

Shenandoah Community School District

Astronomy

Grade - 11

11.1 (SCSD) Earth and Space Astronomy

11.1.1 (SCSD) Understand and explain the tools used by astronomers to study electromagnetic radiation to determine the composition, motions, and other physical attribute of astronomical objects (I,D,M)

- Know and explain the challenges faced by astronomer due to the properties of light and the vast distances in the cosmos (I,D,M)
- Know and evaluate the types of telescope used by astronomer for examining different frequencies of electromagnetic radiation and compare and contrast the uses and advantages of each (e.g. radio, visible, gamma ray, reflector, and refractor)(M)
- Know and mathematically apply Newtonian gravity to celestial bodies to determine their masses and explain their motion (e.g. Kepler's Laws) (I,D,M)
- Know and discuss how spectroscopy provides information about properties and motions of objects (D,M)
- Know and quantitatively analyze data from telescopes (e.g. spectra, multi-wavelength photometry, and images) and/or other astronomical sources (e.g. tide tables, sky charts) (D,M)
- Know that the scientific account of the universe come from studying evidence about its content and imagining, with the help of mathematical models and computer simulations (D,M)

11.1.2 (SCSD) Understand the scientific view of the origin of the universe, the evolution of scientific view of the universe, the identification of celestial objects, and individuals who contributed to historic and current knowledge of astronomy (D,M)

- Know and outline the main arguments and evidence in support of the standard cosmological model (e.g. elements, solar systems, and universe)(D,M)
- Know the "Big Bang Theory" and the "Nebula Theory" (M)
- Describe the cyclical motions people saw through the ages and how they used that motion to form opinions about the universe (D,M)
- Know and describe the life cycle of a star and explain the role of gravity and mass play in the brightness, life span, and end-stages of stars (D,M)
- Know, compare, and contrast the major properties of the components of our solar system (D,M)

11.1.3 (SCSD) Understand and analyze the dynamic nature of astronomy by comparing and contrasting evidence supporting current view of the universe with historical views(I,D,M)

- Know and evaluate the impact that technological advances, as an agent change, have had on our modern view of the solar system and universe (I,D,M)
- Explain the relevance of experimental contributions of scientist to the advancement of the field of astronomy (D,M)

11.1.4 (SCSD) Understand the celestial sphere and astronomical observations made from the point of reference of the Earth (I,D,M)

- Know and evaluate the effects of the relative positions of the Earth, moon, and sun on observable phenomena (e.g. phases of the moon eclipses, seasons, and diurnal cycles)(M)
- Know and describe how latitude and time of the year affect visibility of constellations(D,M)

- Know and predict visibility of planets (major and minor) in the solar system based on relative orbital motion (I,D,M)
- Diagram the evolution of solar nebula into the solar system. Draw to scale both in distance and diameter (I,D,M)

11.1.5 (SCSD) Understand and evaluate the significance of energy transfer, energy transformations, in understanding the universe (I,D,M)

- Know the relationship of nuclear fusion reactions and mass-energy equivalence to the life cycle of stars (I,D,M)
- Know and explain the relationship between the energy produced by fusion in stars to the Luminosity (D,M)
- Know and analyze the energy relationships between the mass, power output, and life span of stars (I,D,M)
- Know and describe energy transfer and transformations associated with the motion and interaction of celestial bodies (e.g. orbits, binary pulsars, meteors, black holes, and galaxy mergers)(I,D,M)
- Know and evaluate the significance of scientific knowledge and theories, in understanding the universe:
 - Electromagnetic spectrum (D,M)
 - Waves carry energy and can interact with matter (D,M)
 - ✚ Sound (D,M)
 - ✚ Seismic (D,M)
 - ✚ Light (D,M)
 - ✚ Water (D,M)
 - Electromagnetic waves include:
 - ✚ Radio (D,M)
 - ✚ Microwaves (D,M)
 - ✚ Infrared radiation (D,M)
 - ✚ Visible light (D,M)
 - ✚ Ultraviolet radiation (D,M)
 - ✚ X-ray (D,M)
 - ✚ Gamma rays (D,M)
 - Electromagnetic waves result when a charged object is accelerated or decelerate
 - ✚ Each wavelength of light delivers energy in packets whose sizes are inversely proportional to the wavelength (D,M)
 - Red Shift and Blue Shift (D,M)
 - Changes in wavelength can provide information about changes in motion (D,M)
 - Theory of Relativity (I,D,M)
 - In contrast to other moving things, the speed of light is the same for all observers (I,D,M)
 - Nothing can travel faster than the speed of light (I,D,M)
 - Force of gravity (D,M)
 - Gravity is a universal force that each mass exerts on any other mass (D,M)
 - The strength of the gravitational attractive forces between two masses is proportional to the masses and inversely proportional to the square of the distance between them (D,M)

11.1.6 (SCSD) Know and explore connections between cosmic phenomena and conditions necessary for life (I,D,M)

- Characterize the habitable zone in solar systems and habitable planetary bodies in our own and other solar systems (I,D,M)
- Know and describe the tools and techniques used to identify extrasolar planets and explore planetary atmospheres (I,D,M)
- Know and describe signatures of life on other worlds and early Earth (I,D,M)

- Know and explain how astronomical hazards and global atmospheric changes have impacted the evolution of life on Earth (I,D,M)

11.4 (SCSD) Science as Inquiry

11.4.1 (SCSD) Identify questions and concepts that guide scientific investigations (M)

- Understand hypothesis and formulate a testable Hypothesis, demonstrating;
 - Logical connections between the scientific concepts guiding:
 - A hypothesis (M)
 - The design of an experiment (M)
- Understand scientific investigations and demonstrate:
 - Appropriate procedures (M)
 - A knowledge base (M)
 - Conceptual understanding (M)

11.4.2 (SCSD) Design and conduct scientific investigations (M)

- Requires:
 - Understanding of the major concepts in the area being investigated (M)
 - Proper equipment (M)
 - Safety precautions (M)
 - Understanding of methodological problems (M)
 - Use of technologies (M)
 - Scientific knowledge obtained from sources other than the actual investigation (M)
 - Clarification of :
 - Ideas that guide the inquiry (M)
 - Question (M)
 - Method (M)
 - Controls (M)
 - Variables (M)
 - Organization and display of data (M)
 - Revision of methods and explanations (M)
 - Public presentation of the results with a critical response from peers (M)
- Must:
 - Use evidence (M)
 - Apply logic (M)
 - Construct an argument for their proposed explanations (M)

11.4.3 (SCSD) Use technology and mathematics to improve investigations and communications (M)

- A variety of technologies are an integral component of scientific investigations (M)
 - Hand tools (M)
 - Measuring instruments (M)
 - Calculators (M)
 - Computers for data (M)
 - Collection (M)
 - Analysis (M)
 - Display (M)
- Mathematics plays an essential role in all aspects of an inquiry investigation (M)
 - Measurement (M)
 - Posing questions (M)
 - Formulas are used for developing explanations (M)
 - Charts and graphs are used for communicating results (M)

11.4.4 (SCSD) Formulate and revise scientific explanations and models using logic and evidence (M)

- Inquiries culminate in formulating an explanation or model (M)
 - Model
 - Physical (M)
 - Conceptual (M)
 - Mathematical (M)
- Process of answering the questions involves:
 - Discussions (M)
 - Arguments (M)
 - Revisions of explanations (M)
 - Based on:
 - Scientific knowledge (M)
 - Use of logic (M)
 - Evidence from investigation (M)

11.4.5 (SCSD) Think critically and logically to make the relationship between evidence and explanations (M)

- Think critically about evidence includes:
 - Deciding what evidence should be used (M)
 - Accounting for anomalous data (M)
- Process
 - Review data from a simple experiment (M)
 - Summarize the data (M)
 - Form a logical argument about the cause-and-effect relationship in the experiment (M)

11.4.6 (SCSD) Recognize and analyze alternative explanations and predictions (M)

- Develop critical abilities of analyzing an argument by reviewing:
 - Current scientific understanding (M)
 - Weighing the evidence (M)
 - Examining the logic (M)
- Develop the ability to decide which explanations and models are best (M)
 - There may be several plausible explanations, they do not all have equal weight (M)
 - Use scientific criteria to find the preferred explanations (M)
- Know that scientific knowledge is based on repeatable standards to ensure accuracy of the information. This knowledge may be constantly updated or corrected as the world tests and makes new advances in science (M)

11.4.7 (SCSD) Communicate and defend scientific procedures and explanations

- Develop the abilities associated with accurate and effective communication these include:
 - Writing and following procedures (M)
 - Expressing concepts (M)
 - Reviewing information (M)
 - Summarizing data (M)
 - Using language appropriately (M)
 - Developing diagrams and charts (M)
 - Explaining statistical analysis (M)
 - Speaking clearly and logically (M)
 - Constructing a reasoned argument (M)
 - Responding appropriately to critical comments (M)

11.4.8 (SCSD) Use mathematics in all aspects of scientific inquiry (M)

- Use mathematics to ask and answer questions about the natural world (M)

- Mathematics is used to:
 - Ask questions (M)
 - Gather data (M)
 - Organize data (M)
 - Present data (M)
 - Structure convincing explanations (M)

11.4.9 (SCSD) Know that a code of ethics governing testing, funding, and the disclosure of scientific information bind progress in science and technology (M)

11.4.10 (SCSD) Know that advances in science involve technology and research that are bound by the laws of our society (M)