

**Richmond Public Schools**  
**Department of Curriculum and Instruction**  
**Curriculum Pacing And Resource Guide – Unit Plan**



**Course Title/ Course #: Earth Science 1 Astronomy**

**Unit Title/ Marking Period # (MP): Cosmology, Origins ES.3a-d, ES.13a-b**

**Start day:**

**Meetings (Length of Unit):**

<b><i>Desired Results ~ What will students be learning?</i></b>
<b><u>Standards of Learning/ Standards</u></b>
<p><b>ES. 3</b> The student will investigate and understand the characteristics of Earth and the solar system. Key concepts include</p> <ul style="list-style-type: none"><li>a) position of Earth in the solar system;</li><li>b) sun-Earth-moon relationships (seasons, tides, and eclipses);</li><li>c) characteristics of the sun, planets and their moons, comets, meteors, and asteroids; and</li><li>d) the history and contributions of space exploration.</li></ul>
<p><b>ES.13</b> The student will investigate and understand scientific concepts related to the origin and evolution of the universe. Key concepts include</p> <ul style="list-style-type: none"><li>a) cosmology including the Big Bang theory; and</li><li>b) the origin and evolution of stars, star systems, and galaxies.</li></ul>
<b><u>Essential Understandings/ Big Ideas</u></b>
<p><b>ES. 3</b> The concepts developed in this standard include the following: 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.</p> <ul style="list-style-type: none"><li>o Earth revolves around the sun tilted on its axis. The axial tilt is responsible for the incidence and duration of sunlight striking a</li></ul>

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.
- The sun consists largely of hydrogen gas. Its energy comes from nuclear fusion of hydrogen to helium.
- 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.
- Much of our knowledge about the solar system is a result of space exploration efforts. These efforts continue to improve our understanding of the solar system.
- Comets orbit the sun and consist mostly of frozen gases.
- A meteoroid is debris located outside Earth's atmosphere; a meteor is debris located within Earth's atmosphere; and a meteorite is debris that has broken apart into smaller pieces before reaching Earth's surface.
- Asteroids are usually leftover debris of the formation of the solar system, or creations of the collisions of other asteroids.
- The atmosphere of Venus is mostly carbon dioxide and very dense. The atmosphere of Mars is very thin and mostly carbon dioxide.
- Much of our knowledge about the solar system is a result of space exploration efforts. These efforts continue to improve our understanding of the solar system

### **ES. 13**

The concepts developed in this standard include the following:

- 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.
- Stars have a finite lifetime and evolve over time. The mass of a star controls its evolution, lifespan, and ultimate fate. Stars form by
  - condensation and gravitational compression of interstellar gas and dust.
- The Hertzsprung-Russell diagram illustrates the relationship between the absolute magnitude and the surface temperature of stars. As stars evolve, their position on the Hertzsprung-Russell diagram moves.
- 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.

## **Key Essential Skills and Knowledge**

### **ES. 3**

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.
- predict what conditions we would need to have in place for another celestial object to support life.
- compare the various types of evidence obtained from the Apollo moon landings and other lunar exploration and how this is used to
- inform thinking about the moon.
- analyze how the role of technology (Galileo's telescope, Hubble telescope, planetary orbiters, landers/rovers) has contributed to social and scientific change and enlightenment.
- create a timeline of key events in space exploration.

### **ES. 13**

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

- contrast the life span and energy output of a blue giant star to that of the sun and relate this to the potential existence of life on planets in its orbit.
- explain the potential origin and role of ultra massive black holes in the center of galaxies.
- using the Hertzsprung-Russell diagram, classify stars as to their place on the main sequence or in beginning or end points in their life cycles.
- evaluate the probability of travel to nearby solar systems using current spacecraft speeds.
- analyze the various fusion products of a blue giant star over its lifetime, and relate this to the presence and abundance of elements
- that make up our solar system and its contents, including living organisms.

## Vocabulary

### ES. 3

seasons

planets

sun

moon phases

lunar

solar system

eclipses

tides

equinoxes

solstices

### ES. 13

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 assessments. 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**

##### ES. 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.

### **ES. 13**

- Space is empty between planets, stars, and other objects.
- All radiation is harmful.
- The spectrum of electromagnetic radiation consists of only visible light.
- The Sun is not a star.
- We view all space objects with only an optical telescope.
- The Hubble Space Telescope can view all objects in space by traveling there to get a better image.
- Stars are on fire and can burn out.
- "Red hot" is hotter than "white hot".

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

### **Learning Experiences/ Best Practice**

#### **ES. 3**

- Have student to analyze how the role of technology (Galileo's telescope, Hubble telescope, planetary orbiters, landers/rovers) has contributed to social and scientific change and enlightenment.

#### **ES.13**

- Have students to create a timeline of key events in space exploration.
- Have the student to analyze the array of climate feedback mechanisms that control the Earth's temperature over time, and compare and contrast these feedback mechanisms to those operating on inner planets and the gas giants.
- Have students to contrast the life span and energy output of a blue giant star to that of the sun and relate this to the potential existence of life on planets in its orbit.
- Have students to explain the potential origin and role of ultra massive black holes in the center of galaxies.
- Have students to using the Hertzsprung-Russell diagram, classify stars as to their place on the main sequence or in beginning or end points in their life cycles.

- Have students to evaluate the probability of travel to nearby solar systems using current spacecraft speeds.
- Have student to analyze the various fusion products of a blue giant star over its lifetime, and relate this to the presence and abundance of elements that make up our solar system and its contents, including living organisms

### **Technology Integrations**

#### **Web Resources**

[Venus](#)

[Phases of Venus](#)

[Planet finder](#)

[Planetary distances](#)

[Transit of Venus](#)

[NASA eclipse homepage](#)

[Solar eclipses](#)

[Lunar eclipses](#)

[Eclipse dates](#)

### **Resources**

#### **Sample Lesson Plans (VDOE)**

[Solar System Modeling](#)

[Planet Line up](#)

[Modeling the Big Bang Theory](#)

### **Cross Curricular Connection**

**Math** - Students can compare/contrast the numbers of stars in constellations in math. Angles can be drawn and measured, then labeled as acute, obtuse, or right.

**English**- Student will report current information from journal and news article on space exploration and technology.