Title	**Roxbury High School Astronomy**
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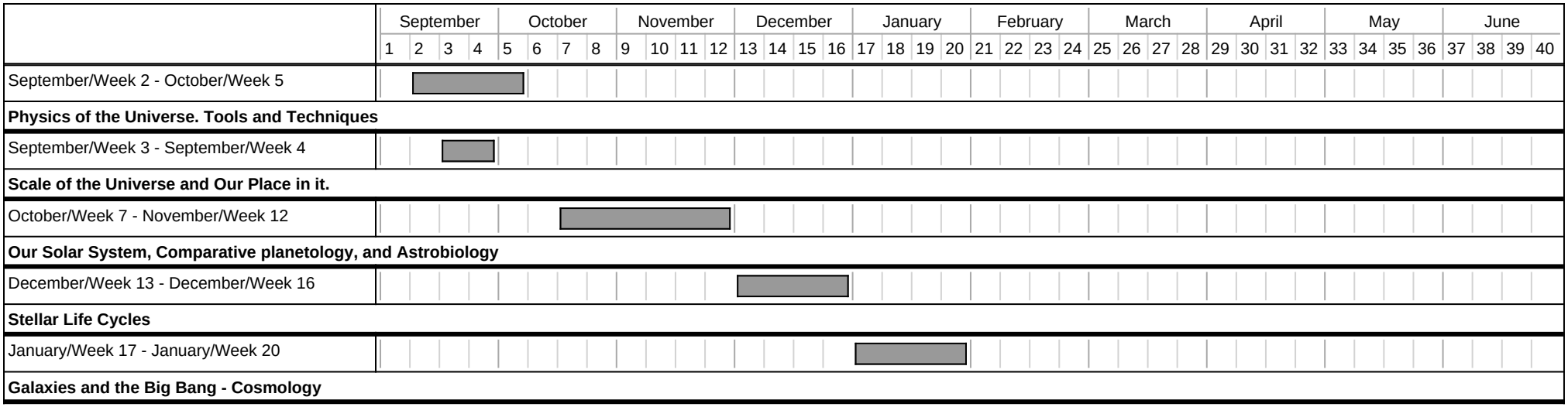
Subject	Science
Course	-SCIENCE-
Grade(s)	11 , 12
Location	
Curriculum Writing History	
Notes	
Attachments	

Title : Roxbury High School Astronomy
Type : Consensus



Title : Roxbury High School Astronomy
Type : Consensus

Duration: September/Week 2 - October/Week 5					
UNIT NAME: Physics of the Universe. Tools and Techniques					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Technology is vital in investigating the Universe. Physics is the search for understanding to everyday phenomena. Motion is caused by an imbalance of forces. The universe is a vast single system in which the basic principles are the same everywhere. Object's motion will change based upon the gravitational attraction between itself and another object. Light is the primary sensor to how the universe behaves. Optical, radio wave and gamma/ x-ray telescopes are used in various situations depending on the surroundings of the telescope to "view" celestial bodies. The seven types of electromagnetic radiation are: Gamma rays, X-rays, Ultraviolet light, visible	To what extent do the interactions of objects in our Solar System cause observable phenomena? Why is it necessary to use models to understand and explain the interactions of objects in the universe? What are Kepler's three laws of planetary motion? How does Newton's law of circular motion relate to the motion of Earth, Moon and Sun? What are the seven types of electromagnetic radiation? How are they related to one another? How do they help us to learn about the universe in which we live? Why are different styles of telescopes used to collect information about the various celestial bodies? Why is it important to make astronomical observations in different regions of the electromagnetic spectrum.	Universal principles of gravitation allow predictions regarding the motions of objects within the Galaxy and beyond. Earth's motion, position, and posture account for a variety of cyclic events observable from Earth. While the composition of planets vary considerably, their components and the applicable laws of science are universal. Humanity's view of the Solar System has expanded enormously as a result of our exploration of outer space. Describe the major contributions of Galileo and Kepler to the development of our understanding of the solar system. State Kepler's laws of planetary motion. Evaluate the types of telescopes used by astronomers for examining different frequencies of	Describe current efforts and technologies used to study the universe, including optical telescopes, radio telescopes, satellites, space probes, spectroscopes, high altitude platforms, and explain how their research impacts human activity. Apply Kepler's Laws and Newton's Universal Law of Gravitation to planetary motion. • Explain how Kepler's laws allow us to construct a scale model of the solar system, and explain the technique used to determine the actual size of the planetary orbits. • State Newton's laws of gravitation and explain how they account for Kepler's laws. • Explain how the law of gravitation enables us to measure the masses of astronomical bodies. Explain the tools used by astronomers to study		HS.ESS1.1.SEP.1-Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HSESS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.1.CCC.1-The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1) (09-12)[Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.SEP.1-Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' ow n investigations, models,

light, Infrared light, Micro waves, and Radio waves. They all travel at the same speed (3.0 x 108 m/s). They can show how galaxies are moving toward or away from an observer.		electromagnetic radiation and compare and contrast the uses and advantages of each (e.g. radio, visible, gamma ray, reflector, and refractor Discuss the nature of electromagnetic radiation and tell how that radiation transfers energy and information through interstellar space. Tell how we can determine the temperature of an object by observing the radiation that it emits.	electromagnetic radiation to determine composition, motions, and other physical attributes of astronomical objects. Use spectroscopes to identify various elements. • Use the lab collected data to explain the relation between emission and absorption lines and what we can learn from those lines. • Describe the general features of spectra produced by molecules. • List and explain the kinds of information that can be obtained by analyzing the spectra of astronomical objects. Demonstrate how the relative motion between a source of radiation and an observer can change the perceived wavelength of the radiation, and explain the importance of this phenomenon to astronomy.		theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CNS.1-A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CNS.2-Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-ESS1-2) (09-12)

					[Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CNS.3-Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.ESS1.A.1-The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.PS4.B.4-Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CCC.1-Energy cannot be created or destroyed–only moved between one place and

					another place, between objects and/or fields, or between systems. (HS - ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.3.SEP.1- Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4-Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.SEP.1-Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards

					(NGSS)] HS.ESS1.4.DCI.ESS1.B.1- Kepler's law s describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Astronomy
Type : Consensus

Duration: September/Week 3 - September/Week 4					
UNIT NAME: Scale of the Universe and Our Place in it.					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Measurement and observation tools are used to categorize, represent and interpret the natural world. Evidence is used for building, refining, and/or critiquing scientific explanations. Scientific knowledge builds itself over time. The earth is a component of a larger set of celestial objects, and relies on their motions and behaviors. The earth's motions determine our daily behaviors and variations can have significant effects on us. Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges. .	How have scientific discoveries affected human perception of the earth? How and why do astronomers make conceptual models? What is astronomy? What is our place in the Universe? What role do constellations play in astronomy today? How do we measure the universe? What can I see from my back yard? What am I actually looking at and what can it tell me about the universe? How would you describe the geocentric theory of the universe? Why was the heliocentric theory of the universe adopted over the geocentric theory? How and why do the Sun,	Astronomy is the study of the universe: from the Earth itself to the most distant galaxy,from deciphering its nature at the beginning of time to predicting its eventual fate in the remote future. Astrophysics is the branch of science in which physical laws are applied to interpret astronomical observations and derive chemical and physical properties of remote objects. We exist in a solar system that is part of a galaxy which is travelling with a group of galaxies in the universe. Special units are used in astronomy due to the scale of the universe. The geocentric theory of the universe was questioned by those astronomers who believed that the epicycles proposed by Ptolemy were to complicated to be a true explanation for the motion of the planets.	Explore how science and society interact and how each affects the other. Identify and describe the components of the solar system and the universe. Use dimensional analysis to model size and motion in space Identify and describe the components of the universe. Describe the position of the solar system in the Milky Way galaxy and the universe. Identify the correct units to use for varying objects in the Universe. Analyze the dynamic nature of astronomy by comparing and contrasting evidence supporting current views of the universe with historical views Students will describe and explain the celestial sphere and astronomical observations made from the point of reference of the		HS.ESS1.2.CNS.1-A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CNS.2-Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CNS.3-Science assumes the universe is a vast single system in which basic

	Moon and stars appear to change their positions from night to night and from month to month.		Earth. •Utilize Right Ascension and Declination to map the sky. Explain the concept of the celestial sphere and how we use angular measurement to locate objects in the sky. Calculate appropriate units for appropriate celestial objects.		laws are consistent. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.3.SEP.1-Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4-Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Astronomy
Type : Consensus

Duration: October/Week 7 - November/Week 12					
UNIT NAME: Our Solar System, Comparative planetology, and Astrobiology					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago. Our solar system has a star (sun), planets, and moons. There is real and apparent motion in our solar system. The Earth is unique compared to the other planets in our solar system. The planets of our solar system differ in size, composition (rock or gas), surface and atmospheric features, and distance from the sun. Planets move around the sun in nearly circular orbits. Other planets have been found beyond our own solar system that challenging our current	How and why are the he planets divided into two groups. What are the real and apparent motions in our solar system? How is our Earth unique compared to other planets in our solar system? To what extent do the interactions of objects in our Solar System cause observable phenomena? How does the current model of the solar system differ from past models? How can we characterize the habitable zone in solar systems and habitable planetary bodies in our own and other solar systems. What are the tools and techniques used to identify extrasolar planets and explore extrasolar planetary atmospheres. What are the odds of intelligent life in our galaxy?	The inner planets are smaller, closer to the sun, and have rocky surfaces, while the outer planets are larger, farther from the sun and do not have solid surfaces. Inertia and gravity combine to keep the planets in orbit. The mass of an object and the distance between objects determine the force of gravity. Our solar system is a single star system, but is located in the Milky Way Galaxy, which contains other single stars, double stars, star systems, and dust and gas. The size of our solar system is relative to the objects it is being compared to. The solar nebula theory accurately describes the evolution of our solar system and the observations of the planets. However, it does not explain all solar system formation.	Compare and contrast the major properties of the components of our solar system. • Discuss the importance of comparative planetology to solar system studies. Describe the overall scale and structure of the solar system. Outline the theory of solar-system formation that accounts for the overall properties of our planetary system. Utilize the drake equation to estimate the odds of intelligent life. Then debate Carl Sagan logic verse the Fermi Paradox. Calculate the temperatures Venus and Earth should be without a greenhouse effect. • Describe the characteristics of Venus' atmosphere and contrast it with that of Earth.		HS.ESS1.2.CNS.1-A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.PS4.B.4-Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CET.1-

models of solar system formation. Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system.		Hypothesizing about "alien" life is a difficult prospect due to the unknown nature of the possibilities. The New Horizons Space Craft has discovered interesting new data about Pluto. Summarize the orbital and physical properties of Pluto and explain how the Pluto – Charon system differs from other planets. Comets and asteroids are left over material from the early accretion of the planets.	• Explain why the greenhouse effect has produced conditions on Venus very different from those on Earth Compare the surface features and geology of Mars and those of the Moon and Earth, and account for these characteristics in terms of Martian history. • Discuss the evidence that Mars once had a much denser atmosphere and running water on its surface. • Compare the atmosphere of Mars with that of Earth and Venus, and explain why the evolutionary histories of these three worlds diverged so sharply. Calculate the distance, mass, and density of extrasolar planets. Outline the properties of known extra-solar planets, and explain how they differ from planets in the solar system.		Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HSESS1-2), (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.3.DCI.ESS1.A.1-The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.DCI.ESS1.B.1-Kepler's law s describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.CCC.1-Algebraic thinking is used

					to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth v s. exponential growth). (HS-ESS1-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS1.5.DCI.PS1.C.1- Spontaneous radioactive decay s follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5), (secondary to HS-ESS1-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.6.DCI.ESS1.C.1- Although active geologic processes, such as plate tectonics and erosion, have destroy ed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of y ears. Studying these objects can provide information about Earth's formation and early history . (HS-ESS1-6) (09-12) [Regional:Next Generation

Title : Roxbury High School Astronomy
Type : Consensus

					Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Astronomy
Type : Consensus

Duration: December/Week 13 - December/Week 16					
UNIT NAME: Stellar Life Cycles					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Stars experience significant changes during their life cycles, which can be illustrated with a Hertzspring- Russell (H-R) diagram. Both high mass and low mass stars begin life in a nebula. High mass stars have higher temperatures, larger stars and shorter life spans. The Sun, a low mass, average, main sequence star will become a red giant, planetary nebula, white dwarf and eventually die as a black dwarf. It will never become a black hole. The source of the Sun's energy is the fusion of hydrogen atoms into helium, a process common in relatively young stars. Most elements are formed as a result of natural astronomical processes, either in the Big Bang itself or in the natural evolution of stars.	What is the difference in life cycle between a low mass and high mass star? What is the next step in the life cycle of our Sun? How do scientist study stars that are incredibly far away. How do scientists explain the origin of all elements heavier than helium? How do supernovae help us measure the size of the universe?	The Sun's influence on Earth include gravity, (which maintains Earth's orbit), electromagnetic radiation (which provides energy for living things), and energetic particles such as coronal mass ejections that can cause electromagnetic disturbances. The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. A hertzsprung diagram is	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. [Communicate scientific ideas about the way stars, over their life cycle, produce elements. Develop an HR diagram and then calculate star properties and distances from the derived data. • 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 • Relate nuclear fusion reactions and mass-energy equivalence to the life cycle of stars. Explain and compare nuclear reactions (radioactive decay, fission		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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.1.SEP.1-Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HSESS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.1.DCI.ESS1.A.1-The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HSESS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.1.DCI.PS3.D.2-Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to

		a way to classify stars that can be used to calculate mass, luminosity, temperature, color, and life cycle evolution. The Universe continually recycles matter through stars and the interstellar medium. Supernovae Type 1A are used as a standard candle for the size of our universe.	and fusion), the energy changes associated with them and their associated safety issues Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, and strong nuclear) Describe the properties of neutron stars. And explain how these strange objects are formed. Describe how black holes are formed, and discuss their effects on matter and radiation in their vicinity. • Relate the phenomena that occur near black holes due to the warping of space around them. • Discuss the difficulties that arise in observing black holes, and explain some of the ways in which the presence of a black hole might be detected. Describe the two types of supernovae, and explain how each is produced.		HS-ESS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.SEP.1-Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' ow n investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.ESS1.A.1-The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-

			• Describe the observational evidence for the occurrence of supernovae in our Galaxy. Investigate and demonstrate understanding of the differences in variable stars, binary star groups and clusters. Students can identify discoveries by Henrietta Leavitt and Harlow. Explain bending of starlight and effects of speed of light travel including time dilation in terms of the theory of relativity.		ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.ESS1.A.3-Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy . Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.PS4.B.4-Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.3.CCC.1-In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3)

					(09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.SEP.1-Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.DCI.ESS1.B.1-Kepler's law s describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.CCC.1-Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth v s. exponential growth). (HS-ESS1-4) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Astronomy
Type : Consensus

Duration: January/Week 17 - January/Week 20					
UNIT NAME: Galaxies and the Big Bang - Cosmology					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Cosomology is the study of the universe, including its properties, structure, and evolution. The model that most accurately describes the birth and current state of the universe is the big bang theory. Galaxies can be generally categorized into three groups that describe and evolutionary process. The Milky Way galaxy is in the form of a barred spiral. Galaxies are some of the largest collections of matter in the Universe, and we reside in one. • Several billion years ago the Universe was extremely hot and dense and some event caused it to expand and to continue to expand today. General knowledge of the Universe, its structure and future, is still in preliminary stages.	How did the Universe begin? Why do theories of the origin of the universe change? How does our current model of the universe differ from the past? What defines a galaxy? How do we know galaxies exist? How and why are galaxies classified? How do we know galaxies are moving away from us? How have astronomers determined the distances to galaxies? What is the role of dark matter in galaxy formation? How is the Universe organized? How did the Universe begin? How can we tell how old	The Milky Way is our barred spiral galaxy Where our solar system is located in the galaxy. The milky way formed as a result of mergers with other galaxies approximately 10 billion years ago. Galaxies are classified by shape which is a function of their evolutionary history. The Hubble Tuning Fork is the tool used to classify galaxies. The difference between active and inactive galaxies can best be identified from the presence of quasars. Hubble's Law is used to calculate the distance to other galaxies. The farther away the galaxy is the faster it is moving. The Big Bang Theory is currently the most widely accepted and supported explanation for the	Classify galaxies using the Hubble Classification Scheme based on their characteristics. Conduct an investigation simulating the period luminosity relationship of variable stars and demonstrate reasoning and logic in explaining how they define the shape of our galaxy and the evidence for the existence of galaxies. Distinguish between different populations of stars and types of clusters, reddening and extinction. Label a drawing of the Milky Way Galaxy indicating all major components and describe the formation of structure and the gravity wave theory. Investigate and demonstrate rotational movement of the Milky Way Galaxy based on observed Doppler shift of 21 cm radiation. Investigate and		HS.ESS1.1.DCI.ESS1.A.1-The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HSESS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.1.DCI.PS3.D.2-Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.1.CCC.1-The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1) (09-12)[Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation

Dark matter and dark energy are theoretical parts of the Universe that may be causing the objects in the Universe to expand away from its origin.	the universe is? What is the history of the universe according to the Big Bang theory? What is occurring to the Universe? How do we know the Universe is changing? What will occur to the Universe in the future?	formation of our universe. The universe is currently expanding. Evidence of that expansion is provided by red shift and cosmic background radiation. The age of the Universe can be determined by using Hubble's Constant. Studies of galactic rotation reveal the size and mass of the galaxy and rotational velocity is evidence for dark matter.	demonstrate understanding of the major classification of galaxies and events leading to their formation including interrelationships of gravitational forces; angular momentum and density waves. Describe the supragalactic structure of the Universe including clusters. Analyze evidence that demonstrates the expansion of the Universe by plotting Hubble's relationship and applying scientific reasoning. Compare and contrast Big Bang versus Steady State cosmologies as well as open, closed, and oscillating universes. • The student will relate events surrounding the discovery of the primordial background radiation to the events surrounding the origin of the universe.		Science Standards (NGSS)] HS.ESS1.2.SEP.1-Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' ow n investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CNS.1-A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards

					(NGSS)] HS.ESS1.2.CNS.3-Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.ESS1.A.1-The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.ESS1.A.2-The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.ESS1.A.3-Other than the hydrogen and helium formed at the time of the Big Bang,

					nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy . Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.DCI.PS4.B.4-Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CCC.1-Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. (HS - ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CET.1-Science and engineering complement each other in

					the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HSESS1-2), (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.3.CCC.1-In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS1.4.DCI.ESS1.B.1-Kepler's law s describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					