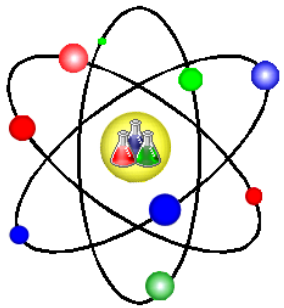
Science Curriculum

High School



Juneau School District Board of Education

Adopted April 17, 2018

JSD High School Science Curriculum

JSD High School Science Curriculum

Introduction

"Don't forget our way of life. This wonderful thing that was born on the world, that saved our ancestors. Don't ever let it go. Hold onto it. It was born for us," - K aajaakwti, Dr. Walter Soboleff, L'eeneidi, Dog Salmon Clan Leader, Scholar

The Juneau School District K-12 Science Curriculum represents the essential skills and knowledge that students will need to be scientifically literate citizens in the twenty-first century. By adopting this curriculum, the Juneau School District affirms its commitment to provide a guaranteed and viable science education for all of our students.

Many stakeholders of the community were involved in developing this curriculum. The goal was to uphold our students to rigor by integrating culturally-relevant and place-based experiences and using the Next Generation Science Standards (NGSS) as the foundation framework.

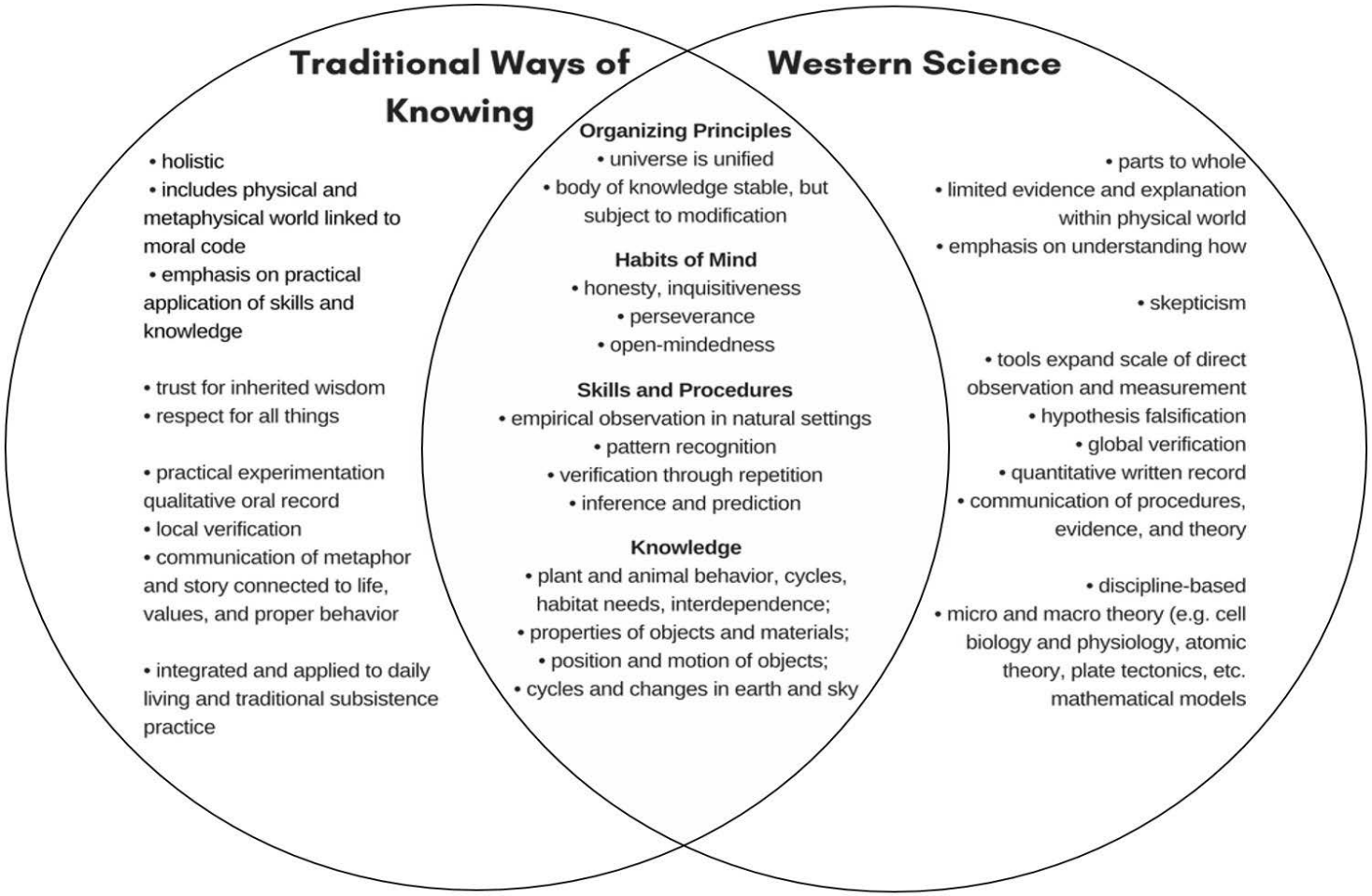
"Place-based education involves integrating local history, indigenous [Tlingit] knowledge and a deep sense of place into the curriculum. Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum. This approach to education, which emphasizes hands-on, real-world learning experiences, increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens. Community vitality and environmental quality are improved through the active engagement of local citizens, community organizations, and environmental resources in the life of the school." (*Place-Based Education Connecting Classrooms & Communities* by David Sobel, Orion Society, 2005).

The use of phenomenon is another dominant component throughout K-12, as the goal of building knowledge in science is to develop general ideas, based on evidence, that can explain phenomena. Phenomena are observable events that occur in the universe. When students are motivated to explain these observable events, the focus of learning shifts from learning about a topic to figuring out why or how something happens.

This document is a reflection of what our community values in education: high standards for all students and a deep respect for both indigenous and Western Knowledge that connects students to this unique place we call home.

Qualities Associated with Traditional Knowledge and Western Science

"Indigenous Knowledge Systems and Alaska Native Ways of Knowing," Ray Barnhardt and Angayuqaq Oscar Kawagley, Anthropology Education Quarterly, vol.36, no.1, 2005



Traditional Native Science is a universal intellect of thought that shares common organizing principles of Western Science. The use of these two knowledge systems mutually strengthen students' connection with place and understanding of local and global issues. The goal is: Wooch een yéi jidané-working together.

JSD High School Science Curriculum

Curriculum Organization

"Every student deserves the opportunity to learn in a world-class educational setting that is respectful and free from bias."
- JSD Board Policy 0450

The curriculum is organized for three levels of education in our district (K-5, 6-8, 9-12) and aligned with:

- Alaska Cultural Standards
- Alaska English Language Arts and Math Standards
- Alaska Science Standards
- International Standards in Technology Education (ISTE)
- Next Generation Science Standards (NGSS)

The Next Generation Science Standards, authored by a consortium of 26 states, is based on the national Framework for K-12 Science Education. Released in 2013, it was a collaborative effort to defining key elements of science and describing progressive steps that help students grow in their capacity to do science. The goal is to shift the focus of learning about a topic to figuring out why or how something happens. The NGSS promote science literacy including an appreciation of understanding how the natural world works and interfaces with the designed world.

The Science Committee worked diligently to make this curriculum relevant to Juneau students by including local phenomena, and cross-curricular, cultural, and place-based connections for each grade-level topic. We will continue to expand cultural and place-based connections over time. Live links to NGSS and other online resources are provided across the curriculum and are identified as underlined in suggested activities and cultural and place-based resources.

The NGSS are organized around three dimensions of how science is practiced:

1. Cross-cutting themes: 7 cross cutting concepts that are a way of linking across multiple content areas.
    a. Patterns, similarity and diversity
    b. Cause and effect
    c. Scale, proportion and quantity
    d. Systems and system models
    e. Energy and matter
    f. Structure and function
    g. Stability and change
2. Disciplinary Core Ideas: 4 key domains of science.
    a. Physical science
    b. Life science
    c. Earth and space science
    d. Engineering, technology and science applications

3. Science & Engineering Practices: Practices for students to think and act like scientists and engineers across all domains.
    a. Asking questions and defining problems
    b. Developing and using models
    c. Planning and carrying out investigations
    d. Analyzing and interpreting data
    e. Using math and computational thinking
    f. Constructing explanations and designing solutions
    g. Engaging in argument from evidence
    h. Obtaining, evaluating and communicating information

The NGSS includes learning goals related to engineering, technology, and applications of science across the K-12 span. These goals highlight a focus on engaging students in the science and engineering practices - all essential components of Science, Technology, Engineering, and Math (STEM). It is also intended to educate learners for civic engagement and personal fulfillment connecting student experiences to societal or personal concerns that require scientific or technological knowledge. STEM and NGSS are complementary and provide the vision for our curriculum to prepare our students to address the challenges and opportunities of the future.

Elementary Curriculum

The Elementary curriculum **i**s organized by the following three domains, with specific topics at each grade level.

1. Earth Science
2. Physical Science
3. Life Science

Performance expectations develop ideas and skills that allow students to explain complex phenomena in the four disciplines as they progress to middle school and high school. Students develop an understanding of the four disciplinary core ideas, beginning with recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s).

Students will participate in hands on learning experiences and investigations. They will use critical thinking and problem solving skills to explore the world. This document is inspired by cultural and place based phenomena. (*Topic Arrangements* of the Next Generation Science Standards Achieve, Inc. 2013)

Middle School Curriculum

Students continue to develop understanding of the three core branches of science: Earth and Space, Physical and Life. The Performance Expectations blend the core ideas with Scientific and Engineering Practices and Crosscutting Concepts to support students in developing useable knowledge across the science disciplines.

Each year, students will explore the Nature of Science to provide a foundation in reasoning, thinking, and methodology so that they graduate seeing themselves as scientifically literate.

The goal for middle school students is to have more experience in engineering design by defining problems more precisely, conducting a more thorough process of choosing the best solution, and optimizing the final design. (*Topic Arrangements of the Next Generation Science Standards*, Achieve, Inc. 2013)

Middle School is organized by topic and grade:

Grade 6 Physical Science

- Nature of Science
- Matter and Energy
- Chemical Reactions
- Forces and Interactions

Grade 7/8 Life Science

- Nature of Science
- Cells
- Body Systems
- Heredity, Evolution
- Ecosystems

Grade 7/8 Earth and Space Science

- Nature of Science
- Space Systems
- History of Earth
- Earth's Systems
- Weather and Climate

JSD High School Science Curriculum

High School Curriculum

High School students continue to build upon their middle school learning about the nature of science, physical, life, and earth sciences. The required courses for graduation, Physical Science and Biology, include the most fundamental concepts of chemistry, physics, and life science and are intended to leave room for further study in upper level high school courses.

Physical Science topics include: Nature of Science, Matter and Interactions, Motion and Stability (Forces and Interactions), Energy, Waves and their application in Technology for Information Transfer. Physical Science topics engage students in more in-depth phenomena central to the physical sciences. The physical science performance expectations focus on scientific practices including: developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and using these practices to demonstrate understanding of core ideas. Students are also expected to demonstrate understanding of several engineering practices including design and evaluation. *(Topic Arrangements of the Next Generation Science Standards, Achieve, Inc. 2013).*

Life Science/Biology ideas build upon students' science understanding and address life science topics: Nature of Science, Photosynthesis/Cellular Respiration, Genetics, Evolution, Ecology and Anatomy and Physiology. The performance expectations for high school life science blend core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge that can be applied across the science disciplines. *(Topic Arrangements of the Next Generation Science Standards, Achieve, Inc. 2013).*

High School Courses are sequenced with the two required courses (2 credits) to meet district graduation requirements, Physical Science and Biology, and require students to take a third credit of science from the elective science options.

Elective course options include Honors and AP courses which students may take as advanced learning options and courses connected to dual credit opportunities and Alaska's high demand career pathways in Health Sciences, Marine Biology, and STEM.

- Honors and AP course options include:
    - Honors Biology, Honors Physical Science, Honors Chemistry, AP Biology, AP Environmental Science, AP Physics.
- Elective science course options include:
    - Applied Science-STEM, Earth Science, EMT, ETT, Fisheries Tech I and II, Forensic Science, Geology, Human Anatomy and Physiology, Introduction to Chemistry, Introduction to Engineering Design, Introduction to Health Sciences, Marine Biology, Oceanography, Outdoor Biology, Physics, Principles of Engineering.

Course descriptions and syllabi are provided for all these course offerings, and the curriculum defines the content for the required Physical Science and Biology courses.

JSD High School Science Curriculum

Community Connections

There has been active community involvement throughout 2016-17 in revising the science curriculum. Community members are excited about the adoption of NGSS and its focus on inquiry-based, cross-disciplinary, and place-based learning. The Committee has used the JSD STEM Coalition Database, suggestions from committee members, and community networking events to develop links to specific Juneau and Alaska-based science experiences. Ongoing work is needed to organize ideas for resources so that they are 1) continually kept up to date and 2) easily and usefully accessed by a wide range of teachers. JSD will coordinate that organizing work with the Juneau STEM Coalition and other community partners including local Native organizations.

Science Committee Members 2016-2017

Elementary Teachers
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Jennifer Thompson, HBV
Joanna Hinderberger, GAST
Julie Leary HBV
Kimberly Frangos, GV
Lisa Mitchell, MRCS
Marnita Coenraad, RVB
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Shawna Puustinen, RB
Shgen George, HBV
Tina Peyerk, GV

Secondary Teachers
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Henry Hopkins, JDHS
James White, DHMS
Jessica Cobley, FDMS
Jonathan Smith, JDHS
Kristen Wells, TMHS
Kathleen Galau, TMHS
Rebecca Farrell, FDMS
Ryia Waldern, YDHS
Ruby Hughes, Cultural ParaEducator, DHMS/JDHS
Topaz Shyrock, TMHS

District Administrators
Barbara Cadiente-Nelson, K-12 Native Students Success Coordinator, Teaching & Learning Support
Kristy Dillingham, Principal, Mendenhall River Community School
Haifa Sadighi, Assistant Principal, Floyd Dryden Middle School

Parents/Community Members

Angie Lunda, Science Educator, faculty, UAS School of Education
Bjorn Wolter, Parent, Science Educator, Alaska Department of Education & Early Development
Bonita Nelson, Biologist, NOAA
Brenda Taylor, Parent, Math Teacher, Juneau Community Charter School
David Katzeek, Cultural Knowledge Bearer, Chair, Juneau Indian Studies Program
Elissa Borges, Consultant, Juneau Indian Studies Program
Kelly Sorenson, Educator, Discovery Southeast
Kristen Romanoff, Parent, Science Educator, Alaska Department of Fish and Game
Lori Buzzell, Parent, Administrative Assistant, Teaching & Learning Support
Marilyn Sigman, Science Educator, Alaska Sea Grant
Norma Shorty, Curriculum Specialist Contractor, Juneau Indian Studies Program
Paul Berg, Curriculum Specialist, Goldbelt Heritage Foundation
Peggy Cowan, Science Consultant, Alaska Sea Grant
Rebecca Soza, STEM, Juneau Economic Development Council
Sarah King, Parent, Administrative Assistant, Teaching & Learning Support
Stephanie Hoag, Science Educator

Facilitators

Carin Smolin, Curriculum Coordinator, Teaching & Learning Support
Pam Garcia, Instructional Coach, Teaching & Learning Support
Ted Wilson, Director, Teaching & Learning Support

JSD High School Science Curriculum

K-12 Science Curriculum: Scope and Sequence

Grade	Life	Physical	Earth	Other
Elementary School				
K	Interdependent Relationships in Ecosystems, Plants, and their Environment	Forces and Interactions: Pushes and Pulls	Weather and Climate	
1	Structure, Function, and Information Processing	Waves: Light and Sound	Space Systems: Patterns and Cycles	
2	Interdependent Relationships in Ecosystems	Structure and Properties of Matter	Earth's Systems: Processes that Shape the Earth	
3	Interdependent Relationships in Ecosystems Inheritance and Variation of Traits	Forces and Interactions	Weather and Climate	
4	Structure, Function, and Information Processing	Energy Waves: Waves and Information	Earth's Systems: Processes that Shape the Earth	
5	Matter and Energy in Organisms and Ecosystems	Structure and Properties of Matter	Earth's Systems Space Systems: Stars/Solar System	
Middle School				
	Life	**Physical**	**Earth**	**Other**
6		QA=Nature of Science QB= Matter & Energy QC=Chemical Reactions QD=Forces and Interactions		
7 Rotating in DZ	Nature of Science Q1 = Cells Q2 = Body Systems Q3= Heredity, Evolution Q4= Ecosystems		Nature of Science Q1 = Space Systems Q2 = History of Earth Q3 = Earth Systems Q4 = Weather and Climate	
8 Rotating in DZ	Nature of Science Q1 = Cells Q2 = Body Systems Q3= Heredity, Evolution Q4= Ecosystems		Nature of Science Q1 = Space Systems Q2 = History of Earth Q3 = Earth Systems Q4 = Weather and Climate	

JSD High School Science Curriculum

High School				
	Life	**Physical**	**Earth**	**Engineering**
9		Physical Science/Honors ● Nature of Science ● Matter & Interaction ● Motion & Stability ● Energy ● Waves & their applications in technologies for info transfer	Physical Science/Honors ● Nature of Science ● The universe and stars ● Earth and solar system ● Weather and Climate ● Natural Resources	
10	Biology/Honors ● Nature of Science ● Photosynthesis/Cellular Respiration ● Genetics ● Evolution ● Ecology ● Anatomy and Physiology		Biology/Honors ● Nature of Science ● Weather & Climate ● Biogeology ● Human Impact - Earth's Systems ● Global Climate Change	
High School Electives (offered depending on school, staff, resources, student demand) (* = CTE courses, # = UAS Dual Credit)				
	*Outdoor Biology	Intro Chemistry	*Geology, .5 credit	*Intro to Eng Design
	#*Marine Biology	Honors Chemistry	*Earth Science/Geology, 1 credit	*Principles of Engineering
	*Human Anatomy and Physiology	Physics		*Applied Science -STEM, .5 credit
	#*Intro Health Sciences, .5 credit	AP Physics		
	AP Biology	#*Forensic Science, .5 credit		
	#*ETT, .5 credit	#*Oceanography		
	#*EMT	AP Environmental Science		
	#*Fisheries Tech I, .5 credit			
	#*Fisheries Tech II, .5 credit			

Alaska Cultural Resources

The following are additional cultural resources and references to support the science curriculum. Some have already been cited in specific grade-level topics in which they align to.

Cultural Tool Kit

- **http://www.ankn.uaf.edu/publications/knowledge.html (Guidelines for Respecting Cultural Knowledge)**
- **http://www.ankn.uaf.edu/publications/Knowledge.pdf (Guidelines for Respecting Cultural Knowledge)**
- **http://www.goldbeltheritage.org/wp-content/uploads/2016/09/GHF-Elder-Culture-Bearer-Request.pdf**
- How to **prepare your students for an elder visit** by Roby Littlefield
- **Tlingit Elders Traditional Education Checklist**
- Email **isp@juneauschools.org** for support in developing or delivering culturally relevant, place-based curricula - Elder Support
- **Indigenous Knowledge Systems/Alaska Native Ways of Knowing** - Venn diagram comparing Traditional Knowledge and Western Science
- **https://drive.google.com/file/d/1XNx2og-mbN7m0yrFgUGq9JaOUXimp7TN/preview (Tlingit Ecological Knowledge / Traditional Oral Narratives: Lecture by Dr. Daniel Monteith**
- **https://vimeo.com/47734749 "Our Grandparents' Names on the Land" - "Our names are science," D. Katzeek**
- Oral Narratives protocols [work in progress - Indian Studies Program, Juneau School District]
- **http://tlingitlanguage.com/media/Nyman_1993.pdf** (Juneau place-based resource)
- **https://trt.geolive.ca/stories.html** (Yanyeidi Clan History of T'aaku Kwaan as told by Yanyeidi Elder (Canadian):
- **http://tlingitlanguage.com/wp-content/uploads/2015/01/Dauenhauer-1987-Haa-Shuk%C3%A1.pdf ("Our Science is our Stories - D. Katzeek")**
- **http://tlingitlanguage.com/media/Dauenhauer-Beginning-Tlingit.pdf**
- **Dictionary of Tlingit by Keri Edwards**
- **http://www.goldbeltheritage.org/wp-content/uploads/2014/02/Tlingit-Dictionary-GHF-UAS-and-Twitchell.pdf**
- **http://www.sealaskaheritage.org/sites/default/files/BeginningTlingitWorkbook.pdf**
- **http://www.sealaskaheritage.org/programs/Language%20Resources/Tlingit_dictionary_web.pdf**
- **https://www.sharingourknowledge.org/program_pdfs/2009_program.pdf**
- **https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd475457.pdf** (Our Food is our Way of Life)

Ways to Include Alaska Culture in the Classroom

- Utilize Juneau School District- Indian Studies Program, Goldbelt Heritage Foundation, Sealaska Heritage Foundation, Douglas Indian Association (a.k.a. T'aaku Kwaan Tribal Government), and Tlingit & Haida Central Council for cultural resources, elders and place based curriculum
- Email JSD Indian Studies (isp@juneauschools.org) or speak to your school's cultural expert on content, protocols, narratives, etc.
- Consider bringing students' summer camp projects from local tribal organizations into the classroom; Héen Latínee Outdoor Classroom - a curriculum guide including Glacier Migration, Stream Ecology & the Story of Soil. *(Proposing a collaborative project between Goldbelt, Fisheries, Marine Biology, UAS and Juneau School District)*.
- Give cultural examples when describing frequent science terms: Phenomena Observations- for example, up in Yukon, white fish come in when the buds come in on plants. Also, take students outside and explore the land at the start. Honing their observation skills.
- --->Scientific Investigations - based around traditional knowledge (for example, Alaska Native Science Fair)

Alaska Cultural Resources Relevant to Teaching Science

- **http://www.ankn.uaf.edu/curriculum/Tlingit/Salmon/axehand.html (Axe Handle Curricula Framework for Place-Based Education)**
- **http://nsgl.gso.uri.edu/aku/akue99001.pdf (Sun, Moon, Tide by Dolly Garza)**
- **http://www.ankn.uaf.edu/publications/handbook/handbook.pdf**
- **http://www.ankn.uaf.edu/publications/VS/toteacher.html Village Science by Alan Dick**
- **http://www.goldbeltheritage.org/elementary-resources/science-units-elementary**
- **http://www.goldbeltheritage.org/middle-school/science-units-middle-school**
- **http://www.goldbeltheritage.org/high-school/science-units-high-school**
- **https://drive.google.com/file/d/0BykCjaiQvmszRnM2ZGw4WE9hQmc/preview (High School Héen Latínee Outdoor Classroom - a curriculum guide including Glacier Migration, Stream Ecology & the Story of Soil)**
- Sealaska Heritage Foundation Middle School Science Curriculum (Developmental Language Process Resource): **http://www.sealaskaheritage.org/institute/education/resources/sciencems**
- Sealaska Heritage Foundation Grade 6 Science (Developmental Language Process Resources)
- Grade 6 Book One: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20Unit%201.pdf**
- Grade 6 Book Two: **http://www.sealaskaheritage.org/sites/default/files/science_6_book_2_web.pdf**
- UNIT 1 A–1: Science as Inquiry Process: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20Unit%201.pdf**
- UNIT 2 A–1: Science as Inquiry Process: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20Unit%202.pdf**
- UNIT 3 B–1: Concepts of Physical Science:**http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%204.pdf**

- UNIT 4 B–1: Concepts of Physical Science:**http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%204.pdf**
- UNIT 5 C–1: Concepts of Life Science: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%205.pdf**
- UNIT 6 C–1: Concepts of Life Science:**http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%206.pdf**
- UNIT 7 D–1: Concepts of Earth Science: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%207.pdf**
- UNIT 8 D–1: Concepts of Earth Science: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%208.pdf**
- UNIT 9 E–1: Science and Technology; F–1: Cultural, Social, Personal Perspectives of Science; G–1: History of Science: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%209.pdf**
- UNIT 10 Raven and the King Salmon: **http://www.sealaskaheritage.org/sites/default/files/Science%20Grade%206%20UNIT%2010.pdf**
- SHI Grade 7 Science (Developmental Language Process Resources)
- Grade 7 Book One: **http://www.sealaskaheritage.org/sites/default/files/Book1_Grade7.pdf**
- Grade 7 Book Two: **http://www.sealaskaheritage.org/sites/default/files/Book2_Grade7.pdf**
- UNIT 1 A–1: Science as Inquiry Process: **http://www.sealaskaheritage.org/sites/default/files/unit1_1.pdf**
- UNIT 2 A–1: Science as Inquiry Process: **http://www.sealaskaheritage.org/sites/default/files/unit2_1.pdf**
- UNIT 3 B–1: Concepts of Physical Science: **http://www.sealaskaheritage.org/sites/default/files/unit3_1.pdf**
- UNIT 4 B–1: Concepts of Physical Science: **http://www.sealaskaheritage.org/sites/default/files/unit4_1.pdf**
- UNIT 5 C–1: Concepts of Life Science: **http://www.sealaskaheritage.org/sites/default/files/unit5_1.pdf**
- UNIT 6 C–1: Concepts of Life Science: **http://www.sealaskaheritage.org/sites/default/files/unit6_1.pdf**
- UNIT 7 D–1: Concepts of Earth Science: **http://www.sealaskaheritage.org/sites/default/files/unit7_1.pdf**
- UNIT 8 D–1: Concepts of Earth Science: **http://www.sealaskaheritage.org/sites/default/files/unit8_1.pdf**
- UNIT 9 E–1: Science and Technology; F–1: Cultural, Social, Personal Perspectives of Science; G–1: History of Science:**http://www.sealaskaheritage.org/sites/default/files/unit9_1.pdf**
- GLOSSARY: **http://www.sealaskaheritage.org/sites/default/files/glossary_2.pdf**

- SHI Grade 8 Science (Developmental Language Process)
- Grade 8 Book One: **http://www.sealaskaheritage.org/sites/default/files/Book1_Science8.pdf**
- Grade 8 Book Two: **http://www.sealaskaheritage.org/sites/default/files/Book2_Science8.pdf**
- INTRODUCTION: **http://www.sealaskaheritage.org/institute/education/resources/sciencems**
- UNIT 1 A–1: Science as Inquiry Process: **http://www.sealaskaheritage.org/sites/default/files/UNIT1_0.pdf**
- UNIT 2 A–1: Science as Inquiry Process: **http://www.sealaskaheritage.org/sites/default/files/UNIT2_0.pdf**
- UNIT 3 B–1: Concepts of Physical Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT3_0.pdf**
- UNIT 4 B–1: Concepts of Physical Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT4_0.pdf**
- UNIT 5 C–1: Concepts of Life Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT5_0.pdf**
- UNIT 6 C–1: Concepts of Life Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT6_0.pdf**
- UNIT 7 D–1: Concepts of Earth Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT7_0.pdf**

- UNIT 8 D–1: Concepts of Earth Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT8_0.pdf**
- UNIT 9 E–1: Science and Technology; F–1: Cultural, Social, Personal Perspectives of Science;
- G–1: History of Science: **http://www.sealaskaheritage.org/sites/default/files/UNIT9_0.pdf**
- UNIT 10 Story of the Frog Crest of the Kiks.ádi of Wrangell: **http://www.sealaskaheritage.org/sites/default/files/UNIT10_1.pdf**
- GLOSSARY: **http://www.sealaskaheritage.org/sites/default/files/glossary_1.pdf**
- Soapberries - Medicinal Use (Helen Watkins - SHI Soapberry Contest with many Elders)
- **https://vimeo.com/71717**
- **89'Nothing but dinner': Seaweed on the plate** - newspaper article about Dolly Garza
- **http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.main** - Subsistence in Alaska - ADF&G
- Village Science- published by Alaska Native Knowledge Network, UAF

Books:

Barnhardt, R. & Kawagley, A.O. (2011). *Alaska Native Education-Views From Within.*
Barnhardt, R. & Kawagley, A.O. (2005). ***Indigenous knowledge systems/Alaska native ways of knowing.***
Barnhardt, R. & Kawagley, A.O. (2011). *Sharing Our Pathways: Native Perspectives on Education in Alaska.*
Biggs, C. (1999). Volume 1 & 2; Wild Edible and Medicinal Plants: Alaska, Canada and Pacific Rainforest. [Resource for medicinal plants]
Garza, D. (2013). Surviving on the Foods and Water from Alaska's Southern Shores. *[Resource for traditional foods]*
Garza, D. (2011). ***Alaska Native Science: A Curriculum Guide.*** Alaska Native Knowledge Network; University of Alaska Fairbanks.
Fortuine, R (1989). Chills And Fever: Health and Disease in the Early History of Alaska. University of Alaska Press.

TRADITIONAL ECOLOGICAL KNOWLEDGE (RESEARCH)

Hunn, Eugene S., Johnson, Darryll, Russell, Priscilla, Thornton, Thomas F Glacier Bay Science Symposium on Huna Seagull Egg Harvest: **https://www.nps.gov/glba/learn/nature/upload/Hunn_etal2007_GullEggHarvests.pdf**
Langdon, Steve Herring Synthesis: Documenting and Modelling Herring Spawning Areas Within Socio-ecological Systems **http://herringsynthesis.research.pdx.edu/final_docs/HerringSynthesisFINAL102710.pdf**
Langdon, Steve (2006) Traditional Knowledge and Harvesting of Salmon by Huna and Hinyaa Tlingit: **http://www.goldbeltheritage.org/wp-content/uploads/2014/03/Fisheries-Unit-Traditional-Knowledge-Final-Report1.pdf**
Nyman, E., & Leer. J. (1993). *Gágiwduł.àt: brought forth to reconfirm: the legacy of a Taku River Tlingit clan.*
Stewart, H. (1995). *Indian Fishing: Early Methods on the Northwest Coast.* University of Washington Press.
Williams, M. (2009). *The Alaska Native Reader: History, Culture, Politics.* Duke University Press Books.
Davis, Neil. (1982) *Alaska Science Nuggets.* University of Alaska Press. [Resource filled with science relevant to Alaska]

Additional Secondary Science Curriculum Resources

General State Resources - Free

Users may need sign-in credentials for these State provided databases.
Contact your school librarian or the State or Public Libraries for information.

1. SLED • SLED, the Statewide Library Electronic Doorway, is an easy-to-use website that connects to high quality Alaska information. Once you leave SLED's main menu, SLED cannot control the information you access.
   - It was developed by the Alaska State Library and Rasmuson Library, University of Alaska Fairbanks, and is currently supported by the Alaska State Library.
2. Science
3. Databases found on SLED
4. Relevant science resources for secondary
   - Brainpop
   - Brainpop Educators

Websites with free resources:

- Alaska Energy Smart: http://www.akenergyefficiency.org/about-us/
- Alaska State Museum: State Museum Hands-On Loan Program
- Bozeman Science: www.bozemanscience.com
- Explore by the seat of your pants: www.exploringbytheseat.com
- Google Earth: www.google.com/earth/
- Juneau City Museum: Tours and Educational Kits
- Mosa Mack Science: https://mosamack.com/
- National Science Foundation, Science 360 videos: https://science360.gov/files/
- NGSS Phenomena: https://www.ngssphenomena.com/
- PhET Online Simulations www.phet.colorado.edu
- Philanthropic media organization: www.explore.org
- Taku River Tlingit Place Names: Trt.geolive.ca
- The Globe Program: www.gobe.gov
- The Nature Conservancy: www.nature.org
- UAF: Geophysical Institute http://www.gi.alaska.edu/
- UC Berkeley Evolution: evolution.berkeley.edu

State of Alaska: Alaska Wildlife Notebook

The Alaska Wildlife Notebook Series is an encyclopedia of Alaska's wildlife, ranging from little brown bats to blue whales. It is available online and in print form, as a perfect-bound, 300-page black and white book. The Alaska Wildlife Notebook series has long been one of the most popular publications of the Alaska Department of Fish and Game. The book was updated in 2008 and the new edition, revised by department biologists, features more than 150 different animals. Included are: big game, small game, furbearers, nongame animals, birds, fish, shellfish, reptile and amphibians. Each chapter offers insights into the life history, reproductions, feeding habits, management and conservation of Alaska's diverse wildlife. Links are also provided throughout the curriculum where appropriate.

Course: Physical Science and Honors Physical Science (required for graduation)	**Grade: 9**
Physical Science is a survey of the laws and theories that govern and allow us to predict the behavior of the world around us. Topics include scientific laws governing motion, energy, waves, electricity and magnetism, light and sound, atoms and molecules, and chemical reactions. Students completing this course will understand the scientific method and achieve basic competency in the skills needed to design, conduct and evaluate experiments. **Honors Physical Science** is comparable to the regular physical science course, but the use of Algebra is fully integrated into the curriculum. Topics are covered at a greater depth and the course moves at a faster pace. Students will be required to apply information learned in class to the completion of a science project.	**Content:** ● Scientific Investigations and Scientific Knowledge ● Scientific Models, Laws, Theories ● Phenomena as a Human Endeavor ● Structure and Properties of Matter ● Types of Interactions ● Chemical Reactions ● Optimizing the Design Solution ● Nuclear Processes ● The Universe and Its Stars ● Energy and Chemical Processes and Everyday Life ● Forces and Motion ● Defining and Delimiting Engineering Problems ● Optimizing the Design Solution ● Definitions of Energy ● Structure and Properties of Matter ● Earth and Solar System ● Electromagnetic Radiation ● The Universe and its Stars ● Definitions of Energy ● Conservation of Energy and Energy Transfer ● Energy in Chemical Processes and Everyday Life ● Defining and Delimiting Engineering Problems ● Relationship between Energy and Forces ● Earth Materials and Systems ● Earth and the Solar System ● Weather and Climate ● Natural Resources ● Developing Possible Solutions ● Wave Properties ● Electromagnetic Radiation ● Energy in the Chemical Processes and Everyday Life ● Information Technologies and Instrumentation
Course Overview: ● Nature of Science ● Matter and Interactions ● Motion & Stability (Forces & Interactions) ● Energy ● Waves and their application in Technology for Information Transfer	

Unit: Nature of Science	**Suggested Anchor Phenomena:** Any discrepant event Water and alcohol with ice cubes	**Standards**	
Pacing: Introductory unit of year, up to one week, and threaded throughout all units	**Essential Questions:** How can we use science to understand our environment /world/universe? • What is science? • What are the ways in which science is accomplished? • What other ways of knowing are there other than western science? o What are the ancient narratives of community and landscape that reveal the process of science? o What do we learn of Tlingit practices of old which are important to current understandings and applications of science today? o How do Tlingit place names reflect scientific knowledge? • What is a theory and what is a law? • What is the importance of modeling and peer review in science? • What is pseudoscience? How can it be used to mislead? • How has the process of science evolved over time?	Alaska Cultural Standards	B1, D5, E3, E4
Content/Topics: • Scientific Investigations • Scientific Knowledge • Scientific Models, Laws, Theories • Phenomena as a Human Endeavor		Alaska ELA Standards	RI.9-10.1, RI.9-10.7, RI.9-10.8, W9-10.1, W9-10.2, W9-10.8, W9-10.9
		Alaska Math Standards	MP 1-5
		Alaska Science Standards	SA1, SA1.1, SA1.2, SA2, SA2.1, SA3, SA3.1, SE2, SG1-4
		ISTE	3, 4, 5

Alaska Cultural Standard to Emphasize	**Community Contacts**
E. Culturally-knowledge students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. **3**: Demonstrate and understand of the relationship between worldview and the way knowledge is formed and used.	• **STEM Database Community Resources**

NGSS		Suggested Activities	Cultural & Place-Based Connections
Nature of Science: Performance Expectations (PEs)	**Nature of Science: Major Themes**		
NGSS Appendix H: Design and revise a basic scientific investigation to test a hypothesis regarding an explanation to an observed phenomenon. **Clarification Statement:** Designs and implementation should include a testable hypothesis, quantifiable data, adequate controls for repeatability, and proper data analysis and conclusion. The overall significance of the findings should be presented in context. **Assessment Boundary:** Assessment should not be restricted to any one specific "scientific method." Assessments should emphasize the need for peer review in science and the difference between science and other ways of knowing.	**NGSS Appendix H**: High School grade level themes for understanding the nature of science ● Scientific Investigations Use a Variety of Methods ● Scientific Knowledge is Based on Empirical Evidence ● Scientific Knowledge is Open to Revisions in Light of New Evidence ● Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena ○ Theories and laws provide explanations in science but theories do not with time become laws or facts ○ A scientific theory is substantiated by some aspect of natural world, based on a body of facts that has repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted ● Science is a Way of Knowing ● Scientific Knowledge Assumes an Order and Consistency in Natural Systems ● Science is a Human Endeavor ● Science Addresses Questions About the Natural and Material World	**Activities:** ● Incorporate any experiment; make it inquiry by doing the classic experiment, then have students investigate their own questions. For example, the sponge animals linked below can be done first with growth over time at different water temperatures. Students brainstorm a list of variables that affect growth rate, conduct experiments, make claims, and support with evidence and reasoning. ● **Sponge Capsules** (this activity also in Biology) ● Nature of Science Lessons ● The Biology Corner (Science Methods) .	**Tlingit World View:** Observe, Listen, Test, Perfect. Wooch.een: How do these work together? Affect the other? In every action is a reaction: Wooch Yaxhdati: Balance; Yan kásanóo: Prove it! **Technological Expertise & Indigenous Knowledge:** Why did Tlingit ancestors do it this way, and why is it important today? Examples of learning and creating from scientific process: Fish traps, tidal salmon traps, medicinal plants, tool making, traditional clam beds, canoe building, food preservation, watertight baskets. ● Montana Creek Fish Trap (at City Museum) ● Codes of ethics for scientists working with people and environment or marine life. [Arctic Council] ● Acknowledgement to studied creatures: Tlingit people may explain to the organisms what they are doing to it and say. **"***I een áwé yei jigaxh tunei, i daat át haa tuwasigoo át wutuskoowú***.** *Gunalchéesh!***"** We are going to work with you. We want to learn about you! Thank you!"

			<u>Thomas Thornton's Cultural Atlas</u> illustrates scientific observation: Tlingit place names are biological and/or topographic. Place names describe the land/ecology and provide a map for navigation and historical record of geography, ecology, biology, hydrology and land ownership. ● **Activity:** Find example of local place name which communicates scientific knowledge/science process skills (observation, biology, topography, hydrology) ***Haa Shuká*, Our Ancestors: Tlingit Oral Narratives** by Richard and Nora Dauenhauer**:** ● *Naatislanéi*: Oceanography, Dendrology, Hydrology, Medical Science. ● *Wooshkáduhaa:* Basket Bay: Oceanography, Science of Resources, Geology (water caves), Marine Science (place where shark sleep). (Study of Basket Bay by Cyril George, Sr.) **Activities or Units Involving Traditional Ways of Knowing:** ● <u>Village Science</u> - by Alan Dick: Camps, Fairs and Experiments ● Modern v. traditional diaper experiment - sphagnum moss, cloth, and diapers. ● Curing, fermenting, brining, drying, smoking to prevent bacterial and fungus growth.

JSD High School Science Curriculum

Unit/Instructional Focus: Matter and Interactions	**Suggested Anchor Phenomena:** ● Candle Trick ● Why do ponds in the Mendenhall Valley develop a reddish tinge?	**Standards**	
Pacing: one quarter		Alaska Cultural Standards	B1, B2, E2, E3, E4
Content/Topics: ● Structure and Properties of Matter ● Types of Interactions ● Chemical Reactions ● Optimizing the Design Solution ● Nuclear Processes ● The Universe and Its Stars ● Energy and Chemical Processes and Everyday Life	**Essential Questions:** ● How can you explain the things you can't see? ● How can one explain the structure, properties and interactions of matter? ● How do particles combine to form the variety of matter on observes? ● How do substances combine or change (react} to make new substances? ● How does one characterize and explain these reactions and make predictions about them? ● What forces hold nuclei together and mediate nuclear processes?	Alaska ELA Standards	RST.9-10.7, WHST.9-12.2 - WHST.9-12.5, RST.11-12.1, WHST.11-12.7, WHST.11-12.8, WHST.11-12.9, SL.11-12.4
		Alaska Math Standards	N-Q.1, N-Q.2, N-Q.3, MP2, MP4, A-CED.2, A-CED.4 , A-SSE.1
		Alaska Science Standards	SB1, SB3, SB3.1-3, SD4.1, SE1, SF1, SG1
		ISTE	1c, 3, 5, 7

Alaska Cultural Standards to Emphasize	**Community Contacts**
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. 4. Demonstrate how ideas and concepts from one's knowledge system relate to those derived from other knowledge systems.	● **STEM Database Community Resources** ● **NOAA/NMFS:** Chemist 789-6000; National Weather Service**:** Meteorologist, 790-6800 ● **UAS:** Chemistry Professor, 796-6580; Physics and Math Professors, 796-6200

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-PS1-1: 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. **Clarification Statement:** Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen (*Does not include Redox Reactions). **Assessment Boundary:** Limited to main group elements. Does not include quantitative understanding of ionization energy beyond relative trends. **Cross-Cutting Concepts:** Patterns (HS-PS1-1) **Science & Engineering Practices**: Developing and Using Models (HS-PS1-1)	**PS1.A: Structure and Properties of Matter:** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) **PS2.B: Types of Interactions:** Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.(HS-PS1-1)	**NGSS Activity Links:** ● Graphing the Periodic Table ● PhET Build an Atom **Other Activities:** ● Create a periodic table ● PhET Introduction to ionic and covalent bonds ● Interactive periodic table ● Lab: Baking Soda and Acid ● Lab: Salts and Solubility ● Lab: pH Scale **Honors Activities:** ● Empirical Formula of Zinc Chloride ● Predicting precipitates lab	**Tlingit World View:** "Ach áwé hél dutieemi at atxh sitee:" That which is matter, you don't see what makes up matter: spirit within defines the content ● Discuss indigenous uses, properties of copper, oxidation of copper, where it was traded from in Alaska, and how it is processed. ● Hardening of copper and annealing, Tináa. ● Invite a guest carver of Tlingit jewelry to talk about copper and how it is processed and hammered out. ● Tlingit dagger made from a meteorite. Tlingit dagger points to hidden history] ● Aurora Borealis is an interaction between charged particles in Earth's upper atmosphere.

HS-PS1-2: 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. **Clarification Statement:** Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen. **Assessment Boundary:** Assessment is limited to chemical reactions involving main group elements and combustion reactions. **Cross-Cutting Concepts:** Patterns (HS-PS1-2) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-PS1-2)	**PS1.A: Structure and Properties of Matter:** The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2) *(*Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.) **PS1.B: Chemical Reactions:** The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2) **AK Science Standard:** (9) SB3.1 Recognizing that a chemical reaction has taken place	**Other Activities:** ● Why do chemical reactions occur? ● "Tidal Vision USA" (patented unique process in making wallets and from crab and shrimp cells - chitin and chitosan) **Honors Activities:** ● Calculating pH using logarithms	● Chemical reactions in food preservation techniques ensured survival/food during winter, i.e.: dried fish/meat. ● Tanning seal hides with urine - a chemical reaction that preserved the hide so it could be used in many ways, i.e.: clothing etc. ● Copper**:** discuss indigenous uses, properties, oxidation, how processed; where it was traded in Alaska ○ Urine and copper mixed together make blue color ● How gold is created and extracted; environmental testing ● Ron's Apothecary: the use of plant compounds to make medicinal products ● Ocean acidification ● CBJ Water Purification Plant ● Chemical reactions in cooking ● CBJ swimming pool sanitation ● Rusting
HONORS PHYSICIAL SCIENCE			
HS-PS1-3: 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.	**PS1.A: Structure and Properties of Matter:** The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3)	**NGSS Activity Links:** ● Evaporation of Alcohols ● Freezing Balloons	● "Goonseek" traditional placer mining, making bullets and other weaponry, and artistic ornaments ● Hardening of copper and annealing, *Tináa*.

Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension. **Assessment Boundary:** Does not include Raoult's law calculations of vapor pressure. **Cross-Cutting Concepts:** Patterns (HS-PS1-3) **Science & Engineering Practices:** Planning and Carrying Out Investigations (HS-PS1-3)	**PS2.B: Types of Interactions:** Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary to HS-PS1-3)		● The practice of filling a canoe with water, heating it with hot rocks, and taking advantage of the property of water of high heat capacity to soften the wood. ● Steam turbines ● Cruise ships plug into onshore steam plant, heated by electricity, to run turbines onboard. Juneau sells them our steam so that they can make clean electricity.
HS-PS1-5: 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. **Clarification Statement:** Emphasis is on student reasoning that focuses on the number and	**PS1.B: Chemical Reactions:** Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-5)	**NGSS Activity Links:** ● Chemical Reactions and Stoichiometry **Other Activities:** ● Lab: Decompose water by electrolysis, noting volumes and ratios of products. Lab: Baking Soda and Acid. ● Lab: Salts and Solubility. ● Lab: pH Scale.	● Urine and copper mixed together make blue color ● Acid based reactions in tanning solutions and dehairing solutions ● Acid rock drainage in local mines: The interaction of acidic terrestrial water and rain with the residual metal in mine tailings and/or Sulphur dissolve the metals which can leach into

energy of collisions between molecules. **Assessment Boundary:** Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature. **Cross-Cutting Concepts:** Patterns (HS-PS1-5) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-PS1-5)	**AK Science Standard:** (9) SB3.3 Recognizing that atoms emit and absorb electromagnetic radiation	● Lab: Empirical Formula of Zinc Chloride. ● Collision Theory Gizmo: Explorelearning.com **Honors Activities:** ● Chemical Reaction Rates: Inquiry on Affecting Factors	watersheds. (Tulsequah Chief Mine on the Taku River) ● Toxic Metals Contaminate Hawk Inlet ● "Irreparable Harm": 20 min documentary (AK Conservation Council) makes the case that run-off from Green's Creek mine is altering chemical make-up of Hawk Inlet, impacting subsistence food.
HONORS PHYSICAL SCIENCE			
HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. **Clarification Statement:** Emphasis is on using mathematical ideas to communicate proportional relationships between masses of atoms in the reactants and the products, and translation of these relationships to the macroscopic scale using the mole as the	**PS1.B: Chemical Reactions:** The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-7)	**NGSS Activity Links:** ● Conservation of mass lab **Other Activities:** ● Online conservation of mass ● PhET Reactions, products and leftovers ● Formal Lab Report ● Lab: Lithium v. Sodium in water ● Lab: Balancing Chemical Equations ● Lab: Reactants, Products, Leftovers ● Candy Compounds	● Local water quality testing (DEC, Juneau Water Dept., Wastewater Treatment, Cruise ship bilge testing, mine monitoring….)

conversion from atomic to macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques. **Assessment Boundary:** Does not include complex chemical reactions. **Cross-Cutting Concepts:** Energy and Matter (HS-PS1-7) **Connections to Nature of Science:** Scientific Knowledge Assumes an Order and Consistency in Natural Systems (HS-PS1-7) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-PS1-7)			
HS-PS1-8: 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. **Clarification Statement:** Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.	**PS1.C: Nuclear Processes:** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HS-PS1-8) **AK Science Standard:** (11) SB3.2 Researching applications of nuclear reactions in which a small amount of matter is	**NGSS Activity Links:** ● Fusion Reactions: How and Where are Elements Created? **Other Activities:** ● nuclearscienceweek.org (Lots of good nuclear science related lessons) ● PhET: Alpha Decay ● Video: Chernobyl: A Taste of Wormwood ● Video: NOVA special Back to Chernobyl	● Solar energy ● Radioactive isotopes used: ○ in medical technologies (imaging processing, radioactive tracers…) ○ Inspection of airline luggage for explosives

Assessment Boundary: Does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays. **Cross-Cutting Concepts:** Energy and Matter (HS-PS1-8) **Science & Engineering Practices:** Developing and Using Models (HS-PS1-8)	converted directly into a huge amount of energy (i.e., $E=MC^2$)	**Honors Activities:** ● Design an electric power system for a small community with a given set of environmental conditions, resources, population, and power needs.	
HS-ESS1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation. **Clarification Statement:** Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries. **Assessment Boundary:** Does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.	**ESS1.A: The Universe and Its Stars:** The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) **PS3.D: Energy in Chemical Processes and Everyday Life:** Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. *(*secondary to HS-ESS1-1) **AK Science Standard:** (9) SD4.1 Recognizing that a star changes over time	**NGSS Activity Links:** ● Energy and Stellar evolution **Honors Activities:** ● Space weather NASA	● Box of Daylight story ● Field trip to Marie Drake Planetarium ● Aurora Borealis (space.com)

Cross-Cutting Concepts: Scale, Proportion, and Quantity (HS-ESS1-1) **Science & Engineering Practices:** Developing and Using Models (HS-ESS1-1)			
HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements. **Clarification Statement:** Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime. **Assessment Boundary:** Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed. **Cross-Cutting Concepts** Energy and Matter (HS-ESS1-3) **Science & Engineering Practices:** Obtaining, Evaluating, and Communicating Information (HS-ESS1-3)	**ESS1.A: The Universe and Its Stars:** The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-3) Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-3)	**NGSS Activity Links:** ● What tools are used to identify elements? ● What importance do X-rays have to astronomy? **Honors Activities:** ● Gas Tubes and Light Spectroscopy ● Nucleosynthesis and the mass of stars	● Tlingit dagger made from a meteorite that was mostly iron with some nickel. Tlingit dagger points to hidden history] ● *Haa Shuká,* Our Ancestors: Tlingit Oral Narratives by Richard and Nora Dauenhauer: *Kaax' achgo'ok*- story of star gazers and navigation ● Navigation with stars ● Field trip to Marie Drake Planetarium ● Observe stars on a clear night

Unit/Instructional Focus: Motion & Stability (Forces & Interactions)	**Suggested Anchor Phenomena:** ● Sledding Inertia **Essential Questions:** ● How can you use graphical, algebraic, and physical models to describe different aspects of motion? ● What information can I use and manipulate to determine where an object will land? ● How can one explain and predict interactions between objects and within systems of objects? ● How can one explain and predict interactions between objects and within systems of objects? ● How can one predict an object's continued motion, change in motion, or stability? ● What underlying forces explain the variety of interactions observed? ● Why are some physical systems more stable than others?	**Standards**	
Pacing: one quarter		Alaska Cultural Standards	B2, E4, E8
Content/Topics: ● Speed, Velocity, and Acceleration ● Forces and Motion ● Defining and Delimiting Engineering Problems ● Optimizing the Design Solution ● Types of Interactions ● Definitions of Energy ● Structure and Properties of Matter ● Earth and Solar System ● Electromagnetic Radiation ● The Universe and its Stars		Alaska ELA Standards	RST.11-12.1, RST.11-12.7, WHST.9-12.2, WHST.11-12.7-9,
		Alaska Math Standards	A-CED.1, A-CED.2, A-CED.4, A-SSE.1, A-SSE.3, F-IF.7, N-Q.1, N-Q.2, N-Q.3, S-ID.1, MP.2, MP.4
		Alaska Science Standards	SD3, SD3.1, 3.2, SD4.1, SE1, SE2, SF1, SG1, SG3
		ISTE	1c, 3, 4, 5, 7

Alaska Cultural Standards to Emphasize	**Community Contacts**
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. 4. Demonstrate how ideas and concepts from one's knowledge system relate to those derived from other knowledge systems.	● **STEM Database Community Resources** ● **AELP:** Hydro projects, 463-6303 Alec.mesdag@aelp.com ● **Hecla/Greens Creek**, 789-8100 and **Coeur/Kensington**, 523-3300, Geologists ● **NOAA/NMFS:** Facilities Manager, 789-6632 ● STEM Robotics coaches ● **UAS:** Physics and Math Professors, 796-6200

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-PS2-1: 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. **Clarification Statement:** Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. **Assessment Boundary:** Limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. **Cross-Cutting Concepts:** Cause and Effect (HS-PS2-1) **Science & Engineering Practices:** Analyzing and Interpreting Data (HS-PS2-1) **Connections to Nature of Science:** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS-PS2-1), (HS-PS2-1)	**PS2.A: Forces and Motion:** Newton's second law accurately predicts changes in the motion of macroscopic objects.(HS-PS2-1) **AK Science Standard:** (8) SB4.1 Demonstrating and explaining circular motion	**NGSS Activity Links:** ● Newton's 2nd law inquiry lab ● Heavy vs. Light Falling Objects ● Feather and Bowling Ball Drop **Other Activities:** ● Figuring out friction ● Conduct races with cars rolling down ramp ● Conduct Balloon races ● Design apparatus to protect an egg in free fall **Honors Activities** ● Dynamics cart, mass and velocity ● Vernier: Investigate collisions between carts ● Vernier: use sonic rangers to match position vs. time; velocity vs. time graph	● Ways of moving a *kootéeyaa* (totem pole) ● **Canoe design**: ocean v freshwater - materials for buoyancy (NPR article-type of wood for canoes that floated at the right level in the water) ● The Tlingit Canoe (Goldbelt Heritage Foundation): How does the design of the canoe front help the canoe break through the water? How should the designs be different in the ocean versus in rivers? ● **Taku wind sails** (Photo of boats in the Archives & stories connecting trade winds); wind and momentum ● **Two Forces Colliding**: Tommy Joseph Explores Tlingit Armor Making - heating the metal and shaping vs Tlingit using wood armor; Does wet armor work better than dry? ● **Friction**: Lighting fires with a match versus a bow; friction for making petroglyph ● Invite Goldbelt Tram Engineer to talk about tram system ● Southeast Alaska Carnival ● Eaglecrest chairlift, snow sports ● Mountain biking ● Ice-skating

HS-PS2-2: 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. **Clarification Statement:** Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. **Assessment Boundary:** Limited to systems of two macroscopic bodies moving in one dimension. **Cross-Cutting Concepts** Systems and System Models (HS-PS2-2) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-PS2-2)	**PS2.A: Forces and Motion:** Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2) If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2)	**NGSS Activity Links:** ● PhET Collision Labs: Introduction to One Dimensional Collisions ● Relating Formulas to Common Sense: "Oomph" ● Momentum Thinking Problems ● Egg Drop and Impulse **Honors Activities:** ● PhET 2D collisions lab ● Momentum, energy and collisions lab	● Juneau Pipeline Skateboard Park ● Pendulums ● Swing sets ● Bowling at Taku Lanes
HONORS PHYSICAL SCIENCE			
HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **Clarification Statement:** Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.	**PS2.B: Types of Interactions:** Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.(HS-PS2-4) Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.	**NGSS Activity Links:** ● Modeling with PhET Gravity Lab ● Model Building Activity of Electrostatics **Other Activities:** ● The Physics of the Geosphere ● Gravitation	

Assessment Boundary: Assessment is limited to systems with two objects. **Cross-Cutting Concepts:** Patterns (HS-PS2-4) **Science & Engineering Practices** Using Mathematics and Computational Thinking (HS-PS2-4) **Connections to Nature of Science:** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS-PS2-4), (HS-PS2-4)	Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electri fields. (HS-PS2-4)		
HS-PS2-5: 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. **Clarification Statement:** none **Assessment Boundary:** Assessment is limited to designing and conducting investigations with provided materials and tools. **Cross-Cutting Concepts:** Cause and Effect (HS-PS2-5) **Science & Engineering Practices:** Planning and Carrying Out Investigations (HS-PS2-5)	**PS2.B: Types of Interactions:** Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-5) **PS3.A: Definitions of Energy:** "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. *(*secondary to HS-PS2-5)	**NGSS Activity Links:** ● Investigating the Strength of the Magnetic Field within a Coil of Wire ● Electromagnetism Experiment **Honors Activities:** ● Electromagnetic experiments ● Build a series circuit ● Build an electromagnet	● Strong Aurora Fields in Alaska Disrupt Magnetic Field ● Geomagnetic Field Monitoring at Barrow

HONORS PHYSICAL SCIENCE			
HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. **Clarification Statement:** Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons. **Assessment Boundary:** Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus. **Cross-Cutting Concepts:** Scale, Proportion, and Quantity (HS-ESS1-4) **Connections to Engineering, Technology, and Applications of Science**: Interdependence of Science, Engineering, and Technology (HS-ESS1-4) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-ESS1-4)	**ESS1.B: Earth and the Solar System:** Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) **AK Science Standards:** (10) SD4.1 Recognizing phenomena in the universe (i.e., black holes, nebula) (9) SD3.1 Recognizing the effect of the moon and tides (11) SD3.2 Exploring cause and effects related to phenomenon (e.g. the aurora, solar wind, Coriolis Effects)	**NGSS Activity Links:** ● Going full circle on gravity and orbits ● Gravity and Orbits **Other Activities:** ● Tides ● PhET Gravity and Orbits ● Orbital Motion	**Tlingit Moon and Tide** excerpts (Dolly Garza) ● Reflecting the tie between people and the sea, Cyrus E. Peck Sr. explains that the word Tlingit, commonly defined as "the people," really means "the Tides People" because Tlin (pronounced lein) means tides in Tlingit and git is Tsimshian for human being (Peck 1975). ● Tlingit people get much of their food from the intertidal area and from the ocean.: "When the tide is out you get your food from the beach; when the tide is in you get your food from the woods." ● *Géesh Daax woogoodi Yéil/*Raven Who Went Down Along the Bull Kelp: p. 34-35

HS-ESS1-2: Construct an explanation of Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, & composition of matter in universe. **Clarification Statement:** Emphasis is on astronomical evidence of the redshift of light from galaxies as indication that universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, & observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by Big Bang theory (3/4 hydrogen and 1/4 helium). **Assessment Boundary:** none **Cross-Cutting Concepts:** Energy and Matter (HS-ESS1-2) **Connections to Engineering, Technology, and Applications of Science:** Interdependence of Science, Engineering, and Technology (HS-ESS1-2) **Connections to Nature of Science:** Scientific Knowledge Assumes an Order and Consistency in Natural Systems (HS-ESS1-2), (HS-ESS1-2)	**PS4.B: Electromagnetic Radiation:** Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2) **ESS1.A: The Universe and Its Stars:** The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and distances from Earth. (HS-ESS1-2) The Big Bang theory is supported by observations of distant galaxies receding from our own, measured composition of stars & non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2)	**NGSS Activity Links:** ● The Big Bang ● Different Big Bang theory lesson **Honors Activities**: ● Infrared Astronomy ● Light Spectroscopy Lab	● Tlingit creation narratives ● Photographing the universe: Indie Alaska - video ● Neon signs (color is due to the combination of elements in the gas) ● Field trip to Marie Drake Planetarium

Science & Engineering Practices: Constructing Explanations and Designing Solutions (HS-ESS1-2) **Connections to Nature of Science:** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS-ESS1-2)	**AK Science Standards:** (9) SB2.2 Recognizing simple electrical circuits (10) SB4.1 Recognizing that when one thing exerts a force on another, an equal amount of force exerted back on it (10) SB4.2 Explaining that different kinds of materials respond to electric and magnetic forces (i.e. conductors, insulators, magnetic , and non-magnetic materials)		

Unit/Instructional Focus: Energy	**Suggested Anchor Phenomena:** ● Ted Steven NOAA Heat Pump **Essential Questions:** Why do things have energy? How are able to extract useful energy out of a system? ● How is energy transferred and conserved? ● What is energy? ● What is meant by conservation of energy? How is energy transferred between objects or systems? ● How are forces related to energy? ● How do food and fuel provide energy? If energy is conserved, why do people say it is produced or used?	**Standards**	
Pacing: one quarter		Alaska Cultural Standards	B2, E1, E4, E8
Content/Topics: ● Definitions of Energy ● Conservation of Energy and Energy Transfer ● Energy in Chemical Processes and Everyday Life ● Defining and Delimiting Engineering Problems ● Relationship between Energy and Forces ● Earth Materials and Systems ● Earth and the Solar System ● Weather and Climate ● Natural Resources ● Developing Possible Solutions		Alaska ELA Standards	SL.11-12.5, RST.11-12.1, RST.11-12.8 WHST.11-12.7, WHST.11-12.8 WHST.11-12.9
		Alaska Math Standards	N-Q.1,N-Q.2, N-Q.3, MP.2, MP.4
		Alaska Science Standards	SB2, SB2.1, S.B.2.2, SB4, SB.4.1, SB.4.2, SE1, SF1, SG1, SG3
		ISTE	1c, 3, 4, 5, 7

Alaska Cultural Standards to Emphasize

E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them.

1. Recognize and build upon the interrelationships that exist among the spiritual, natural and human realms in the world around them, as reflected in their own cultural traditions and beliefs as well as those of others.

Community Contacts

- **STEM Database Community Resources**
- **AELP:** Director of Energy Service, Hydro projects, 463-6303 Alec.mesdag@aelp.com
- **AK Dept. of Transportation:** Engineers, 465-1227
- **Juneau Amateur Radio Club**: KL7JRC@gmail.com, http://www.juneauamateurradioclub.com
- **Juneau Electric Vehicle Association:** https://juneauev.org
- **Juneau Makerspace:** juneaumakerspace@gmail.com
- **NOAA:** Facilities Manager, heating system 789-6632; Quantitative Fisheries Biologists, 789-6000
- **REAP:** Energy Education Director, education@realaska.org, 907-929-7770 x6
- **Transparent Devices LLC:** general physics and engineering; great source of scientific classroom supplies 957-1014; jmhousley@aol.com
- **US Geological Survey:** Biology: 364-1576, Water: 586-7216, 888-

	ASK-USGS, askusgs@usgs.gov

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. **Clarification Statement:** Emphasis is on explaining the meaning of mathematical expressions used in the model. **Assessment Boundary:** Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields. **Cross-Cutting Concepts:** Systems and System Models (HS-PS3-1) **Connections to Nature of Science:** Scientific Knowledge Assumes an Order and Consistency in Natural Systems (HS-PS3-1)	**PS3.A: Definitions of Energy:** Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1) **PS3.B: Conservation of Energy and Energy Transfer:** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1) Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept	**NGSS Activity Links:** ● Conservation of Energy (Lab 3) ● Physics 250 Laboratory: Conservation of Energy ● Conservation of Energy Using Hot Wheels **Other Activities:** ● Calculate output and input work and set efficiency using multiple pulley arrangements to lift weights ● Use a spring scale to compare the force needed to pull an object up a ramp and to lift the same height. Calculate efficiency. ● Energy transfer from dams ● Internal Combustion engines ● Fossil Fuels ● Hydroelectric power ● Air Source / ground source ● Heat pumps ● Home Building Efficiency in Heating **Honors Activities** ● Construct Pendulums and Conversion ● Thermochemistry Lab: Energy in a candle	● **Traditional Heat transfer** from rocks to boiling water vs heat transfer directly to cooking pot. Pit cooking, hot rocks in baskets to make water boil (trial and error of which rocks work best; some elders have had a cooking rock that was passed through generations (it was the size of an egg). ● AK Energy Smart Curriculum: Energy Efficiency and Alaska Native Dwellings ● Snettisham Hydroelectric Power Plant ● Coast Guard: downtown wind turbine/solar ● JEDC Economic Cluster: Renewable Energy activities ● Juneau's combination of precipitation and high elevation makes Juneau an ideal location for hydropower. Hydropower harnesses the force or energy of moving water and converts this kinetic (moving) energy into mechanical (machine) energy. ● Juneau-Douglas City Museum: Juneau's History of Hydropower (Salmon Creek Dam) ● ChenaPower- geothermal

Science & Engineering Practices: Using Mathematics and Computational Thinking (HS-PS3-1)	of conservation of energy to be used to predict and describe system behavior.(HS-PS3-1) The availability of energy limits what can occur in any system. (HS-PS3-1) **AK Science Standard:** (11) SB2.1 Demonstrating energy (e.g., nuclear, electromagnetic, chemical, mechanical, thermal) transfers and transformations by comparing useful energy in total (entropy)		● Walter Soboleff Building is was designed to meet the U.S. Green Building Council's gold standard for energy efficiency. The wood pellets come mostly from the Sealaska Corp. land on Prince of Wales Island. Rosita Worl says that's part of keeping the core cultural values in the design.
HS-PS3-2: 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). **Clarification Statement:** Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.	**PS3.A: Definitions of Energy:** Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-2) At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of	**NGSS Activity Links:** ● Conservation of Energy (Lab 3) ● Work and Energy Thinking Problems **Honors Activities:** ● Inclined to Conserve for PASSPORT Systems	**Oral Narrative:** *Shangukeidí-* Lightning Story and how we learned about electricity- (invite David Katzeek to tell story) ● Thunderbird Screen at Alaska State Museum ● Tlingit burned hooligan oil which transferred chemical energy into heat energy ● Bowling at Taku Lanes ● Burning wood in a wood stove or fireplace ● Hypothermia-State of AK Cold Injuries Guideline

Assessment Boundary: none **Cross-Cutting Concepts:** Energy and Matter (HS-PS3-2) **Science & Engineering Practices:** Developing and Using Models (HS-PS3-2)	particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)		
HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. **Clarification Statement:** Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. **Assessment Boundary:** Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.	**PS3.A: Definitions of Energy:** At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-3) **PS3.D: Energy in Chemical Processes and Everyday Life:** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.(HS-PS3-3)	**NGSS Activity Links:** ● Lesson and Lab Activity with Photovoltaic Cells ● Concentrated Solar Power ● Solar Water Heater **Honors Activities:** ● Emphasis on 3D modeling "makerspace" ● Build and test solar ovens	● How Raven Brought Fire ● Alaska Center for Energy and Power

Cross-Cutting Concepts: Energy and Matter (HS-PS3-3) **Connections to Engineering, Technology, and Applications of Science**: Influence of Science, Engineering, and Technology on Society and the Natural World (HS-PS3-3) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-PS3-3)	**ETS1.A: Defining and Delimiting Engineering Problems:** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS3-3)		
HONORS PHYSICAL SCIENCE			
HS-PS3-4: 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). **Clarification Statement:** Emphasis is on analyzing data from student investigations and using mathematical thinking to describe energy changes both quantitatively and conceptually. Examples: include mixing liquids at different initial temperatures or	**PS3.B: Conservation of Energy and Energy Transfer:** Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-4) Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhil objects hotter than their surrounding environment cool down). (HS-PS3-4) **PS3.D: Energy in Chemical Processes and Everyday Life:** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to	**NGSS Activity Links:** ● Physics Calorimetry Lab **Other Activities:** ● Peanut calorimetry ● AK Energy Smart Lesson: Diesel and Gasoline: Energy Heavyweights	● Tlingit burned hooligan oil which transferred chemical energy into heat energy ● Plan an investigation using a Bentwood box to determine relationship between number of heated rocks and water temperature. Can it boil? ● Burning wood in a wood stove or fireplace ● Hypothermia-State of AK Cold Injuries Guideline

adding objects at different temperatures to water. **Assessment Boundary:** Assessment is limited to investigations based on materials and tools provided. **Cross-Cutting Concepts:** Systems and System Models (HS-PS3-4) **Science & Engineering Practices:** Planning and Carrying Out Investigations (HS-PS3-4)	thermal energy in the surrounding environment. (HS-PS3-4)		
HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. **Clarification Statement:** Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. **Assessment Boundary:** Limited to systems containing two objects. **Cross-Cutting Concepts:** Cause and Effect (HS-PS3-5) **Science & Engineering**	**PS3.C: Relationship Between Energy and Forces**: When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)	**NGSS Activity Links:** ● Electric motor boats ● Interactions of charges ● Right Hand Rule **Honors Activities:** ● PhET Faraday's Law ● Magnetic fields in slinkys, coils and permanent magnets	Electromagnetic pump as opposed to a direct-coupled pump, used in home heating systems.

Practices: Developing and Using Models (HS-PS3-5)			
HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. **Clarification Statement:** Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition. **Assessment Boundary:** Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution. **Cross-Cutting Concepts:** Cause and Effect (HS-ESS2-4) **Science & Engineering Practices:** Developing and Using Models (HS-ESS2-4) **Connections to Nature of**	**ESS1.B: Earth and the Solar System:** Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4) **ESS2.A: Earth Materials and Systems:** The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4) **ESS2.D: Weather and Climate:** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land	**NGSS Activity Links:** ● Climate and Water ● NOAA Climate change lessons **Other Activities:** ● The Ocean and Climate: Heat Redistribution **Honors Activities:** ● Aviation infrastructure ● Comparing IPCC Scenarios interactive	● History, science, and the year of 2 winters (article from the Yukon that relates to a volcanic eruption) ● Vocabulary: *Tax´* (volcano) ● *Haa Shuká*, Our Ancestors: Tlingit Oral Narratives: Glacier Bay History by Richard and Nora Dauenhauer ● The Legacy of the Taku River Clan by Elizabeth Nyman and Jeff Leer: *Khudzitiyi Át Khulagàwu/*The Battle of the Giants and *T'àkhu Yanyèdf Dàt Shkalnik/*The Taku Story: Windpipe references weather pressure differential between Interior and ocean which produces the Taku Winds, *´Xoon, T´aaku* ● Local evidence of climate change at Mendenhall Glacier; bogs, near- shore and on-shore sediment samples, pollen found in sediment layers at bottom of ponds, lakes, oceans ● Climate Change: Predicted Impacts on Juneau (2007 report) ● Terminus Behavior of Juneau Icefield Glaciers (Maynard Miller research) ● Mendenhall Glacier time-lapse

Science: Science Knowledge Is Based on Empirical Evidence (HS-ESS2-4)	systems, and this energy's re-radiation into space. (HS-ESS2-4) Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4)		
HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. **Clarification Statement:** Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen. **Assessment Boundary:** none **Connections to Engineering, Technology, and Applications of Science**: Influence of Science, Engineering, and Technology on Society and the Natural World (HS-ESS3-2), (HS-ESS3-2)	**ESS3.A: Natural Resources:** All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2) **ETS1.B: Developing Possible Solutions:** When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (secondary to HS-ESS3-2)	**NGSS Activity Links:** ● Bioenergy Farm Game **AK Energy Smart Lessons:** ● Designing Your Energy Efficient House Part 1: The Heat Loss Equation ● Designing Your Energy Efficient House Part 2: Modeling Your Energy Efficient House ● My Daily Energy Use **Honors Activities:** ● Mineral resources cost benefit analysis ● AK Energy Smart Lessons: ○ Alaska Energy Resource Map ○ Community Waste: An Energy Debate ○ Mapping Our Stuff	● R values in house logs relative to purpose; as in higher R values for housing construction and location of fire pits and smoke stacks; larger house logs for large R values ● North Slope oil and gas: exploration and production

Connections to Nature of Science: Science Addresses Questions About the Natural and Material World (HS-ESS3-2), (HS-ESS3-2), (HS-ESS3-2) **Science & Engineering Practices:** Engaging in Argument from Evidence (HS-ESS3-2)			

Unit/Instructional Focus: Waves and their application in Technology for Information Transfer	**Suggested Anchor Phenomena:** ● Northern Lights ● How does a cell phone work? **Essential Questions:** ● How can you use a wave to communicate? ● How are waves used to transfer energy and information? ● What are the characteristic properties and behaviors of waves? ● What is light? How can one explain the varied effects that involve light? ● What other forms of electromagnetic radiation are there? ● How are instruments that transmit and detect waves used to expand human senses?	**Standards**	
Pacing: one quarter		Alaska Cultural Standards	B2, E1, E4, E8
Content/Topics: ● Wave Properties ● Electromagnetic Radiation ● Energy in the Chemical Processes and Everyday Life ● Information Technologies and Instrumentation		Alaska ELA Standards	RST.9-10.8, WHST.9-12.2 RST.11-12.1, RST.11-12.7, RST.11-12.8, WHST.11-12.8
		Alaska Math Standards	A-CED.4, A-SSE.1 - A-SSE.3, MP.2, MP.4
		Alaska Science Standards	SB3, (10) SB3.3 ,SB4, SB4.1 (8), SB4.3 (6,7,9), SA1, SE1, SE2, SF1, SG1, SG2
		ISTE	1c, 3, 4, 5, 7

Alaska Cultural Standard to Emphasize	**Community Contacts**
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. 8. Identify and appreciate who they are and their place in the world.	● **STEM Database Community Resources** ● **AK Dept. Transportation:** Engineers, 465-6941 ● **UAS:** Physics and Math Professors, 796-6200; Computer Science Professors, 796-6349

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
MS-PS4-1: Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. **Clarification Statement:** Emphasis is on describing waves with both qualitative and quantitative thinking. **Assessment Boundary:** Assessment does not include electromagnetic waves and is limited to standard repeating waves. **Cross-Cutting Concepts:** Patterns (MS-PS4-1) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (MS-PS4-1) **Connections to Nature of Science**: Science Knowledge Is Based on Empirical Evidence (MS-PS4-1)	**PS4.A: Wave Properties:** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) **AK Science Standard:** SB4.3 Describing the characteristics of a wave (i.e. amplitude, wavelength and frequency)	**Activities:** ● PhET Fourier-making waves ● Speed of a wave unit ● PhET Waves on a string ● PhET Sound ● PhET Simplified MRI **Honors Activities** ● PhET Radio waves and Electromagnetic fields ● Sound waves and beats ● The speed of sound	● Different types of waves and canoeing ○ tléin teet: big wave large water breakers/curlers ○ heen tléin jinastanch: huge ocean waves ○ xóook jáa: wave spray ○ teet aka yatí: to measure crest to crest of wave ○ teet aka háni: wave height ○ kooh ka ya dá titch: refraction ○ Teet yaagás axch: sound of big wave approaching ● Goldbelt Heritage Foundation: Southeast Math, Lesson 3, Measuring Wavelength; *Ooxjaa Toox yaa Kakux* ● Local harbors and breakwaters are built with due consideration for wave properties
MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	**PS4.A: Wave Properties:** A sound wav needs a medium through which it is transmitted.(MS-PS4-2) **PS4.B: Electromagnetic Radiation:** When light shines on an object, it is reflected, absorbed, or transmitted	**Activities:** ● Symmetry and Reflection ● Earthquake waves ● Get Binary Code of all letters, have kids write a message to a friend in binary. Connect this activity to how computers use	● Point Retreat Lighthouse ● Lighthouse lens at State of Alaska Museum

Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions. **Assessment Boundary:** Assessment is limited to qualitative applications pertaining to light and mechanical waves. **Cross-Cutting Concepts:** Structure and Function (MS-PS4-2) **Science & Engineering Practices:** Developing and Using Models (MS-PS4-2)	through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)	binary code that use transistors (on and off) then to computer chips (large number of transistors). **Honors Activities** ● Light, brightness and distance experiment ● Polarization of light	
HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. **Clarification Statement:** Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth. **Assessment Boundary:** Limited to algebraic relationships and describing those relationships qualitatively.	**PS4.A: Wave Properties:** The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1) **AK Science Standard:** (6) SB4.3 Making waves move through a variety of media	**Other Activities:** ● Wave properties unit ● Intro to Waves Unit ● Wave motion lesson ● Speed of a wave unit ● PhET Waves on a string ● PhET Radio waves and Electromagnetic fields ● PhET Sound ● PhET Simplified MRI **Honors Activities** ● PhET Fourier-making waves ● Doppler Effect Equations-Vernier ● Mathematics of music	● Different types of waves and canoeing ● Goldbelt Heritage Foundation: Southeast Math, Lesson 3, Measuring Wavelength; *Ooxjaa Toox yaa Kakux* ● Measuring distance and depth with sonar and depth sounders

Cross-Cutting Concepts: Cause and Effect (HS-PS4-1) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-PS4-1)			
HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information. **Clarification Statement:** Could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft. **Assessment Boundary:** none **Cross-Cutting Concepts:** Stability and Change (HS-PS4-2) **Connections to Engineering, Technology, and Applications of Science**: Influence of Science, Engineering, and Technology on Society and the Natural World (HS-PS4-2), (HS-PS4-2) **Science & Engineering Practices:** Asking Questions and Defining Problems (HS-PS4-2)	**PS4.A: Wave Properties:** Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2)	**Activities:** ● Properties of waves unit ● Design your own instrument ● Analog world, digital world **Honors Activities:** ● Symmetry and Reflection ● Earthquake waves ● Get Binary Code of all letters, have kids write a message to a friend in binary. Connect this activity to how computers use binary code that use transistors (on and off) then to computer chips (large number of transistors). ● The physics of cell phone	**Tlingit vocabulary** ● *akaa*: to measure ● *tás*: linear measuring device ● *adali:* measure the weight

HS-PS4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. **Clarification Statement:** Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect. **Assessment Boundary:** Assessment does not include using quantum theory. **Cross-Cutting Concepts:** Systems and System Models (HS-PS4-3) **Science & Engineering Practices:** Engaging in Argument from Evidence (HS-PS4-3) **Connections to Nature of Science:** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS-PS4-3)	**PS4.A: Wave Properties:** [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3) **PS4.B: Electromagnetic Radiation:** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)	**Activities:** ● Electromagnetic Investigations ● The Nature of Light ● Wave Lab Stations 1 **Honors Activities:** ● Eclipse bomb	**Tlingit Vocabulary:** ● akaa: to measure ● tás: linear measuring device ● adali: measure the weight ● Auditorium designs are based on the interaction of sound waves

HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. **Clarification Statement:** Emphasis is on that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. **Assessment Boundary:** Limited to qualitative descriptions. **Cross-Cutting Concepts:** Cause and Effect (HS-PS4-4) **Science & Engineering Practices:** Obtaining, Evaluating, and Communicating Information (HS-PS4-4)	**PS4.B: Electromagnetic Radiation:** When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4) **AK Science Standard:** (10) SB3.3 Comparing the relative wavelengths and applications of different forms of electromagnetic radiation (i.e., x-rays, visible, infrared, microwaves, radio)	**Activities:** ● Light, Energy, Color ● The solar army **Honors Activities:** ● What blocks cell phones?	● AK State Museum- uses techniques for protecting artifacts from absorbed light energy that would cause damage to artifacts ● Use of Ultraviolet in the Examination of Museum Objects- article ● Radiation therapy at Southeast Radiation Oncology Center ● Alaska Clinical Infrared Thermography

HS-PS4-5: Communicate technical information about about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. **Clarification Statement:** Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology. **Assessment Boundary:** Assessments are limited to qualitative information. Assessments do not include band theory. **Cross-Cutting Concepts:** Cause and Effect (HS-PS4-5) **Connections to Engineering, Technology, and Applications of Science**: Influence of Science, Engineering, and Technology on Society and the Natural World (HS-PS4-5) Interdependence of Science, Engineering, and Technology (HS-PS4-5) **Science & Engineering Practices:** Obtaining, Evaluating, and Communicating Information (HS-PS4-5)	**PS3.D: Energy in Chemical Processes and Everyday Life:** Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (HS-PS4-5) **PS4.A: Wave Properties:** Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-5) **PS4.B: Electromagnetic Radiation:** Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) **PS4.C: Information Technologies and Instrumentation:** Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)	**Activities:** ● Splashing around with sound ● Slinky rules ● Simplified MRI **Honors Activities:** ● Mixing colors with light	● Use of solar panels in remote cabins ● UAA Goes Solar ● Alaska's Digital Archives is a major repository of digitized maps, manuscripts, photographs, newspapers ● Fiber optic telecommunications cable from Lena Point through Lynn Canal to Haines and Skagway ● Microwave Towers Bring Internet to Remote Villages ● Local cell towers ● Alaska Clinical Infrared Thermography

Supplemental Physical Science			
MS-PS4-3: Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. **Clarification Statement:** Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen. **Assessment Boundary:** Does not include binary counting nor the specific mechanism of any given device. **Cross-Cutting Concepts:** Structure and Function (MS-PS4-3) **Connections to Engineering, Technology, and Applications of Science**: Influence of Science, Engineering, and Technology on Society and the Natural World (MS-PS4-3)	**PS4.C: Information Technologies and Instrumentation:** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	**Activities:** ● Analog world, digital world ● Engineering earthquake structures	● Fiber optic telecommunications cable from Lena Point through Lynn Canal to Haines and Skagway ● Microwave Towers Bring Internet to Remote Villages

Connections to Nature of Science: Science Is a Human endeavor (MS-PS4-3) **Science & Engineering Practices**: Obtaining, Evaluating, and Communicating Information (MS-PS4-3)			

Course: Biology and Honors Biology (required for graduation)	**Grade: 10**
Biology introduces students to concepts basic to life sciences. Among these are the structural and chemical basis of life as shown by microbiology, cellular processes, and human anatomy/physiology; the diversity and continuity of life demonstrated through genetics, evolution and paleontology; and the interrelationships of global and local ecological processes. Student will be expected to participate in class discussion and content integrated laboratory experiences. Dissections may be required. **Honors Biology** has a greater emphasis on the quantitative nature of the material covered. Students will be required to complete a science project. There will be regular rigorous reading assignments and dissections may be required.	**Content:** • Scientific Investigations • Scientific knowledge • Scientific Models, Laws, Theories • Phenomena as a Human Endeavor • Organization for Matter and Energy Flow in Organizations • Cycles of Matter and Energy Transfer in Ecosystems • Genetics: Structure and Function • Growth and Development of Organisms • Inheritance of Traits • Variation of Traits • Social Interactions and Group Behavior • Biochronology • Evidence of Common Ancestry and Diversity • Natural Selection • Adaptation • Nuclear Processes • History of the Planet Earth • Taxonomy • Interdependent Relationships in Ecosystems • Cycles of Matter and Energy Transfer in Ecosystems • Energy in the Chemical Processes and Everyday Life • Ecosystem Dynamics, Functioning, and Resilience • Biodiversity and Humans • Developing Possible Solutions • Weather and Climate • Biogeology • Human Impacts on Earth Systems • Global Climate Change • Anatomy and Physiology: Structure and Function
Course Overview: • Nature of Science • Photosynthesis/Cellular Respiration • Genetics • Evolution • Ecology • Anatomy and Physiology	

Unit: Nature of Science	Suggested Anchoring Phenomena: Any Discrepant event ● Water and alcohol with ice cubes **Essential Questions:** How can we use science to understand our environment/world/universe? • What is science? • What are the ways in which science is accomplished? • What other ways of knowing are there other than western science? o What are the ancient narratives of community and landscape that reveal the process of science? o What do we learn of Tlingit practices of old which are important to current understandings and applications of science today? o How do Tlingit place names reflect scientific knowledge? • What is a theory and a law? • How are models valuable to the process of science? • What is the importance of peer review in science? • What is pseudoscience and how can it be used to mislead? • How has the process of science evolved over time?	**Standards**	
Pacing: Introductory unit of year, to one week and threaded throughout all units		Alaska Cultural Standards	B1, D5, E3, E4
Content/Topics: • Scientific Investigations • Scientific knowledge • Scientific Models, Laws, Theories • Phenomena As a Human Endeavor		Alaska ELA Standards	RI.9-10.1, RI.9-10.7, RI.9-10.8, W9-10.1, W9-10.2, W9-10.8, W9-10.9
		Alaska Math Standards	MP 1-5
		Alaska Science Standards	SA1, SA1.1, SA1.2, SA2 SA2.1, SA3, SA3.1, SE2, SG1, SG2, SG3, SG4
		ISTE	3, 4, 5

Alaska Cultural Standard to Emphasize	Community Contacts
E. **Culturally-knowledge students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them.** **4:** Determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems.	• **STEM Database Community Resources** • **AK Dept. Fish & Game:** SE Regional Wildlife Education Specialist, abby.lowell@alaska.gov, 465-4292; Statewide Wildlife Education & Outreach Coordinator, kristen.romanoff@alaska.gov, 465-8547

NGSS		Suggested Activities	Cultural and Place-Based Connections
Nature of Science: Performance Expectations (PEs)	**Nature of Science: Major Themes**		
NGSS Appendix H: Design and revise a basic scientific investigation to test a hypothesis regarding an explanation to an observed phenomenon. **Clarification Statement:** Designs and implementation should include a testable hypothesis, quantifiable data, adequate controls for repeatability, and proper data analysis and conclusion. The overall significance of the findings should be presented in context. **Assessment Boundary:** Assessment should not be restricted to any one specific "scientific method." Assessments should emphasize the need for peer review in science and the difference between science and other ways of knowing.	**NGSS Appendix H:** High School grade level themes for understanding the nature of science • Scientific Investigations Use a Variety of Methods • Scientific Knowledge is Based on Empirical Evidence • Scientific Knowledge is Open to Revisions in Light of New Evidence • Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena o Theories and laws provide explanations in science but theories do not with time become laws or facts o A scientific theory is substantiated by some aspect of natural world, based on a body of facts that has repeatedly confirmed through observation and experiment. The science community validates each theory before accepted. • Science is a Way of Knowing • Scientific Knowledge Assumes an Order and Consistency in Natural Systems • Science is a Human Endeavor • Science Addresses Questions About the Natural and Material World	Incorporate any experiment; make it inquiry by doing the classic experiment, then have students investigate their own questions. For example, the sponge animals linked below can be done first with growth over time at different water temperatures. Students brainstorm a list of variables that affect growth rate, conduct experiments, make claims, and support with evidence and reasoning. • Sponge Capsules • Nature of Science Lessons	**Tlingit World View**: Observe, Listen, Test, Perfect Wooch.een: How do these work together? Affect the other? In every action is a reaction: Wooch Yaxhdati: Balance Yan kásanóo: Prove it! **Technological Expertise & Indigenous Knowledge:** Why did Tlingit ancestors do it this way and why is it important today? Examples of learning and creating from scientific process: Fish traps, tidal salmon traps, medicinal plants, tool making, traditional clam beds, canoe building, food preservation, watertight baskets. • Codes of ethics for scientists working with people and environment or marine life. [Arctic Council] • Acknowledgement to studied creatures: Tlingit people may explain to the organisms what they are doing to it and say: *"I een áwé yei jigaxh tunei, i daat át haa tuwasigoo át wutuskoowú. Gunalchéesh!"* We are going to work with you. We want to learn about you! Thank you!"

			<u>Thomas Thornton's Cultural Atlas</u> illustrates scientific observation: Tlingit place names are biological and/or topographic. Place names describe the land/ecology and provide a map for navigation and historical record of geography, ecology, biology, hydrology and land ownership. • **Activity:** Find example of local place name which communicates scientific knowledge/science process skills (observation, biology, topography, hydrology) **Haa Shuká, Our Ancestors: Tlingit Oral Narratives** by Richard and Nora Dauenhauer**:** • Naatislanéi: oceanography, dendrology, hydrology, medical science. • Wooshkáduhaa/Basket Bay: oceanography, science of resources, geology (water caves), marine science (place where shark sleep). **Activities or Units Involving Traditional Ways of Knowing:** • <u>Village Science</u> - by Alan Dick: Camps, Fairs and Experiments • Modern v. traditional diaper experiment - sphagnum moss, cloth, and diapers • Curing, fermenting, brining, drying, smoking to prevent bacterial and fungus growth

			AK Dept. Fish & Game research • Division of Wildlife Conservation - Publications Database, Search by topic, species, author, year. • Divisions of Sport Fish, Commercial Fisheries and Subsistence - Publications Database

Unit/Instructional Focus: Photosynthesis/Cellular Respiration	**Suggested Unit Phenomena:** • Where does the mass of a tree come from? • Plants growing in terrariums and getting needs met • Ocean acidification and cycles of matter • Why can a candle keep burning if in a closed container with an actively photosynthesizing plant? • Plants have oxygen as a waste and animals have carbon dioxide as a waste product. • Plants release carbon dioxide too. • Breathing out some atoms you ate for breakfast • Why do you quickly perish if you don't have oxygen? • How do ecosystems flourish in extreme environments, like the ocean floor, even without photosynthesis? • How could people survive in a biosphere? • Why can there be algal blooms near river drainages? **Essential Questions:** • How do organisms obtain and use energy they need to live and grow? • How do matter and energy move through ecosystems?	**Standards**	
Recommended Pacing: 5 weeks		Alaska Cultural Standards	E1, E2
Content/Topics: • Organization for Matter and Energy Flow in Organisms • Cycles of Matter and Energy Transfer in Ecosystems		Alaska ELA Standards	SL.11-12.5 , RST.11-12.1, WHST.9-12.2, WHST.9-12.5
		Alaska Math Standards	MP 1-7
		Alaska Science Standards	SA1, SA3, SC2, [10] SC2.2, SC3, SE1, SE2, SF1, SG1, SG3
		ISTE	1, 3, 5

Alaska Cultural Standard to Emphasize	**Community Contacts**
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. **1**. Recognize and build upon the interrelationships that exist among the spiritual, natural and human realms in the world around them, as reflected in their own cultural traditions and beliefs as well as those of others	• **STEM Database Community Resources** • **AK Dept. Fish & Game:** SE Regional Wildlife Education Specialist, abby.lowell@alaska.gov, 465-4292; Statewide Wildlife Education & Outreach Coordinator, 465-8547**;** kristen.romanoff@alaska.gov • **Landscape Alaska:** 790-4916, Landscapealaska@gmail.com • **UAS:** Biology & Marine Science: Chemist 796-6200 • **US Forest Service:** Mendenhall Glacier Visitor Center: 789-6614**;** Juneau Ranger District**:** 789-6252, Pacific NW Research Station 586-8811, https://www.fs.fed.us/pnw/about/programs/index.shtml

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. **Clarification Statement:** Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models. **Assessment Boundary:** Does not include specific biochemical steps. **Cross-Cutting Concepts:** Energy and Matter (HS-LS1-5) **Science & Engineering Practices:** Developing and Using Models (HS-LS1-5)	**LS1.C: Organization for Matter and Energy Flow in Organisms:** The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)	**NGSS Activity Links:** • Build a model of photosynthesis • Elodea and snails virtual lab **Other Activities:** • Photosynthesis in sun and shade (nettle) **Honors Activities:** • Plant growth and gas exchange	**Local knowledge:** Pick berries at lower elevations first as they have been uncovered by snow earlier, therefore have had access to sunlight which plant converts to the production of berries. Berries at higher elevations ripen later as they were under snow longer and didn't get light energy until later. **AK Dept. Fish & Game** • Alaska Wildlife Curriculum - Alaska's Wetlands & Wildlife, Energy Flow in an Alaska Wetland, Section II. • Division of Wildlife Conservation - Publications Database, Search by topic (e.g. physiology, genetics…), species, author, year. • Divisions of Sport Fish, Commercial Fisheries and Subsistence - Publications Database

HS-LS1-7: 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. **Clarification Statement:** Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration. **Assessment Boundary:** Assessment should not include identification of the steps or specific processes involved in cellular respiration. **Cross-Cutting Concepts:** Energy and Matter (HS-LS1-7) **Science & Engineering Practices:** Developing and Using Models (HS-LS1-7)	**LS1.C: Organization for Matter and Energy Flow in Organisms:** As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-7) As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7) AK Science Standard: (10) SC2.2 Explaining that cells have specialized structures in which chemical reactions occur	**NGSS Activity Links**: • Cellular Respiration (Molecular Workbench Curriculum Module) • CarbonTIME Animals Unit • CarbonTIME Plants Unit **Other Activities**: • Build and compare models of photosynthesis molecules and cellular respiration molecules. **Honors Activities:** • Elodea photosynthesis and cellular respiration lab.	Anooch'/gills taking up oxygen, processing oxygen **Traditional Nutrition** • Macromolecules: Understanding the impact of food on the body (winter foods-are there foods better to eat before heading out in the cold to hunt?) • Energy Food: o Tlingit salmon egg cheese: Khaghóo l'i; Dried salmon eggs: kaháakw'kaxóok • Haa atxaayi haa kusteeyix sitee - Our Food is Our Tlingit Way of Life: Newton, R. G. (2005). • Final Report on the Alaska Traditional Diet Survey: Study on top 50 household foods include traditional pp. 16 -25 • Dr. Walter Soboleff KeyNote-Alaska Native Educators' Conference (Seasons for Traditional Foods: berries, fermentation, fish runs, herring spawns, seaweeds, seal hunting, mushrooms; pp. 141 - 142) • Alaska Traditional Food Resources (Eat Smart Alaska)

HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. **Clarification Statement**: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments. **Assessment Boundary:** Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration. **Cross-Cutting Concepts:** Energy and Matter (HS-LS2-3) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-LS2-3) **Connections to Nature of Science**: Scientific Knowledge Is Open to Revision in Light of New Evidence (HS-LS2-3)	**LS2.B**: **Cycles of Matter and Energy Transfer in Ecosystems:** Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)	**NGSS Activity Links:** • Fermentation in a Bag • CarbonTIME Decomposers Unit • Fermentation of cabbage (sauerkraut). Try different containers, length of time, salts **Honors Activities**: • Food Webs, Energy Flow, Carbon Cycle, and Trophic Pyramids	**Fermentation:** • This Ain't Yo Momma's Muktuk (Discover Magazine) • Health benefits of fermentation: eulachon oil, fish heads (gink), fermented fish eggs and high bush cranberries (egg pudding), wine, sauerkraut. Traditional preservation and probiotics. • Tlingit names for foods, rather than stink eggs, stinkheads. • Chal xook: Slightly fermented coho, submerged/aged in cold river. Chilkats specialty. • Compressed mountain blueberries with seal oil, pressed in bentwood box (laxt). Eaten for the sugar and fats: ts'éekáxk'w. • Rendered marrow: Sookh katayi • Toow: Smoked Mountain Goat belly fat **AK Dept. Fish & Game** • Alaska Wildlife Curriculum - Alaska's Ecology, Section II: Mineral Cycling through Ecosystem; Creating class compost box.

HONORS BIOLOGY			
HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. **Clarification Statement:** Emphasis is on using evidence from models and simulations to support explanations. **Assessment Boundary:** Assessment does not include the details of the specific chemical reactions or identification of macromolecules. **Cross-Cutting Concepts:** Energy and Matter (HS-LS1-6) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-LS1-6)	**LS1.C: Organization for Matter and Energy Flow in Organisms:** As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6) The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)	**NGSS Activity Links:** • Plant Growth and Gas Exchange Unit • CarbonTIME Animals Unit • CarbonTIME Plants Unit **Other Activities:** • Create and revise a model of the cycling of elements through the biosphere and in the human body	**Tlingit World View:** Understanding the interconnection between all things; for example, how food turns into energy. Respect for all living things. **Study on top 50 household foods**; top foods are not traditional foods pp. 16 -25 **AK Dept. Fish & Game** research**:** • Division of Wildlife Conservation - Publications Database, Search by topic (e.g. food, subsistence), species, author, year • Divisions of Sport Fish, Commercial Fisheries and Subsistence - Publications Database

<table>
<tr><td>Unit/Instructional Focus: Genetics</td><td rowspan="3">Suggested Unit Phenomena:
Why do family members often have similar characteristics?
When exposed to sunlight, why do you tan?
How can parents with type A blood have a child with type O blood?
Why do traits sometimes seem to disappear and reappear between generations?
Is it possible to be closer related to a sibling than a parent?
How can a mutation leading to sickle cell anemia or cystic fibrosis be beneficial in some circumstances?
How do genetic testing services know your ancestry? Do they know all of your ancestry?
How does DNA code for your eye color?
Does ability to taste PTC affect your taste preferences?
Genetically modified Atlantic salmon with growth hormone gene from Pacific salmon for larger size.
Growth spurts and mitosis
Essential Questions:
How are transgenic organisms created?
What are some of the biological, moral and ethical concerns with the use of biotechnology?
How is DNA gel electrophoresis performed and what are its applications?
What is the epigenome and does it interact with gene translation?
How is PCR/DNA gel electrophoresis performed and what are its applications?
How is DNA sequencing performed and what are its applications?</td><td colspan="2">Standards</td></tr>
<tr><td>Recommended Pacing: 8 weeks</td><td>Alaska Cultural Standards</td><td>E3, E 8</td></tr>
<tr><td>Content/Topics:
Structure and Function
Growth and Development of Organisms
Inheritance of Traits
Variation of Traits
Social Interactions and Group Behavior
Biochronology
Transgenic technologies
PCR/DNA gel electrophoresis
Epigenomics
DNA sequencing</td><td>Alaska ELA Standards</td><td>RST.11-12.1, RST.11-12.9, WHST.11-12.9, WHST.9-12.2, SL.11-12.5</td></tr>
<tr><td></td><td>Alaska Math Standards</td><td>MP.4, F-BF.1, F-IF.7</td></tr>
<tr><td></td><td>Alaska Science Standards</td><td>SA1, SA2, SA3, SE1, SF1 SF3, SG3, [9] SC2-3, [10] SC2.1, [10] SC3.3, [10] SC2.4, [11] SC2.3</td></tr>
<tr><td></td><td>ISTE</td><td>1, 3, 5</td></tr>
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Alaska Cultural Standard to Emphasize	Community Contacts
A. Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community. 2. Recount their own genealogy and family history	• **STEM Database Community Resources** • **AK Dept. Fish & Game**: SE Regional Wildlife Education Specialist, 465-4292; Statewide Wildlife Education & Outreach Coordinator kristen.romanoff@alaska.gov, 465-8547 • **NOAA/NMFS:** Auke Bay Lab: Genetics, 789-6000 • **UAF:** Fisheries Genetics- Fisheries Biologists: 796-5441 • **US Forest Service:** Mendenhall Glacier Visitor Center: 789-6614**;** Juneau Ranger District**:** 789-6252, Pacific NW Research Station 586-8811, https://www.fs.fed.us/pnw/about/programs/index.shtml

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-LS1-1: 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. **Clarification Statement:** none **Assessment Boundary:** Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis. **Cross-Cutting Concepts:** Structure and Function (HS-LS1-1) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-LS1-1)	**LS1.A: Structure and Function:** Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1)	**NGSS Activity Links:** • DNA to Protein • Understanding the Functions of Proteins and DNA • Decoding Cancer **Honors Activities:** • DNA extraction • DNA gel electrophoresis	**Tlingit Genetics:** • Making Indigenous People Equal Partners in Gene Research • DNA Tracks Ancient Alaskan's Descendants • Tlingit Family Linked to Long Ago Person Found - video • Teachings From Long Ago Person Found - online booklet • Migration and Genetic Diversity • Clan, language, and migration history has shaped genetic diversity in Haida and Tlingit populations from Southeast Alaska • Kwäday Dän Ts'ìnchi - "Tlingit Ice Man" shows connection between coastal Tlingit to inland Tlingit

			AK Dept. Fish & Game-research**:** • Division of Wildlife Conservation - Publications Database, Search by topic (e.g. physiology, genetics…), species, author, year. • Exploring the ecological and genetic separation of two sibling species (harbor seals and spotted seals) • Mark-recapture using tetracycline and genetics reveal record-high bear density
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. **Clarification Statement:** none **Assessment Boundary:** Assessment does not include rote memorization of the steps of mitosis. **Cross-Cutting Concepts:** Systems and System Models (HS-LS1-4) **Science & Engineering Practices:** Developing and Using Models (HS-LS1-4)	**LS1.B: Growth and Development of Organisms:** In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)	**Other Activities:** • Mitosis in root tips **Honors Activities:** • Determining percent of time spent in the phases of mitosis using onion root tip cells	**Tlingit Healing Practices** involved applying a plant poultice or ointment to a wound to support mitosis of epidermal cells that would otherwise be inhibited by bacterial infection. • Traditional healing for a healthy self • Harvesting therapies of the Earth

HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. **Clarification Statement:** none **Assessment Boundary:** Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process. **Cross-Cutting Concepts:** Cause and Effect (HS-LS3-1) **Science & Engineering Practices:** Asking Questions and Defining Problems (HS-LS3-1)	**LS3.A: Inheritance of Traits:** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) **LS1.A: Structure and Function:** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)	**NGSS Activity Links:** • Genetic origin of variation in human skin color **Other Activities:** • Wisconsin Fast Plants • Make a baby lab • ABO blood types **Honors Activities:** • Pedigrees and the Inheritance of Lactose Intolerance	**Genetics of SE AK indigenous people:** How long have the Tlingit been in this area? Tlingit have stories of living among prehistoric animals and escaping to mountain tops at the time of a great flood. Geologists believe floods occurred at the end of the last major ice age, more than 10,000 years ago. Ancient cairns or rock nests found in the alpine have been described by Tlingit as flood markers. • Clan, Language, and Migration History has Shaped Genetic Diversity in Haida and Tlingit Populations from Southeast Alaska • Kwäday Dän Ts'ìnchi - "Tlingit Ice Man" coastal to inland Tlingit connection • Teachings From Long Ago Person Found • Tlingit Family Linked to Long Ago Person Found- video • DNA Tracks Ancient Alaskan's Descendants • **Haa Shuká, Our Ancestors: Tlingit Oral Narratives**: Basket Bay History by Robert Zuboff pp. 63-71. Oral narratives tell about the Tlingit traveling by canoe under glaciers in the Taku and Stikine areas.

HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. **Clarification Statement:** Emphasis is on using data to support arguments for the way variation occurs. Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process. **Assessment Boundary:** Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process. **Cross-Cutting Concepts:** Cause and Effect (HS-LS3-2) **Science & Engineering Practices:** Engaging in Argument from Evidence (HS-LS3-2)	**LS3.B: Variation of Traits:** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)	**NGSS Activity Links:** • Environmental Influence on Genotypes and Phenotypes **Other Activities:** • Crossing over • Lactase-co-evolution of genes and culture **Honors Activities:** • Drug-Resistant TB: A Genetic Analysis Using Online Bioinformatic Tools	• Hatcheries change salmon genetics after a single generation-article

HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. **Clarification Statement:** Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. **Honors Biology:** Also includes other forms of inheritance beyond simple Mendelian inheritance. Students may also be asked to create pedigrees and/or use one to deduce the genetics of a condition. **Assessment Boundary:** May include up to simple Hardy-Weinberg calculations. **Cross-Cutting Concepts:** Scale, Proportion, and Quantity (HS-LS3-3) **Connections to Nature of Science**: Science Is a Human Endeavor (HS-LS3-3), (HS-LS3-3) **Science & Engineering Practices:** Analyzing and Interpreting Data (HS-LS3-3)	**LS3.B: Variation of Traits:** Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-3)	**NGSS Activity Links:** • Mendelian Genetics: Why Are the Stem and Leaf Color Traits of the Wisconsin Fast Plant Inherited in a Predictable Pattern? • Drosophila Virtual Lab **Other Activities:** • Variation of traits • Punnett squares and Hardy Weinberg • Population genetics, selection and evolution **Honors Activities:** • Model of Inheritance: Which Model of Inheritance Best Explains How a Specific Trait is Inherited in Fruit Flies? • Using Genetic Crosses to Analyze a Stickleback Trait	**Tlingit Customs**: Clan-based marriages had to be with somebody from an opposite clan. Tlingit mothers give this essential knowledge to their children to combat inbreeding and depression. Lineage is known and celebrated to great great grandparents' level. **How long have the Tlingit been in this area?** Did they travel by land bridge or along the coastline to Southeast Alaska? • Haa Shuká, Our Ancestors: Tlingit Oral Narratives: Basket Bay History by Robert Zuboff pp. 63-71

Non-NGSS Performance Expectations (PEs)	Non-NGSS Disciplinary Core Ideas (DCIs)	Suggested Activities	Cultural & Place-Based Connections
Plan and conduct an investigation using transgenic technologies or DNA gel electrophoresis **OR** Develop and use a model to illustrate steps involved in transgenic technologies or DNA gel electrophoresis. Construct an argument based on an understanding of biotechnological and epigenomics processes for ethical, biological, or moral implications using that technology. **Clarification Statement:** Emphasis on most current and possible future uses of biotechnology and moral, biological and ethical issues. **Assessment Boundary:** Does not include historical context of each of these technologies. **Cross-Cutting Concepts:** Systems and System Models (HS-LS1-2) **Science & Engineering Practices:** Developing and Using Models (HS-LS1-2), Planning and Carrying Out Investigations (HS-LS1-3)	The methods of biotechnology and an understanding of epigenomics can be used to improve the human condition, but also raises many ethical, biological and moral concerns that must be addressed. **AK Science Standard:** (10) SC1.3 Examining issues related to genetics	**Other Activities:** • DNA extraction from strawberries • Virtual labs for extraction, PCR, and gel electrophoresis • Gel electrophoresis lab • Ethics of genetic testing **Honors Activities:** • DNA Microarrays (Gene Chips) and Cancer • Genetic Testing for Huntington's Disease	• Comparison of three methods of DNA extraction from cold-smoked salmon and impact of physical treatments- research

Unit/Instructional Focus: Evolution	Suggested Unit Phenomena:	Standards	
Recommended Pacing: 8 weeks	• Adaptations of brown bears versus black bears for Southeast Alaska. • Adaptations of flying squirrels within the rainforest ecosystem. • Narrow and curled antler structure on Sitka black tail deer for dense forests. • Coyotes in Southeast Alaska having an adaptive behavior to form packs; different from their relatives in desert habitats. • Adaptations for strong smell of chocolate lilies and skunk cabbage for attracting pollinators. • Similarities between modern birds and dinosaurs. • Similarities between seals and wolves • Dinosaur tail with feathers preserved in amber • Whales and vestigial parts • Selective breeding of dogs in Alaska such as the Alaskan Malamute and Iditarod dogs	Alaska Cultural Standards	E3, E8
Content/Topics: • Evidence of Common Ancestry and Diversity • Natural Selection • Adaptation • Classification	**Essential Questions:** • How can there be so many similarities among organisms yet so many different plants, animals and microorganisms? • How is biodiversity important?	Alaska ELA Standards	RST.11-12.1, RST.11-12.9, WHST.11-12.9, WHST.9-12.2, SL.11-12.5
		Alaska Math Standards	MP.4, F-BF.1, F-IF.7
		Alaska Science Standards	SA1, SA2, SA3, SE1, SF1 SF3, SG3, [9] SC2-3, [10] SC2.1, [10] SC3.3, [10] SC2.4, [11] SC2.3
		ISTE	1, 3, 5

Alaska Cultural Standard to Emphasize	Community Contacts
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. 4. determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems	• **STEM Database Community Resources** • **AK Dept Fish & Game:** Abby Lowell, SE Regional Wildlife Education Specialist, abby.lowell@alaska.gov, 465-4292; Kristen Romanoff, Statewide Wildlife Education & Outreach Coordinator kristen.romanoff@alaska.gov, 465-8547 • **DIPAC**: 463-5114 • **Discovery Southeast**: Naturalists, 463-1500; info@discoverysoutheast.org • **NOAA/NMFS:** Auke Bay Lab: Genetics, 789-6000; Auke Creek Marine Station, 789-6000

	• **UAS:** Evolution, Ecology, Conservation Biologists, Fish Genetics/Fish Stock Assessment: 796-5441; UAS Sculpin study at Auke Creek; Fisheries Biologists: 796-6200 • **US Forest Service:** Mendenhall Glacier Visitor Center: 789-6614**;** Juneau Ranger District**:** 789-6252, Pacific NW Research Station 586-8811, https://www.fs.fed.us/pnw/about/programs/index.shtml

NGSS		**Suggested Activities**	**Cultural & Place-Based Connections**
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. **Clarification Statement:** Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development. **Assessment Boundary:** none **Cross-Cutting Concepts:** Patterns (HS-LS4-1) **Connections to Nature of Science**: Scientific Knowledge Assumes an Order and Consistency in Natural Systems (HS-LS4-1) **Science & Engineering Practices:** Obtaining, Evaluating, and Communicating Information (HS-LS4-1)	**LS4.A: Evidence of Common Ancestry and Diversity:** Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)	**NGSS Activity Links:** • Stickleback Evolution Virtual Lab • Evolutionary Relationships in Mammals (Genetics and Evolution) **Other Activities:** • Natural selection and the peppered moth • Mimicry **Honors Activities:** • The making of the fittest-excellent collection of resources • HHMI evolution resources	**Smoked Fish vs Bacterial Growth** Which type of smoked fish is best for long term storage and why? • 3 Levels: naayadi (half-dried), át ´xeeshi (dry fish), át úwa ´xeeshi (twice dried fish) Tlingit people have experienced natural selection for a high fat high protein diet; modern diets contain high levels of starch and sugars and have led to elevated rates of diabetes in Native populations. Successive small pox epidemics killed a majority of Tlingit; remaining people of Southeast Alaska now have the same level of small pox resistance as European populations. **Haa Shuká, Our Ancestors: Tlingit Oral Narratives***:* Mosquito story by Robert Zuboff: mosquitoes originating when giant was killed. **Local Artificial Selection:** • Virus infects arboretum's Tlingit potato crop • A potato revival • Sitka Local Foods Network: Tlingit Potato

Connections to Nature of Science: Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS-LS4-1)			• Maria's Tlingit Potato: journey to the Dauenhauer garden - video **AK Dept. Fish & Game** research: • Division of Wildlife Conservation - Publications Database, Search by topic (e.g. physiology, genetics…), species, author, year. • Divisions of Sport Fish, Commercial Fisheries and Subsistence - Publications Database
HS-LS4-2: 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. **Clarification Statement:** Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.	**LS4.B: Natural Selection:** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2) **LS4.C: Adaptation:** Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)	**NGSS Activity Links:** • Natural Selection • Making Sense of Natural Selection • HHMI Data Point: Schooling Behavior of Stickleback Fish from Different Habitats • HHMI Data Point: Effects of Natural Selection on Finch Beak Size **Other Activities:** • Natural selection and the peppered moth • Bird beak adaptation to available food source • HHMI Evolution in action: Data analysis • Choosing local organisms for examples or research. • Mammal March Madness- animal adaptations and survival of the fittest	**Tlingit Value**: You will not have inbreeding: hél woocheen gaxh yi da xéet Tlingits had extensive trade networks and far reaching wars that enabled genflows including the Haida, and Nez Perce. Today gene flow is evident in the diversity of Tlingit people.

Assessment Boundary: None **Cross-Cutting Concepts:** Cause and Effect (HS-LS4-2) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-LS4-2)		**Honors Activities:** • The making of the fittest- excellent collection of resources • HHMI evolution resources • Genetic drift and gene flow through migration.	
HS-LS4-3: 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. **Clarification Statement:** Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. **Assessment Boundary:** Limited to basic statistical and graphical analysis. Assessment can include simple allele frequency calculations. **Cross-Cutting Concepts:** Patterns (HS-LS4-3) **Science & Engineering Practices:** Analyzing and Interpreting Data (HS-LS4-3)	**LS4.B: Natural Selection**: The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3), (HS-LS4-3) **LS4.C: Adaptation:** Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3) Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)	**NGSS Activity Links:** • HHMI Data Point: Schooling Behavior of Stickleback Fish from Different Habitats • HHMI Data Point: Effects of Natural Selection on Finch Beak Size **Other Activities:** • Punnett squares • Choosing local organisms for examples or research **Honors Activities:** • Stickleback Evolution Virtual Lab	• Mountain goats grow more wool during the winter to survive. For this reason, Native peoples would hunt mountain goats during the winter as the thicker hides would provide more wool per goat. • Snowshoe hare, ptarmigan, ermine change color during winter and summer so as not to be noticed visually. • **Bear:** o Brown bear have well-developed shoulder muscles and longer, straighter claws with toes almost bound together to dig for roots, tubors, and to turn over rocks. Female brown bear are more aggressive than black bear females; they will hold their ground or charge as they are not tree-climbers. o Black bear have splayed claws to climb trees; they require a forest environment for protection.

			• Devil's club have very wide leaves to gather as much light as possible from their shady forest habitat. The pointy, toothed tip on each lobe allows it to shed rain easily.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations. **Clarification Statement:** Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations. **Assessment Boundary:** none **Cross-Cutting Concepts:** Cause and Effect (HS-LS4-4) **Connections to Nature of Science**: Scientific Knowledge Assumes an Order and Consistency in Natural Systems (HS-LS4-4) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-LS4-4)	**LS4.C: Adaptation:** Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-4)	**NGSS Activity Links:** • Stickleback Evolution Virtual Lab • Color Variation over Time in Rock Pocket Mouse Populations **Other Activities:** • Darwin's Finches • Ring species **Honors Activities:** • A step in speciation lab	**Adaptations of human populations to life in their specific environment:** Resources on human adaptations to their environment. Explore Inuit adaptations to their food sources (The Secret to the Inuit High-Fat Diet May Be good Genes). **Adaptations of local marine mammals to their environment:** Comparing and contrasting adaptations of sea otters, seals and porpoises. **Goldbelt Heritage Foundation: Salmon in the Trees** Unit approaches adaptation and ecology from western biological knowledge and traditional Tlingit knowledge of the natural world. Unit begins with "Alive in the Eddy" as told by A.P. Johnson. Making of the Fittest: Alaska sticklebacks- video

HS-LS4-5: Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. **Clarification Statement:** Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species. **Assessment Boundary:** none **Cross-Cutting Concepts:** Cause and Effect (HS-LS4-5) **Science & Engineering Practices:** Engaging in Argument from Evidence (HS-LS4-5)	**LS4.C: Adaptation:** Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5) Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) **AK Science Standard:** (9) SC1.3 Inferring evolutionary pathways from evidence (e.g., fossils, geological samples, recorded history)	**NGSS Activity Links:** • Uncovering Wildlife • HHMI Beaks as Tools **Other Activities:** • Geological time scale • Galapagos Islands speciation and variation **Honors Activities:** • Understanding Evolution speciation in real time • HHMI The origins of species: Lizards in an evolutionary tree	**Tlingit World View:** Everything is woven together: Ldákat át woosht kasi xát **Local Environmental Pressure Shifts** affect certain local organisms more than others. Rapid ocean warming due to human impacts challenges adaptive response by fish populations (pollock, salmon, black cod....) • Auke Creek Fish studies • Glacier Bay: glacial and ice sheet changes - new species taking over habitat • Heavy spring run-off can scour stream beds and destroy eggs, a diminished snow pack could reduce the number of spawning pools, and rising sea level could flood freshwater pools with salt water. • Murres in Southeast Affected by Die-Off - article • Haul-out patterns and effects of vessel disturbance on harbor seals on glacial ice in Tracy Arm - research • Spruce Aphid: Small bugs, big problems - article • Biological Impacts of the 2013-2015 Warm-Water Anomaly in the Northeast Pacific - research • Richard Carstensen's Juneau Nature research, maps, journals, natural history blog

HS-ESS1-6: 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. **Clarification Statement:** Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces. **Assessment Boundary:** none **Cross-Cutting Concepts:** Stability and Change (HS-ESS1-6) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-ESS1-6) **Connections to Nature of Science**: Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS-ESS1-6), (HS-ESS1-6)	**PS1.C: Nuclear Processes:** Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-6) **ESS1.C: The History of Planet Earth:** Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)	**NGSS Activity Links:** • Weighing the evidence for a mass extinction • Finding the crater **Other Activities:** • Make a Geological time scale **Honors Activities:** • HHMI Extinctions- large	**Carbon Dating** • Carbon dating artifacts such as the fish trap in Montana creek, Kohklux's map • Clothing and tools of Kwäday Dän Ts'ìnch, and artifacts in Alaska State Museum. • Radiocarbon dating and dietary stable isotope analysis of Kwädäy Dan Ts'inchi **Plate Tectonics** • Connecting plate tectonics to The History of the Taku Yanyèdf story (The Legacy of a Taku River Tlingit Clan by Elizabeth Nyman)

	Taxonomy: The identification, naming, and classification of living organisms based on evolutionary relationships. **AK Science Standard:** (9) SC2.1 Describe and compare characteristics of phyla/divisions of each of the six traditional kingdoms and gain awareness of how current genetic studies are changing this classification	**Other Activities:** • Taxonomy lessons	• Surviving on the Foods and Water from Alaska's Southern Shores, (2013); Common Edible Seaweeds in the Gulf of Alaska (2005), Dolly Garza • Wild Edible and Medicinal Plants: Alaska, Canada and Pacific Rainforest**,** Carol Biggs (1999) • Traditional Foods Guide:(SEARHC) • Battle of the Giant Story: The Legacy of a Taku River Tlingit Clan by Elizabeth Nyman
HONORS BIOLOGY			
MS-LS4-3: Analyze displays of pictorial data to compare patterns of similarities in embryological development across multiple species to identify relationships not evident in formed anatomy. **Clarification Statement:** Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. **Assessment Boundary:** Comparisons limited to gross appearance of anatomical structures in embryological development. **Cross-cutting Concepts:** Patterns (MS-LS4-3) **Science and Engineering Practices:** Analyzing and Interpreting Data (MS-LS4-3)	**LS4.A: Evidence of Common Ancestry and Diversity:** Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)	**NGSS Activity Links:** • Translating the NGSS for Classroom Instruction • Lab 20: Descent with Modification and Embryonic Development: Does Animal Embryonic Development Support or Refute the Theory of Descent With Modification? **Other Activities:** • Study Chicken embryos • Compare and contrast embryos in several related and unrelated species	• DIPAC Field Trip **AK Dept. Fish & Game** research • Division of Wildlife Conservation- Publications Database, Search by topic (e.g. ecology), species, author, year. • Divisions of Sport Fish, Commercial Fisheries and Subsistence - Publications Database

Unit/Instructional Focus: Ecology	Suggested Unit Phenomena:	Standards	
Recommended Pacing: 8 weeks	• Fluctuating red tides rates, ocean temperatures and ocean ecology • Alder and nitrogen fixation • Ground cones parasitizing alder and blueberries • Carnivorous plants like the sundew • Moose and coyotes migrating into the Juneau area • Return of sea otters to Southeast Alaska and impacts • Polar bear and spotted owl loss of habitat • Raven and eagle populations near towns versus in the wild • Cedar trees and symbiotic relationships with fungi • Speedy retreat of the Mendenhall Glacier (while the Taku Glacier is advancing) • Population increase of coyotes in California during the drought.	Alaska Cultural Standards	E2, E3
Content/Topics: • Interdependent Relationships in Ecosystems • Cycles of Matter and Energy Transfer in Ecosystems • Energy in the Chemical Processes and Everyday Life • Ecosystem Dynamics, Functioning, and Resilience • Biodiversity and Humans • Developing Possible Solutions • Weather and Climate • Biogeology • Human Impacts on Earth Systems • Global Climate Change	**Essential Questions:** • How do organisms interact with the living and non-living environment to obtain matter and energy? • How do matter and energy move through ecosystems?	Alaska ELA Standards	RST.9-10.8, RST.11-12.1, RST.11-12.7, RST.11-12.8, WHST.9-12.2, WHST.11-12.7
		Alaska Math Standards	N-Q.1, N-Q.2, N-Q.3, MP.2, MP.4
		Alaska Science Standards	SA1, SA2, SA3, [9] SC3.1, [9] SC3.3, [10 & 11] SC3.1, [10] SC3.2, [11] SC3.2, [11] SC2.2, SD1, SD2, SD3, SE1, SE2, SE3, SF1, SF3, SG1, SG3
		ISTE	1, 3, 5

Alaska Cultural Standard to Emphasize	Community Contacts
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. 2. understand the ecology and geography of the bioregion they inhabit	• **STEM Database Community Resources** • **AK Dept Environmental Conservation**: Environmental Engineer, 465-5066 • **AK Dept Fish and Game:** SE Regional Wildlife Education Specialist, abby.lowell@alaska.gov, 465-4292; Statewide Wildlife Education & Outreach Coordinator, 465-8547, kristen.romanoff@alaska.gov; Salmon Ecology, Commercial Fisheries Management, Quantitative Genetics, 465-4256 • **CBJ:** Engineering Assistant, Mendenhall Water Treatment Plant, 957-0572 • **Cooperative Extension Service**: 523-3280 • **Discovery Southeast**: Naturalists, 463-1500, email: info@discoverysoutheast.org

	• **Hecla/Greens Creek Mine**: Engineer, 523-3803 • **NOAA/NMFS:** Ecosystem Monitoring and Assessment: 789-6000; Recruitment Energetics & Coastal Assessment: 789-6621; National Weather Service: Meteorologist, 790-6800 • **UAS/UAF:** UAS Evolution, ecology, and conservation biology 796-6200; UAF Fishery ecology 796-5441: Auke Creek Fish Studies; Fish Habitat Assessment; Fisheries Oceanography Sea Otter Populations; UAS Environmental Science/Geologist, 796-6523, 796-6410 • **US Forest Service:** Mendenhall Glacier Visitor Center: 789-6614**;** Juneau Ranger District**:** 789-6252, Pacific NW Research Station 586-8811, https://www.fs.fed.us/pnw/about/programs/index.shtml

NGSS		**Suggested Activities**	**Cultural & Place-Based Connections**
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. **Clarification Statement:** Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets. **Assessment Boundary:** Assessment does not include deriving mathematical equations to make comparisons.	**LS2.A: Interdependent Relationships in Ecosystems:** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1) **AK Science Standards:** (9) SC3 Identifying dynamic factors (e.g., carrying capacity, limiting factors, biodiversity, and	**NGSS Activity Links:** • African Lions: Modeling Populations • Population Explosion • Population Dynamics Based on Resource Availability & Founding Effects: Live & Computational Models • NetLogo Wolf Sheep Predation Model **Other Activities:** • Alaska Rainforest Ecology slideshow & booklet • The great Elephant Census modeling population • Population dynamics **Honors Activities** • HHMI Ecology • Tracking genetically altered mosquitoes	Signs of Red Tide: Kookénaa- small beach invertebrates are observed to help establish if paralytic shellfish poisoning is present. Sun and warmth may be connected with the occurrence. Héen Latinee Experimental Forest **Traditional Oral Narrative:** • Raven Goes Down the Bull Kelp (Bi-valve knowledge: clams, mussels, food categorized under shellfish) Differences in ecosystems of Coastal and Inland Tlingit led to: different items to trade, seasonal movements, and travel to different natural gardens. **Richard Carstensen's Juneau Nature:** research, maps, journals, natural history blog **Outdoor fieldwork:**

Cross-Cutting Concepts: Scale, Proportion, and Quantity (HS-LS2-1) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-LS2-1)	productivity) that affect population size. (10) SC3.2 Exploring ecological relationships (e.g., niche, feeding relationships, symbiosis. (11) SC2.2 Learned Behaviors - Describing the learned behaviors (e.g., classical conditioning, imprinting, trial and error) that are utilized by living organisms to meet the requirements of life.		• Transects measuring plant species diversity • Pond water invertebrate observations • Invasive plant studies **AK Dept. Fish & Game: Alaska Wildlife Curriculum** • Wildlife for the Future - Section II: Population Dynamics and Section III: Sustaining Wildlife & Communities • Alaska's Forests & Wildlife - Section II: Forest Puzzlers • Alaska's Ecology - Section II: Ecosystem Partners • Alaska Species Profiles • Sounds Wild 90 Second Science & Nature Audio Programs
HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. **Clarification Statement:** Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems:** Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and	**NGSS Activity Links:** • Surviving Winter in the Dust Bowl (Food Chains and Trophic Levels) • Matter cycles and energy flows in ecosystems **Other Activities:** • Food webs and trophic levels **Honors Activities:** • Exploring trophic cascades • Gorongosa National Park	**Tlingit World View:** In traditional Native cultures, all things had their places and all things worked together. This included a variety of cycles in the environment. **Food chain/ayaa naayi** • That which devours each other: wooch hás ada éen át • The energy that flows from the lowest level to highest: wooch toonaxh ya kanadein át Origin of the Killer Whale (oral narrative)- how Orca fits into our ecosystem. **Héen Latínee Outdoor Classroom** - A curriculum guide developed and implemented in 2012 by T&HCC, GHF, USFA, JSD. Includes lessons on

Assessment Boundary: Limited to proportional reasoning to describe the cycling of matter and flow of energy. **Cross-Cutting Concepts:** Energy and Matter (HS-LS2-4) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-LS2-4)	recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)		Stream Ecology, Glacier Migration and the Story of Soil. **Goldbelt Heritage Foundation:** Southeast Alaska Ecology unit
HONORS BIOLOGY			
HS-LS2-5: using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. **Clarification Statement:** Examples of models could include simulations and mathematical models. **Assessment Boundary:** Does not include the specific chemical steps of photosynthesis and respiration. **Cross-Cutting Concepts:** Systems and System Models (HS-LS2-5) **Science & Engineering Practices:** Developing and Using Models (HS-LS2-5)	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems:** Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) **PS3.D: Energy in Chemical Processes and Everyday Life:** The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5)	**NGSS Activity Links:** • Carbon Transfer Through Snails and Elodea • Carbon Lab (Learner.org Interactive Lab) • HHMI Data Point: Trends in Atmospheric Carbon Dioxide **Other Activities:** • Plant biomass • Trophic levels and energy pyramids	**Goldbelt Heritage Foundation:** • Southeast Math, Lesson 2, The Amazing Life of Trees - Students investigate a simulated stand of trees • Salmon in Trees: This unit approaches adaptation and ecology from western biological knowledge and traditional Tlingit knowledge of the natural world. Unit begins with "Alive in the Eddy" as told by A.P. Johnson. • Investigating Tlingit Ecological Knowledge
HS-LS2-7: Design, evaluate, and refine a solution for reducing the	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience:** Anthropogenic changes (induced by	**NGSS Activity Links:** • Catching the Wrong Species	**Traditional Tlingit Value:** Respect for the most minute creature

impacts of human activities on the environment and biodiversity. **Clarification Statement:** Examples of human activities can include urbanization, building dams, and dissemination of invasive species. **Assessment Boundary:** none **Cross-Cutting Concepts:** Stability and Change (HS-LS2-7) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-LS2-7)	human activity) in the environment, including habitat destruction, pollution, invasive species, over-exploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) **LS4.D: Biodiversity and Humans:** Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(HS-LS2-7)* Humans depend on the living world for resources and other benefits provided by biodiversity. But human activity is having adverse impacts on biodiversity through overpopulation, over-exploitation, habitat destruction, pollution, invasive species, and climate change. Sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth and aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) **ETS1.B: Developing Possible Solutions:** When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social,	• Finding Solutions to Environmental Issues/Problems **Other Activities:** ● Rainforest habitat fragmentation • The Anthropocene: Human Impact on the Environment **Honors Activities:** • HHMI Gogongosa biodiversity	**Tlingit Halibut Hook:** designed to only catch halibut of a certain size; prevents getting reproducing female halibut. **Traditional Ecological Knowledge and Natural Resource Management** edited by Charles R. Menzies **Alaskan Inuit Food Security Conceptual Framework:** How to Assess the Arctic for Food Security from an Inuit Perspective **Goldbelt Heritage Foundation:** • Investigating Tlingit Ecological Knowledge The natural habitats of Southeast Alaska represent a wealth of niches. This includes the habitats of both plants and animals. For example, in areas where logging has removed the trees, blueberry bushes abound.

	cultural and environmental impacts. (secondary to HS-LS2-7) **AK Science Standard:** (11) SCS3.2 Analyzing the potential impacts of changes (e.g., climate change, habitat loss/gain, cataclysms, human activities) within an ecosystem		
HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. **Clarification Statement:** Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms. **Assessment Boundary:** none **Cross-Cutting Concepts:** Energy and Matter (HS-ESS2-6) **Science & Engineering Practices:** Developing and Using Models (HS-ESS2-6)	**ESS2.D: Weather and Climate:** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6) Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6)	**NGSS Activity Links:** • IRIS Rapid Earthquake Viewer (REV) • National Oceanic and Atmospheric Administration (NOAA) Carbon Tracker **Other Activities:** • Create a biosphere model • GLOBE Digital Earth System Posters (NASA) **Honors Activities:** • Exploring climate change	**Tlingit Value:** You will be stewards of the earth: aan daa tlein tuti • Build a model of local area including carbon interactions
HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. **Clarification Statement:** Emphasis is on dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, where	**ESS2.D: Weather and Climate:** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-7) **ESS2.E: Biogeology:** The many dynamic and delicate feedbacks between the biosphere and other	**NGSS Activity Links:** • Coral Reef ecology curriculum • How endosymbiosis changed life on Earth • The coevolutionary arms race **Other Activities:** • Explain the shape of beaks of hummingbirds	• USFS Pacific NW Research: Measurement of Coastal Soils for CO_2 and CH_4

geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples: photosynthetic life altered the atmosphere through production of oxygen, which increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased formation of soil, and allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms. **Assessment Boundary:** Does not include a comprehensive understanding of how the biosphere interacts with all of Earth's other systems. **Cross-Cutting Concepts** Stability and Change (HS-ESS2-7) **Science & Engineering Practices:** Engaging in Argument from Evidence (HS-ESS2-7)	Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)	• Red queen hypothesis • History of oxygen on Earth **Honors Activities:** • How endosymbiosis changed life on Earth • The coevolutionary arms race • Keeping It Real- Ground Validation Campaigns for NASAs GPM Core Observatory	
HS-ESS3-5: 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.	**ESS3.D: Global Climate Change:** Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)	**NGSS Activity Links:** • My NASA Data - GLOBE Digital Earth Systems Poster and Activity Guide • NASA Graphing global temperature trends • Climate Outlooks for the Next 3 Months - Probability Maps	Invite elders to discuss the environmental changes they have witnessed. Could include oral narratives of glaciers changing. **Videos:** • An Unpredictable Climate • Inuit Observations on Climate Change

Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition). **Assessment Boundary:** Limited to one example of a climate change and its associated impacts. **Cross-Cutting Concepts:** Stability and Change (HS-ESS3-5) **Science & Engineering Practices:** Analyzing and Interpreting Data (HS-ESS3-5) **Connections to Nature of Science**: Science Knowledge Is Based on Empirical Evidence (HS-ESS3-5) **Connections to Nature of Science**: Scientific Investigations Use a Variety of Methods (HS-ESS3-5), (HS-ESS3-5)	**AK Science Standard:** (11) SC3.2 Analyzing the potential impacts of changes (e.g., climate change, habitat loss/gain, cataclysms, human activities) within an ecosystem	• Hurricane Frequency and Intensity **Other Activities:** • When extremes become the mean • Satellite meteorology **Honors Activities:** • Vostok Ice Core: Excel • NASA Graphing sea level trends	• Alaska Native Teens Help Researchers • Arctic Climate Perspectives Where did the herring in Auk Kwaan and Taku Kwaan go? Impacts of humans on the ecology of the area with warming waters and ocean acidification. Resources: (historical photo in archives of expired herring on sandy beach in Juneau) and oratory from elders and knowledge bearers. Sitkoh Bay: name speaks of a glacier having been there **Articles:** • Culturally valuable yellow cedar on the decline • Conservation interests fear prized yellow cedar may face extinction • Sea Level Rise and Storm Surge **National Park Service/Sitka:** Climate Change **AK Dept. of Fish and Game: Alaska Wildlife Curriculum** • Wildlife for the Future, Section III: Sustaining Wildlife & Communities • Alaska's Ecology Human Impacts on Ecosystems, Section IV • Alaska's Wetlands- Wetlands in a changing world, Section IV • Alaska's Forests & Wildlife, Human Impacts on Forest Ecosystems, Section V

HONORS BIOLOGY			
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. **Clarification Statement:** Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. **Assessment Boundary:** Assessment is limited to provided data. **Cross-Cutting Concepts:** Scale, Proportion, and Quantity (HS-LS2-2) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-LS2-2) **Connections to Nature of Science:** Scientific Knowledge Is Open to Revision in Light of New Evidence (HS-LS2-2)	**LS2.A: Interdependent Relationships in Ecosystems:** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience:** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of	**NGSS Activity Links:** • Bug Lyphe! A Next Generation-linked observational study in biodiversity • NetLogo: Rabbits, Grass, Weeds - Ecosystem Model • Niche partitioning HHMI **Other Activities:** • Carrying capacity and bears in Alaska • HHMI Earth and Environment • Recycling for the Future • NOAA ocean pollution	**Traditional Tlingit Value:** Respect for the most minute creature **Wooch yaxh hadaali**: weighted evenly, balance of any two different species **Tlingit Stories:** Human dependence on water and the environment: • How Raven Stole the Water • Box of Daylight **Tlingit Halibut Hook:** designed to only catch halibut of a certain size; prevents getting reproducing female halibut. **Traditional Ecological Knowledge and Natural Resource Management** edited by Charles R. Menzies **Phenomena Research:** • Where have all the swallows gone? Juneau • Glacial and ice sheet changes- new species taking over habitat • Murre studies, dying off • Harbor seals and ice flows • Clams and mussels…. distribution in comparison with past psp • Bering Sea pollock • Wolf pack studies **AK Dept. Fish & Game** curriculum: • Alaska's Ecology - Human Impacts on Ecosystems, Section IV • Alaska's Forests & Wildlife- Human uses and impacts in forest ecosystems, Section V

	ecosystems in terms of resources and habitat availability. (HS-LS2-2)		• Alaska's Tundra- Human uses and impacts in tundra ecosystems, Section V • Alaska's Wetlands - Wetlands in a changing world, Section IV
HS-ESS3-3: Create computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. **Clarification Statement:** Factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, new technologies. Factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning. **Assessment Boundary:** Computational simulations is limited to using multi-parameter programs or constructing simplified spreadsheet. **Cross-Cutting Concepts:** Stability and Change(HS-ESS3-3) **Connections to Engineering, Technology, and Applications of Science:** Influence of Science, Engineering, and Technology on Society and the Natural World (HS-ESS3-3), (HS-ESS3-3)	**ESS3.C: Human Impacts on Earth Systems:** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)	**NGSS Activity Links:** • Human Footprint • Conservation in Action • Fisheries and Seafood Consumption • Energy Consumption Rates Around the World **Other Activities:** • Your carbon footprint • Gorongosa National Park • Fisheries and Seafood Consumption • Biodiversity in Alaska • Recycling for the Future • NOAA ocean pollution	**Traditional Tlingit Value**: Respect for the most minute creature • There is a relationship between how hard a person works to gather food and the quality of life. There is also a relationship between the amount available for harvesting and the actual harvest. **Tlingit Halibut Hook**: designed to only catch halibut of a certain size; prevents getting reproducing female halibut. • The effects of early commercial fisheries nearly wiped-out all of the salmon resources by use of fish traps. All of these issues are sovereignty issues. **Tlingit Stories**: Human dependence on water and the environment: • How Raven Stole the Water • Box of Daylight **Traditional Ecological Knowledge and Natural Resource Management** edited by Charles R. Menzies • Specific places in Tlingit country have specific plants and animals that flourish. This helps set up the trading network, with reciprocity of trading resources. For example, herring eggs in Sitka were traded for hooligan, soap

Connections to Nature of Science: Science Is a Human Endeavor (HS-ESS3-3) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-ESS3-3)			berries, high bush cranberries, dried seaweed, mountain goat meat, dyes for Chilkat blankets, copper and other items. (Subsistence Harvest of Herring Eggs in Sitka Sound p. 12)
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. **Clarification Statement:** Examples of data on the impacts of human activities include quantities and types of pollutants released, changes to biomass and species diversity, areal changes in land surface use (such as for development, agriculture, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean). **Assessment Boundary:** none **Cross-Cutting Concepts:** Stability and Change (HS-ESS3-4)	**ESS3.C: Human Impacts on Earth Systems:** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4) **ETS1.B: Developing Possible Solutions:** When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (secondary to HS-ESS3-4)	**NGSS Activity Links:** • UN Climate Council • Community Resilience • 5E Resource Conservation: E Waste • Human Footprint **Other Activities:** • HHMI Earth and Environment • Recycling for the Future • NOAA ocean pollution	**Traditional Tlingit Value**: Respect for the most minute creature **Tlingit Halibut Hook:** designed to only catch halibut of a certain size; prevents getting reproducing female halibut. **Traditional Ecological Knowledge and Natural Resource Management** edited by Charles R. Menzies **Phenomena research:** • Where have all the swallows gone? • Glacial and ice sheet changes- new species taking over habitat • Murre studies, dying off • Harbor seals and ice flows • Clams and mussels…. distribution in comparison with past psp • Bering Sea pollock • Wolf pack studies **AK Dept. of Fish and Game Alaska Wildlife Curriculum:** • Alaska's Ecology - Human Impacts on Ecosystems, Section IV • Alaska's Forests & Wildlife - Human uses and impacts in forest ecosystems, Section V

Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World (HS-ESS3-4) **Science & Engineering Practices:** Constructing Explanations and Designing Solutions (HS-ESS3-4)			• Alaska's Tundra - Human uses and impacts in tundra ecosystems, Section V • Alaska's Wetlands - Wetlands in a changing world, Section IV
HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. **Clarification Statement:** Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations. **Assessment Boundary:** Assessment does not include running computational representations but is limited to using the published results of scientific computational models.	**ESS2.D: Weather and Climate**: Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) **ESS3.D**: **Global Climate Change:** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)	**NGSS Activity Links:** • Climate Science in Focus • Human Footprint • Will there be enough freshwater? • Earth's Dynamically Changing Climate • Analysis: Leaves, buds, and climate change **Other Activities:** • Model ocean acidification • Global climate change	**A Time of Two Winters**: Tlingit oral narratives about a time of two winters due to a volcanic eruption that spread a thick layer of ash so widely that it had the effect of winter-like conditions where the ground was covered in ashen "snow". **Spruce Aphid: Small bugs, big problems** - shifting environmental pressures affect certain animals more than others

Cross-Cutting Concepts: Systems and System Models (HS-ESS3-6) **Science & Engineering Practices:** Using Mathematics and Computational Thinking (HS-ESS3-6)			

Unit/Instructional Focus: Anatomy and Physiology	**Suggested Unit Phenomena:** • Homeostasis of body temperature in the cold • Flight or fight response • Why is a defibrillator used to get somebody's heart beating again? • When you drink a glass of water, why do you have to urinate? • Why do women have menstrual cycles? • Why can use pull your hand back from a hot stove before you feel the pain? • Why do you have to eat? • How do vaccines work? • How does skin cancer form? **Essential Questions:** • How do the human organ systems work to maintain homeostasis in the body? • How do organ systems of the body interact with one another to maintain human life? • How do diseases affect the organ systems of the body, and what medical technologies are used for diagnosis and treatment	**Standards**	
Recommended Pacing: 7 weeks		Alaska Cultural Standards	C3, D6
Content/Topics: • Structure and Function		Alaska ELA Standards	SL.11-12.5, WHST.11-12.7, WHST.11-12.8
		Alaska Math Standards	MP 5, 6
		Alaska Science Standards	SC2, (9), SC2.3, (10) SC2.1, .3, .4, (11) SC2.3, SE1, SE3, SG1
		ISTE	1c, 3

Alaska Cultural Standard to Emphasize	**Community Contacts**
C. Culturally-knowledgeable students are able to actively participate in various cultural environments. 3. Attain a healthy lifestyle through which they are able to maintain their own social, emotional, physical, intellectual and spiritual well-being.	• **STEM Database Community Resources** • **US Forest Service:** Mendenhall Glacier Visitor Center: 789-6614**;** Juneau Ranger District**:** 789-6252, Pacific NW Research Station 586-8811, https://www.fs.fed.us/pnw/about/programs/index.shtml

NGSS		Suggested Activities	Cultural & Place-Based Connections
Performance Expectations (PEs)	**Disciplinary Core Ideas (DCIs)**		
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **Clarification Statement:** Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Example: An artery depends on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system. **Assessment Boundary:** Does not include interactions and functions at the molecular or chemical reaction level. **Cross-Cutting Concepts:** Systems and System Models (HS-LS1-2) **Science & Engineering Practices:** Developing and Using Models (HS-LS1-2)	**LS1.A: Structure and Function:** Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)	**NGSS Activity Links:** • Designing a Digestive System • Enzymes Help Us Digest Food • Adapting to the Environment, Using Leaves to Introduce Students to Ecophysiology **Honors Activities:** • Enzyme lab • Using dialysis tubing to model kidney function	Tlingit interacted with their environment and learned about all parts of the animals and plants, including tissues. • *Guwakaan*/deer: Cultural significance and anatomy of the black-tailed deer • Common Edible Seaweeds in the Gulf of Alaska by Dolly Garza- functions of holdfast, stipe, bulb and traditional uses of **Traditional Use of Urine-** related to kidneys & waste filtration: Ammonia, a break-down product of urine, had uses when people could not just go to the store for chemicals. Bring in a guest speaker with knowledge of its uses.
HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	**LS1.A: Structure and Function:** Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external	**NGSS Activity Links:** • Human Homeostasis • Conceptualizing A System: Introduction to Anatomy and Physiology: Systems, Subsystems and Balance	**Tlingit World View:** All living things, including the land and water, breathe.

Clarification Statement: Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels. **Assessment Boundary:** Assessment does not include the cellular processes involved in the feedback mechanism. **Cross-Cutting Concepts:** Stability and Change (HS-LS1-3) **Science & Engineering Practices:** Planning and Carrying Out Investigations (HS-LS1-3) **Connections to Nature of Science**: Scientific Investigations Use a Variety of Methods (HS-LS1-3)	conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) **AK Science Standards:** (10) SC2.1 Describing the structure-function relationship (e.g., joints, lungs). (10) SC2.3 Explaining the functions of organs of the major systems. (i.e., respiratory, digestive, circulatory, reproductive, nervous, musculoskeletal, and excretory). (10) SC2.4 tracing the pathways of the digestive, circulatory, and excretory systems. (9&10) SC2.3 - Explaining the function of organs of major systems (i.e. respiratory, digestive, circulatory, reproductive, nervous, musculoskeletal, integumentary, endocrine, immune and excretory). (11) SC2.3 - Describing the functions and inter- dependencies of the organs within the immune system and endocrine system.	**Honors Activities:** • Sitka Spruce and the temperate rainforest climate • Heart rate and homeostasis lab	**Dissection:** Tlingit were well aware of the specialized purposes of the different body parts. Much of their knowledge about the internal function of a body would have come from the butchering of harvested animals. Cultural consideration with regard to dissection as some animals are clan emblems of different groups. For example, the Ishkahittan Tlingit clan and the Kiks.adi have the frog as their clan emblem. Tlingit words for edible body parts during dissections: • a muscle: katási **Salmon Boy**: *Shanyáak'utlaax*- story with dissections as a way to share respect for all creatures **Health benefits from fermentatio**n of traditional foods (ooligan oils) **Phenomena research:** • Cancer: diet and health indicators • Face painting for going out on the water for protection from sun **Articles:** • Tlingit men trained hard to become warriors • The warrior code • Sealaska to honor warriors, veterans for Native American heritage month **Dissections:** Contact Fish and Wildlife for local road kill

Juneau School District Science Curriculum
High School Course Descriptions and Syllabi

High School Science Courses

Required for Graduation: 3 credits including:

- Physical Science or Honors Physical Science, 9th grade, 1 credit
- Biology or Honors Biology, 10th grade, 1 credit

Electives:

- AP Biology, 11-12th grade, 1 credit
- AP Environmental Science, 11-12th grade, 1 credit
- AP Physics, 11-12th grade, 1 credit
- Applied Science-STEM, 9-12th grade, .5 credit
- Earth Science, 11-12th grade, 1 credit
- Emergency Medical Technician Training, EMT, 12th grade, 1 credit
- Emergency Trauma Technician Training, ETT, 9-12th grade, .5 credit
- Fisheries Tech I, 11-12th grade, .5 credit
- Fisheries Tech II, 11-12th grade, .5 credit
- Forensic Science, 11-12th grade, .5 credit
- Geology, 11-12th grade, .5 credit
- Human Anatomy and Physiology, 11-12th grade, 1 credit
- Honors Chemistry, 11-12th grade, 1 credit
- Introduction to Chemistry, 11-12th grade, 1 credit
- Introduction to Health Sciences, 11-12th grade, .5 credit
- Marine Biology, 11-12th grade, 1 credit
- Oceanography, 11-12th grade, 1 credit
- Outdoor Biology, 11-12th grade, 1 credit
- Physics, 11-12th grade, 1 credit
- Project Lead the Way: Introduction to Engineering Design, 9-12th grade, 1 credit
- Project Lead the Way: Principles of Engineering, 9-12th grade, 1 credit

Course Name	Physical Science (required for graduation)
Course Number	S111
High School Credits	1
Course Description	This course is a survey of the laws and theories that govern and allow us to predict the behavior of the world around us. Topics include scientific laws governing motion, energy, waves, electricity and magnetism, light and sound, atoms and molecules, and chemical reactions. Students completing this course will understand the scientific method and achieve basic competency in the skills needed to design, conduct, and evaluate experiments.
Pre-Requisites	n/a
Course Sequence, if applicable	
Alaska Cultural Standards	B1, B2, E1, E3, E4
Alaska Science Standards	SA1, SA1.1, SA1.2, SA2, SA2.1, SA3, SA3.1, SB1, SB2, SB2.1, SB2.2, SB3, SB3.1, (10) SB3.3, SB4, SB4.1 (8), SB4.2, SB4.3 (6,7,9), SD3, SD3.1, SD3.2, SD4.1, SE1, SE2, SF1, SG1, SG3
Alaska ELA Standards	RI.9-10.1, RI.9-10.7, RI.9-10.8, RST.9-10.7, RST.9-10.8, RST.11-12.1, RST.11-12.7, RST.11-12.8, W9-10.1, W9-10.2, W9-10.8, W9-10.9, WHST.9-12.2, WHST.9-12.5, WHST.11-12.7, WHST.11-12.8, WHST.11-12.9, SL.11-12.4, SL.11-12.5,
Alaska Math Standards	MP 1-5, N-Q.1, N-Q.2, M-Q.3, A-CED.2, A-CED.4, A-SSE.1, A-SSE.3, F-IF.7, S-ID.1,
ISTE Standards	1C, 3, 4, 5, 7
Course Topics by identified by quarter/timelines	Week 1: Nature of Science Q: Matter and Interactions: Structure and Properties of Matter, Types of Interactions, Chemical Reactions, Optimizing the Design Solution, Nuclear Processes, Universe and Stars, Energy and Chemical Processes and Life Q: Motion and Stability (Forces and Interactions): Forces and Motion, Defining and Delimiting Engineering Problems, Optimizing Design Solution, Types of Interactions, Definitions of Energy, Structure and Properties of Matter, Earth and Solar System, Electromagnetic Radiation, Universe and Stars Q: Energy: Definitions of Energy, Conservation of Energy and Energy Transfer, Energy in Chemical Processes and Everyday Life, Defining and Delimiting Engineering Problems, Relationship between Energy and Forces, Earth Materials and Systems, Earth and Solar System, Weather and Climate, Natural Resources, Developing Possible Solutions Q: Waves and application in technology for information transfer: wave properties, electromagnetic radiation, energy in the chemical processes and everyday life, information technologies and instrumentation
Instructional Resources	Hewitt, P. Conceptual Physical Science
Assessment Plan	labs, projects, quizzes, tests

Course Name	Honors Physical Science
Course Number	S113
High School Credits	1
Course Description	This course is a survey of the laws and theories that govern and allow us to predict the behavior of the world around us. Topics include scientific laws governing motion, energy, waves, electricity and magnetism, light and sound, atoms and molecules, and chemical reactions. Students completing this course will have the understanding of the scientific method and basic competency in the skills needed to design, conduct, and evaluate experiments. This course is comparable to the regular physical science course, but the use of Algebra is fully integrated into the curriculum. Topics are covered at a greater depth and the course moves at a faster pace than the regular Physical Science. Students will be required to apply information learned in class to the completion of a science project.
Pre-Requisites	C or better in Algebra 1
Course Sequence, if applicable	
Alaska Cultural Standards	B1, B2, E1, E3, E4
Alaska Science Standards	SA1, SA1.1, SA1.2, SA2, SA2.1, SA3, SA3.1, SB1, SB2, SB2.1, SB2.2, SB3, SB3.1, (10) SB3.3, SB4, SB4.1 (8), SB4.2, SB4.3 (6,7,9), SD3, SD3.1, SD3.2, SD4.1, SE1, SE2, SF1, SG1, SG3
Alaska ELA Standards	RI.9-10.1, RI.9-10.7, RI.9-10.8, RST.9-10.7, RST.9-10.8, RST.11-12.1, RST.11-12.7, RST.11-12.8, W9-10.1, W9-10.2, W9-10.8, W9-10.9, WHST.9-12.2, WHST.9-12.5, WHST.11-12.7, WHST.11-12.8, WHST.11-12.9, SL.11-12.4, SL.11-12.5,
Alaska Math Standards	MP 1-5, N-Q.1, N-Q.2, M-Q.3, A-CED.2, A-CED.4, A-SSE.1, A-SSE.3, F-IF.7, S-ID.1,
ISTE Standards	1C, 3, 4, 5, 7
Course Topics by identified by quarter/timelines	Week 1: Nature of Science Q: Matter and Interactions: Structure and Properties of Matter, Types of Interactions, Chemical Reactions, Optimizing the Design Solution, Nuclear Processes, Universe and Stars, Energy and Chemical Processes and Life Q: Motion and Stability (Forces and Interactions): Forces and Motion, Defining and Delimiting Engineering Problems, Optimizing Design Solution, Types of Interactions, Definitions of Energy, Structure and Properties of Matter, Earth and Solar System, Electromagnetic Radiation, Universe and Stars Q: Energy: Definitions of Energy, Conservation of Energy and Energy Transfer, Energy in Chemical Processes and Everyday Life, Defining and Delimiting Engineering Problems, Relationship between Energy and Forces, Earth Materials and Systems, Earth and Solar System, Weather and Climate, Natural Resources, Developing Possible Solutions Q: Waves and application in technology for information transfer: wave properties, electromagnetic radiation, energy in the chemical processes and everyday life, information technologies and instrumentation
Instructional Resources	Hewitt, P. Conceptual Physical Science
Assessment Plan	Labs, projects, quizzes, tests

JSD High School Science Curriculum

Course Name	Biology (required for graduation)
Course Number	S211
High School Credits	1
Course Description	Biology introduces students to concepts basic to life sciences. Among these are the structural and chemical basis of life as shown by microbiology, cellular processes, and human anatomy/physiology; the diversity and continuity of life demonstrated through genetics, evolution and paleontology; and the interrelationships of global and local ecological processes. Student will be expected to participate in class discussion and content integrated laboratory experiences. Dissections may be required.
Pre-Requisites	n/a
Course Sequence, if applicable	
Alaska Cultural Standards	B1,C3, D6, E1, E2, E3, E4, E8
Alaska Science Standards	(10,11) SC3.3, (10) SC2.1, (10) SC2.2, (10) SC2.3, (10) SC2.4, (10) SC2.4, (11) SC2.2, (11) SC2.3, (11) SC3.2,(9, 10) SC3.3, (9) SC2.3, (9) SC3.1, SA1, SA1.1, SA1.2, SA2, SA2.1, SA3, SA3.1, SC2, SC2,SC3 (10), SC3.1, SC3.2, SD1, SD2, SD3, SE1, SE3, SF1, SF3, SG1, SG3
Alaska ELA Standards	RI.9-10.1, RI.9-10.7, RI.9-10.8, RST.11-12.1, RST.11-12.7, RST.11-12.8, RST.11-12.9, SL.11-12.5, W9-10.1, W9-10.2, W9-10.8, W9-10.9, WHST.11-1.7, WHST.11-12.9, WHST.9-11.12.9, WHST.9-12.2, WHST.9-12.5
Alaska Math Standards	MP 1-7, F-BF.1, F-IF.7, N-Q.1, N-Q.2, N-Q.3
ISTE Standards	1, 3, 4, 5
Course Topics by identified by quarter/timelines	Week 1: Nature of Science Weeks 2-6: Photosynthesis/Cellular Respiration: Organization for matter and energy flow in organisms, cycles of matter and energy transfer in ecosystems Weeks 7-14: Genetics: Structure and Function, Growth and Development of Organisms, Inheritance of Traits, Variation of Traits, Social Interactions and Group Behavior Weeks 15-22: Evolution: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, Classification Weeks 23-30: Ecology: Interdependent Relationships in Ecosystems, Cycles of Matter and Energy Transfer in Ecosystems, Energy in the Chemical Processes and Everyday Life, Ecosystem Dynamics, Functioning, Resilience, Biodiversity and Humans, Developing Possible Solutions, Weather and Climate, Biogeology, Human Impacts on Earth Systems, Global Climate Change Weeks 31-36: Anatomy and Physiology: Structure and Function
Instructional Resources	Miller and Levine, *Biology,* 6th edition
Assessment Plan	labs, projects, quizzes, tests

Course Name	Honors Biology
Course Number	S213
High School Credits	1
Course Description	Honors Biology introduces students to concepts basic to life sciences. Among these are the structural and chemical basis of life as shown by microbiology, cellular processes, and human anatomy/physiology; the diversity and continuity of life demonstrated through genetics, evolution and paleontology; and the interrelationships of global and local ecological processes. Students will be expected to participate in class discussions and content integrated laboratory experiences. A greater emphasis is placed on the quantitative nature of the material covered. Students will be required to complete a science project. There will be regular rigorous reading assignments and dissections may be required.
Pre-Requisites	C or better in Physical Science or instructor permission
Course Sequence, if applicable	
Alaska Cultural Standards	B1,C3, D6, E1, E2, E3, E4, E8
Alaska Science Standards	(10,11) SC3.3, (10) SC2.1, (10) SC2.2, (10) SC2.3, (10) SC2.4, (10) SC2.4, (11) SC2.2, (11) SC2.3, (11) SC3.2,(9, 10) SC3.3, (9) SC2.3, (9) SC3.1, SA1, SA1.1, SA1.2, SA2, SA2.1, SA3, SA3.1, SC2, SC2,SC3 (10), SC3.1, SC3.2, SD1, SD2, SD3, SE1, SE3, SF1, SF3, SG1, SG3
Alaska ELA Standards	RI.9-10.1, RI.9-10.7, RI.9-10.8, RST.11-12.1, RST.11-12.7, RST.11-12.8, RST.11-12.9, SL.11-12.5, W9-10.1, W9-10.2, W9-10.8, W9-10.9, WHST.11-1.7, WHST.11-12.9, WHST.9-11.12.9, WHST.9-12.2, WHST.9-12.5
Alaska Math Standards	MP 1-7, F-BF.1, F-IF.7, N-Q.1, N-Q.2, N-Q.3
ISTE Standards	1, 3, 4, 5
Course Topics by identified by quarter/timelines	Week 1: Nature of Science Weeks 2-6: Photosynthesis/Cellular Respiration: Organization for matter and energy flow in organisms, cycles of matter and energy transfer in ecosystems Weeks 7-14: Genetics: Structure and Function, Growth and Development of Organisms, Inheritance of Traits, Variation of Traits, Social Interactions and Group Behavior Weeks 15-22: Evolution: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, Classification Weeks 23-30: Ecology: Interdependent Relationships in Ecosystems, Cycles of Matter and Energy Transfer in Ecosystems, Energy in the Chemical Processes and Everyday Life, Ecosystem Dynamics, Functioning, Resilience, Biodiversity and Humans, Developing Possible Solutions, Weather and Climate, Biogeology, Human Impacts on Earth Systems, Global Climate Change Weeks 31-36: Anatomy and Physiology: Structure and Function
Instructional Resources	Campbell and Resse, *Concepts and Connections,* 6th edition
Assessment Plan	labs, projects, quizzes, tests

Course Name	AP Biology
Course Number	S231
High School Credits	1 credit
Course Description	AP Biology is an introductory college-level biology course. The course encompasses core scientific principles, theories, and processes that cut across traditional boundaries and provide a broad way of thinking about living organisms and biological systems. The core units include the following concepts: the process of evolution which explains the diversity and unity of life; biological systems which utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis; living systems which store, retrieve, transmit, and respond to information essential to life processes and biological systems interactions; and how these systems and their interactions possess complex properties. Required lab experiences will require time outside of regular school hours. A personal commitment to a consistent rigorous study schedule is an expectation.
Pre-Requisites	Biology or Honors Biology and Honors Chemistry (can be taken concurrently)
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	B1, B2, B4, E3, E4
Alaska Science Standards	SA1-3, SC1-3, SE1-3, SF1-2, SG1-3
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1, 2, 3, 5, 6, 7
Course Topics by identified by quarter/timelines	<u>Weeks 1-3 Biochemistry</u> Elementary principles of inorganic chemistry, Role of water and carbon and the functional groups, Macromolecules: carbohydrates, lipids, proteins, nucleic acids, Free energy and enzymes <u>Weeks 4-9 Cell Biology</u> Structure of cells, including bacteria and viruses, Organelles, Membrane structure, function, and transport, Cellular respiration, Photosynthesis <u>Weeks 10-17 Genetics</u> Cell cycle, Mitosis and Meiosis, Mendelian genetics, probability, segregation, independent assortment, Non-Mendelian patterns: codominance, epitasis, etc., Human genetics, pedigree analysis, Sex linkage, autosomal linkage, linkage maps, Chromosomal abnormalities due to non-disjunction, Eukaryotic chromosome, DNA structure and replication, Protein synthesis, transcription and translation, Control of gene expression, Biotechnology techniques: cloning, PCR, gel electrophoresis <u>Weeks 18-21 Evolution</u> Evidences for evolution, Evolution in action today Population genetics, Hardy-Weinberg equation Natural selection, microevolution events, types of selection

	Speciation, prezygotic and postzygotic mechanisms, allopatric and sympatric speciation Week 22-24 Plant form and function Plant structures and response Week 25-31 Animal form and function Overview of structure and function of organ systems, reproduction and embryology Weeks 32-36 Ecology Community ecology, ecological succession, succession Ecosystem ecology, trophic structure and productivity, Population ecology
Instructional Resources	Campbell and Resse, *Biology* 8th edition AP College Board text
Assessment Plan	labs, projects, quizzes, tests

Course Name	AP Environmental Science
Course Number	S546
High School Credits	1 credit
Course Description	AP Environmental Science is an introductory college level course. It provides students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary and it embraces a wide variety of topics from different areas of study with several major unifying constructs themes. Mandatory lab and field experiences will require time outside of regular school hours.
Pre-Requisites	C or better in Biology/Honors Biology and Physical Science/Honors Physical Science
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, B1, B2, B4, E3, E4
Alaska Science Standards	SA1-3, SB 1-4, SD 1-4, SE1-3, SF1-2, SG1-3
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1, 2, 3, 5, 6, 7
Course Topics by identified by quarter/timelines	<u>Weeks 1-3 Earth Systems and Resources</u> A. Earth Science Concepts B. The Atmosphere C. Global Water Resources and Use D. Soil and Soil Dynamics <u>Weeks 4-6 The Living World</u> A. Ecosystem Structure B. Energy Flow C. Ecosystem Diversity D. Natural Ecosystem Change E. Natural Biogeochemical Cycles <u>Weeks 7-9 Population</u> A. Population Biology Concepts B. Human Population <u>Weeks 10-13 Land and Water Use</u> A. Agriculture B. Forestry C. Rangelands D. Other Land Use E. Mining F. Fishing

	G. Global Economics Weeks 14-19 Energy Resources and Consumption A. Energy Concepts B. Energy Consumption C. Fossil Fuel Resources and Use D. Nuclear Energy E. Hydroelectric Power F. Energy Conservation G. Renewable Energy Weeks 20-29 Pollution A. Pollution Types B. Impacts on the Environment and Human Health C. Economic Impacts Weeks 30-33 Global Change A. Stratospheric Ozone B. Global Warming C. Loss of Biodiversity Weeks 34-36 Field experience presentations
Instructional Resources	AP College Text
Assessment Plan	labs, quizzes, projects, tests

Course Name	AP Physics C: Mechanics
Course Number	S421
High School Credits	1 credit
Course Description	AP Physics C: Mechanics is equivalent to a one-semester, calculus-based, college-level physics course, especially appropriate for students planning to specialize or major in physical science or engineering. The course explores topics such as kinematics; Newton's laws of motion; work, energy and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation. Introductory differential and integral calculus is used throughout the course.
Pre-Requisites	junior or senior; Pre-Calculus or concurrent enrollment
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science; Calculus or concurrent enrollment in calculus
Alaska Cultural Standards	A1, B1, B2, B4, D5, E1, E4
Alaska Science Standards	SA1, SA2, SB1, SB2, SB4, SD3, SG1, SG3, SG4
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Weeks 1-3: Introduction: units, computer interfacing, Excel, curve fitting and power functions (vs shape and log/log graphics), exponential function and decay; Labs: Suite of labs (heft v mass of projectile; period v mass of pendulum; period v mass of spring/mass oscillator; mass v diameter of sphere; mass v length of cylinder; Newton's Law of cooling; Excel exercise Weeks 4-6: 1-D Kinematics Labs: Motion Sensor Graphing; Bowling Ball on incline; Egg drop Weeks 7-9: 2D Kinematics: Unit vectors, Projectile motion; Circular motion; Relative motion Labs: Basketball shot video analysis; ring shoot Weeks 10-13: Newton's Labs: Force, Mass, Weight; Tension and normal force; Free body diagrams, 2nd Law Analysis; Friction; Circular motion Labs: Friction lab; Air Resistance Lab Weeks 14-18: Energy: Work and scalar product; Kinetic energy; Center of mass work and work-kinetic energy theorem; Power; Conservative & non-conservative forces; Potential energy; Springs, Hooke's Law and elastics potential energy; Potential energy curves, conservative forces and potential energy; Conservation of energy Labs: Projectile Launcher Spring Lab; Hot Wheels Loop the Loop Weeks 19-22: Impulse-Momentum: Center of mass; Momentum; Impulse; Conservation of momentum; Explosions; Perfectly inelastic collisions; Elastic collisions and partially elastic collisions; 2-d collisions Labs: Methanol Cannon; Ballistic Pendulum

	Weeks 23-27: Rotation: Rotational kinematics; Kinetic energy in rotation; Moments of inertia; Parallel axis theorem; Torque and vector product; 2nd Law for Rotation; Work and power in rotation; Rolling motion; Angular momentum; Conservation of angular momentum; Statics; Labs: Rotational Inertia Lab Weeks 28-31: Oscillations: Spring/mass oscillator; Simple harmonic motion and uniform circular motion; Simple harmonic motion; Pendulum; Energy; Torsional pendulum, physical pendulum; Labs: Minimum Period of a Physical Pendulum; Springs in Parallel and Series; Weeks 32-33: Gravity: Newton's Law of Universal Gravitation; Kepler's Laws and Planetary motion; Gravitational fields; Gravitational potential energy; Energy and escape speed; Labs: Virtual lab-Ptolemaic v Keplerian motion applet Weeks 34-35: Review for AP exam: review of topics; sample AP exam practice
Instructional Resources	AP Physics College Board Text: Supplementary: *Principles of Physics* (Kinetic Books) Additional materials supplemented by teacher
Assessment Plan	labs, projects, quizzes, tests Unit tests at end of each unit. Units have multiple labs and homework assignments.

Course Name	Applied Science-STEM
Course Number	YS41
High School Credits	.5 credit
Course Description	The goal of the class is to foster a learning environment in which students are guided to produce original ideas, projects, and structures according to certain specifications using concepts and skills from math, science, engineering, and technology. Emphasis is placed on scientific methodology and/or engineering research process and engineering designs. Students may be engaged in independent or collaborative scientific research and/or engineering projects. Students are expected to fulfill a minimum of 67.5 hours in the course of completing their projects.
Pre-Requisites	Physical Science (or concurrent enrollment) and instructional approval
Course Sequence, if applicable	n/a
Alaska Cultural Standards	A1, B1, B2, B4, E3, E4
Alaska Science Standards	SA 1-3, SB 1-4, SC1-3, SE 1-3, SF 1-3, SG1-4
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Weeks 1-4 Understanding and performing inquiry science Weeks 5-8 Understanding the basics of engineering and/or scientific methodology Weeks 9-12 Practicing inquiry and/or engineering design Weeks 13-18 Final project design and testing and presentation
Instructional Resources	Scientific/engineering notebooks Intel Science Fair guidelines FIRST Robotics resources
Assessment Plan	labs, projects, tests, product/portfolio/presentations

Course Name	Earth Science
Course Number	S252
High School Credits	1 credit
Course Description	Students will learn the foundations of Earth Science, the forces that shape our Earth and universe, and explore their local environment. This course focuses on local and global environmental issues connected to the major Earth Science components: geology, hydrology, meteorology (including climatology) and astronomy.
Pre-Requisites	junior or senior
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	B3, D3, D5, E1-4
Alaska Science Standards	SA1, 2, SB1, SD1-4, SE1-3, SF1, 3, SG1-4
Alaska ELA Standards	RST.11-12, 1, 4, 7, 8, 9 WHST.11-12, 1, 2, 6, 7, 8, 9
Alaska Math Standards	CED.2, S-ID.3, S-ID.9, MP 1-7
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q1: Explore Earth Systems: Earth's Layers and Plate Movements Q2: Explore Earth Systems: How the water and carbon cycle influence climate Q3: Explore Earth Systems: Climatology with emphasis on human impact Q4: Explore Astronomy
Instructional Resources	PBS.org, NASA, Inconvenient Truth (movie), Geophysical Institute (UAF), Earth: A Biogeography (movie), Annenberg Learner (www.learner.org/interactives/dynamicearth, www.learner.org/interactives/rockcycle/index.html) Alaska Resource (www.akresource.org/e-curriculum) USGS: http://ga.water.usgs.gov/edu/watercycle.html, http://response.restoration.noaa.gov/watercyclegame Alaska State Museum/NOAA: SOS (science on a sphere)
Assessment Plan	homework, labs, projects, quizzes, exams

Course Name	Emergency Medical Technician Training, EMT 1
Course Number	Z354
High School Credits	1 credit
Course Description	*EMT 1 is a tech prep course offering dual credit (6 UAS credits - HS S119).* This 140-hour course leads to eligibility for certification as an Emergency Medical Technician 1 and as an EMT-Basic with the State of Alaska and National Registry of Emergency Medical Technicians. Topics include: roles and responsibilities of the EMT; medical legal considerations of EMS; respiratory and cardiac emergencies; CPR; practical use of airway adjuncts; bleeding and shock; trauma management; medical emergencies and their management; environmental emergencies; emergency childbirth; pediatrics; geriatrics; exposure to hazardous situations; introduction to hazardous materials; psychological emergencies; patient packaging and triage; stabilization and transport of sick and injured; communications and report writing. Also included: content from Alaska Skill Sheets, Alaska Cold Injuries Guidelines, Alaska Trauma Guidelines, Alaska Burn Protocols, certain Alaska statutes and regulations related to EMS. Certification as an EMT-I with the Alaska Department of Health and Social Services, or as an EMT-Basic with the National Registry of Emergency Medical Technicians, requires meeting additional qualifications for certification which include the successful completion of written and practical examinations for certification.
Pre-Requisites	junior or senior
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, A2, B4, B2, C3, C4, D6, E4
Alaska Science Standards	SA1, SA2, SA3, SB1, SC2, SC3, SE2, SE3, SF1, SF2, SF3, SG2, SG3
Alaska ELA Standards	RST.11-12, 1, 4, 7, 8, 9 WHST.11-12, 1, 2, 6, 7, 8, 9
Alaska Math Standards	Math F-IF-4, A-CED-4, S-ID-9, MP 1-7
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Roles and Responsibilities of EMT; Medical legal responsibilities of EMS; Respiratory and cardiac emergencies; CPR; practical use of airway adjuncts; bleeding and shock; trauma management; medical emergencies and their management; environmental emergencies; emergency childbirth; pediatrics; geriatrics; exposure to hazardous situations; introduction to hazardous materials; psychological emergencies; patient packaging and triage; stabilization and transport of sick and injured; communications and report writing
Instructional Resources	Emergency Care and Transportation of the Sick and Injured Alaska EMT 1 Skill Sheets
Assessment Plan	homework, labs, quizzes, exams, state exam and practical

Course Name	Emergency Trauma Technician Training - ETT
Course Number	Z353
High School Credits	.5 credit
Course Description	*ETT is a tech prep course offering dual credit (3 UAS credits - HS S118).* This course introduces students to emergency medical care for Alaskan first responders and prepares students for registration for Emergency Trauma Technician (ETT) with the State of Alaska. Students will learn to provide assessment and care as a first responder to medical emergencies, illnesses and injuries. This level of training is the next step beyond initial first aid and CPR. This is the State of Alaska Emergency Medical course where students may earn a certificate after successfully completing an exit exam and practical. This class involves lecture, skills-based labs, and case studies. Course also includes content from the Alaska Skill Sheets, Alaska Cold Injuries Guidelines, Alaska Trauma Guidelines, Alaska Burn Protocols, and Alaska statutes and regulations related to Emergency Medical Services.
Pre-Requisites	n/a
Course Sequence, if applicable	n/a
Alaska Cultural Standards	A1, B2, B4, E4, C3, D6
Alaska Science Standards	SA1, SA2, SA3, SB1, SC2, SC3, SE2, SE3, SF1, SF2, SF3, SG2, SG3
Alaska ELA Standards	RST.11-12.1,2,4, 5,7,9,10 WHST.11-12.4,7,9, 10, L.11-12.2, 3, 4,5, SL.11-12.1.d,2,3,6
Alaska Math Standards	S-ID.1-4, N-Q.1-3, G-CO.2, G-MG.1, MP.1-7, F-BF.2
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Topics include: Roles and Responsibilities of ETT; EMS Professions; Legal and Ethical Issues; Controlling Infections; Basic Structure and function of Human Body; Airway; Oxygen Therapy and BLS; BLS Certification; Patient Assessment; Vital Signs; Trauma; Medical Emergencies; Pediatric Emergencies; Environmental Injuries; EMS Operations; Pneumatic Anti-Shock Garment; patient packaging and triage; stabilization and transport; communications and report writing.
Instructional Resources	*Alaska's Emergency Trauma Training Manual: A guide for Frontier Emergency Medical Responders* (SEREMS) American Heart Association - *Basic Life Support Text* Alaska Skill Sheets: Alaska Cold Injuries Guidelines, Alaska Trauma Guidelines, Alaska Burn Protocols, and Alaska statutes and regulations related to Emergency Medical Services.
Assessment Plan	homework, labs, quizzes, tests, exams, practical

Course Name	Fisheries Tech 1
Course Number	Z355
High School Credits	.5 credit
Course Description	Fisheries Tech 1 is the first course of a two semester sequence which introduces students to the principles, concepts, methods used in the production of Pacific Salmon with an emphasis on modern fish culture techniques used by Alaskan producers. The course covers all aspects of fry and smolt production. Topics include water quality, broodstock management, egg collection, incubation, egg and live fish transport, fresh and salt water rearing techniques, feeding practices, growth, recordkeeping and fish harvest management. *Fisheries Tech 1 is one of the four courses required for the Alaska Salmon Enhancement Occupational Endorsement with UAS.*
Pre-Requisites	junior or senior
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, B1, B2, C2, E1, 2, 3, 4
Alaska Science Standards	SA1-3, SC1-3, SE 1-3, SF1-3, SG1-4
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q1: Overview Pacific Salmon Production in Alaska, Brood Stock Management, Egg Collection and Incubation, Egg and Live Fish Transport Q2: Enhancement Projects, Hatchery Site Selection/Design, Water Quality, Fry Production, Feeding Practices, Fish Health Management
Instructional Resources	ADFB and USFWS publications Aquaculture Training Manual (Swift) Fishing News Books Fish Hatchery Management, USFWS
Assessment Plan	Labs, Projects, Quizzes, Tests

Course Name	Fisheries Tech 2
Course Number	Z455
High School Credits	.5 credit
Course Description	Fisheries Tech 2 is the second course in a two semester sequence which introduces students to the principles, concepts and methods used in the production of Pacific Salmon with an emphasis on modern fish culture techniques used by Alaskan producers. The course covers all aspects of fry and smolt production. Topics include: water quality, live fish transport fresh and saltwater rearing technique, feeding practices, growth, recordkeeping and fish health management and more aspects of the economic effects of salmon production and harvesting in Alaska. *Fisheries Tech 2 is one of the four courses required for the Alaska Salmon Enhancement Occupational Endorsement with UAS.*
Pre-Requisites	Junior or Senior
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, B1, B2, C2, E1, 2, 3, 4
Alaska Science Standards	SA1-3, SC1-3, SE 1-3, SF1-3, SG1-4
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q3: Raceways, Troughs, Circular Tanks, Design and Operation; Growth Measurements and Feed Rates and Projections; Sampling Techniques; Hatchery Management and Recordkeeping, Feeds and Feeding Techniques; Fish Health Management Q4: Live Fish Transport, Pen Systems, Saltwater Rearing, Diseases, Recirculating Systems
Instructional Resources	ADFB and USFWS publications Aquaculture Training Manual (Swift) Fishing News Books Fish Hatchery Management, USFWS
Assessment Plan	Labs, Projects, Quizzes, Tests

JSD High School Science Curriculum

Course Name	Forensic Science
Course Number	Z108
High School Credits	.5 credit
Course Description	This course applies biological and physical concepts to solve problems in forensics. Students will learn forensic techniques including evidence collecting, fingerprint analysis, blood spatter analysis, hair and fiber analysis, DNA analysis and other forensics techniques that apply to crime analysis.
Pre-Requisites	Physical Science and Biology
Course Sequence, if applicable	n/a
Alaska Cultural Standards	A1, B1, B2, E2, E3, E4
Alaska Science Standards	SA 1-3, SB1-4, SE1-3, SF1, 3, SG1-4
Alaska ELA Standards	RST.11-12.1-.9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-7
ISTE Standards	1-6
Course Topics by identified by quarter/timelines	Week 1-2 Observation skills Week 3-5 Evidence collection Weeks 6-7 Hair and fibers evidence Weeks 8-10 Fingerprints and DNA Weeks 11-12 Death Weeks 13-14 Blood splatter Weeks 15-16 Drugs and poisons Weeks 17-18 Crime scene scenario
Instructional Resources	*Forensic Science Fundamentals and Investigations* by Bertino science labs, Juneau Police Department
Assessment Plan	Projects, Labs, Quizzes, Tests

Course Name	Geology
Course Number	S251
High School Credits	.5 credit
Course Description	Geology is a lab and field course where students will be introduced to the components and structures of the Earth, the processes that shape the Earth's surface, and the rocks and minerals which make up the Earth's crust. Students will also study earthquakes, volcanoes and other natural disasters.
Pre-Requisites	Physical Science and Biology
Course Sequence, if applicable	n/a
Alaska Cultural Standards	E1-4, D3, D5, B1, B3
Alaska Science Standards	SA1, 2, SB1, SD1-4, SE1-3, SF1, 3, SG1-3
Alaska ELA Standards	RST.11-12. 1, 4, 7, 8, 9 WHST.11-12, 1, 2, 6, 7, 8, 9
Alaska Math Standards	MP 1-7, ACED.2, S-ID.3, 9
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Weeks 1-5 Rocks and mineral identification Weeks 6-10 Geological time and the fossil record Weeks 11-18 Plate tectonics, plate boundaries, volcanoes, and earthquakes
Instructional Resources	PBS.org www.pbslearningmedia.org/collection/ean/ NASA www.nasa.org Geophysical Institute (UAF) www.gi.alaska.edu/auroraforecast Anneberg Learner www.learner.org/interactives/dynamicearth, www.learner.org/interatives/rockcycle/index.html Alaska Resource: www.akresource.org/are/curriculum USGS http://ga.water.usgs.gov/watercycle.html, http://response.restoration.noaa.gov/watercyclegame Alaska State Museum and NOAA: Science on a Sphere
Assessment Plan	projects, labs, quizzes, tests

Course Name	Human Anatomy and Physiology
Course Number	S234
High School Credits	1
Course Description	This course is designed for students who are interested in learning about the human body in depth or considering a career in health-care related occupations. Career opportunities in the medical field are emphasized. Students study the human systems in detail, explore various disorders and diseases and expand their medical vocabulary. Dissections are required.
Pre-Requisites	Biology and Physical Science
Course Sequence, if applicable	n/a
Alaska Cultural Standards	A5, B1-5, C3, D5, E1, 3
Alaska Science Standards	SA1-3, SC1-2, SE1-3, SF1, SF3, SG1-3
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4, 6-9
Alaska Math Standards	MP 1- 7, N-q. 1, 2, N-vm, 6, 8
ISTE Standards	1, 2, 3, 4, 5, 6, 7
Course Topics by identified by quarter/timelines	Qtr 1: Body organization, basic body chemistry, cell structure and function, tissues, skin and integument tissue Qtr 2: Skeletal system/articulations, muscular, central and peripheral nervous systems, endocrine system Qtr 3: Blood, cardiovascular, immune systems Qtr 4: Respiratory and digestive systems, excretory and reproductive systems, human genetics
Instructional Resources	McGraw Hill's: Hole's Essentials of Human Anatomy & Physiology (12th Edition)], videos
Assessment Plan	Class Activities, Labs, Homework, Quizzes, Tests

Course Name	Honors Chemistry
Course Number	S322
High School Credits	1 credit
Course Description	This course is the science of matter, the branch of the natural sciences dealing with the composition of substances, and their properties and reactions. Chemistry is a quantitative course, meaning the manipulation of measurements and data are a large part of the class. A good background in Algebra is essential to success. Laboratory work applies knowledge learned in class. This course is a pre-requisite for AP Chemistry.
Pre-Requisites	junior or senior; C or better in Algebra 2
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science, Algebra 2 or concurrent enrollment with instructor recommendation.
Alaska Cultural Standards	A1, B1, B2, B4, D5, E1, E4
Alaska Science Standards	SA1, SA2, SB1, SB2, SB4, SD3, SG1, SG3, SG4
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q: Matter and Measurements; Atoms, Molecules and Ions; Focus on naming compounds; Formula Mass, Mass Stoichiometry, RXN types, Balancing Equations Q: Molarity; Reactions and stoichiometry in Aqueous solution; Gases (and Gaseous Chemical Equilibrium); Phases, Specific Heat, Calorimetry; Intro of electronic structure. Q: Electronic Structure of Atom (Quantum model); Trends in Periodic Table; Basic Concepts of Chemical Bonding-Molecular Geometry and Bonding Theories; Liquids and Solids; Concentrations units, Solubility rules Q: Solutions: Precipitation Equilibria; Solutions: Acids and Bases; Organic Introduction; Electrochemistry; Nuclear Chemistry
Instructional Resources	Chemistry: AP Edition, 9th edition, Zumdahl and Zumdahl
Assessment Plan	Homework, Projects, Labs, Quizzes, Exams

Course Name	Introduction to Chemistry
Course Number	S270
High School Credits	1 credit
Course Description	The course is designed for students who want science preparation to further explore the nature of matter and its interactions including the composition of substances, along with their properties and reactions. Topics covered will be similar to Honors Chemistry but with much less emphasis on math computations. This course does not serve as a pre-requisite for AP Chemistry.
Pre-Requisites	junior or senior, Geometry
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, B1, B2, B4, D5, E1, E4
Alaska Science Standards	SA1, SA2, SB1, SB2, SB4, SD3, SG1, SG3, SG4
Alaska ELA Standards	RST.11-12.1-9, WHST.11-12.1-2, 4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q1: Matter and Measurements; Atoms, Molecules and Ions; Focus on naming compounds; Formula Mass, Stoichiometry, RXN types, Balancing Equations Q2: Molarity; Reactions in Aqueous solution; Gases (and Gaseous Chemical Equilibrium); Phases, Specific Heat, Calorimetry; Intro of electronic structure. Q3: Electronic Structure of Atom (Quantum model); Trends in Periodic Table; Basic Concepts of Chemical Bonding-Molecular Geometry and Bonding Theories. Q4: Solutions: Precipitation; Solutions: Acids and Bases; Organic Introduction; Solution; Nuclear Chemistry; Applications to Technology
Instructional Resources	*Conceptual Chemistry,* Suchocki, Pearson
Assessment Plan	homework, labs, projects, quizzes, tests

Course Name	Introduction to Health Sciences
Course Number	S235
High School Credits	.5 credit
Course Description	*Introduction to Health Sciences is a tech prep course offering dual credit (3 UAS credits - HS S101).* Students explore a variety of health related careers and a gain a basic overview of the following areas: roles and responsibilities of health care workers, job and educational opportunities, medical terminology, legal and ethical issues, confidentiality, personal safety and infection control, and problem solving. Students will also participate in job shadows to explore various health careers.
Pre-Requisites	junior or senior
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, B3, D6, E4, E3, E7, E8
Alaska Science Standards	A2 E1, E2, E3, F1, F2, G1
Alaska ELA Standards	RSL 2, 7, 9, Writing Standards 4, 7, 8, Speaking/Listening 1, 4, WSL 1, 6, 7, 8
Alaska Math Standards	N-q 1-3, n-vm 6, 8
ISTE Standards	1-6
Course Topics by identified by quarter/timelines	Introduction to health careers; communication skills Infection Control Disease and disease prevention Work Ethics Legal and Ethical Issues Culture and delivery of health care Careers in health care
Instructional Resources	*Intro to Health Professions*, Stanfield and Cross Guest speakers
Assessment Plan	quizzes, tests, projects

Course Name	Marine Biology
Course Number	S260
High School Credits	1 credit
Course Description	This course studies marine organisms including a survey of the form and function of marine organisms found in different taxonomic classifications. Marine ecosystems and the factors that affect them will be explored. In addition, students may also perform a marine mammal skeletal reconstruction and may include live dissections. *(TMHS Only: Marine Biology is a co-sponsored course offering dual credit with UAF, 2 UAF credits, FISH 100)*
Pre-Requisites	Biology, and junior or senior standing
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A4, B1, B3, D3, E1, E2, E4
Alaska Science Standards	(10) SA1.1, SA2.1, (10, 11) SC.1, (9) SC1.3, (9, 10, 11) SC2.1, (11) SC2.2, (9, 10) SC2.3, (10) SC2.4, (9 10, 11) SC3.1, (10, 11) SC3.2, (9) SC3.3, (9) SD2.2, (9) SD3.1, (10) SE1.1, (10) SE2.1, (10)SE3.1, (10)SF1.1-SF1.3, (10) SG1.1, .3.4
Alaska ELA Standards	RST.11-12.1-5, 7-9, WHST.11-12.1-,2, 4-9
Alaska Math Standards	S-ID.2, S-ID.3, S-IC.1, S-IC.4 MP 1-7
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q1: Chemical and physical features of oceans, marine biology basics and marine ecology Q2: Marine ecosystems, classification of marine organisms, creatures of sea and their anatomy and physiology (microbes, multi-cellular plants and algae, invertebrates) Q3: More creatures of the sea and their anatomy and physiology (fish, reptiles, marine mammals), marine ecology Q4: Marine mammals anatomy and physiology and human connections
Instructional Resources	*Marine Biology*, Castro and Huber
Assessment Plan	Labs, Projects, Quizzes, Exams

Course Name	Oceanography
Course Number	S511
High School Credits	1 credit
Course Description	Oceanography is a lab and field science. Oceanography is the study of processes on Earth associated with the world's oceans and specific aspects of the ocean itself. Students will examine the geological (plate tectonics, etc.), physical (waves, etc.), chemistry (water), and biology (marine life) of oceans. All these units will include a variety of learning opportunities including group projects, lab experiments, guest scientists and field trips. An emphasis will be placed on current events and local issues. *(JDHS only: Oceanography is a tech prep course offering dual credit, 3 UAS credits - FT S193).*
Pre-Requisites	Biology, junior or senior
Course Sequence, if applicable	Biology/Honors Biology and Physical Science/Honors Physical Science
Alaska Cultural Standards	A1, A7, B1, B3, B4, C1, E2, E4
Alaska Science Standards	SA1, SA2, SD1, SD2, SD3, SC1, SC2, SC3, SE1, SE2, SF1, SF3, SG1, SG2, SG3
Alaska ELA Standards	RST.9-10.1-10, RST.11-12, R.Ki.1-9
Alaska Math Standards	MP 1- 7
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Plate Tectonics, Sedimentation, Ocean Topography, Major and Minor Chemical Elements of Seawater, Currents and Water Masses, Waves and Tides, Upwelling, Plankton and Nekton, Benthic and Pelagic Life
Instructional Resources	Essentials of Oceanography by Garrison Rachel Carson, The Sea Around Us USGS websites, AOOS Website, NOAA, news and journal articles, presenters, field trips
Assessment Plan	homework, labs, projects, quizzes, exams

Course Name	Outdoor Biology
Course Number	S521
High School Credits	1
Course Description	This course is a survey of outdoor biology skills and local resources taught through the lens of Southeast Alaska. Topics include but not limited to: fishing, hunting, wildlife management, cultural and subsistence skills, indigenous resources, cultural topics related to science, water safety, seamanship, land and water navigation, and wilderness safety. Class includes guest speakers from the community and field trips to provide hands-on experience. Each semester is differentiated based on seasonal availability of resources.
Pre-Requisites	Biology and Physical Science
Course Sequence	n/a
Alaska Cultural Standards	A3, 6, 7, B1, 3, 4, C1, 4, D4, 5, E2, 4, 5, 6
Alaska Science Standards	SA1-3, SC2, SD2, SE1-3, SF1-3, S1-4
Alaska ELA Standards	RST.11-12.4-6, RST.11-12.7-9, WHST.11.12.1-2, 4-9
Alaska Math Standards	Nq2, 3, N-vm.1-3 MP 1-3, 5, 6, 7
ISTE Standards	1, 3 4, 5, 6, 7
Course Topics by identified by quarter/timelines	Course sequence dependent on time of year, weather and community expert availability: Weeks 1-8: Ecology of Southeast Alaska Weeks 9-18: Subsistence and Wilderness safety
Instructional Resources	Local community and cultural resources including: Native Elders, NOAA, ADFG, US Fish and Wildlife, US Coast Guard, AK Marine Education Association, NRA, STEM Coalition Database
Assessment Plan	Quizzes, Tests, Projects

Course Name	Physics
Course Number	S411
High School Credits	1
Course Description	Physics is the science of matter and its motion, as well as space and time. It uses concepts such as energy, force, mass and charge. Students apply and refine their math skills on problems of a physical nature while developing a conceptual understanding of physical phenomena. Physics is an experimental science, creating theories that are tested against observations. The labs make use of concepts learned in class.
Pre-Requisites	Algebra 2/Trig
Course Sequence	n/a
Alaska Cultural Standards	A1, B1, B4, E2, E4
Alaska Science Standards	SA1, SA2, SB1, SB2, SB3, SB4, SD3, SG1, SG2, SG3, SG4
Alaska ELA Standards	RST.11-12.1-5, 7-9, WHST.11-12.1,2,4-9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Q1: Introduction units, computer interfacing, Excel, curve fitting and power functions, 1-D kinematics, 2-D kinematics Q2: Newton's laws (force, mass, weight, tension and normal force, free body diagrams, 2nd law analysis, friction) and energy (work and scalar product, kinetic energy, center of mass work and work-kinetic energy theorem, power, conservative and non-conservative forces, potential energy, Springs, Hooke's Law and elastic potential energy, conservation of energy Q3: Impulse-Momentum (momentum, impulse, conservation of momentum, explosions, perfectly inelastic collisions, elastic collisions and partially elastic collisions), statics (torque, static equilibrium, center of mass) Q4: Gravity and Circular Motion (angular velocity and radian measure, centripetal acceleration, Newton's Law of Universal Gravitation)
Instructional Resources	Principles of Physics (Kinetic Books)
Assessment Plan	Homework, labs, projects, quizzes, tests

Course Name	Project Lead the Way: Introduction to Engineering Design
Course Number	V401
High School Credits	1
Course Description	Introduction to Engineering Design is a course that teaches problem-solving skills using a design development process. Models of product solutions are created, analyzed and communicated using solid modeling computer design software. This course is part of the Project Lead the Way (PLTW) Pre- Engineering Program.
Pre-Requisites	C or better in Algebra 1
Course Sequence, if applicable	n/a
Alaska Cultural Standards	A6, B1, B3, D6, E1, E3, E4
Alaska Science Standards	SA1, SA2, SB1, SB2, SB3, SB4, SE1, SE2, SE3, SF1, SG1, SG2, SG3, SG4
Alaska ELA Standards	RST.9-10.1,3, 4,6,7,10, WHST.9.10.1-10
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Evolution of Innovation Sketching and Visualization Production Elements of Design Geometric Relationships Marketing Design Analysis Modeling
Instructional Resources	PLTW Lab PLTW POE Curriculum
Assessment Plan	Homework, labs, projects, quizzes, tests

Course Name	Project Lead the Way: Principles of Engineering
Course Number	V301
High School Credits	1
Course Description	Principles of Engineering is a course that helps students understand the field of engineering and engineering technology. Students will learn the methods, processes and principles of physics and apply them to engineering projects. This course is part of the Project Lead the Way (PLTW) Pre-Engineering Program.
Pre-Requisites	C or better in Algebra 1 and Physical Science
Course Sequence, if applicable	n/a
Alaska Cultural Standards	A1, A6, B1, B2, B3, E1, E2, E3, E5, E6, E7, E8
Alaska Science Standards	SA1, SA2, SB1, SB2, SB3, SB4, SE1, SE2, SE3, SF1, SG1, SG2, SG3, SG4
Alaska ELA Standards	RST.9-10.1-8, RST.11-12.1-8 WHST.9-10.1, 2, 6, 7 8, 9
Alaska Math Standards	MP 1-8
ISTE Standards	1-7
Course Topics by identified by quarter/timelines	Engineering Teams, Simple Machines, Electrical Systems, Engineering for Reliability, Technical Writing, Thermodynamics, Control System, Dynamics/Kinematics, Design Process, Fluid Systems, Materials and Materials Testing
Instructional Resources	PLTW Lab PLTW POE Curriculum
Assessment Plan	Homework, labs, projects, quizzes, tests

Appendices

- **Alaska Cultural Standards**
- **Alaska Science Standards**
- **ISTE Standards**

Cultural Standards for Students

A. Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community.

Students who meet this cultural standard are able to:

1. assume responsibility for their role in relation to the well-being of the cultural community and their life-long obligations as a community member;
2. recount their own genealogy and family history;
3. acquire and pass on the traditions of their community through oral and written history;
4. practice their traditional responsibilities to the surrounding environment;
5. reflect through their own actions the critical role that the local heritage language plays in fostering a sense of who they are and how they understand the world around them;
6. live a life in accordance with the cultural values and traditions of the local community and integrate them into their everyday behavior.
7. determine the place of their cultural community in the regional, state, national and international political and economic systems;

B.

Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life.

Students who meet this cultural standard are able to:

1. acquire insights from other cultures without diminishing the integrity of their own;
2. make effective use of the knowledge, skills and ways of knowing from their own cultural traditions to learn about the larger world in which they live;
3. make appropriate choices regarding the long-term consequences of their actions;
4. identify appropriate forms of technology and anticipate the consequences of their use for improving the quality of life in the community.

C.

Culturally-knowledgeable students are able to actively participate in various cultural environments.

Students who meet this cultural standard are able to:

1. perform subsistence activities in ways that are appropriate to local cultural traditions;
2. make constructive contributions to the governance of their community and the well-being of their family;
3. attain a healthy lifestyle through which they are able to maintain their own social, emotional, physical, intellectual and spiritual well-being;
4. enter into and function effectively in a variety of cultural settings.

D.

Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning.

Students who meet this cultural standard are able to:

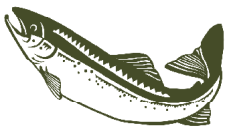
1. acquire in-depth cultural knowledge through active participation and meaningful interaction with Elders;
2. participate in and make constructive contributions to the learning activities associated with a traditional camp environment;
3. interact with Elders in a loving and respectful way that demonstrates an appreciation of their role as culture-bearers and educators in the community;
4. gather oral and written history information from the local community and provide an appropriate interpretation of its cultural meaning and significance;
5. identify and utilize appropriate sources of cultural knowledge to find solutions to everyday problems;
6. engage in a realistic self-assessment to identify strengths and needs and make appropriate decisions to enhance life skills.

E.

Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them.

Students who meet this cultural standard are able to:

1. recognize and build upon the inter-relationships that exist among the spiritual, natural and human realms in the world around them, as reflected in their own cultural traditions and beliefs as well as those of others;
2. understand the ecology and geography of the bioregion they inhabit;
3. demonstrate an understanding of the relationship between world view and the way knowledge is formed and used;
4. determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems;
5. recognize how and why cultures change over time;
6. anticipate the changes that occur when different cultural systems come in contact with one another;
7. determine how cultural values and beliefs influence the interaction of people from different cultural backgrounds;
8. identify and appreciate who they are and their place in the world.



Alaska Science Performance Standards

Specific expectations by grade band may be found on pages 105-132 of the Content and Performance Standards for Alaska Students (4th edition).

SCIENCE AS INQUIRY & PROCESS

SA1. Investigate problems, design and conduct experiments, and scientific argumentation

SA2. Reasoning, skepticism, openness, dialog, & review

SA3. Local history, knowledge, and interaction

PHYSICAL SCIENCE

SB1. Properties of matter, structure, behavior

SB2. Energy forms, transformation, transference, and conservation

SB3. Matter & energy: physical, chemical, nuclear changes, effects on systems

SB4. Motion & force: characteristics, relationships, natural forces

LIFE SCIENCE

SC1. Change over time/evolution

SC2. Structure & function, development, life cycles, biodiversity

SC3. Transfer and transformation of energy and matter.

EARTH SCIENCE

SD1. Geochemical cycles

SD2. Earth origins, processes, and forces

SD3. Earth & the solar system, energy flow & cycle from sun

SD4. Cosmic evolution

SCIENCE & TECHNOLOGY

SE1. Science, technology, & everyday life

SE2. Problem-solving

SE3. Technology innovation and advances

CULT., SOCIAL, PERSONAL PERSPECTIVES, & SCIENCE

SF1. Relationships between individuals, culture, society, people, & science.

SF2. Alternate world-views

SF3. Recording & validating cultural knowledge

HISTORY & NATURE OF SCIENCE

SG1. Scientific knowledge evolves

SG2. Parameters for scientific advancement

SG3. The role of evidence in science

SG4. Science based on curiosity, creativity, & imagination

2016

ISTE STANDARDS
FOR STUDENTS

1. Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

a. articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
b. build networks and customize their learning environments in ways that support the learning process.
c. use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
d. understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

2. Digital Citizen

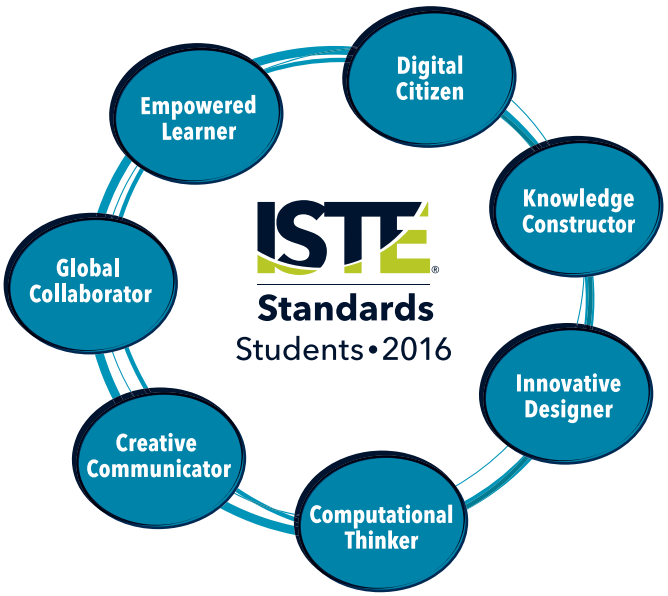
Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. Students:

a. cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world.
b. engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
c. demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.
d. manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.

3. Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students:

a. plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
b. evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
c. curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
d. build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.



4. Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

a. know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
b. select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
c. develop, test and refine prototypes as part of a cyclical design process.
d. exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

5. Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Students:

a. formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
b. collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
c. break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
d. understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

6. Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

a. choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
b. create original works or responsibly repurpose or remix digital resources into new creations.
c. communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
d. publish or present content that customizes the message and medium for their intended audiences.

7. Global Collaborator

Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. Students:

a. use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning.
b. use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
c. contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
d. explore local and global issues and use collaborative technologies to work with others to investigate solutions.