested Pacing: 2 weeks</td><td>Textbook Chapter(s)/Lessons: TBD</td></tr>
<tr><th colspan="2">Key Objectives</th><th>Suggested Activities & Resources</th></tr>
<tr><td colspan="2">Describe the transfer of energy through marine ecosystems.</td><td rowspan="4">• Draw models of energy flow.
• Diagram the carbon, nitrogen, and phosphorous cycles.</td></tr>
<tr><td colspan="2">Describe the cycling of matter through marine ecosystems.</td></tr>
<tr><td colspan="2">Provide examples of how cycles of matter and energy link living organisms and their environment.</td></tr>
<tr><td colspan="2">Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</td></tr>
<tr><td>Standards List:</td><td colspan="2">LS2.4: Interdependent Relationships in Ecosystems: HS-LS2.1, HS-LS2.2, LS2.B: Cycles of Matter & Energy Transfer in Ecosystems: HS-LS2.4</td></tr>
</table>

UNIT 4: INTERDEPENDENCE BETWEEN ORGANISMS	
Suggested Pacing: 6 weeks	**Textbook Chapter(s)/Lessons**: TBD
Key Objectives	**Suggested Activities & Resources**
Give examples of the interdependence between marine organisms and their environment.	• Draw food webs of local marine plant and animal species. • Use individual student reports to explore the characteristics of predator/prey, symbiotic, and herbivorous organism interactions.
Describe the levels of organization in marine ecosystems from the individuals to populations and communities.	
Describe theories that explain patterns of diversity from the equator to the poles.	
Standards List:	**LS2.D: Social Interactions & Group Behavior:** HS-LS2.8; **LS4.C: Adaptation:** HS-LS4.5, HS-LS4.6; **LS4.D: Biodiversity & Humans:** HS-LS2.7

UNIT 5: EVOLUTION OF MARINE SPECIES	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: TBD
Key Objectives	**Suggested Activities & Resources**
Explain how variation in the environment provides the mechanisms for natural selection, evolution, and diversity of species.	• Do a report on one of the extinct sea species from the Cambrian.
Give examples of how the natural variation in individuals allows species to survive in changing environments.	
Describe the evidence scientists use to link the evolutionary history of organisms and their classification.	
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in:	
Increases in the number of individuals of some species.	
The emergence of new species over time.	
The extinction of other species.	
Standards List:	**LS4.D: Biodiversity & Humans:** HS-LS2.7, HS-LS4.6; **LS4.A: Evidence of Common Ancestry & Diversity:** HS-LS4.1; **LS4.C: Adaptation:** HS-LS4.4, HS-LS4.5

UNIT 6: MARINE SCIENCES AND CULTURE	
Suggested Pacing: Ongoing throughout the course.	**Textbook Chapter(s)/Lessons**: TBD
Key Objectives	**Suggested Activities & Resources**
Recognize the importance of marine systems to society.	• Research career possibilities in the field of marine biology. • Describe the fisheries of the North Pacific.
Describe how indigenous people use local marine organisms.	
Give examples of how humans can alter ecosystems.	
Explain why it is important for citizens to be knowledgeable on current issues and policies of natural resource use.	
Give examples of specific examples of Alaskan marine use issues.	
Describe human dependence upon the marine environment, concentrating on Alaskan uses.	
List and describe marine careers.	
Give examples of how humans can alter the structures of ecosystems.	
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	
Standards List:	**LS4.D: Biodiversity & Humans:** HS-LS2.7, HS-LS.4-6

Wildlife Biology

Grade(s): 9-12 **Length**: two semesters **Credit**: 1 **Prerequisites**: None	**Course Overview**: *Wildlife Biology* is focused on teaching key biological concepts through the study of Alaska wildlife. Through a placed-based lens, students who take this class will learn how to connect local, indigenous, and scientific knowledge together. **Adopted Textbook**: TBD

Units (Recommended Order)	
Semester 1	**Semester 2**

• Studying Wildlife
• Ecology
• Evolution of Alaska Life
• Wildlife Nutrition
• Single Celled Life of Alaska:
  ○ Bacteria
  ○ Protist
• Viruses and Biotechnology
	• Simple Multicellular Life in Alaska
	• Complex Multicellular Life of Alaska:
	  ○ Plants
	  ○ Fungi
	• Complex Multicellular Life of Alaska
	  ○ Invertebrates
	  ○ Vertebrates
	• Wildlife Management and Human Impact

UNIT 1: STUDYING WILDLIFE	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Show the methods of studying wildlife in Alaska from remote tracking, tagging, sample collection, and other methods.	Create or gather models that students can use to collect data for study of organisms & populations.
Look at the research of AK wildlife to show how we study organisms as individuals in order to look at the health of the whole population.	Do an activity to show how different forms of tracking wildlife are developed and used to inform scientists and policy makers.
Use current wildlife studies to show how & why key Alaska organisms are being studied for the longevity of life in AK.	Read through recent wildlife research to show how research drives conservation.
Look into the importance of wildlife conservation and study.	Look at past event in human history to show the importance of study & conservation (e.g. whale).
Standards List:	**GLEs: S.A.1-3, HS LS 1-4, PS 1.1**

UNIT 2: ECOLOGY	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Create an activity to show how biogeochemical cycles work to connect the biosphere with all the other spheres on Earth.
Describe symbiotic interactions between organisms in a community.	Any symbiotic interaction activity to show students how the interaction between different organisms work.
Show how a community of organisms are built with the interactions of populations of organisms.	Build food chains and webs to illustrate the unique connection between AK wildlife & their environment.
Look at the ecosystems of Alaska & how they are made up of a unique collections of both physical & biological elements.	Play an ecosystem game to explain the interconnectedness of the physical and biological world.

Standards List:	**HS PS3.3-4, HS LS2.1-4, HS LS4.1-6, HS PS1.1**

UNIT 3: EVOLUTION OF ALASKA LIFE	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	Use a variety of activities to show the evidence of evolution such as the homologous structure coloring or the fossil building or the various natural selection simulations online (pHet or Biointerative).
Describe the mechanisms that drive the evolutionary process and how it has driven the wide diversity of AK life.	Simulation online to show the mechanisms and can be linked back to AK animals during to Pleistocene.
Explain how the diversity of AK life has arisen through geological & evolutionary processes.	
Explain how variation within a species and natural selection could result in speciation or extinction.	Create a speciation activity to show how different speciation events can happen and link them to past and current events in AK history.
Standards List:	**HS LS3.1-3, HS LS4.1-6**

UNIT 4: WILDLIFE NUTRITION	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Show the importance of micro & macro nutrients to biological life by using the student own needs as a reference.	Use online nutrient calculators to figure out the needs of each kid and connect it to their current eating habits.
Build a model organism to calculate how much and what they need to eat to survive.	Design an activity to show an organisms need for nutrients and how much they would need.
Use a model to explain the process of cellular respiration & how organism release energy from the breaking of chemical bonds.	Any Cellular respiration activity found online could work.

Standards List:	**HS LS1, HS PS1, HS PS3**

UNIT 5: SINGLE CELLED LIFE OF ALASKA - BACTERIA	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Explain the structure and function of the cell membrane and cell wall.	Bubblelicious membrane lab or any activity teaching how the cell membrane works.
Describe diffusion and osmosis and the importance of these processes for cells.	Gummy bear osmosis or orbeez osmosis/diffusion labs.
Show the importance of bacteria to all life in AK.	Look at the bacteria in mammal guts (ruminants &/or humans) and how many organisms cannot live without a healthy amount bacteria.
Explain how antibiotics work and how growing resistance is a large concern to the human population.	Run through a game or simulation explaining how antibiotics work & how bacteria can grow resistance to them.
Standards List:	**HS PS3, HS LS1.1-7, HS LS3.1**

UNIT 6: SINGLE CELLED LIFE OF ALASKA - PROTISTS	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Describe the structure & functional differences to bacteria to introduce eukaryotes.	Build models of protists with organelles to describe their structure and function and differences to bacteria.
Explain the difference between prokaryotes & eukaryotes.	Compare the structure and function of bacteria and protists.

Show the importance of protists to other life in AK, and how protists are a crucial part of many food webs and produce 50% of the Earth's oxygen.	Numerous Algae labs online as well as algae growth activities.
Show the structure and function of cell organelles in eukaryotes.	Cell analogy activity to help understand the structure and function of cell organelles in Eukaryotes.
Standards List:	**HS PS 3, HS LS 1.1-7, HS LS 3.1**

UNIT 7: VIRUSES AND BIOTECHNOLOGY	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Show how viruses are not living organisms but how they affect organisms.	Research viral diseases in AK life.
Describe the structure and function of viruses.	Build virus models and show how they spread.
Look into how humans are using virus in a number of ways from gene editing to new gen antibiotics.	Use CRISPR labs to see gene editing in action.
Standards List:	**HS LS1; HS LS 4; ETS 1.2; HS PS 1; HS ESS 3**

UNIT 8: SIMPLE MULTICELLULAR LIFE OF ALASKA	
Suggested Pacing: 1-2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Utilize tools to categorize organisms (i.e., taxonomic keys, cladograms).	Build a Cladogram using multicellular organisms.
Describe the characteristics of domains and kingdoms of organisms.	

Explain the way cell communication works.	
Show how multicellular life is built of a large interconnected relationship between single cells communicating.	Tissue lab or build models of tissue and how they communicate.
Standards List:	**HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2**

UNIT 9: COMPLEX MULTICELLULAR LIFE OF ALASKA - PLANTS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Any photosynthesis lab or activity building the macromolecules crucial to life.
Explain the structure and function of plants, and how/why they are the foundation of most terrestrial food webs.	Study the different plants native to Alaska.
Look at how plants have been used by the indigenous peoples and organisms of Alaska for food, shelter, etc.	Gather samples of AK plants to make stuff with, or maybe even bring in a guest speaker to talk about how groups of people use different plants of AK.
Standards List:	**HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2**

UNIT 10: COMPLEX MULTICELLULAR LIFE IN ALASKA - FUNGI	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Use models or samples to show the structure and function of fungi and the mycelial network they form in an area.	Mushroom dissection. Mycelial network communication articles.

Explain the importance of fungi as decomposers.	Decompose bread, fruit, or veggies using fungi in a sealed bag.
Show how mycorrhizal fungi are a crucial part of the boreal forest.	Dissect the roots of spruce trees to see the mycorrhizal fungi growing into and around the roots.
Standards List:	**HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2**

UNIT 11: COMPLEX MULTICELLULAR LIFE OF ALASKA - INVERTEBRATES	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Explain the relationship between structure and function of invertebrate.	Build or dissect invertebrates (build models with air dry clay).
Show the importance of many invertebrates to plant life in AK, and where they fit in the AK food web.	Simulate pollination by insects and how they are crucial to the reproduction of plants.
Identify the major invertebrate groups of Alaska, including general anatomy.	Compare the various invertebrate groups of Alaska through samples or pictures.
Look at the importance of invertebrate to human life in Alaska both for needed sustenance and economic value.	Poll the class on how many students know of or themselves rely on invertebrate. Research the nutritional &/or economic value of AK invertebrates (crab fishing, etc.).
Standards List:	**HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2**

UNIT 12: COMPLEX MULTICELLULAR LIFE OF ALASKA - VERTEBRATES	
Suggested Pacing: 5-7 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Explain the relationship between structure and function of vertebrate.	Build or dissect vertebrates (build models with air dry clay).
Show the interconnectedness of many vertebrates and where they fit in the various AK ecosystems.	
Identify the major vertebrate groups of Alaska, including general anatomy, physiology, and behavioral patterns.	Compare the various vertebrate groups of Alaska through samples or pictures.
Look at the importance of vertebrates to human life in Alaska, both needed sustenance & economic value.	Poll the class on how many students know of or themselves rely on invertebrate. Research the nutritional &/or economic value of AK invertebrates (crab fishing, etc.).

Standards List:	**HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2**

UNIT 13: WILDLIFE MANAGEMENT AND HUMAN IMPACT	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Look into mass extinctions to see the effect of rapid changes in an ecosystem on wildlife.	Research mass extinctions.
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	Human impact project (kids choose a way humans impact wildlife and research possible solutions).
Show how sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.	Biodiversity lab showing the impact of changes in ecosystems.
Study local wildlife management laws and why they are important to maintaining Alaska's biodiversity.	Read over hunting & fishing regulations and discuss their importance to the longevity of AK wildlife.
Standards List:	**HS ESS3.1-3, HS PS3.3-4, HS LS2.1-4, HS LS4.1-6, ETS1.2**

Physical Science Options

Advanced Placement Chemistry

Grade(s): 11-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: Teacher recommendation	**Course Overview**: The *AP Chemistry* course provides students with a college-level foundation to support future advanced coursework in chemistry. Students cultivate their understanding of chemistry through inquiry-based investigations, as they explore content such as: atomic structure, intermolecular forces and bonding, chemical reactions, kinetics, thermodynamics, and equilibrium. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). **Adopted Textbook**: *Chemistry: A Molecular Approach*. Savvas/Pearson, 2023

Advanced Placement Environmental Science (semester 2)

Grade(s): 11-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: Teacher recommendation, *Biology,* and *Chemistry*	**Course Overview**: The *AP Environmental Science* course is designed to engage students with the scientific principles, concepts, and methodologies required to understand the interrelationships within the natural world. The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). **Semester one fulfills the Life Science graduation requirement and semester two fulfills the Physical Science requirement.**

Advanced Placement Physics 1

Grade(s): 11-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: Teacher recommendation	**Course Overview**: *AP Physics 1* is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: kinematics, dynamics, circular motion and gravitation, energy, momentum, simple harmonic motion, torque and rotational motion, electric charge and electric force, DC circuits, and mechanical waves and sound. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). **Adopted Textbook**: *Cutnell & Johnson Physics*. HMH/Wiley, 2018

Advanced Placement Physics 2

Grade(s): 11-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: Teacher recommendation	**Course Overview**: *AP Physics 2* is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: fluids; thermodynamics; electrical force, field, and potential; electric circuits; magnetism and electromagnetic induction; geometric and physical optics; and quantum, atomic, and nuclear physics. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). **Adopted Textbook**: *Cutnell & Johnson Physics*. HMH/Wiley, 2018

Advanced Placement Physics C: Mechanics

Grade(s): 11-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: *Calculus* (May be concurrently enrolled.)	**Course Overview**: *AP Physics C: Mechanics* is a calculus-based, college-level physics course. It covers Kinematics, Newton's laws of motion, work, energy, and power, systems of particles and linear Momentum, circular motion and rotation, oscillations, and gravitation. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). **Adopted Textbook**: *Physics for Scientist and Engineers*. Cengage, 2019

Chemistry

Grade(s): 10-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: Teacher recommendation or *Algebra 1*	**Course Overview**: *Chemistry* is an introductory, general chemistry course that builds a foundation for college-level chemistry, physics, and biology courses. Students learn about chemical reactions and the structure of matter in order to explain how and why substances react the way they do. Laboratory work and laboratory reporting are an integral part of the course, helping students develop an understanding of the concepts as well as the process of science. **Adopted Textbook**: *Glencoe Chemistry: Matter and Change*. McGraw-Hill, 2016.

Units (Recommended Order)	
Semester 1	**Semester 2**
• Changes and Interactions of Matter • Structure of Matter • Ionic Bonding	• Covalent Bonding • Stoichiometry and Chemical Reactions • Gasses • Acids and Bases If time allows, explore the following topics: • Polymers, plastics, and hydrocarbons • Electrochemistry

SCIENTIFIC PRACTICE AND DESIGN	
Suggested Pacing: These principles should be present throughout all units of study.	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Recognize SI units of measurements.	• Flinn Safety Contract and Test. • Lab safety classroom scavenger hunt. • Make a poster of conversion tips/significant digit rules. • Lab: Density of Unknown Metal (slope of the line mass vs. volume gives density). • Lab: Measurement. • Lab: Equipment Identification.
Convert data into scientific notation and from one unit to another.	
Round numbers correctly based on the certainty of the measurement.	
Use and create graphs to represent data.	
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	
Use mathematical representations of phenomena to support claims.	
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	
Use a model to predict the relationships between systems or between components of a system.	
Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	
Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	
Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.	

Standards List:	**PS1.A: Structure and Properties of Matter:** HS-PS1.1, HS-PS1.3; **PS1B: Chemical Reactions:** HS-PS1.2, HS-PS1.5, HS-PS1.6

UNIT 1: CHANGES AND INTERACTIONS OF MATTER	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: Chapter 3
Key Objectives	**Suggested Activities & Resources**
Describe the changes and interactions that result in observable changes in the properties of matter including chemical, physical, and nuclear changes such as radioactive decay.	• Lab: Separation of a Mixture. • Lab: Chemical and Physical Changes. • Demo: Electrolysis of Water.
Explain the Law of Conservation of Mass as it relates to chemical and physical changes.	
Distinguish between endothermic and exothermic reactions.	
Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	
Standards List:	**PS1.B: Chemical Reactions:** HS-PS1.2, HS-PS1.4, HS-PS1.5, HS-PS1.6, HS-PS1.7; **PS1.C: Nuclear Processes:** HS-PS1.8

UNIT 2: STRUCTURE AND MATTER	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: Chapters 4 and 5.
Key Objectives	**Suggested Activities & Resources**
Draw or build models describing the nature of molecules, atoms, and subatomic particles.	• Lab: Isotope (pennies/Runts candy). • Periodic chart poster (trends and grouping). • Lab/Observations: Atomic Emission Spectra. • Lab: Reactivity of the Alkaline Earth Metals. • Design and construct atom model (element includes p orbitals).
Describe how the current model of the atom is related to the structure and behavior of matter.	
Explain the relationship between nuclear stability and radioactivity.	
Compare wave and particle models of light.	
Express the arrangements of electrons in atoms using orbital notation.	
Relate the group and periodic trends (periodic table) to the electron configuration of atoms.	
Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	
Standards List:	**PS1.A: Structure and Properties of Matter:** HS-PS1.1, HS-PS1.2, HS-PS1.4; **PS1.C: Nuclear Processes:** HS-PS1.8

UNIT 3: IONIC BONDING	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: Chapters 7
Key Objectives	**Suggested Activities & Resources**
Define and describe chemical bonding; differentiating between ionic, covalent, and metallic bonding.	• Lab: Formation of an Ionic Compound. • Lewis Structures. • Demo: Formation of NaCl. • Demo: Polarity of Liquids.
Describe how ions form.	
Use and understand the current model of an atom to predict the formulas of simple ionic and covalent compounds.	
Write the names and formulas of simple ionic and covalent compounds.	
Determine shapes/geometry of molecules.	
Compare and contrast polar and nonpolar molecules.	
Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	
Standards List:	**PS1.A: Structure and Properties of Matter:** HS-PS1.3

UNIT 4: COVALENT BONDING	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 8.
Key Objectives	**Suggested Activities & Resources**
Define and describe chemical bonding; differentiating between ionic, covalent, and metallic bonding.	• Lab: Modeling Covalent Compounds Using Computer-based Models. • Lewis Structures. • Demo: Formation of NaCl. • Demo: Polarity of Liquids.
Describe how ions form.	
Use and understand the current model of an atom to predict the formulas of simple ionic and covalent compounds.	
Write the names and formulas of simple ionic and covalent compounds.	
Determine shapes/geometry of molecules.	
Compare and contrast polar and nonpolar molecules.	
Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	
Standards List:	**PS1.A: Structure and Properties of Matter:** HS-PS1.3

UNIT 5: STOICHIOMETRY AND CHEMICAL REACTIONS	
Suggested Pacing: 4weeks	**Textbook Chapter(s)/Lessons**: Chapters 10 and 11
Key Objectives	**Suggested Activities & Resources**
Balance chemical equations.	• Mole poster. • Lab: Empirical Formula of Magnesium Oxide. • Lab: Formula of a Hydrate. • Lab: Formation of a Precipitate/% Yield. • Statistical Analysis: Mean, Median, Mode. • PhET Online Lab: Balancing Equations https://phet.colorado.edu.
Translate written descriptions of chemical reactions into chemical equations.	
Classify and identify chemical reactions.	
Convert among moles, mass, and number of particles.	
Calculate empirical and molecular formulas for compounds and determine formulas for hydrates.	
Solve stoichiometry problems.	
Solve limiting reactant problems.	
Determine the percent yield of a chemical reaction.	
Solve reaction stoichiometry problems.	
Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	
Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Standards List:	**PS1.B: Chemical Reactions:** HS-PS1.2, HS-PS1.4, HS-PS1.5, HS-PS1.6, HS-PS1.7

UNIT 6: GASSES	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 12, section 1 and chapter 13.
Key Objectives	**Suggested Activities & Resources**
Use the kinetic molecular theory to explain physical properties of solids, liquids, and gasses.	• PhET Gas Law Online Lab: https://phet.colorado.edu
Describe the role of energy in phase changes.	
Use gas laws to calculate how pressure, temperature, volume and number of moles change.	
Apply gas laws and Avogadro's principle to chemical equations.	
Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.	
Standards List:	**PS1.B: Chemical Reactions:** HS-PS1.4, HS-PS1.5

UNIT 7: ACIDS AND BASES	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 18
Key Objectives	**Suggested Activities & Resources**
Compare acids and bases and understand why strengths vary.	• Lab: Titration of Vinegar. • PhET Online Lab: PH https://phet.colorado.edu
Calculate pH and pOH of aqueous solutions.	
Standards List:	**PS1.A: Structure and Properties of Matter:** HS-PS1.3; **PS1.B: Chemical Reactions:** HS-PS1.6

Earth & Space Science

Grade(s): 9-12 **Length**: two semesters **Credit**: 1 **Prerequisites**: None	**Course Overview**: *Earth & Space Science* is often broken down into five major areas of specialization: geology, astronomy, meteorology, oceanography and environmental science. Geology is the study of the Earth's surface and below. It includes minerals, rocks, the Earth's crust and interior, and the processes that change them. Astronomy is the study of everything beyond Earth's atmosphere. This includes the Earth & moon system, the solar system, the stars, galaxies, galaxy clusters, and the universe. Meteorology is the study of Earth's atmosphere and the weather. Oceanography is the study of the 70% of Earth covered in seawater and its interactions with the rest of the Earth. Environmental science adds life to the mix, and combines all the other categories and how they support life on this planet; so environmental science is "cross disciplinary." Given Alaska's high latitude and seasons, geology in the fall before the cold, dark and heavy snow allows for fieldtrips to examine rock outcrops at road cuts, visit mining operations, etc. Astronomy in mid-winter, when it is dark, lets classes go outside and use telescopes. Weather and oceanography in spring can mean clouds will have more variety. One can vary the order, however. If hurricanes and tornadoes are in the news in the fall, some of the weather and ocean material can be slipped in early to make the class relevant to what is happening in the news. The actual units can be studied in full detail later and teachers can refer back. **Adopted Textbook**: *Earth Science: Geology, the Environment, and the Universe*. Glencoe/ McGraw-Hill, 2017

Units (Recommended Order)	
Semester 1	**Semester 2**
• Introduction to Earth and Space Science • Composition of the Earth • Surface Processes (Optional) • Resources and Our Environment (Optional) • Dynamic Earth	• Beyond the Earth • Earth's Atmosphere, Weather, and Climate • Earth's Oceans and the Marine Environment • Geologic Time

INTRODUCTION TO EARTH AND SPACE SCIENCE	
Suggested Pacing: 10 days	**Textbook Chapter(s)/Lessons**:
Since science is a process, as well as a body of knowledge, this course is taught through lab activities and experiences as well as book work. The NGSS grounding phenomenon / driving questions (storyline) teaching process is different from the traditional teaching. A poor music analogy is teaching Jazz instead of Classical music. "Helping Students Make Sense of the World: Using Next Generation Science & Engineering Practices" (NSTA Press 2017) explains the new methods.	
Key Objectives	**Suggested Activities & Resources**

• Demonstrate understanding of how Earth is a complex system of interacting subsystems of Rock, Water, Air and Life by engaging in argument from evidence.
• Explain the importance of technology in the study of Earth Science. Exploring these requires lab activities maps to visually organize the information, remote sensing and geographic information systems (computer software that puts all the information into visual overlays that can be displayed on the maps as needed)
• Design experiments that require asking questions, developing hypotheses, collecting data, interpreting data, and developing conclusions.
• Demonstrate appropriate laboratory procedures and use of safety equipment in the science classroom.
• Develop, revise, test and then use models to describe phenomena and design systems.
• See the appendix for a detailed explanation of Earth Systems.
• Use lines of latitude and longitude, and other common map features, to navigate a global map.
• See the appendix for a detailed explanation of Map Latitude and Longitude.
• Describe and utilize different types of maps of the Earth and their digital equivalents.
• See the appendix for a detailed explanation of Map Types and Overlays.
• Explain how satellites and sonar are used to collect data and map Earth's surface. Students will be able to describe the difference between GPS and GIS and how each works.
• See the appendix for a detailed explanation of GPS and GIS Systems.
	• Two Teaching Styles may be implemented depending on circumstances::
	  ○ Student Driven: Grounding Phenomenon/ Driving Questions/ Students' Sense Making (Storyline for short) According to the NGSS guidelines is more engaging and effective for student retention. It is also more work for the teacher and takes more time. Our textbook is not set up for this.
	  ○ See "Teacher Handbook for NextGen Science Storylines, v1.1." (NextGen Science Storylines, 2019)
	  ○ Teacher Driven: Teacher introduces & leads the discussion. It is the traditional way of teaching science. Follow the suggested lessons in the Teacher Handbook and use labs, activities and the internet software that came with the textbook. These lessons are well thought out, but not as effective as Student Driven. If a teacher has to prepare for classes on three or four different subjects or a teacher is running out of time to finish a unit; this is an option.
	• Module 1: Introduction: Grounding Phenomenon: The Earth (1.0 days)
	  ○ Observe "Image of Earth" (pages 4-5) or show "One Year in Earth's Life" video (KUAC PBS)
	  ○ Asking Driving Questions:
	  ▪ After introductions and class rules, syllabus, etc, explain the difference between closed and open ended questions.
	  ▪ Each group submits three to five of their best open-ended questions about the Earth (e.g. inside, outside, beyond). Help students turn any one word answer question into open-ended.

	▪ As a class, sort the best twenty five or so questions into four or five categories. Store the categorized twenty five questions into Google. ▪ Jamboard - put the sticky notes on a classroom bulletin board. ▪ As you go through the unit, you will revisit the list. • Lab safety (1.5 days): Flinn Lab Safety Review & contract for parents & students to sign. (OR families read pages 904-905 in textbook and use the safety contract at "Student Earth and Environmental Science Laboratory Safety Agreement" (Carolina Biological Supply Company, 2016). • Students draw individual lab safety maps of the classroom showing exits, fire extinguisher, fire blanket, emergency eye wash, emergency shower, phone with emergency #'s posted (1.5 days). • Internet Resources: Assign the students the *Brain Pop* Science Lab Safety video; it works like *Ed Puzzle*. The students stop and answer questions to be able to proceed. It is entertaining and accurate. • Example of Earth Systems Interacting: (4.0 days) ○ Textbook: read pp. 6-9 ○ Internet Resources: Show these two video clips: ▪ Earth Systems (2 NASA video clips 5 and 5.5 minutes linked) (0.5 days) ▪ "Real World: Earth System Video" (Chose 9-12) (KUAC PBS) ○ (Teachers can make ed puzzle quizzes from all videos for easier formative testing & grade entry if desired.) • Investigation 1, Interacting parts of the Earth System. (3.5 days) ○ Show 1st video clip "Changing Hunting at Barrow (Utqiagvik)" ○ "Arctic Climate Perspective Rural Alaska Seeing Changes" (KUAC PBS) • Class discussion about what systems are interacting making this a problem. Groups record their ideas and save for the next part. ○ Work through the "What's a feedback loop and Daisy world" interactive activity. ○ "Daisey World Interactive Models Feedback Loops" (KUAC PBS)

	• Individuals write their final essay on notebook paper and keep it for the next discussion.

	• In light of the "feedback loop activity," class discusses and comes to consensus on what is making it harder to hunt whales in the arctic in spring.
	• When there is a class model for what is causing changes in the spring hunt, students write a first draft of their claim as to what causes it, followed by supporting evidence and the reasons showing why the evidence supports the claim.
	• Students work in teams to help each other be sure they are using complete sentences and that the grammar and spelling are correct. Now make a second draft using conjunctions "because, but, and so" to expand and clarify the reasoning. Present these second drafts to class either on whiteboards or projected on a slide. Classmates make positive editing suggestions to each presenter so that the corrections can be made while the presentation is happening. Then each perfected final product is checked off by the teacher for a grade.
	• Wrap it Up. Summarize the evidence you gathered from your investigations around the phenomenon and research on the questions. What conclusions did you reach about the best model for what is happening? State your conclusion as a Claim. Explain how your evidence supports your claim. Be sure to write in complete sentences.
	• Big Idea 3: "Earth Systems Interact" (YouTube, AGIeducation)
	• Understanding Maps: (2.0 days)
	  ○ Textbook: Read pp. 28-30
	  ○ View Internet Resources:
	  ○ Map Projections: How to Make the Surface of a Ball Flat. It's Hard! – "Why all World Maps are Wrong" (YouTube Vox)
	  ○ Topographic Maps:
	  ▪ "What is a contour map?"
	  ▪ "Calculating the Gradient of a Slope from a Topgraphic Map" (YouTube, Mike Sammartano)
	  ▪ "Constructing a Profile from a Topographic Map" (YouTube, Mike Sammartano)
	• Latitude and Longitude coordinates on Earth; Text pp. 30-33
	• Do a quick globe activity. Give students globes of the Earth and help them find the equator, north & south poles, and the prime meridian. Explain how the coordinates work. Next, read off some

	coordinates of places on Earth & help students find them. Then, ask students to find places on the globe that interest them, point to the

	spot and figure out the latitude and longitude, and share it with the class. Finally do a formative assessment based on what they have learned. Make copies of the worksheet from the text and have the students use the attached map to complete it.
	• From teacher resources in the textbook Chapter 2, Section 1, Teaching visual 4: The map and question worksheet. Students can work together or individually to locate positions on the map given coordinates and then give the coordinates for cities listed.
	• Textbook p. 48-49. Complete the Geo lab from the map in the book. Answer all the questions in complete sentences and draw your profile carefully. You may use graph paper if you wish. Turn both the answers and the profile in when you are finished.
	• Wrap it Up. Summarize the evidence you gathered from your investigations around the phenomenon and research on the questions. What conclusions did you reach about the best model for what is happening? State your conclusion as a Claim. Explain how your evidence supports your claim. Be sure to write in complete sentences.
	• Remote sensing & GIS: (1.0 days)
	  ○ Textbook: Read pp. 41-47
	  ○ Internet Resources
	  ▪ "How GPS Works" (YouTube, Seeker)
	  ▪ "What is a GIS" (YouTube, Esri Ireland)
	• National Geographic Lesson for Earth Science. "Introduction to GIS" (National Geographic Society). This prepackaged lesson gives directions, objectives, preparation, background, and vocabulary.
	• Example: *Alaska Department of Fish & Game* Example: GIS for Hunter's AK Fish & Game - Make your own Hunting Map App. Put a check in overlays that say: Special areas, subunits, and Alaska towns. In the top right corner, click the little squares to see six different base maps you can put at the bottom. Explore everything and see what happens. Exit ticket: Make a story about creating a GIS map for friends from out of town visiting where you live. Tell what overlays you would give them and why. Draw a picture of what it might look like with all the overlays in place. Make a claim about how this technology might change people's lives, support your claim with evidence from your life, and explain the reasons that the

	evidence supports your claim.

	• Data sources for further research if desired: ○ *Fairbanks North Star Borough* website: "Get FNSB GIS Data" ○ *USGS* National Map USA GIS website: "GIS Data Downoad" ○ Fun Option - Video Game Version of GIS: Alaska Delta Junction Map Tour Game Explained: "MAP UPDATED The Best All-Around Map Yet?" (YouTube, Mighty Mike Farms - Alaska Delta Junction Map Tour, Farming Simulator 19). ○ Before GPS: Russian Alaska Map 1775 (University of Washington Library) • Wrap it Up. Summarize what you learned about geographic information systems while doing the National Geographic modeling a GIS system activity. Make suggestions about how to improve the lab. Be sure to write in complete sentences.
Standards List:	**HS-ESS2-2, HS-ESS3-2, HS-ESS3-1**

UNIT 1: COMPOSITION OF THE EARTH	
Suggested Pacing: 26 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

▪ Use the atomic model and the periodic table to predict the properties of different minerals elements and compounds.
▪ Design experiments to test the predictions they made and communicate their results using different formats (written, verbal, or multimedia) in the CER (Claim Evidence Reasoning) form.
▪ Demonstrate understanding of mixtures to explain some properties of rocks (which are mixtures of minerals in solid form)
▪ See the appendix for a detailed explanation of Matter and its Changes.
	• Module 2: Matter & Change: (8 days)
	  ○ Grounding Phenomenon: How did these crystals get so big?
	  ○ Show this video: Video Showing the Giant Crystals in Spain (*YouTube* - from BBC Travel Article)
	  ○ (The source article is from *BBC Travel*: "The World's Largest Crystal Cave" - BBC Travel Article)
	• Asking Driving Questions (1 Days):
	  ○ Students in small groups ask questions about the Pulpi Geode while watching the video at their own tables, and put them on sticky notes.
	  ○ Each group submits three to five of their best open-ended questions. As a class, sort the best questions into five categories. Put the categorized twenty five questions into Google jamboard or on sticky notes bulletin board. As you go through the unit, revisit the list.
	• Matter & The Periodic Table of Elements:
	  ○ Text: pp. 60-65

	o Internet Resources: Structure of Atoms Interactive Lesson (*ChemThink)* • Combining Matter: o Chemical Bonding Text pp. 66-70 o Internet Resources: ▪ Ionic Bonding Interactive Lesson (*ChemThink)* ▪ Covalent Bonding Interactive Lesson (*ChemThink)* o Brain Pop (set to 7&8 grade quiz) o Chemical Bonds with quiz o Metallic Bonding Video: "What are Metallic Bonds, Properties of Matter, Chemistry, FuseSchool" (*YouTube* – Fuse School) • Wrap it up: Consider the following images o Salt spilled on table: Salt Crystals on Table o Salt Diagram: Salt Crystals Atomic Diagram o Copper Being Hammered: Artist Hammering Copper o Copper Diagram: Copper Metal Atomic Diagram • In table groups, discuss how you would use the models you have learned about chemical bonding to explain why copper gets dented when hit with a hammer, but salt shatters. When your table comes to consensus on the explanation, share it with the class. When the class reaches consensus on the best way to write it (short and to the point, but leaving nothing out), copy it on half a sheet of paper and turn it in as an exit ticket. • Mixing o Text pp. 71-72 o Internet Resources: ▪ "What Is An Atom And How Do We Know?" (*YouTube* – Stated Clearly*)* ▪ *Bond Breaker* Game Classroom Edition (Be The Proton!) ▪ "Mixtures" – (YouTube – *BioEd Online)* • States (phases) of matter: solid, liquid, gas, plasma o Text pp. 73-75 o Internet resources: ▪ "Bill Nye The Science Guy Phases of Matter" (*YouTube* – Scott Thrope) ▪ Granite: Pink Feldspar White Quartz and Black Hornblende

	Crystals in Granite ▪ Spoonful of Mayonnaise ▪ Example Caesar Salad

	▪ Water in Dead Sea Near Palestine • Smokey Air: Canadian Wildfire Smoke in New York City Image • Wrap it up: In table groups, sort the images, identify solid, liquid, or gas mixtures, and tell if they are homogeneous or heterogeneous. Explain the reasons you chose that, citing evidence from the pictures. You may not all agree on some of them; that is fine as long as your reasoning from the evidence makes sense. Write up your final idea and turn it in as an exit ticket.

▪ Describe the properties of minerals and mineral groups.
▪ Identify common minerals based on scientific observations and tests.
▪ See the appendix for a detailed explanation of Minerals and their Properties.
	• Module 3: Minerals: (6 Days)
	• Grounding Phenomenon: Pulpi Geode (1.0Day)
	• As a class, read the 400 word article, in *BBC Travel*, on the abandoned silver mine in Pulpi, Spain.
	• "The World's Largest Crystal Cave" – (*BBC Travel*). Discuss the pictures. Keep this in mind as you go through the lessons coming up. At the end of the unit, decide if the crystals in the cave count as minerals and why.
	
	• What is a mineral (2 days)
	  ○ Watch Brain Pop Movie "Crystals"
	  ○ Textbook Read p. 86-89 and p. 96-101
	• Identify the types of minerals (3 days)
	  ○ Watch Brain Pop Movie " Mineral Identification"
	  ○ Textbook Read p. 90-95
	• Mho's Hardness scale: "Mohs Hardness Scale - Science Educational Video for Elementary Students" (*YouTube* – Bow Tie Guy and Wife)
	• Mineral properties: "Identifying Minerals" (*YouTube* – Earth Rocks!)
	• Wrap it up - Identify minerals using various properties. If available, set up class labs using mineral sets your school has, students use common items - fingernails, streak plates, copper pennies, glass slides, iron nails, etc. - to determine hardness and ID tables or dichotomous keys to identify about twenty common minerals for themselves. Unit ends when all students have correctly identified all minerals in the kits.

• Explain how different conditions produce different types of rocks. • Explain how Earth is a closed system that leads to the rock cycle.	• Module 4: Types of Rocks: (12 days) ○ Grounding Phenomenon:

• See the appendix for a detailed explanation of Rocks and the Rock Cycle.	*o* "Mars Rock Samples Collect by the Perseverance Rover" (*NASA Science Mars Exploration)* ○ Think about single elements, compounds and minerals, types of mixtures, and phases of matter. Pause for 5 minutes and discuss what you know about these things with a classmate. Now watch the video from NASA's Jet propulsion lab about perseverance rover's rock samples, (select samples #6 & #7) video. ○ Students in small groups ask questions about the two samples of rocks while watching the video at their own tables and put them on sticky notes. ○ Each group submits three to five of their best open-ended questions. As a class, sort the best questions into five categories. Put the categorized twenty five questions into Google jamboard or on sticky notes bulletin board. As you go through the unit, revisit the list. • Internet Resources: *o* Content background for teachers for University of Houston's open source minerals & rocks: "Chapter 2: Earth Materials" (*University of Houston* website - *The Story of Earth: An Observational Guide)* ○ The Three Types of Rocks Video: "Geology Kitchen: The 3 Types of Rocks" (*YouTube* – Esteem Education Co.) • Igneous Rocks: (6 days) ○ "Identifying Igneous Rock" (*YouTube* – Earth Rocks!) ○ 1 What are igneous rocks: Text pp. 112-117 (1.o days) ○ 2 Classification of Igneous rocks: Text pp. 118-123 • Lab activity formative assessment: If school has a class set of igneous rocks, do a lab activity where students examine a set of high iron low silica, intermediate, and low iron high silica igneous rocks. Students should be able to tell if the rocks were intrusive or extrusive by the large crystals or lack thereof. They should also be able to tell by the ratio of light and dark minerals which samples are mafic (high iron), which are intermediate, and which are low iron (felsic). • Alternative: (4 days) ○ Use the Concord Consortium Rocks & Tectonics Module (2023-2024) ○ Activities 1, 3, 4 and 5. It is free, you can put your class in and it will grade the units, they are challenging and well thought out.

	○ *The Concord Consortium* "Rocks & Tectonics Module" - Earth Science Interactive lessons • Sedimentary Rocks: (1 day) ○ "Identifying Sedimentary Rocks" (*YouTube* – Earth Rocks!) ○ 1 Formation of Sedimentary Rocks Text pp. 131-140 ○ 2 Types of Sedimentary Rocks Text pp. 141-144 • Metamorphic Rocks: (4.0 days) ○ 3 Recognizing Metamorphic Rocks Text pp. 145-150 ○ "Identifying Metamorphic Rocks" (*YouTube* – Earth Rockes!) • The Rock Cycle: Text p151 (0.5 days) ○ "Bill Nye the Science Guy – Sea 03 Epis 04 Rocks & Soil" (*YouTube* - Vern Burn) ○ "The Rock Cycle" (*YouTube* – Short Simple Science)
Standards List:	**HS-ESS2-2, HS-ESS2-3**

UNIT 2: SURFACE PROCESSES (Optional)	
Suggested Pacing: 31 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

• Identify the concepts in the model of weathering and erosion in the release of minerals, formation of soils and habitat and the formation of sedimentary rock.
• See the appendix for a detailed explanation of Weathering and Erosion.
	• Weathering Erosion & Soil (8.5 days)
	  ○ Weathering Text pp. 164-170
	  ○ Erosion & Deposition pp. 171-175
	  ○ Soil Text pp.176-183
	  ○ Brain Pop Weathering movie & Quiz from the textbook resources
	• Mass Movement (Wind & Glaciers) (7.0 days)
	  ○ Landslides Text pp. 194 - 200
	  ○ Wind Text pp. 201-206
	  ○ Glaciers Text pp. 207-212
	  ○ Brain Pop Rock Cycle Movie
	  ○ Brain Pop Erosion movie & Quiz (Choose question set 3, pause points for grades 7&8)
	• Surface Water & Groundwater
	  ○ Surface Water Text pp. 224-241 (8 days)
	  ○ Ground Water Text pp. 252-268 (7.5 days)
	• "The Water Cycle for Kids" (*YouTube* – Learn Bright)

	• Brain Pop "Water Cycle "Movie & Take Quiz
Standards List:	**HE-ESS2-2, HS-ESS2-5**

UNIT 3: RESOURCES AND OUR ENVIRONMENT (Optional)	
Suggested Pacing: 36 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

• Identify the concepts related to human use of natural resources.
• Model how available resources determine the size of living populations.
• Discuss how human use of energy sources, development of technology through applied science, and engineering has solved problems and created environmental impacts (e.g. allowed us to feed the world, as well as side effects such as pollution and global warming).
• Describe and compare renewable and non-renewable resources.
• See the appendix for a detailed explanation for Energy, Fossil Fuels, and Renewables.
• Describe human impacts on land, air, and water resources.
• Describe (or design) human conservation efforts regarding land, air, and water resources.
• See the appendix for a detailed explanation for Earth's Resources Extraction and Conservation.
	• Earth Resources:
	  ○ Natural Resources: Text pp. 678-681 (6.0 days)
	  o (*YouTube* Ken ReidUMN)
	• Resources in Land Text pp. 682- 686 (4.0 days)
	• "What is Mining?" (*YouTube* Climate and Community) A short film explaining the process of mining to people of the Solomon Islands.
	• "Modern Mining - How Eagle Mine Produces Nickel and Copper" (*YouTube* – Eagle Mine) A video explaining copper mining in Minnesota on a low grade intrusive body. It is almost identical to the Fort Knox gold mining operation north of Fairbanks, except the intrusion brought gold rather than copper.
	• "Mining" (*YouTube* – Bozeman Science) A short film, produced by Bozeman Science, explaining mining from prospecting through reclamation, but also explaining the five main types of mines. (Not ocean mining, which is new but has not started at this time.)
	• Air Resources Text pp. 687-692 (4 days)
	  ○ Alternative possibility
	  ○ *Concord Consortium: High Adventure Science* – "Factors that Affect Air Quality" Air Quality Model surface view interactive.
	  ○ *Concord Consortium: High Adventure Science* – "Movement of Pollutants" - Factors that Affect Air Quality - Aerial View
	• Water Resources Text pp. 693-697 (5 days)
	  ○ Alternative possibility: *Concord Consortium: High Adventure Science* "HASBOT Will There be Enough Fresh Water" - Concord Consortium interactive six lessons
	• Energy

	○ Conventional Energy Resources Text pp. 708-713 ((2 days) ▪ "Fossil Fuels for Kids | Learn All About Fossil Fuels, What They Are, And Where They Come From" (*YouTube* – Learn Bright) Explanation of their origin, their extraction, and their uses. ○ Alternative Energy Resources Text pp. 714-719 ((1 day) ▪ "What is renewable energy?" (*YouTube* – The Independent) Seven minute summary. ▪ "Our Mr.Sun 1956- Complete" (*YouTube* – GBPPR2) Frank Kapra Bell Telephone science special. entertaining science movie for students well done. ○ Conservation of energy Resources Text pp 720-723 (5 days) ▪ "Energy Conservation vs. Energy Efficiency" (*YouTube* – IGS Energy) ▪ "Energy Conservation for Kids – Insulation" (*YouTube* – Horizon Utilities) ▪ Watch the first video telling the difference between energy conservation and energy efficiency. Then read pages 720 – 723, and watch the second video for kids on insulating houses. Based in the first video, decide if the book and the second video have correctly labeled what they are discussing. Write up your conclusion as a claim supported by evidence from all of the materials and explain the reasons that the evidence supports your claim. • Human Impact on Resources: ○ Populations and Use of Resources Text pp 734-736 (1 day) ▪ Concord alternative (See 2,3 & 4 below) ○ Human Impact on Land Resources Text pp 737-742 (5 days) ▪ Concord Alternative: "Can we Feed the Growing Population?" (*Concord Consortium High Adventure Science*)

	○ Human Impact on Air Resources Text pp. 743-747 (2 days) *o* Concord Alternative: "Will the Air be Clean Enough to Breathe?" (*Concord Consortium STEM Resource Finder)* ○ " Real World: The Carbon Cycle – Essential for Life on Earth" (*Youtube* – NASA eClips) ○ Carbon Cycle Diagram (Wikimedia) ○ Human Impact on Water Resources Text pp. 748-750 (3 Days)

	o Concord Alternative: "HASBOT Will there be Enough Fresh Water?" (*Concord Consortium High Adventure Science*
Standards List:	**HS-ESS2-2, HS-ESS2-5, HS-ESS3-1, HS-ESS3-2, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6**

UNIT 4: DYNAMIC EARTH	
Suggested Pacing: 37 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

• Create models or explanations how Earth's internal systems drive processes in the geosphere such as plate tectonics, mountain building, volcanism, and earthquakes.
• Explain the scientific evidence and historical development of Plate Tectonic Theory.
• Describe the causes of plate motion.
• Describe the three major plate boundaries and resulting features on Earth's surface.
• See appendix for a detailed explanation for Plate Tectonics.
• Create a model or explain how plate tectonics influences the formation of volcanoes and major zones of volcanism.
• Explain the relationship between major types of magma and resulting characteristics of an eruption.
• Create a model or explain how magma forms geologic features below ground that differ from those formed at the surface by lava.
• Describe how faults form at Earth's surface.
• Describe the three types of seismic waves.
• Develop a model or explanation of how scientists use seismic waves to determine the structure of Earth's interior.
• Develop a model or explanation of how scientists use seismic waves to measure and locate earthquakes.
• Create recommendations regarding preparedness and construction based on an understanding of factors affecting the probability of an earthquake occurring, the amount of damage caused by an earthquake, and how different structures are affected by an earthquake.
• See appendix for a detailed explanation of Earthquake Waves Causes and Effects.
	• Plate Tectonics
	  ○ Drifting Continents Text pp. 468-472
	  ▪ "Animated Life: Pangea, Wegener, and Continental Drift" (YouTube, Biointeractive)
	  ▪ Interactive Continent Move Viewer (Biointeractive Earth Viewer website)
	  ▪ "Plate Tectonics: An Introduction" (KUAC PBS)
	  ○ Seafloor Spreading Text pp. 473-479
	  ▪ Evidence of seafloor spreading – "Plate Tectonics: Evidence of Mid-Ocean Ridges" (KUAC PBS)
	  ▪ "Magnetic Striping and Seafloor Spreading" (YouTube, Science with Thomas Stevenson)
	  ○ Plate Boundaries Text pp. 480-485
	  ▪ "Tectonic Plate Movement in Alaska" (KUAC PBS)
	  ▪ "Earthquakes and Volcanoes Interactive" (PBS)
	  ○ Causes of Plate Motion pp. 486- 488
	  ▪ "What will Earth Look Like in 500 Million Years?" (The Concord Consortium)
	  ▪ Interactive types of plate motion simulation and resources for teachers: "Mechanisms of Plate Movement" (KUAC PBS)
	• Volcanism
	  ○ Volcanoes Text pp. 500-507
	  ▪ "Volcanism" (PBS)
	  ▪ "Vibrant Volcanos" (KUAC PBS)
	  ▪ Vesuvius cross section video and teacher resources: "Plate Tectonics and Volcanoes: The Next Pompeii" (KUAC PBS)
	  ▪ "Plate Tectonics: The Hawaiian Archipelago" (KUAC PBS)
	  ○ Eruptions Text pp. 508-513

	▪ Types of eruptions and hazards interactive – "Volcanic Eruptions and Hazards" (KUAC PBS)

• Develop models or explanations of orogeny to include mountain formation through plate convergence and alternative processes. • See appendix for a detailed explanation of Mountain Building.	▪ "Mount St. Helens: May 18, 1980" (YouTube, USGS) ▪ Hawaiian effusive eruptions - "Kilauea Volcano Eruption Update; New Eruption Occurs, Expected Length of Eruption" (YouTube, Geology Hub) ○ Intrusive Activity Text pp. 514-517 ▪ "Igneous Intrusions Animation" (YouTube, Metfan869) • Earthquakes ○ Forces Within the Earth Text pp. 528-533 ○ "The Science of Earthquakes" (USGS) ○ Seismic Waves and Earth's Interior Text pp. 534-538 ○ "Mechanical Waves: Interactive Lesson" (KUAC PBS) ○ "Wave Machine Demonstration" (YouTube, National STEM Centre" ○ "GCSE Physics – Seismic Waves #75" (YouTube, Cognito) ○ Measuring and Locating Earthquakes Text pp. 539-544 ○ Measuring and Locating Earthquakes: PBS Video ○ Earthquakes and Society Text pp. 545-551 ○ "Earthquake and Its Hazards" (YouTube, DOST-PHIVOLCS) • Mountain Building ○ Crust Mantle Relationships Text pp. 562-566 ○ Earth's Interior and How Seashells get to Mountain Tops – "Mountain Building" (YouTube, Jackson Wheat) ○ Orogeny Text pp. 567-573 ○ Other Types of Mountain Building Text pp. 574-576
Standards List:	**HS-ESS1-5, HS-ESS2-1, HS-ESS2-3, HS-ESS2-5**

UNIT 5: BEYOND THE EARTH	
Suggested Pacing: 36.5 days	**Textbook Chapter(s)/Lessons**:

Key Objectives	Suggested Activities & Resources

• Demonstrate understanding of how various tools and methods, such as electromagnetic waves, telescopes, gravity waves, and multi-messenger astronomy, are employed to explore and comprehend the universe, including their applications in uncovering celestial phenomena, gravitational interactions, and cosmic events.
• See the appendix for a detailed explanation of the Tools of Astronomy.
	• The Sun-Earth-Moon System
	  ○ Tools of Astronomy Text pp. 764-769 (1 day)
	  ▪ "Afterschool Universe: Telescope Assembly" (YouTube, AfterschoolUniverse)
	  ▪ "NOTGLaDOS: Electromagnetic Spectrum the Musical" (YouTube, Universe Unplugged)
	  ▪ "Spectroscopy, Explained" (Goddard Media Studios, NASA)

• Describe how the interplay of celestial movements within the Earth-Sun-Moon system influences specific phenomena on Earth, including day-night cycles, seasons, lunar phases, tides, and solar and lunar eclipses. • Explain the theory of the formation of our solar system, detailing the key processes, such as nebular hypothesis, planetesimal accretion, and the role of gravity, that led to the creation of our Sun and planetary system. • Explain Kepler's Laws of Planetary Motion, including their fundamental principles and their significance in understanding the motion of celestial bodies within our solar system. • Demonstrate understanding of Newton's Laws of Universal Gravitation, explaining how these laws govern the behavior of objects. • Create a model to demonstrate the scale of the solar system. • Distinguish between inner and outer planets in our solar system, describing their unique characteristics, orbits, and positions. • Analyze the properties, origins, and trajectories of comets and asteroids within our solar system, understanding their roles as remnants of the early solar system and their potential impact. • Differentiate major planets from dwarf planets based on defining features. • Demonstrate understanding of the roles of the Oort Cloud and Kuiper Belt in our solar system. • Explain or model the layers and features of our Sun and the resulting impact on Earth such as space weather, solar cycles, etc. • Explain how parallax, cepheid variable stars, and doppler effect led astronomers to model how the universe works. • Use the H-R Diagram to explain the life cycle of stars including stars on the order of the sun's mass end as white-dwarf stars, while a star an order of magnitude larger than our sun will end as a neutron star, and the most massive stars will end as black-holes. • Explain how nuclear fusion in the core provides the energy source for stars and ultimately creates heavier elements at the end of a star's life. • See the appendix for a detailed explanation of the Evolution of Stars and Gravity Waves. • Describe the size, shape, formation, and evolution of the Milky Way galaxy.	▪ "The Electromagnetic Spectrum" (KUAC PBS) ▪ "Gravitational Wave Discovery Leads to Greater Understanding of the Fabric of our Universe" (YouTube, PBS NewsHour) ▪ "LIGO: Journey of a G-Wave" (YouTube, Caltech) ○ The Moon Text pp. 770-774 (2 days) ▪ *Inside and Out*: "How did the Moon Form?" (NASA Science) ▪ "Evolution of the Moon" (KUAC PBS) ○ The Sun-Earth-Moon System Text pp. 775-784 (4 days) ▪ Educator Guide: "Moon Phases" (NASA Jet Propulsion Laboratory, California Institute of Technology) ▪ Moon Phases Interactive Lesson with Simulator - "Phases of the Moon: Part 2" (BH) ▪ "Lunar Eclipse 101" (YouTube, National Geographic) ▪ "Solar Eclipse 101" (YouTube, National Geographic) • Our Solar System ○ Formation of the Solar System Text pp. 796-803 (4 days) ▪ "How The Universe Works: "Birth of the Earth" video ▪ "NASA - Solar System Dynamics: Orbits and Kepler's Laws" (KUAC PBS) ▪ "Segment F: Gravity" (Georgia Public Broadcasting, PBS, NPR) ▪ "Real World: Scaling the Solar System" (KUAC PBS) ○ The Inner Planets Text pp. 804-810 (1 day) ▪ "The Inner Solar System: Discovering Earth's Neighborhood with Dr. James Garvin" (NASA Goddard Media Studios)

	▪ "Mercury 101" (YouTube, National Geographic) ▪ "Venus 101" (YouTube, National Geographic) ▪ "Earth 101" (YouTube, National Geographic) ○ The Outer Planets Text pp. 811-815 (1 day) ▪ "The Outer Planets: Hubble's Continuing Legacy" (NASA Goddard) ▪ "Jupiter 101" (YouTube National Geographic) ▪ "Saturn 101" (YouTube, National Geographic) ▪ "Uranus 101" (YouTube, National Geographic) ▪ "Neptune 101" (YouTube, National Geographic) ○ Other Solar System Objects Text pp. 816-819 (4 days) ▪ Asteroid Belt - "Real World: Small Bodies Orbiting the Sun" (KUAC PBS)

• Define “galaxy” and classify galaxies based on properties (spiral, barred spiral, elliptical, and irregular). • Explain where the idea of an expanding universe came from and give the supporting evidence. • See the appendix for a detailed explanation of Galaxies, Hubble, and the Expanding Universe.	▪ “Pluto 101” (YouTube, National Geographic) ▪ “What is the Difference Between Asteroids, Comets, and Meteors? We Asked NASA Scientist: Episode 16” (NASA website) ▪ “Kuiper Belt and Oort Cloud Explained” (YouTube, Explified) • Stars ○ The Sun Text pp. 830-836 (2.5 days) ▪ “NOTGLaDOS: Fusion vs. Fission” (YouTube, ExploreAstro) ▪ “Sun 101” (YouTube, National Geographic) ○ Measuring Stars pp. 837-846 (2 days) ▪ “How do we Measure the Distance to Stars? Parallax and Cepheids Explained” (YouTube, AstroNaught) ▪ “The Star that Redefined the Universe” (YouTube, ScienceOnline) ○ Stellar Evolution pp. 847-851 (3 days) ▪ “The Life Cycle of Stars” (YouTube, Institute of Physics” ▪ “Constructing the Hertzsprung-Russell Diagram for Globular Star Cluster Omega Centauri” (YouTube, Hubble Space Telescope) • Galaxies and the Universe ○ The Milky Way Galaxy Text pp. 862-868 (3 days) ○ “What is a Galaxy?” (YouTube, James Webb Space Telescope) ○ Other Galaxies in the Universe Text pp. 869-877 (5 days) ▪ “Galaxies Explained” (YouTube, Astronomic)

	▪ "Classroom Aid – Hubble Galaxy Classification" (YouTube, David Butler) ○ Cosmology pp. 878-881 (4 days) ▪ "The Big Bang, Cosmology Part 1: Crash Course Astronomy #42" (YouTube, CrashCourse) ▪ "Origins of the Universe 101" (YouTube, National Geographic)
Standards List:	**HS-ESS1-1, HS-ESS1-2, HS-ESS1-4**

UNIT 6: EARTH'S ATMOSPHERE, WEATHER, AND CLIMATE	
Suggested Pacing: 34.5 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

• Describe or model the layers, composition, and properties of Earth's atmosphere. • Describe or model how unequal heating of the Earth by the sun transfers energy throughout the atmosphere which drives weather. • See the appendix for a detailed explanation of Properties of the Atmosphere. • Identify cloud types. • See appendix for a detailed explanation of Clouds. • Distinguish between the major storm systems and how they are formed. • Describe how the global conveyor belt and coriolis effect interact to produce three prevailing global wind systems; the polar easterlies, the prevailing westerlies, and the trade winds. • Explain the formation and characteristics of fronts caused by interacting air masses, and high and low pressure systems. • Interpret weather data and isobaric maps to describe weather conditions. • See appendix for a detailed explanation of Weather and its Causes. • Define climate and describe causes of climate on Earth. • Describe the impact of human activities on climate. • Describe the impact of climate on human activities. • See appendix for a detailed explanation of Climate and its Classification.	• Atmosphere: o "Resources to Help Integrate NOAA Science into Formal and Informal Education" (National Oceanic and Atmospheric Administration) o Atmosphere Basics Text pp. 282-288 (2.5 days) ▪ "Bill Nye Atmosphere" full version (SchoolTube, MrMasin) ▪ "How Big is the Atmosphere" (YouTube, Jared Owen) ▪ "Mr. Lee – Layers of the Atmosphere Rap" (YouTube, tfashady410) o Properties of the Atmosphere Text pp. 289-296 (2.5 days) ▪ "Bill Nye the Science Guy on the Atmosphere" (YouTube, Bill Nye) o Clouds & Precipitation Text pp. 297-303 (4 days) ▪ The first part (Prevailing Winds, Coriolis, Clouds) of "The Unchained Goddess (1958)" (YouTube, Jack Fuller) – This is 70 years old, but essentially accurate and an entertaining story line. ▪ "Weather 101: A Tutorial on Cloud Types" (YouTube, NWSAlbuquerque) • Meteorology o The Causes of Weather Text pp. 314-317 (2 days) o "Real World: Earth's Energy Balance – Energy In and Energy Out" (NASA eClips) o Weather Systems Text pp. 318-323 (1 day) ▪ The last part of "The Unchained Goddess (1958)" (YouTube, Jack Fuller) ▪ "What is the Jet Stream and How Does it Affect the Weather?" (YouTube, Met Office- Learn About Weather) ▪ "What are Weather Fronts and How do They Affect our Weather?" (Met Office- Learn About Weather) ▪ "Weather for Pilots – 02 – Air Masses and Fronts"

	(YouTube, ERAU SpecialVRF) ○ Gathering Weather Data Text pp. 324-328 (1 day)

	▪ "Reading a Weather Station Model" (YouTube, MooMooMath and Science) ▪ "V.53 Isobars and Isotherms" (YouTube, WoodsScience6) ▪ "High and Low Pressure Areas" (YouTube, Physics Channel) ○ Weather Analysis & Precipitation Text pp. 329-332 (3 days) ▪ "The Science Behind Weather Forecasting" (YouTube, Dylan Robichaud) • The Nature of Storms ○ Thunderstorms Text pp. 344-349 (1.5 days) ▪ "How Thunderstorms are Formed" (YouTube, NorCast Weather) ○ Severe Weather Text pp. 350-354 (1 day) ▪ The middle part of "The Unchained Goddess" (YouTube, Jack Fuller) ▪ "The Supercell – Mother of Storms" (YouTube, Pecos Hank) ▪ "The Science Behind a Microburst – Weather Wisdom" (YouTube, The Weather Channel) ○ Tropical Storms Text pp. 355-360 (2 days) ▪ "Water Vapor Fuels Hurricanes" (KUAC PBS) ▪ "Formation of a Tropical Cyclone" (YouTube, ClickView) ○ Recurrent Weather Text pp. 361-365 (4 days) ▪ "Understanding Drought" (YouTube, Bureau of Meteorology) ▪ "Understanding Floods" (YouTube, Bureau of Meteorology) ▪ "Understanding ENSO" (YouTube, Bureau of Meteorology)

	• Climate ○ Defining Climate Text pp. 376-380 (2 days) ▪ "Weather Versus Climate Change – Cosmos: A Spacetime Odyssey" (YouTube, National Geographic) ▪ *Climate Kids* "What's the Difference Between Weather and Climate?" (NASA) ○ Climate Classification Text pp. 381-386 (2 days) ▪ "All About Climate" (National Geographic) ○ Climatic Changes Text pp. 387-392 (2 days) ○ "The Science of Climate Change" (YouTube, Biointeractive)

	○ The last part of "The Unchained Goddess (1958)" (YouTube, Jack Fuller). Compare the average number of Atlantic hurricanes moving on land in 1958 to now. Compare the annual CO_2 from fossil fuel burning in 1958 to now. ○ Impact of Human Activities Text pp. 393-395 (4 days)
Standards List:	**HS-ESS2-2, HS-ESS2-4, HS-ESS3-5**

UNIT 7: EARTH'S OCEANS AND THE MARINE ENVIRONMENT	
Suggested Pacing: 15.5 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

• Describe Earth's ocean system and resulting effects on climate and weather.
• Explain how temperature and salinity differences drive currents and the "global conveyor belt" which transfers heat from the equator to the poles, and returns colder water from the poles to the equator.
• Model or explain how motions of the oceans such as tides are controlled by the moon and sun.
• Distinguish between ocean waves and tsunamis and their causes.
• Describe features of the ocean floor, the seawater column, and the associated plants and animals that live in different regions.
• Explain how phytoplankton play a vital role in providing oxygen to the Earth's atmosphere.
• See appendix for a detailed explanation of Oceans.
	• Earth's Oceans
	  ○ An overview of oceans Text pp. 406-412 (1.5 days)
	  ▪ "The Ocean: A Driving Force for Weather and Climate" (KUAC PBS)
	  ○ Seawater Text pp. 413-420 (3 days)
	  ▪ "Ocean Water Chemistry" (YouTube, Jenna Francis)
	  ○ Ocean Movements pp. 421-427 (3 days)
	  ▪ "The Gulf Stream Explained" (YouTube, Kurzgesagt – In a Nutshell)
	  ▪ "Surface Ocean Currents and Gyres" (YouTube, EcoDisco)
	• The Marine Environment
	  ○ Shoreline Features Text pp. 438-446 (3 days)
	  ▪ "Coastal Geological Processes" (KUAC PBS)
	  ▪ "Coastal Geological Materials" (KUAC PBS)
	  ▪ Rocky shorelines and coasts: "Rocky Coasts" (PBS)
	  ▪ "Sandy Coasts" (KUAC PBS)
	  ○ Seafloor Features Text pp. 447-453 (5 days)
	  ▪ "Touring the Ocean Bottom" (YouTube, NOAAVisualizations)
	  ▪ "How Did Hawaii Forms?" (YouTube, Scientific American)
	  ▪ "How Studying the Ocean Floor Explains the History of Earth's Climate" (KUAC PBS)
	  ▪ "Life on Undersea Mountains" (Marine Conservation Institute, ARGIS)
	• Online Resources: "Mapping the Seafloor" (*NOAA National Ocean Service)*

Standards List:	**HS-ESS2-4, HS-ESS2-5, HS-ESS2-7**

UNIT 8: GEOLOGIC TIME	
Suggested Pacing: 25 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Explain the history and current methods of scientifically dating the age of the Earth. • See appendix for a detailed explanation of the History of Dating Earth. • Describe the methods by which fossils form and are used to interpret Earth's physical and biological history. • See appendix for a detailed explanation of Fossils. • Describe Precambrian time including the formation of the crust and continents, oceans, atmosphere, and early life. • See appendix for a detailed explanation of Precambrian. • Describe the Phanerozoic Eon including distinguishing characteristics of the Paleozoic, Mesozoic, and Cenozoic Eras (which starts when we begin to see multicellular fossils).	• Geologic Time: ○ Grounding Phenomenon: A modern picture of the Siccar point outcrop in Scotland would make a great grounding phenomena. ○ "Siccar Point Hutton's Unconformity" (International Commission on Geoheritage) ○ Questions like, "How did this happen?" "How long did it take?" "How do we know?" These would be great driving questions to investigate. • Fossils and the Rock Record ○ The Rock Record Text pp. 590-594 (2 days) ▪ "Tiktaalik and the Fossil Record" (YouTube, Biointeractive) ○ Relative Age Dating Text pp. 595- 600 (2 days) ▪ "Relative Dating" (YouTube, Conceptual Academy) ○ Absolute Age Dating Text pp. 601-605 (1 day) ▪ "How Does Radiocarbon Dating Work?" (YouTube, Scientific American) ▪ "The Strange Case of Cosmic Rays (1957)" (YouTube, Jack Fuller) ▪ "Dating Lava Flows on Mauna Loa Volcano, Hawaii" (KUAC PBS) ○ Fossil Remains Text pp. 606-609 (4 days) ▪ What do fossils tells us about evolution? – PBS Video (PBS) ▪ "The Making of a Theory: Darwin, Wallace, and Natural Selection" (YouTube, biointeractive) • The Precambrian Earth ○ Early Earth Text pp. 620-622 (1 day) ○ Formation of the Crust and Continents Text pp. 623-627 (2 days) ○ Formation of the Atmosphere and Oceans Text pp. 628-632 (2 days)

	○ "Where did Earth's Water Come From?" (YouTube, Be Smart) ○ Early Life on Earth Text pp. 633-637 (3 days) ○ "Deep History of Life on Earth" (Howard Hughes Medical Institute, Biointeractive) Click on the images to get explanations or short videos explaining the events in the images. ○ "The Search for the Earliest Life" (KUAC PBS)

	• The Paleozoic, Mesozoic, and Cenozoic Eras (3 days) ○ The Paleozoic Era Text pp. 648-654 ▪ "From the Cambrian Explosion to the Great Dying" (KUAC PBS) ○ The Mesozoic Era Text pp. 655-659 (2 days) ▪ "The Day the Mesozoic Died" (Biointeractive) ○ The Cenozoic Era Text pp. 660-665 (3 days) ▪ "Out of the Ashes: Dawn of the Age of Mammals" (YouTube, Biointeractive)
Standards List:	**HS-ESS1-6, HS-ESS2-1,HS-ESS2-7**

Environmental Science 1B

Grade(s): 9-11 **Length**: two semesters **Credit**: 1 (0.5 life science credit and 0.5 physical science credit) **Prerequisites**: Teacher recommendation	**Course Overview**: Students in this course explore systems and the ways in which human systems affect and are affected by environmental systems. Students approach environmental issues by understanding ecological components and human perspectives. Students address bias and misunderstandings to develop their own opinions about environmental issues. This course focuses on climate change, natural resources, pollution, and energy, and uses all fields of sciences to help students form educated opinions and solutions based on evidence about current and future environmental problems facing society. **Semester one (1A) fulfills the Life Science graduation requirement and semester (1B) two fulfills the Physical Science requirement.** See the semester two curriculum under Environmental Science (page 61) in the Life Science options.

Geology

Grade(s): 11-12 **Length**: one semester **Credit**: 0.5 **Prerequisites**: Teacher recommendation or one semester of *Chemistry* or *Physical Science*	**Course Overview**: Geology is designed to provide students with a better understanding of geology; it provides an introduction to current events related to geology, and explore the multiple career pathways in the field. Over the course, students will discuss careers, employment, and current issues related to geology. Geology teaches fundamental science techniques and concepts through an exploration of the world around us. Physical concepts, such as density and heat transfer, will be explored through an in-depth study of rocks, geological formations, minerals, volcanoes, earthquakes, aquifers, groundwater pollutants, glaciers, petroleum and natural gas, metals, and mining. **Adopted Textbook**: None at this time.

Units (Recommended Order)
• Aquifers and Pollutants in Groundwater • Rock Forming Minerals • Earthquakes and Plate Tectonics • Volcanoes • Metals and Mining • Petroleum and Natural Gas • Glaciers • Independent Student Research Project

UNIT 1: AQUIFERS AND POLLUTANTS IN GROUNDWATER	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Identify metals and non-metals on the periodic table.	• Flinn Lab Safety Contract and Test. • Lab safety scavenger hunt. • Table-top demo of sand, water, and food coloring to show movement of groundwater. • pH & D.O. measurements. • Septic system design and calculations. • Arsenic in Fairbanks water. • Sulpholane in North Pole water. • DEC (SPAR) plume mapping and predicting. • Superfund sites.
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	
Identify an aquifer and determine criteria for sustainability.	
Show how pollutants can move into and through an aquifer.	
Analyze geoscience data to make the claim that one-change to the Earth's surface can create feedbacks that cause changes to other Earth systems.	
Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	
Standards List:	**PS1.A: Structure & Properties of Matter:** HS-PS1.1; **ESS2.A: Earth Materials and Systems:** HS-ESS2.1, HS- ESS2.2; **ESS2.C: The Roles of Water in the Earth's Surface Processes:** HS-ESS2.5

UNIT 2: ROCK FORMING MINERALS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Identify common rock forming minerals.	• Lab: Mineral Identification • Mineral chemical formula matching • Minerals vs. gems • Mineral mines
Identify common rocks.	

Standards List:	**ESS2.a: Earth Materials & Systems:** HS-ESS2.3; **ESS2.C: The Roles of Water in Earth's Surface Processes:** HS-ESS2.5; **ESS3.A: Natural Resources:** HS-ESS3.1, HS-ESS3.2

UNIT 3: EARTHQUAKES AND PLATE TECTONICS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	• Phet plate tectonics. • Examine geologic maps. • Contact/visit the Alaska Earthquake Information Center (AEIC).
Develop a model to i **l**ustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	
Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	
Standards List:	**ESS1.C: The History of Planet Earth:** HS-ESS1.5; **ESS2.B: Plate Tectonics and Large-Scale System Interactions:** HS-ESS2.1; **ESS2.A: Earth Materials & Systems:** HS-ESS2.3; **ESS3.A: Natural Resources:** HS-ESS3.1

UNIT 4: VOLCANOES	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	• Map the Ring of Fire and explain its origin. • Compare and contrast shield, composite, and cinder volcanoes. • Yellowstone history. • Volcanology on other planets. • Contact/visit the Alaska Volcano Observatory (AVO).
Develop a model to i **l**ustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	
Standards List:	**ESS1.C: The History of Planet Earth:** HS-ESS1.5; **ESS2.B: Plate Tectonics & Large-Scale System Interactions:** HS-ESS2.1; **ESS2.A: Earth Materials & Systems:** HS-ESS2.3; **ESS3.A: Natural Resources:** HS-ESS3.1

UNIT 5: METALS AND MINING	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	• Identify metals on the periodic table. • Uses of metals. • Mines in Alaska. • Price of gold history. • Prices of other traded metals. • Recycling costs of metals. • Mining standards in the U.S. vs. other countries.
Standards List:	**ESS3.A: Natural Resources:** HS-ESS3.1, HS-ESS3.2

UNIT 6: PETROLEUM AND NATURAL GAS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	• Geologic Formations: Folds, faults, anticlines, and synclines. • Source, reservoir, and trap rocks. • Stratigraphy/fence mapping.
Standards List:	**ESS2.B: Plate Tectonics & Large-Scale System Interactions:** HS-ESS2.3; **ESS3.A: Natural Resources:** [HS- ESS3.1] [HS-ESS3.2]

UNIT 7: GLACIERS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	• Identify glacial features using topographic maps and aerial photos. • Glacier ice cream terminology. • Mapping changes in glacier extents.
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to earth systems.	
Standards List:	**ESS2.A: Earth Materials & Systems:** HS-ESS2.1, HS-ESS2.2, HS-ESS2.3; **ESS1.B: Earth & the Solar System:** HS-ESS2.4; **ESS3.D: Global Climate Change:** HS-ESS3.5

UNIT 8: INDEPENDENT STUDENT RESEACH – PAPER AND POSTER PROJECT	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Choose a research topic appropriate to grade level.	• Invite UAF grad students to share their research with the class. • Develop a list of interests. • Draft proposal for teacher's review. • Students conduct research inside and outside the classroom. • Multiple peer revisions in class. • Research poster presentations.
Review scientific articles and develop background research.	
Write a paper or develop a poster using multiple teacher/mentor-reviewed drafts.	
Present the results of research to the public as scientific paper/poster and oral presentation.	
Standards List:	**ETS1.B: Developing Possible Solutions:** HS-ESS3.2, HS-ESS3.4

Physical Science

Grade(s): 9-12 **Length**: two semesters **Credit**: 1.0 **Prerequisites**: None	**Course Overview**: *Physical Science* provides an introduction to the core concepts of physics and chemistry. Laboratory work is an integral part of the inquiry-based learning process, helping students develop an understanding of the concepts as well as the process of science. The first semester provides an introduction to the core concepts of chemistry (matter and its interactions) with little emphasis on mathematics. The second semester includes an exploration of mechanics (motion, forces, and energy), in addition to the development of important process skills. **Adopted Textbook**: *Physical Science*. Glencoe/ McGraw-Hill, 2017.

Units (Recommended Order)	
Semester 1	**Semester 2**
• Structure and Properties of Matter • Chemical Reactions • Nuclear Processes, Energy in Chemical Processes, and Engineering Design	• Science Practice and Design • Newton's Law • Electricity and Magnetism • Work and Energy

UNIT 1: STRUCTURE AND PROPERTIES OF MATTER	
Suggested Pacing: 5 weeks	**Textbook Chapter(s)/Lessons**: Chapter 16
Key Objectives	**Suggested Activities & Resources**
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	• Phet simulation: Build an Atom http://phet.colorado.edu. • Black box experiment (for circumstantial evidence). • Adopt an element and present its "life history" in a poster. • Demo: Lithium vs. Sodium in Water. • Lab: Trends Among the Elements. • Periodic chart of objects (i.e., candy, shoes, hats).
Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	
Standards List:	**PS1.A: Structure & Properties of Matter:** [HS-PS1.1, HS-PS1.2, HS-PS1.3

UNIT 2: CHEMICAL REACTIONS	
Suggested Pacing: 5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 15, 19, 21, and 22.
Key Objectives	**Suggested Activities & Resources**
Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	• Lab: Decompose water by electrolysis, noting volumes and ratios of products. • Lab: Baking Soda and Acid. • Lab: Salts and Solubility. • Lab: pH Scale. • PhET Online Lab: http://phet.colorado.edu. • Lab: Empirical Formula of Zinc Chloride.
Explain how the Law of Conservation of Mass helps to support the atomic model of matter.	
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Balance simple chemical equations.	
Measure solubility of solutes in solutions.	
Discuss the difference between concentration and saturation of solutes in solutions.	
Use power of ten notations to explain pH; explain the difference between acids and bases.	
Identify the range of the pH scale and give examples of strong and weak acids, and bases.	

Standards List:	**PS1.B: Chemical Reactions:** HS-PS1.2, HS-PS1.7

UNIT 3: NUCLEAR PROCESSES, ENERGY IN CHEMICAL PROCESSES, AND ENGINEERING DESIGN	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: Chapters 4 and 8.
Key Objectives	**Suggested Activities & Resources**
Explain the Law of Conservation of Energy as it applies to transfers of energy for physical and chemical changes.	• Lab: Radioactive Decay. • PhET Online Labs: http://phet.colorado.edu. • Videos: Chernobyl: A Taste of Wormwood or the NOVA special Back to Chernobyl. • Activity: Design an electric power system for a small community with a given set of environmental conditions, resources, population, and power needs.
Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
Discuss the role nuclear power for electrical generation may play in reducing the emission of greenhouse gasses and for smaller Alaskan communities.	
Standards List:	**ETS1.C: Optimizing the Design Solution:** HS-ETS1.2, HS-PS1.6; **PS1.C: Nuclear Processes:** HS-PS1.8; **PS3.D: Energy in Chemical Reactions:** HS-PS3.3

UNIT 4: SCIENCE PRACTICE AND DESIGN	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapter 1
Key Objectives	**Suggested Activities & Resources**
Recognize that all measurements have some uncertainty.	• Flinn Safety Contract and Test. • Lab safety classroom scavenger hunt. • Graphing skills packet. • Investigation: Graphing Volume of Water in a Test Tube vs. Height of Water.
Make and interpret line graphs and scatter plots.	
Standards List:	**ETS1.C: Optimizing the Design Solution:** HS-ETS1.2

UNIT 5: NEWTON'S LAW	
Suggested Pacing: 5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 2 and 3.
Key Objectives	**Suggested Activities & Resources**
Distinguish between the terms speed, velocity, and acceleration.	• Use sonic rangers (sonars) to match position vs. time; velocity vs. time graphs. • Conduct races with electric cars and fan cars or cars rolling down ramps. • Investigate collisions between spring-loaded cars. • Conduct balloon races. • Design apparatus to protect egg in free-fall using cost-effective approach.
Use and interpret graphs that describe the motion of objects (position-time, velocity-time, acceleration-time).	
Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	
Apply Newton's three laws to explain inertia, acceleration when net force is not zero, and action-reaction forces.	
Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	
Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	
Standards List:	**PS2.A: Forces & Motion:** HS-PS2.1, HS-PS2.2, HS-PS2.3 **ETS1.A: Defining & Delimiting the Engineering Problem:** Secondary to HS-PS2.3; **ETS1.C: Optimizing the Design Solution:** Secondary to HS-PS2.3

UNIT 6: ELECTRICITY AND MAGNETISM	
Suggested Pacing: 5 weeks	**Textbook Chapter(s)/Lessons**: Chapters 6 and 7.
Key Objectives	**Suggested Activities & Resources**
Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.	• Static Electric Forces Activity: Attraction and Repulsion (comparison to gravitational force). • Build a simple circuit. • Build a simple electromagnet. • Build a simple motor.
Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing	

magnetic field can produce an electric current.	
Standards List:	**PS2.B: Types of Interactions:** HS-PS2.4, HS-PS2.5; **PS3.A: Definitions of Energy:** Secondary to PS2.5

UNIT 7: WORK AND ENERGY	
Suggested Pacing: 6 weeks	**Textbook Chapter(s)/Lessons**: Chapter 4
Key Objectives	**Suggested Activities & Resources**
Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).	• Model dwelling construction and insulation used in traditional Alaskan dwellings before modern insulating materials became available.
Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	
Build and test the efficiency for a simple machine.	
Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	
Standards List:	**PS3.A: Definitions of Energy:** HS-PS3.1, HS-PS3.2; **PS3.B: Conservation of Energy & Energy Transfer:** HS-PS3.1, **PS3.D: Energy in Chemical Properties:** HS-PS3.3, HS-PS3.4

Physics

Grade(s): 10-12 **Length**: two semesters **Credit**: 1 **Prerequisites**: Teacher recommendation or *Algebra 2* (can be taken concurrently)	**Course Overview**: Students best learn science when they do science. This physics course is organized around real world experiences (called storylines) that start with an interesting phenomenon leading students to ask questions that they investigate through hands-on activities, labs, and simulations. When they develop models that explain what is going on, they present their conclusions as a claim that is supported with reasoning from the evidence they collected. The teacher, as facilitator of the student research, can insert any questions that cover an aspect of the topic the students did not think of. **Adopted Textbook**: *Experience Physics*. Savvas, 2022.

Units (Recommended Order)	
Semester 1	**Semester 2**
• Forces and Motion • Forces at a Distance • Conservation of Energy	• Conservation of Energy • Waves and Electromagnetic Radiation • From the Nucleus to the Universe

<table>
<tr><th colspan="3">UNIT 1: FORCES AND MOTION</th></tr>
<tr><td colspan="2">Suggested Pacing: approximately 23.5 days</td><td>Textbook Chapter(s)/Lessons:</td></tr>
<tr><th colspan="2">Key Objectives</th><th>Suggested Activities & Resources</th></tr>
<tr><td colspan="2">Investigation 1:
• Distinguish between distance, displacement, speed, velocity and acceleration. Represent their relationships with graphs, diagrams and equations. Free fall acceleration. Use vector representation for displacement, velocity, and acceleration.
• Projectile motion involves a horizontal velocity with a perpendicular acceleration superimposed on it. The path is parabolic. Circular orbital motion of a satellite involves a horizontal velocity that is continuously being deflected by an acceleration toward the center of the orbit due to the much larger mass of the body it orbits.</td><td rowspan="2">• Anchoring Phenomenon: “How will we get to Mars?” (0.5 days)
• Investigation 1 Modeling Motion (10 days) Text pp (4-49)
o Phenomenon: How does this rock move (0.5 days)
o Experience 1 Dis[placement & Velocity (2.5 days)
o Experience 2 Acceleration (2.5 days)
o Experience 3 Circular & Projectile Motion (3 days)
o Investigation Assessment (1.5 Days)
• Investigation 2 Forces (13 Days) Text pp (50-111)
o Phenomenon: “How does a self-driving car calculate stopping time?” (0.5 days)
o Experience 1 Force, Mass, Acceleration (2.5 days)
o Experience 2 Types of Forces (2.5 days)
o Experience 3 Forces on Systems (3.0 days)
o Experience 4 Earth’s Surface Forces (3.0 days)
o Investigation Assessment
• “Staying Fit to Mars and back”. (1.5 days)</td></tr>
<tr><td colspan="2">Investigation 2:
• Newton’s three laws explain the causes of the types of motion in investigation 1. Expand the use of mathematics both graphically and with Algebra to describe forces and motion. Apply these concepts to practical situations like space travel and motions in the Earth’s crust.</td></tr>
<tr><td>Standards List:</td><td colspan="2">PS2-1, PS2-2, PS2-4, PS2-1, ESS2-1</td></tr>
</table>

UNIT 2: FORCES AT A DISTANCE

Suggested Pacing: approximately 31 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Investigation 3: • Expand the concepts developed in the previous storyline to include Newton's law of Universal Gravitation to explain the behavior of planets orbiting the sun and why they obey Kepler's three laws of orbital motion. Gravitation is always attractive between masses and an inverse square law. It is described by vectors.	• Anchoring Phenomenon: "How does the Moon shape our coastline?" (0.5 days) • Investigation 3 Gravitational Forces (10 days) Text pp (112-153) o Phenomenon: What causes the Seasons? (0.5 days) o Experience 1 Universal Gravitation (2.5 days) o Experience 2 Orbital Motion (2.5 days) o Experience 3 Kepler's Laws (3 days) o Investigation Assessment (1.5 Days) • Investigation 4 Electric Forces (9.5 days) Text pp (154-195) o Phenomenon: Why can't people walk through walls? (0.5 days) o Experience 1 Coulomb's Law (2.5 days) o Experience 2 Electric Fields (2.5 days) o Experience 3 Electric current (2.5 days) o Investigation Assessment (1.5 Days) • Investigation 5 Magnetic Forces (11.0 days) Text pp (196-293) o Phenomenon: How does an egg cook on a stove that does not get hot? (0.5 days) o Experience 1 Magnetism (3.0 days) o Experience 2 Magnetic Fields (3.0 days) o Experience 3 Inducing Current (3.0 days) o Investigation Assessment (1.5 days) • Investigation 6 Forces in Materials Text pp (241-277) (14 Days) **Skip until the end of 2nd semester**, then use Experience 1 "Atoms and Atomic Structure" and Experience 2 "Attractive and Repulsive Forces" to prepare students for Storyline 5 "From the Nucleus to the Universe." The 14 days are needed to complete collisions & conservation of momentum 1st semester, but storyline 5 "nuclear physics" won't make much sense without a background understanding of atoms. So, at least the first two experiences are needed to get students ready for nuclear physics at the end of 2nd semester. o Phenomenon: What happens inside a pole vaulter's pole as it bends and springs back? (0.5 days) o Experience 1 Atoms and Atomic Structure (3.0 days) o Experience 2 Attractive and Repulsive Forces (3.0 days) o Experience 3 Material Properties (3.0 days)
Investigation 4 • Electric charges are two kinds (+ & -). Likes repel, opposites attract. Charge differences can be caused by transfer during contact or temporarily induced by nearness w/o contact. The force between two point charges follows an inverse square law called Coulomb's law. Electric forces are described by vectors. Gravitational forces are much smaller than electric forces. For example the electric force between a negatively charged electron and a positively charged proton in a hydrogen atom is 10^29 times larger than the gravitational force between their two masses. Graphic descriptions and calculations are similar to the mathematics used to describe gravity. Electric field and electric potential are useful ways to describe more complicated situations than point charges. Electric currents in circuits obey Ohm's and Kirchoff's laws. Calculations can be done applying these laws to parallel, series, and combined electric circuits.	
Investigation 5 • Magnetic fields are caused by moving electrons AND changing magnetic fields can cause electrons to move. Students will be able to use the right hand rule and mathematics to calculate the strength and direction of fields created by permanent magnets and current carrying loops. They connect magnetic flux and electromotive force to induction and calculate the relationships represented by Biot-Savart's and Faraday's Laws. Electric current loops in spinning Earth at the boundary between the liquid and solid core generates the magnetic field around us that protects us from charged particle radiation from the solar wind. Throughout this investigation students will model systems and solve problems related to electromagnetic induction.	

	○ Experience 4 Structure and function (3.0 days) ○ Investigation Assessment (1.5 days)
Standards List:	**PS2-4, ESS1-4, PS1-3, PS2-4, PS2-6, PS3-5, PS2-4, PS2-5, PS3-5, PS1-3, PS2-4, PS2-6**

UNIT 3: CONSERVATION OF ENERGY (PART ONE - SEMESTER ONE)	
Suggested Pacing: Approximately 22 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Investigation 7: • Differentiating work (positive, negative and zero work) and energy, kinetic energy, and the work energy theorem. Differentiate between work and power. Mechanical energy, kinetic energy and gravitational potential energy. Elastic potential energy. Friction conversion of mechanical energy into heat. Conservation of energy. Use equations to model the kinetic energy converted into heat energy during the K-T Boundary asteroid impact that caused many extinctions sixty million years ago. Swinging pendulums and vertical and horizontal oscillating masses on springs and conservation of mechanical energy in those systems. Also oscillation decay and where that energy goes. The energy changes during a rocket launch. Energy and work are not vectors.	• Anchoring Phenomenon: "How does this machine transfer energy?" (0.5 days) • Investigation 7 Energy (8.5 days) Text pp (278-319) ○ Phenomenon: "Why does a bungee jumper bounce up and down?" (0.5 days) ○ Experience 1: Classifying Energy and Work (2.5 days) ○ Experience 2: Mechanical Energy (2.0 days) ○ Experience 3: Conservation of Energy (2.0 days) ○ Investigation Assessment (1.5 days) • Investigation 8 Collisions (13.0 days) Text pp (320-363) ○ Phenomenon: "Why do car brakes use a pedal instead of an on off switch?" (0.5 days) ○ Experience 1: Momentum and Impulse (3.0 days) ○ Experience 2: Conservation of Momentum (4.0 days) ○ Experience 3: Collisions in Earth's Crust (4.0 days) ○ Investigation Assessment (1.5 days)
Investigation 8: • Defining momentum. The relationship between the change in momentum of an object and the force applied to it and the length of time the force is applied. (The impulse-momentum equation). Momentum, Force and Impulse are all vectors. Elastic and Inelastic collisions. Kinetic energy and collisions. Collisions in the Earth's crust result in Earthquakes, moving crustal plates with spreading centers causing new sea floor with associated underwater volcanoes and earthquakes, converging plates with associated mountain building, volcanoes and earthquakes, and transform faults like in California with associated earthquakes.	
Standards List:	**PS3-1, PS3-2, PS3-3, PS2-2, PS2-3, ESS2-1**

UNIT 4: CONSERVATION OF ENERGY (PART TWO - SEMESTER TWO)	
Suggested Pacing: approximately 26.5 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

Investigation 9
Energy flow in both open and closed systems. Thermal energy on a microscopic scale is related to the total kinetic energy in a material, while the temperature is related to the average kinetic energy of the molecules in a material. Two objects of different temperature in contact transfer energy by conduction of motion from the fast molecules to the slow molecules. The transferring energy is called heat. The final temperature of both is in between the starting temperature. The three laws of thermal energy dynamics are Law 1: The best one could ever do is have energy in equal energy out, conservation of energy. Law 2: random motion always tends to increase over time so that some mechanical energy gets converted to thermal energy and you never get perfect conservation. The measure of increasing disorder is called entropy and it usually increases. Law 3: Increasing disorder slows down as the temperature approaches absolute zero (0°K). The Zeroth Law: Temperatures may approach absolute zero but can never get there. Compare temperature vs energy graphs will show they are not linear. The relationship between temperature, pressure and volume for gasses can be described by Boyle's Law, Charles Law, and Guy-Lussac's Law or they can be combined into the Ideal Gas Law. Specific heat describes how temperature in materials that are in the same phase respond to changes in thermal energy. Latent heat describes the heat necessary to change a material from one phase to another, liquid to gas for example, before the temperature will change. Heat is also transferred by convection and radiation. All three methods transfer heat from the hot core of the Earth into cold outer space. These processes, conduction from the core to the mantle, convection in the mantle breaking the crust into moving plates and radiation into space, drive plate tectonics. This results in seafloor spreading, mountain building, subduction zones, earthquakes at plate boundaries and volcanoes of various kinds on the surface of our planet.
 	
From Investigation 4 we know electric charges are two kinds (+ & -). Likes repel, opposites attract. Charge differences can be caused by transfer during contact or temporarily induced by nearness w/o contact. The force between two point charges follows an inverse
	• Anchoring Phenomenon: "How does this machine transfer energy?" (0.5 days)
	• Investigation 9 Thermal Energy (11.0 days) Text pp (364-407)
	  ○ Phenomenon: "How does a blanket keep you warm?" (0.5 days)
	  ○ Experience 1: Temperature (3.0 days)
	  ○ Experience 2: Thermal Equilibrium and Heat Flow (3.0 days)
	  ○ Experience 3: Heat Flow within the Earth (3.0 days)
	  ○ Investigation Assessment: (1.5 days)
	• Investigation 10 Electromagnetic Energy (15.0 days) Text pp (408-461)
	  ○ Phenomenon: "How do we sustainably generate electricity for our lives?" (0.5 days)
	  ○ Experience 1: Electric Potential (3.0 days)
	  ○ Experience 2: Energy in Electric Circuits (3.0 days)
	  ○ Experience 3: Power Generation (3.0 days)
	  ○ Experience 4: Energy Resources and Conservation (4.0 days)
	  ○ Investigation Assessment (1.5 days)

square law called Coulomb's law. Electric forces are described by vectors. Gravitational forces are much smaller than electric forces. For example the electric force between a negatively charged electron and a positively charged proton in a hydrogen atom is 10^29 times larger than the gravitational force between their two masses. Graphic descriptions and calculations are similar to the mathematics used to describe gravity. Electric field and electric potential are useful ways to describe more complicated situations than point charges. Electric force and electric potential energy equations can be made into very useful functions called electric field and electric potential. The electric field equation tells what force a complicated assembly of charges would have on a small charge at different distances from them. The electric potential equation tells what potential energy they would give the small charge at that spot. If you know the electric field and the electric potential it is much easier to predict what will happen than trying to grind through Coulomb's law for many charges. The electric field can also be represented as a picture. For example, the field around a positive charge is a plus sign with straight line arrows pointing out from it in all directions. The place where the lines are really close together the force is stronger and where they are far apart it is weaker. A negative charge would have converging arrows. Electric potential is very useful in explaining how batteries push electrons through wires. In circuits the difference in electric potential (V) between the positive and negative end of the battery pushes electrons in a wire. The metal the wire is made of determines how easily the electrons move. Resistance (R) is how these differences are described. The flowing electrons in the wires are called the current (I). Power is the rate at which electrical energy is used. The different devices in an electrical circuit can be in series or parallel. The way the current moves will differ depending on how the circuits are built. The main equations are Ohm's Law V=I•R, the power law P = I^2 • R, or P = I•V, also Total resistance for series R = R1 + R2 + R3 etc and Total resistance for parallel 1/R = 1/R1+ 1/R2 + 1/R3 ETC	

Changing magnetic fields can move electrons in conductors. This electromagnetic induction can be used to make electric motors and also electric generators. Finally, how the spinning magnets in the generators are turned relates to our climate. If water or steam turns them, the way the steam is made has different impacts on global warming. Steam from geothermal hot water sources near volcanoes does not produce greenhouse gasses. Heat from burning methane, petroleum, or coal does. Heat from nuclear fission does not. Heat from concentrated sunlight does not.	
Standards List:	**PS3-2, PS3-4, ESS2-3, PS2-5, PS3-3, PS3-5, ESS3-2, ESS3-3**

UNIT 5: WAVES AND ELECTROMAGNETIC RADIATION	
Suggested Pacing: approximately 27.5 days	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Waves carry energy as a disturbance traveling through a medium. Waves have amplitude, frequency, wavelength, height, and can be longitudinal, transverse, or torsional. The medium can be solid, liquid, or gas; it can also be electric and magnetic fields. The electromagnetic field model assumes charged particles have associated electric fields that extend from each one out through all space. When they accelerate, they generate ripples along their field lines and also associated magnetic field ripples that travel away from them at the speed of light. These electromagnetic waves are what we call light. This range has wavelengths between 780 nanometers (red) and 390 nanometers (purple), but any other wavelengths are possible. There can be wavelengths from kilometers (radio waves) to wavelengths less than one hundredth of a nanometer (gamma rays). These electromagnetic waves are transverse waves that can be circularly, elliptically, or linearly polarized. The electromagnetic field model breaks down at very small distances, like the atomic level. Here quantum effects become dominant. At this level light can behave either as a wave or a particle depending on what it interacts with. One can transmit information from one place to another by modulating the waves either by changing the amplitude (amplitude modulation) or by changing the wavelength (frequency modulation). One can also interrupt the wave to create on and off conditions. If on is ONE and off is ZERO, binary number codes can transmit information. Information carried by electromagnetic waves can be transmitted through glass fiber cables, through outer space, and through Earth's atmosphere. There are also proposals to capture solar energy with large satellites in space and broadcast it down to Earth's surface as diffuse microwaves (which go through clouds) to be concentrated at the surface receiving power station. It must be designed well and diffuse coming down, otherwise people, birds, plants in it or passing through it might get cooked like in a microwave oven. Also, planes flying through it might have their instruments melted like a piece of aluminum foil in a microwave.	• Anchoring Phenomenon: "How do waves transfer energy?" (0.5 days) • Investigation 11 Waves (8.5 days) Text pp (462-509) o Phenomenon: "How do waves change coastlines?" (0.5) o Experience 1: Wave Properties (2.0 days) o Experience 2: Wave Behavior and Energy (2.5 days) o Experience 3: Wave Optics (2.0 days) o Investigation Assessment (1.5 days) • Investigation 12 Electromagnetic Radiation (9.0 days) Text pp (510-537) o Phenomenon: "How does this 'polaroid' lens remove glare? (0.5 days) o Experience 1: Electromagnetic Waves and their properties (2.0 days) o Experience 2: Particle-Wave Duality (2.0 days) o Experience 3: Electromagnetic Radiation and Matter (2.0 days) o Investigation assessment (1.5 days) • Investigation 13 Information & Instrumentation (9.5 days) Text pp (538-565) o Phenomenon: "How does a mobile device transmit information?" (0.5 days) o Experience 1: Digital Information (2.5 days) o Experience 2: Capturing and Transmitting Information (2.5 days) o Experience 3: Capturing and Transmitting Energy (2.5 days) o Investigation Assessment (1.5 days)

Standards List:	PS3-3, PS4-1, PS4-3, PS4-5, PS4-3, PS4-4, PS4-2, PS4-5

UNIT 6: FROM THE NUCLEUS TO THE UNIVERSE	
Suggested Pacing:	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**

From Investigation The atomic model of matter is powerful and eventually leads to the periodic table of elements, which enables us to predict what will happen when atoms of elements interact. The negative electrons in clouds around the tiny and massive positively charged nucleus of an atom, which is made of positive protons and neutral neutrons (that hold it together); has its electrons in different energy levels associated with how many protons are in the nucleus. The electrons in the outermost energy level of one atom can interact with the outermost electrons of another atom resulting in forces between the atoms. This produces situations where the two atoms get close together and share pairs of electrons. This bonding is called “covalent bonding". In a different situation, one outer electron may be pulled from one atom to another. The element that lost the electron has a positive charge. The element that took the electron has a negative charge. The two atoms are pulled together by their opposite charges. This type of bonding is called “ionic bonding". A third possibility is that a large number of atoms of the same metal element, such as copper, are all together and the outer electrons slosh between identical atoms making the net positive inner parts somewhat like positive islands surrounded by a sea of electrons that keep them inside. This type of bonding is called “metallic bonding” The nucleus of all atoms, except for the hydrogen with only one proton in its nucleus, is made of positive protons held together by neutral neutrons. Protons that close together have VERY strong electric force pushing them apart. The neutrons are mediators on the much larger strong nuclear force . Without that it would be impossible to have atoms more complex than one proton and one electron. Mass and energy are interchangeable as denoted by the famous equation E = MC^2. When you compare the mass of a helium atom’s nucleus to the total mass of the four particles that made it (2 protons and 2 neutrons), the nucleus doesn’t have as much mass as the total mass of its parts. Why? The missing mass was released as light energy during the formation of the nucleus. The apparent missing mass is called the mass deficit of the nucleus. When you look at the other elements’ nuclei iron has the highest mass deficit. This means that you	• Present background information on atoms using the first two Experiences from Investigation 6 “ Forces in Materials’,’ that was skipped, to prepare students to start Investigation 14 “Nuclear Physics” Then do investigation 15 Experience 1 “Radioactive Decay”. (6.5 days) • If there is extra time, one could teach two or more experiences that there was not time to cover, of the teacher’s choice, such as: o Radiometric Dating and Geologic Time would apply to the Age of Rocks, Investigation 15. o The Sun and Stars would apply to The Universe, Investigation 16. o Material Properties and Structure and Function would apply to Forces in Materials, Investigation 6 • Storyline 5: Anchoring Phenomenon: “How did the atoms that make up your body form?” (0.5 days) • Investigation 14 Nuclear Physics (11 days) Text pp (566-607) o Phenomenon: “How can your electricity come from the fusion of atoms?” (0.5 days) o Experience 1: Nuclear Particles (3.0 days) o Experience 2: Nuclear forces (3.0 days) o Experience 3: Fission and Fusion (3.0) o Investigation Assessment (1.5 days) • Investigation 15 Ages of Rocks (11 days) Text pp (608-651) o Phenomenon: “How did Earth Form?” (0.5 days) o Experience 1: Radioactive Decay (3.0 days) o Experience 2: Radiometric Dating (3.0 days) o Experience 3: Geologic Time (3.0) o Investigation Assessment (1.5 days) • Investigation 16 The Universe (11 days) Text pp (652-691) o Phenomenon: “How will the sun change over time?” (0.5 days) o Experience 1: The Sun (3.0 days) o Experience 2: Stars (3.0 days) o Experience 3: The Big Bang (3.0)

can combine nuclei of the lighter elements up to iron and squeeze some energy out. This is nuclear fusion. On the other side of iron, the more massive elements can, in principle, be split into smaller pieces to get out some energy. This is nuclear fission. For practical purposes, the only fusion human beings can do at this time is heavier isotopes of hydrogen fused into helium releasing large amounts of energy. The only fission we can do is creating conditions where Uranium 233, Uranium 235, or Plutonium 239 atoms can spontaneously split, releasing energy for our purposes. An exploding star going supernova sent a shock wave through a massive cloud of interstellar dust, left over from previous stars exploding. causing eddies that were swirling solar systems in the making. Most of the mass in this swirling cloud was concentrated at the center (called a protostar) and as the gravitational compression at the center became greater and greater as mass accreted, the core became dense and hot enough for the fusion of hydrogen into helium to begin. The sun was born. As long as the inward pressure from gravity balances the outward pressure from nuclear fusion in the core our sun will be a stable star. Earth and the other planets formed in the surrounding eddies orbiting the sun as static electricity first turned the dust into clumps and the lightning in the dust melted the clumps into rocks that collided to become planetesimals and eventually proto planets that smashed into each other until only five terrestrial planets remained in the inner solar system and the two gas giants and two ice giants were left in the outer solar system. One mars sized inner planet hit the Earth with a glancing blow that vaporized it and a good part of the upper mantle and crust producing a ring of hot debris that coalesced into the moon. Radioactive decay is the natural process in which unstable nuclei emit ionizing radiation to eventually turn into stable non radioactive elements. Alpha particles are pieces consisting of two protons and two neutrons (essentially a helium nucleus), beta particles are electrons emitted when neutrons turn into protons while forming an electron and throwing it out so total charge remains the same. (Other things are conserved besides energy) Each radioactive element has its own pattern that is not affected by heat, chemical reactions or anything else outside the atom's nucleus. The amount of time for half the original amount of material to change is called the "half-life". In that amount of time half of the material will change. In that amount of time again half of what remains will change, and so in. It takes about TEN half lives for the starting amount of	○ Investigation Assessment (1.5 days)

radioactive material to be one thousandth of the starting a]mount. It takes TWENTY half lives to drop to one millionth of the starting amount. The graph of material versus time is an exponential decay curve that can be used to predict remaining amounts at a given time or time to get to a particular amount. This makes it great for dating if you know how much material there was at the start. For example cosmic rays smash into oxygen and nitrogen atoms at the top of our atmosphere destroying them sending showers of protons and neutrons down into the lower atmosphere. If a neutron hits a nitrogen 14 nucleus and replaces the proton that it knocked out, you now have a carbon 14 atom. It is radioactive with a half life of 5700 years. When it goes through beta decay and a neutron becomes a proton turning it back into N14. Plants pull carbon from the air and put it in their bodies during photosynthesis. Animals eat plants etc. So living things have the same level of C14 in their bodies as is found naturally in the atmosphere. When they die, replacement stops. So comparing the C14 left in the body to the regular carbon in it one can calculate how long since it died. These are very small ratios so the method is not practical beyond 50,000 years or about ten half lives.

Using uranium to lead radioactive dating the age of the earth is Four and a half billion years.

The sun is one of the types of star that lives for about ten billion years. It is presently around five billion years old. As the hydrogen in the core gets used up as it is converted into helium. When the hydrogen is used up, the burned out core will collapse until it's hot enough to fuse helium into heavier elements such as carbon through iron. The new outward heat pressure will push the red outer layers out until it is a red giant. So about five billion years in the future, as the red giant stage ends, the outer gasses will expand away from the core leaving a dense hot white dwarf star that will cool by radiation over billions of years.

How do we know the behavior and history of stars since they live so much longer than human beings? Our telescopes let us observe stars near and far and we see them in all stages of their development. This is similar to a family photo album for human beings. It shows babies, young people, adults and old people. Also we use Newton’s and Kepler’s Laws on binary star orbits to determine their masses, we use their electromagnetic spectra to find out what elements are are in them and how fast they are moving and in what direction (the Doppler effect), and we apply the

mathematics of nuclear fusion physics to figure out what is going on	

inside. It is all applied physics. The easiest way to visualize what is happening is with the Hertzsprung-Russell diagram which plots the brightness of stars on the vertical axis (from dimmest to brightest) and the temperature of stars (from hottest to coldest) on the horizontal axis. Stars start out as protostars that begin fusion at their cores when they get massive enough. They become adult stars whose temperature, brightness and lifetimes are determined by their initial mass. A star that is less than eight times the mass of the sun will go through its adult main sequence stage and end as a white dwarf star. A star that is between eight and twenty times the mass of the sun will end with a supernova explosion (creating many of the elements heavier than helium and through carbon) blowing all the outer layers into space leaving a neutron star behind in the middle. A star that is more than twenty times the mass of the sun will experience a supernova explosion leaving a black hole behind. In the early twentieth century Hubble observed that the spectra of hydrogen and helium from stars in nearby galaxies were slightly longer wavelengths than found in a lab. The farther away the galaxies were in all directions from use the worse it got. Waves generated by a source moving away from an observer get slightly longer. The shift can be used to calculate the speed of motion. Hubble had found that all galaxies were moving away from us and the farther away they were the faster they were going. Either we were the center of the universe (unlikely) or the universe was expanding similar to bread dough full of raisins expanding before it gets baked. From the standpoint of any raisin, the others will be moving away and the farther away they are the faster they will be moving. Fred Hoyle, an astronomer who did not support the expanding universe model, coined the term “Big Bang” during a talk in 1949 to help the general audience visualize the model he was attacking. The name stuck. The Big Bang event is a physical theory that describes how the universe expanded from an initial state of high density and temperature to what it is now.	
Standards List:	**PS1-3, PS2-4, PS2-6, PS1-8, PS1-8, ESS1-5, ESS1-6, ESS2-1, ESS1-1, ESS1-2, ESS1-3**

Science Elective Options

Astronomy

Grade(s): 10-12 **Length**: one semester **Credit**: 0.5 credit **Prerequisites**: Teacher recommendation or *Geometry*	**Course Overview**: *Astronomy* is an introductory course, which will educate students about ancient and modern astronomical knowledge and research methods to build a strong foundation for college-level courses in science. Mathematics and science concepts as well as ancient and modern technology will be used to help students explore and understand the universe they live in. Astronomy focuses on historical development of astronomical knowledge, the solar system, and an introduction to modern research methods. Additional topics could include life cycles of stars, properties of star groupings and galaxies, and the use of modern research methods. **Adopted Textbook**: *Astronomy: Journey to the Cosmic Frontier.* McGraw-Hill, 2008

Units (Recommended Order)
• Classical Astronomy • The Solar System • Using Light and the Electromagnetic Spectrum to Study Space • Stars and their Life (time permitting) • Star Groupings and Galaxies (time permitting) • Cosmology (time permitting) Pacing may be adjusted to account for teacher expertise and current events.

UNIT 1: CLASSICAL ASTRONOMY	
Suggested Pacing: 1 – 2 weeks	**Textbook Chapter(s)/Lessons**: Chapters 3, 4, 7, 8, 9, and 17.
Key Objectives	**Suggested Activities & Resources**
Be able to predict solar positions during the seasons. Model how eclipses occur. Explain early experiments to measure the size of the Earth.	• The effect of solar altitude on insolation. • Use Stonehenge to predict moon phases and eclipses. • Using Aristarchus' method for measuring Earth-Moon-Sun distance ratios. • Using Eratosthenes' method of measuring the Earth.
Standards List:	**ESS1.B: Earth and the Solar System:** HS-ESS2.4

UNIT 2: THE SOLAR SYSTEM	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapters 5, 7, 14, 15, and 18.
Key Objectives	**Suggested Activities & Resources**
Explain how tides work. Explain how Copernicus' findings drastically changed the understanding of the universe. Use Newton's law of universal gravitation to calculate forces on bodies in the solar system. Discuss the theories of the formation of the solar system. Explain the existence of comets, meteors, and asteroids.	• Determine the orbit of Mars using a cross-staff and quadrant for astronomical observations. • Use a pinhole projection to measure the size of the sun.

Standards List:	**ESS1.A: The Universe and Its Stars:** HS-ESS1.1; **ESS1.B: Earth and the Solar System:** HS-ESS1.4 **PS2.B: Types of Interactions:** HS-PS2.4, HS-PS2.5

UNIT 3: USING LIGHT AND THE ELECTROMAGNETIC SPECTRUM TO STUDY SPACE	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: Chapter 6, 16, 19, 20, and 21.
Key Objectives	**Suggested Activities & Resources**
Compare and contrast the wave and particle nature of light.	• Examine the factors related to the operation of a telescope. • Lab: Wien's Law.
Discuss factors affecting angular resolution.	
Explain what the emission and absorption spectra tell scientists about the composition of stars.	
Explain what an optical telescope is and how it works.	
Describe how a radio telescope works.	
Standards List:	**PS4.A: Wave Properties:** HS-PS4.1, HS-PS4.2, HS-PS4.5; **PS4.B: Electromagnetic Radiation:** HS-PS4.3

UNIT 4: STARS AND THEIR LIFE	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: Chapters 17, 18, 19, 20, and 21.
Key Objectives	**Suggested Activities & Resources**
Describe the sun's composition and internal structure.	• Lab: The Doppler Effect. • Lab: The Stefan-Boltzmann Law. • Lab: The Zeeman Effect. • Search for Novae.
Explain how scientists measure the basic properties of stars.	
Use the Hertzsprung-Russell Diagrams to explain the main sequence and classification of stars.	

Describe stellar evolution and the factors which contribute to a star's demise.	
Explain how the aurora works.	
Standards List:	**ESS1.A: The Universe and Its Stars:** HS-ESS1.1, HS-ESS1.2, HS-ESS1.3

UNIT 5: STAR GROUPINGS AND GALAXIES	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: Chapters 2, 21, 22, 23, 24, and 25.
Key Objectives	**Suggested Activities & Resources**
Describe different types of interstellar regions.	• Examine interstellar materials and reddening. • Examine open clusters in the Milky Way Galaxy. • Use spectroscopy to examine active galactic nuclei.
Compare and contrast methods for determining binary and multiple star systems.	
State the structure and theories of formation of galaxies.	
Describe mapping methods for galaxies.	
Classify galaxies and explain population distributions.	
Discuss the expansion of the universe.	
Standards List:	**ESS1.A: The Universe and Its Stars:** HS-ESS1.2, HS-ESS1.3; **PS2.B: Types of Interactions:** HS-PS2.4

UNIT 6: COSMOLOGY	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapters 26 and 27.
Key Objectives	**Suggested Activities & Resources**
Learn about early cosmologies.	• Simulate sending and receiving messages to and from extraterrestrials.
Explain Olbers' paradox.	
Examine modern mathematical cosmologies.	

Discuss SETI: the search for extraterrestrial life.	
Standards List:	**ESS1.A: The Universe and Its Stars:** HS-ESS1.2; **PS2.B: Types of Interactions:** HS-PS2.4; **PS4.C: Information Technologies and Instrumentation:** HS-PS4.5

Forensic Science 1

Grade(s): 11-12 **Length**: one semester **Credit**: 0.5 **Prerequisites**: Teacher recommendation or *Biology* and *Chemistry*	**Course Overview**: *Forensic Science* explores the principles & techniques of science and analyzing crime scene evidence. Emphasis is placed on laboratory techniques, scientific inquiry, communication skills, as well as aspects of the criminal justice system and the admissibility of evidence. Prior knowledge of human genetics and chemistry is preferred. **Adopted Textbook**: *Forensic Science Fundamentals and Investigations*. Cengage.

Units (Recommended Order)
• Crime Scene Investigation and Documentation • Forensic Pathology • Forensic Serology • Fingerprints and Other Impressions • Forensic Anthropology

UNIT 1: CRIME SCENE INVESTIGATION AND DOCUMENTAION	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapters 1 and 2.
Key Objectives	**Suggested Activities & Resources**
Define forensic science.	• Mock crime scene to show how crime scenes are properly sketched, photographed, and how evidence is collected. • Digital camera to practice taking overall, medium, and close-up pictures with placards, scales, and using a photo page/photolog. • Faces computer identification software.
Demonstrate understanding of Locard's Principle of Exchange.	
Develop observation skills and understand their importance to forensic science.	
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	
Define and provide examples of physical evidence, circumstantial evidence, and trace evidence.	
Discuss the responsibilities of law enforcement at crime scenes.	
Describe the responsibilities of expert witnesses in the judicial system.	
Standards List:	**ETS1.B: Developing Possible Solutions:** HS-ETS1.3, HS-ETS1.4 HS-ESS3.2, HS-ESS3.4

UNIT 2: FORENSIC PATHOLOGY	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 12
Key Objectives	**Suggested Activities & Resources**
Determine time of death using various methods including insect life cycle, livor, algor, and rigor mortis.	• Set up entomology experiments outside, using meat samples to attract insects and document decay processes. • Lab: Blunt and Sharp Force Trauma. • Post-mortem interval determination. • Guest Speakers: Handlers of search and rescue dogs.
Investigate autopsy procedures through simulation.	
Be familiar with the training and usefulness of search and rescue dogs.	
List job descriptions and training required for coroners and medical examiners.	
Identify various wounds as blunt force, sharp force, and high velocity.	
Standards List:	**LS1.A. Structure & Function:** HS-LS1-1, HS-LS1-2; **LS1.B:** HS-LS1-7, HS-LS2-3, HS-LS2-4, HS-LS2-5, **LS2.A:** HS-LS2-1, HS-LS2-6, HS-LS2-8

UNIT 3: FORENSIC SEROLOGY	
Suggested Pacing: 3-4 weeks	**Textbook Chapter(s)/Lessons**: Chapter 7
Key Objectives	**Suggested Activities & Resources**
Explain the antigen/antibody system of blood typing in humans. [SC.2]	• Lab: Saliva and Secretions. • Lab: Blood Splatter. • Lab: Electrophoresis. • Lab: Presumptive Fluids.
Describe the use of saliva, blood, semen, and vaginal fluid to identify and eliminate individuals from suspicion.	
Analysis of Alaska based statistics involving body fluid analysis (such as Homicide, Burglary, Sexual Assault, Kidnapping, and Substance related crimes).	
Demonstrate understanding of presumptive tests.	
Explain the difference between a secretor and non-secretor.	
Experiment with and analyze blood splatter patterns.	
Experiment with an analyze genetic profiling.	
Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	
Explain the principles behind the polymerase chain reactions.	
Explain how DNA techniques such as DQ alpha, restriction length polymorphism, short tandem repeats, and PCR can be used to narrow the list of suspects.	

Detail the advantages and disadvantages of mitochondrial and nuclear DNA for use in forensic analysis.	
Standards List:	**LS1.A: Structure and Function:** HS-LS1.1, **LS3.A: Inheritance of Traits:** HS-LS3.1

UNIT 4: FINGERPRINTS AND OTHER IMPRESSIONS	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 6 and 16
Key Objectives	**Suggested Activities & Resources**
Explain why a fingerprint is a permanent feature of human anatomy.	• Use a variety of powders to collect fingerprints on porous and non-porous surfaces. • Iodine, ninhydrin, super-glue lifts. • Cast tire tracks or shoe prints using dental stone. • http://www.scafo.org.
Classify a set of fingerprints.	
Identify ridge characteristics (minutiae) in fingerprints.	
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
Define latent, patent, and plastic and patent prints.	
Describe the chemistry of different techniques for developing latent fingerprints.	
Practice collecting fingerprints from a variety of surfaces.	
Describe the process of casting shoe and tire-track impressions.	
Analyze impressions in dental stone.	
Standards List:	**PS1.A: Structure and Properties of Matter:** HS-ETS1.2; **ETS1.B: Developing Possible Solutions:** HS-ETS1.4, HS-ESS3.2, HS-ESS3.4

UNIT 5: FORENSIC ANTHROPOLOGY	
Suggested Pacing: 3-4 weeks	**Textbook Chapter(s)/Lessons**: Chapter 14
Key Objectives	**Suggested Activities & Resources**
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	• Bone Lab: Determine gender, height, age, and general health. • Facial reconstruction project.
Identify characteristics of a crime victim by using bones.	
Describe how a victim is identified through forensic odontology. Give examples of how forensic anthropologists can assist in crime solving.	
Participate in the art and science of facial reconstruction.	
Standards List:	**ETS1.B: Developing Possible Solutions:** HS-ESS3.2, HS-ESS3.4; **ETS1.C: Optimizing the Design Solution:** HS- ETS1.2

Forensic Science 2

Grade(s): 11-12 **Length**: one semester **Credit**: 0.5 **Prerequisites**: • Teacher recommendation, or • Forensic Science 1 and Geometry	**Course Overview**: *Forensic Science 2* is intended for the more serious forensic science students. They will build upon their forensic knowledge by investigating advanced forensic science techniques. Students will continue to apply the principles and techniques of science to analyzing crime scene evidence. Emphasis will be placed on both qualitative and quantitative engineering design, as well as aspects of the criminal justice system and the admissibility of evidence. Being familiar with human genetics and chemistry is preferred. **Adopted Textbook**: *Forensic Science Fundamentals and Investigations*. Cengage.

Units (Recommended Order)
• Forensic Psychology • Questioned Documents • Forensic Toxicology • Fire Science/ Investigation • Tool Marks and Firearms/ Ballistics • Trace Evidence Analysis • Advanced DNA Analysis • Accident Reconstruction

UNIT 1: FORENSIC PSYCHOLOGY	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Define and apply common legal terms. • Identify the roles of prosecuting and defense attorneys in court cases.	• Guest Speaker: Lawyer.
• Explain how criminal profiling can be helpful in solving crimes. • Use an understanding of brain development, genetics, and environmental factors to explain risk factors of criminal behavior.	• Watch/discuss videos on serial killers' behaviors. • Serial Killer Box Profile Gallery
• Identify behaviors associated with lying and truth-telling.	• Play Malarky and other lying behavior games.
Standards List:	**LS1.A: Structure and Function, HS-LS2: Ecosystems: Interactions, Energy, and Dynamics** **LS2.D: Social Interactions and Group Behavior, GLEs**: SA.1-3; SC.1-2; SF.1-3; SG.1-4

UNIT 2: QUESTIONED DOCUMENTS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapter 10
Key Objectives	**Suggested Activities & Resources**
• Describe and demonstrate handwriting exemplars. • List some important guidelines to be followed in collecting known writing samples for use as comparisons with a questioned document. • Identify the major goals of a forensic handwriting analysis.	• Handwriting Analysis Lab
• Identify several ways in which businesses prevent check forgery. • Identify real and counterfeit U.S. money.	• Microscopic Examination of Currency • Expert Analysis of Representation in Media • Catch Me If You Can - Film/Book
Standards List:	**ETS1.A: Defining and Delimiting Engineering Problems, GLEs**: SA.1-3; SF.1-3; SG.1-4

UNIT 3: FORENSIC TOXICOLOGY	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapter 9
Key Objectives	**Suggested Activities & Resources**
• Identify common drugs of abuse by description. • Describe the proper collection and preservation of drug evidence.	• Guest Presenter: State Troopers & Fairbanks PD Officer • Flipbook of controlled substances
• Describe the chemistry behind various ways of identifying and quantifying chemicals and drugs.	• Identify (unknown) over-the-counter drugs using chemical and physical characteristics.
• Explain the Controlled Substances Act.	•
Standards List:	**HS-LS1: From Molecules to Organisms: Structures and Processes, LS1.A: Structure and Function, HS-LS3: Heredity: Inheritance and Variation of Traits, LS3.A: Inheritance of Traits, GLEs**: SA.1-3; SB.1-2; SF.1-3; SG.1-4

UNIT 4: FIRE SCIENCE/ INVESTIGATION	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Define the heat of combustion and ignition temperature.	• Testing the Fire Triangle.
• Use the fire triangle to explain what elements are required for combustion. • Describe the characteristics and effects of Alaskan wildfires.	• Lab: Matchstick Forest. • Lab: Dollhouse Arson
• Identify the types of evidence left in a fire. • Describe how physical evidence is collected at the scene of a suspected arson.	• Guest Speaker: Fire Marshal
Standards List:	**HS-PS1: Matter and Its Interactions, PS1.B: Chemical Reactions, GLEs**: SA.1-3; SB.1; SF.1-3; SG.1-4

UNIT 5: TOOL MARKS & FIREARMS/ BALLISTICS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapter 18
Key Objectives	**Suggested Activities & Resources**
• Describe and identify types of tool mark impressions. • Explain how bullets are test-fired and matched.	• Lab: Match twist patterns of Bullets
• Describe the characteristic of handguns, rifles, and shotguns and their ammunition. • List procedures for the proper collection and preservation of firearm and tool mark evidence.	• Basics of Ballistics Booklet
• Determine the position of the shooter based on bullet trajectory. • Describe the rifling on a gun barrel and how it affects the flight of projectiles.	• Lab: NERF Dart Gun Ballistics
Standards List:	**HS-PS1: Matter and Its Interactions, PS1.B: Chemical Reactions**

UNIT 6: TRACE EVIDENCE ANALYSIS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Describe the properties of fibers that are most useful for forensic comparisons.	• Fiber identification using chemical and physical properties. • Fiber identification using microscopy.
• List the important forensic properties of soil. • Describe the chemical components of paint. • Determine how density can help identify substances. • Describe the behavior of light as it travels through various substances.	• Soil collections. • Glass density experiments. • Glass impact patterns. • Patterns of bullet holes. • Refractive index.
• Practice analyzing trace evidence including hairs, fibers, paints, coating, explosive, fire residues, glass, and soil.	•

Standards List:	**HS-PS1: Matter and Its Interactions, PS1.A: Structure and Properties of Matter, GLEs**: SA.1-3; SB.1-2; SF.1-3; SG.1-4

UNIT 7: ADVANCED DNA ANALYSIS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
• Explain the differences between nuclear DNA and mitochondrial DNA. • Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	• Study how mitochondrial DNA was used to solve the Anny Anderson/Princess Anastasia mystery. • Apply the mitochondria DNA technique to Argentina's missing children situation of the 1980's.
• Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	•
• Explain the training and technology required to carry out current DNA analysis.	• Isolate DNA from bone and/or plant material. • Use pollen analysis to identify its source.
Standards List:	**HS-LS1: From Molecules to Organisms: Structures and Processes,** LS1.A: Structure and Function, **HS-LS3: Heredity: Inheritance and Variation of Traits,** LS3.A: Inheritance of Traits, **GLEs**: SA.1-3; SC.1; SF.1-3; SG.1-4

UNIT 8: ACCIDENT RECONSTRUCTION	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapter 16
Key Objectives	**Suggested Activities & Resources**
• Use physics to analyze the dynamics of a collision.	• Analysis of Skid Marks
• Use measurements, sketches, after-accident diagrams and photographs to systematically investigate traffic collisions. • Make scale drawings of the accident scene.	• Measure an accident scene and make a scale drawing. • Lab: Mario Kart Accident Reconstruction

• Determine blood alcohol content (BAC) from suspect's drinking history.	• Determine a suspect's BAC using drinking history and math formulas.
Standards List:	**HS-ETS1: Engineering Design, ETS1.B: Developing Possible Solutions, GLEs**: SA.1-3; SB.4; SF.1-3; SG.1-4

Introduction to Basic Pathophysiology

Grade(s): 11-12 **Length**: one semester **Credit**: 0.5 **Prerequisites**: Teacher recommendation or *Biology* and *Human Anatomy and Physiology*	**Course Overview**: *Intro to Basic Pathophysiology* applies knowledge of normal human anatomy and physiology to promote a clear understanding of common disease processes. The course will review basic cellular function, tissue types, and body systems to compare to the body's response to injury or illness. This course is highly recommended for students interested in pursuing a career in health science. **Adopted Textbook**: *Human Disease*. Delmar, 2015

Units (Recommended Order)
• Introduction to Basic Pathophysiology and Mechanism of Disease • Neoplasms/ Cancer • Heart Disease – Cardiovascular System • Immune Systems – Our Body's Defense and Treatment • Microorganisms as Infectious Agents • Pharmacology and Drug Development • Hereditary/ Genetic Disorders

UNIT 1: INTRODUCTION TO BASIC PATHOPHYSIOLOGY AND MECHANISM OF DISEASE	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 1
Key Objectives	**Suggested Activities & Resources**
Review A&P body systems, tissue types, homeostasis, and medical terminology	• Create and label a life size body poster • Research diseases of the tissue types • Use prefix, root words, and suffixes to build medical terms
Understand Pathology: acute vs chronic disease, signs vs symptoms, eitology, pathogenesis, morphology, and prognosis	• Define and practice terms with case studies • Choose a system (ex: skeletal system) and disease of that system and research the pathology • Practice application of terms with case studies
Mechanisms of Disease: heredity, trauma, infection/inflammation, hyperplasias/neoplasms, nutritional imbalance, and impaired immunity	• Practice application of terms with case studies • Case study: When eating makes you sick (Inflammatory Bowel Syndrome) • Scientific Process of Diagnosis Lab • This Podcast Will Kill You
Standards List:	**Structure and Function:** HS-LS1-1, HS-LS1-2, HS-LS1-3

UNIT 2: NEOPLASMS/ CANCER	
Suggested Pacing: 1-2 weeks	**Textbook Chapter(s)/Lessons**: Chapter 2
Key Objectives	**Suggested Activities & Resources**
What is cancer, how are cancer cells different than normal cells, causes, statistics, and treatments (current and future)	• Cancer stations (explore different topics)
Types of cancer and current cancer research	• Independent research and presentations • TED Talk and partner share
Cancer risk factors and preventative measures	• Interactive website • Cancer sniffing dogs and ants

Standards List:	**Structure and Function:** HS-LS1-1, HS-LS1-2, HS-LS1-3**; Inheritance and Variation of Traits** : HS-LS1-4, HS-LS3-1, HS-LS3-2, HS- LS3-3; **Natural Selection and Evolution:** HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 3: HEART DISEASE – CARDIOVASCULAR SYSTEM	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**: Chapter 8
Key Objectives	**Suggested Activities & Resources**
Review Cardiovascular system anatomy and physiology	• Heart and blood flow stop motion video • Build a heart model from clay
Heart disease is the number 1 killer. Learn the signs, symptoms, risk factors and treatments.	• Case studies of risk factors • Read ECGs • Virtual Cardiology Lab- HHMI Biointeractive • Live from the Heart (case study and open heart surgery video)
Standards List:	**Structure and Function:** HS-LS1-1, HS-LS1-2, HS-LS1-3**; Inheritance and Variation of Traits:** HS-LS1-4, HS-LS3-1, HS-LS3-2, HS- LS3-3; **Natural Selection and Evolution:** HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 4: IMMUNE SYSTEM – OUR BODY'S DEFENSE AND TREATMENT	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: Chapters 4 and 5
Key Objectives	**Suggested Activities & Resources**
Understand the inflammatory response, and innate vs adaptive immunity including the cells of the immune system (neutrophil, macrophage, T-cells, B-cells, antibodies, memory B-cells)	• Sutures and wound healing • Immune system comic • Blood typing simulation lab
Diseases of the immune system	• Research and presentations • Case study
Standards List:	**Structure and Function:** HS-LS1-1, HS-LS1-2, HS-LS1-3**; Interdependent Relationships in Ecosystem s:** HS-LS2-7, HS-LS3-1, HS-LS3-2, HS-LS3-3; **Natural Selection and Evolution:** HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 5: MICROORGANISMS AS INFECTIOUS AGENTS	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Bacteria as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	• Research specific disease, presentation (Battle of Infectious Diseases in March Madness format) • Culture bacterial plates
Viruses as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Protozoans as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Fungi as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Helminths as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Standards List:	**Structure and Function:** HS-LS1-1, HS-LS1-2, HS-LS1-3**; Matter and Energy in Organisms and Ecosystem s:** HS-LS1-6, HS-LS1-7, HS-LS2-4; **Inheritance and Variation of Traits:** HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; **Interdependent Relationships in Ecosystem s:** HS-LS2-7, HS-LS3-1, HS-LS3-2, HS-LS3-3; **Natural Selection and Evolution:** HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-**5**

UNIT 6: PHARMACOLOGY AND DRUG DEVELOPMENT	
Suggested Pacing: 2-3 weeks	**Textbook Chapter(s)/Lessons**:
Key Objectives	**Suggested Activities & Resources**
Development and types of vaccines. How do vaccines work and what diseases do we have vaccines for?	• NOVA- Vaccines, Calling the Shots • Research the diseases vaccines prevent
Antibiotics- how they work, antibiotic resistance, replacing antibiotics with bacteriphage therapy	• On cultured bacteria, place antibiotic discs and view zone of inhibition • Antibiotic Resistance Simulation: http://antibiotics.inquiry-hub.net • Gram positive vs gram negative bacteria
Drug Development- the process of clinical trials, and the careers associated with the development of new pharmaceuticals	• HIV Drug Development role play
Standards List:	**Structure and Function:** HS-LS1-1, HS-LS1-2, HS-LS1-3**; Matter and Energy in Organisms and Ecosystem s:** HS-LS1-6, HS-LS1-7, HS-LS2-4; **Inheritance and Variation of Traits:** HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; **Interdependent Relationships in Ecosystem s:** HS-LS2-7, HS-LS3-1, HS-LS3-2, HS-LS3-3; **Natural Selection and Evolution:** HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 7: HEREDITARY/ GENETIC DISORDERS	
Suggested Pacing: 1 week	**Textbook Chapter(s)/Lessons**: Chapter 19
Key Objectives	**Suggested Activities & Resources**
Understand the pathogenesis of congenital, chromosomal, and genetic diseases/disorders.	• Case studies • Karyotype lab (chromosomal disorders) • Research genetic disorder, present or share
Standards List:	**Inheritance and Variation of Traits:** HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; **Natural Selection and Evolution:** HS-LS4-1, HS-LS4- 2, HS-LS4-3, HS-LS4-4, HS-LS4-5

Paleontology

Grade(s): 11-12 **Length**: one semester **Credit**: 0.5 **Prerequisites**: Teacher recommendation or *Biology* and *Chemistry*	**Course Overview**: *Paleontology* is designed to provide students an opportunity to further investigate and describe the temporal and spatial changes in Earth's flora and fauna within the context of geological processes, stratigraphy, and evolution. Another goal of the course is to demonstrate the interdependence of scientific disciplines in any investigation of large-scale patterns and events in the natural world. Consequently, the study of paleontology requires a working knowledge of more than one discipline. The course will be reading intensive with advanced articles on the subject of paleontology. **Adopted Textbook**: None at this time.

Units (Recommended Order)
• Geologic Time • Precambrian Time • Paleozoic Time • Mesozoic Time • Cenozoic Time • Independent Student Research Paper and Poster Project

UNIT 1: GEOLOGIC TIME AND EXTINCTIONS	
Suggested Pacing: 2 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Review scientific articles and develop background research.	• Measure out geologic time to scale. • Analyze Jurassic Park movie for scientific accuracy. • Compare extinction events. • Examine claims of current extinction event. • Examine geologic maps.
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	
Construct an explanation based on evidence that the process of evolution primarily results from four factors: • The potential for a species to increase in number. • The heritable genetic variation of individuals in a species due to mutation and sexual reproduction. • Competition for limited resources. • The proliferation of those organisms that are better able to survive and reproduce in the environment.	
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	

Standards List:	**ESS1.C: The History of Planet Earth:** HS-ESS1.6; **ESS2.A: Earth Materials & Systems:** HS-ESS1.1, HS-ESS2.2; HS-ESS2.4; **ESS2.D: Weather & Climate:** HS-ESS2.7; **LS4.A: Evidence of Common Ancestry & Diversity:** HS-LS4.1, HS-LS4-2; **LS2.C: Exosystem Dynamics, Functioning, and Resilience:** HS-LS2-6

UNIT 2: PRECAMBRIAN TIME	
Suggested Pacing: 1 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating- game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	

Standards List:	

UNIT 3: PALEOZOIC TIME	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Review scientific articles and develop background research. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Review scientific articles and develop background research. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating- game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
Standards List:	

UNIT 4: MESOZOIC TIME	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating- game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	
Standards List:	

UNIT 5: CENOZOIC TIME	
Suggested Pacing: 4 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating- game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	
Standards List:	

UNIT 6: INDEPENDENT STUDENT RESEARCH PAPER AND POSTER PROJECT	
Suggested Pacing: 3 weeks	**Textbook Chapter(s)/Lessons**: N/A
Key Objectives	**Suggested Activities & Resources**
Choose a research topic appropriate to grade level.	• Invite UAF grad students to share their research with the class. • Develop a list of interests. • Draft proposal for teacher's review. • Students conduct research inside and outside the classroom. • Multiple peer revisions in class. • Research poster presentations.
Review scientific articles and develop background research.	
Write paper or develop poster using multiple teacher/mentor-reviewed drafts.	
Present the results of research to the public as scientific paper/poster and oral presentation.	
Standards List:	**ETS1.B: Developing Possible Solutions:** HS-ESS3.2, HS-ESS3.4

The Fairbanks North Star Borough School District is an equal employment and educational opportunity institution, as well as tobacco and nicotine- free learning and work environment.

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