Richmond Public Schools

Department of Curriculum and Instruction

Curriculum Pacing And Resource Guide – Unit Plan

Course Title/ Course #: Astronomy, Our Universe

Unit Title/ Marking Period # (MP 2): Scientific Investigation and the Nature of Science, Our Universe

AS.1, AS.4

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. 4

The student will research and summarize theories about the universe, galaxy and solar system. Key concepts include

a) describe the universe in terms of its diverse components and their relationships.
b) explain evidence that the universe is expanding
c) compare and contrast the characteristics and theories of formation of the universe, galaxy and our solar system. (e.g., Big bang theory, Solar nebular theory and Impact theory.)
d) identify shapes of various galaxies
e) describe the overall scale and structure of the solar system.
f) compare and contrast the terrestrial and Jovian planets.
g) differentiate between: Asteroids, comets, meteoroids

h) identify how earths proximity to the sun can determine the season

determine sun, moon and earth interactions (season, tides, moon phases, eclipse)

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.4

- The universe is vast in size and very old.
- The Big Bang theory is our best current model for the origin of the universe.
- The Big Bang theory states that the universe began in a very hot, dense state that expanded and eventually condensed into galaxies.
- The solar nebular theory is our best current idea for the origin of the solar system.
- The solar nebular theory explains that the planets formed through the condensing of the solar nebula.
- Galaxies are collections of billions of stars.
- The basic types of galaxies are spiral, elliptical, and irregular.
- The solar system is located in the Milky Way galaxy.
- A light-year is the distance light travels in one year and is the most commonly used measurement for distance in astronomy.

- Much of our information about our galaxy and the universe comes from ground-based observations across the electromagnetic spectrum.
- Much information about other planets comes from ground-based observations from Earth, but also from landers and orbiting spacecraft.
- The solar system consists of many types of celestial bodies. Earth is the third planet from the sun and is located between the sun and the asteroid belt. It has one natural satellite, the moon.
- Water occurs on Earth as a solid (ice), a liquid, or a gas (water vapor) due to Earth's position in the solar system.
- Earth revolves around the sun tilted on its axis. The axial tilt is responsible for the incidence and duration of sunlight striking a given hemisphere that varies during the Earth's revolution around the Sun, thus causing seasons.
- Equinoxes and solstices represent four distinct quarterly points signaling the cyclic change of seasons.
- The moon revolves around Earth creating the moon phases and eclipses. Solar eclipses occur when the moon blocks sunlight from Earth's surface, while lunar eclipses occur when Earth blocks sunlight from reaching the moon's surface.
- The tides are the periodic rise and fall of water level caused by the gravitational pull of the sun and moon.
- There are essentially two types of planets in our solar system. The four inner (terrestrial) planets consist mostly of solid rock. The four outer planets are gas giants, consisting of thick outer layers of gaseous materials, perhaps with small rocky cores.
- The dwarf planet, Pluto, has an unknown composition but appears to be solid. It is part of the Kuiper Belt.
- Moons are natural satellites of planets and vary widely in composition.

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.4

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

- analyze the role of 1) the position of Earth in the Solar System; 2) the size of Earth and sun; and 3) Earth's axial tilt in affecting the evolution of the planet and life on the planet.
- analyze historical explanations for the origin of the moon.
- create a model showing the position of Earth, the moon, and the resulting moon phases.
- explain why there is not a solar and lunar eclipse each month.

- create a model showing the position of Earth, moon, and sun during a solar and lunar eclipse.
- differentiate between the inner (terrestrial) planets and the outer (gaseous) planets and their corresponding atmospheric characteristics.
- compare and contrast the internal makeup of the four inner planets and explain why they vary so significantly.
- compare and contrast the atmospheres, planetary makeup, surface conditions, and rotation of the planets.
- compare the classification of the dwarf planet Pluto to the planets in relation to its orbit, and its similarity to other objects in the Kuiper Belt.
- compare and contrast the defining characteristics among moons, comets, meteoroids, and asteroids.
- compare and contrast the characteristics of Venus, Earth, Mercury, and Mars, and interpret various reasons why each planet has such characteristics.

Vocabulary

conclusion hypotheses reasoning predicts
theories observation inference theory
Zenith
Horizon
asteroids cosmology nebulae stellar black hole
Big Bang galaxies nebular stellar evolution
comets meteors planet sun
constellations moons star systems

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.4

- 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."
- Have students to compare and contrast hypotheses, theories, and scientific laws.
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AS.4

- Have students to analyze the role of 1) the position of Earth in the Solar System; 2) the size of Earth and sun; and 3) Earth's axial tilt in affecting the evolution of the planet and life on the planet.
- Have students to analyze historical explanations for the origin of the moon.
- Have students create a model showing the position of Earth, the moon, and the resulting moon phases.
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Technology Integrations

Web Resources

Resources for Teaching High School Astronomy **http://outreach.as.utexas.edu/marykay/highschool/hs.html**

Online Astronomy Resources **http://www.skyandtelescope.com/online-resources/**

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
English- make science come to life with biographies of great astronomers or true stories about their discoveries.