

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



Course Title/ Course #: Astronomy, Stars

Unit Title/ Marking Period # (MP): Scientific Investigation and the Nature of Science, Stars AS.1, AS.5

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. 5

The student will investigate and demonstrate an understanding of the sun, other stars, and star systems

- a) trace the production of energy by the Sun.
- b) summarize the composition and properties of the interstellar medium including dark matter.
- c) summarize the sequence of events leading to star formation.
- d) analyze the evolution of stars off the main sequence.
- e) discuss the observations that help verify the theory of stellar evolution.
- f) discuss the motions of stars through space and how those motions are measured from Earth.
- g) summarize the events leading to the violent death of a massive star.
- h) describe the two types of supernovae.
- i) discuss the nature of neutron stars, pulsars, gamma ray bursts, and black holes

j) interpret a HR diagram

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.5

- The Sun is the star at the centre of our solar system and is responsible for the Earth's climate and weather.
- The Sun is an almost perfect sphere with a difference of just 10km in diameter between the poles and the equator.
- The solar interior includes the core, radiative zone and convective zone.
- The photosphere is the visible surface of the Sun.
- The solar atmosphere includes the chromosphere and corona.
- 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.
- A star's life begins in a ... Nebula! – A cloud of gas and dust, consisting mostly of Hydrogen
- A star's life begins... Gas and dust begin to clump together to form a Protostar (a baby star).
- The star's main goal in life is to achieve stability, or equilibrium

- The smaller a star is the longer it will live.
- Life Cycle of a Star like our Sun... Nebula, Protostar, Main Sequence Star, Red Giant, Planetary Nebula, White Dwarf
- Life Cycle of a Star With Greater Mass Than Our Sun... Nebula, Protostar, Main Sequence Star, Red Supergiant, Supernova, Black Hole or Neutron Star
- 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.

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.5

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

- identify the approximate mass, size, motion, temperature, structure, and composition of the Sun
- distinguish between nuclear fusion and nuclear fission, and identify the source of energy within the Sun as nuclear fusion of hydrogen to helium
- describe the eleven-year solar cycle and the significance of sunspots
- analyze solar magnetic storm activity, including coronal mass ejections, prominences, flares, and sunspots.
- identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition
- characterize star formation in stellar nurseries from giant molecular clouds, to protostars, to the development of main sequence stars
- evaluate the relationship between mass and fusion on the dying process and properties of stars
- differentiate among the end states of stars, including white dwarfs, neutron stars, and black holes
- compare how the mass and gravity of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole
- relate the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion
- use the Hertzsprung-Russell diagram to plot and examine the life cycle of stars from birth to death.
- relate apparent versus absolute magnitude to the distances of celestial objects

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 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

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 scientist follow.

AS.5

- 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.
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AS.5

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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/>

About the sun <https://www.noao.edu/outreach/resource/sun.html>

Life cycle of a star <http://imagine.gsfc.nasa.gov/educators/lifecycles/Imagine2.pdf>

YouTube

[Scientific Investigation](#)

[Scientific graphing measurement](#)

[Scientific Method](#)

Life cycle of stars <https://www.youtube.com/watch?v=PM9CQDIQI0A&noredirect=1>

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.