Pequea Valley School District
Science

Unit 1: Nature of Science and Astronomy **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How and why does applying the scientific method in astronomy contribute to society?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.2.10.A - Apply knowledge and understanding about the nature of scientific and technological knowledge.
- Compare and contrast scientific theories and beliefs.
- Know that science uses both direct and indirect observation means to study the world and the universe.
- Integrate new information into existing theories and explain implied results.

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Explain the impact of the Copernican and Newtonian thinking on man's view of the universe.

3.8.12.A – Synthesize and evaluate the interactions and constraints of science and technology on society.
- Compare and contrast how scientific and technological knowledge is both shared and protected.
- Evaluate technological developments that have changed the way humans do work and discuss their impacts
- Evaluate socially proposed limitations of scientific research and technological application.

Pacing: Approximate number of class sessions per unit
- 20

Tier 3 Vocabulary (Content specific vocabulary)
- Theory
- Law
- Hypothesis
- Fact
- Belief
- Physics
- Science

- Technology
- Math
- Model
- Control
- Variable
- Independent Variable
- Dependent Variable
- Constant
- Astrology
- Astronomy
- Pseudoscience

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- The parts of the scientific method
- The differences between theories, laws, hypotheses, facts
- The purposes of variables and controls in an experiment
- The differences between science and pseudoscience

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How pseudosciences are structured
- How to evaluate claims
- How science is our best path to knowledge

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will be able to identify the independent and dependent variables in an experiment.
- Learners will be able to identify the constants and controls in an experiment.
- Learners will be able to describe the similarities and differences between theories, hypotheses, laws, and facts.
- Learners will be able to describe the differences between the common usage and scientific usage of theories, hypotheses, laws, and facts.
- Learners will be able to design tests to be applied to pseudosciences such as astrology.

Assessments:

- Nature of Science Formative Assessment
- Quiz
- Astrology Essay

Software/Resources:

- Schoology
- Google Drive
- EdPuzzle

Pequea Valley School District
Science

Unit 2: Size and Scope of the Universe **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How have astronomers figured out the size of the universe, and what does that mean to you?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.2.10.A - Apply knowledge and understanding about the nature of scientific and technological knowledge.
- Compare and contrast scientific theories and beliefs.
- Know that science uses both direct and indirect observation means to study the world and the universe.

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Explain the impact of the Copernican and Newtonian thinking on man's view of the universe.

Pacing: Approximate number of class sessions per unit
- 20

Tier 3 Vocabulary (Content specific vocabulary)
- Meteor
- Asteroid
- Comet
- Moon
- Planet
- Sun
- Solar System
- Galaxy (Milky Way)
- Local Group
- Supercluster
- Universe

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- The characteristics of each object in the universe

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How big each structure is compared to each other
- How we know how big the universe is

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Students will be able to state the hierarchy of objects in the universe from smallest to largest
- Students will be able to express numbers in scientific notation
- Students will be able to define and use units such as the light year and astronomical unit

Assessments:

- Lab write up - Categorizing the Universe
- Quiz

Software/Resources:

- Schoology
- Google Drive
- EdPuzzle

Pequea Valley School District
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Unit 3: Naked Eye Observing **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How does our perspective of the night sky and our motions differ from the cosmic perspective?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).
- Explain how correlation of variables does not necessarily imply causation.
- Evaluate the patterns of change in a technology

3.2.10.B - Apply process knowledge and organize scientific and technological phenomena in varied ways.
- Describe materials using precise quantitative and qualitative skills based on observations.
- Develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing variables, manipulating variables, interpreting data, and producing solutions.
- Use process skills to make inferences and predictions using collected information and to communicate, using space / time relationships, defining operationally.

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Compare absolute versus apparent star magnitude and their relation to stellar distance.
- Explain the impact of the Copernican and Newtonian thinking on man's view of the universe.

Pacing: Approximate number of class sessions per unit
- 20

Tier 3 Vocabulary (Content specific vocabulary)
- Constellation
- Asterism
- Ecliptic
- Zenith
- Zodiac

- Horizon System
- Altitude
- Azimuth
- Equatorial System
- Right Ascension
- Declination
- Cardinal Points
- Diurnal Motion
- Solar Day
- Sidereal Day
- Solstice
- Equinox
- Precession
- Waxing
- Waning
- Gibbous
- Sidereal Month
- Synodic Month
- Eclipse
- Umbra
- Penumbra
- Planetes
- Retreograde
- Prograde
- Epicycle
- Deferent
- Milky Way
- Galaxy
- Light Pollution
- Conjunction
- Meteor Shower
- Radiant

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Constellations
- Equatorial and Horizon Systems
- Earth's Motions

- The Moon's motions
- Planets' motions
- Naked eye objects

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How the night sky and its objects move
- How constellations change each season
- How the night sky is mapped
- How the Earth, Sun, and Moon move
- How the planets move
- How to observe the night sky

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Students will be able to identify north circumpolar stars and constellations
- Students will be able to identify seasonal constellations
- Students will be able to explain why different constellations appear in the sky each season
- Students will be able to define the zodiac
- Students will be able to use both the horizon and equatorial systems
- Students will be able to know when to use each mapping system
- Students will be able to describe the differences between rotation and revolution
- Students will be able to distinguish between solar and sidereal days
- Students will be able to describe how annual motion creates climates and seasons
- Students will be able to explain the mechanics behind Moon phases
- Students will be able to explain the mechanics behind eclipses
- Students will be able to explain the mechanics behind retrograde motion
- Students will be able to identify naked eye objects in the night sky and describe their motion
- Students will be able to practice methods of finding objects in the night sky
- Students will be able to reliably predict how many stars are visible in a particular sky

Assessments:

- Quiz
- Test
- Star Counting Lab

Software/Resources:

- Planetarium
- Starry Night

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Unit 4: Telescopes & Technology **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How has technology made astronomy better for amateurs and professionals?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).
- Evaluate the patterns of change within a technology

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Compare absolute versus apparent star magnitude and their relation to stellar distance.
- Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.

3.4.12.D - Analyze the essential ideas about the composition and structure of the universe.
- Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.

3.8.12.A – Synthesize and evaluate the interactions and constraints of science and technology on society.
- Compare and contrast how scientific and technological knowledge is both shared and protected.
- Evaluate technological developments that have changed the way humans do work and discuss their impacts (e.g., genetically engineered crops).
- Evaluate socially proposed limitations of scientific research and technological application.

3.8.12.B – Apply the use of ingenuity and technological resources to solve specific societal needs and improve the quality of life.
- Apply appropriate tools, materials and processes to solve complex problems.
- Use knowledge of human abilities to design or modify technologies that extend and enhance human abilities.
- Apply appropriate tools, materials and processes to physical, informational or biotechnological systems to identify and recommend solutions to international problems.
- apply knowledge of agricultural science to develop a solution that will improve on a human need or want

3.8.12.C – Evaluate the consequences and impacts of scientific and technological solutions.
- Propose solutions to specific scientific and technological applications, identifying possible financial considerations.
- Analyze scientific and technological solutions through the use of risk/benefit analysis.
- Analyze and communicate the positive or negative impacts that a recent technological invention had on society.

- Evaluate and describe potential impacts from emerging technologies and the consequences of not keeping abreast of technological advancements. (e.g., assessment alternatives, risks, benefits, costs, economic impacts, constraints).

Pacing: Approximate number of class sessions per unit

- 20

Tier 3 Vocabulary (Content specific vocabulary)

- Reflector
- Refractor
- Newtonian
- Schmidt-cassegrain
- Dobsonian
- Diagonal
- Eyepiece
- Ccd
- Messier
- double star
- Galaxy
- Nebula
- open cluster
- globular cluster
- Comet
- adaptive optics
- Spectrometer
- electromagnetic spectrum
- Radio
- Ultra-violet
- Infrared
- Interferometer
- Spectroscopy
- emission spectrum
- absorption spectrum
- Kirchoff's Laws
- ionized state
- Photon

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Types of telescopes
- Observing Targets
- Observatory Telescopes
- Light is electromagnetic radiation
- Discoveries made by telescopes

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How to use a simple telescopes
- How telescopes work
- How to find objects in the sky
- How astronomers use telescopes
- How astronomers use spectroscopy
- How technology has improved telescopes

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Students will be able to operate a basic telescope
- Students will be able to discuss the advantages and disadvantages of different telescopes
- Students will be able to discuss purposes for improvements in telescopes
- Students will be able to discuss how observatories used telescopes in their discoveries
- Students will be able to explain how spectroscopy is a valuable tool for astronomers

Assessments:

- Quizzes
- Presentations of research telescopes

Software/Resources:

- Planetarium
- Starry Night
- Galileoscopes
- FirstScopes
- Gizmos

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Unit 5: Astronomical Figures in History **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How did changes to our model of the universe change society?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.2.12.A - Evaluate the nature of scientific and technological knowledge.
- Know and use the ongoing scientific processes to continually improve and better understand how things work.
- Critically evaluate the status of existing theories (e.g., germ theory of disease, wave theory of light, classification of subatomic particles, theory of evolution, epidemiology of aids).

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Explain the impact of the Copernican and Newtonian thinking on man's view of the universe.
- Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.

3.4.12.D - Analyze the essential ideas about the composition and structure of the universe.
- Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.
- Correlate the use of the special theory of relativity and the life of a star.

Pacing: Approximate number of class sessions per unit
- 20

Tier 3 Vocabulary (Content specific vocabulary)
- Stonehenge
- Medicine Wheel
- Caracol Temple
- Geocentric
- Planetes
- Heliocentric
- retrograde motion

- Epicycle
- Deferent
- Aristotle
- Ptolemy
- Aristarchus of Samos
- Copernicus
- Galileo
- Newton
- Einstein
- Sidereus Nuncius
- Tycho Brahe
- Johannes Kepler
- Ellipse
- Focus

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Astronomer's names and contributions
- Mechanics of the Solar System

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How ancients used astronomy
- How our model of the universe has changed and why
- Why previous models were incorrect, yet held to be true

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will be able to identify astronomers' contributions
- Learners will be able to explain why each new model is an improvement
- Learners will be able to explain why scientific models change
- Learners will be able to discuss societal impacts of scientific models and their changes
- Learners will be able to debate importance of astronomers' contributions

Assessments:

- Quizzes
- Test
- Class Discussion
- Timeline Project Presentation

Software/Resources:

- Planetarium
- Starry Night

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Unit 6: Our Solar System **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How does our knowledge of the solar system and its history affect our society?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.2.10.A - Apply knowledge and understanding about the nature of scientific and technological knowledge.
- Compare and contrast scientific theories and beliefs.
- Know that science uses both direct and indirect observation means to study the world and the universe.
- Integrate new information into existing theories and explain implied results.

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Describe the structure and life cycle of star, using the Hertzsprung-Russell diagram.
- Describe the nuclear processes involved in energy production in a star.
- Explain the impact of the Copernican and Newtonian thinking on man's view of the universe.
- Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.

3.4.12.D - Analyze the essential ideas about the composition and structure of the universe.
- Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.
- Correlate the use of the special theory of relativity and the life of a star.

Pacing: Approximate number of class sessions per unit
- 20

Tier 3 Vocabulary (Content specific vocabulary)
- Terrestrial
- Jovian
- Titius-Bode "Law"
- Protostar

- density
- Rotation
- Mass
- orbital period
- gravity assist
- Cassini
- Voyager
- Spirit & Opportunity
- Juno

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Gravity's role in formation
- Planetary properties
- Planetary exploration missions and their discoveries

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How the solar system was formed
- How astronomers compare planets
- How astronomers and engineers design, plan, control a planetary exploration mission

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will be able to describe how the solar system formed
- Learners will be able to explain why Pluto is a dwarf planet
- Learners will be able to plan a planetary exploration mission

Assessments:

- Quiz
- Mission Baseball Card presentations

Software/Resources:

- Planetarium
- Starry Night

Pequea Valley School District
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Unit 7: Stars & Stellar Evolution **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
What does our knowledge of the Sun and other stars tell us about the future of Earth and humanity?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Describe the structure and life cycle of a star, using the Hertzsprung-Russell diagram.
- Describe the nuclear processes involved in energy production in a star.
- Compare absolute versus apparent star magnitude and their relation to stellar distance.
- Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.

3.4.12.D - Analyze the essential ideas about the composition and structure of the universe.
- Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.
- Correlate the use of the special theory of relativity and the life of a star.

Pacing: Approximate number of class sessions per unit
- 20

Tier 3 Vocabulary (Content specific vocabulary)
- Core
- Radiation zone
- convection zone
- Photosphere
- Chromosphere
- transition zone
- Corona
- solar wind

- Luminosity
- Helioseismology
- Granulation
- Spicule
- Prominence
- solar flare
- Sunspots
- solar cycle
- Prominence
- Fusion
- E=mc2
- Positron
- Neutrino
- apparent brightness
- absolute magnitude
- magnitude scale
- supergiant star
- giant star
- red giant
- Dwarf
- white dwarf
- HR diagram
- main sequence
- blue giant
- blue supergiant
- red dwarf
- interstellar medium
- interstellar cloud
- collapsing cloud fragment
- Protostar
- ZAMS
- brown dwarf
- helium flash
- carbon core
- planetary nebula
- white dwarf
- black dwarf
- Nova

- Supernova
- neutron star
- Pulsar
- black hole

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Layers of the Sun
- Sun's effect on Earth
- Types of stars
- Life cycle stages of a star
- Possible end points of a star
- Black Holes

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How energy is transferred throughout a solar system
- How the Sun works
- How astronomers classify stars
- How a star is born, lives, and dies
- The conditions necessary for particular stars

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will be able to describe the features and functions of the Sun's layers
- Learners will be able to describe the process of nuclear fusion and how it relates to the universe
- Learners will be able to categorize stars according the H-R diagram, and describe why this process works
- Learners will be able to tell the story of a star's birth, life, and death

Assessments:

- Quiz
- Test
- Stellar Evolution Flipbook

Software/Resources:

- Planetarium
- Starry Night

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Unit 8: Galaxies **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
What do our observations of galaxies tell us about the universe?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.2.10.A - Apply knowledge and understanding about the nature of scientific and technological knowledge.
- Compare and contrast scientific theories and beliefs.
- Know that science uses both direct and indirect observation means to study the world and the universe.
- Integrate new information into existing theories and explain implied results.

3.2.10.B - Apply process knowledge and organize scientific and technological phenomena in varied ways.
- Describe materials using precise quantitative and qualitative skills based on observations.
- Develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing variables, manipulating variables, interpreting data, and producing solutions.
- Use process skills to make inferences and predictions using collected information and to communicate, using space / time relationships, defining operationally.

3.2.12.A - Evaluate the nature of scientific and technological knowledge.
- Know and use the ongoing scientific processes to continually improve and better understand how things work.
- Critically evaluate the status of existing theories (e.g., germ theory of disease, wave theory of light, classification of subatomic particles, theory of evolution, epidemiology of aids).

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Describe the nuclear processes involved in energy production in a star.
- Explain the “red-shift” and Hubble’s use of it to determine stellar distance and movement.
- Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.

3.4.12.D - Analyze the essential ideas about the composition and structure of the universe.
- Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.

Pacing: Approximate number of class sessions per unit

- 20

Tier 3 Vocabulary (Content specific vocabulary)

- Galaxy
- Galactic Bulge
- Galactic Disk
- Galactic Halo
- Galactic Center
- Spiral Arms
- Rotation Curve
- Dark Matter
- Spiral Galaxy
- Barred-Spiral Galaxy
- Elliptical
- Irregular
- Galaxy Cluster
- Local Group
- Hubble's Law
- Redshift

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Types of Galaxies
- Structure of Galaxies
- Clusters of Galaxies

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How galaxies form
- Why we categorize them the way we do
- How galaxies are observed
- What our observations tell us about the universe

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will be able to describe the methods of studying galaxies
- Learners will be able to discuss how galaxies have been formed

Assessments:

- Quiz
- Test
- Presentation
- Galaxy Zoo work

Software/Resources:

- Planetarium
- Starry Night
- Galaxy Zoo

Pequea Valley School District
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Unit: The Universe **Course: Astrophysics** **Grade: 10-12**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
How has our understanding of the Universe changed and what does it mean to us now?

PA Academic Standards for Science and Technology
3.1.12.E - Evaluate change in nature, physical systems and man-made systems.
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories).
- Analyze how models, systems and technologies have changed over time (e.g., germ theory, theory of evolution, solar system, cause of fire).

3.2.10.A - Apply knowledge and understanding about the nature of scientific and technological knowledge.
- Compare and contrast scientific theories and beliefs.
- Know that science uses both direct and indirect observation means to study the world and the universe.
- Integrate new information into existing theories and explain implied results.

3.2.10.B - Apply process knowledge and organize scientific and technological phenomena in varied ways.
- Describe materials using precise quantitative and qualitative skills based on observations.
- Develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing variables, manipulating variables, interpreting data, and producing solutions.
- Use process skills to make inferences and predictions using collected information and to communicate, using space / time relationships, defining operationally.

3.2.12.A - Evaluate the nature of scientific and technological knowledge.
- Know and use the ongoing scientific processes to continually improve and better understand how things work.
- Critically evaluate the status of existing theories (e.g., germ theory of disease, wave theory of light, classification of subatomic particles, theory of evolution, epidemiology of aids).

3.4.10.D - Explain essential ideas about the composition and structure of the universe.
- Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).
- Explain the “red-shift” and Hubble’s use of it to determine stellar distance and movement.
- Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.

3.4.12.D - Analyze the essential ideas about the composition and structure of the universe.
- Analyze the Big Bang Theory’s use of gravitation and nuclear reaction to explain a possible origin of the universe.
- Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.

Pacing: Approximate number of class sessions per unit

- 20

Tier 3 Vocabulary (Content specific vocabulary)

Cosmology
Cosmological principle
Big Bang Theory
Critical Density
Dark Energy
Cosmological Constant
Critical Universe
Cosmic Microwave Background

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- The Big Bang Theory
- Properties of Dark Matter and Dark Energy
- Models of the Universe

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How the model of the universe has changed and why

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will be able to describe what happened in the Big Bang, and the evidence for it
- Learners will be able to explain how dark matter was discovered
- Learners will be able to describe how the model of the universe has change and why
- Learners will be able to describe the past of the Universe and the evidence supporting it
- Learners will be able to describe the future of the Universe and the evidence supporting it

Assessments:

- Quiz
- Test
- Presentation

Software/Resources:

- Planetarium
- Starry Night