Course Title: Astronomy
Board Approval Date: 07/21/14
Credit / Hours: 0.5 credit

Course Description:

Astronomy focuses on mastery of the PA Academic Standards for Science and Technology as well as Environment and Ecology. As students progress through astronomy they will participate in a systematic study of the history of astronomy, the Earth, Moon, and other objects in the solar system, the Sun, stars, tools used by astronomers, galaxies, and cosmology.

Astronomy is the science that describes celestial objects according to their location, motion, size, composition, and appearance, but this course encompasses much more. A broad goal of this course is to enable the student to gain an appreciation for the historic and scientific significance of astronomy emphasizing how astronomers learn about the cosmos—in other words "how we know what we know". Topics range from the history of astronomy, methods of astronomy, studies of planetary bodies, the sun, stars, and other celestial objects and their relation in the universe.

Learning Activities / Modes of Assessment:

Large group instruction	Tests and Quizzes
Laboratory experiments	Checklists / Teacher Observation
Small group work	Projects with Rubrics
Computer simulations / Video Analysis	Lab Reports / Write-ups
Reading assignments	Writing / essays

Instructional Resources:

Project Star: The Universe in Your Hands textbook by Harvard Observatory
Logger Pro software
Interactive Physics software
Excel, PowerPoint, Word
Moodle
EInstruction software
Phet online physics simulations
An Inconvenient Truth, documentary, ice core and CO_2 graph scene only
Google Docs
Discovery Education video services
Central Columbia School District Educational Video Library
Various instructional videos and educational websites

Course Pacing Guide

Course: **Astronomy**

Course Unit (Topic)	**Length of Instruction (Days/Periods)**
1. History of Astronomy	14 days
2. The Earth – Moon Systems	18 days
3. Solar Systems Body	14 days
4. Telescopes, The Sun and Spectroscopy	18 days
5. Stars	17 days
6. Milky Way, Galaxies, and Cosmology	<u>05 days</u>
DAYS TOTAL	86 Days

Topic: 1-History of Astronomy

Subject(s): Science

Days: 14

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
terms: heliocentric, geocentric, retrograde, zodiac, Ptolemaic model, solstice, equinox concepts: cycle of sun positions (sunrise, sunset, path through the sky), Kepler's Laws of Planetary Motion, Newton's Laws of Motion and Gravity, astronomy versus astrology, importance of astronomy to early civilization	The solar system can be modeled in different ways. Models have changed as our understanding of the solar system has evolved.	**S11.A.3.2.1 – Essential** Compare the accuracy of predictions represented in a model to actual observations and behavior. **S11.A.3.2.2 – Important** Describe advantages and disadvantages of using models to simulate processes and outcomes. S11.A.3.2.1 - Compare the accuracy of predictions represented in a model to actual observations and behavior. S11.A.3.2.2 - Describe advantages and disadvantages of using models to simulate processes and outcomes. S11.A.3.3.3 - Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves). S11.A.3.3.1 - Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.

Topic: 2-The Earth-Moon System

Subject(s): Science

Days: 18

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
S11.A.3.3.3 – Essential Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves).	The Earth/ Moon system reveals information about the history of the solar system and structure of planetary objects. The Earth's motion through space results in the motions we see of celestial objects and the	**S11.A.3.3.3 – Essential** Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves).
S11.A.3.3.1 – Important Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.		**S11.A.3.2.1 – Essential** Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.2.2.1 – Essential Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).		**S11.A.2.2.1 – Essential** Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
		S11.A.2.2.2 – Essential Explain how technology is used to extend human abilities and precision (e.g., GPS, spectroscope, scanning electron microscope, pH meters, probes, interfaces, imaging technologies, telescope).
S11.A.2.2.2 – Essential Explain how technology is used to extend human abilities and precision (e.g., GPS, spectroscope, scanning electron microscope, pH meters, probes, interfaces, imaging technologies, telescope).		**3.3.10.A7.a – Important** UNIFYING THEMES - SCALE/MODELS Interpret and create models of the Earth's physical features in various mapping representations.
3.3.10.A1.a – Important EARTH FEATURES AND THE PROCESSES THAT CHANGE IT - Relate plate tectonics to both slow and rapid changes in the earth's surface.		S11.A.3.2.1 - Compare the accuracy of predictions represented in a model to actual observations and behavior.

S11.A.2.2.1 - Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).

3.3.10.A7.a - UNIFYING THEMES - SCALE/ MODELS Interpret and create models of the Earth's physical features in various mapping representations.

S11.A.3.3.3 - Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves).

Topic: 2-The Earth-Moon System

Subject(s): Science

Days: 18

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
3.3.10.A7.a – Important UNIFYING THEMES - SCALE/MODELS Interpret and create models of the Earth's physical features in various mapping representations. **3.3.10.A7.d – Compact** UNIFYING THEMES - CONSTANCY/ CHANGE Describe factors that contribute to global climate change. **3.3.10.A7.c – Compact** UNIFYING THEMES - SCALE Apply an appropriate scale to illustrate major events throughout geologic time. terms: differentiation, solar nebula, accretion, care, mantle, crust, greenhouse gas, maria, highlands, rotation, revolution, precession, longitude, latitude, right ascension, declination, zero hour, prime meridian concepts: determining the size of the earth, distance to the moon, size of the moon;determining the density of the earth, plate tectonics, climate change, eclipses, tides, impact theory		S11.A.3.3.1 - Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order. S11.A.2.2.1 - Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality). S11.A.2.2.2 - Explain how technology is used to extend human abilities and precision (e.g., GPS, spectroscope, scanning electron microscope, pH meters, probes, interfaces, imaging technologies, telescope). 3.3.10.A1.a - EARTH FEATURES AND THE PROCESSES THAT CHANGE IT - Relate plate tectonics to both slow and rapid changes in the earth's surface. 3.3.10.A7.a - UNIFYING THEMES - SCALE/ MODELS Interpret and create models of the Earth's physical features in various mapping representations. 3.3.10.A7.d - UNIFYING THEMES - CONSTANCY/CHANGE Describe factors that contribute to global climate change. 3.3.10.A7.c - UNIFYING THEMES - SCALE Apply an appropriate scale to illustrate major events throughout geologic time.

Topic: 3-Solar System Bodies

Subject(s): Science

Days: 14

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
3.3.10.A7.d – Compact UNIFYING THEMES - CONSTANCY/CHANGE Describe factors that contribute to global climate change.	The properties of solar system objects are related to their composition and location.	**3.3.10.B1.a – Essential** COMPOSITION AND STRUCTURE - Explain how gravity is responsible for planetary orbits.
3.3.10.A7.c – Compact UNIFYING THEMES - SCALE Apply an appropriate scale to illustrate major events throughout geologic time.		**S11.A.3.3.3 – Essential** Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves).
3.3.10.B1.b – Compact COMPOSITION AND STRUCTURE - Explain what caused the sun, Earth, and most of the other planets to form between 4 and 5 billion years ago.		3.3.10.B1.a - COMPOSITION AND STRUCTURE - Explain how gravity is responsible for planetary orbits.
S11.A.3.3.3 – Essential Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, waves).		3.3.10.A7.d - UNIFYING THEMES - CONSTANCY/CHANGE Describe factors that contribute to global climate change.
3.3.10.B2.b – Important UNIFYING THEMES - CONSTANCY AND CHANGE Describe changes in the universe over billions of years.		3.3.10.A7.c - UNIFYING THEMES - SCALE Apply an appropriate scale to illustrate major events throughout geologic time.
		3.3.10.B1.b - COMPOSITION AND STRUCTURE - Explain what caused the sun, Earth, and most of the other planets to form between 4 and 5 billion years ago.
terms: frost line, Terrestrial, Jovian, exoplanets concepts:		

Topic: 3-Solar System Bodies

Subject(s): Science

Days: 14

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
Solar Nebula Theory, methods of finding exoplanets, classifying and categorizing planets and exoplanets, properties of the planets		

Topic: 4-Telescopes, The Sun and Spectroscopy

Subject(s):

Days: 18

Grade(s):

Know:

S11.A.2.2.2 – Essential
Explain how technology is used to extend human abilities and precision (e.g., GPS, spectroscope, scanning electron microscope, pH meters, probes, interfaces, imaging technologies, telescope).

S11.A.3.1.1 – Essential
Apply systems analysis, showing relationships (e.g., flowcharts, decision trees, dichotomous keys, mind map), input and output, and measurements to explain a system and its parts.

S11.A.3.1.4 – Important
Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating systems, motor, food production) and identify the resources necessary for operation of the system.

S11.C.2.1.1 – Essential
Compare or analyze different types of waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, x-rays, microwaves) as it relates to their properties, energy levels, and motion.

Understand:

The sun is a star that produces its energy through nuclear fusion. We learn about the sun and stars by studying the electromagnetic radiation they emit. Telescopes are used to gather light and increase the detail of images.

Do:

S11.A.2.2.2 – Essential
Explain how technology is used to extend human abilities and precision (e.g., GPS, spectroscope, scanning electron microscope, pH meters, probes, interfaces, imaging technologies, telescope).

S11.A.3.1.1 – Essential
Apply systems analysis, showing relationships (e.g., flowcharts, decision trees, dichotomous keys, mind map), input and output, and measurements to explain a system and its parts.

S11.A.3.1.4 – Important
Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating systems, motor, food production) and identify the resources necessary for operation of the system.

S11.C.2.1.1 – Essential
Compare or analyze different types of waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, x-rays, microwaves) as it relates to their properties, energy levels, and motion.

3.2.10.B3.b – Important
HEAT/HEAT TRANSFER - Analyze the processes of convection, conduction, and radiation between objects or regions that are at different temperatures.

3.2.10.B5.c – Essential
NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Describe the components of the electromagnetic spectrum.

3.3.10.B1.d – Important
COMPOSITION AND STRUCTURE - Describe the basic nuclear processes involved in energy production in a star.

3.3.10.B2.a – Essential
UNIFYING THEMES - SCALE AND MEASUREMENT Explain how scientists obtain information about the universe by using technology to detect electromagnetic radiation that is emitted, reflected, or absorbed by stars and other objects.

Topic: 4-Telescopes, The Sun and Spectroscopy

Subject(s):

Days: 18

Grade(s):

Know:	Understand:	Do:
3.3.10.B1.d – Important COMPOSITION AND STRUCTURE - Describe the basic nuclear processes involved in energy production in a star. terms: electromagnetic spectrum, infrared, ultraviolet, spectroscopy, doppler effect, resolving power, light gathering power, magnification, photosphere, corona, prominence, solar flare, sunspot, convective envelope, radiation zone, core, solar wind, proton-proton cycle, fusion, feedback, photovoltaic concepts: spectroscopy, types of spectra, nuclear fusion, feedback regulating output of the sun, sunspot cycle		S11.A.2.2.2 - Explain how technology is used to extend human abilities and precision (e.g., GPS, spectroscope, scanning electron microscope, pH meters, probes, interfaces, imaging technologies, telescope). S11.A.3.1.1 - Apply systems analysis, showing relationships (e.g., flowcharts, decision trees, dichotomous keys, mind map), input and output, and measurements to explain a system and its parts. S11.A.3.1.4 - Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating systems, motor, food production) and identify the resources necessary for operation of the system. S11.C.2.1.1 - Compare or analyze different types of waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, x-rays, microwaves) as it relates to their properties, energy levels, and motion. 3.2.10.B3.b - HEAT/HEAT TRANSFER - Analyze the processes of convection, conduction, and radiation between objects or regions that are at different temperatures. 3.2.10.B5.c - NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Describe the components of the electromagnetic spectrum. 3.3.10.B1.d - COMPOSITION AND STRUCTURE - Describe the basic nuclear processes involved in energy production in a star. 3.3.10.B2.a - UNIFYING THEMES - SCALE AND MEASUREMENT Explain how scientists obtain information about the universe by using technology to detect electromagnetic radiation that is emitted, reflected, or absorbed by stars and other objects.

Topic: 5-Stars

Subject(s): Science

Days: 17

Grade(s): 9th, 10th, 11th, 12th

Know:

3.3.10.B1.d – Important COMPOSITION AND STRUCTURE - Describe the basic nuclear processes involved in energy production in a star.

3.3.10.B2.c – Important UNIFYING THEMES - SCALE AND MEASUREMENT Explain the scale used to measure the sizes of stars and galaxies and the distances between them.

terms:

binary star, variable star, Hertzsprung-Russell diagram, luminosity, absolute magnitude, apparent (or visual) magnitude, white dwarf, neutron star, black hole, inverse square, supernova, planetary nebula, red giant, parsec, stellar parallax

concepts:

stellar evolution, factors affecting the luminosity of a star, brightness-distance relationship, colors/temperatures of stars, finding distances to stars

Understand:

There are many kinds of stars, but they evolve in predictable ways.

Do:

3.2.10.B1.c – Important FORCE & MOTION OF PARTICLES AND RIGID BODIES - Use Newton's Third Law to explain forces as interactions between bodies.

3.3.10.B1.d – Important COMPOSITION AND STRUCTURE - Describe the basic nuclear processes involved in energy production in a star.

3.3.10.B2.a – Essential UNIFYING THEMES - SCALE AND MEASUREMENT Explain how scientists obtain information about the universe by using technology to detect electromagnetic radiation that is emitted, reflected, or absorbed by stars and other objects.

3.3.10.B2.c – Important UNIFYING THEMES - SCALE AND MEASUREMENT Explain the scale used to measure the sizes of stars and galaxies and the distances between them.

3.2.10.B1.c - FORCE & MOTION OF PARTICLES AND RIGID BODIES - Use Newton's Third Law to explain forces as interactions between bodies.

3.3.10.B1.d - COMPOSITION AND STRUCTURE - Describe the basic nuclear processes involved in energy production in a star.

3.3.10.B2.a - UNIFYING THEMES - SCALE AND MEASUREMENT Explain how scientists obtain information about the universe by using technology to detect electromagnetic radiation that is emitted, reflected, or absorbed by stars and other objects.

3.3.10.B2.c - UNIFYING THEMES - SCALE AND MEASUREMENT Explain the scale used to measure the sizes of stars and galaxies and the distances between them.

Topic: 6-Milky Way, Galaxies, and Cosmology

Subject(s): Science

Days: 5

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
3.3.10.B1.c – Compact COMPOSITION AND STRUCTURE - Provide evidence to suggest the Big Bang Theory.	The evolution of the universe can be studied by looking at distant galaxies.	**3.3.10.B2.c – Important** UNIFYING THEMES - SCALE AND MEASUREMENT Explain the scale used to measure the sizes of stars and galaxies and the distances between them.
3.3.10.B2.c – Important UNIFYING THEMES - SCALE AND MEASUREMENT Explain the scale used to measure the sizes of stars and galaxies and the distances between them.		3.3.10.B2.c - UNIFYING THEMES - SCALE AND MEASUREMENT Explain the scale used to measure the sizes of stars and galaxies and the distances between them.
3.3.12.B1.b – Important COMPOSITION AND STRUCTURE - Analyze the influence of gravity on the formation and life cycles of galaxies, including our own Milky Way galaxy; stars; planetary systems; and residual material left from the creation of the solar system.		3.3.10.B1.c - COMPOSITION AND STRUCTURE - Provide evidence to suggest the Big Bang Theory. 3.3.10.B2.b - UNIFYING THEMES - CONSTANCY AND CHANGE Describe changes in the universe over billions of years. 3.3.12.B1.b - COMPOSITION AND STRUCTURE - Analyze the influence of gravity on the formation and life cycles of galaxies, including our own Milky Way galaxy;stars;planetary systems;and residual material left from the creation of the solar system.
3.3.12.B2.a – Compact UNIFYING THEMES - MODELS AND SCALE Apply mathematical models and computer simulations to study evidence collected relating to the extent and composition of the universe.		3.3.12.B2.a - UNIFYING THEMES - MODELS AND SCALE Apply mathematical models and computer simulations to study evidence collected relating to the extent and composition of the universe.
3.3.12.B2.b – Important UNIFYING THEMES - PATTERNS AND CONSTANCY AND CHANGE Analyze the evidence supporting theories of the origin of the universe to predict its future.		3.3.12.B2.b - UNIFYING THEMES - PATTERNS AND CONSTANCY AND CHANGE Analyze the evidence supporting theories of the origin of the universe to predict its future.

Topic: 6-Milky Way, Galaxies, and Cosmology

Subject(s): Science

Days: 5

Grade(s): 9th, 10th, 11th, 12th

Know:	Understand:	Do:
terms: galaxy, halo, nucleus, globular cluster, local group, cosmology, red shift, dark energy, dark matter, cosmic microwave background radiation concept: structure of the Milky Way galaxy, types of galaxies, big bang, Hubble Law, possible fates of the universe		