Richmond Public Schools

Department of Curriculum and Instruction

Curriculum Pacing And Resource Guide – Unit Plan

Course Title/ Course #: Astronomy, Scientific Investigation & History, Evidence

Unit Title/ Marking Period # (MP 1): Scientific Investigation and the Nature of Science, Historical Astronomy, Astronomical Evidence AS.1, AS.2, AS.3

Start day:

Meetings (Length of Unit):

Desired Results ~ What will students be learning?

Standards of Learning/ Standards

AS. 1

The student will apply inquiry-based and problem-solving processes and skills to scientific investigations. Key concepts include

a) describe the scientific method and the role of critical thinking in science.
b) differentiate among the scientific facts, laws (principles), hypotheses, and theories.
c) contrast the scientific use of the word "theory" with its more popular uses.
d) identify pseudo-sciences (e.g. astrology) and describe their lack of valid hypothesis testing.
e) discuss how other approaches to understanding our world (e.g. Art, Philosophy, Theology) complement, rather than contradict, the scientific approach.

AS. 2

The student will develop an understanding of theories pertaining to the history of the universe and concepts related to the interaction of celestial bodies. Key concepts include

a) discuss the contributions, in the development of various astronomical models, by the following individuals: Ptolemy, Copernicus, Kepler, Brahe, Galileo, Newton, and Einstein.
b) explain the concept of the celestial sphere and how we use angular measurement to locate objects in the sky.
c) describe how and why the Sun, Moon, and stars appear to change their positions over time.
d) explain how astronomers measure distances and sizes of objects in the universe.

AS. 3

The student will demonstrate the ability to conduct astronomical laboratory and field investigations. Key concepts include

a) discuss the nature of electromagnetic radiation.
b) relate emission spectra to atomic structure.
c) explain the types of information that can be obtained by analyzing the spectra of astronomical objects.
d) identify different types of telescopes and their uses.
e) differentiate and evaluate the significance of technologies and instruments used in ground and space-based astronomy (e.g., optical telescopes, radio telescopes, x-ray telescopes, long-base interferometers, space probes, artificial satellites, spectra, probes, Doppler radar, etc.)

Essential Understandings/ Big Ideas

AS.1

- The concepts developed in this standard include the following:
- The nature of science refers to the foundational concepts that govern the way scientists formulate explanations about the natural world.
  The nature of science includes the concepts
- the natural world is understandable;
- science is based on evidence - both observational and experimental;
- science is a blend of logic and innovation;
- scientific ideas are durable yet subject to change as new data are collected;
- science is a complex social endeavor; and
- scientists try to remain objective and engage in peer review to help avoid bias.
- Earth is a dynamic system, and all atmospheric, lithospheric, and hydrospheric processes interrelate and influence one another.
- A hypothesis is a tentative explanation that accounts for a set of facts and can be tested by further investigation. Only hypotheses that are testable are valid. A hypothesis can be supported, modified, or rejected based on collected data. Experiments are designed to test hypotheses.
- Scientific theories are systematic sets of concepts that offer explanations for observed patterns in nature. Theories provide frameworks for relating data and guiding future research. Theories may change as new data become available. Any valid scientific theory has passed tests designed to invalidate it. Changing relevant variables will generally change the outcome.
- Scientific laws are generalizations of observational data that describe patterns and relationships. Laws may change as new data become available.

AS.2

The concepts developed in this standard include the following:

- Astronomy impacted ancient civilizations
- Eygptians built huge temples and pyramids with certain astronomical orientation
- Mayans made observations and recorded the motion of the Sun, the Moon, and the stars
- Aztec used a 365 day calender of the year but only 360 were accounted for, as five of them were days for sacrifice
- Europeans built Stonehenge, researchers believe it was a calendar or almanac
- Native Americans constructed the Big Horn Medicine Wheel in Wyoming which is similar to Stonehenge in design
- Around 140 ad, a Greek astronomer named Claudius Ptolemaeus (known today as Ptolemy) constructed perhaps the best geocentric model of all time. Geocentric = Earth-centered universe
- Nicholas Copernicus presented a heliocentric (Sun-centered) model of the universe
- Galileo built a telescope and was referred to as the father of experimental science.
- Kepler discovered a set of simple empirical (based on observation) laws that accurately described the motions of the planets.
- Tycho's made observations with the naked eye that were of very high quality and were used by Kepler
- Newton is responsible for the Three Laws of Motion
- Albert Einstein is responsible for the Special theory of Relativity
- Maria Mitchell was the first female professor of astronomy in the United States. She discovered the Comet of 1847
- Henrietta Swan Leavitt is known for her 1904 discovery of a type of variable Cepheid, variables stars, because of this discovery she was able to determine the distances between stars and the Earth
- Constellations are group of stars forming a recognizable pattern that is traditionally named after its apparent form or identified with a mythological figure. Modern astronomers divide the sky into eighty-eight constellations with defined boundaries.
- An Astronomical Unit (AU) is the average distance between Earth and the Sun, which is about 93 million miles or 150 million kilometers

AS.3

- Electromagnetic (EM) radiation is a form of energy that is all around us and takes many forms, such as radio waves, microwaves, X-rays and gamma rays.
- The emission spectrum of an element or compound is how bright certain frequencies are when energy is added to the atoms or molecules.
- There are two basic types of telescopes, refractors and reflectors. The part of the telescope that gathers the light, called the objective, determines the type of telescope. A refractor telescope uses a glass lens as its objective. The glass lens is at the front of the telescope and light is bent (refracted) as it passes through the lens. A reflector telescope uses a mirror as its objective. The mirror is close to the rear of the telescope and light is bounced off (reflected) as it strikes the mirror.
- Hubble's extensive observations of galaxies helped him develop the idea of an expanding universe

Key Essential Skills and Knowledge

AS.1

In order to meet this standard, it is expected that students will

- analyze how natural processes explain multiple aspects of Earth systems and their interactions (e.g., storms, earthquakes, volcanic
- make predictions, using scientific data and data analysis.
- use data to support or reject a hypothesis.
- differentiate between systematically-obtained, verifiable data and unfounded claims.
- evaluate statements to determine if systematic science is used correctly, consistently, thoroughly, and in the proper context.
- distinguish between examples of observations and inferences.
- explain how scientific methodology is used to support, refute, or improve scientific theories.
- contrast the formal, scientific use of the term "theory" with the everyday nontechnical usage of "theory."
- compare and contrast hypotheses, theories, and scientific laws.

AS. 2

In order to meet this standard, it is expected that students will

- research and describe the use of astronomy in ancient civilizations such as the Egyptians, Mayans, Aztecs, Europeans, and the native Americans;
- research and describe the contributions of scientists to our changing understanding of astronomy, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, Newton, Einstein, and Hubble, and the contribution of women astronomers, including Maria Mitchell and Henrietta Swan Leavitt;
- describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation
- recognize and identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations of the zodiac.
- calculate astronomical distances using a variety of units including: kilometers, AU, and light years
- explain the concept of the celestial sphere and how we use angular measurement to locate objects in the sky.
- describe how and why the Sun, Moon, and stars appear to change their positions over time.
- explain how astronomers measure distances and sizes of objects in the universe.

AS.3

- discuss the nature of electromagnetic radiation.
- relate emission spectra to atomic structure.
- explain the types of information that can be obtained by analyzing the spectra of astronomical objects.
- identify different types of telescopes and their uses.
- examine the limitations of making astronomical observations from the ground.

Vocabulary

conclusion	hypotheses	reasoning	predicts
theories	observation	inference	theory
Zenith			
Horizon			

Assessment Evidence ~ What is evidence of mastery? What did the students master & what are they missing?

Assessment/ Evidence

Evidence of mastery: Students will display mastery by consistently scoring at a "C" or above on all assessements. Success and mastery will also be shown by increasing scores from the beginning of the unit to the end of the unit. Overall mastery of the content and targeted objectives will be assessed during final unit assessment.

Assessment Methods:

- Teacher created IA Test/Quiz
- Group Discussions
- Predict and Explain Assessments- students apply principles and evidence
- Research Reports & Presentations
- Visual Displays- Concept maps, Diagrams, Models

Possible learning Gaps/Misconceptions

AS.1

- Vocabulary
- Science concept application
- Understanding the Limits of Science
- Identifying variables
- Recording and Analyzing Data
- Science is a collection of facts
- There is a single Scientific Method that all scientists follow.

AS.2, AS.3

- Astronomy Vocabulary
- The Sun is not a star.
- The Sun disappears at night.
- The Sun will never burn out.
- The surface of the Sun is without visible features.
- The Sun rises exactly in the east and sets exactly in the west every day.
- The Sun is always directly south at 12:00 noon.
- The tip of a shadow always moves along an east-west line.

- The amount of daylight increases each day of summer.
- We experience seasons because of Earth's changing distance from the Sun–––closer in summer, farther in winter.
- The Earth is the largest object in the solar system. It is larger than the Sun.

Learning Plan ~ What are the strategies and activities you plan to use

Learning Experiences/ Best Practice

AS.1

- Have students to analyze how natural processes explain multiple aspects of Earth systems and their interactions (e.g., storms, earthquakes, volcanic eruptions, floods, climate, mountain chains and landforms, geological formations and stratigraphy, fossils) can be used to make predictions of future interactions and allow scientific explanations for what has happened in the past.
- Have student to make predictions, using scientific data and data analysis.
- Have students to use data to support or reject a hypothesis.
- Have student to differentiate between systematically-obtained, verifiable data and unfounded claims.
- Have student to evaluate statements to determine if systematic science is used correctly, consistently, thoroughly, and in the proper context.
- Have student to distinguish between examples of observations and inferences.
- Have student to explain how scientific methodology is used to support, refute, or improve scientific theories.
- Have students to contrast the formal, scientific use of the term "theory" with the everyday nontechnical usage of "theory."
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Technology Integrations

Web Resources

Astronomy in Ancient civilizations power point www.gcisd-k12.org/cms/lib/TX01000829/Centricity/ModuleInstance/22093/Astronomy%20in%20Civilization%20and%20contributing%20scientists.ppt

YouTube

Scientific Investigation
Scientific graphing measurement
Scientific Method

Resources

Sample lesson plans (VDOE)
Scientific Investigation Analyzing Your School Quadrangle

Cross Curricular Connection

English- Students use rubric to write lab reports
Math- Students calculate mean, median, mode
Math- Students construct line/bar graphs, pie charts