Course Title – Astronomy

Implement start year – 2018-2019

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Unit # 3 , topic – The Stars

Transfer Goal –

Students will be able to independently use their learning to analyze the implications of the Sun's energy by applying stellar knowledge.

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-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.
HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

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 Technology) Literacy

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. 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.	*Life and Career Skills:* _x__Flexibility and Adaptability _x__Initiative and Self-Direction _x__Social and Cross-Cultural Skills _x__Productivity and Accountability _x__Leadership and Responsibility

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. 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* stars generate energy and transform matter. *EU 2*	**Essential Questions:** *EU 1* • How do stars generate energy? • How do stars change matter? • How do we utilize energy from the sun?

stars have cycles of life and death that have direct implications to the regions around them.	*EU 2* • How do astronomers classify stars? • Why are some stars brighter than others?
Knowledge: *Students will know . . .* *EU 1* • electromagnetic radiation is made up of electric and magnetic fields, has wave-like and particle-like properties, and travels at the speed of light. • The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1- 2),(HS-ESS1-3) • The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) • other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3) • the Sun has several different layers, including the corona, transition zone, chromosphere, photosphere, convection zone, radiation zone, and core. • solar flares, prominences, sunspots, and coronal mass ejections (CMEs) are a few examples of solar activity that is caused by the Sun's large magnetic field. *EU 2* • atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2) • the Sun is a relatively average star on the main sequence that is middle-aged and halfway through its life cycle.	**Skills:** *Students will be able to . . .* *EU 1* • Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6) ○ compare and contrast the properties of various wavelengths of the electromagnetic (EM) spectrum. ○ identify a particular element through analysis of an emission or absorption spectra. ○ determine if an object is moving towards/away from an observer by analyzing its Doppler shift in the EM spectrum. ○ illustrate the layers of a star to include the process of nuclear fusion and the transfer of energy through conduction, convection and radiation. ○ explain the effects of iron formation in a star's core. ○ compare and contrast how much of the Sun's energy is distributed to each of the planets. ○ describe how a star's magnetic field create sunspots, prominences, flares, & coronal mass ejections. ○ explain why the number of sunspots on the Sun at any given time varies over an 11 year cycle. • describe how the sun's solar wind impacts human life and the solar system. EU 2 • distinguish between apparent magnitude, absolute magnitude, and luminosity. • determine a star's color given its surface temperature.

• stars have an apparent brightness, which is different from intrinsic brightness. • absolute visual magnitude of a star can be found by using the magnitude-distance formula. • luminosity of a star is the total energy that a star radiates in one second and can be used to determine the size of a star. • stars can be classified by spectral types, or classes, based on temperature. • a Hertzsprung-Russell (H-R) diagram is a graph that plots stars based on luminosity and temperature. • our Sun is currently a main-sequence star • stars belong to a luminosity class, which is based on size. • spectroscopic parallax is different from stellar parallax, as it is a technique used to estimate the distance to a star by utilizing the H-R diagram. • binary stars, two stars that orbit their common center of mass, are abundant in the universe and allow astronomers to directly calculate the mass of stars within the system. • light curves show variation of brightness over time. • main sequence stars follow a mass-luminosity relationship; the more massive a star, the more luminous it is. • the interstellar medium (ISM) is gas and dust between stars. • stars evolve as energy and matter get transformed, and their positions on the H-R diagram change. • when a star comes to the end of its life cycle, it will become either a white dwarf, neutron star, or black hole. • there are two types of supernovae, which are rare and caused by the violent, explosive death of stars. • neutron stars are dense stars made of tightly packed neutrons created when giant stars die and their cores collapse. • a black hole is created by the death of a massive star; they exhibit strange behavior and emit no light.	• assign a star to a spectral class by analyzing a star's temperature/color and its radius. • derive the characteristics of a star, including our Sun, by analyzing its location on an H-R diagram. • determine a star's distance through analyzing a star's magnitude and its spectral class. • predict the end of a star's life cycle by analyzing its mass.

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: *A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

- Students will be given a Wordsplash of terms about electromagnetic (EM) radiation and asked to group words based on what they "think they mean" and "how do they apply to one another". (A/M)
- Teacher-led discussion and notes on electromagnetic radiation which is made up of electric and magnetic fields, has wave-like and particle-like properties, and travels at the speed of light. Then refer back to the wordsplash to help clarify and make connections that may have been missed.(A/M)
- Teacher-led notes and discussion on properties and applications of electromagnetic radiation and spectral analysis. (A)
- Students will construct a diagram of the EM Spectrum. (A)
- Students will compare and contrast the properties of various wavelengths of the electromagnetic (EM) spectrum. (A/M)
- Students will identify a particular element through analysis of an emission or absorption spectra. (A/M)
- Students will determine if an object is moving towards/away from an observer by analyzing its Doppler shift in the EM spectrum. (A/M/T)
- Teacher-led notes and discussion on our Sun.(A)
- Teacher-led discussion of nuclear fusion. (A)
- Students will illustrate the layers of a star to include the process of nuclear fusion and the transfer of energy through conduction, convection and radiation. (A/M)
- Students will explain the effects of iron formation in a star's core. (A/M)
- Students will compare and contrast how much of the Sun's energy is distributed to each of the planets. (A/M)
- Students will complete the following:Starry Night Activities http://www.starrynighteducation.com/products-astronomy-education-high-school.html (A/M/T)
  F- The Sun as a Star
  F1: The Sun as a Source of Energy
  F2: Solar Weather
  F3: The Formation of the Sun and Solar System
- Teacher-led discussion of a star's magnetic field, sunspots, prominences, flares, & coronal mass ejections. (A)
- Students will explain how a star's magnetic field create sunspots, prominences, flares, & coronal mass ejections. (A/M)
  - Students will describe how the sun's solar wind impacts human life and the solar system. (A/M/T)
- Teacher-led discussion and notes about star properties such as apparent magnitude, absolute magnitude, luminosity, color, surface temperature, spectral class, and radius. (A)
- Students will derive the characteristics of a star, including our Sun, by analyzing its location on an H-R diagram. (M/T)
- Students will determine a star's distance through analyzing a star's magnitude and its spectral class. (M/T)
- Students will complete a KWL Chart on Black Holes (A/M)
- Black Hole Activities (A/M)
  https://www.cfa.harvard.edu/seuforum/einstein/resources/JourneyBlackHole/JourneyBlackHoleManual.pdf
- Students will predict the end of a star's life cycle by analyzing its mass. (M/T)

- Students will complete the following:Starry Night Activities http://www.starrynighteducation.com/products-astronomy-education-high-school.html (A/M/T)
  G- The Stars
  G1: The Solar Neighborhood
  G2: The Stars
  G3: Black Holes
- Video: Interstellar
- 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)