EARTH and SPACE SCIENCE Curricular Documents

Table of Contents

- Course Information 1
- Desired Results
  - Course Enduring Understandings
  - Course Essential Questions
  - Science Standards Grade Level Band and by Unit

Unit 1 : Geology 11
- Unit Desired Results
  - *Layers of the Earth*
  - *Plate Tectonics*
  - *Earthquakes/Volcanoes/Mountains*
  - *Rocks and Minerals*
  - *Geologic Time*
- Unit Assessment Evidence

Unit 2: Meteorology 18
- Unit Desired Results
  - *Atmosphere, Water and Clouds*
  - *Fronts, Storms, and Climate*
  - *Moon/Sun, Seasons and Tides*
- Unit Assessment Evidence

Unit 3: Astronomy 26
- Unit Desired Results
  - *Planets and Solar System*
  - *Universe*
- Unit Assessment Evidence

Earth Science & Space Course Information	
CURRICULUM/CONTENT AREA	**COURSE LENGTH**
Science	1 Semester
GRADE LEVEL	**DATE LAST REVIEWED**
11-12	2016 Approved Curricular Docs 2023 Evaluation of Program
PREREQUISITE(s) ***if applicable***	**BOARD APPROVAL DATE**
NA	*December 2024*
PRIMARY RESOURCE ***if applicable***	
OpenSciEd *Supplemental:* CK-12	

Desired Results

COURSE DESCRIPTION

This course provides a phenomena based exploration of Earth and atmospheric sciences, encompassing geology, astronomy, and meteorology. Students will delve into the geological processes shaping our planet's surface, including the description, classification, and origin of minerals and rocks. Additionally, internal and external processes such as volcanism, earthquakes, deformation, mountain building, weathering, mass wasting, glaciers, and hydrological cycles will be examined.

The course will also introduce fundamental principles of astronomy and meteorology, challenging students to think critically and analytically. They will explore scientific theories, develop observational skills, and draw conclusions. Students will adopt the perspectives of astronomers and meteorologists, engaging in discussions and written analyses of current topics related to core concepts. Astronomy topics will include the origin and history of the universe, the formation of Earth and the moon, as well as the solar system and the sun. Meteorology subjects will encompass atmospheric composition, air quality, weather formation, climate dynamics, and the human impact on weather and climate. Through this integrated approach, students will develop a holistic understanding of Earth's dynamic systems and the interconnectedness of natural phenomena.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Scale, Proportion, and Quantity:** In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. **Systems and Models:** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. **Energy and Matter:** Tracking energy and matter flows, into, and out of, and within systems helps one understand their system's behavior. **Structure and Function:** The way an object is shaped or structured determines many of its properties and functions. **Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control the rates of change are critical elements to consider and understand.	Unit 1: Geology ● How do Forces in Earth's interior determine what will happen to the surface we see? ● Why do only some volcanoes erupt? ● How do mountains grow so large? ● What makes diamonds so special? How are kimberlites formed? ● How can water carve a shoreline? ● Where does sediment come from, and where does it end up? ● How do scientists determine the age of rocks and fossils? ● How has life on Earth changed over time? ● How do geological events impact Earth's climate and environment over time? Unit 2 : Meteorology ● Which characteristics determine the layers of the atmosphere? ● What is our atmosphere made of? ● How can we slow the flow of energy on Earth to protect vulnerable coastal communities? ● What causes lightning? Why are some places safer than others when it strikes? ● What causes differences in weather and climate? ● Why is all weather spiraling? ● Why do different hemispheres have different seasons? ● What is the significance of the equinox and solstices? Unit 3: Astronomy ● How have collisions with objects from space changed Earth in the past, and how could they affect our future? ● How do gas giants and ice giants differ in their chemical composition? ● Why is the solar system shaped like a disc? ● What are the characteristics and properties of the planets in our solar system? ● Why do stars shine? And will they shine forever? ● How do we know that there are other galaxies? ● What role does technology play in the understanding of our universe?

3 Dimensional Standards



Cross Cutting Concepts BY GRADE BAND AND UNIT	Unit 1	Unit 2	Unit 3
Standard SCI.CC1 - Patterns Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.	X	X	X
Standard SCI.CC2 - Cause and Effect Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.	X	X	X
Standard SCI.CC3 - Scale, Proportion, and Quantity Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	X		X
Standard SCI.CC4 - Systems and System Models	X	X	X

Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.			
Standard SCI.CC5 - Energy and Matter Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	X	X	X
Standard SCI.CC6 - Structure and Function Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.	X		X
Standard SCI.CC7 - Stability and Change Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.	X	X	X

Science and Engineering Practices by GRADE BAND and UNIT	Unit 1	Unit 2	Unit 3
standard SCI.SEP1 - **A.Asking Questions** Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following: • Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. • Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model or an explanation • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. • Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design. **B.Defining Problems** Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. • Clarify and refine an engineering problem.	X	X	X
Standard SCI.SEP2 - Developing and Using Models Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability.	X	X	X

• Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. • Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.			
Standard SCI.SEP3 - Planning and Conducting Investigations Students plan and carry out investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models: This includes the following: • Individually and collaboratively plan an investigation or test a design to produce data that can serve as evidence to build and revise models, support explanations for phenomena, and refine solutions to problems. Consider possible variables or effects and evaluate the investigation's design to ensure variables are controlled. • Individually and collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence. • In the design, decide on types, how much, and accuracy of data needed to produce reliable measurements. Consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points, • or to improve performance relative to criteria for success.	X	X	X
Standard SCI.SEP4 - Analyze and Interpret Data Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: • Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. • Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. • Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation or model of a proposed process or system. • Analyze data to optimize design features or characteristics of system components relative to criteria for success.	X	X	X
Standard SCI.SEP5 - Mathematics and Computational Thinking Students use algebraic thinking and analysis, a range of linear and nonlinear functions (including trigonometric functions, exponentials, and logarithms), and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. This includes the following: • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and algorithmic representations of phenomena or design solutions to describe and support claims and explanations. • Apply techniques of algebra and functions to represent and solve scientific and engineering problems. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world.	X	X	X

• Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, and others).			
Standard SCI.SEP6 - **A.Construct Explanations** Students create explanations that are supported by multiple and independent student generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources, including students' own investigations, models, theories, simulations, and peer review. • Explanations should reflect the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and evidence to provide an explanation of phenomena taking into account possible, unanticipated effects. • Apply scientific reasoning, theory, and models to link evidence to the claim and to assess the extent to which the reasoning and data support the explanation. B. **Design Solutions** Students create designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Design, evaluate, and refine a solution to a complex realworld problem, based on scientific knowledge, student-generated sources of evidence, and prioritized criteria. Consider tradeoffs. • Apply scientific ideas, principles, and evidence to solve design problems, taking into account possible unanticipated effects.	X	X	X
Standard SCI.SEP7 - Engage in Arguments Students use appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science. This includes the following: • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and receive critiques on scientific arguments by probing reasoning and evidence, by challenging ideas and conclusions, by responding thoughtfully to diverse perspectives, and by determining what additional information is required to resolve contradictions. • Construct, use, and present oral and written arguments or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments. Consider relevant factors (e.g. economic, societal, environmental, and ethical considerations).	X	X	X
Standard SCI.SEP8 - Obtain, evaluate, and Communication Information Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. • Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible.	X	X	X

• Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.			

Disciplinary Core Ideas by GRADE BAND and UNIT			
PHYSICAL SCIENCE			
Standard SCI.PS1			
A. **NUCLEAR PROCESSES:** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.	X		
Standard SCI.PS2			
A. **FORCES AND MOTION:** Motion and changes in motion can be quantitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). Newton's second law of motion (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects. 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.	X	X	X
B. **TYPES OF INTERACTIONS:** Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields. 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	X	X	X
Standard SCI.PS3			
A. **DEFINITIONS OF ENERGY:** Systems move towards more stable states.	X	X	X
B. **CONSERVATION OF ENERGY AND ENERGY TRANSFER:** The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).	X		
C. **ENERGY IN CHEMICAL PROCESSES AND EVERYDAY LIFE:** Sunlight is captured by plants and used in a chemical reaction to produce sugar molecules for storing this energy. This stored energy can be released by respiration or combustion, which can be reversed by burning those molecules to release energy	X		X
Standard SCI.PS4			
A. **WAVE PROPERTIES:** The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.		X	
EARTH AND SPACE SCIENCE			
Standard SCI.ESS1			
A. **THE UNIVERSE AND ITS STARS:** Light spectra from stars are used to determine their characteristics, processes, and life cycles. Solar activity creates the elements through nuclear fusion. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory			X

B. **EARTH AND THE SOLAR SYSTEM:** Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Cyclical changes in Earth's tilt and orbit, occurring over tens to hundreds of thousands of years, cause cycles of ice ages and other gradual climate changes.		X	X
C. **THE HISTORY OF PLANET EARTH:** The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.	X		X
Standard SCI.ESS2			
A. **EARTH MATERIALS AND SYSTEMS:** Feedback effects exist within and among Earth's systems.	X	X	X
B. **PLATE TECTONICS AND LARGE-SCALE SYSTEM INTERACTIONS:** Radioactive decay within Earth's interior contributes to thermal convection in the mantle.	X		
C. **THE ROLES OF WATER IN EARTH'S SURFACE AND PROCESSES:** The planet's dynamics are greatly influenced by water's unique chemical and physical properties.		X	
D. **WEATHER AND CLIMATE:** The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.		X	
E. **BIOGEOLOGY:** The biosphere and Earth's other systems have many interconnections that cause a continual coevolution of Earth's surface and life on it.			
Standard SCI.ESS3			
A. **NATURAL RESOURCES:** Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.		X	
B. **NATURAL HAZARDS:** Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.		X	
C. **HUMAN IMPACTS ON EARTH SYSTEMS:** Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies	X	X	X
D. **GLOBAL CLIMATE CHANGE:** Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.			
ENGINEERING AND TECHNICAL SCIENCE			
Standard SCI.ETS1			
A. **DEFINING AND DELIMITING ENGINEERING PROBLEMS:** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.		X	
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. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical. They are also useful in making a persuasive presentation to a client about how a given design will meet his or her needs.	X	X	X

C. **OPTIMIZING THE DESIGN SOLUTION:** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.		X	
Standard SCI.ETS2			
A. **INTERDEPENDENCE OF SCIENCE, ENGINEERING, AND TECHNOLOGY:** 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.		X	
B. **INFLUENCE OF ENGINEERING, TECHNOLOGY, AND SCIENCE ON SOCIETY AND THE NATURAL WORLD:** • Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications. • Engineers continuously modify these systems to increase benefits while decreasing costs and risks. • New technologies can have deep impacts on society and the environment, including some that were not anticipated. • Analysis of costs and benefits is a critical aspect of decisions about technology.		X	
Standard: SCI.ETS3:			
A. **SCIENCE AND ENGINEERING ARE HUMAN ENDEAVORS:** • Individuals from diverse backgrounds bring unique perspectives that are valuable to the outcomes and processes of science and engineering. • Scientists' and engineers' backgrounds, perspectives, and fields of endeavor influence the nature of questions they ask, the definition of problems, and the nature of their findings and solutions. • Scientists and engineers embrace skepticism and critique as a community. Deliberate deceit in science is rare and is likely exposed through the peer review process. When discovered, intellectual dishonesty is condemned by the scientific community.	x	x	x
B. **SCIENCE AND ENGINEERING ARE UNIQUE WAYS OF THINKING WITH DIFFERENT PURPOSES:** • Science is both a body of knowledge that represents current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. These processes differentiate science from other ways of knowing. • Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. • Science and engineering innovations may raise ethical issues for which science and engineering, by themselves, do not provide answers and solutions.	x	x	x
C. **SCIENCE AND ENGINEERING USE MULTIPLE APPROACHES TO CREATE NEW KNOWLEDGE AND SOLVE PROBLEMS:** • Scientists use a variety of methods, tools, and techniques to develop theories. A scientific theory is an explanation of some aspect of the natural word, based on evidence that has been repeatedly confirmed through observation, experimentation (hypothesis-testing), and peer review. • The certainty and durability of science findings varies based on the strength of supporting evidence. Theories are usually modified if they are not able to accommodate new evidence. • Engineers use a variety of approaches, tools, and techniques to define problems and develop solutions to those problems. Successful engineering solutions meet stakeholder needs and safety requirements, and are economically viable. Trade-offs in design aspects balance competing demands.	X	X	X

UNIT 1: *Geology*

Students use science and engineering practices, crosscutting concepts, and an understanding of the forces that shape the Earth to make sense of phenomena and solve problems. Key unit phenomena may include Afar Region (Ethiopia): Rift Valley, volcanoes, radioactive decay, 2011 Tohoku earthquake in Japan, Crystal Caves, Cascade Mountain Range, and strata correlation of Grand Canyon NP, Zion NP, and Bryce

How do forces in Earth's interior determine what will happen to the surface we see? This unit is designed to help students build an intuitive understanding of the relationship between energy transfer and unbalanced forces as they explore science ideas related to plate tectonics, radioactivity, convection, and rock formation.

UNIT 1 DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ How do Forces in Earth's interior determine what will happen to the surface we see?
- ➔ What types of mantle convection would you expect to find beneath a convergent plate boundary? A divergent boundary?
- ➔ Why do only some volcanoes erupt?
- ➔ How do mountains grow so large?
- ➔ Why can't we accurately predict earthquakes?
- ➔ What makes diamonds so special? How are kimberlites formed?
- ➔ How can water carve a shoreline?
- ➔ How do scientists determine the age of rocks and fossils?
- ➔ How has life on Earth changed over time?
- ➔ How do geological events impact Earth's climate and environment over time?

UNIT PRIORITY STANDARDS: *Students will know and be able to describe how various forces shape the Earth, and what changes may occur in the future due to these forces.*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1 - Patterns** Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify	➔ **SCI.SEP1 - A. Asking Questions** Students ask questions to formulate, refine, and evaluate empirically testable questions.	➔ **SCI.ESS1 THE HISTORY OF PLANET EARTH:** The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.

and analyze patterns of performance in order to reengineer a designed system.		
➔ **Standard SCI.CC2 - Cause and Effect** Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.	➔ **SCI.SEP2 - Developing and Using Models** Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world.	➔ **SCI.ESS2 EARTH MATERIALS AND SYSTEMS:** Feedback effects exist within and among Earth's systems.
➔ **Standard SCI.CC5 - Energy and Matter** Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	➔ **SCI.SEP4 - Analyze and Interpret Data** Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.	➔ **SCI.ESS2 PLATE TECTONICS AND LARGE-SCALE SYSTEM INTERACTIONS:** Radioactive decay within Earth's interior contributes to thermal convection in the mantle.
➔ **Standard SCI.CC4 - Systems and System Models** ➔ Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.	➔ **SCI.SEP7 - Engage in Arguments** Students use appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science.	➔ **Standard SCI.PS2 DEFINITIONS OF ENERGY:** Systems move towards more stable states.
3 DIMENSIONAL LEARNING TARGETS		

- ➔ 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.
- ➔ HS-ESS2-1 - Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- ➔ HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.
- ➔ HS-ESS2-3 - Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- ➔ HS-ESS1-5 - Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

GEOLOGY ASSESSMENT EVIDENCE

Performance is evaluated in terms of students' depth of understanding of learning targets. Students will show their learning by successfully reaching the standards of projects, performance tasks, and lab reports.

Performance Task Description(s):

- ➔ How do Forces in Earth's interior determine what will happen to the surface we see?
  - ◆ HS-ESS2-1 - Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- ➔ Why do only some volcanoes erupt?
  - ◆ HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.
- ➔ How do mountains grow so large?
  - ◆ HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.
- ➔ What makes diamonds so special? How are kimberlites formed?
  - ◆ HS-ESS2-3 - Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- ➔ How do scientists determine the age of rocks and fossils?
  - ◆ HS-ESS2-1 - Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- ➔ How has life on Earth changed over time?
  - ◆ HS-ESS2-1 - Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- ➔ How do geological events impact Earth's climate and environment over time?
  - ◆ HS-ESS1-5 - Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback. (Rubric links- TBD)

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs,*

and goals.

- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & College/Career Readiness may include:*

- ◆ All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

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The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

STAGE 3: UNIT LEARNING PLAN (under construction- note: this section does not require board approval) *Planned learning experiences and instruction: Learner Readiness, Key vocab, materials & resources unique to the unit*		
Plan & Prep for the Unit Stage:		
Review Learners' Attributes and needs: ● Review 504s & IEP at a Glance ● Review current classroom data (by standard) ● Review any ACT, screening, or diagnostic data ● Other?	Send Family Unit Communication ☐ *ADD example link*	Review any previous student exemplars Proficient ☐ *ADD LINK* Advanced/Excellent ☐ *ADD LINK*
Implementation Stage:		
Key Unit Vocabulary/ Root words:	Unit 1-A: Layers of the Earth and Plate Tectonics: geosphere, hydrosphere, biosphere, atmosphere, geology, meteorology, Astronomy, Oceanography, density, crust, lithosphere, asthenosphere, mantle, outer core, inner core, Harry Hess, seafloor spreading, sonar, magnetometer, paleomagnetism, reversed polarity, Alfred Wegener, continental drift, tectonic plates, convection current, continental crust, oceanic crust, divergent boundary, convergent boundary, transform boundary, rift valley, subduction, island arcs, ridge, trench Unit 1-B: Earthquakes/Volcanoes/Mountains: volcano, shield, cinder cone, composite, super volcano, hot spot, viscosity, silica, basalt, andesite, rhyolite, parasitic cone, lahar, ash cloud, pyroclastic flow, ash fall, laval flow, folds, anticline, syncline, monocline, stress, compression, tension, shear, faults, orogeny, folded mountains, uplifted mountains, fault-block mountain, earthquake, focus, epicenter, seismic waves, EQ intensity, EQ magnitude, shadow zone, seismograph, seismogram, richter scale, modified mercalli scale, tsunami, liquefaction	

	Unit 1-C: Rocks, Minerals, and Erosion: mineral, crystal, streak, fracture, cleavage, hardness, luster, magnetism, diaphaneity, transparent, translucent, opaque, igneous, magma, lava, extrusive, intrusive, porphyritic, vesicular, sedimentary, clastic, coarse, medium, fine, chemical biochemical, contact metamorphism, regional metamorphism, foliate, non-foliated, rock cycle, weathering, erosion, deposition, compaction, cementation Unit 1-D: Geologic Time: Geologic Time Scale, Eon, Era, Period, Epoch, catastrophism, principle of uniformitarianism, relative age, superposition, inclusions, cross-cutting relationship, original horizontality, absolute age, radioactive decay, ice cores, dendrochronology, carbon dating, precambrian, phanerozoic, paleozoic, mesozoic, cenozoic		
Days	**Daily Content**	**Differentiation, Accommodation, and Extensions**	**Teacher Resources: Videos, Open Sci Ed simulations, PhET's, etc.**
Unit 1 A - Layers of the Earth and Plate Tectonics			
Day 1 - Layers of the Earth Scale Drawing			
Day 2 - Layers of the Earth Notes and Finish Drawing			
Day 3 - Earth Layers Density Lab			
Day 4 - Intro to Seafloor Spreading "Where is Lystrosaurus" Map			
Day 5 - Continental Drift Notes and Plate Map Slides			
Day 6 - Types of Boundaries Drawings			
Day 7 - Seafloor Spreading Notes and Questions			
Day 8 - Review for Unit Assessment			
Day 9 - Unit Assessment			
Unit 1 B - Volcanoes, Mountains, Earthquakes			
Day 1 - Intro to Volcanoes			

Day 2 - Parts of Volcanoes			
Day 3 - Dangers of Volcanoes			
Day 4 - Mountain Building - Types of Mountains in the USA			
Day 5 - Earthquake Notes Part 1			
Day 6 - Earthquake Note Part 2			
Day 7 - Start Earthquake Patterns Lab - Collect Data			
Day 8 - Finishing Collecting data and start graphing			
Day 9 - Type final draft and summarize			
Day 10 - Review for Assessment			
Day 11 - Assessment on Volcanoes, Mountains, and Earthquakes			
Unit 1 C - Rocks and Minerals			
Day 1- Minerals Notes and Uses			
Day 2 - Mineral ID Lab Day 1			
Day 3 - Mineral ID Lab Day 2			
Day 4 - Igneous Rock Notes and Mini Lab			
Day 5 - Sed. Rock Notes and Questions			
Day 6 - Sed. Rock Notes and Start Lab			
Day 7 - Complete Sed. Rock Lab			
Day 8 - Review of Igneous and Sed. Rock			

Day 9 - Rock Cycle Day 1			
Day 10 - Rock Cycle Day 2			
Day 11 - Review for Assessment			
Day 12 - Unit Assessment			
Unit 1 D - Geologic Time			
Day 1 - Time Scale Notes and Questions			
Day 2 - Relative Dating Rules and Practice			
Day 3 - Mass Extinctions and Anthropocene one slider			
Day 4 - Absolute Dating			
Day 5 - Review and Assess			

End of Unit Reflection:

- What successes did we have with students learning our desired results (Enduring Understandings, Essential Questions, Priority Standards)? How do we know? (summative results? Progress monitoring data?)
- What opportunities do we have to leverage desired results (Enduring Understandings, Essential Questions, Priority Standards, Anchor Phenomenon) in the future?
- How are we celebrating with students and as a team?

24/25	•
25/26	•
26/27	•
27/28	•

UNIT 2: *Meteorology*

Students use science and engineering practices, crosscutting concepts, and an understanding of the forces and processes that cycle through Earth's atmosphere to make sense of phenomena and solve problems. Key unit phenomena may include; weather balloons, cloud seeding, tornado alley, crop growth and harvesting.

UNIT 2 DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ Which characteristics determine the layers of the atmosphere?
- ➔ What is our atmosphere made of?
- ➔ How can we slow the flow of energy on Earth to protect vulnerable coastal communities?
- ➔ What causes lightning? Why are some places safer than others when it strikes?
- ➔ What causes differences in weather and climate?
- ➔ Why is all weather spiraling?
- ➔ Why do different hemispheres have different seasons?
- ➔ What is the significance of the equinox and solstices?

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1 - Patterns** Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.	➔ **Standard SCI.SEP8 - Obtain, evaluate, and Communication Information -** Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information.	➔ **DEFINITIONS OF ENERGY:** Systems move towards more stable states. **WAVE PROPERTIES:** The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.

➔ **Standard SCI.CC2 - Cause and Effect** Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.	**Standard SCI.SEP5 - Mathematics and Computational Thinking** Students use algebraic thinking and analysis, a range of linear and nonlinear functions (including trigonometric functions, exponentials, and logarithms), and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. This includes the following: • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and algorithmic representations of phenomena or design solutions to describe and support claims and explanations. • Apply techniques of algebra and functions to represent and solve scientific and engineering problems. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, and others).	➔ **EARTH AND THE SOLAR SYSTEM:** Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Cyclical changes in Earth's tilt and orbit, occurring over tens to hundreds of thousands of years, cause cycles of ice ages and other gradual climate changes. F. **THE ROLES OF WATER IN EARTH'S SURFACE AND PROCESSES:** The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
➔ **Standard SCI.CC3 - Scale, Proportion, and Quantity -** Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to	**tandard SCI.SEP4 - Analyze and Interpret Data** Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: • Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible.	➔ **DEFINING AND DELIMITING ENGINEERING PROBLEMS:** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	• Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. • Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation or model of a proposed process or system. • Analyze data to optimize design features or characteristics of system components relative to criteria for success.	
➔ **Standard SCI.CC5 - Energy and Matter** Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	**Standard SCI.SEP2 - Developing and Using Models** Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. • Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.	➔ **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. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical. They are also useful in making a persuasive presentation to a client about how a given design will meet his or her needs.

3 DIMENSIONAL LEARNING TARGETS

- ➔ HS - ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- ➔ HS - ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- ➔ HS - ESS 2 - 2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.

- ➔ HS - ESS 2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

UNIT 2 ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ Which characteristics determine the layers of the atmosphere?
  - ◆ HS - ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- ➔ What is our atmosphere made of?
  - ◆ HS - ESS 2 - 2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.
- ➔ How can we slow the flow of energy on Earth to protect vulnerable coastal communities?
  - ◆ HS - ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- ➔ What causes lightning? Why are some places safer than others when it strikes?
  - ◆ HS - ESS 2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- ➔ What causes differences in weather and climate?
  - ◆ HS - ESS 2 - 2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.
- ➔ Why is all weather spiraling?
  - ◆ HS - ESS 2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- ➔ Why do different hemispheres have different seasons?
  - ◆ HS - ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- ➔ What is the significance of the equinox and solstices?
  - ◆ HS - ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback. (Rubric links- TBD)

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*

- ➔ *Extensions & College/Career Readiness may include:*
  - ◆ All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

STAGE 3: UNIT LEARNING PLAN (under construction- note: this section does not require board approval) *Planned learning experiences and instruction: Learner Readiness, Key vocab, materials & resources unique to the unit*			
Plan & Prep for the Unit Stage:			
Review Learners' Attributes and needs: • Review 504s & IEP at a Glance • Review current classroom data (by standard) • Review any ACT, screening, or diagnostic data • Other?		Send Family Unit Communication ☐ *ADD example link*	Review any previous student exemplars Proficient ☐ *ADD LINK* Advanced/Excellent ☐ *ADD LINK*
Implementation Stage:			
Key Unit Vocabulary/ Root words:	2-A; Atmosphere, Water Cycle, and Clouds: atmosphere, troposphere, stratosphere, mesosphere, thermosphere, energy transfer, radiation, conduction, convection, reflection, scattering, wind, global winds, coriolis effect, trade winds, westerlies, easterlies, jet stream, land breeze, sea breeze, relative humidity, saturated, orographic lifting, convective lifting, barometer, high pressure, low pressure, dew point, condensation nuclei, collision-coalescence, stratus, cirrus, cumulus, fog, hail, cloud seeding, water cycle, transpiration, infiltration, precipitation, condensation, evaporation, runoff 2-B; Fronts, Storms, and Climate Patterns: temperature, moisture, air mass, modified air mass, coriolis effect, barometer, air pressure, pressure gradient, front, cold front, warm front, occluded front, stationary front, dissipating stage, mature stage, cumulus stage, thunderstorm, supercell, tornadoes, anticyclone, cyclone, tropical wave, tropical depression, tropical storm, hurricanes 2-C; Seasons and Tides (Earth/Moon/Sun Relationships): tide, spring tide, neap tide, gravity, high tide, low tide, tilt, eclipse, penumbra, umbra, lunar cycle, full moon, new moon, crescent, gibbous, quarter, waning, waxing, partial lunar eclipse, total solar eclipse		
Days	**Daily Content**	**Differentiation, Accommodation, and Extensions**	**Teacher Resources:**
Unit 2 A - Atmosphere, Water Cycle, and Clouds			
Day 1 - Moisture and Relative			

Humidity			
Day 2 - Atmosphere Trends and Graphing			
Day 3 - Energy in the Atmosphere			
Day 4 - Heat Transfer			
Day 5 - Global Winds			
Day 6 - Cloud notes and Thinking Maps			
Day 7 - "Whos your Daddy" Cloud Project			
Day 8 - Review for Assessment			
Day 9 - Unit Assessment			
Unit 2 B - Storms, Fronts, and Climate Patterns			
Day 1 - Air Pressure, Fronts, and Air Masses			
Day 2 - Reading Air Pressure and Isobars			
Day 3 - Climate Factors			
Day 4 - Climate Search			
Day 5 - Climate Graphs and World Maps			
Day 6 - Hurricane Notes and Mapping			
Day 7 - Tornado Mapping			
Day 8 - What's wrong with this Map?			
Day 9 - Review for Assessment			
Day 10 - Unit Assessment			

Unit 2 C - Seasons and Tides (Earth/Moon/Sun Relationships)			
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			
Day 8			
Day 9			
Day 10			
Day 11			

UNIT 3: *Astronomy*

Students use science and engineering practices, crosscutting concepts, and an understanding of celestial objects and forces to make sense of phenomena and solve problems. Key unit phenomena may include the first neutron star (1967), the habitable Earth, and the Hertzsprung Russell Diagram .

UNIT 3 DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ How have collisions with objects from space changed Earth in the past, and how could they affect our future?
- ➔ How do gas giants and ice giants differ in their chemical composition?
- ➔ Why is the solar system shaped like a disc?
- ➔ What are the characteristics and properties of the planets in our solar system?
- ➔ Why do stars shine? And will they shine forever?
- ➔ How do we know that there are other galaxies?

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1 - Patterns** Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.	**standard SCI.SEP1 - A.Asking Questions** Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following: • Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. • Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model or an explanation • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.	➔ **FORCES AND MOTION:** Motion and changes in motion can be quantitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). Newton's second law of motion (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects. 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.

	• Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design. **B.Defining Problems** Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. • Clarify and refine an engineering problem.	
➔ **Standard SCI.CC5 - Energy and Matter** Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	**Standard SCI.SEP2 - Developing and Using Models** Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. • Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.	➔ **EARTH AND THE SOLAR SYSTEM:** Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Cyclical changes in Earth's tilt and orbit, occurring over tens to hundreds of thousands of years, cause cycles of ice ages and other gradual climate changes.
➔ **Standard SCI.CC7 - Stability and Change** Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems	**Standard SCI.SEP4 - Analyze and Interpret Data** Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: • Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	➔ **SCIENCE AND ENGINEERING ARE HUMAN ENDEAVORS:** • Individuals from diverse backgrounds bring unique perspectives that are valuable to the outcomes and processes of science and engineering. • Scientists' and engineers' backgrounds, perspectives, and fields of endeavor influence the

can be designed for greater or lesser stability.	• Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. • Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. • Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation or model of a proposed process or system. • Analyze data to optimize design features or characteristics of system components relative to criteria for success.	nature of questions they ask, the definition of problems, and the nature of their findings and solutions. • Scientists and engineers embrace skepticism and critique as a community. Deliberate deceit in science is rare and is likely exposed through the peer review process. When discovered, intellectual dishonesty is condemned by the scientific community.
➔ **Standard SCI.CC6 - Structure and Function** Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.	**Standard SCI.SEP8 - Obtain, evaluate, and Communication Information** Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. • Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible. • Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.	➔ **SCIENCE AND ENGINEERING USE MULTIPLE APPROACHES TO CREATE NEW KNOWLEDGE AND SOLVE PROBLEMS:** • Scientists use a variety of methods, tools, and techniques to develop theories. A scientific theory is an explanation of some aspect of the natural word, based on evidence that has been repeatedly confirmed through observation, experimentation (hypothesis-testing), and peer review. • The certainty and durability of science findings varies based on the strength of supporting evidence. Theories are usually modified if they are not able to accommodate new evidence. • Engineers use a variety of approaches, tools, and techniques to define problems and develop solutions to those problems. Successful engineering solutions meet stakeholder needs and safety requirements, and are economically viable. Trade-offs in design aspects balance competing demands.

3 DIMENSIONAL LEARNING TARGETS

- ➔ HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system
- ➔ 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 that eventually reaches Earth in the form of radiation.
- ➔ HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
- ➔ HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.

UNIT 3 ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ How have collisions with objects from space changed Earth in the past, and how could they affect our future?
  - ◆ HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system
- ➔ How do gas giants and ice giants differ in their chemical composition?
  - ◆ HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- ➔ Why is the solar system shaped like a disc?
  - ◆ HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system
- ➔ What are the characteristics and properties of the planets in our solar system?
  - ◆ HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
- ➔ Why do stars shine? And will they shine forever?
  - ◆ 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 that eventually reaches Earth in the form of radiation.
- ➔ How do we know that there are other galaxies?
  - ◆ HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback. (Rubric links- TBD)

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
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The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

STAGE 3: UNIT LEARNING PLAN (under construction- note: this section does not require board approval) *Planned learning experiences and instruction: Learner Readiness, Key vocab, materials & resources unique to the unit*			
Plan & Prep for the Unit Stage:			
Review Learners' Attributes and needs: • Review 504s & IEP at a Glance • Review current classroom data (by standard) • Review any ACT, screening, or diagnostic data • Other?		Send Family Unit Communication ☐ *ADD example link*	Review any previous student exemplars Proficient ☐ *ADD LINK* Advanced/Excellent ☐ *ADD LINK*
Implementation Stage:			
Key Unit Vocabulary/ Root words:	3-A Planets and Solar System: Solar Nebula Hypothesis, collapse, spinning, flattening, condensing, accretion, planetesimals, centripetal force, Sun, Mercury, Venus, Earth, Mars, Asteroid Belt, Jupiter, Saturn, Uranus, Neptune, Kuiper Belt, Oort Cloud, Giant Moons, Dwarf Planets, eccentricity, Comet, geocentric, heliocentric, asteroid, meteoroid, meteor, meteorite, solar wind, prominence, solar places, fusion, core, radiation zone, convection zone, photosphere, chromosphere, corona, sunspot, albedo, highlands, maria, ejecta, lava tubes, rilles, rays 3-B Universe and Stars: Big Bang Theory, cosmic background radiation, temperature, expanding universe, open universe, closed universe, flat universe, dark matter, dark energy, galaxies, elliptical, lenticular, spiral, active galaxy, radio, active galactic nuclei, quasar, local group, supercluster, Milky Way, variable stars, spiral arms, halo, population I, population II, binary stars, constellations, circumpolar constellations, open cluster, globular cluster, parallax, light-year, parsec, doppler shifts, magnitude, apparent, absolute, spectral class, spectra, hydrostatic equilibrium, fusion, spectroscope, massive star, red supergiant, supernova, neutron star, black hole, nebula, protostar, average mass, red giant, planetary nebula white dwarf, black dwarf		
Days	**Daily Content**	**Differentiation, Accommodation, and Extensions**	**Teacher Resources:**
Unit 3 A - Planets and Solar System			

Day 1 - Solar Nebula Hypothesis			
Day 2 - Planet Notes Day 1			
Day 3 - Plante Notes Day 2			
Day 4 - Light Years			
Day 5 - Other Objects			
Day 6 - Mars Mission Data Table			
Day 7 - Start Project			
Day 8 - Project Work Time and Peer Review			
Day 9 - Solar System Review			
Day 10 - Unit Assessment			
Unit 3 - B - Universe and the Stars			
Day 1 - "Big Bang" Theory Intro, Inquiry, and Questions			
Day 2 - Big Bang Notes and Alternative Theories			
Day 3 - Galaxy Notes, Sample Galaxy, and Start Classification Lab			
Day 4 - Milky Way Video, and Finish Classification Lab			
Day 5 - Star Notes, Magnitude and Parallax			
Day 6 - Star Spectra			
Day 7 - Star Cycle Notes and			

Finish Spectra Questions			
Day 8 - Star Cycle Review and Flow Map			
Day 9 - HR Diagram			
Day 10 - Review for Assessment			
Day 11- Unit Assessment			

End of Unit Reflection:

- What successes did we have with students learning our desired results (Enduring Understandings, Essential Questions, Priority Standards)? How do we know? (summative results? Progress monitoring data?)
- What opportunities do we have to leverage desired results (Enduring Understandings, Essential Questions, Priority Standards, Anchor Phenomenon) in the future?
- How are we celebrating with students and as a team?

24/25	•
25/26	•
26/27	•
27/28	•