

2019 H CHEM Unit 6: The Universe and the Stars

Content Area: **Science**
Course(s): **Chemistry**
Time Period: **May**
Length: **20 days**
Status: **Published**

Unit Overview:

In this unit of study, energy and matter are studied further by investigating the processes of nuclear fusion and fission that govern the formation, evolution, and workings of the solar system in the universe. Students examine the processes governing the formation, evolution, and workings of the solar system and universe. Some concepts studied are fundamental to science, such as understanding how the matter of our world formed during the Big Bang and within the cores of stars. Others concepts are practical, such as understanding how short-term changes in the behavior of our sun directly affect humans. Engineering and technology play a large role here in obtaining and analyzing the data that support the theories of the formation of the solar system and universe. The crosscutting concepts of patterns; scale, proportion, and quantity; energy and matter; and interdependence of science, engineering, and technology are called out as organizing concepts for these disciplinary core ideas. Students demonstrate proficiency in developing and using models; using mathematical and computational thinking, constructing explanations; and obtaining, evaluating, and communicating information; and to use these practices to demonstrate understanding of the core ideas.

Enduring Understandings:

- Nuclear fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.
- 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.
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and nonstellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
- The significance of the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth is dependent on the scale, proportion, and quantity at which it occurs.
- 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.
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Essential Questions:

- How can chemistry help us to figure out ancient events?
- How do stars produce elements?
- How is Kepler's Law used to explain elliptical orbits?
- If there was nobody there to Tweet about it, how do we know that there was a Big Bang?
- Is the life span of a star predictable?

Standards/Indicators/Student Learning Objectives (SLOs):

- 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. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]
- Communicate scientific ideas about the way stars, over their life cycle, produce elements. [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.]
- 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. [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).]
- 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. [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 subatomic processes involved with the sun's nuclear fusion.]
- Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [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.]

9-12.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.
9-12.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.
9-12.HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
9-12.HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
9-12.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.

9-12.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
9-12.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.

Lesson Titles:

- Doppler Effect
- Electromagnetic Spectrum
- Element Formation
- Heliocentric vs. Geocentric Theory History
- Red/Blue Shift
- Solar System Formation
- Star Formation
- The Big Bang Theory

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
LA.RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
LA.RST.11-12.4	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 11-12 texts and topics.
LA.RST.11-12.5	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
LA.RST.11-12.6	Analyze the author's purpose in providing an explanation, describing a procedure, or

	discussing an experiment in a text, identifying important issues that remain unresolved.
LA.RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.1.B	Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
LA.WHST.11-12.1.C	Use transitions (e.g., words, phrases, 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.
LA.WHST.11-12.1.D	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
LA.WHST.11-12.1.E	Provide a concluding paragraph or section that supports the argument presented.
MA.A-REI.A	Understand solving equations as a process of reasoning and explain the reasoning
MA.A-REI.D	Represent and solve equations and inequalities graphically
TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Asteroid Chromebook Act.
- Asteroid Lab
- Big Bang Misconceptions Act. Sht
- Doppler Chromebook Act
- Electromagnetic Chromebook Act
- Elements from Stars Chromebook Act
- Elliptical Orbit Activity
- Expanding Universe Lab
- Formation of the Solar Sys. Act
- How Many Stars Lab
- HR Diagram Act
- HR Diagram Chromebook Act.
- Hubble's Law Graph Act
- Red/Blue Shift Act. Sht
- Spectral Lines Lab
- Stellar Evolution Act. Sht

Modifications

ELL Modifications:

- 1:1 testing
- Be flexible with time frames and deadlines
- Digital translators
- Group students
- Offer alternate/modify assessments
- Offer resources for specific topics in primary language
- Provide formal and informal verbal interaction to provide practice
- Provide multiple literacy strategies
- Repeat, reword, clarify
- Tap prior knowledge
- Use real objects when possible

IEP & 504 Modifications:

- Allowing student to edit with teacher comments the first attempt at a graded assignment
- Breaking up larger assignments into shorter tasks with clear deadlines for each section
- Less problems/questions per page or assignment
- Modeling and showing lots of examples
- Non-verbal redirection of behaviors
- Provide a copy of the notes from class
- Provide paraphrased or modified reading materials at the student's reading level
- Provide student with content vocab prior to lesson that includes that vocab
- Provide study guides that pare down the material to study
- Pull student(s) aside for individualized teaching by the special ed teacher
- Rewording questions
- Teach main concept multiple ways over multiple days or interactions

G&T Modifications:

- Allow generation and testing of hypotheses
- Ask students higher level questions to make conclusions and connections
- Employ differentiated curriculum to keep interest high
- Encourage further exploration of topics through reading or investigations
- Offer additional activities that solicit a deeper understanding of the material
- Offer opportunities for peer leadership or mentoring
- Provide additional challenging problems
- Provide different test items
- Provide opportunities for inquiry based learning
- Refrain from having them complete more work in the same manner
- Require graphical analysis and interpretation

At Risk Modifications

- Assign a peer to help keep the student on task
- Break tests down into smaller increments
- Check in with student often to keep on task
- If possible, one on one testing or oral exams
- Increase interaction time between you and the student
- Make directions and instruction short and simple
- Modify or reduce assignments
- Preferential seating
- Provide hands on tasks when applicable
- Regular communication with parents and guardians

Formative Assessment:

- Demonstration
- Exit ticket
- Google survey
- Image/Video clip
- Kahoot
- KWL form
- Lesson summary
- Object
- Previous class review
- Question of the day
- Think-pair-share

Summative Assessment:

- Asteroid Lab Report
- Expanding Universe Lab Report
- How Many Stars Lab Report
- HR Activity Post Lab
- Spectral Lines Lab Report
- Test (Universe)

Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

Alternative Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Resources & Materials:

- Adding Machine Tape
- How Stars are made and how they make elements <https://www.youtube.com/watch?v=80eMTnnLjhs>
- How Stars Make the Elements <http://tinyurl.com/grcndeq>
- Light Boxes, Gas Tubes
- Spectroscopes
- Star Life Cycle Chart
- Star Map, Milky Way Map
- Text on Big Bang
<https://drive.google.com/open?id=1MMVfANn7VC8ehazLGCrbUsP4845SX4ZeZbZtLmdSCIA>
- The Big Bang Theory <https://www.youtube.com/watch?v=bbSEZZCiMFE>

Technology:

- Chromebooks
- Graphing Calculators
- LoggerPro
- Temperature Probe

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
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TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.