ACALANES UNION HIGH SCHOOL DISTRICT
COURSE OF STUDY: CURRICULAR AREA – SCIENCE

COURSE TITLE:	PHYSICS OF THE UNIVERSE
GRADE LEVEL:	11-12
COURSE LENGTH:	One Year
PREFERRED PREVIOUS COURSE OF STUDY:	Chemistry in the Universe
CREDIT:	10 Credits
UC/CSU CREDIT:	Meets UC/CSU credit for Science requirement; subject area (“d”) - PENDING
GRADUATION REQUIREMENT:	Fulfills one year of two-year science requirement for graduation
STANDARDS AND BENCHMARKS:	Next Generation Science Standards
ADOPTED:	March 6, 2019
INSTRUCTIONAL MATERIALS:	Physics in the Universe; Houghton Mifflin Harcourt, Galisky and Rylander, 2020

COURSE DESCRIPTION: Physics of the Universe, a course based on the Next Generation Science Standards, explores the way in which physical processes govern the universe. Physics is the study of matter, forces, and their interactions. By using science and engineering practices, evidence from experiments, research, and observations, students will learn how to formulate questions, evaluate claims, use mathematics and computational thinking, and develop models to make interpretations and investigate the natural world.

DEFINITIONS:

Instructional Segment: Grouping elements or concepts from multiple PEs in lessons, units, and/or assessments that students can develop and use together to build toward proficiency on a set of PEs in a coherent manner.

Performance Expectation: The NGSS is not a set of daily standards, but a set of expectations for what students should be able to do by the end of instruction (years or grade-bands). The performance expectations set the learning goals for students, but do not describe how students get there.

Crosscutting Concepts: These are concepts that hold true across the natural and engineered world. Students can use them to make connections across seemingly disparate disciplines or situations, connect new learning to prior experiences, and more deeply engage with material across the other dimensions. The NGSS requires that students explicitly use their understanding of the CCCs to make sense of phenomena or solve problems.

Assessment Boundary: These specify the limits of assessment on the California Science Test. They are not meant to put limits on what can be taught or how it is taught, but to provide guidance.

Disciplinary Core Ideas: The fundamental ideas that are necessary for understanding a given science discipline. The core ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.

Science and Engineering Practices: The practices are what students do to make sense of phenomena. They are both a set of skills and a set of knowledge to be internalized. The SEPs reflect the major practices that scientists and engineers use to investigate the world and design and build systems.

Phenomenon: Observable events that students can use the three dimensions to explain or make sense of.

Course Codes:
LS - Life Science
ESS - Earth and Space Science
ETS - Engineering and Technology and Applications of Science

CURRICULAR PRACTICES:

Within the Physics of the Universe course, there are three distinct and equally important dimensions to learning science. These dimensions are combined to form each standard—or performance expectation—and each dimension works with the other two to help students build a cohesive understanding of science over time.

The Three Dimensions:

- The Science and Engineering Practices are what scientists/engineers DO.
- The Disciplinary Core Ideas are what scientists/engineers KNOW.
- The Crosscutting Concepts are HOW scientists/engineers THINK.

Crosscutting Concepts:

1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter: flows cycles and conservation
6. Structure and function
7. Stability and change of systems

Science and Engineering Practices:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

ASSESSMENT: Physics of the Universe incorporates a variety of assessment activities that mirror the variety in NGSS-aligned instructional practices. The distinction between instructional activities and assessment activities may be blurred, particularly when the assessment purpose is formative.

Assessments will focus on:

1. Tasks that have multiple components so they can yield evidence of three-dimensional learning (and multiple performance expectations).
2. Explicit attention to the connections among scientific concepts.
3. Gathering of information about how far students have progressed along a defined sequence of learning.

GRADING GUIDELINES: See AUHSD Grading Guidelines: Final Course Mark Determination

COURSE INSTRUCTIONAL SEGMENTS:

1. Forces and Motion
2. Forces at a Distance
3. Energy and Energy Conservation
4. Waves and Electromagnetism
5. Nuclear Processes
6. Stars and Universe

Suggested Unit Structure and Order of Instruction

1. Motion and Forces
    a. Kinematics
    b. Force, Mass, Acceleration
2. Momentum and Collisions
    a. Momentum
    b. Collisions – tectonic plates
3. Forces at Distance
    a. Gravity/Planetary
    b. Electrostatic force
    c. Forces in materials
4. Energy Conversion
    a. Conservation of energy
    b. Work
5. Electricity and Magnetism
    a. Electricity
    b. Magnetism
    c. Electrical energy

6. Waves
   a. Waves and matter
   b. Wound
   c. Earthquakes
   d. EM radiation
   e. Information and energy transfer
7. Nuclear Processes
   a. Nucleus
   b. Radiometric dating
8. Stars and Universe
   a. Stars/space
   b. Bing Bang

COURSE CONTENT:

Physics of the Universe Instructional Segments	
Instructional Segment 1: Forces and Motion	
Guiding Questions • How can Newton's laws be used to explain how and why things move? • How can mathematical models of Newton's laws be used to test and improve engineering designs? • What are some ways that we can protect ourselves during collisions?	
Unit Overview: Students make predictions using Newton's laws and mathematically describe how changes in motion relate to forces. Students will investigate Momentum & Collisions as well as collisions in Earth's crust and in an engineering challenge**.**	
Students who demonstrate understanding can:	**Clarification statement**
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: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.*
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: Assessment is limited to systems of two macroscopic bodies moving in one dimension.*
HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision	Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. *Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.*

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants		
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering		
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts		
HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem		
Highlighted Science and Engineering Practices	**Highlighted Disciplinary Core Ideas**	**Highlighted Cross-cutting Concepts**
• [SEP-1] Asking Questions and Defining Problems • [SEP-4] Analyzing and Interpreting Data • [SEP-5] Using Mathematics and Computational Thinking • [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)	• PS2 A: Forces and Motion PS2 B: Types of Interactions • ETS1 A: Defining and Delimiting Engineering Problems • ETS1 B: Developing Possible Solutions • ETS1 C: Optimizing the Design Solution	• [CCC-2] Cause and Effect • [CCC-4] Systems and System Models

Physics of the Universe Instructional Segments	
Instructional Segment 2: Forces at a Distance	
Guiding Questions • How can different objects interact when they are not even touching? • How do interactions between matter at the microscopic scale affect the macroscopic properties of matter that we observe? • How do satellites stay in orbit?	
Unit Overview: Students investigate gravitational and electromagnetic forces and describe them mathematically. They predict the motion of orbiting objects in the solar system. Students link the macroscopic properties of materials to microscopic electromagnetic attractions.	
Students who demonstrate understanding can:	**Clarification statement**
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. *Assessment Boundary: Assessment is limited to systems with two objects.*
HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials *The performance expectations marked with an asterisk integrate traditional science content with engineering through a practice or disciplinary core idea	Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors. *Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.*
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.*

Highlighted Science and Engineering Practices	Highlighted Disciplinary Core Ideas	Highlighted Cross-cutting Concepts
• [SEP-5] Using Mathematics and Computational Thinking • [SEP-8] Obtaining, Evaluating, and Communicating Information	• PS2 B: Types of Interactions • ESS1 B: Earth and the Solar System	• [CCC-1] Patterns • [CCC-2] Cause and Effect: Mechanism and Explanation • [CCC-3] Scale, Proportion, and Quantity • [CCC-6] Structure and Function

Physics of the Universe Instructional Segments	
Instructional Segment 3: Energy Conversion and Renewable Energy	
Guiding Questions • How do power plants generate electricity? • What engineering designs can help increase the efficiency of our electricity production and reduce the negative impacts of using fossil fuels?	
Unit Overview: Energy Conversion Students track energy transfer and its conversion through different stages of power generation They evaluate different power plant technologies They investigate electromagnetism to create models of how generators work and obtain and communicate information about how solar photovoltaic systems operate They design and test their own energy-conversion devices	
Students who demonstrate understanding can:	**Clarification statement**
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	*Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.*
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.*

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 position 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
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.*
HS-PS4-5. Communicate technical information 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.*
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios * *The performance expectations marked with an asterisk integrate traditional science content with engineering through a practice or disciplinary core idea	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.
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity	Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning. *Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.*
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants	

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering		
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts		
HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem		
Highlighted Science and Engineering Practices	**Highlighted Disciplinary Core Ideas**	**Highlighted Cross-cutting Concepts**
• [SEP-1] Asking Questions and Defining Problems • [SEP-2] Developing and Using Models • [SEP-3] Planning and Carrying Out Investigations • [SEP-5] Using Mathematics and Computational Thinking • [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)	• PS2 B: Types of Interactions PS3 A: Definitions of Energy • PS3 B: Conservation of Energy and Energy Transfer • PS3 C: Relationship Between Energy and Forces • PS3 D: Energy in Chemical Processes and Everyday Life • ETS1 A: Defining and Delimiting Engineering Problems • ETS1 B: Developing Possible Solutions • ETS1 C: Optimizing the Design Solution	• [CCC-2] Cause and Effect: Mechanism and Explanation • [CCC-4] Systems and System Models • [CCC-5] Energy and Matter: Flows, Cycles, and Conservation

Physics of the Universe Instructional Segments	
Instructional Segment 4: Waves and Electromagnetic Radiation	
Guiding Questions • How do we know what is inside the Earth? • Why do people get sunburned by UV light? • How do can we transmit information over wires and wirelessly?	
Unit Overview: Waves and Electro-magnetic Radiation; Students make mathematical models of waves and apply them to seismic waves traveling through the Earth. They obtain and communicate information about other interactions between waves and matter with a particular focus on electromagnetic waves. They obtain, evaluate, and communicate information about health hazards associated with electromagnetic waves. They use models of wave behavior to explain information transfer using waves and the wave-particle duality.	
Students who demonstrate understanding can:	**Clarification statement**
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	Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion). *Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.* (Introduced in IS4)
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: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]*
HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information	Clarification Statement: Examples of advantages 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.

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.*
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 the idea 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. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. *Assessment Boundary: Assessment is limited to qualitative descriptions.*
HS-PS4-5. Communicate technical information 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.*

Highlighted Science and Engineering Practices	**Highlighted Disciplinary Core Ideas**	**Highlighted Cross-cutting Concepts**
• [SEP-1] Asking Questions and Defining Problems • [SEP-2] Developing and Using Models • [SEP-5] Using Mathematics and Computational Thinking • [SEP-7] Engaging in Argument from Evidence • [SEP-8] Obtaining, Evaluating, and Communicating Information	• ESS2 A: Earth Materials and Systems • ESS2 B: Plate Tectonics and Large-Scale System Interactions • PS3 D: Energy in Chemical Reactions • PS4 A: Wave Properties PS4 B: Electromagnetic Radiation • PS4 C: Information Technologies and Instrumentation	• [[CCC-2] Cause and Effect: Mechanism and Explanation • [CCC-4] Systems and System Models • [CCC-7] Stability and Change

Physics of the Universe Instructional Segments	
Instructional Segment 5: Nuclear Processes and Earth History	
Guiding Questions • What does $E=mc^2$ mean? • How do nuclear reactions illustrate conservation of energy and mass? • How do we determine the age of rocks and other geologic features?	
Unit Overview: Students develop a model of the internal structure of atoms and then extend it to include the processes of fission, fusion, and radioactive decay. They apply this model to understanding nuclear power and radiometric dating and use evidence from rock ages to reconstruct the history of the Earth and processes that shape its surface.	
Students who demonstrate understanding can:	**Clarification statement**
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	Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions). (Also addressed in Chemistry in the Earth System, with emphasis on WHY plates flow, not the evidence from their flow).
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. (Also addressed in the High School Living Earth course)
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	Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion). (Also addressed in the High School Living Earth course) *Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.*

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay	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. *Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.*	
Highlighted Science and Engineering Practices	**Highlighted Disciplinary Core Ideas**	**Highlighted Cross-cutting Concepts**
• [SEP-2] Developing and Using Models • [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering) • [SEP-7] Engaging in Argument from Evidence	• ESS1 C: The History of Planet Earth • ESS2 A: Earth Materials and Systems • ESS2 B: Plate Tectonics and Large-Scale System Interactions • PS1 A Structure and Properties of Matter • PS1 C: Nuclear Processes	• [[CCC-1] Patterns • [CCC-5] Energy and Matter: Flows, Cycles, and Conservation • [CCC-7] Stability and Change

Physics of the Universe Instructional Segments	
Instructional Segment 6: Stars and the Origins of the Universe	
Guiding Questions • How do we know what stars are made of? • What fuels our Sun? Will it ever run out of that fuel? • Do other stars work the same way as our Sun? • How do patterns in motion of the stars tell us about the origin of our universe?	
Unit Overview: Stars and the Origin of the Universe Students apply their model of nuclear fusion to trace the flow of energy from the Sun's core to Earth. They use evidence from the spectra of stars and galaxies to determine the composition of stars and construct an explanation of the origin of the universe.	
Students who demonstrate understanding can:	**Clarification statement**
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: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.	
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	Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the 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 the Big Bang theory (3/4 hydrogen and 1/4 helium) .	
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.*	
Highlighted Science and Engineering Practices	**Highlighted Disciplinary Core Ideas**	**Highlighted Cross-cutting Concepts**
• [[SEP-2] Developing and Using Models • [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering) • [SEP-8] Obtaining, Evaluating, and Communicating Information	• ESS1 A: The Universe and Its Stars • PS3 D: Energy in Chemical Processes and Everyday Life • PS4 B Electromagnetic Radiation	• [CCC-3] Scale, Proportion, and Quantity • [CCC-5] Energy and Matter: Flows, Cycles, and Conservation