Course Title – Astronomy

Implement start year – 2018-2019

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Unit # 1 , topic – Our Place in Space

Transfer Goal –

Students will be able to independently use their learning to identify their location in space and be able to make simple observations on their own when observing the night sky.

Stage 1 – Desired Results

Established Goals

New Jersey Student Learning Standards (NJSLS)-Science
http://www.state.nj.us/education/cccs/2016/science/
New Jersey Student Learning Standards (NJSLS)-English/Language Arts
http://www.state.nj.us/education/cccs/2016/ela/

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

HS-PS2-1 Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

21st Century Themes
(www.21stcenturyskills.org)

__X_ Global Awareness
__X_Financial, Economic, Business and Entrepreneurial Literacy
_X__Civic Literacy
_X__Health Literacy
_X__Environmental Literacy

21st Century Skills

Learning and Innovation Skills:
_x__Creativity and Innovation
_X__Critical Thinking and Problem Solving
_X__Communication and Collaboration

Information, Media and Technology Skills:
__X_Information Literacy
__X_Media Literacy
__X_ICT (Information, Communications and

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. NJSLSA.R1. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas. NJSLSA.R4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed. NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. NJSLSA.W3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	Technology) Literacy *Life and Career Skills:* ___Flexibility and Adaptability _x__Initiative and Self-Direction _X_Social and Cross-Cultural Skills _X_Productivity and Accountability ___Leadership and Responsibility

NJSLSA.W5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation. NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research. NJSLSA.W10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.	
Enduring Understandings: *Students will understand that….* *EU 1* Earth is just a small part of a larger universe. *EU 2* Information regarding the universe can be determined through qualitative and quantitative observations.	**Essential Questions:** *EU 1* • Where are we? • What caused the advancement of our understanding of our location in the universe? • How has our understanding of the universe evolved over time? • How big is “big”? And how long is a “long time”? *EU 2* • How have the advancements of tools and techniques changed our understanding of the universe? • How have these astronomical discoveries affected society?

Knowledge: *Students will know . . .* *EU 1*	**Skills:** *Students will be able to . . .* *EU 1*
• Earth has a specific location in our solar system, the Milky Way Galaxy, and the Universe. • units such as km, AU, light year, and parsec are used to describe astronomical distances. • mass is related to gravity, which causes objects to accelerate and change velocity. • techniques such as parallax can be used to determine the distance to celestial bodies and their motion. • ancient civilizations attempted to utilize the motions of the sky to predict time and create calendars. • scientific models (geocentric and heliocentric) of the solar system and universe have changed over time as new scientific discoveries occurred. • scientists such as Ptolemy, Copernicus, Galileo, Brahe, Kepler, and Newton contributed to models of the solar system. • electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) • forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. (HS-PS2-4) • Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)	• use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4) • assemble an accurately scaled model of the solar system. • make comparisons of Earth and our Sun to various objects in the universe. • solve various calculations using units such as km, AU, light year, parsec and conversions within the metric system, and properly use scientific notation. • analyze data to discover the relationship between force, mass, and acceleration. • determine the weight of an object based on the acceleration due to gravity of a celestial body using Newton's 2nd Law. • differentiate between Newton's of Laws of Motion and how each one can be applied to different aspects of the universe. • calculate the gravitational force between two masses. • determine an unknown distance using the stellar parallax method. • compare and contrast geocentric and heliocentric models. • apply Kepler's Laws of Planetary motion to discover the relationship between planetary distance and period of revolution.
EU 2 • the relationship between Earth's tilt and orbit cause the seasons. • the location of the Earth, Moon and Sun has an effect on seasons, tides, and eclipses. • celestial coordinates are used to identify the locations of objects in the sky.	*EU 2* • model the position of the Earth, Sun, and Moon during a spring and neap tide, each season, and a solar and lunar eclipse. • predict spring and neap tides, the seasons, and solar/lunar eclipses based on the positions of the Earth, Sun and Moon. • locate an object in the night sky given a set of celestial coordinates. • identify objects in the night sky using a telescope and the naked eye. • predict the rising or setting of constellations based on the time of year. select the most appropriate telescope when given a specific observational task.

• constellations are imagined figures in the sky and are used as reference points to find different celestial objects. • constellations as seen from a specific location rise and set throughout the year as Earth revolves around the sun • various types of telescopes exist and can collect a wide array of data. • ground based telescopes are useful but have limitations compared to space-based telescopes.	

Stage 2 – Assessment Evidence

Other Recommended Evidence:

- Quizzes
- Summarizers
- Essays
- Research
- Presentations
- Formal lab write ups
- Discussions
- Kahoot it
- Diagrams
- Unit Test

Stage 3 – Learning Plan

Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: *Consider the WHERETO elements. Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

- Students will complete Five Words- Three Words on what what comes to mind when you think of Astronomy? (A)
- Discussion: Why study Astronomy? (A/M)
- Discussion: What is Earth's specific location in our solar system, the Milky Way Galaxy, and the Universe? (A/M)
- Students will Draw Pictures or Diagrams of Earth's Location in the Universe (A/M)
- Students will create a KWL chart about distance and size in terms of space. (A/M)
- Discussion: How "big" is big?, How "long" is a long time?, How "far" is far away?(A)
- Students will practice using units such as km, AU, light year, and parsec used to describe astronomical distances. (A)
- Students will apply knowledge of conversions within the metric system to make conversions using units such as km, AU, light year, parsec and properly use scientific notation. (A/M)
- Video: Powers of Ten (A/M)
- Students will make size and distance comparisons of Earth and our Sun to various objects in the universe (A /M)
- Students will assemble an accurately scaled model of the solar system (Scale Model/ Football Field Activity see z-drive) (M)
- Students will complete the following: Starry Night Activities http://www.starrynighteducation.com/products-astronomy-education-high-school.html - (A/M/T)
  B- The Solar System
  B1: Overview of the Solar System
  B2: Size and Scale of the Solar System
- Students will apply parallax to determine the distance to celestial bodies and their motion (parallax activity). (A/M)
- Students will complete the "Virtual Astronomy Lab" computer lab activity: "Angular Size" https://www.physicscurriculum.com/virtualastronomy/ (A/M)
- Video: The Universe http://www.history.com/shows/the-universe (A/M)
- Teacher Led: notes and discussions on ancient civilizations attempts to utilize the motions of the sky to predict time and create calendars. (A)
- Teacher-led notes and discussions on the scientific models (geocentric and heliocentric) of the solar system and how the universe has changed over time as new scientific discoveries occurred. (A)
- Students will compare and contrast through diagram, discussion or other method, the geocentric and heliocentric models of the solar system (M)
- Teacher-led notes and discussions on scientists such as Ptolemy, Copernicus, Galileo, Brahe, Kepler, and Newton and the contributions they made to models that explain the solar system. (A)
- Students will create a timeline/summary of the changes to the models of the universe following each scientist's contributions. (A/M)
- Students will complete the Virtual Astronomy Lab computer activity: "Measuring Planet Size using Eratosthenes' Method" https://www.physicscurriculum.com/virtualastronomy/ (A/M/T)

- Students will discover the relationship between force, mass, and acceleration by analyzing data in a “Newton’s 2nd Law” lab.
- Students will apply Newton’s 2nd Law to determine the weight of an object based on the acceleration due to gravity of a celestial body. (A/M)
- Students will differentiate between Newton’s of Laws of Motion and how each one can be applied to different aspects of the universe, by creating a diagram/drawing/cartoon or other. (M)
- Students will practice calculating the gravitational force between two masses. (A/M)
- Students will apply Kepler’s Laws of Planetary motion to discover the relationship between planetary distance and period of revolution. (A/M)
- Teacher-led notes and class discussions on the relationship between Earth’s tilt and orbit and the seasons. (A)
- Teacher-led notes and class discussions on the location of the Earth, Moon and Sun as it affects the seasons, tides, and eclipses. (A)
- Students will model the position of the Earth, Sun, and Moon during a spring and neap tide, each season, and a solar and lunar eclipse. (A/M)
- Students will create a diary/record of the moon over a period of 29 days. (A/M)
- Students will complete the following: Starry Night Activities http://www.starrynighteducation.com/products-astronomy-education-high-school.html(A/M/T)
  A- Earth, Moon and Sun
  A1: Day and Night Cycle
  A2: The Year and Seasons
  A3: The Moon
  A4: Phases of the Moon
  A5: Eclipses
- Students will Predict spring and neap tides, the seasons, and solar/lunar eclipses based on the positions of the Earth, Sun and Moon. (M/T)
- Reading Assignments Non-Fiction and Fiction including scientific journal articles and books examples: Life As We Knew It and the Dead and the Gone by Susan Beth Pfeffer https://www.bccls.org/BookClubBooks/LifeAsWeKnewIt.pdf (M/T)
- Teacher-led notes and discussions about how celestial coordinates are used to identify the locations of objects in the sky. (A)
- Students will locate an object in the night sky given a set of celestial coordinates (celestial sphere globe activity). (A/M)
- Students will Identify objects in the night sky using a telescope or the naked eye. (A/M/T)
- Teacher-led notes and discussions about how constellations are imagined figures in the sky and are used as reference points to find different celestial objects. (A)
- Teacher-led notes and discussions about how constellations, as seen from a specific location, rise and set throughout the year as Earth revolves around the sun. (A)
- Constellation Project power point slides including history, where and when constellations can be seen, images of the constellation, main stars.(A/M)
- Students will create their own constellation by looking at the night sky and create a story/tale to explain the image. (M/T)
- Students will debate: Astrology Fact or Fiction? (A/M/T)
- Students will complete the following: Starry Night Activities http://www.starrynighteducation.com/products-astronomy-education-high-school.html (A/M/T)
  E- Star Finding and Constellations
  E1: Finding Your Way Around the Night Sky
  E2: Constellations and Star Lore
  E3: Seasonal Constellations
  E4: The Zodiac and Astronomy’s Astrological Roots

- Teacher-led notes and discussions about how various types of telescopes exist and can collect a wide array of data. (A)
- Students will practice matching “famous” telescopes and the type(s) of data that they can collect. (Kahoot it) (A)
- Teacher-led presentation of images obtained from various telescopes to compare and contrast the various telescopes and the image enhancement techniques that apply. (A)
- Students will compare and contrast ground based telescopes to space-based telescopes. (A/M)
- Students will practice selecting the most appropriate telescope when given a specific observational task. (M/T)
- Videos: The Universe http://www.history.com/shows/the-universe
  Crash Course Astronomy https://www.youtube.com/playlist?list=PL8dPuuaLjXtPAJr1ysd5yGIyiSFuh0mIL
  Through the Wormhole Series https://www.sciencechannel.com/tv-shows/through-the-wormhole/
  How the Universe Works https://www.sciencechannel.com/tv-shows/how-the-universe-works/
  The Cosmos Series http://channel.nationalgeographic.com/cosmos-a-spacetime-odyssey/ (A/M)