

ASTRONOMY CURRICULUM

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Brief Summary of Unit:

PRE-REQUISITE SKILLS: Basic graphing skills (X & Y axis and plot 2 variables) and general laboratory skills (measurement and utilization of basic science equipment), basic navigation on the internet for gathering research materials.

The primary focus of this unit is to understand the processes of astronomy. The processes include formation of the universe and solar system, the roll of gravity in the formation and motion of planets, using the HR diagram to explain star characteristics and life spans, describing how we use light to study the universe and the processes in the sun that provide us with energy.

BELOW LEVEL ACTIVITIES: If students are struggling with this material, differentiation of instruction could include use of fewer, more simplified vocabulary words and definitions; chunked content with notes outline; a simplified, graphic organizer for key concepts.

EXTENSION ACTIVITIES for advanced learners could include real data that would require more complex graphical representation and breakdown of data; more complex examples; more complex activities; and additional article research via scientific online resources.

Materials and Resources

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| <ul style="list-style-type: none">• Teacher developed presentations.• Teacher developed laboratory exercises.• PhET online simulations. | <ul style="list-style-type: none">• Materials necessary to complete the performance tasks.<ul style="list-style-type: none">• Planetarium• Spectra scopes and Light sources• H-R Diagram Resources• Doppler Resources• Data Studio software• Materials necessary to perform hands-on labs. |
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ELIGIBLE CONTENT

3.3.10. B Origin and Evolution of the Universe

*Students will be able to use their learning independently to:***1- Composition and Structure**

3.3.10.B1.-Explain how gravity is responsible for planetary orbits.

3.3.10.B1.-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.-Provide evidence to suggest the Big Bang Theory

3.3.10.B1.-Describe the basic nuclear processes involved in energy production in a star.

3.3.12.B1.-Describe the **life cycle** of stars based on their mass.3.3.12.B1.-Analyze the influence of **gravity** on the formation and life cycles of galaxies (including our own Milky Way), stars, planetary systems, and residual material left from the creation of the solar system.3.3.12.B1.-Relate the **nuclear processes** involved in energy production in stars and supernovas to their **lifecycles**.**2-Unifying Themes****3.310.B2.-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.

3.310.B2.-CONSTANCY AND CHANGE

Describe changes in the universe over billions of years.

3.310.B2.-SCALE AND MEASUREMENT

Explain the scale used to measure the sizes of stars and galaxies and the distances between them.

3.3.12.B2.-MODELS AND SCALE

Apply mathematical models and computer simulations to study evidence collected relating to the extent and composition of the universe.

3.312.B2.-PATTERNS OF CONSTANCY AND CHANGE

Analyze the evidence supporting theories of the origin of the universe to predict its future.

Understandings	Essential Questions
<ul style="list-style-type: none"> ● Definition & properties of stars including the process that makes energy in their cores ● Diagram life-cycles of stars based on mass with emphasis on formation of black holes. ● Interpret H-R diagrams for star characteristics and life spans ● Know the affect of the Doppler Effect on the star spectrum (red/blue shift) ● Kepler's Laws of Planetary Motion - Inertia & Gravity ● Provide evidence for the Big Bang Theory (Doppler Red shift, microwave radiation ,etc) ● Explain the processes that led to the formation of the Universe and Solar System ● Describe the technology that is used to study the exosphere (telescopes, spectra) ● Use units of distance to comprehend the scale of size and distance in the universe ● Constellations can be used to identify time of year. ● Galaxies are classified by shape and size and can be used to determine distances and speed. ● Our solar system can be characterized as having two classes of planets, dwarf planets, comets and asteroids. ● Relate the relative position of the moon and Earth to Moon phases, Tides and Eclipses. ● Explain how our current technology is being used to locate exoplanets, identify their atmospheres, and identify if they are located in their stars' habitable zone. ● Explain the following consequences of the theory of special relativity: time dilation, length contraction , and mass increase. 	<ul style="list-style-type: none"> ● What are the properties of stars and how do they vary? ● How do stars produce energy in their cores? ● What determines the life cycle of stars? ● How are luminosity and temperature related on the HR diagram? ● How can the Doppler Effect support the Big Bang Theory and describe stellar motion? ● What role does gravity play in the formation of the solar system? ● How do inertia and gravity play a role in the shape of the orbits? ● What is the difference between the Big Bang Theory and The Nebular Theory ● How do we describe distances in the Solar System and Universe? ● How is light used to study the Universe? ● How does the sun's passage through the zodiac constellations reflect the time of year? ● What are the different classifications of galaxies? ● How can we distinguish between planets and other objects in the solar system based on characteristics? ● What are the different phases of the moon? ● How are the location and properties of exoplanets identified? ● How is the constancy of the speed of light related to time dilation, length contraction and mass increase?
Knowledge	Skills
<ul style="list-style-type: none"> ● <u>Vocabulary:</u> Doppler Effect, red shift, blue shift, Big Bang Theory, H-R Diagram, luminosity (absolute brightness), apparent brightness, fission, fusion, nebula theory, inertia, gravity, star, main sequence, (black/ white) 	<ul style="list-style-type: none"> ● Interpret H-R diagram ● Identify stages in formation of stars ● Distinguish between absolute & apparent brightness ● Recognize how the Big Bang Theory is supported by the expanding

dwarf, giant (supergiant) nova, supernova, black hole, planetary nebula, inertia, gravity, astronomical unit, light-year, telescopes, the EMR spectrum, spectra, spectroscopes

universe

- Describe how fusion plays a role in a star's energy production
- Model the planetary orbits based on Kepler's Laws
- Identify components of stars using their spectra
- Calculate the distance of an Astronomical Unit and Light year
- Differentiate between winter, summer and circumpolar constellations.
- Differentiate between solar and lunar eclipse
- Apply algebraic skills to relativity problems

Evidence of Understanding

Performance Tasks

- Written assessments: Vocabulary quizzes, unit tests (with SAS questions)
- Graphing: HR diagram, crater depth vs. speed, length vs. speed (relativity)
- Scale models of : solar system distances and sizes, cosmological time
- Illustrations of electromagnetic spectra, parallax, Big Bang Theory, Milky Way & other galaxy shapes
- Laboratory sessions on: Identify Galaxies, Stellar Parallax
- Internet simulations: Stellar Spectra, Big Bang Theory, Moon phases
- Mathematical calculations of distances (AU and LY)

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
<ul style="list-style-type: none">● Bell ringers● Correct/Incorrect model.● Laboratory reports● Simulation summaries.● Graphing	<ul style="list-style-type: none">● Written assessments: Vocabulary quizzes, unit tests (with SAS questions)● Graphing: HR diagram● Illustrations of electromagnetic spectra, parallax, Big Bang Theory, Milky Way & other galaxy shapes● Laboratory sessions on: Identifying Galaxies, Stellar Parallax● Internet simulations: Stellar Spectra, Discovery Learning Big Bang Theory

*can be embedded into formative and summative assessments.

Integration of ELA Common Core Standards (*The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted*)

Reading/Writing in Science and Technical Subjects

[CCSS.ELA-Literacy.RST.9-10.1](#) Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

- Students will read and analyze an article from an online science journal, regarding human activity that is thought to affect climate change. Students will write a one-two paragraph summary of the article, focusing only on two of the specific examples of evidence involving human activity and climate change.

[CCSS.ELA-Literacy.RST.9-10.2](#) Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

- Students will read and analyze an article from an online science journal, regarding the dangers of introducing nonnative species into an ecosystem. Students will write a one page summary of the article, explaining what a nonnative species is and the effects they have on ecosystems when introduced.

[CCSS.ELA-Literacy.RST.9-10.3](#) Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

[CCSS.ELA-Literacy.RST.9-10.4](#) Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.

- In an effort to further stress the difference between biotic and abiotic factors, students will complete an activity in which students, given a list of living and nonliving factors, will write a narrative explanation as to why each factor should be classified and “biotic” or “abiotic.”

[CCSS.ELA-Literacy.RST.9-10.5](#) Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

[CCSS.ELA-Literacy.RST.9-10.6](#) Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

[CCSS.ELA-Literacy.RST.9-10.7](#) Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

[CCSS.ELA-Literacy.RST.9-10.8](#) Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

[CCSS.ELA-Literacy.RST.9-10.9](#) Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

[CCSS.ELA-Literacy.WHST.9-10.1](#) Write arguments focused on *discipline-specific content*.

[CCSS.ELA-Literacy.WHST.9-10.1a](#) Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.

[CCSS.ELA-Literacy.WHST.9-10.1b](#) Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns.

[CCSS.ELA-Literacy.WHST.9-10.1c](#) Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

[CCSS.ELA-Literacy.WHST.9-10.1d](#) Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

[CCSS.ELA-Literacy.WHST.9-10.1e](#) Provide a concluding statement or section that follows from or supports the argument presented.

[CCSS.ELA-Literacy.WHST.9-10.2](#) Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

[CCSS.ELA-Literacy.WHST.9-10.2a](#) Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting

(e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

[CCSS.ELA-Literacy.WHST.9-10.2b](#) Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

[CCSS.ELA-Literacy.WHST.9-10.2c](#) Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.

[CCSS.ELA-Literacy.WHST.9-10.2d](#) Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

[CCSS.ELA-Literacy.WHST.9-10.2e](#) Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

[CCSS.ELA-Literacy.WHST.9-10.2f](#) Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

[CCSS.ELA-Literacy.WHST.9-10.4](#) Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

[CCSS.ELA-Literacy.WHST.9-10.5](#) Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

[CCSS.ELA-Literacy.WHST.9-10.6](#) Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

[CCSS.ELA-Literacy.WHST.9-10.7](#) Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

[CCSS.ELA-Literacy.WHST.9-10.8](#) Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

[CCSS.ELA-Literacy.WHST.9-10.9](#) Draw evidence from informational texts to support analysis, reflection, and research.

[CCSS.ELA-Literacy.WHST.9-10.10](#) Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.