Kenilworth Public Schools

Curriculum Guide

Content Area: Astronomy
Grade: 10-12
BOE Approved: 10/11/22

Revision Date: N/A
Submitted by: Phil Giordano
BOE Revision Approved: N/A

Astronomy Grade 10-12

Unit 1- History of Astronomy	Unit 2- The Moon	Unit 3- The Earth	Unit 4- The Sun	Unit 5- The Inner Planets	Unit 6- The Gas Giants
Weeks 1-2	Weeks 3-4	Weeks 5-6	Weeks 7-8	Weeks 9-10	Weeks 11-12
Unit Description: In this unit of study students will explore the nature and history of astronomy and how it led to societal change. Explore the methods in which early man studied the sky and the evolution of the science. Investigate the conflicts between astronomers and officials	*Unit Description:* In this unit of study students will investigate and explain the phases of the moob. Understand how the moon rotates and revolves around the earth. Describe the what causes the tides on earth. Explain the changes in tide throughout the calendar month. Describe the causes of eclipses. Understand the exploration of the moon and future plans for exploration.	*Unit Description:* In this unit of study students will examine the dimensions of the earth and how they came to be. Explore Earth's contents from the inside of the planet to the atmosphere. Examine how our atmosphere affects our ability to explore the sky. Explain how radioactive dating can determine of not only the Earth, but universe at large.	*Unit Description:* In this unit of study students will explain how the composition of the Sun differs from that of Earth. Describe the various layers of the Sun and their functions. Explain what happens in the different parts of the Sun's atmosphere. Describe the sunspot cycle and, more generally, the solar cycle. Explain how magnetism is the source of solar activity. Describe the various ways in which the solar	*Unit Description:* In this unit of study students will characterize the orbit of Mercury around the Sun Describe Mercury's structure and composition. Explain why it's difficult to learn about Venus from Earth-based observation alone. Describe the history of our interest in Mars before the Space Age. Compare the basic physical properties of Earth, Mars, and Venus, including their orbits.	*Unit Description:* In this unit of study students will provide an overview of the composition of the giant planets. Chronicle the robotic exploration of the outer solar system. Summarize the missions sent to orbit the gas giants. Describe the basic physical characteristics, general appearance, and rotation of the giant planets. Describe the composition and structure of Jupiter

			activity cycle manifests itself, including flares, coronal mass ejections, and prominences. Identify different forms of energy. Understand the law of conservation of energy. Trace the nuclear reactions in the solar interior. Describe the state of equilibrium of the Sun. Understand the energy balance of the Sun. Explain how energy moves outward through the Sun. Describe the structure of the solar interior	Describe the general composition and structure of the atmosphere on Venus. Explain how the greenhouse effect has led to high temperatures on Venus. Discuss the main missions that have explored Mars. Explain what we have learned from examination of meteorites from Mars. Describe the various features found on the surface of Mars. Compare the volcanoes and canyons on Mars with those of Earth. Describe the general conditions on the surface of Mars. Compare the planetary evolution of Mercury, Venus, Earth, and Mars	and Saturn. Compare and contrast the internal heat sources of the giant planets. Describe the discovery and characteristics of gas giant planets' magnetic fields.
Unit Targets: • Identify the concepts of Aristotelian astronomy.	*Unit Targets:* • Identify the characteristics of the	*Unit Targets:*	*Unit Targets:* • Describe the basic characteristics of the	*Unit Targets:*	*Unit Targets:* • Explain why Jupiter and Saturn are considered gas giants.

• Explain the basic faults of the geocentric universe. • Explain the meaning of the word "planet". • Describe why Copernicus' discoveries were censured by the Catholic Church. • Explain what role the defining of gravity played in the understanding of celestial motion. • Identify the contributions Galileo and Newton made to the reversal of the churches positions on the heavens. • Describe the importance of Haley's Comet in the final chapter of the understanding of orbital and elliptical motion. • Explain how Kepler's Laws redefined our understanding of the clockwork universe.	Moon and how it creates tides on Earth. • Describe the events that generate the different phases of the Moon. • Understand the positions and appearance of the sun, moon and earth during eclipses. • Define the most common terms related to the appearance of the moon during its various phases and eclipses. • Identify the angle and tilt of the moon that creates phases and makes eclipses a regular but rare occurrence. • Understand why the moon's football shape is related to gravity lock and the torque created by the earth • Explain the "Moon Race" in terms of the Cold War. • Identify scientific facts that prove that	• Explain how the size of the Earth was determined • List the phenomenon created by the Earth's atmosphere. • Explain how the magnetic field is generated and how it produces the Northern Lights. • Explain how the magnetic field protects us from the solar wind. • Describe how important the ozone layer is to life on earth. • Describe how ozone is destroyed and replenished. • Explain how the age of the earth was determined. List the rock formations that gave us clues to the formation of the early Earth. • Describe how the presence of oxygen made way for the development of photosynthesis and respiration.	Sun and the nuclear reaction at its core. • Describe the relative age of the sun and how much longer it will live. • Explain the evidence that tells us that our sun is a relative newcomer to the universe. • Explain the relative size of the sun in relation to other stars. • Describe the term Yellow Dwarf in relation to our sun. • Explain the movement of materials at the surface of the sun. • Explain the nature and relationship between the Sun's magnetic field and sunspots. • Describe the layers of the Sun and the importance of the Corona. • Explain how heavy elements are created in the Sun's core.	• Explain the concept of a temporary atmosphere. • Identify which planets have moons. • Explain how a planet can capture an asteroid. • List the forces that create a runaway greenhouse effect. • Explain the existence of the extra thick atmosphere on Venus. • Describe the temperature ranges of Mercury Venus and Mars • Identify Venus as one of only two planets in the solar system that rotates in the opposite direction Explain why Mars appears red. • List the latest discoveries about Mars provided by the curiosity rover.	• Explain why Jupiter is considered a failed star. • Describe the atmospheres of the Jupiter and Saturn, and how it affects their appearance. • Identify the planets with a ring system and explain Saturn's unique place among them. • Identify the source of Jupiter's anonymous magnetic field. • Describe the unique characteristics of Jupiter's red spot. • List the number of moons that Jupiter and Saturn have respectively. • Identify by name the four moons of Jupiter that are the most famous. • Describe the nature of Jupiter storms above and below the equator. • Explain how Jupiter can be considered the guardian of the inner solar system. •

	the moon landings were not a “hoax”. • Understand and explain why the moon was created by an off-center collision with another heavenly body the size of Mars. • Explain the formation of Maria, highlands and rills on the lunar surface. • Identify the current knowledge concerning the presence of water on the moon. • Describe the future plans regarding a return to the moon by either probes or humans.		• Describe the nature of the Solar Wind and how the limit of its influence can be detected. • Explain the phenomenon of Coronal Mass Ejections and how they can affect the Earth		Explain why Saturn shape is pleasing to the eye. • Identify the astronomer who first discovered the gap in Saturn’s rings. • Identify the substances that Saturn’s rings are composed of. • Describe the orbital speed of Saturn’s inner and outer rings in terms of Kepler’s law. • Describe the width and unique thickness of Saturn’s rings. • Explain why Saturn would float in a bathtub. • Identify the size and shape of the enormous storms found at the North and South Pole of Saturn. • Explain the existence of Saturn’s outer rings in terms of Newton’s laws.

					• Describe the effect of a shepherd moon on Saturn's inner rings. • Explain why astronomers chose Titan instead of Europa to search for life in our solar system • Explain the concept of a temporary atmosphere. • Identify which planets have moons. • Explain how a planet can capture an asteroid.

Unit 7- The Ice Giants	Unit 8- Asteroids, Meteors, and Comets	Unit 9- Stars, Galaxies, and the History of the Universe
Weeks 13-14	Weeks 15-16	Weeks 17-20
Unit Description: In this unit of study students will provide an overview of the composition of the giant planets. Chronicle the robotic exploration of the outer solar system. Summarize the missions sent to orbit the ice giants. Describe the basic physical characteristics, general appearance, and	*Unit Description:* In this unit of study students will explain what a meteor is and why it is visible in the night sky. Describe the origins of meteor showers. Explain the origin of meteorites and the difference between a meteor and a meteorite. Describe how most meteorites have	*Unit Description:* In this unit of study students will describe the distribution of stellar masses found close to the Sun. Distinguish the different types of binary star systems. Understand how we can apply Newton's version of Kepler's third law to

rotation of the ice giant planets. Describe the composition and structure of Uranus and Neptune. Compare and contrast the internal heat sources of the giant planets. Describe the discovery and characteristics of ice giant planets' magnetic fields.	been found. Explain how primitive stone meteorites are significantly different from other types. Explain how the study of meteorites informs our understanding of the age of the solar system. Explain the formation process of the terrestrial and giant planets. Describe the main events of the further evolution of the solar system. Outline the story of the discovery of asteroids and describe their typical orbits. Describe the composition and classification of the various types of asteroids. Discuss what was learned from spacecraft missions to several asteroids. Characterize the general physical appearance of comets. Explain the range of cometary orbits	derive the sum of star masses in a binary star system. Apply the relationship between stellar mass and stellar luminosity to determine the physical characteristics of a star. Explain how interstellar matter flows into and out of our Galaxy and transforms from one phase to another, and understand how star formation and evolution affects the properties of the interstellar medium. Explain how the heavy elements and dust grains found in interstellar space got there and describe how dust grains help produce molecules that eventually find their way into planetary systems. Explain the life cycle of stars and their deaths. Describe the evolution of the universe from is' origins to it possible ends.
Unit Targets: • Identify the concepts of Aristotelian astronomy. • Explain why Uranus and Neptune are considered gas giants. • Describe how methane creates Uranus soft blue color. • Explain why your Uranus on its side at 90°.	*Unit Targets:* • Identify the characteristics of asteroids, meteoroids and comets. • Describe the composition of a comet. • List the phenomenon that creates the two tails of a comet. • Explain how the direction of the comet tails change as it circles the sun.	*Unit Targets:* • Describe the events that lead to the formation of a star. • List the forces that determine a star's size. • Explain the basic nature of binaries and how they are used to determine the size of stars. • Explain what event indicates the death of a star.

• Describe why Uranus and Neptune are not considered naked eye planets. • Explain how Neptune and Pluto were discovered. • Explain the nature of Neptune's great dark spot. • Explain how Uranus Neptune Pluto got their names. • Describe why Neptune's atmosphere produces the strongest winds in the solar system. • Describe what astronomers believe is the cause of Neptune's retrograde rotation. • Describe the new scientific methods that led to the discovery of Neptune and Pluto • Explain how Pluto's orbit and Neptune's axis of rotation are unique in our universe. • Explain why Pluto is no longer considered a planet. • Describe other minor planets in the Kuiper belt that are larger than Pluto • Explain how Pluto's new moons got their names.	• Explain why comets will eventually "burn out". • Describe the events that led to the extinction of the dinosaurs. • Explain the methods used to detecting "Near Earth" objects. • Describe the sequence of events that would follow an impact in the ocean or on the earth's surface. • Explain how an impact might be avoided in the future. • Describe the precautions that might preserve life on the planet in the event of an impact	• Describe a red giant and explain what effect it will have on the planets in our solar system. • Describe the appearance and basic nature of planetary nebula. • Explain how color and temperature are related in the appearance of a star. • Identify the pathway taken by high and low mass stars. • Describe the circumstances that lead to a nova. • Describe the circumstances that lead to a type IA supernova. • Explain how type IA supernova can be used to determine distances in the cosmos. • Describe why the production of carbon is critical in taking the next step of the stars lifecycle. • Explain why iron is the ultimate element that can be produced in the core of a star. • Describe the events leading to a supernova and what effects it has on the entire universe. • Explain how a neutron star is formed after a supernova event. • Explain how the spin rate of the neutron star can produce a beam of x-rays. • Describe the nature of a pulsar.

		• Explain why some neutron stars could be pulsars without astronomers knowing

Astronomy- Grades 10-12

Unit 1 Title: History of Astronomy

Unit Summary: In this unit of study students will explore the nature and history of astronomy and how it led to societal change. Explore the methods in which early man studied the sky and the evolution of the science. Investigate the conflicts between astronomers and officials

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

ELA

RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Career Readiness, Life Literacies, and Key Skills: 9.1.12.CFR.2 9.1.12.CFR.3 9.1.12.CFR.4 9.1.12.CFR.6 9.2.12.CAP.1 9.2.12.CAP.2 9.2.12.CAP.3 9.2.12.CAP.4 9.2.12.CAP.5 9.2.12.CAP.6 9.2.12.CAP.7 9.2.12.CAP.8 9.4.12.CI.1 9.4.12.CI.2 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2 9.4.12.CT.3 9.4.12.CT.4 9.4.12.DC.7 9.4.12.DC.8

Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

Climate Change Standards: HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

ELA Companion Standards: RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Big Idea: Prior to the work of 17th-century astronomers, scientists believed the Earth was the center of the universe (geocentric model). Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Unit Essential Questions:	**Unit Enduring Understandings:**
• Why should students study astronomy? • What is the history of the discovery of the sun centered universe? • Who were the important figures in the early years of astronomical discovery?	• Students should study astronomy because it plays an integral part of their understanding of the universe around them. • Having students learn the history behind the acceptance of the sun centered universe will help them to develop an appreciation that

• What is the importance of revealing scientific breakthroughs to the general public?	astronomy is not only a science but a sociological component of our lives. • Students will be able to detail the developments that led to Newton's Universal Gravitation.

Unit Learning Targets
Students will…

- Identify the concepts of Aristotelian astronomy.
- Explain the basic faults of the geocentric universe.
- Explain the meaning of the word "planet".
- Describe why Copernicus' discoveries were censured by the Catholic Church.
- Explain what role the defining of gravity played in the understanding of celestial motion.
- Identify the contributions Galileo and Newton made to the reversal of the churches positions on the heavens.
- Describe the importance of Haley's Comet in the final chapter of the understanding of orbital and elliptical motion.
- Explain how Kepler's Laws redefined our understanding of the clockwork universe.

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

- Quizzes
- Chapter Tests
- Take home assignments

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Lecture and classroom discussion • Computer Research projects • Astronomy Journal • Current Events	2 Weeks
Teacher Resources	*Teacher Note*
• Lab Materials • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw	

-Pear Deck -BrainPOP -Book Creator -FlipGrid -Kahoot -Kami -Quizizz -Freckle -ALEKs -Raz Kids -Touch Math -Scholastic Magazines -No Red Ink -Newsela -Merge Cubes	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:

- Use of visual and multisensory formats
- Use of assisted technology
- Use of prompts
- Modification of content, student products, and assessment tools (rubrics for example)
- Testing accommodations
- Authentic assessments (ex: write an email to your state senator about a current event issue you are passionate about, design/implement a class debate, create and balance a college freshman budget, create a commercial that dispels a myth about climate change)

Examples of Strategies and Practices that Support Gifted & Talented Students:

- Adjusting the pace and content of lessons
- Curriculum compacting
- Inquiry-based instruction
- Independent study
- Higher-order thinking skills
- Interest-based content
- Student-driven instruction
- Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:

- Pre-teaching of vocabulary and concepts
- Visual learning, including graphic organizers

• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Unit 2 Title: The Moon

Unit Summary: In this unit of study students will investigate and explain the phases of the moob. Understand how the moon rotates and revolves around the earth. Describe the what causes the tides on earth. Explain the changes in tide throughout the calendar month. Describe the causes of eclipses. Understand the exploration of the moon and future plans for exploration.

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

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RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Career Readiness, Life Literacies, and Key Skills: 9.1.12.CFR.2 9.1.12.CFR.3 9.1.12.CFR.4 9.1.12.CFR.6 9.2.12.CAP.1 9.2.12.CAP.2 9.2.12.CAP.3 9.2.12.CAP.4 9.2.12.CAP.5 9.2.12.CAP.6 9.2.12.CAP.7 9.2.12.CAP.8 9.4.12.CI.1 9.4.12.CI.2 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2 9.4.12.CT.3 9.4.12.CT.4 9.4.12.DC.7 9.4.12.DC.8

Learning Targets

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Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

Climate Change Standards: HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

ELA Companion Standards: RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Big Idea: The relative positions and motions of the Sun, Earth, and Moon result in the phases of the Moon, eclipses, and the daily and monthly cycle of tides. The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces. The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.

Unit Essential Questions:	Unit Enduring Understandings:
• How did the falling apple inspire Newton's understanding of the moon and the universal nature of gravity? • Exactly how many men have landed on the moon and how much lunar material has been brought back to earth? • Why do we see only one side of the moon? • How does the moon's rotation and revolution affect its shape? • What are some of the distinguishing characteristics of the moon as it relates to other moons in our solar system? • How are the phases of the moon related to "Neap" and "Spring" tides? • How does the moon create the tides? • What Moon-Earth-Sun relative positions account for the various phases of the moon? • In what alignment of Sun, Moon and Earth does a solar and lunar eclipse occur? • What do the terms "totality and corona" refer to? • Why does the moon appear "red" during a lunar eclipse? • What is meant by the terms "Umbra" and "Penumbra"? • What planetary alignment makes eclipses so rare? • What are a "Ring of Fire", "Super Moon", "Blue Moon" and "Harvest Moon"? • How did the "Cold War" fuel the race to the moon? • What were the objectives and accomplishments of the "Mercury", "Gemini" and "Apollo" missions? • What are some of the scientific facts that support the veracity of the moon landings? • What are some of the theories that explain the origin of the moon? • How does the moon's low density and lack of iron help support the accepted theory of its origin?	• Students should have a basic understanding of the Moon, its origins, characteristics and effect on the Earth's oceans. • Students will able to explain the appearance of the Moon in its different phases relative to the position of the Earth and Sun. • Students will able to explain the appearance of the moon and sun during solar and lunar eclipses. • Students will able to account for the infrequency of eclipses. • Students will able to explain the forces that allow us to only see one side of the moon. • Students will able to understand the political dynamics that led to the race to the moon. • Students will able to list scientific evidence that verifies the moon landings. • Students will able to identify and explain the accepted view of the moon's origin. • Students will able to explain the topography of the moon in terms of impacts with meteoroids and other space rocks. • Students will able to explain the most up to date information on the moon. • Students will able to identify any future plans for a return to the moon.

• How does the lack of iron explain why the moon has no magnetic field? • Why does the moon lack an atmosphere and how does that account for its crater covered surface? • How did the impact with meteoroids create the moon's highlands, rills and Maria (seas)? • • What is the new evidence that indicates that water does exist on the moon? • What future plans does mankind have in relation to lunar exploration? • What are the most current probes doing to expand our understanding of the moon?	

Unit Learning Targets
Students will…

- Identify the characteristics of the Moon and how it creates tides on Earth.
- Describe the events that generate the different phases of the Moon.
- Understand the positions and appearance of the sun, moon and earth during eclipses.
- Define the most common terms related to the appearance of the moon during its various phases and eclipses.
- Identify the angle and tilt of the moon that creates phases and makes eclipses a regular but rare occurrence.
- Understand why the moon's football shape is related to gravity lock and the torque created by the earth
- Explain the "Moon Race" in terms of the Cold War.
- Identify scientific facts that prove that the moon landings were not a "hoax".
- Understand and explain why the moon was created by an off-center collision with another heavenly body the size of Mars.
- Explain the formation of Maria, highlands and rills on the lunar surface.
- Identify the current knowledge concerning the presence of water on the moon.
- Describe the future plans regarding a return to the moon by either probes or humans.

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

- Quizzes
- Chapter Tests
- Take home assignments

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Lecture and classroom discussion • Computer Research projects • Astronomy Journal • Current Events	2 Weeks
Teacher Resources	*Teacher Note*
• Lab Materials • A & E: The Planets – "The Moon" (can be found online) • The Universe: Secrets of the Moon (can be found online) • The Lunar Hoax Debunked (can be found online) • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw -Pear Deck -BrainPOP -Book Creator -FlipGrid -Kahoot -Kami -Quizizz -Freckle -ALEKs -Raz Kids -Touch Math -Scholastic Magazines -No Red Ink -Newsela -Merge Cubes	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:

• Use of visual and multisensory formats
• Use of assisted technology
• Use of prompts
• Modification of content, student products, and assessment tools (rubrics for example)
• Testing accommodations
• Authentic assessments (ex: write an email to your state senator about a current event issue you are passionate about, design/implement a class debate, create and balance a college freshman budget, create a commercial that dispels a myth about climate change)

Examples of Strategies and Practices that Support Gifted & Talented Students:
• Adjusting the pace and content of lessons
• Curriculum compacting
• Inquiry-based instruction
• Independent study
• Higher-order thinking skills
• Interest-based content
• Student-driven instruction
• Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:
• Pre-teaching of vocabulary and concepts
• Visual learning, including graphic organizers
• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Unit 3 Title: The Earth

Unit Summary: In this unit of study students will examine the dimensions of the earth and how they came to be. Explore Earth's contents from the inside of the planet to the atmosphere. Examine how our atmosphere affects our ability to explore the sky. Explain how radioactive dating can determine of not only the Earth, but universe at large.

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

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Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

Climate Change Standards: HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

ELA Companion Standards: RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Big Idea: Global climate differences result from the uneven heating of Earth's surface by the Sun. Seasonal climate variations are due to the tilt of Earth's axis with respect to the plane of Earth's nearly circular orbit around the Sun. Draw evidence from informational texts to support analysis, reflection, and research. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Unit Essential Questions:

- How was the size of the earth determined by the Greeks?
- How was the size of the earth determined by the British?
- By using Newton's gravity formula what properties of the earth where the British able to determine?
- What is the origin of the Earth's magnetic field?
- How does the Earth's magnetic field protect us from the solar wind?
- What visual evidence do we have of the solar wind's existence?
- How is skylight generated?
- How does the Earth's atmosphere generate the colorful sunrises and sunsets?
- Why do the oceans appear blue?
- Why are clouds white and rain clouds gray?
- Why do distant mountains appear blue or

Unit Enduring Understandings:

- Students will use their knowledge of the Earth to describe the phenomenon associated with its atmosphere: sunrises, sunsets, skylight and UV protection.
- Students will use their knowledge of the Earth to describe the phenomenon associated with its magnetic field: the solar wind and the Northern Lights.
- Students should have a basic understanding of the tides as it relates to the position of the Sun, Moon and Earth.
- Students will be able to explain how the Greeks to British determine the size and shape of the earth.
- Students should have a basic understanding of the importance of ozone to life on our planet.
- Students will understand that the Earth wobbles on its axis and that the moon regulates this motion.

yellow?

- What role does the ozone layer play in protecting life on Earth?
- How is the ozone layer destroyed and how is it regenerated?
- Why is ultraviolet light so dangerous to life on earth?
- Why is the regulation of Freon so important to the ozone layer?
- How does the Earth's tilt affect the seasons?
- What makes the Earth's atmosphere unique?
- How does the strength of the Moon's gravitational pull affect the tides on Earth? What is procession and how does the moon affect it?
- How was the age of the earth determined?
- Where were the oldest rocks on Earth found?
- During its formation why did heavier elements sink to the core of the Earth?
- Early lava rock formations called Amphibolites gave us what estimate for the thickness of the early crust?
- Banded Iron Formations gave us what clues to the existence of early oceans on Earth?
- What important compounds did meteorites bring to the earth's surface?
- Modern Stromatolites are the home for cyanobacteria that produce what essential gas?
- The oxygen-rich atmosphere poisoned sulfur-based organisms and made way for what chemical process that dominates the present earth?

Unit Learning Targets

Students will…

- Explain how the size of the Earth was determined
- List the phenomenon created by the Earth's atmosphere.

- Explain how the magnetic field is generated and how it produces the Northern Lights.
- Explain how the magnetic field protects us from the solar wind.
- Describe how important the ozone layer is to life on earth.
- Describe how ozone is destroyed and replenished.
- Explain how the age of the earth was determined. List the rock formations that gave us clues to the formation of the early Earth.
- Describe how the presence of oxygen made way for the development of photosynthesis and respiration.

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

- Video Quizzes
- WebQuest Reports
- Quizzes
- Tests
- Projects
- Inquiry Based Activities

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Lecture and classroom discussion • Computer Research projects • Astronomy Journal • Current Events	2 Weeks
Teacher Resources	*Teacher Note*
• Lab Materials • "How the Earth was Made" (can be found online) • A & E: The Planets – "Terra Ferma" (can be found online) • A & E: The Planets – "Atmosphere" (can be found online) • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw -Pear Deck -BrainPOP	

-Book Creator -FlipGrid -Kahoot -Kami -Quizizz -Freckle -ALEKs -Raz Kids -Touch Math -Scholastic Magazines -No Red Ink -Newsela -Merge Cubes	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

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• Pre-teaching of vocabulary and concepts
• Visual learning, including graphic organizers
• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced

English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Unit 4 Title: The Sun

Unit Summary: In this unit of study students will explain how the composition of the Sun differs from that of Earth. Describe the various layers of the Sun and their functions. Explain what happens in the different parts of the Sun's atmosphere. Describe the sunspot cycle and, more generally, the solar cycle. Explain how magnetism is the source of solar activity. Describe the various ways in which the solar activity cycle manifests itself, including flares, coronal mass ejections, and prominences. Identify different forms of energy. Understand the law of conservation of energy. Trace the nuclear reactions in the solar interior. Describe the state of equilibrium of the Sun. Understand the energy balance of the Sun. Explain how energy moves outward through the Sun. Describe the structure of the solar interior

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

ELA

RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Career Readiness, Life Literacies, and Key Skills: 9.1.12.CFR.2 9.1.12.CFR.3 9.1.12.CFR.4 9.1.12.CFR.6 9.2.12.CAP.1 9.2.12.CAP.2 9.2.12.CAP.3 9.2.12.CAP.4 9.2.12.CAP.5 9.2.12.CAP.6 9.2.12.CAP.7 9.2.12.CAP.8 9.4.12.CI.1 9.4.12.CI.2 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2 9.4.12.CT.3 9.4.12.CT.4 9.4.12.DC.7 9.4.12.DC.8

Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

Climate Change Standards: HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

ELA Companion Standards: RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Big Idea: The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces. Draw evidence from informational texts to support analysis,

reflection, and research. Nuclear reactions (fission and fusion) convert very small amounts of matter into energy. The Sun is the major external source of energy for Earth's global energy budget. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Unit Essential Questions:	**Unit Enduring Understandings:**
• Approximately how old is the sun? • • How much longer will the sun with live? • • How large is the sun relative to other stars in our universe? • How would your sun be described in relation to other stars? • How much of the sun's mass is converted to energy every second? • What happens to the Sun's mass as it burns? • What new evidence did Skylab reveal about the sun? • What evidence do we have that the sun is a relatively young star? • What nuclear reaction takes place at the Sun's core? • What are the names of the various layers of the sun? • Why have the suns layers acquired these names? • How does the Sun's photosphere and chromosphere differ? • How are elements heavier than hydrogen and helium formed? • What is the solar wind? • How long does it take charged particles from the sun's core to reach the earth? • What evidence on earth proves the existence of the solar wind? • How far from the sun does the influence of the solar wind end? • Where does interstellar space begin? • How is the Voyager spacecraft helping scientists determine the beginning of interstellar space? • Is the sun's surface stationary like the earth	• Students will be able to describe the composition of the Sun, the nuclear reaction at its core and its relative age. • Students will have a basic understanding of the layers of the Sun and how its magnetic field creates sunspots. • Students were able to describe the effects of CMEs on our planet. • Students will be able to explain how the sun generates solar wind. • Students will be able to describe where interstellar space begins based on the influence of the solar wind. • Students will be able to list the current satellites and probes studying the sun and what information they provide. • Students will be able to explain the relationship between Solar Max and the Greenhouse Effect

or mobile? • Why does the Sun have multiple magnetic poles? • Why doesn't the sun have a unified magnetic field? • How does magnetic activity on the sun's surface create sunspots? • How large are sunspots and how long do they last? • What does the term Solar Max referred to and how is it related to sunspot activity? • What is the relationship between the Solar Max and the greenhouse effect? • What are prominences and coronal mass ejections? • Why is the position and time of coronal mass ejections important to life on earth? • What historical evidence do we have about the effect of CMEs here on earth? • How could the" power grid" be affected by the CME? • What effect would a CME have on satellites and radio communications here on earth? • Could a supermassive CME have lethal effects to life on earth? • What are the current satellites and probes studying the sun and what new evidence have they provided us?	

Unit Learning Targets
Students will…

- Describe the basic characteristics of the Sun and the nuclear reaction at its core.
- Describe the relative age of the sun and how much longer it will live.
- Explain the evidence that tells us that our sun is a relative newcomer to the universe.
- Explain the relative size of the sun in relation to other stars.
- Describe the term Yellow Dwarf in relation to our sun.
- Explain the movement of materials at the surface of the sun.
- Explain the nature and relationship between the Sun's magnetic field and sunspots.
- Describe the layers of the Sun and the importance of the Corona.
- Explain how heavy elements are created in the Sun's core.
- Describe the nature of the Solar Wind and how the limit of its influence can be detected.

- Explain the phenomenon of Coronal Mass Ejections and how they can affect the Earth

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

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- WebQuest Reports
- Quizzes
- Tests
- Projects
- Inquiry Based Activities

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Lecture and classroom discussion • Computer Research projects • Astronomy Journal • Current Events	2 Weeks
Teacher Resources	*Teacher Note*
• Lab Materials • "A & E: The Planets – "Star" (can be found online) • A & E: The Planets – "Destiny" (can be found online) • The Universe – "The Secrets of the Sun" (can be found online) • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw -Pear Deck -BrainPOP -Book Creator -FlipGrid -Kahoot -Kami	

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• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
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•Think-pair-share
•Cooperative learning groups

Unit 5 Title: The Inner Planets

Unit Summary: In this unit of study students will characterize the orbit of Mercury around the. Sun Describe Mercury's structure and composition. Explain why it's difficult to learn about Venus from Earth-based observation alone. Describe the history of our interest in Mars before the Space Age. Compare the basic physical properties of Earth, Mars, and Venus, including their orbits. Describe the general composition and structure of the atmosphere on Venus. Explain how the greenhouse effect has led to high temperatures on Venus. Discuss the main missions that have explored Mars. Explain what we have learned from examination of meteorites from Mars. Describe the various features found on the surface of Mars. Compare the volcanoes and canyons on Mars with those of Earth. Describe the general conditions on the surface of Mars. Compare the planetary evolution of Mercury, Venus, Earth, and Mars

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

ELA

RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

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Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

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Big Idea: The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces. Draw evidence from informational texts to support analysis, reflection, and research. The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements,

or performing technical tasks; analyze the specific results based on explanations in the text.	
Unit Essential Questions: • How old is our Universe? • What is the Big Bang Theory? • What is most of "Space" made of? • Why is our solar system in a flat disc formation? • How did the planets form? • Into what two major groups are the planets divided and why? • Which of the inner planets have atmospheres and what are they composed of? • What is the Asteroid Belt, where is it located and what is believed to be its origin? • What are the Kuiper Belt and the Ort Cloud and where are they located? • Why is Mercury the most cratered planet in the solar system? • What is Mercury's relative size to the rest of the planets in the solar system? • What is a "Temporary Atmosphere" and described how this affects Mercury? • How are a planet's size, its gravity and the density of the gases it can hold to its surface related? • What is unusual about the length of Mercury's day and year? • Mercury processes around the sun in an elliptical orbit. • How did Einstein make sense of this strange phenomenon? • What is a temperature range between night and day on Mercury? • What is the name of the only spacecraft to visit Mercury? • Are there any moons orbiting Mercury? • Are there any moons orbiting Venus? • What is the relative size of Venus to the other planets in our solar system? • Why Venus is considered Earth's twin?	**Unit Enduring Understandings:** • Students should understand the origin of the universe and our solar system. • Students will be able to describe the nature and arrangement of the planets in order. • Students will be able to distinguish between the inner and outer planets. • Student will understand the nature and locations of the Asteroid and Kupier Belts, and the Ort Cloud. • Students will be able to describe Mercury in terms of its size, geography, temperature and unique orbiting characteristics. • Students will be able to understand the nature of Mercury's temporary atmosphere. • Students will be able to explain the usual day/year relationship of Mercury. • Students will be able to explain the unusual orbit of Mercury around the sun. • Students will be able to understand the concept of the temporary atmosphere. • Students will understand that Mercury and Venus are the only planets in the solar system without moons. • Students will be able to explain why Venus is considered Earth's twin. • Students will be able to understand the cause of Venus's extra thick atmosphere. • Students will be able to explain the term runaway greenhouse effect. • Students will understand that other than Neptune, Venus is the only planet in our solar system that rotates in the opposite direction. • Students will be able to explain why Mars appears red. • Students will be able to describe Olympus Mons and compare it to Mount Everest here on earth. • Students will be able to list the moons of Mars. • Students will be able to explain why Martian moons are considered captured asteroids. •

• Which planet has the most volcanoes than any other in the universe? • What is the source of Venus is extra thick atmosphere? • Why do astronomers use the term "Runaway Greenhouse Effect" when referring to temperatures on Venus? • Unlike Mercury, Venus has a permanent atmosphere. What is it mainly composed of? • Besides Venus there is only one other planet in our solar system that rotates in the opposite direction of all the others. Which is it? • What is the relative size of Mars compared to the other planets in our solar system? • What is the surface of Mars appear red? • Astronomers are aware of frequent dust storms on Mars. • Are they able to engulf the entire planet? • What is the composition of Mars atmosphere? • Olympus Mons is considered the largest volcano in our solar system. How does it compare to Mount Everest here on earth? • Recently, water ice has been discovered just under the surface on Mars. Astronomers predict approximately how much of it is there? • Mars has two moons that are considered to be captured asteroids. • What are their names and relative sizes? • What was the fate of the Spirit and Opportunity rovers on Mars? • What new information has the Curiosity rover provided scientists?	• Students will be able to explain the faith of the Spirit and opportunity rovers on Mars. • Students will be able to describe the new information that the curiosity rover has provided for scientists
Unit Learning Targets *Students will…* • Explain the concept of a temporary atmosphere. • Identify which planets have moons. • Explain how a planet can capture an asteroid.	

- List the forces that create a runaway greenhouse effect.
- Explain the existence of the extra thick atmosphere on Venus.
- Describe the temperature ranges of Mercury Venus and Mars
- Identify Venus as one of only two planets in the solar system that rotates in the opposite direction Explain why Mars appears red.
- List the latest discoveries about Mars provided by the curiosity rover.

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

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- WebQuest Reports
- Quizzes
- Tests
- Projects
- Inquiry Based Activities

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
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Teacher Resources	*Teacher Note*
• Lab Materials • A & E: The Planets – “Different Worlds” (can be found online) • A & E: The Planets – “Giants” (can be found online) • The Universe – “The Inner Planets" (can be found online) • The Universe – “Mars-The New Evidence” (can be found online) • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw -Pear Deck -BrainPOP	

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English language skills
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Unit 6 Title: The Gas Giants

Unit Summary: In this unit of study students will provide an overview of the composition of the giant planets. Chronicle the robotic exploration of the outer solar system. Summarize the missions sent to orbit the gas giants. Describe the basic physical characteristics, general appearance, and rotation of the giant planets. Describe the composition and structure of Jupiter and Saturn. Compare and contrast the internal heat sources of the giant planets. Describe the discovery and characteristics of gas giant planets' magnetic fields.

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

ELA

RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Career Readiness, Life Literacies, and Key Skills: 9.1.12.CFR.2 9.1.12.CFR.3 9.1.12.CFR.4 9.1.12.CFR.6 9.2.12.CAP.1 9.2.12.CAP.2 9.2.12.CAP.3 9.2.12.CAP.4 9.2.12.CAP.5 9.2.12.CAP.6 9.2.12.CAP.7 9.2.12.CAP.8 9.4.12.CI.1 9.4.12.CI.2 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2 9.4.12.CT.3 9.4.12.CT.4 9.4.12.DC.7 9.4.12.DC.8

Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

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Big Idea: The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces. Draw evidence from informational texts to support analysis, reflection, and research. The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements,

or performing technical tasks; analyze the specific results based on explanations in the text.	
Unit Essential Questions: • Why Jupiter and Saturn are called the gas giants? • Which gases is Jupiter composed of? • What is the name of the space probe currently studying Jupiter? • Why Jupiter is considered a failed star? • What is responsible for its enormous magnetic field? • Who discovered Jupiter's red spot? • How long have astronomers been observing the red spot and is there a larger storm in the solar system? • What are the unique characteristics of the red spot? • Currently how wide is the red spot and is it shrinking or gaining size? • In which direction do the storms on Jupiter travel above and below the equator? • Which Planets have rings and why are Saturn's rings different from the other planets? • Which of the Gas Giants have moons and what are their relative numbers? • Which of Jupiter's moons are the most well-known and who were they named after? • How does Jupiter serve as a guardian for the inner solar system? • What is an oblate spheroid and why is pleasing to the eye? • Who named the dark areas in Saturn's giant rings? • What is the name of the space probe currently studying Saturn? • Is there a gap between the rings and Saturn surface? • What are Saturn's rings composed of? • What do scientists believe is the fate of Saturn's rings? • According to Kepler's law, what area of	**Unit Enduring Understandings:** • Students will have a basic understanding of why Jupiter and Saturn are called gas giants. • Students will be able to explain why Jupiter is considered a failed star. • Students will understand the source of Jupiter's enormous magnetic field. • Students will have a basic understanding of Jupiter's atmosphere, moons and its magnetic field. • Students will be able to explain the history and nature of Jupiter's red spot. • Students will understand the dynamics of Jupiter's atmosphere above and below the equator. • Students will be able to explain the origin of the names given to Jupiter's four most important moons. • Students will be able to explain why Jupiter is considered the guardian of the inner solar system. • Students will understand the nature of Saturn's rings. • Students will be able to explain the speed at which the inner and outer rings move according to Kepler's • Students will be able to explain the nature of a shepherd moon. • Students will understand the existence of Saturn's outer most rings. • Students will be able to identify and explain the size and shape of the storms at Saturn's north and south poles. • Students will be able to explain why scientists chose Titan instead of Europa to search for life. • Students will understand the nature of Titan according to the information returned by probes that have landed there. • Students will use their knowledge of the conditions that promote life to identify the moons that scientists want to investigate

the rings travel faster? • What is a Shepherd Moon and how does it make debris follow them? • Saturn's outermost rings should not be there according to Newton's law, what is the explanation for their existence? • Although they are 100 million miles wide, how thick our Saturn's rings? • Would Saturn float in the bathtub? • What is the shape of the huge storm found at the north pole of Saturn? • What is the size of the enormous hurricane like storm in the South Pole of Saturn? • Which moons do scientists find most interesting for the discovery of life? • Why did scientists choose Titan instead of Jupiter's Europa to search for life? • Upon landing what did the space probes discover about its Titan's surface? • Titan is the only moon in our solar system with an atmosphere. What is it composed of?	

Unit Learning Targets
Students will…

- Explain why Jupiter and Saturn are considered gas giants.
- Explain why Jupiter is considered a failed star.
- Describe the atmospheres of the Jupiter and Saturn, and how it affects their appearance.
- Identify the planets with a ring system and explain Saturn's unique place among them.
- Identify the source of Jupiter's anonymous magnetic field.
- Describe the unique characteristics of Jupiter's red spot.
- List the number of moons that Jupiter and Saturn have respectively.
- Identify by name the four moons of Jupiter that are the most famous.
- Describe the nature of Jupiter storms above and below the equator.
- Explain how Jupiter can be considered the guardian of the inner solar system. • Explain why Saturn shape is pleasing to the eye.
- Identify the astronomer who first discovered the gap in Saturn's rings.
- Identify the substances that Saturn's rings are composed of.
- Describe the orbital speed of Saturn's inner and outer rings in terms of Kepler's law.
- Describe the width and unique thickness of Saturn's rings.
- Explain why Saturn would float in a bathtub.
- Identify the size and shape of the enormous storms found at the North and South Pole of

Saturn.
- Explain the existence of Saturn's outer rings in terms of Newton's laws.
- Describe the effect of a shepherd moon on Saturn's inner rings.
- Explain why astronomers chose Titan instead of Europa to search for life in our solar system
- Explain the concept of a temporary atmosphere.
- Identify which planets have moons.
- Explain how a planet can capture an asteroid.

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- Inquiry-based instruction
- Independent study
- Higher-order thinking skills
- Interest-based content
- Student-driven instruction
- Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:

- Pre-teaching of vocabulary and concepts
- Visual learning, including graphic organizers
- Use of cognates to increase comprehension
- Teacher modeling
- Pairing students with beginning English language skills with students who have more advanced English language skills
- Scaffolding

•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Unit 8 Title: The Ice Giants

Unit Summary: In this unit of study students will provide an overview of the composition of the giant planets. Chronicle the robotic exploration of the outer solar system. Summarize the missions sent to orbit the ice giants. Describe the basic physical characteristics, general appearance, and rotation of the ice giant planets. Describe the composition and structure of Uranus and Neptune. Compare and contrast the internal heat sources of the giant planets. Describe the discovery and characteristics of ice giant planets' magnetic fields.

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

ELA

RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Career Readiness, Life Literacies, and Key Skills: 9.1.12.CFR.2 9.1.12.CFR.3 9.1.12.CFR.4 9.1.12.CFR.6 9.2.12.CAP.1 9.2.12.CAP.2 9.2.12.CAP.3 9.2.12.CAP.4 9.2.12.CAP.5 9.2.12.CAP.6 9.2.12.CAP.7 9.2.12.CAP.8 9.4.12.CI.1 9.4.12.CI.2 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2 9.4.12.CT.3 9.4.12.CT.4 9.4.12.DC.7 9.4.12.DC.8

Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

Climate Change Standards: HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

ELA Companion Standards: RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Big Idea: The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces. Draw evidence from informational texts to support analysis, reflection, and research. The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Unit Essential Questions:	Unit Enduring Understandings:
• Why are Uranus and Neptune considered Ice Giants? • How does the methane and Uranus atmosphere account for its soft blue color? • What is the source of the smog on Uranus? • Uranus spins on its side at a 90° tilt. • What do astronomers believe is the cause for this? • Uranus is not a “naked eye” planet. • Which of the other planets were discovered only by telescope? • Why is there no wind or weather on Uranus? • How many rings does Uranus have? • What do scientists believe is the source of Uranus’ rings? • What makes Uranus the coldest planet in our solar system? • How did the study of Uranus lead to the discovery of Neptune? • What is unique about Neptune’s axis of rotation and what do scientists believe caused it? • Because of the lack of friction in Neptune’s atmosphere it produces the strongest winds in the solar system. What are they? • Why Neptune is considered an unfinished planet? • What is the nature of the possible heat source on Neptune? • What is the nature of Neptune’s giant dark spot? • By what new method was Pluto discovered? • What does the term perturbation mean? • Why is Pluto sometimes closer to the Earth than Neptune? • How did the last three planets get their names? • Why Pluto is no longer considered a	• Students will be able to explain why Neptune and Uranus are considered ice giants? • Students will be able to describe how the methane in Uranus atmosphere creates its soft blue color. • Students will be able to describe why Uranus is tilted 90° and its orbit. • Students will be able to explain why Neptune and Uranus are not considered “naked eye” planets. • Students will be able to explain the source and number of Uranus rings. • Students will be able to explain why Uranus is the coldest planet in our solar system. • Students will be able to describe the discovery of Neptune as a result of the study of Uranus. • Students will understand the nature of Neptune’s unique axis of rotation and describe what caused it. • Students will understand why Neptune produces the strongest winds in our solar system. • Students will understand why Neptune is considered an unfinished planet. • Students will be able to understand the possible heat source at Neptune’s core. • Students will be able to explain the strange nature of Neptune’s dark spot.

Planet? • How many moons are orbiting Pluto? • Name at least two minor planets larger than Pluto in the Kuiper belt?	

Unit Learning Targets
Students will…

- Explain why Uranus and Neptune are considered gas giants.
- Describe how methane creates Uranus soft blue color.
- Explain why your Uranus on its side at 90°.
- Describe why Uranus and Neptune are not considered naked eye planets.
- Explain how Neptune and Pluto were discovered.
- Explain the nature of Neptune's great dark spot.
- Explain how Uranus Neptune Pluto got their names.
- Describe why Neptune's atmosphere produces the strongest winds in the solar system.
- Describe what astronomers believe is the cause of Neptune's retrograde rotation.
- Describe the new scientific methods that led to the discovery of Neptune and Pluto
- Explain how Pluto's orbit and Neptune's axis of rotation are unique in our universe.
- Explain why Pluto is no longer considered a planet.
- Describe other minor planets in the Kuiper belt that are larger than Pluto
- Explain how Pluto's new moons got their names.

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

- Video Quizzes
- WebQuest Reports
- Quizzes
- Tests
- Projects
- Inquiry Based Activities

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Lecture and classroom discussion • Computer Research projects • Astronomy Journal • Current Events	2 Weeks

Teacher Resources	*Teacher Note*
• Lab Materials • A & E: The Planets – "Different Worlds" (can be found online) • A & E: The Planets – "Giants" (can be found online) • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw -Pear Deck -BrainPOP -Book Creator -FlipGrid -Kahoot -Kami -Quizizz -Freckle -ALEKs -Raz Kids -Touch Math -Scholastic Magazines -No Red Ink -Newsela -Merge Cubes	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:

• Use of visual and multisensory formats
• Use of assisted technology
• Use of prompts
• Modification of content, student products, and assessment tools (rubrics for example)
• Testing accommodations
• Authentic assessments (ex: write an email to your state senator about a current event issue you are passionate about, design/implement a class debate, create and balance a college freshman budget, create a commercial that dispels a myth about climate change)

Examples of Strategies and Practices that Support Gifted & Talented Students:

• Adjusting the pace and content of lessons
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• Independent study
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• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Unit 9 Title: Stars, Galaxies and the History of the Universe

Unit Summary: In this unit of study students will describe the distribution of stellar masses found close to the Sun. Distinguish the different types of binary star systems. Understand how we can apply Newton's version of Kepler's third law to derive the sum of star masses in a binary star system. Apply the relationship between stellar mass and stellar luminosity to determine the physical characteristics of a star. Explain how interstellar matter flows into and out of our Galaxy and transforms from one phase to another, and understand how star formation and evolution affects the properties of the interstellar medium. Explain how the heavy elements and dust grains found in interstellar space got there and describe how dust grains help produce molecules that eventually find their way into planetary systems. Explain the life cycle of stars and their deaths. Describe the evolution of the universe from is' origins to it possible ends.

Primary Interdisciplinary Connections:

Math

MP.2 MP.4 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3 HSA-SSE.A.1 HSA-CED.A.2 HSA-CED.A.4 HSF-IF.B.5 HSS-ID.B.6 7.EE.B.4

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Learning Targets

NJSLS Standards: HS-ESS1-1 HS-ESS1-2 HS-ESS1-3 HS-ESS1-4 HS-ESS1-6

Computer Science and Design Thinking Standards: 8.2.12.ED.1 8.2.12.ED.4 8.2.12.ED.5 8.2.12.ED.6 8.2.12.ITH.1 8.2.12.ITH.2 8.2.12.ITH.3 8.2.12.NT.1 8.2.12.NT.2 8.2.12.ETW.1 8.2.12.ETW.2 8.2.12.ETW.3

Climate Change Standards: HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

ELA Companion Standards: RST.11-12.1 RST.11-12.8 WHST.9-12.1 WHST.9-12.2 SL.11-12.4

Big Idea: The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces. Draw evidence from informational texts to support analysis, reflection, and research. The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Unit Essential Questions:

- What is a protostar?
- What process changes a protostar to s full-fledged star?
- What are the inward and outward forces acting on a star?
- What do the inward and outward forces acting on a star have to do with its size? •
- Where did the elements heavier than helium come from?
- How is a stars mass related to its lifespan?
- How is a stars color related to its temperature and spin rate?
- What is the color is a very low mass stars?
- How common are binary stars in the universe?
- What measurements of binaries provide data for measuring their masses?
- What is the companion star to the theoretical star "Nemesis"?
- What is the theory that associates nemesis with periodic extinction events on earth?
- How is angular momentum related to planetary systems?
- How does the Doppler Effect and the Red

Unit Enduring Understandings:

- Students will understand how a Star is formed.
- Students will understand the event that changes a protostar to a full-fledged star.
- Students will understand how the size of the star is determined.
- Students will understand how a star's mass is related to its lifespan.
- Students will understand how stars color is related to its temperature.
- Students will understand that stars come in either a binary or multiple star system.
- Students will understand how to use Kepler's Law to determine the mass of a star in a binary system.
- Students will understand the theory of our son's companion star nemesis.
- Students will understand why the night sky appears dark between stars.
- Students will understand what events lead to the red giant stage.
- Students will understand the origin of planetary nebula.
- Students will understand the nature of a white dwarf.

Shift account for the dark sky between stars? • What event marks the death of a star? • When will our sun reach the “Red Giant” stage? • What conditions at the core of a low mass star create planetary nebula? • After all the gases have peeled away what is left of the original star? • Why a white dwarf is no longer considered a star and instead called a stellar remnant? • What color changes does a stellar remnant go through before it is completely dead? • What special circumstances create a Nova event between a white wharf and its companion star? • How often can nova events take place? • What circumstances lead to a type IA supernova? • How are type IA supernova used to measure distances in the cosmos? • When stars have enough mass and gravitational contraction they can produce this next critical element in its core, are what is it? • Why is Iron the ultimate element able to be produced at the core of a star? • What event’s lead to the creation of a supernova? • How are elements heavier than iron created during the supernova phase? • Why are elements heavier than iron less abundant in our universe? • After the explosion, what special conditions create what astronomers call a neutron star? • What is the density of a neutron star compared to that of a white dwarf? • Neutron stars spin at fantastic speeds and some of them radiate x-rays. • What term do astronomers use to describe them?	• Students will understand the circumstances that create a nova event. • Students will understand the circumstances that lead to a type IA supernova. • Students will understand how type IA super nova is used to measure distances in the cosmos. • Students will understand why iron is the ultimate element that can be created at the core of a star. • Students will understand how the production of iron leads to the supernova explosion and the death of a star. • Students will understand how elements heavier than iron are produced during the supernova event. • Students will understand why elements heavier than iron are less abundant in our universe. • Students will understand how a neutron star is created after a supernova. • Students will understand the relationship between a pulsar and a neutron star

• Approximately how many pulsars have been discovered? • How is it possible that many neutron stars are pulsars that have not been identified?	

Unit Learning Targets
Students will…

- Describe the events that lead to the formation of a star.
- List the forces that determine a star's size.
- Explain the basic nature of binaries and how they are used to determine the size of stars.
- Explain what event indicates the death of a star.
- Describe a red giant and explain what effect it will have on the planets in our solar system.
- Describe the appearance and basic nature of planetary nebula.
- Explain how color and temperature are related in the appearance of a star.
- Identify the pathway taken by high and low mass stars.
- Describe the circumstances that lead to a nova.
- Describe the circumstances that lead to a type IA supernova.
- Explain how type IA supernova can be used to determine distances in the cosmos.
- Describe why the production of carbon is critical in taking the next step of the stars lifecycle.
- Explain why iron is the ultimate element that can be produced in the core of a star.
- Describe the events leading to a supernova and what effects it has on the entire universe.
- Explain how a neutron star is formed after a supernova event.
- Explain how the spin rate of the neutron star can produce a beam of x-rays.
- Describe the nature of a pulsar.
- Explain why some neutron stars could be pulsars without astronomers knowing

Evidence of Learning

Summative Assessment: Labs Unit test

Formative Assessments:

- Video Quizzes
- WebQuest Reports
- Quizzes
- Tests
- Projects
- Inquiry Based Activities

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Lecture and classroom discussion	4 Weeks

• Computer Research projects • Astronomy Journal • Current Events • Final Project	
Teacher Resources	*Teacher Note*
• Lab Materials • The Universe: Life and Death of Stars • Projector • Tools (add/delete as appropriate): -Google Classroom -Seesaw -Pear Deck -BrainPOP -Book Creator -FlipGrid -Kahoot -Kami -Quizizz -Freckle -ALEKs -Raz Kids -Touch Math -Scholastic Magazines -No Red Ink -Newsela -Merge Cubes	

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