Course: Astronomy **Unit #1:** Our Place in Space	**Year of Implementation:** 2025-2026

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Stage One - Desired Results

Link(s) to New Jersey Student Learning Standards for this course:
{provide all applicable links to standards here}
https://www.nj.gov/education/standards/

- **Unit Standards:**
  - ***Content Standards***
    - **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 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.
    - **HS-PS4-3**. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
    - **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.
  - ***Science and Engineering Practices***

The content of this unit will strengthen student skills in the following SEPs.

- Practice 1 Ask Questions
- Practice 2 Developing and Using Models
- Practice 3 Planning and Carrying Out Investigations
- Practice 4 Analyzing and Interpreting Data
- Practice 5 Using Mathematics and Computational Thinking
- Practice 6 Constructing Explanations and Designing Solutions
- Practice 7 Engaging in Argument from Evidence
- Practice 8 Obtain, Evaluate and Communicate Information

- ***21st Century Life & Career Standards***
  - 9.4.12.CI.1 - Demonstrate the ability to reflect, analyze and use creative skills and ideas
  - 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
  - 9.4.12.IML.3 - Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
  - 9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
  - 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
  - 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
  - All curriculum writers/revisionists need to include standards that apply to “Career Readiness, Life Literacies, and Key Skills”. This should include a brief description of the standard and the standard number. Document only those standards and practices that apply to each unit. Use the following link to assist you [see pages of 31-36; 41-42; 53-56 for specific standard #’s and strands] https://www.state.nj.us/education/cccs/2020/2020%20NJSLS-CLKS.pdf
- ***English Companion Standards***
  - 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.
- 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.

        - List grade-level appropriate companion standards for History, Social Studies, Science and Technical Subjects (CTE/Arts) 9-12. English Companion Standards are required only in these subject/content areas. This section can be deleted for all other content areas.
        - Grade 9-10 Companion Standards: https://www.nj.gov/education/standards/ela/Docs/2016NJSLS-ELA_Companion9-10.pdf
        - Grade 11-12 Companion Standards: https://www.nj.gov/education/standards/ela/Docs/2016NJSLS-ELA_Companion11-12.pdf
    - ***Interdisciplinary Content Standards***
        - MP.2 - Reason abstractly and quantitatively.
        - MP.4 - Model with mathematics.
        - HSN-Q.A.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
        - HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling.
        - HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
        - HSA-SSE.A.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
        - 6.2.12.HistoryCC.2.b: Explore the factors that laid the foundation for the Renaissance (i.e., Asian and Islamic, Ancient Greek and Roman innovations).
        - List any standards from other content areas that apply to this unit.
    - ***NJ Statutes:*** NJ State law mandates the inclusion of the following topics in lesson design and instruction as aligned to elementary and secondary curriculum.

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

      Holocaust Law: N.J.S.A. 18A:35-28 Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction

shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

LGBT and Disabilities Law: N.J.S.A. 18A:35-4.35 A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards (N.J.S.A.18A:35-4.36) A board of education shall have policies and procedures in place pertaining to the selection of instructional materials to implement the requirements of N.J.S.A. 18A:35-4.35.

Diversity and Inclusion (N.J.S.A. 18A:35-4.36a) A board of education shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards.

Asian American and Pacific Islanders (AAPI) P.L.2021, c.410 Ensures that the contributions, history, and heritage of Asian Americans and Pacific Islanders (AAPI) are included in the New Jersey Student Learning Standards (NJSLS) for Social Studies in kindergarten through Grade 12 (P.L.2021, c.416)

For additional information, see

NJ Amistad Curriculum: ***https://www.nj.gov/education/amistad/about/***

Diversity and Inclusion: ***https://www.nj.gov/education/standards/dei/index.shtml***

- *(Sample Activities/ Lessons):* ***https://www.nj.gov/education/standards/dei/samples/index.shtml***

Asian American and Pacific Islanders:

- ***Asian American and Pacific Islander Heritage and History in the U.S.***
  A Teacher's Guide from EDSITEment offering a collection of lessons and resources for K-12 social studies, literature and arts classrooms that center around the experiences, achievements and perspectives of Asian Americans and Pacific Islanders across U.S. history.

Transfer Goal: Students will be able to independently use their learning to explain that we are a tiny part of the larger universe by using past and present data as evidence.

As aligned with LRHSD Long Term Learning Goal(s): https://www.lrhsd.org/academics/program-of-studies/curriculum

The Lenape Regional High School District Science program, in alignment with the New Jersey Core Curriculum Content Science Standards, prepares our students to become scientifically literate and informed citizens able to function in an increasingly complex society. Through completing our coursework with its emphasis on authentic experiences that enable students to investigate and explain scientific phenomena, our students will be better able to

1. design, critique, and carry out experiments in order to investigate scientific questions and/or propose solutions
2. collect, interpret, and analyze data in order to solve a defined problem
3. apply mathematics to express relationships efficiently and accurately
4. draw evidence-based conclusions from data in order to make informed decisions;
5. construct, interpret, and refine models (scientific and mathematical) to explain the physical and natural world
6. effectively communicate scientific ideas and evidence-based arguments to an appropriate audience through written and oral means
7. evaluate the validity of arguments that rely on scientific reasoning presented in the popular press and informational sources

Enduring Understandings	*Essential Questions*
Students will understand that. . . EU 1 Earth is part of a vast universe. EU 2 phenomena in the universe can be explained through qualitative and quantitative observations.	• *Where are we in the universe?* • *How has our understanding of space and the universe changed over time?*

Knowledge *Students will know . . .*	*Skills* *Students will be able to. . .*
EU 1 ● Earth has a specific location in our solar system, the Milky Way Galaxy, and the Universe. **(HS-ESS1-4) (ESS1.A)** ● units such as km, AU, light year, and parsec are used to describe astronomical distances. **(HS-ESS1-4) (ESS1.A)** ● mass is related to gravity, which causes objects to accelerate and change velocity. **(HS-PS2-4) (PS2.B)** ● techniques such as parallax can be used to determine the distance to celestial bodies and their motion. **(HS-ESS1-2) (ESS1.B)** ● ancient civilizations attempted to utilize the motions of the sky to predict time and create calendars. **(HS-ESS1-4) (ESS1.A)** ● scientific models (geocentric and heliocentric) of the solar system and universe have changed over time as new scientific discoveries occurred. **(HS-ESS1-2) (ESS1.A)** ● scientists such as Ptolemy, Copernicus, Galileo, Brahe, Kepler, and Newton contributed to models of the solar system. **(HS-ESS1-2) (HS-PS2-1) (ESS1.A)** ● electromagnetic radiation (e.g., radio, microwaves, visible 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) (PS4.B)** ● forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. **(HS-PS2-4) (PS2.B)**	*EU 1* ● use mathematical or computational representations of phenomena to describe explanations. **(HS-ESS1-4) (SEP5)(9.4.12.IML.3)(9.4.12.TL.1)** ● develop an accurately scaled model of the solar system. **(SEP2) (9.4.12.IML.4)** ● make comparisons of Earth and our Sun to various objects in the universe.**(HS-ESS1-4) (SEP2) (9.4.12.IML.4)** ● solve various calculations using units such as km, AU, light year, parsec and conversions within the metric system, and properly use scientific notation. **(HS-PS2-4) (SEP5)** ● analyze data to discover the relationship between force, mass, and acceleration. **(HS-PS2-1)(SEP5)** ● determine the weight of an object based on the acceleration due to gravity of a celestial body using Newton's 2nd Law. **(HS-PS2-1) (SEP5)** ● construct an explanation between Newton's Laws of Motion and how each one can be applied to different aspects of the universe. **(HS-PS2-1) (SEP6)** ● calculate the gravitational force between two masses. **(HS-PS2-4) (SEP5)** ● determine an unknown distance using the stellar parallax method. **(HS-PS2-4) (SEP5)** ● compare and contrast geocentric and heliocentric models. **(HS-ESS1-2) (SEP6)** ● apply Kepler's Laws of Planetary motion to discover the relationship between planetary distance and period of revolution. **(HS-PS2-4) (SEP2) (SEP5)**

• 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) (ESS1.B)** *EU2* • the relationship between Earth's tilt and orbit cause the seasons. **(HS-ESS1-1) (ESS1.B)** • the location of the Earth, Moon and Sun has an effect on seasons, tides, and eclipses. **(HS-ESS1-1) (ESS1.A)** • celestial coordinates are used to identify the locations of objects in the sky. **(HS-ESS1-2) (ESS1.B)** • constellations are imagined figures in the sky and are used as reference points to find different celestial objects. **(HS-ESS1-2) (ESS1.B)** • constellations, as seen from a specific location, rise and set throughout the year as Earth revolves around the sun. **(HS-ESS1-2) (ESS1.B)** • Various types of telescopes, including optical (e.g., reflecting and refracting telescopes), radio (e.g., the Very Large Array), infrared (e.g., the James Webb Space Telescope), ultraviolet, X-ray (e.g., the Chandra X-ray Observatory), and gamma-ray (e.g., the Fermi Gamma-ray Space Telescope), exist and are used to collect diverse types of data about the universe. **(HS-ESS1-3) (ESS1.B)** • ground based telescopes are useful but have limitations compared to space-based telescopes. **(HS-ESS1-3) (ESS1.B)**	*EU2* • model the position of the Earth, Sun, and Moon during a spring and neap tide, each season, and a solar and lunar eclipse. **(HS-ESS1-4) (SEP2)** • predict spring and neap tides, the seasons, and solar/lunar eclipses based on the positions of the Earth, Sun and Moon. **(HS-ESS1-1) (SEP4)** • locate an object in the night sky given a set of celestial coordinates. **(HS-ESS1-2) (SEP8)** • identify objects in the night sky using a telescope and the naked eye. **(HS-ESS1-3) (SEP8)** • predict the rising or setting of constellations based on the time of year. **(HS-ESS1-4) (SEP4)**

Stage Two - Assessment

Performance Task:

Other Evidence:

- Quizzes
- Summarizers
- Essays
- Research
- Presentations
- Formal lab write ups
- Discussions
- Diagrams
- Models
- Debate
- CER
- Unit Test

Stage Three - Instruction

Learning Plan: **Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: 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.** *{place A, M and/or T along with the applicable EU number in parentheses after each statement} All knowledge and skills must be addressed in this section with a corresponding lesson/activity which teaches each concept. The following color codes are used to notate activities that correspond with interdisciplinary connections and 21st Century Life & Career Connections (which involves Technology Literacy): Red = Interdisciplinary Connection; Purple = 21st Century Life & Career Connection*

PHENOMENON: The universe doesn't end at the edge of the solar system.**(M/T) (EU2)**

Goal: Students will be able to describe Earth's location in the universe and the relative distances between celestial objects.

1. Discussion: What is Earth's specific location in our solar system, the Milky Way Galaxy, and the Universe? **(A/M) (EU1)**
2. Students will Draw Pictures or Diagrams of Earth's Location in the Universe **(A/M) (EU1)**
3. Students will create a KWL chart about distance and size in terms of space. **(A/M) (EU1)**
4. Discussion: How "big" is big?, How "long" is a long time?, How "far" is far away? **(A) (EU1)**
5. Students will practice using units such as km, AU, light year, and parsec used to describe astronomical distances.**(A) (EU1)**
6. 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) (EU1)**
7. Video: Powers of Ten **(A/M) (EU1)**
8. Students will make size and distance comparisons of Earth and our Sun to various objects in the universe **(A/M) (EU1)**
9. Students will assemble an accurately scaled model of the solar system (Scale Model/ Football Field Activity see z-drive) **(M) (EU1)**
10. Students will complete the following: Starry Night Activities
    http://www.starrynighteducation.com/products-astronomy-education-high-school.html - **(A/M/T) (EU1)**
    B- The Solar System
    B1: Overview of the Solar System
    B2: Size and Scale of the Solar System
11. Students will apply parallax to determine the distance to celestial bodies and their motion (parallax activity). **(A/M) (EU1)**
12. Video: The Universe S2 E4: The Milky Way http://www.history.com/shows/the-universe **(A/M) (EU1)**
13. 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) (EU1)**
14. Students will create a timeline/summary of the changes to the models of the universe following each scientist's contributions. **(A/M) (EU1)**
15. Students will discover the relationship between force, mass, and acceleration by analyzing data in a "Newton's 2nd Law" lab.**(A/M) (EU1)**
16. 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) (EU1)**

17. Students will differentiate between Newton's 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) (EU1)**
18. Students will practice calculating the gravitational force between two masses. **(A/M) (EU1)**
19. Students will apply Kepler's Laws of Planetary motion to discover the relationship between planetary distance and period of revolution. **(A/M) (EU1)**

PHENOMENON: Why does New Jersey have four seasons? **(M/T) (EU2)**

Goal: Students will be able to describe that Earth's motion through space has consequences on what is observed and is responsible for Earth's seasonal changes.

1. Teacher Led: notes and discussions on ancient civilizations attempts to utilize the motions of the sky to predict time and create calendars. **(A) (EU2)**
2. 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) (EU2)**
3. Students will compare and contrast through diagram, discussion or other method, the geocentric and heliocentric models of the solar system **(M) (EU2)**
4. Teacher-led notes and class discussions on the relationship between Earth's tilt and orbit and the seasons. **(A) (EU2)**
5. Teacher-led notes and class discussions on the location of the Earth, Moon and Sun as it affects the seasons, tides, and eclipses. **(A) (EU2)**
6. 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) (EU2)**
7. Students will create a diary/record of the moon over a period of 29 days. **(A/M) (EU2)**
8. Students will research each month the Full Moon (image, names, notable rituals, celebrations, or traditions linked specifically to the December full moon across different cultures or civilizations) **(M/T) (EU2)**
9. Moon Stories: Students will create their own Moon Story. **(M/T) (EU2)**
10. Students will complete the following: Starry Night Activities
    http://www.starrynighteducation.com/products-astronomy-education-high-school.html**(A/M/T) (EU2)**
    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

11. 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) (EU2)**
12. Students will construct a Sundial model and demonstrate how it works **(A/M) (EU2)**
13. Students will compare and contrast Alaska's seasonal patterns with those of New Jersey. **(A/M/T) (EU2)**
14. Students will be able to create an explanation of Manhattanhenge. **(M/T) (EU2)**
15. Students will compare and contrast astrology and astronomy to understand their distinct methodologies and perspectives within the study of celestial phenomena. **(A/M/T) (EU2)**
16. Students will research factors that determine the visibility of the Moon during daylight hours, and how its appearance varies with different phases. **(M/T) (EU2)**
17. Students will explore ancient navigation techniques using stars and develop practical skills for celestial orientation without modern technology. **(A/M/T) (EU2)**
18. Students will construct a starwheel and answer questions to demonstrate their understanding. **(M/T) (EU2)**

Pacing Guide

{This chart will be identical in all of the units for this course.}

Unit #	***Title of Unit***	***Approximate # of teaching days***
1	Our Place in Space	40
2	The Solar System	30
3	The Stars	40
4	The Universe	25

Instructional Materials

Interactive Models and Simulations

- ☐ Starry Night Education Software (Solar System and Earth-Moon-Sun modules)
- ☐ Online parallax simulators for celestial distance measurement
- ☐ Digital or physical solar system scale model kits

Visual Aids and Videos

Videos:

- ☐ Powers of Ten video (size and scale of the universe)
- ☐ The Universe (History Channel): Season 2, Episode 4 – The Milky Way

Diagrams and Infographics:

- ☐ Comparative sizes and distances of celestial objects
- ☐ Models of geocentric and heliocentric systems

Astronomy Tools and Materials

- ☐ Star wheels (for celestial navigation and seasonal changes)
- ☐ Materials for constructing sundials and other time-keeping tools
- ☐ Moon phase trackers for observational diaries

Hands-on Activity Supplies

- ☐ Football field layout or equivalent space for solar system scale activity
- ☐ Supplies for creating moon stories (craft or presentation materials)
- ☐ Newton's Second Law lab materials (masses, spring scales, etc.)

Scientific Equipment and Technology

- ☐ Access to telescopes (optical and/or online telescope resources like NASA's Eyes on the Universe)
- ☐ Tools for calculating gravitational force and other celestial measurements

Astronomical Data Sources

- ☐ Current full moon data and cultural significance resources (NASA and other astronomy sites)
- ☐ Data sets for comparing seasonal patterns (e.g., Alaska vs. New Jersey)

Historical and Cultural Resources

- ☐ Primary sources or biographies on Ptolemy, Copernicus, Galileo, Brahe, Kepler, and Newton
- ☐ Examples of ancient navigation techniques using stars

Interactive Student Worksheets and Guides

- ☐ KWL charts for astronomical distances and size comparisons

- ☐ Worksheets for Kepler’s Laws, Newton’s Laws, and metric system conversions

Assessment and Practice Materials

- ☐ Scientific notation and unit conversion practice problems
- ☐ Diagram templates for geocentric vs. heliocentric models
- ☐ Prediction and modeling activities for tides, seasons, and eclipses

Online Resources and Research Tools

- ☐ Websites for moon observation and research (e.g., NASA, Starry Night, or Stellarium)
- ☐ Tools for exploring Manhattanhenge and cultural connections to celestial events

Accommodations

Special Education: The curriculum will be modified as per the Individualized Education Plan (IEP). Students will be accommodated based on specific accommodations listed in the IEP.

Students with 504 Plans: Students will be accommodated based on specific accommodations listed in the 504 Plan.

English Language Learners: Students will be accommodated based on individual need and in consultation with the ELL teacher.

Students at Risk of School Failure: Students will be accommodated based on individual need and provided various structural supports through their school.

Gifted and Talented Students: Students will be challenged to enhance their knowledge and skills through acceleration and additional independent research on the subject matter.