Course Title:	Content Area:	Grade Level:	Credit (if applicable)
Astronomy	Science	10-12	0.5

Course Description:
Students will explore the Universe and gain knowledge of Space from Earth's vantage point and beyond to answer the questions, "What comprises the Universe?" and "How has the Universe evolved?" and "Is there intelligent life elsewhere in the Universe?" An examination of stars, planets, and other structures and events within the Cosmos will help us explore these and many other questions.

Aligned Core Resources:	Connection to the *BPS Vision of the Graduate*
N/A	Critical Thinking and Problem Solving

Additional Course Information: *Knowledge/Skill Dependent courses/prerequisites*	Link to *Completed Equity Audit*
None	

Standard Matrix

District Learning Expectations and Standards	Unit 1	Unit 2	Unit 3	Unit 4
HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.			X	X
HS-PS2-4 Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.		X		
HS-PS4-3 Evaluate the claims, evidence, and the 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.	X			

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.	X			
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.		X	X	
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.	X			X
HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.			X	X
HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.		X		
HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.		X		
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	X	X	X	X

HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	X	X	X	X

Unit Links

Tools Used in Astronomy Throughout History
Earth, Moon, Sun, and Solar System
Understanding Stars
The Universe

Unit Title:

Tools Used in Astronomy Throughout History

Relevant Standards: Bold indicates priority

- HS-PS4-3 Evaluate the claims, evidence, and the 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-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-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Essential Question(s):	**Enduring Understanding(s):**
• Why study Astronomy? • What is Astronomy? How is it similar to, or different from Cosmology? • What were the accomplishments of early astronomers? • How does the geocentric model differ from the heliocentric model of the solar system? • What are Kepler's Laws of Planetary Motion? • What are astronomical units and other ways of measuring astronomical distances? • How has our understanding of the cosmos developed over time? • How do ancient tools for observing the cosmos compare to the tools of today? • How does light help us understand the universe? • What is a light year, and why do we use light years to measure vast distances? • What is gravity? What role does it play in our universe? • How is the EMR spectrum used to study the universe?	• Astronomy is one of the oldest natural sciences. The early civilizations in recorded history made methodical observations of the night sky. These include the Egyptians, Babylonians, Greeks, Indians, Chinese, Maya, and many ancient indigenous peoples of the Americas. In the past, astronomy included disciplines as diverse as astrometry, celestial navigation, observational astronomy, and the making of calendars. • Before tools such as the telescope were invented, early study of the stars was conducted using the naked eye. As civilizations developed, most notably in Egypt, Mesopotamia, Greece, Persia, India, China, and Central America, astronomical observatories were assembled and ideas on the nature of the Universe began to develop. Most early astronomy consisted of mapping the positions of the stars and planets, a science now referred to as astrometry. From these observations, early ideas about the motions of the planets were formed, and the nature of the Sun, Moon and the Earth in the Universe were explored philosophically. The Earth was believed to be the center of the Universe with the Sun, the Moon and the stars rotating around it. This is known as the geocentric model of the Universe, or the Ptolemaic system, named after Ptolemy.
Demonstration of Learning:	**Pacing for Unit**
	10 classes/blocks

Family Overview (link below)	Integration of Technology:
	Intentionally aligned use of digital tools and resources to support acquisition of content, researching, organizing and communicating learning
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
Astronomy, Universe, Cosmology, Geocentric, Heliocentric, Constellation, Universe, Telescope, Hubbel, Webb, Myths, Electromagnetic spectrum, Spectroscope, Light year, Planet, Circumpolar, Orbit, Ellipse, Eccentricity, Focus/Foci, Gravity, Universal Gravity, Rotation, Revolution, Astronomical Unit, Orbital period ('year'), Mass, Astrolabe, Hubble's Law	• Astronomy Pictures of the Day • Windows to the Universe • Cosmos A Spacetime Odyssey (Neil DeGrasse Tyson) clips • Introduction to Astronomy
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
Connections to Prior Units:	**Connections to Future Units:**
Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**
Comprehension (guideline3) • Activate or supply background knowledge • Highlight patterns, critical features, big ideas, and relationships • Guide information processing and visualization • Maximize transfer and generalization	• Anchor instruction by linking to and activating relevant prior knowledge (e.g., using visual imagery, concept anchoring, or concept mastery routines) • Make explicit cross-curricular connections. • Highlight or emphasize key elements in text, graphics, diagrams, formulas • Provide interactive models that guide exploration and new understandings • Provide templates, graphic organizers, concept maps to support note-taking
Supporting Multilingual/English Learners	
Related *CELP standards:*	**Learning Targets:**
9-12.2 An EL can . . . participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.	See all Learning Targets below

Lesson Sequence	Learning Target	Success Criteria/ Assessment	Resources
1	• I can compare and contrast the tools of ancient astronomy with the tools of modern astronomy.	• I can investigate ancient and modern tools used in astronomy and	Timeline of astronomy

		understand their purpose. • I can identify differences in ancient and modern tools. • I can discuss the significance of the telescope over time.	
2	• I can compare and contrast the geocentric model of the solar system to the heliocentric model. • I can examine how changing technology has changed our perspective of the solar system.	• I know the geocentric model has the EARTH at the center of the solar system. • I know the heliocentric model has the SUN at the center of the solar system. • I know the historical background to both models. • I know which tools were used that led to each perspective.	
3	• I can explain how gravity organizes our solar system. • I can predict how gravity plays a major role in the interactions of celestial bodies. • I can examine how changing technology has changed our perspective of the organization of celestial bodies.	• I know that gravity is a relationship between mass and distance. • I understand how the role of mass and distance (gravity) impacts the motion and location of celestial bodies. • I can understand the types of observations and data that have supported human understanding of celestial organization.	
4	• I can examine how Kepler's laws determine the motions of the planets.	• I know Kepler's laws and how they define the movement of celestial objects. • I can use Kepler's laws to define the motion of a specific celestial object.	• Kepler's First Law • Kepler's Second Law • Kepler's Third Law
5	• I can examine why the speed of light is used to determine interstellar distances. • I can differentiate between the different forms of light (electromagnetic spectrum) and their use in observational tools.	• I know the different astronomical units used in astronomy. • I can understand the magnitude of each astronomical unit. • I know that the speed of	

		light is used to measure distance in the universe because it is a constant and because of the vast size of the universe. ● I can define the different types of light in the electromagnetic spectrum. ● I can develop a model to explain how a telescope is a time machine. ● I can explain how a telescope works.	
6	● I can identify several constellations and connect their star organization to the constellation name. ● I can identify patterns in naming constellations identified in the ancient world.	● I can name several constellations seen in the night sky. ● I know the history of naming constellations and the mythological stories related to each. ● I can explain how constellations were used in navigation and agriculture.	● How do we know? ● Constellation in a Canister ● Carl Sagan's Cosmos clips (constellations through time, cultures, perspectives)

Unit Title:

Earth, Moon, Sun, and Solar System

Relevant Standards: Bold indicates priority

HS-PS2-4 Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.
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-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Essential Question(s):	**Enduring Understanding(s):**
• How did the solar system form? • What are the components of our solar system? • How do the different bodies within our solar system compare? • What factors combine to keep bodies in orbit? • What are the patterns that exist within/because of the sun, moon and earth system? • How far apart are the different bodies within our solar system/universe? • How can we represent the scale of the solar system in a defined amount of space? • How did the Space Race advance our understanding of the solar system and beyond?	• Our solar system formed about 4.5 billion years ago from a dense cloud of interstellar gas and dust. The cloud collapsed, possibly due to the shockwave of a nearby exploding star, called a supernova. When this dust cloud collapsed, it formed a solar nebula – a spinning, swirling disk of material. • The order and arrangement of the planets and other bodies in our solar system is due to the way the solar system formed. Nearest to the Sun, only rocky material could withstand the heat when the solar system was young. For this reason, the first four planets – Mercury, Venus, Earth, and Mars – are terrestrial planets. They are all small with solid, rocky surfaces. • The Space Race played a significant part in the Cold War as the Americans and Soviets competed to prove their technological and intellectual superiority by becoming the first nation to put a human into space. From beginning to end, the world's attention was captivated by this contest for dominance.
Demonstration of Learning:	**Pacing for Unit**
	15 class/blocks
Family Overview (link below)	**Integration of Technology:**
	Intentionally aligned use of digital tools and resources to support acquisition of content, researching, organizing and communicating learning

Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
Sun, Planet, Asteroid, Exoplanet, Comets, Gravity, Inertia, Orbit, Ellipse, Seasons, Axis/Axial tilt, Terrestrial, Gas Giants, Satellite, Solar energy, Mass, Moon, Phases, Crescent, Gibbous, Eclipse (Solar and Lunar), Umbra, Penumbra, Tides (Neap, Spring, High, Low), System, Luminosity, Surface features, Density, Atmosphere, Naked-eye viewing, Rings, Solstice, Equinox, Winds/weather, Erosion, Zenith, Asteroid, Meteoroid, Meteor, Meteorite, Crater, Tectonic plate activity, Volcano, Mass, Weight, Year, Atmosphere, Day/Night, Rotation, Revolution, Solar wind, Sun's layers and features, Core, Photosphere, Chromosphere, Radiative zone, Corona, Flares, Prominences, Sunspots, Magnetic field, Solar Storms, Aurora, Near-Earth Objects, Speed of light (light minutes), Kilometers, Astronomical Units, Dwarf planet, Habitable zone,	• Label the layers and identify the features of our sun • Station Lab for eclipses and tides: both solar and lunar, neap and spring • WebQuest/Lab • History Channel's The Universe: DVD series on planets, the moon, the sun, etc. • YouTube: Crash Course Astronomy • Solar System Scavenger Hunt • Solar System, Eclipses, Phases Task Cards • Solar System Quick Checks • Comparing Celestial Objects
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
Connections to Prior Units:	**Connections to Future Units:**

Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**
Expression & Communication • Use multiple media for communication • Express learning in flexible ways.	Compose in multiple media such as text, speech, drawing, illustration, comics, storyboards, design, film, music, dance/movement, visual art, sculpture, or video

Supporting Multilingual/English Learners	
Related *CELP standards:*	**Learning Targets:**
9-12.2 An EL can . . . participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.	• I can describe what it means to be a "system". • I can develop an initial model of the solar system. • I can examine and explain relative patterns of motions for Earth, Moon, and Sun. • I can explain how cycles are the basis for keeping time and a calendar.

Lesson Sequence	**Learning Target**	**Success Criteria/ Assessment**	**Resources**
1	• I can describe what it means to be a "system". • I can distinguish between the different objects in the solar system. • I can develop an initial model of the solar system.	• Compare and contrast celestial bodies (planet, moon, dwarf planet, asteroid, comet, meteoroid, etc) in the solar system	Solar System Bead Activity Kinesthetic Radial Model of the Solar System

		• I can examine the features and stats of bodies in the solar system. • I can model the solar system using images and explanations. • I can explain how the solar system is a system, including how the bodies interact with one another.	
2	• I can investigate the relationship between the Sun, Earth, and Moon system. • I can examine and explain relative patterns of motions for Earth, Moon, and Sun. • I can describe/model how Earth, Sun and moon cycles played a role in the development of a calendar.	• Explain how gravity organizes our solar system. • I can use the motions of the sun, earth and moon to explain the types of eclipses. • I can use the motions of the sun, earth and moon to explain the tides • I can use the motions of the sun, earth and moon to explain day and night • I can use the motions of the sun, earth and moon to explain the seasons • I can describe the reason that the appearance of the night sky and positions of the stars change at different times. • I can model/explain how celestial patterns allowed for the development of the calendar.	EarthMoonSun
3	• I can revise my solar system model to include accurate scale and deeper explanation of the system and its inner workings.	• Models should include descriptions of the motions and patterns of the earth, sun, and moon; the impact of gravity on the system, solar system bodies and their characteristics and statistics. Models should use astronomical units as the unit of measurement.	
4	• I can understand how the space race/exploration has changed over the	• I can understand what is meant by the term	

	past century. ● I can understand how the space race has impacted the study of the solar system.	space race. ● I can describe the historical changes to the space race over time. ● I can describe how the space race has impacted our understanding of the solar system and led to the development of new tools and technologies.. ● I can examine past explorations, such as the space race, as well as present day probes, Hubble space telescope, and space stations etc. and the future of space exploration ● I can develop a timeline/model to showcase the major events in space exploration.	

Unit Title:	
Understanding Stars	
Relevant Standards: Bold indicates priority	
• HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. • **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-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.**	
Essential Question(s):	**Enduring Understanding(s):**
• Why is the big bang theory the most widely accepted scientific explanation for the formation of the universe? • How do scientists think our universe will end/what do they predict about the future of our universe? • What evidence substantiates the big bang theory? • What evidence contradicts the big bang theory? • How does a star form? • What causes stars to shine? • How do stars change throughout their lifespan? • What drives the changes within a star? • What limits a star's life span? • How can we predict the lifespan of a distant star? • Where did all the known elements of the Universe come from? • How do scientists classify stars? • How do these classifications inform astronomers? • What happens to different stars when they run out of fuel?	• The best-supported theory of our universe's origin centers on an event known as the big bang. This theory was born of the observation that other galaxies are moving away from our own at great speed in all directions, as if they had all been propelled by an ancient explosive force. • Stars are born within the clouds of dust and scattered throughout most galaxies. As the cloud collapses, a dense, hot core forms and begins gathering dust and gas. Not all of this material ends up as part of a star — the remaining dust can become planets, asteroids, or comets or may remain as dust. • Stars are fueled by the nuclear fusion of hydrogen to form helium deep in their interiors. The outflow of energy from the central regions of the star provides the pressure necessary to keep the star from collapsing under its own weight, and the energy by which it shines. • All naturally occurring elements heavier than nickel are formed in the rare but spectacular cataclysmic explosions called supernovas
Demonstration of Learning:	**Pacing for Unit**
	15 blocks
Family Overview (link below)	**Integration of Technology:**
	Intentionally aligned use of digital tools and resources to support acquisition of content, researching, organizing and communicating learning
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
Big Bang, Edwin Hubble, Expansion, Contraction/collapse, Temperature, Elements, Singularity, Periodic Table, Supernova, Gases, Metals	• History Channel's The Universe: Life Cycle of a Star • Crash Course Astronomy on YouTube • Stellar Activity

(Iron), Spectral lines, Spectroscope, Doppler effect, Red shift, Blue shift, Brightness (Apparent and Absolute), Magnitude, Cosmic microwave background radiation, Composition, Mass, Fusion, Energy, Core, Evolution, Nucleosynthesis, Black Hole, Neutron Star, Atom, Nucleus, Proton, Neutron, Electron, Nebula (Stellar and Planetary), White dwarf, Black dwarf, Protostar, Red Giant, Blue Giant, Supergiants, Massive star, Average star, Hertzsprung-Russell diagram, Luminosity, Pulsar, Main sequence, Parallax, Gravity, Pressure, Age/Lifespan	• Luminosity and Brightness • H-R Diagram activities - Plotting, drawings • Phet Build an Atom • Star Magnitude worksheet • Universe Size Comparison 3D • Journey Through the Universe at the speed of light or Journey through the universe beyond the speed of light
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
	Students may confuse big bang with star formation, concepts will need to be discretely defined and discussed throughout the unit. Encourage students to draw connections between formation of stars and the Big Bang theory.
Connections to Prior Units:	**Connections to Future Units:**
Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**
Comprehension • Activate or supply background knowledge • Highlight patterns, critical features, big ideas, and relationships	• Anchor instruction by linking to and activating relevant prior knowledge (e.g., using visual imagery, concept anchoring, or concept mastery routines) • Use advanced organizers (e.g., KWL methods, concept maps). • Highlight or emphasize key elements in text, graphics, diagrams, formulas • Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships • Use multiple examples and non-examples to emphasize critical features • Use cues and prompts to draw attention to critical features • Highlight previously learned skills that can be used to solve unfamiliar problems
Supporting Multilingual/English Learners	
Related *CELP standards:*	**Learning Targets:**
9-12.6-An EL can . . .analyze and critique the arguments of others orally and in writing.	• I can cite evidence of the Big Bang theory. • I can compare and explain current theories that describe the “death” of the universe.

Lesson Sequence	Learning Target	Success Criteria/ Assessment	Resources

1	• I can cite evidence of the Big Bang theory. • I can recall/investigate where known elements of the Universe come from. • I can examine and explain how the laws of physics that govern Earth are the same that govern the rest of the universe.	• I can identify elements on the periodic table and connect them to their stellar evolution. • I can explain the different cosmic events that form the elements. • I can explain the universal law of gravitation and how it applies to all bodies, including stars. • I can use evidence of light spectra, motion of distant galaxies, composition of matter in the universe to explain the Big Bang Theory.	• Phet Build an Atom
2	• I can compare the formation of a star to the big ban. • I can examine and explain different stars' life cycles based on their mass • I can hypothesize how/why stars evolve to their deaths. • I can develop a model to illustrate the life span of our sun and the role of nuclear fusion in the sun's core to release energy. • I can compare and explain current theories that describe the "death" of the universe.	• I can define similarities and differences between star formation and the big bang theory. • I can understand the stages of the star's life cycle and the balance of energy and gravity. • I can explain how a star's fuel changes throughout its life cycle and how that impacts the color, shape and size of the star. • I can compare and contrast big crunch, big freeze, and the big rip theories in regard to the death of the universe.	• Universe Size Comparison 3D • History Channel's The Universe: Life Cycle of a Star • Crash Course Astronomy: Stars, High Mass Stars, Low Mass Stars, etc.
3	• I can use data to support the claim that a star's brightness as observed from Earth is a function of both distance and actual brightness. • I can apply learning from star life cycles to understand the Sun. • I can examine solar storms and their impact on earth.	• I can define the Sun's current life cycle phase. • I can define 3 types of solar storms and how they impact Earth.	

Unit Title:	
The Universe	
Relevant Standards: Bold indicates priority	
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.	
Essential Question(s):	**Enduring Understanding(s):**
• *What are the relative sizes and distances of objects in the universe?** • *What does it mean to be "looking back in time" when we observe the universe?** • *What causes/How does our night sky change over time? ** • What do we see in our night sky from Earth, compared to what we see from the Hubble telescope? • *How does light and the speed of light help us understand the universe?** • What did the Hubble deep field reveal to us? • *What created our universe, and what are some theories about the end of the universe?* • *What evidence do we have of the big bang, and the ever-expanding universe?** • What is the probability that life exists elsewhere in the universe? • What are the different types of galaxies? • What are objects we find in deep space beyond our galaxy? • What do we know about our own galaxy, as well as others? • What happens when galaxies or other objects interact or collide? • What are the key events and individuals in history that have led to our current understanding of space or have allowed for deeper space exploration? • What does future space exploration involve? **continued from previous unit*	• Hubble takes sharp pictures of objects in the sky such as planets, stars and galaxies. Hubble has made more than one million observations. These include detailed pictures of the birth and death of stars, galaxies billions of light years away • As Hubble orbits Earth, the Fine Guidance Sensors lock onto stars. The Fine Guidance Sensors are part of the Pointing Control System and aim Hubble in the right direction. The telescope can lock onto a target that is one mile away without moving more than the width of a human hair. • The Drake equation is a probabilistic argument used to estimate the number of active, communicative extraterrestrial civilizations in the Milky Way Galaxy. • Scientists sometimes categorize galaxies based on their shapes and physical features. Other classifications organize galaxies by the activity in their central regions – powered by a supersized black hole – and the angle at which we view them. • Many large galaxies can attract a smaller galaxy. The gravity of the large galaxy will pull the smaller one towards it, creating a collision. If one galaxy has enough momentum, the galaxy with enough movement or momentum could keep moving away after the collision. However, most galaxies are pulled towards one another and do not continue moving past each other because they do not have enough momentum and the gravitational pulls are too strong to escape. • Future space exploration will potentially involve expeditions and the other planets and settlements on the moon as well as establishing mining and fueling outposts, particularly in the asteroid belt. Physical exploration outside the solar System will be robotic for the foreseeable future.
Demonstration of Learning:	**Pacing for Unit**
	10 blocks

Family Overview (link below)	**Integration of Technology:**
	Intentionally aligned use of digital tools and resources to support acquisition of content, researching, organizing and communicating learning
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
Galaxy, Stars, Quasar, Interstellar, Expansion, Big Bang, Dark matter, SETI, Drake Equation, Hubble Deep Field, Big Crunch, Big Freeze, Big Rip, Black Holes	• Big Bang Activities • Big Bang and Structure of Universe • TedEd: 3 Ways the Universe Could End • Big Bang Evidence Workbook • Quick Checks - Big Bang • Crash Course Astronomy: Galaxies parts 1&2 • History Channel's The Universe
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
Connections to Prior Units:	**Connections to Future Units:**

Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**
Comprehension • Activate or supply background knowledge	Bridge concepts with relevant analogies and metaphors Use advanced organizers (e.g., KWL methods, concept maps)

Supporting Multilingual/English Learners	
• **Related *CELP* standards:**	**Learning Targets:**
An EL can . . . participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.	All targets in this unit.

Lesson Sequence	**Learning Target**	**Success Criteria/ Assessment**	**Resources**
1	• I can examine the evidence for answering the question "Are we alone?" • I can explain the Drake Equation's significance.	• I can access and use SETI information to examine the question, "Are we alone?". • I can analyze evidence and determine its legitimacy. • I understand all of the parts of the Drake equation.	Student Reading: History of SETI SETI Institute Cosmos: Traveller's Tales (Voyager's golden record) The Golden Record and Voyager-The Golden Record

		• I can explain the importance of the Drake equation and the SETI program.	
2	• I can explain the ways in which the use of the Hubble telescope has revealed the age and scope of the universe. • I can describe the types of celestial bodies found throughout deep space. • I can explain the statement that "using a telescope is like looking back in time".	• I can describe how data from the Hubble explains the expansion of the universe. • I can describe how data from the Hubble helps scientists define the age of the universe.	The 1995 Hubble photo that changed astronomy
3	• I can define how scientists use light spectra to gain a deeper understanding of the universe. • I can distinguish between redshift and blueshift and explain how the light shifts provide information about the	• I can identify stars that are receding or approaching Earth. • I can explain redshift/blueshift as evidence of the expansion of the universe.	Red shift Blue shift webquest Bozeman Science: Doppler Effect on YouTube