

## Carter County NGSS Science Curriculum

Unit Title/Topic: Astronomy	Grade: 9th	Time: 6 weeks
<p><b>Performance Expectations:</b>  <b>Students who demonstrate understanding can:</b>            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. <b>[Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]</b>            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. <b>[Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]</b>            HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements. <b>[Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.]</b>            HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. <b>[Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.]</b></p>		
<p><b>Learning Targets/I Cans:</b>            I can explain the Big Bang Theory and evidence that supports this theory.            I can use the HR Diagram to describe and classify characteristics of stars.            I can describe the stellar evolution of stars located in various positions on the HR Diagram.            I can describe how gravitational laws can predict motion of interstellar bodies.</p>		
<p><b>Science and Engineering Practices</b>            Developing and Using Models  <b>Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).</b>  <ul style="list-style-type: none"> <li>▪ Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HSESS1-1)</li> </ul>           Using Mathematical and Computational Thinking  <b>Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for</b></p>	<p><b>Disciplinary Core Ideas</b>  <b>ESS1.A: The Universe and Its Stars</b>  <ul style="list-style-type: none"> <li>▪ The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HSESS1-1)</li> <li>▪ 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)</li> <li>▪ 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</li> </ul></p>	<p><b>Crosscutting Concepts</b>  <b>Scale, Proportion, and Quantity</b>  <ul style="list-style-type: none"> <li>▪ The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)</li> <li>▪ Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-ESS1-4)</li> </ul> <b>Energy and Matter</b>  <ul style="list-style-type: none"> <li>▪ 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)</li> <li>▪ In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HSESS1-3)</li> </ul> <hr/> <b>Connection to Engineering, Technology,</b></p>

**statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.**

- Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)

Constructing Explanations and Designing Solutions

**Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.**

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own 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)

Obtaining, Evaluating, and Communicating Information

**Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.**

- 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)

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Connections to Nature of Science  
 Science Models, Laws, Mechanisms, and Theories  
 Explain  
 Natural Phenomena

- 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)

(cosmic microwave background) that still fills the universe. (HS-ESS1-2)

- 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)

**ESS1.B: Earth and the Solar System**

- Kepler’s laws 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)

**PS3.D: Energy in Chemical Processes and Everyday Life**

- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1)

**PS4.B Electromagnetic Radiation**

- 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)

**and Applications of Science Interdependence of Science, Engineering, and Technology**

- 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)

**Connection to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- 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)
- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2)

**Critical Content Vocabulary:**  
 Gravity  
 HR Diagram  
 Fusion  
 Big Bang Theory  
 Stellar Evolution

**Resources:**

