



MIDLAND PARK PUBLIC SCHOOLS
Midland Park, New Jersey
CURRICULUM

Astronomy

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Superintendent of Schools:
Marie C. Cirasella, Ed.D.

MPHS Exploring Astronomy Curriculum Overview

This course will introduce students to the exploration, composition, behavior and structure of the universe. This elective course will provide the student with a study of the universe and the conditions, properties, and motions of bodies in space. The topics of study include, but not limited to, historical studies of space, astronomical instruments and tools, the physical features of solar system, the earth as a system in space, other space bodies, stars and the future of space exploration. Aspects of the physical sciences, engineering, technology & applications of science are taught throughout this half year course. A guided inquiry program gives students the opportunity to explore topics and concepts through investigations. Participating in this hands-on program helps students:

1. To foster a life-long enjoyment of learning science.
2. To observe science in the world around them.
3. To meet the science standards for New Jersey Public Schools.

Suggested Course Sequence*:

Unit One: Historical Perspective of Space Exploration and Astronomy

Unit Two: Tour of the Solar System

Unit Three: Technology, Light and Telescopes

Unit Four: The Earth as a Planet and its One Moon

Unit Five: Energy in the Stars and Galaxies

Unit Six: The Future of Exploration and Knowledge of Space

Pre-Requisites:

**The number of instructional days is an estimate based on the information available at this time. 1 day equals approximately 48 minutes of seat time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.*

Content Area: Astronomy	
Unit Title: Historical Perspective of Space Exploration and Astronomy (1)	
Grade Level: 11/12	
<p>Unit Summary: Students will analyze the dynamic nature of astronomy by comparing and contrasting evidence supporting current views of the universe with historical views, while studying the contributions of various people and programs to space exploration.</p> <p>Interdisciplinary Connections: Math, Art, History, Chemistry, English</p> <p>21st Century Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.</p>	
Standards (Content and Technology):	
CPI#:	Statement:
Next Generation Science 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 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.
2014 New Jersey Core Curriculum Content Standards - Technology	
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.1.12.E.2	Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers.
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
<p>Unit Essential Question(s):</p> <ul style="list-style-type: none"> • How has our knowledge of space expanded and changed through history? • What is the relevance of certain experimental work and explorations? • How is Astronomy an ever changing science? 	<p>Unit Enduring Understandings:</p> <ul style="list-style-type: none"> • Satellites, probes, rovers, and manned space shuttles are used to collect data about objects within our solar system. • Technological advances that were developed by the space program have influenced our lives. • Astronomy is a very dynamic science because new discoveries are made everyday

Unit Learning Targets/Objectives:

Students will...

- Evaluate the impact that technology advances have had on our modern view of the solar system and universe.
- Explain the relevance of experimental contributions of scientists to the advancement of the field of astronomy.

Formative Assessments:

Teacher feedback, class discussion

Summative/Benchmark Assessment(s):

Journals, Quizzes, Tests, Labs, Projects

Resources/Materials:

Crash Course "Astronomy"

[National Science Foundation](#)

[Astronomy.org](#)

<https://www.nasa.gov>

Modifications:

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| <ul style="list-style-type: none"> ● Special Education Students <ul style="list-style-type: none"> ○ modified readings ○ student choice on topics ● English Language Learners <ul style="list-style-type: none"> ○ modified readings ○ student choice on topics | <ul style="list-style-type: none"> ● At-Risk Students <ul style="list-style-type: none"> ○ modified readings ○ student choice on topics ● Gifted and Talented Students <ul style="list-style-type: none"> ○ advanced readings ○ mathematical analysis problems |
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Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Intro Activity	Recognize the various events in the space exploration in history	2 class periods
Video Clip	View and discuss the launch of rockets and satellites	2 class periods
Notes Presentation	Name and describe several key events in the early days of space explorations	1-2 class periods
Edpuzzle Quiz	Identify people, places and things	1 class period
Research work	Make a claim about the most important event, person, machine... in space exploration history	4 class periods
Lab/Hands on Investigation	Create a model of the researched topic	2 class periods
Assessment	Demonstrate understanding and appreciation of the history of space exploration	1 class period

Teacher Notes:

Activities will be adjusted as current events and news arise.

Content Area: Astronomy

Unit Title: Tour of the Solar System (2)

Grade Level: 11/12

Unit Summary: Students will describe the scientific view of the origin of the universe, the evolution of matter and the development of resulting celestial objects.

Interdisciplinary

Connections: Math, Art, History, Chemistry, English

21st Century

Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

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8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.

<p>Unit Essential Question(s):</p> <ul style="list-style-type: none"> • What evidence is there that supports our understanding of the solar systems and the universe? • What are the major properties and components of the celestial objects? • How are planets, stars and other space objects that same and different? 	<p>Unit Enduring Understandings:</p> <ul style="list-style-type: none"> • Our solar system consists of the Sun and everything that orbits the Sun. (includes 8 planets, moons (satellites), dwarf planets, asteroids, meteoroids, comets, Asteroid belt, Kuiper belt, and the Oort cloud). • The planets orbit the sun and rotate in the same direction. • Planets are classified by density as either inner planets or outer planets. • Properties of planets can be determined by observations and calculations based on Kepler's and Newton's Laws. The objects of the solar system formed at the same time, 4.6 billion years ago, from a rotating cloud of gas and dust.
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Unit Learning Targets/Objectives:

Students will...

- Outline the main arguments and evidence in support of the standard cosmological model. (e.g. elements, solar systems, planets, moons)
- Compare and contrast the major components of the our solar system.
- Mathematically apply Newtonian gravity to celestial bodies to determine their masses and explain their motion (e.g. Kepler’s Laws)
- Classify objects in space based on their physical characteristics and behaviors

Formative Assessments:

Teacher feedback, class discussion

Summative/Benchmark Assessment(s):

Journals, Quizzes, Tests, Labs, Projects

Resources/Materials:

Crash Course “Astronomy”

[National Science Foundation](#)

[Astronomy.org](#)

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Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Intro Activity	Model the relative distances from the sun of each planet in our solar system	2 class period
Crash Course Video #9, (13-20, as needed)	Describe the features of the various objects in the Solar System	2-3 class periods
Notes Presentation	Identify similarities and differences	2-3 class periods
Label and design	Create Model of Solar System	4-5 class periods
Edpuzzle Quiz	Demonstrate ability to match description to object	1 class period
Virtual Activity	Explore Solar system	2 class periods
Lab/Hands on Investigation	Gather information that supports our understanding of the solar system	2-3 class periods (includes write up time)
Assessment	Summarize the objects of our solar system	1-2 class periods (with review)

Teacher Notes:

<https://www.solarsystemscope.com/>

Content Area: Astronomy**Unit Title:** Technology, Light and Telescopes (3)**Grade Level:** 11/12

Unit Summary: Students will explain the tools used by astronomers to study electromagnetic radiation to determine the composition, motions, and other physical attributes of astronomical objects.

Interdisciplinary**Connections:** Math, Art, History, Chemistry, English**21st Century**

Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

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8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.

- **Unit Essential Question(s):**

- How are the properties of light both a challenge and a tool in our study of the universe?
- What are the different types of telescopes and their uses?
- How does spectroscopy provide information about the inherent properties and motion of objects in space?
- How did the invention of the telescope influence science?

- **Unit Enduring Understandings:**

- The use of scientific instruments, specifically the optical telescope, led to great advancements in the understanding of our universe.
- Telescopes work by collecting radiation, which can be converted into a picture.
- Satellites, probes, rovers, and manned space shuttles are used to collect data about objects within our solar system.
- Technological advances that were developed by the space program have influenced our lives.
- Astronomy is a very dynamic science because new discoveries are made everyday

- How do telescopes work?

Unit Learning Targets/Objectives:

Students will...

- Explain the challenges faced by astronomers due to the properties of light and the vast distances in the cosmos.
- 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, visible, gamma ray, reflector, and refractor).
- 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).

Formative Assessments:

Teacher feedback, class discussion

Summative/Benchmark Assessment(s):

Journals, Quizzes, Tests, Labs, Projects

Resources/Materials:

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[National Science Foundation](#)

[Astronomy.org](#)

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Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Intro Activity	Create a timeline of how telescopes have developed over time.	1 class period
Crash Course Video #24 & 25	Describe the uses of telescopes and energy in the study of space	2 class periods
Notes Presentation	Compare and contrast optical reflecting and refracting telescopes. List the advantages and drawback of optical telescopes.	2-3 class periods
Quiz	Identify telescopes	1 class period
Images activity	Appreciate how energy is used to create images of objects in space	4-5 class periods

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Lab/Hands on Investigation	Build a telescope and compare a simple classroom telescope to the more modern and complex tools used today	2-3 class periods (includes write up time)
Assessment	Explain how scientific instruments can enhance observations and lead to new discoveries	1-2 class periods (with review)
Teacher Notes: "Visualization - From Energy to Image" NASA		

Content Area: Astronomy	
Unit Title: The Earth as a Planet and its One Moon (4)	
Grade Level: 11/12	
Unit Summary: Students will describe and explain our sun -moon - earth system and the astronomical observations made from the point of reference of the Earth.	
Interdisciplinary Connections: Math, Art, History, Chemistry, English	
21st Century Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.	
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8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
Unit Essential Question(s): <ul style="list-style-type: none"> • How do the sun, the earth and the moon interact? • How do the positions of the three allow us to predict and observe various phenomena? • How are various laws of science observable in this system? 	Unit Enduring Understandings: <ul style="list-style-type: none"> • Objects appear to move through the sky due to the rotation of the earth. • The axis on which the Earth rotates is tilted relative to its orbital plane. • The tilt combined with Earth's revolution around the Sun causes changes in the amount of heating throughout the year. • Constellations are patterns of the stars created by ancient civilizations. They have been used for navigating and creating calendars.

- The Earth's orbit is slightly elliptical. Earth is closer to the Sun during the Northern Hemisphere's winter.
- As the Moon revolves we see different amounts of its lighted half; these are called phases. The Moon's rotational and orbital period are both 27.3 days allowing us to only see one side of the moon from Earth.
- Zodiac constellations are a group of star patterns centered on the plane of the Earth's orbit.
- The Moon and Sun cause the tides. Tides have a daily and monthly set of changes.
- A solar eclipse happens when the Earth moves into the Moon's shadow. A lunar eclipse happens when the Moon moves into Earth's shadow.

Unit Learning Targets/Objectives:

Students will...

- Evaluate the effects of the relative positions of the Earth, moon, and sun on observable phenomena, e.g. phases of the moon, eclipses, seasons, and diurnal cycles.
- Describe how latitude and time of the year affect visibility of constellations.
- Predict visibility of planets (major and minor) in the solar system based on relative orbital motion.

Formative Assessments:

Teacher feedback, class discussion

Summative/Benchmark Assessment(s):

Journals, Quizzes, Tests, Labs, Projects

Resources/Materials:

Crash Course "Astronomy"

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[Astronomy.org](#)

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Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Intro Activity	Distinguish facts from common misconceptions	1 class period
Crash Course Video #4,5, 10-12	Describe the features and interaction of the Earth-Moon Sun System	2 class periods

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Notes Presentation	Describe the features and interaction of the Earth-Moon Sun System	2-3 class periods
Edpuzzle Quiz	Demonstrate understanding and knowledge	1 class period
Virtual Activities	Name Tides, Phases and Eclipses	3-4 class periods
Lab/Hands on Investigation	Plot the Apparent Motion of the Sun	2-3 class periods (includes write up time)
Assessment	Give a clear description of the motions and interactions of the Sun-Earth-and Moon	1-2 class periods (with review)
Teacher Notes:		

Content Area: Astronomy**Unit Title:** Energy in the Stars and Galaxies (5)**Grade Level:** 11/12**Unit Summary:** Students will evaluate the significance of energy transfers and energy transformations in understanding the universe.**Interdisciplinary****Connections:** Math, Art, History, Chemistry, English**21st Century**

Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

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Unit Essential Question(s):

- How does energy relate to the life cycles of stars?
- What determines the luminosity of stars?
- In what ways is the transfer of energy and energy transformation associated with the motion and interactions of celestial bodies?
- How do stars go through a "life cycle"?

Unit Enduring Understandings:

- The Sun contains most of the mass of the solar system and is fueled by the fusion of hydrogen into helium.
- Solar activity varies, sometimes producing large flares that affect Earth's radio communications and cause Auroras.
- Stars are classified by their size and brightness.
- Stars are formed with a limited amount of fuel that eventually runs out.
- Massive stars explode into supernovas and produce the heavier elements in the universe and can collapse into black holes.

Unit Learning Targets/Objectives:

Students will...

- Relate nuclear fusion reactions and mass-energy equivalence to the life cycle of stars.
- Explain the relationship between the energy produced by fusion in stars to the luminosity.
- Analyze the energy relationships between the mass, power output, and life span of stars.
- Describe energy transfers and transformations associated with the motion and interactions of celestial bodies (e.g. orbits, binary pulsars, meteors, black holes, and galaxy mergers).
- Describe the life cycle of a star and explain the role gravity and mass play in the brightness, life span, and end-stages of stars.

Formative Assessments:

Teacher feedback, class discussion

Summative/Benchmark Assessment(s):

Journals, Quizzes, Tests, Labs, Projects

Resources/Materials:

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Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Intro Activity	Explain how solar wind is created and its influence on Earth's magnetic sphere. Compile a list of conditions necessary for the formation of auroras.	1 class period
Crash Course Video #24, 26	Describe the features, life cycles and types of stars	1 class period
Notes Presentation	Describe the features, life cycles and types of stars	1-2 class periods
Lab and Edpuzzle Quiz	Explain why stars form in clusters	2-3 class period
Virtual Activity	Measure and Classify Stars	2 class periods
Lab/Hands on Investigation	Calculate the luminosity of a star using apparent magnitude and distance	2-3 class periods (includes write up time)

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	Determine a star's size based on luminosity and temperature	
Assessment	Demonstrate ability to apply energy concepts as they relate to the universe	1-2 class periods (with review)
Teacher Notes:		

Content Area: Astronomy**Unit Title:** The Future of Exploration and Knowledge of Space (6)**Grade Level:** 11/12

Unit Summary: Students are introduced to the historical motivation for space exploration. They learn about the International Space Station as an example of space travel innovation and are introduced to new and futuristic ideas that space engineers are currently working on to propel space research far into the future.

Interdisciplinary**Connections:** Math, Art, History, Chemistry, English, Engineering**21st Century**

Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

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Unit Essential Question(s):

- Why do we explore space?
- What is the value of space exploration?
- How much more will life in space and on Earth change with continued exploration?
- How is technology related to the future of our space knowledge?
- Should we continue to spend money and resources in the pursuit of space exploration?

Unit Enduring Understanding

- There are potential reasons why people want to travel to space.
- Many different types of engineers each contribute to space travel.
- There are endless possibilities for what the future may hold for space travel and how this can affect us.
- Space exploration involves many facets such as financial, political, social issues

Unit Learning Targets/Objectives:

Students will...

- Identify and describe products used in daily life developed as a result of space exploration.
- Identify and describe the physiological and engineering challenges inherent in long-duration spaceflight.
- Explain solutions and countermeasures used to overcome the challenges of long-duration spaceflight.
- Demonstrate how technologies developed for space exploration have contributed to solutions for problems found on Earth.
- Research/Design a unique innovation reliant on technology for future space missions.
- Justify the need for continued space exploration.

Formative Assessments:

Teacher feedback, class discussion

Summative/Benchmark Assessment(s):

Journals, Quizzes, Tests, Labs, Projects

Resources/Materials:

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| <ul style="list-style-type: none"> ● Special Education Students <ul style="list-style-type: none"> ○ modified readings ○ student choice on topics ● English Language Learners <ul style="list-style-type: none"> ○ modified readings ○ student choice on topics | <ul style="list-style-type: none"> ● At-Risk Students <ul style="list-style-type: none"> ○ modified readings ○ student choice on topics ● Gifted and Talented Students <ul style="list-style-type: none"> ○ advanced readings ○ mathematical analysis problems |
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Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Intro Activity	List 5 products we use as a result of space exploration	1 class period https://www.jpl.nasa.gov/infographics/infographic.view.php?id=11358
Video	Observe the different ideas about the future of space travel	1 class period https://www.youtube.com/watch?v=4epBt2o9M0o
Design Activity	Illustrate and journal about their own ideas of space travel	1-2 class periods
Virtual Activity	Design a mission to/through space	2-3 class periods
Lab/Hands on Investigation	Explore the basic conditions necessary for life and where in the universe these conditions are most likely to exist	2-3 class periods (includes write up time) http://astro.unl.edu/naap/habitablezones/habitablezones.html

Teacher Notes: