

Pascack Valley Regional High School District

**Pascack Hills High School, Montvale, New Jersey
Pascack Valley High School, Hillsdale, New Jersey**

Course Name: Astronomy

Born On: August, 2026
Board Approval: 8/24/26

New Jersey Curricular Mandates for Science Instruction

Disabled & LGBT:

18A:35-4.35 - History of disabled and LGBT persons included in middle and high school curriculum. A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards.

Diversity, Equity, and Inclusion (DEI):

C.18A:35-4.36a - Curriculum to include instruction on diversity and inclusion. 1. a. Beginning in the 2021-2022 school year, each school district shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards. b. The instruction shall: (1) highlight and promote diversity, including economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance; (2) examine the impact that unconscious bias and economic disparities have at both an individual level and on society as a whole; and (3) encourage safe, welcoming, and inclusive environments for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs. c. The Commissioner of Education shall provide school districts with sample learning activities and resources designed to promote diversity and inclusion.

Amistad Law:

N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

Climate Change:

2026 NJSLS-Science: Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. Global climate change has already resulted in a wide range of impacts across New Jersey and in many sectors of its economy. The addition of academic standards that focus on climate change is important so that all students will have a basic understanding of the climate system, including the natural and human-caused factors that affect it. The underpinnings of climate change span across physical, life, as well as Earth and space sciences. The goal is for students to understand climate science as a way to inform decisions that improve quality of life for themselves, their community, and globally and to know how engineering solutions can allow us to mitigate impacts, adapt practices, and build resilient systems.

Dissection Law

N.J.S.A. 18A:35-4.25 and N.J.S.A. 18A:35-4.24 authorizes parents or guardians to assert the right of their children to refuse to dissect, vivisect, incubate, capture or otherwise harm or destroy animals or any parts thereof as part of a course of instruction.

Astronomy		
Unit Title	Approx # of weeks	Months
Introduction to Astronomy	3 Weeks	February
The Moon	2 Weeks	February – March
The Terrestrial Planets (The Inner Planets)	2-3 Weeks	March
The Outer Planets	2-3 Weeks	March-April
Small Bodies Orbiting the Sun	1-2 Weeks	April
The Sun	2 Weeks	April
Stars and Constellations	2 Weeks	May
“Bad Astronomy” Myths	2 Weeks	May
Modern Astronomical Technology	2 Weeks	June

Astronomy		
Unit 1: Introduction to Astronomy		
Anchoring Phenomenon: Why do astronomers say we are looking back in time when we observe distant galaxies? As astronomers observe increasingly distant galaxies using telescopes such as the James Webb Space Telescope and Hubble Space Telescope, they are detecting light that has traveled for billions of years before reaching Earth. These observations provide evidence for the expansion of the universe, stellar evolution, and the Big Bang while allowing scientists to study how galaxies, stars, and planetary systems formed over cosmic time.		
Related Phenomena - Why does the night sky appear different depending on where and when you observe it? - How did the James Webb Space Telescope discover galaxies that formed shortly after the Big Bang? - Why do constellations appear to change throughout the year even though the stars themselves remain relatively fixed?		
Time Allotted: Approximately 3 Weeks		
New Jersey Student Learning Standards (NJSLS) 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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Obtaining, Evaluating, and Communicating Information - Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and	ESS1.A: The Universe and Its Stars - The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. - The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.	Energy and Matter - Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. - In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). Using Mathematical and Computational Thinking - Use mathematical or computational representations of phenomena to describe explanations. ----- <i>Connections to Nature of Science</i> Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. ESS1.B: Earth and the Solar System - Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. PS4.B: Electromagnetic Radiation - Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. <i>(secondary)</i>	Scale, Proportion, and Quantity - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. ----- <i>Connections to Nature of Science</i> Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. - Science assumes the universe is a vast single system in which basic laws are consistent.	
Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- Where is the Earth located with respect to the rest of the cosmos? - If I could travel to the Milky Way, what would I encounter and see? - What are the objects and patterns we	- Students will be able to create a model that shows our address in the cosmos - Students will use valid research sources to discover folk stories	“Starry Night” computer-based simulations to investigate solar system, stars, galaxies, and the known universe - Cosmic Timeline Activity - Milky Way creation story activity to	Assess computer-based simulations for understanding of solar system, stars, galaxies, and the known universe

see in our nighttime sky? - What causes the moon to change shape and position over time? - How did we come to our current understanding of the Cosmos?	about the Milky Way's creation - Students will analyze the basic structure of the Milky Way - Students will communicate what causes the seasons on earth - Students will study the patterns we see in the sky and how the constellations can be studied - Students will understand the different phases of the moon. - Students will explore the different types of eclipses and understand what causes them - Students will investigate the astronomers that revolutionized modern astronomy. - Students will draw a labeled diagram of the structure of our planet and our solar system. - Students will explain how the earth's position affects our seasons on the surface.	communicate understanding of how the Milky Way was created - "Famous Astronomers" research project and presentations to evaluate and communicate understandings of the contributions of famous astronomers - Flat Earth Video and Debate to construct arguments pertaining to the Earth's structure - Gizmo "Phases of the Moon" Activity to investigate the phases of the moon - Gizmo "2D eclipse" and "3D eclipse" Activities to explore the formation of eclipses	- Assessment of ability to evaluate and synthesize information to construct a model of the Cosmos - Assess analysis and communication of how the Milky Way was created - Assess for the evaluation and communication revolutionization of modern astronomy Assess participation in class discussions for current and ongoing understanding of astronomy - Assessment of construction and communication of arguments pertaining to the Earth's structure
Interdisciplinary Connections	<u>English Language Arts</u> ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. <u>Mathematics</u> ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.1 Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HS.S-ID.6 Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets and interpret differences in context.		

	Visual & Performing Arts 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as astronomy, astrophysics, aerospace engineering, planetary science, and space exploration. 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		
Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
- Pre-teach astronomy vocabulary (e.g., galaxy, nebula, light-year, spectrum, fusion, redshift, constellation, cosmic microwave background) using visuals, bilingual glossaries, and interactive word walls. - Use NASA and ESA imagery, planetarium software, and labeled diagrams to reinforce concepts. - Provide sentence frames and graphic organizers for scientific explanations and CER writing. - Allow bilingual dictionaries and translated instructional materials when appropriate. - Pair students strategically during simulations and collaborative investigations. - When possible, modify assignments so the ELL student writes less, has	- Break investigations and computer simulations into smaller sequential tasks using visual checklists. - Provide guided notes, graphic organizers, and partially completed concept maps. - Offer extended time for simulations, research activities, and presentations. - Allow alternate assessments such as recorded presentations, annotated diagrams, or oral explanations. - Use tactile solar system models and digital planetarium software before independent investigations.	- Connect astronomy concepts to current discoveries from the James Webb Space Telescope, Artemis missions, and current NASA research. - Scaffold data interpretation using teacher modeling before independent analysis. - Reinforce concepts through interactive simulations and collaborative learning groups. - Use frequent formative assessments and exit tickets to monitor understanding. - Provide visual summaries and concept maps to reinforce large-scale astronomical relationships.	- Lead the class in the deciphering of new learning. - Analyze authentic datasets from NASA, ESA, or the Sloan Digital Sky Survey. - Compare competing cosmological models using peer-reviewed scientific literature. - Investigate recent James Webb Space Telescope discoveries and evaluate their implications for models of galaxy formation. - Develop computational or scale models illustrating distances, stellar evolution, or galactic structure. - Conduct an independent research investigation into

simpler questions to answer, fewer spelling words, etc. • Provide models of completed homework assignments, projects, etc. • Assign a native language partner. • Use sentence/paragraph frames to assist with writing peer review. • Provide extended time for written responses and reports.			exoplanets, black holes, dark matter, or cosmology and present findings in a professional scientific format.
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Astronomy		
Unit 2: The Moon		
Anchoring Phenomenon: Why do we always see the same side of the Moon, yet its appearance changes every night? Although the Moon rotates on its axis, people on Earth always observe nearly the same lunar face while simultaneously watching the Moon progress through a predictable sequence of phases. Understanding this phenomenon requires examining orbital motion, gravity, tidal locking, and the changing geometry of the Earth-Moon-Sun system. Related Phenomena • Why did the Apollo astronauts observe different geological features than scientists expected? • Why are some lunar craters billions of years old while Earth's impact craters are much less common? • Why are ocean tides on Earth controlled primarily by the Moon's gravitational pull?		
Time Allotted: Approximately 2 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today	ESS1.A: The Universe and Its Stars • The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. • The Big Bang theory is supported by observations of distant galaxies receding from our own,	Energy and Matter • Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. -----

as they did in the past and will continue to do so in the future.

Obtaining, Evaluating, and Communicating Information

- Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Using Mathematical and Computational Thinking

- Use mathematical or computational representations of phenomena to describe explanations.

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.

- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

ESS1.B: Earth and the Solar System

- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.

PS4.B: Electromagnetic Radiation

- Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. *(secondary)*

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Scale, Proportion, and Quantity

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.
- Science assumes the universe is a vast single system in which basic laws are consistent.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is the structure of the moon and how does it relate to earth's structure? - What are the theories for the moon's formation and which one is regarded as correct? - How did the moon's surface get its current characteristics? - How does the moon's atmosphere compare to earth's atmosphere? - What are the 4 phases of the moon (in detail)? - What are the different types of eclipses and how do they occur? - How does the moon rotate and how does this rotation affect the oceanic tides on earth?	- Students will investigate the structure of the moon and how it relates to earth's structure. - Students will compare and contrast the different theories about the moon's formation and debate the pros and cons of each hypothesis. - Students will explore the moon's atmosphere and compare it to the atmosphere of earth. - Students will research the moon's surface and learn the correct vocabulary to describe its features. - Students will learn the 4 phases of the moon and how the rotation and tilt of the moon affects the tides on earth.	- "Starry Night" computer-based simulations to investigate the moon's surface - Gizmo "Ocean Tides" Activity to explore the impact of the moon on ocean tides - Moon features vocabulary activities to explore the surface of the moon - "Formation Hypotheses" research activities and debate to construct and communicate arguments about the moon's formation	- Assess computer-based simulation submissions for understanding of the structure and function of the moon - Laboratory investigation submissions assessed for analysis of the impact of the the moon on ocean tides - Class Presentations assessed for ability to research, construct and communicate arguments about the moon's formation - Assess participation in class discussions for current and ongoing understanding of the structure and function of the moon
Interdisciplinary Connections	English Language Arts ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. Mathematics ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.1 Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. Visual & Performing Arts		

	● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as planetary science, aerospace engineering, astronomy, geology, and space exploration. ● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		
Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
● Pre-teach astronomy vocabulary (e.g., tidal locking, maria, regolith, eclipse, crater, orbit, phase, gravity, apogee, perigee) using visuals, bilingual glossaries, and labeled lunar diagrams. ● Use NASA animations, lunar maps, and interactive Moon visualizations to reinforce concepts. ● Provide sentence frames and graphic organizers for CER writing and lunar formation debates. ● Allow bilingual dictionaries and translated instructional materials when appropriate. ● Pair students strategically during investigations and computer simulations to support collaborative language development. ● When possible, modify	● Break lunar investigations and simulations into smaller sequential tasks using visual checklists. ● Provide guided notes, labeled diagrams, and partially completed concept maps for lunar phases, eclipses, and tides. ● Offer extended time for simulations, laboratory investigations, and presentations. ● Allow alternate assessments such as oral explanations, annotated diagrams, digital presentations, or recorded responses. ● Use physical Sun-Earth-Moon models before transitioning to abstract diagrams and simulations. ● Provide extended time for the creation of products. ● Scaffolded explanations for proper use of equipment.	● Connect lunar concepts to observable phenomena such as monthly moon phases, eclipses, and local tidal patterns. ● Use teacher-guided modeling before independent interpretation of lunar diagrams and orbital models. ● Reinforce concepts using NASA animations, Starry Night simulations, and hands-on modeling activities. ● Scaffold CER writing using structured templates and guided discussions. ● Provide frequent formative feedback through exit tickets and small-group instruction. ● Provide peer mentoring to improve techniques. ● Provide an outline for project tasks.	● Analyze authentic Apollo mission data and lunar imagery from NASA's Lunar Reconnaissance Orbiter. ● Compare historical and current hypotheses for lunar formation using peer-reviewed scientific evidence. ● Investigate Artemis mission objectives and evaluate future lunar exploration technologies. ● Develop scale models illustrating the Earth-Moon system, orbital mechanics, or eclipse geometry. ● Conduct an independent investigation examining the Moon's influence on Earth's tides, long-term climate stability, or future human exploration. ● Lead the class in the deciphering of new learning.

assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. • Provide models of completed homework assignments, projects, etc. • Assign a native language partner. • Use sentence/paragraph frames to assist with writing peer review. • Provide extended time for written responses and reports.	• Provide an outline of lessons • Get a written list of instructions • Receive large project as smaller tasks with individual deadlines • Work or take a test in a different setting, such as a quiet room with few distractions. • Sit where they learn best (for example, near the teacher) • Use an alarm to help with time management • Work with a partner	• Incorporate student choice • Use effort and achievement rubrics • Assure students they can be successful • Promote mastery or challenging tasks • Allow students many opportunities for practice and learning • Use scaffolding for complex tasks • Evaluate students on the basis of mastery and not one another.	• Advanced product design.
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Astronomy		
Unit 3: The Terrestrial Planets (The Inner Planets)		
Anchoring Phenomenon: Why did Earth become a habitable planet while the other terrestrial planets evolved so differently? Mercury, Venus, Earth, and Mars formed from similar materials in the early solar system, yet each developed dramatically different atmospheres, climates, surface conditions, and geologic histories. By comparing these planets, scientists can better understand planetary evolution, habitability, and the conditions necessary to support life. Related Phenomena - Why is Venus hotter than Mercury even though Mercury is closer to the Sun? - Why does Mars show evidence of ancient rivers and lakes but little liquid water today? - Why do impact craters dominate Mercury's surface while Earth's surface is continually reshaped by plate tectonics and erosion?		
Time Allotted: Approximately 2-3 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Obtaining, Evaluating, and Communicating Information - Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and	ESS1.A: The Universe and Its Stars - The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. - The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. - Other than the hydrogen and helium formed at the time of the	Energy and Matter - Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. - In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Using Mathematical and Computational Thinking

- Use mathematical or computational representations of phenomena to describe explanations.

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

ESS1.B: Earth and the Solar System

- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.

PS4.B: Electromagnetic Radiation

- Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. *(secondary)*

Scale, Proportion, and Quantity

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Connections to Engineering, Technology, and Applications of Science

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.
- Science assumes the universe is a vast single system in which basic laws are consistent.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is the structure of each terrestrial/inner planet? - How does each inner planet compare to the Earth?	- Students will learn to actively participate in group work - Students will research the inner planets history, structure and atmosphere and compare the information to the information about earth - Students will present their findings to the class in a presentation format	- Group inner planet research project (Poster/Pamphlet/Media Choice) and Presentation) to collaborate to communicate the structure of the inner planets - “Starry Night” computer-based simulations to investigate the structure of the inner planets - Gizmo “Solar System Explorer” Activity to explore the structures of the the inner planets - Gizmo “Compare Earth to Venus” activity to construct understandings about how the inner planets compare to the Earth	- Assessment of gathering, synthesis and communication of information in inner planets project research, project poster/pamphlet submissions and project group presentations - Laboratory activity submissions assessed for analysis of the structure and function of the inner planets as compared to the Earth - Assess computer-based simulation submissions for understanding of the inner planets - Assess participation in class discussions for current and ongoing understanding of the structure and function of the inner planets
Interdisciplinary Connections	English Language Arts ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. Mathematics ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.1 Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. Visual & Performing Arts ● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		

Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as planetary science, geology, aerospace engineering, astronomy, and planetary exploration. ● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		
Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
● Pre-teach planetary science vocabulary (e.g., terrestrial planet, atmosphere, lithosphere, greenhouse effect, albedo, impact crater, tectonics, regolith) using visuals, bilingual glossaries, and labeled planetary diagrams. ● Use NASA imagery, planetary comparison charts, and interactive solar system models to reinforce concepts. ● Provide sentence frames and graphic organizers for CER writing and planetary comparison activities. ● Allow bilingual dictionaries and translated instructional materials when appropriate. ● Pair students strategically during simulations and collaborative investigations. ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer	● Break planetary comparison investigations into smaller sequential tasks using visual checklists. ● Provide guided notes, comparison charts, and partially completed graphic organizers. ● Offer extended time for simulations, laboratory investigations, research, and presentations. ● Allow alternate assessments such as oral presentations, annotated diagrams, digital presentations, or recorded responses. ● Use physical and digital models of the terrestrial planets before transitioning to comparative data analysis. ● Use scaffolds, such as prompting to assist with the learning process. ● Provide extended time for written responses and reports. ● Use a graphic organizer to	● Connect planetary concepts to current NASA missions such as Mars Perseverance, Ingenuity, MESSENGER, and DAVINCI. ● Scaffold planetary comparison activities using structured graphic organizers and teacher modeling. ● Reinforce concepts through Starry Night simulations, NASA videos, and interactive planetary visualizations. ● Use cooperative learning groups with clearly defined roles during research projects. ● Provide frequent formative feedback through exit tickets, small-group instruction, and concept checks. ● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice. ● Provide peer mentoring to improve	● Analyze authentic planetary datasets from NASA's Planetary Data System. ● Compare atmospheric evolution on Mercury, Venus, Earth, and Mars using current scientific literature. ● Investigate the potential habitability of Mars and evaluate evidence for ancient water using rover mission data. ● Develop computational or scale models illustrating planetary density, orbital characteristics, or atmospheric composition. ● Conduct an independent research investigation examining planetary habitability, terraforming, or current planetary exploration missions and present findings in a professional scientific format. ● Take on an additional or more complex design challenge.

spelling words, etc. • Provide models of completed homework assignments, projects, etc. • Assign a native language partner. • Use sentence/paragraph frames to assist with writing peer review. • Provide extended time for written responses and reports.	categorize concepts. • Get a written list of instructions • Receive a large project as smaller tasks with individual deadlines. • Work or take a test in a different setting, such as a quiet room with few distractions. • Sit where they learn best (for example, near the teacher). • Use an alarm to help with time management. • Work with a partner.	techniques. • Use effort and achievement rubrics • Assure students they can be successful. • Promote mastery or challenging tasks. • Allow students many opportunities for practice and learning. • Use scaffolding for complex tasks.	• Interview someone in the field of technology education about how they use the lesson content and skills in their profession. • Offer choices, once finished with the standard lesson activity, taking into consideration students' interests and goals.
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Astronomy		
Unit 4: The Outer Planets		
<u>Anchoring Phenomenon:</u> Why do the giant planets look so different from Earth, and how can some of their moons be among the most promising places to search for life? Jupiter, Saturn, Uranus, and Neptune formed in the cold outer solar system, developing into gas and ice giants with powerful storms, magnetic fields, ring systems, and dozens of diverse moons. Despite their great distance from the Sun, several of these moons show evidence of subsurface oceans and active geology that may provide environments capable of supporting life. <u>Related Phenomena</u> • Why has Jupiter's Great Red Spot persisted for centuries while storms on Earth dissipate within days or weeks? • Why do Saturn's rings remain stable instead of collapsing into the planet? • Why are Europa and Enceladus considered among the best locations to search for extraterrestrial life?		
Time Allotted: Approximately 2-3 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer	ESS1.A: The Universe and Its Stars • The study of stars' light spectra and brightness is used to identify compositional elements of stars,	Energy and Matter • Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems.

review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Obtaining, Evaluating, and Communicating Information

- Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Using Mathematical and Computational Thinking

- Use mathematical or computational representations of phenomena to describe explanations.

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

their movements, and their distances from Earth.

- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

ESS1.B: Earth and the Solar System

- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.

PS4.B: Electromagnetic Radiation

- Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an

- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Scale, Proportion, and Quantity

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

		element, even in microscopic quantities. <i>(secondary)</i>	Science assumes the universe is a vast single system in which basic laws are consistent.
Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is the structure of each outer planet? - How did the outer planets form? - If the outer planet has moons, what makes them unique? - How does each outer planet compare to the Earth?	- Students will learn to actively participate in group work - Students will research the outer planets history, structure and atmosphere and compare the information to the information about earth - Students will examine the diversity of the moons around the outer planets - Students will differentiate Pluto from the other 4 outer planets - Students will understand the difference between the outer 4 planets and the inner 4 planets (and the Kuiper Belt) - Students will present their findings to the class in a presentation format	- Group outer planets and Kuiper Belt research project (Poster/Pamphlet/Media Choice and Presentation) to collaborate to communicate the structure of the outer planets - “Starry Night” computer-based simulations to investigate the structure of the outer planets - Gizmo “Solar System Explorer” Activity to explore structure of the outer planets and how they compare to the Earth	- Assessment of gathering, evaluation, synthesis and communication of information about outer planets in project research, submissions and presentations - Laboratory investigation submissions assessed for analysis of the structure and function of the outer planets as compared to the Earth - Assess computer-based simulation submissions for understanding of the outer planets - Assess participation in class discussions for current and ongoing understanding of the structure and function of the outer planets
Interdisciplinary Connections	<u>English Language Arts</u> ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. <u>Mathematics</u>		

	● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.1 Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. Visual & Performing Arts ● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as planetary science, geology, aerospace engineering, astronomy, and planetary exploration. ● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		
Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
● Pre-teach astronomy vocabulary (e.g., gas giant, ice giant, magnetosphere, ring system, Kuiper Belt, moon, atmosphere, density, orbital resonance) using visuals, bilingual glossaries, and labeled planetary diagrams. ● Use NASA imagery, Voyager, Cassini, Galileo, and Juno mission visuals to reinforce concepts. ● Provide sentence frames and graphic organizers for CER writing and planetary comparison activities. ● Allow bilingual dictionaries and	● Break research projects and simulations into manageable steps using written checklists. ● Provide guided notes, comparison charts, and partially completed graphic organizers for planetary data. ● Offer extended time for simulations, research activities, and presentations. ● Allow alternate assessments such as oral presentations, annotated diagrams, digital presentations, or recorded explanations. ● Use physical and digital solar	● Connect learning to current NASA missions such as Juno, Europa Clipper, and Dragonfly. ● Scaffold planetary comparison activities using structured graphic organizers and teacher modeling. ● Reinforce concepts using Starry Night simulations, NASA videos, and interactive planetary visualizations. ● Use cooperative learning groups with clearly defined roles during research activities. ● Provide frequent formative feedback through exit tickets, conferencing, and small-group instruction.	● Analyze authentic data from NASA's Juno, Cassini, Voyager, or New Horizons missions. ● Compare atmospheric dynamics and internal structures of gas giants and ice giants using current scientific literature. ● Investigate the habitability of Europa, Enceladus, Titan, or Triton using mission data and peer-reviewed research. ● Develop computational or scale models illustrating planetary mass, density, magnetic fields, or orbital characteristics.

translated instructional materials when appropriate. ● Pair students strategically during research and collaborative investigations. ● Provide extended time for written responses and reports. ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provide a variety of texts and resources on curriculum topics at a range of reading levels. ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner. ● Use sentence/paragraph frames to assist with writing reports.	system models to reinforce relative size, distance, and planetary characteristics. ● Use scaffolds, such as prompting to assist with the design process and with the writing process. ● Provide extended time for written responses and reports. ● Use a graphic organizer to categorize concepts. ● Get a written list of instructions ● Receive large project as smaller tasks with individual deadlines ● Work or take a test in a different setting, such as a quiet room with fewer distractions. ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management. ● Work with a partner.	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics. ● Assure students they can be successful. ● Allow students many opportunities for practice and learning. ● Use scaffolding for complex tasks.	● Conduct an independent research investigation evaluating future robotic or human exploration of the outer solar system and present findings using professional scientific formats. ● Interview someone in the field of astronomy about how they use their knowledge in their profession. ● Offer choices, once finished with the standard lesson activity, taking into consideration students' interests and goals.
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Astronomy		
Unit 5: Small Bodies Orbiting the Sun		
Anchoring Phenomenon: Why did NASA intentionally crash a spacecraft into an asteroid, and could a mission like this one day save Earth? In 2022, NASA's Double Asteroid Redirection Test (DART) successfully altered the orbit of the asteroid Dimorphos by intentionally colliding with it. This mission demonstrated that humans may be able to change the trajectory of potentially hazardous asteroids, providing the first real-world test of planetary defense technology.		
Related Phenomena - Why do some comets suddenly develop spectacular tails as they approach the Sun? - Why are asteroids considered "time capsules" that preserve information about the early solar system? - How did asteroid impacts influence the evolution of life on Earth?		
Time Allotted: Approximately 1-2 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Obtaining, Evaluating, and Communicating Information - Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including	ESS1.A: The Universe and Its Stars - The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. - The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. - Other than the hydrogen and helium formed at the time of	Energy and Matter - Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. - In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology - Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

orally, graphically, textually, and mathematically). Using Mathematical and Computational Thinking 3. Use mathematical or computational representations of phenomena to describe explanations. ----- <i>Connections to Nature of Science</i> Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena 4. A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. ESS1.B: Earth and the Solar System 4. Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. PS4.B: Electromagnetic Radiation 5. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. <i>(secondary)</i>	Scale, Proportion, and Quantity 4. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 1. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. ----- <i>Connections to Nature of Science</i> Scientific Knowledge Assumes an Order and Consistency in Natural Systems 1. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. 2. Science assumes the universe is a vast single system in which basic laws are consistent.	
Essential Questions - What are meteors, meteorites, and meteoroids? - How might we predict the behavior of asteroids and comets?	Student Learning Objectives - Students will investigate the difference between meteors, meteorites, meteoroids, comets, and asteroids. - Students will explore the comets and	Suggested Tasks/Activities - Famous Comets research project to investigate the appearance and behavior of comets - “Starry Night” computer-based	Evidence of Learning (Assessment) - Assessment of gathering, analysis, synthesis and communication of information in research, project - Assess computer-based simulation

- How might we predict the movements of comets and meteor showers that are famous? - How do we know if the Earth has ever been hit by an asteroid? - What is the significance of the Oort Cloud?	meteor showers that reappear in Earth's sky and understand how we can predict them. - Students understand the basic physics of a comet. - Students research the evidence of an asteroid collision with earth and make the connection to the dinosaur's extinction.	simulations to explore the behavior of the Earth's sky - Short Oort Cloud video observe the significance of the Oort Cloud	submissions for understanding the behavior of the Earth's sky
Interdisciplinary Connections	<u>English Language Arts</u> ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. <u>Mathematics</u> ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.1 Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HS.S-ID.6 Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets and interpret differences in context. <u>Visual & Performing Arts</u> ● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as astronomy, astrophysics, aerospace engineering, planetary science, and space exploration. ● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data		

	collected from a phenomenon or process.		
	● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		
Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
● Pre-teach astronomy vocabulary (e.g., asteroid, comet, meteoroid, meteor, meteorite, Kuiper Belt, Oort Cloud, orbital eccentricity, planetary defense) using visuals, bilingual glossaries, and labeled diagrams. ● Use NASA mission animations (DART, OSIRIS-REx, Lucy, Psyche) and interactive orbital simulations to reinforce concepts. ● Provide sentence frames and graphic organizers for Claim-Evidence-Reasoning (CER) writing and discussions about planetary defense. ● Allow bilingual dictionaries and translated instructional materials when appropriate. ● Pair students strategically during research investigations and computer simulations to support collaborative language development. ● Provide a template for documenting lesson content or project processes. ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provide models of completed	● Break orbital modeling and research activities into smaller, sequential tasks using written checklists and graphic organizers. ● Provide guided notes, comparison charts, and scaffolded data tables for asteroid, comet, and Kuiper Belt investigations. ● Offer extended time for simulations, laboratory investigations, and presentations. ● Allow alternate assessments such as oral presentations, annotated diagrams, digital presentations, or recorded explanations. ● Use physical orbital models and tactile solar system manipulatives before transitioning to computer-based simulations. ● Provide additional time for project development. ● Utilize graphics to support learning. ● Provide an outline of lessons ● Get a written list of instructions ● Receive large project as smaller tasks with individual deadlines ● Work or take a test in a different setting, such as a quiet room with few distractions. ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management.	● Connect instruction to current NASA missions including DART, OSIRIS-REx, Lucy, and Psyche to demonstrate the real-world importance of planetary science. ● Scaffold orbital modeling and data interpretation through teacher-guided examples and structured graphic organizers. ● Reinforce concepts using NASA videos, asteroid impact simulations, and interactive solar system visualizations before independent investigations. ● Use cooperative learning groups with clearly defined research roles during investigations. ● Provide frequent formative feedback through exit tickets, conferencing, and concept checks to monitor understanding. ● Invite parents, neighbors, friends, the school principal and other community members to attend class performances. ● Break the design process into smaller pieces. ● Conference with the teacher during the project planning process. ● Provide a detailed framework for the project design. ● Incorporate student choice. ● Provide peer mentoring to improve	● Analyze authentic orbital and compositional datasets from NASA's Planetary Data System and Minor Planet Center. ● Investigate current planetary defense strategies and evaluate their effectiveness using peer-reviewed scientific literature. ● Compare asteroid populations within the Main Asteroid Belt, Near-Earth Objects, Kuiper Belt, and Oort Cloud using authentic observational data. ● Develop computational models predicting asteroid trajectories, orbital perturbations, or potential Earth impact probabilities. ● Conduct an independent research investigation evaluating NASA's DART, ESA's Hera, OSIRIS-REx, Lucy, or Psyche missions and present findings in a professional scientific format. ● Design an evidence-based planetary defense proposal that considers scientific, engineering, economic, and societal constraints for mitigating a potential asteroid impact. ● Offer choices, once finished with the standard lesson activity, taking into consideration students' interests and goals.

homework assignments, projects, etc. ● Assign a native language partner. ● Provide extended time for written responses and reports.		techniques. ● Assure students they can be successful. ● Allow students many opportunities for practice and learning. ● Use scaffolding for complex tasks	● Develop more complex projects based on extensive research both individually and in collaboration with peers.
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Astronomy		
Unit 6: The Sun		
Anchoring Phenomenon: Why can an eruption on the Sun disrupt satellites, GPS, radio communication, and power grids on Earth? The Sun constantly releases energy and charged particles into space. During powerful solar flares and coronal mass ejections (CMEs), this energy can interact with Earth's magnetic field, producing auroras while also disrupting satellites, electrical infrastructure, navigation systems, and communication networks around the world. Related Phenomena • Why is the Sun's outer atmosphere (corona) millions of degrees hotter than its visible surface? • How does nuclear fusion inside the Sun produce the energy that sustains life on Earth? • Why has NASA's Parker Solar Probe traveled closer to the Sun than any spacecraft in history?		
Time Allotted: Approximately 2 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions 3. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Obtaining, Evaluating, and Communicating Information 4. Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or	ESS1.A: The Universe and Its Stars 6. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. 7. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. 8. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within	Energy and Matter 5. Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. 6. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 7. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

system) in multiple formats (including orally, graphically, textually, and mathematically). Using Mathematical and Computational Thinking 5. Use mathematical or computational representations of phenomena to describe explanations. ----- <i>Connections to Nature of Science</i> Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena 6. A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. ESS1.B: Earth and the Solar System 9. Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. PS4.B: Electromagnetic Radiation 10. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. <i>(secondary)</i>	Scale, Proportion, and Quantity 8. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 2. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. ----- <i>Connections to Nature of Science</i> Scientific Knowledge Assumes an Order and Consistency in Natural Systems 7. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. 8. Science assumes the universe is a vast single system in which basic laws are consistent.	
Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- How large is the sun when compared to the planets and other stars in our solar system?	- Students will explore the sun’s size relative to planets and other stars. - Students will research the layers of the	- “Size of the Sun” research and comparison activity - Image comparisons of solar flares,	- Assessment of gathering, analysis, synthesis and communication of information in a research

- What is the significance of the structure of the sun? - How does the sun produce heat? - What are sunspots, flares, and prominences and how are they different?	sun and what elements are present. - Students will investigate the energy producing nuclear reactions that keep the sun hot and hypothesize what will happen when the sun uses all its fuel. - Students will learn about the different types of observable actions produced by the sun.	spots, and prominences (include gifs and videos) - Labeling activity for the “anatomy of the sun” to communicate and understanding of the structure of the sun - “The Amazing Sun” Documentary to explore the structure and behavior of the sun - Starry Night Activities to investigate the structure and behavior of the sun	project/activity - Assess computer-based simulation submissions for understanding the behavior of the Sun - Assess comparisons of Solar flare, spots, and prominence discussions for the construction of explanations and arguments based upon evidence - Assess written reflections for the analysis and communication of information pertaining to the structure and function of the sun
Interdisciplinary Connections	<u>English Language Arts</u> ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. <u>Mathematics</u> ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HS.S-ID.6 Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets and interpret differences in context. ● HSF.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. ● HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. <u>Visual & Performing Arts</u> ● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as astronomy,		

	astrophysics, aerospace engineering, planetary science, and space exploration.		
	● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		
Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
● Pre-teach solar science vocabulary (e.g., photosphere, chromosphere, corona, fusion, sunspots, solar flare, coronal mass ejection, solar wind, heliosphere) using visuals, bilingual glossaries, and labeled diagrams. ● Use NASA Solar Dynamics Observatory (SDO), Parker Solar Probe imagery, and animations to reinforce concepts. ● Provide sentence frames and graphic organizers for Claim-Evidence-Reasoning (CER) writing and investigations. ● Allow bilingual dictionaries and translated instructional materials when appropriate. ● Pair students strategically during laboratory investigations, simulations, and collaborative activities. ● Provide a template for documenting new learning and the project design process. ● When possible, modify assignments so the ELL student writes less, has	● Break investigations and solar modeling activities into smaller, sequential tasks using visual checklists. ● Provide guided notes, labeled diagrams, and scaffolded concept maps for solar structure and nuclear fusion. ● Offer extended time for simulations, laboratory investigations, and presentations. ● Allow alternate assessments such as oral presentations, annotated diagrams, digital presentations, or recorded explanations. ● Use physical models of the Sun's layers before transitioning to abstract diagrams and simulations. ● Provide additional time for project development. ● Work with a peer to develop a simpler design. ● Utilize graphics to support learning. ● Provide an outline of lessons. ● Get a written list of instructions ● Receive large project as smaller tasks with individual deadlines	● Connect instruction to recent solar storms, auroras visible in New Jersey, and current NASA missions such as Parker Solar Probe and Solar Orbiter. ● Scaffold interpretation of solar imagery and data using teacher-guided examples. ● Reinforce concepts through NASA videos, interactive simulations, and authentic satellite imagery. ● Use cooperative learning groups with clearly defined investigation roles. ● Provide frequent formative feedback through exit tickets, conferencing, and concept checks. ● Invite parents, neighbors, friends, the school principal and other community members to attend class performances. ● Break the design process into smaller pieces. ● Conference with the teacher during the project planning process. ● Provide a detailed framework for the project design. ● Incorporate student choice	● Analyze authentic solar datasets from NASA's Solar Dynamics Observatory (SDO), Parker Solar Probe, and ESA's Solar Orbiter. ● Investigate current theories explaining coronal heating using peer-reviewed scientific literature. ● Compare historical and contemporary methods of observing and measuring solar activity. ● Develop computational models illustrating solar cycles, sunspot activity, or solar radiation reaching Earth. ● Conduct an independent investigation evaluating how solar activity affects satellites, communication systems, navigation technologies, and Earth's magnetosphere, presenting findings in a professional scientific format. ● Offer choices, once finished with basic tasks, with personal interest being the key. ● Develop more complex designs

simpler questions to answer, fewer spelling words, etc. ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner. ● Provide extended time for written responses and reports.	● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management.	● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	based on extensive research both individually and in collaboration with peers.
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Astronomy		
Unit 7: Stars and Constellations		
Anchoring Phenomenon: Why are some stars blue while others are red, and how can astronomers determine a star's age, composition, and future simply by analyzing its light? Stars appear different in color, brightness, and size because of differences in temperature, mass, composition, and evolutionary stage. By analyzing stellar spectra, luminosity, and position on the Hertzsprung–Russell Diagram, astronomers can determine a star's physical properties and predict how it will evolve over billions of years.		
Additional Related Phenomena - Why did the James Webb Space Telescope detect stars forming inside dense clouds that were previously invisible? - Why do some constellations appear unchanged over human history while the stars themselves are constantly moving? - Why do astronomers describe stars as "element factories" responsible for producing the atoms that make up planets and living organisms?		
Time Allotted: Approximately 2 Weeks		
New Jersey Student Learning Standards (NJSL)		
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.		
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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions 9. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	ESS1.A: The Universe and Its Stars 11. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. 12. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.	Energy and Matter 9. Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. 10. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
Obtaining, Evaluating, and Communicating Information 10. Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or	13. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within	----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 11. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

system) in multiple formats (including orally, graphically, textually, and mathematically). Using Mathematical and Computational Thinking 11. Use mathematical or computational representations of phenomena to describe explanations. ----- <i>Connections to Nature of Science</i> Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena 12. A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. ESS1.B: Earth and the Solar System 14. Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. PS4.B: Electromagnetic Radiation 15. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. <i>(secondary)</i>	Scale, Proportion, and Quantity 12. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 3. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. ----- <i>Connections to Nature of Science</i> Scientific Knowledge Assumes an Order and Consistency in Natural Systems 13. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. 14. Science assumes the universe is a vast single system in which basic laws are consistent.
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Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What are the traditional zodiac constellations and where are they located in the night sky? - Is the night sky the same for the entire year and in every place on earth? - How can the stars and constellations be used to navigate the globe?	- Students will explore the night sky and identify different constellations. - Students will understand the dynamic nature of the night sky and the differences between the northern and southern night skies. - Students will investigate the methods	- Starry Night Activities and Simulations to investigate and compare the night sky and various constellations in different parts of the world - Teacher-led presentations using the simulations to promote student questions and thinking about how the	- Assess computer-based simulation submissions for understanding of the night sky - Assess participation in class discussions for current and ongoing understanding of how the star and constellations can be

	used by explorers to navigate the globe by using the stars and constellations.	stars and constellations can be used to navigate the globe	used to navigate the globe
Interdisciplinary Connections	English Language Arts - RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. - RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. - W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. - SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. Mathematics MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Visual & Performing Arts 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as astronomy, astrophysics, aerospace engineering, planetary science, and space exploration. 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		

Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
● Pre-teach astronomy vocabulary (e.g., luminosity, magnitude, spectrum, main sequence, red giant, white dwarf, supernova, neutron star, black hole, H-R diagram) using visuals, bilingual glossaries, and labeled diagrams. ● Use Hubble and James Webb Space Telescope imagery, spectra, and animations to reinforce concepts. ● Provide sentence frames and graphic organizers for CER writing and stellar evolution activities. ● Allow bilingual dictionaries and translated instructional materials when appropriate. ● Pair students strategically during data analysis and collaborative investigations. ● Provide a template for documenting the design process. ● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner. ● Provide extended time for written responses and reports.	● Break stellar classification and H-R diagram investigations into smaller, sequential tasks using written checklists. ● Provide guided notes, color-coded H-R diagrams, and scaffolded concept maps for stellar evolution. ● Offer extended time for simulations, research activities, and presentations. ● Allow alternate assessments such as oral presentations, annotated diagrams, digital presentations, or recorded explanations. ● Use physical and digital stellar evolution models before transitioning to abstract diagrams and graphs. ● Provide additional time for project development. ● Work with a peer to develop a simpler design. ● Utilize graphics to support learning. ● Provide an outline of lessons ● Get a written list of instructions ● Receive large project as smaller tasks with individual deadlines ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management	● Connect instruction to current discoveries from the James Webb Space Telescope and Gaia missions. ● Scaffold interpretation of H-R diagrams, spectra, and stellar data through teacher-guided modeling. ● Reinforce concepts using NASA videos, interactive simulations, and authentic astronomical imagery. ● Use cooperative learning groups with clearly defined research roles. ● Provide frequent formative feedback through exit tickets, conferencing, and concept checks. ● Invite parents, neighbors, friends, the school principal and other community members to attend class performances. ● Break the design process into smaller pieces. ● Conference with the teacher during the project planning process. ● Provide a detailed framework for the project design. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks	● Analyze authentic stellar datasets from the Gaia mission and Hubble or James Webb Space Telescope observations. ● Investigate stellar spectra to determine temperature, composition, and evolutionary stage using current scientific methods. ● Compare stellar evolution models for low-mass and high-mass stars using peer-reviewed literature. ● Develop computational models illustrating stellar evolution or H-R diagram relationships. ● Conduct an independent investigation examining star formation, exoplanet host stars, or recent James Webb discoveries and present findings using a professional scientific format. ● Offer choices, once finished with basic task, with personal interest being the key. ● Develop more complex designs based on extensive research both individually and in collaboration with peers.

Astronomy		
Unit 8: “Bad Astronomy” Myths		
Anchoring Phenomenon: Why do scientific misconceptions about astronomy continue to spread even when there is overwhelming scientific evidence to the contrary? Claims such as "the Moon landing was faked," "the Earth is flat," "astrology predicts human behavior," or "Planet X will collide with Earth" continue to circulate through social media and popular culture. Scientists use evidence, observations, and the scientific method to evaluate these claims and distinguish science from pseudoscience. Additional Related Phenomena - Why do lunar eclipses provide evidence that Earth is spherical? - Why do astrology and astronomy study the same objects but reach fundamentally different conclusions? - Why are extraordinary scientific claims required to have extraordinary evidence?		
Time Allotted: Approximately 2 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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. 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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions 15. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Obtaining, Evaluating, and Communicating Information 16. Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and	ESS1.A: The Universe and Its Stars 16. The study of stars’ light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. 17. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. 18. Other than the hydrogen and helium formed at the time of the	Energy and Matter 13. Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. 14. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 15. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Using Mathematical and Computational Thinking

17. Use mathematical or computational representations of phenomena to describe explanations.

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

18. A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

ESS1.B: Earth and the Solar System

19. Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.

PS4.B: Electromagnetic Radiation

20. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. *(secondary)*

Scale, Proportion, and Quantity

16. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

4. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

19. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.
20. Science assumes the universe is a vast single system in which basic laws are consistent.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- Where do we see Astronomy in popular culture? - What are some Astronomy Myths in our society and how can they be explained?	- Students will relate astronomy to popular culture - Students will debate myths that are related to astronomy.	- “Bad Astronomy” (by Phil Plait) reading and presentation to class which students will use to construct arguments about astronomical myths	- Assess construction of arguments in presentations, peer review and student discussions
Interdisciplinary Connections	English Language Arts ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. Mathematics ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Visual & Performing Arts ● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as astronomy, astrophysics, aerospace engineering, planetary science, and space exploration. ● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		

Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
• Pre-teach academic vocabulary (e.g., pseudoscience, scientific theory, hypothesis, evidence, bias, credibility, peer review, astronomy, astrology) using visuals, bilingual glossaries, and concept maps. • Use side-by-side comparisons of scientific claims and misconceptions supported by diagrams, videos, and NASA resources. • Provide sentence frames for Claim-Evidence-Reasoning (CER) writing and scientific debates. • Allow bilingual dictionaries and translated instructional materials when appropriate. • Pair students strategically during discussions and collaborative investigations. • Provide a template for documenting the design process. • When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. • Provide models of completed homework assignments, projects, etc. • Assign a native language partner. • Provide extended time for written responses and reports.	• Break research and claim-evaluation activities into smaller, sequential tasks using written checklists. • Provide guided notes, evidence organizers, and graphic organizers for evaluating scientific claims. • Offer extended time for research, presentations, and written responses. • Allow alternate assessments such as oral presentations, recorded explanations, annotated diagrams, or multimedia projects. • Use teacher-modeled examples of evaluating credible and non-credible scientific sources before independent analysis. • Provide additional time for project development. • Work with a peer to develop a simpler design. • Utilize graphics to support learning. • Provide an outline of lessons • Get a written list of instructions • Receive large project as smaller tasks with individual deadlines • Work or take a test in a different setting, such as a quiet room with few distractions • Sit where they learn best (for example, near the teacher) • Use an alarm to help with time management	• Connect lessons to current examples of misinformation found on social media and in popular culture. • Scaffold scientific argumentation using structured CER templates and guided discussion questions. • Reinforce concepts through NASA videos, fact-checking activities, and interactive media. • Use cooperative learning groups with clearly defined discussion roles. • Provide frequent formative feedback through exit tickets, conferencing, and concept checks. • Invite parents, neighbors, friends, the school principal and other community members to attend class performances. • Break the design process into smaller pieces. • Conference with the teacher during the project planning process. • Provide a detailed framework for the project design. • Incorporate student choice. • Provide peer mentoring to improve techniques. • Assure students they can be successful. • Allow students many opportunities for practice and learning. • Use scaffolding for complex tasks.	• Analyze peer-reviewed scientific literature addressing common astronomical misconceptions. • Compare historical misconceptions in astronomy with current scientific understanding and evaluate how scientific knowledge changes over time. • Investigate the psychology of misinformation and why pseudoscientific beliefs persist despite scientific evidence. • Design a multimedia public education campaign that uses scientific evidence to address a common astronomy misconception. • Conduct an independent investigation evaluating how scientific literacy influences public understanding of astronomy and space exploration. • Offer choices, once finished with the standard lesson activity, taking into consideration students' interests and goals. • Engage in more complex projects designs based on extensive research both individually and in collaboration with peers.

Astronomy		
Unit 9: Modern Astronomical Technology		
Anchoring Phenomenon: How can telescopes and spacecraft reveal objects that human eyes can never see? Modern observatories such as the Hubble Space Telescope, James Webb Space Telescope (JWST), International Space Station (ISS), and advanced robotic spacecraft allow scientists to observe distant galaxies, detect exoplanets, study black holes, and investigate the origins of the universe using technologies far beyond the capabilities of ground-based observation.		
Additional Related Phenomena - Why was the James Webb Space Telescope placed nearly one million miles from Earth instead of in Earth orbit? - How do astronauts live and conduct scientific research aboard the International Space Station? - How do modern telescopes use infrared, ultraviolet, X-ray, and radio wavelengths to study objects invisible to the human eye?		
Time Allotted: Approximately 2 Weeks		
New Jersey Student Learning Standards (NJSLS)		
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.		
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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions 21. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	ESS1.A: The Universe and Its Stars 21. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. 22. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.	Energy and Matter 17. Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. 18. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ----- <i>Connections to Engineering, Technology, and Applications of Science</i>
Obtaining, Evaluating, and Communicating Information 22. Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or	23. Other than the hydrogen and helium formed at the time of the Big Bang,	Interdependence of Science, Engineering, and Technology 19. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

system) in multiple formats (including orally, graphically, textually, and mathematically). Using Mathematical and Computational Thinking 23. Use mathematical or computational representations of phenomena to describe explanations. ----- <i>Connections to Nature of Science</i> Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena 24. A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. ESS1.B: Earth and the Solar System 24. Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. PS4.B: Electromagnetic Radiation 25. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. <i>(secondary)</i>	Scale, Proportion, and Quantity 20. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ----- <i>Connections to Engineering, Technology, and Applications of Science</i> Interdependence of Science, Engineering, and Technology 5. Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. ----- <i>Connections to Nature of Science</i> Scientific Knowledge Assumes an Order and Consistency in Natural Systems 25. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. 26. Science assumes the universe is a vast single system in which basic laws are consistent.	
Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is the significance of the International Space Station? - Why is the Hubble Telescope important? - What is the significance of the James	- Students will understand the importance of the International Space Station and the Hubble Telescope in present day astronomy - Students will articulate the significance	- “International Space Station” Documentary to analyze the significance of International Space Station - Hubble picture presentations and research to investigate the significance	- Assess ability to evaluate and communicate information about the importance of the Hubble Telescope - Case Studies/Discussions will be assessed for the quality of arguments

Webb Space Telescope?	of the James Webb Space Telescope	of the Hubble telescope - Case Study: “Building Hubble” to analyze and construct arguments about the significance of the Hubble telescope	based upon evidence
Interdisciplinary Connections	<u>English Language Arts</u> ● RI.CR.11–12.1 Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. ● RI.MF.11–12.6 Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information. ● W.WR.11–12.5 Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple authoritative sources while demonstrating understanding of the subject under investigation. ● SL.PI.11–12.4 Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. <u>Mathematics</u> ● MP.2 Reason abstractly and quantitatively. ● MP.4 Model with mathematics. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ● HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. <u>Visual & Performing Arts</u> ● 1.5.12prof.Cn10a Document the process of developing ideas from early stages to fully elaborated ideas. ● 1.5.12prof.Pr6a Convey meaning through the presentation of artistic work, considering audience, venue, and presentation methods.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.EG.5 Evaluate the economic and environmental impacts of sustainability practices at the local, national, and global levels. ● 9.2.12.CAP.5 Assess how knowledge, skills, ethics, and preparation contribute to career success in careers such as astronomy, astrophysics, aerospace engineering, planetary science, and space exploration. ● 9.4.12.CT.2 Develop multiple solutions to a problem and evaluate which is the most effective. ● 9.4.12.IML.5 Evaluate, synthesize, and apply information while considering the ethical and legal use of technology.		
Computer Science and Design Thinking	● 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. ● 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.2.12.ED.1 Design and refine a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● 8.2.12.ETW.2 Analyze the positive and negative impacts of technology on society, the environment, and the global economy and evaluate how technological innovations influence sustainability and quality of life.		

Modifications			
English Language Learners	Special Education	At-Risk	Gifted and Talented
• Pre-teach engineering and astronomy vocabulary (e.g., telescope, spectrometer, infrared, orbit, robotics, microgravity, satellite, observatory, instrumentation) using visuals, bilingual glossaries, and labeled diagrams. • Use NASA videos, virtual ISS tours, and Hubble/JWST imagery to reinforce concepts. • Provide sentence frames and graphic organizers for engineering design challenges and scientific presentations. • Allow bilingual dictionaries and translated instructional materials when appropriate. • Pair students strategically during engineering investigations and collaborative research. • Provide a template for documenting the project design process or new learning. • When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. • Provide models of completed homework assignments, projects, etc. • Assign a native language partner. • Provide extended time for written responses and reports.	• Break engineering design activities and research projects into manageable sequential tasks using written checklists. • Provide guided notes, labeled diagrams, and scaffolded engineering design templates. • Offer extended time for research, simulations, laboratory investigations, and presentations. • Allow alternate assessments such as oral presentations, annotated diagrams, digital presentations, or recorded explanations. • Use physical telescope models and interactive virtual observatories before independent investigations. • Provide additional time for project development. • Work with a peer to develop a simpler design. • Utilize graphics to support learning. • Provide an outline of lessons • Get a written list of instructions • Receive large project as smaller tasks with individual deadlines • Work or take a test in a different setting, such as a quiet room with few distractions • Sit where they learn best (for example, near the teacher) • Use an alarm to help with time management	• Connect instruction to current NASA missions, Artemis, the International Space Station, James Webb Space Telescope, and future Mars exploration. • Scaffold engineering design challenges using teacher-guided modeling and structured planning templates. • Reinforce concepts using NASA videos, virtual field trips, and interactive mission simulations. • Use cooperative learning groups with clearly defined engineering and research roles. • Provide frequent formative feedback through exit tickets, conferencing, and concept checks. • Invite parents, neighbors, friends, the school principal and other community members to attend class performances. • Break the design process into smaller pieces. • Conference with the teacher during the project or presentation-planning process. • Provide a detailed framework for the project design. • Incorporate student choice. • Provide peer mentoring to improve techniques. • Allow students many opportunities for practice and learning. • Use scaffolding for complex tasks.	• Analyze authentic datasets from Hubble, James Webb Space Telescope, Chandra X-ray Observatory, or the International Space Station. • Compare engineering trade-offs involved in the design of modern telescopes, satellites, and spacecraft using current scientific literature. • Investigate future missions such as Roman Space Telescope, Europa Clipper, or Artemis and evaluate their scientific objectives. • Design an original space mission or observatory that addresses a current unanswered question in astronomy, incorporating engineering constraints and scientific goals. • Present findings in a professional proposal modeled after NASA mission concept studies. • Offer choices, once finished with the standard lesson activity, taking into consideration students' interests and goals. • Engage in more complex projects based on extensive research both individually and in collaboration with peers.

Course Resources**Curriculum & Reference Materials**

- 2026 New Jersey Student Learning Standards for Science – <https://www.nj.gov/education/standards/science/>
- New Jersey Student Learning Standards (All Content Areas) – <https://www.nj.gov/education/standards/>
- New Jersey Department of Education Climate Change Resources – <https://www.nj.gov/education/climate/>
- NASA – <https://www.nasa.gov/>
- NASA Science – <https://science.nasa.gov/>
- NASA Solar System Exploration – <https://science.nasa.gov/solar-system/>
- NASA Eyes on the Solar System – <https://eyes.nasa.gov/apps/solar-system/>
- NASA Eyes on Exoplanets – <https://eyes.nasa.gov/apps/exo/>
- NASA Eyes Visualization – <https://eyes.nasa.gov/>
- NASA Earth Observatory – <https://earthobservatory.nasa.gov/>
- NASA Astronomy Picture of the Day (APOD) – <https://apod.nasa.gov/apod/>
- NASA Hubble Space Telescope – <https://science.nasa.gov/mission/hubble/>
- NASA James Webb Space Telescope – <https://science.nasa.gov/mission/webb/>
- NASA Parker Solar Probe – <https://science.nasa.gov/mission/parker-solar-probe/>
- NASA Solar Dynamics Observatory – <https://sdo.gsfc.nasa.gov/>
- NASA Planetary Data System – <https://pds.nasa.gov/>
- NASA Artemis Program – <https://www.nasa.gov/artemis/>
- NASA Mars Exploration Program – <https://mars.nasa.gov/>
- NASA Europa Clipper – <https://europa.nasa.gov/>
- NASA DART Mission – <https://dart.jhuapl.edu/>
- NASA OSIRIS-REx Mission – <https://science.nasa.gov/mission/osiris-rex/>
- NASA Lucy Mission – <https://science.nasa.gov/mission/lucy/>
- NASA Psyche Mission – <https://science.nasa.gov/mission/psyche/>
- European Space Agency (ESA) – <https://www.esa.int/>
- ESA Gaia Mission – <https://www.cosmos.esa.int/gaia>
- ESA Solar Orbiter – https://www.esa.int/Science_Exploration/Space_Science/Solar_Orbiter
- ESA Hera Mission – https://www.esa.int/Space_Safety/Hera
- HubbleSite – <https://hubblesite.org/>
- James Webb Space Telescope Image Gallery – <https://webbtelescope.org/>
- Chandra X-ray Observatory – <https://chandra.harvard.edu/>

- Sloan Digital Sky Survey – <https://www.sdss.org/>
- Minor Planet Center – <https://minorplanetcenter.net/>
- Jet Propulsion Laboratory (JPL) Solar System Dynamics – <https://ssd.jpl.nasa.gov/>
- International Astronomical Union (IAU) – <https://www.iau.org/>
- Stellarium Planetarium Software – <https://stellarium.org/>
- Starry Night Astronomy Software – <https://starrynight.com/>
- ExploreLearning Gizmos – <https://www.explorelearning.com/>
- NOIRLab (NSF National Optical-Infrared Astronomy Research Laboratory) – <https://noirlab.edu/>
- Vera C. Rubin Observatory – <https://rubinobservatory.org/>
- Las Cumbres Observatory – <https://lco.global/>
- Zooniverse Citizen Science Projects – <https://www.zooniverse.org/>
- Globe at Night – <https://globeatnight.org/>
- American Astronomical Society – <https://aas.org/>
- Sky & Telescope – <https://skyandtelescope.org/>
- EarthSky – <https://earthsky.org/>
- National Geographic Education – <https://education.nationalgeographic.org/>
- Smithsonian National Air and Space Museum – <https://airandspace.si.edu/>
- Khan Academy Astronomy and Cosmology – <https://www.khanacademy.org/science/cosmology-and-astronomy>