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Curriculum Development Timeline

School: Ocean Township High School

Course: Astronomy

Department: Science

Board Approval	Supervisor	Notes
July 2008	Patrick Sullivan	Born Date/Alignment to NJCCCS
August 2011	Patrick Sullivan	Update Standards
August 2013	Patrick Sullivan	Update Standards
December 2017	Patrick Sullivan	Update Standards
August 2018	Patrick Sullivan	Revisions
August 2019	Patrick Sullivan	Review

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Week	Marking Period 1 & 2	Week	Marking Period 3 & 4
1	Nature of Science	11	Galaxies
2	Astronomy's Place in Science	12	The Sun
3	Astronomy on Earth	13	Life Cycles of Stars
4	History of Astronomy	14	Solar Systems
5	Planetary Motion	15	Planets & Moons
6	The Moon	16	Planets & Moons
7	Waves & Electromagnetism	17	Asteroids, Meteors, Comets
8	Telescopes	18	Space Exploration - Technology
9	The Universe	19	Life in the Universe
10	Midterm/Project	20	Final Exam/Project

Core Instructional & Supplemental Materials including various levels of Texts
Required Reading: Cosmos by Carl Sagan Observation Exercises in Astronomy by Lauren Jones <u>Digital Resources Across All Levels: (D=differentiated)</u> Edpuzzle (D)

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Gizmo (D)
New York Times Articles
PhET Interactive Simulations (D)
Science News (D)
Tedtalks
Stellarium
Streaming and video clips

Time Frame	4 weeks

Topic

Nature of Science / Astronomy's Place in Science / Astronomy on Earth / History of Astronomy

Essential Questions

- What is science?
- Why should people study the night sky?
- 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?
- What is the importance of revealing scientific breakthroughs to the general public?
- What is the size or scale of the universe?
- How has our understanding of Astronomy changed during human history?
- What are constellations and how are they identified?

Enduring Understandings

- 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 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.

Alignment to Standards

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HS-PS4-1; HS-PS4-5; HS-ESS1-3; HS-ESS1-2; HS-ESS1-6

Learning Activities & Key Concepts and Skills

Learning Activities

- Lecture and classroom discussion
- Computer Research projects (Historical Astronomer Project)
- Astronomy Journal
- Current Events
- Hands-on Lab Activities (Grains of Sand Lab; Star Wheel Activity; 3-D Constellation Lab; Parallax Lab)
- Cosmos Readings

Key Concepts and Skills

- Identify the concepts of Aristotelian astronomy.
- Describe the events that led to the Papal Council at Trento.
- List the changes the Roman Catholic Church instituted to respond to the Protestant Revolution.
- 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.

Assessments

<u>Formative:</u>

- Do Now / Warm-up: speed/distance/time equations, speed of light calculations, solar system and galaxy distances.
- Strategic Questioning
- Pre & Post Lab Analysis Questions

<u>Summative:</u>

- Unit Tests (Multiple Choice and Free Response)

- Unit Quizzes and Cosmos Reading Quizzes (Multiple Choice and Free Response)

- Benchmark:
- A pre- and post-test will be given to measure skills and knowledge with core course concepts. (Pre-test during week 1).

Alternative:

- Students apply astronomy and physics concepts and problem-solving techniques to solve problems involving estimation & sizes of and distances to certain celestial bodies.
- Students use online astronomy software applications to become familiar with the motions and coordinate systems used for navigating the night sky.
- Students create models of constellations using mathematical calculations and available in-class materials.

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Career Education
• CRP-2 – Students use knowledge and skills through their lab work. • CRP4. Communicate clearly and effectively and with reason. • CRP11. Use technology to enhance productivity. • CRP-12 – Students work productively in collaborative groups using culturally global competence.
21st Century Skills
• 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. • 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. • 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.
Interdisciplinary Connections
• LA.11-12.WHST.11-12.1.D (Constellation Presentations) • LA.11-12.WHST.11-12.2.A (Historical Astronomer/Space Scientist Project)
Technology Integration
• TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom. • TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content. • TECH.8.1.12.A.4 - Perform orbital motion calculations using a spreadsheet.

Time Frame	2 weeks
Topic	
Planetary Motion & The Moon	
Essential Questions	
• What is Earth's motion in our solar system? • How is the Moon's orbit tied to the Earth?	

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- What were Tycho Brahe's & Johannes Kepler's contributions to planetary motion?
- What are Kepler's Three Laws of Planetary Motion?
- What are the characteristics of an ellipse?
- How many/what types of Moon Missions have occurred?
- 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 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 theories that explain the origin of the moon?
- 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?

Enduring Understandings

- Students should understand the roles Brahe, Kepler, Newton, and Galileo played in determining the motions of the planets.
- Students should be able to describe and apply Kepler's Laws of Planetary Motion.
- 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.

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- 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.

Alignment to Standards

HS-PS4-1; HS-PS4-5; HS-ESS1-4; HS-PS2-4; HS-ESS1-5; HS-ESS1-6; HS-ESS2-4

Learning Activities & Key Concepts and Skills

Learning Activities:

- Lecture and classroom discussion
- Computer Research projects (Moon Missions)
- Astronomy Journal (Brahe-Kepler relationship)
- Current Events
- Hands-on Lab Activities (Distance to Moon Lab; Mercury Orbit-Kepler's Law Lab)
- Cosmos Readings

Key Concepts & Skills:

- Explain how Kepler's Laws redefined our understanding of the clockwork universe.
- 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.

Assessments

Formative:

- Do Now / Warm-up: Kepler's 3rd Law questions & calculations, Ellipse drawings.
- Strategic Questioning
- Pre & Post Lab Analysis Questions

Summative:

- Unit Tests (Multiple Choice and Free Response)
- Unit Quizzes and Cosmos Reading Quizzes (Multiple Choice and Free Response)

Benchmark:

Alternative:

- Students apply physics concepts and problem-solving techniques to solve problems involving Kepler's 3 Laws of Planetary Motion and Eclipse phenomena.
- Students track orbiting comets and near-earth asteroids and predict their respective locations in the future.

Career Education

- CRP-2 – Students use knowledge and skills through their lab work.
- CRP11. Use technology to enhance productivity.
- CRP-12 – Students work productively in collaborative groups using culturally global competence.

21st Century Skills

- 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

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Interdisciplinary Connections
• LA.11-12.WHST.11-12.4 (Moon Adjectives and Meanings) • LA.11-12.RST.11-12.7 (Apollo 13 Mission Research) • LA.11-12.WHST.11-12.7 (Mercury Orbit Lab)
Technology Integration
• TECH.8.1.12.F.CS3 - Students will use technology in the collection and analysis of data to identify solutions and/or make informed decisions. • TECH.8.1.12.C. – Students will use google docs and google slides to formulate and submit lab reports and research projects to google classroom. • TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content.

Time Frame	2 weeks
Topic	
Waves & Electromagnetism / Telescopes	
Essential Questions	
• What is Light? • What is the Electromagnetic Spectrum? • How can the EM Spectrum be classified? • How can properties of wavelength, frequency, speed, and energy be described for light? • What is spectroscopy? • What is the Doppler Effect and Reshift/Blueshift? • What are some of the basic characteristics of the refractor and reflector telescopes? • What are some of the drawbacks of using lenses for deep space observation? • How did Newton's reflector design revolutionize the field of astronomy? • What is the nature of a parabolic mirror? • Why does increased aperture greatly improve the effectiveness of a reflector telescope?	

- What problems limit the size and construction of larger parabolic mirrors?
- What is the basic design of the Hubble space telescope?
- What advantage does photographic film have over the naked eye?
- What time of year is the best for observing the heavens?
- How does atmospheric turbulence affect telescope clarity?
- What is the advantage of building observatories on mountain tops?
- What is light pollution and how does it affect telescope clarity?
- How can digital cameras be used to aid in astrophotography?

Enduring Understandings

- Students will explain the tools used by astronomers to study electromagnetic radiation to determine composition, motions, and other physical attributes of astronomical objects.
- Students will be able to understand how lens development led to the invention of the telescope.
- Students will be able to explain why the inventor of the telescope is so controversial.
- Students will understand how Galileo's observations change the face of astronomy forever.
- Students will be able to explain why larger lenses posed great problems for early astronomers.
- Students will understand how Newton's invention of the reflector telescope revolutionized astronomy.
- Students will be able to understand why Newton's invention of the reflector telescope is still used today over 500 years later.
- Students will be able to explain why replacing the naked eye with photographic film greatly advanced astronomy.
- Students will understand how Hubble was able to discover the Andromeda galaxy and the expanding universe using the 100 inch Hooker telescope.
- Students will understand the concept of spectroscopy and how reveals a stars composition.
- Students will be able to explain the Doppler Effect and how the Red Shift led to the discovery of the expanding universe.

Alignment to Standards

HS-PS4-1; HS-PS3-1; HS-PS4-5; HS-PS4-3; HS-PS4-4;

Learning Activities & Key Concepts and Skills

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Learning Activities:

- Lecture and classroom discussion
- Computer Research projects (Electromagnetic Spectrum WebQuest; Famous Telescope Slideshow Project)
- Astronomy Journal (Describing 'Waves' and 'Light')
- Current Events
- Hands-on Lab Activities (Build a Spectrometer Lab; Spectroscopy Lab; Designing a Virtual Telescope)
- Cosmos Readings

Key Concepts and Skills:

- Explain the challenges faced by astronomers due to the properties of light and the vast distances in the cosmos.
- Rank the seven categories of the EM Spectrum in terms of frequency, wavelength, and energy.
- Evaluate the types of telescopes used by astronomers for examining different frequencies of electromagnetic radiation and compare and contrast the uses and advantages of each (e.g. radio, microwave, IR, visible, UV, X-ray, gamma ray; reflectors vs. refractors).
- Discuss how spectroscopy provides information about the inherent properties and motions of objects.
- Quantitatively analyze data from telescopes (e.g. spectra, multi-wavelength photometry, and images) and/or other astronomical sources (e.g. tide tables, sky charts).
- Explain how better lenses led to the invention of the telescope.
- Describe the observations made by Galileo that change the face of astronomy.
- Explain how larger lenses became unusable for you early astronomers.
- Describe the basic design of the new reflector telescope.
- Explain why photographic film greatly advanced astronomy.
- List the great discoveries made by Hubble using the hooker 100 inch telescope.
- Describe the concept of spectroscopy and its uses.
- Explain how the expanding universe was discovered by the red shift.

Assessments

Formative:

- Do Now / Warm-up: EM Spectrum Ranking Tasks; Name that telescope.
- Strategic Questioning
- Pre & Post Lab Analysis Questions

Summative:

- Chapter Tests (Multiple Choice and Free Response)
- Chapter Quizzes (Free Response)

Benchmark:

Alternative:

- WebQuest (Light); Mystery Spectra; Telescope Presentations.

Career Education

- CRP-2 – Students use knowledge and skills through their lab work.
- CRP11. Use technology to enhance productivity.
- CRP-12 – Students work productively in collaborative groups using culturally global competence.

21st Century Skills

- 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Interdisciplinary Connections

- LA.11-12.WHST.11-12.1.D (Famous Telescope Research Project)
- LA.11-12.WHST.11-12.2.A (WebQuest)

Technology Integration

- TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom.
- TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content.

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Time Frame	2 weeks

Topic

The Universe / Galaxies

Essential Questions

- How can information about light spectra, motion of galaxies, and composition of matter in the universe support the Big Bang theory?
- How does the Big Bang theory explain the origins and expansion of our universe?
- How can the movement of distant objects in space be observed from earth?
- How do galaxies form?
- What sizes and types of galaxies are there?
- What are the physical characteristics of the Milky Way Galaxy?
- Who was Edwin Hubble and what is Hubble's Law?

Enduring Understandings

Students Will Be Able To:

- Describe the Big Bang Theory and evidence that supports the theory.
- Describe theories regarding the end of the universe, including the Big Freeze, the Big Crunch, and Steady State Theories.
- Identify the different types of galaxies based upon Hubble's tuning fork model.
- Describe the size, structure, and physical components of the Milky Way Galaxy.

Alignment to Standards

HS-PS1-8; HS-ESS1-4; HS-ESS1-3; HS-ESS1-2; HS-ESS1-1

Learning Activities & Key Concepts and Skills

Learning Activities:

- Gizmos (online simulation): The Big Bang Theory
- Hubble's Constant Lab

- Galaxy Classification Activity
- Current Events
- Cosmos Reading
- Lecture and Class Discussion

Key Concepts and Skills:

- The Big Bang theory describes the origin of the universe and is supported by observations of moving celestial objects, including galaxies and stars.
- Galaxies are clusters of stars, gases and other celestial debris and exist in various forms. Galaxies are grouped in clusters.
- The electromagnetic spectrum describes the various forms of radiation that exist in our universe, and each form of radiation can be differentiated based on wavelength, frequency and speed.
- Each different wavelength of electromagnetic radiation has a unique signature, and is based on the composition of the object emitting that radiation.
- Spectroscopy is the branch of science that measures spectra produced when matter emits electromagnetic radiation.
- Different elements, stars, galaxies, as well as other objects in space have spectra that allow us to identify their composition.
- Using known spectral signatures, the Doppler Effect shows how the movement of an object towards or away from the viewpoint can shift the spectra of an object. This shift allows scientists to know what direction an object in space is moving.
- Wein's displacement law and Planck's law can be used to further understand the electromagnetic radiation of an object in space.

Assessments

Formative:

- Do Now / Warm-ups: Fate of Universe Questions
- Strategic Questioning
- Post Lab Analysis Questions

Summative:

- Chapter Tests (Multiple Choice and Free Response)
- Chapter Quizzes (Free Response)

Benchmark:

Alternative:

- Gizmos simulations; Hubble Law Graphs

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21st Century Skills
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Interdisciplinary Connections
• LA.11-12.WHST.11-12.1.D (Galaxy Classification Activity)
Technology Integration
• TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom. • TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content. • TECH.8.1.12.A.4 - Perform light-year to parsec conversions using a spreadsheet.

Time Frame	3 weeks
Topic	
The Sun / Life Cycles of Stars / Solar Systems	
Essential Questions	

- What is the role of energy in our world?
- What is a star?
- How is the creation of chemical elements related to stars?
- What is the structure and what are properties of our Sun?
- How are stars classified?
- How do a star's properties effect its life cycle?
- How does mass determine the characteristics of a star's life?
- How are the life cycles different for low-mass stars compared to high-mass stars?
- What are neutron stars?
- What are black holes?
- What is a Hertzsprung-Russel Diagram?
- What is Wien's Law?

Enduring Understandings

Students Will Be Able To:

- Trace the production of energy by the Sun.
- Summarize the composition and properties of the interstellar medium including dark matter.
- Summarize the sequence of events leading to star formation.
- Analyze the evolution of stars off the main sequence.
- Describe the magnetic properties of stars.
- Discuss the observations that help verify the theory of stellar evolution.
- Discuss the motions of stars through space and how those motions are measured from Earth.
- Summarize the events leading to the violent death of a massive star.
- Describe the two types of supernovae.
- Discuss the nature of neutron stars, pulsars, gamma ray bursts, and black holes.
- Describe a Hertzsprung-Russell Diagram.
- Describe what Wien's Law tells us about a star.

Alignment to Standards

HS-PS1-8; HS-ESS1-4; HS-ESS1-3; HS-ESS1-2; HS-ESS1-1

Learning Activities & Key Concepts and Skills

Learning Activites:

- Lecture and classroom discussion
- Computer Research projects (Life Cycle of a Star Project: From Protostar to Black Hole)
- Astronomy Journal
- Current Events
- Hands-on Lab Activities (Wien's Law Lab; Diameter of the Sun Lab; H-R Diagram Activity; Black Hole Lab; Magnetism Observation Lab)
- Cosmos Readings

Key Concepts and Skills:

- Summarize the events leading to the violent death of a massive star.
- Describe differences in lives of low-mass stars compared to lives of high-mass stars.
- Use an H-R diagram to identify stellar properties.
- Use Wien's Law to determine the temperature of the surface of a star.
- Calculate differences between apparent and absolute magnitude.
- Observe solar features using appropriate telescopic equipment.

Assessments

Formative:

- Do Now / Warm-up: Layers of the Sun; Magnetism Q's.
- Strategic Questioning
- Post Lab Analysis Questions

Summative:

- Chapter Tests (Multiple Choice and Free Response)
- Chapter Quizzes (Free Response)

Benchmark:

Alternative:

- Students apply physics concepts to explain solar phenomena (solar wind, solar flares, magnetic storms, coronal mass ejections) and relate to the Auroras.
- Life Cycle of Star Packet

Career Education

- CRP-2 – Students use knowledge and skills through their lab work.
- CRP11. Use technology to enhance productivity.

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- CRP-12 – Students work productively in collaborative groups using culturally global competence.

21st Century Skills

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- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Interdisciplinary Connections

- LA.11-12.WHST.11-12.1.D (Pulsar, Magnetar, Neutron Star, Black Hole assignment)
- LA.11-12.WHST.11-12.2.A (One-Stage in the Life-Cycle of a Star Presentation)

Technology Integration

- TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom.
- TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content.
- TECH.8.1.12.A.4 - Perform black hole calculations using a spreadsheet.

Time Frame	3 weeks

Topic

Planets & Moons / Asteroids, Meteors, & Comets

Essential Questions

- What is a planet?
- What is the current theory of planetary system formation?
- How do the properties differ between the Terrestrial and Jovian planets?
- What are the characteristics of moons in our solar system?
- What is an asteroid?

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- What is the difference between a meteor, a meteorite, and a meteoroid?
- How do comets and asteroids differ?
- What is an extrasolar planet (exoplanet) and how many have been discovered?
- What are the techniques that are used for exoplanet detection?

Enduring Understandings

Students Will Be Able To:

- Outline the theory of solar-system formation.
- Discuss the role of collisions in determining planetary characteristics.
- Describe the overall scale and structure of the solar system.
- Compare and contrast the terrestrial and Jovian planets.
- Compare and contrast the characteristics and theories of formation of the Moon and the planets in our solar system.
- Describe physical characteristics of (compare and contrast) planets, moons, asteroids, meteors, and comets (including formation theories of each).

Alignment to Standards

HS-ESS1-5; HS-ESS1-6; HS-ESS2-1;

Learning Activities & Key Concepts and Skills

Learning Activities:

- Create a scale model of the Earth-Moon system.
- Lecture and classroom discussion
- Computer Research projects (Exoplanet research project; detection techniques)
- Astronomy Journal (Oumuamua: Asteroid, Comet, neither, or both?)
- Current Events (Modeling an Asteroid Activity)
- Cosmos Readings

Key Concepts and Skills:

- Describe different exoplanet environments.
- Describe exoplanet detection techniques.
- Explain differences in characteristics of Terrestrial vs. Jovian planets.
- 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.
- 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.

Assessments

Formative:

- Do Now / Warm-up: Classifying objects: meteoroid, asteroid, moon, or planet?
- Strategic Questioning
- Pre & Post Lab Analysis Questions

Summative:

- Chapter Tests (Multiple Choice and Free Response)
- Chapter Quizzes (Free Response)

Benchmark:

Alternative:

- Exoplanet Research and Presentations

Career Education

Career Education

- CRP-2 – Students use knowledge and skills through their lab work.
- CRP11. Use technology to enhance productivity.
- CRP-12 – Students work productively in collaborative groups using culturally global competence.

21st Century Skills

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- 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Interdisciplinary Connections

- LA.11-12.WHST.11-12.1.D (SpaExoplanet research project)
- LA.11-12.WHST.11-12.2.A (Oumuamua articles: Reading & Reflection Assignment)

Technology Integration

- TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom.
- TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content.
- TECH.8.1.12.A.4 - Perform exoplanet mass calculations using a spreadsheet.

Time Frame	2 weeks

Topic

Space Exploration & Technology/ Life in the Universe

Essential Questions

- What Moon missions have taken place and what types of technologies have been used?
- What Mars missions have taken place and what types of technologies have been used?
- What other planets/moons in our solar system have been visited?
- What technologies are being used today or are planned for the future in regards to learning more about astronomy?
- What is the process of cosmic evolution?
- What are the basic ingredients of life on Earth?
- What is the Drake Equation?
- What are some techniques we might use to search for extraterrestrials and to communicate with them?

Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

SPARTAN MISSION:
Meeting the needs of all students with a proud tradition of academic excellence.

Enduring Understandings

Students Will Be Able To:

- Describe historical lunar missions from historical, technological, and astronomical perspectives.
- Describe Mars missions from historical, technological, and astronomical perspectives.
- Summarize the process of cosmic evolution.
- Describe the basic ingredients of life on Earth.
- Identify the most promising sites for life elsewhere in the solar system, and explain why they are promising.
- Summarize the various probabilities used to estimate the number of advanced civilizations that might exist in a galaxy.

Alignment to Standards

HS-PS2-1; HS-PS2-3; HS-ESS1-2; HS-ESS1-3; HS-ESS2-7

Learning Activities & Key Concepts and Skills

Learning Activities:

- Lecture and classroom discussion
- Computer Research projects (SETI research project)
- Astronomy Journal (Sagan's Contact)
- Current Events
- Hands-on Lab Activities (Solar Sail Construction Lab, Hubble Telescope Models)
- Cosmos Readings

Key Concepts and Skills:

- Cosmic evolution is the continuous process that has led to the appearance of galaxies, stars, planets, and life on Earth.
- The Drake Equation provides a means for estimating the probability of intelligent life in the galaxy.
- Currently, space travel is not a feasible means of searching for intelligent life. Scanning the EM spectrum for signals is our best current method of searching.
- The Apollo Program successfully landed men on the moon.

- Mars has been the target of active robotic exploration.
- Mariner, Pioneer, and Voyager Missions in the 1960s-1970s paved the way for more modern solar system exploration.

Assessments

Formative:

- Do Now / Warm-up: Drake's Equation; Relativity Equations; Wormholes; Outcomes of Quantum Mechanical Theory
- Strategic Questioning
- Post Lab Analysis Questions

Summative:

- Chapter Tests (Multiple Choice and Free Response)
- Chapter Quizzes (Free Response)

Benchmark:

Alternative:

- SETI@Home research;

Career Education

- CRP-2 – Students use knowledge and skills through their lab work.
- CRP11. Use technology to enhance productivity.
- CRP-12 – Students work productively in collaborative groups using culturally global competence.

21st Century Skills

- 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Interdisciplinary Connections

- LA.11-12.WHST.11-12.1.D (SETI Research assignment)

Technology Integration

- TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom and google slides to create presentations.
- TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content.

Time Frame: 1 week

Topic

Astronomy Picture of the Day (APOD) Final Exam Project

Essential Questions

- Who created the image, where, and when?
- Why were you drawn to the image?
- Is there any relevant history associated with the image?
- What is the object classified as (planet, star, galaxy, etc.)?
- Have any scientific discoveries been made regarding your object?
- What does the image bring to the scientific community? (ex: is it the discovery of a new object? Is it an object we use for some purpose? Is a piece of equipment? Etc).
- What are the scientific processes concerning your object?
- What is still unknown about your object?
- Is there any current or planned research on your object or other objects similar to yours?

Enduring Understandings

Students Will Be Able To:

- Apply scientific principles from class to their selected photo.
- Research and learn about astronomical phenomena.
- Write about and share research with the class in slideshow format.
- Describe scientific processes at a level appropriate to the course.

Alignment to Standards
HS-ESS1; HS-ESS2; HS-ESS3
Learning Activities & Key Concepts and Skills
Learning Activities: • Visit apod.nasa.gov and search images. • Computer research. • Writing paper. • Creating slideshow. • Student presentations. Key Concepts and Skills: • Describe where, when, and by whom the image was taken. • Describe the history of the image. • Differentiate between types of celestial objects. • Display scientific research in multiple formats (written paper and visual slideshow). • Demonstrate knowledge of selected image. • Identify how the image relates to topics covered in the course.
Assessments
Formative: • Essential Questions Summative: • Written Paper • Slideshow • Presentation Benchmark: • A pre- and post-test will be given to measure skills and knowledge with core course concepts. (Post-test during week 20). Alternative:
Career Education

- CRP-2 – Students use knowledge and skills through their lab work.
- CRP4. Communicate clearly and effectively and with reason.
- CRP11. Use technology to enhance productivity.
- CRP-12 – Students work productively in collaborative groups using culturally global competence.

21st Century Skills

- 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Interdisciplinary Connections

- LA.11-12.WHST.11-12.1.D (APOD Project)
- LA.11-12.WHST.11-12.2.A (APOD Project)
- LA.11-12.WHST.11-12.10 (APOD Project)
- LA.11-12.WHST.11-12.4 (APOD Project)
- RST.11-12.2. Determine the central ideas, themes, or conclusions of text; summarize complex concepts, processes, or information presented in the text by paraphrasing them in simpler but still accurate terms. (APOD Project)
- RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. (APOD Project)

Technology Integration

- TECH.8.1.12.C. – Students will use google docs to formulate and submit lab reports to google classroom.
- TECH.8.1.12.D.5 – Demonstrate personal responsibility for life-long learning by researching the internet to apply skills to new content.

Modifications (ELL, Special Education, At-Risk Students, Gifted & Talented, & 504 Plans)

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ELL:

- Work toward longer passages as skills in English increase
- Use visuals
- Introduce key vocabulary before lesson
- Teacher models reading aloud daily
- Provide peer tutoring
- Use of Bilingual Dictionary
- Guided notes and/or scaffold outline for written assignments
- Provide students with English Learner leveled readers.

Supports for Students With IEPs:

- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Allow answers to be given orally or dictated
- Use large print books, Braille, or books on CD (digital text)
- Follow all IEP modifications

At-Risk Students:

- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Allow answers to be given orally or dictated
- Use visuals / Anchor Charts
- Leveled texts according to ability

Gifted and Talented:

- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Provide options, alternatives and choices to differentiate and broaden the curriculum
- Organize and offer flexible small group learning activities
- Provide whole group enrichment explorations
- Teach cognitive and methodological skills
- Use center, stations, or contracts

- Organize integrated problem-solving simulations
- Propose interest-based extension activities
- Expose students to beyond level texts.

Supports for Students With 504 Plans:

- Follow all the 504 plan modifications
- Text to speech/audio recorded selections
- Amplification system as needed
- Leveled texts according to ability
- Fine motor skill stations embedded in rotation as needed
- Modified or constrained spelling word lists
- Provide anchor charts with high frequency words and phonemic patterns