Unit 3 - Origin and Nature of the Solar System

Content Area: **Science**
Course(s): **Introduction to Astronomy**
Time Period: **3rd Marking Period**
Length: **~19 Days (2 days per week)**
Status: **Published**

Unit Overview

This Unit takes an in depth look at the formation of our own Solar System and the Earth along with it, along with evaluating the conditions for life on Earth and scientists search for other worlds with similar conditions.

Sequence and Pacing Guide

Transfer

Students will be able to independently use their learning to understand that the conditions that led to life on Earth will ultimately assist us in predicting where other planets that may harbor life may exist.

Meaning

Understandings

Students will understand that...

The formation of the solar system is widely believed to be as a result of a nebula coalescing to form our Sun and, eventually, the planets.

Planetary motion can determine whether or not a world can sustain life, specifically the availablility of liquid water.

Planetary size and distances to stars and satellites can effect the ability of a planets water to be in liquid form.

Essential Questions

Students will keep considering...

How does the formation of the solar system relate to its current properties?

What are the life-sustaining properties of planets?

What would change about the Earth's life-sustaining abilities if its motion was different, or if its distance to the Moon and other planets were changed?

Application of Knowledge and Skill

Students will know...

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The solar system formed from a nebula and the evidence that supports that are the properties and characteristics of solar system objects, radioactive dating of meteorites and lunar samples.

The unique characteristics of the planets of our solar systems are due to factors such as temperature, composition, and distance from the Sun.

The conditions that created Earth and its life-sustaining capabilities are not unique, and have already been observed in many other planets in other solar systems (exoplanets).

Students will be skilled at...

Students will be skilled at...

Collect, analyze and critique evidence that supports the assumption that the Soalr System formed form a nebular 4.6 Billion years ago.

Compare and Contrast the eight planets, asteroids, satellites, comets and other bodies in our own Solar System.

Evaluate the evidence that created a life-sustaining Earth and calculate what it would take to replicate that

evidence for a similar stellar system.

Academic Vocabulary

Sun

Solar System

Planetisimal

Planet

Asteroid

Comet

Meteroid

Meteorite

Meteor

Terrestrial

Jovian

Kupier Belt

Oort Cloud

Interplanetary Space

Satellite

Exoplanet

Learning Goal 1

Devise an explanation for the origin of the solar system.

Proficiency Scale

- Devise an explanation for the origin of the solar system.

SCI.HS-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and

	other planetary surfaces to construct an account of Earth's formation and early history.
9-12.HS-PS2-2.PS2.A.2	If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.
9-12.HS-PS2-4.PS2.B.1	Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
9-12.HS-PS2-4.PS2.B.2	Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

Target 1

SWBAT evaluate evidence for solar nebula theory.

- SWBAT evaluate evidence for solar nebula theory

Target 2

SWBAT utilize radioactive dating and Earth materials to estimate age of the Solar System.

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Learning Goal 2

Identify the characteristics that make a celestial body a planet.

Proficiency Scale

- Identify the characteristics that make a celestial body a planet.

SCI.HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
9-12.HS-PS2-1.PS2.B.1	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

Target 1

SWBAT evaluate Kepler's Law of Planetary Motion.

- SWBAT evaluate Kepler's Law of Planetary Motion.

Target 2

SWBAT categorize celestial objects by comparing and contrasting their properties.

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Learning Goal 3

Recognize that the conditions for life are not unique to Earth.

Proficiency Scale

- Recognize that the conditions for life are not unique to Earth.

SCI.HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
SCI.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
9-12.HS-ESS1-6.ESS1.C.1	Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth’s formation and early history.
9-12.HS-ESS3-3.ESS3.C.1	The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.
9-12.HS-ESS3-6.ESS3.D.1	Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.
9-12.HS-LS2-2.LS2.C.1	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
9-12.HS-PS2-3.PS2.B.1	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
9-12.HS-PS2-4.PS2.B.2	Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
9-12.HS-PS3-1.PS3.A.1	Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.
9-12.HS-PS3-1.PS3.B.3	Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.
9-12.HS-PS3-1.PS3.B.4	The availability of energy limits what can occur in any system.

Target 1

SWBAT model how changes in the Earth's orbit and rotational periods affect the amount of liquid water on Earth.

- SWBAT model how changes in the Earth's orbit and rotational periods affect the amount of liquid water on Earth

Target 2

SWBAT compute the so-called "Goldilocks Zone" for planets to harbor life.

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Formative Assessment and Performance Opportunities

Various group and lab activities including online labs, in-class discussions, report on planets and exoplanets, modelling, and comparing and contrasting objects in the solar system, including making timelines and classifying objects within the solar system.

Summative Assessment

The Unit Summative Assessment will have students build a scale model of the Solar System, including distances and revolution/rotational periods, as well as composition of celestial bodies. Additionally, students will be required to explain how planets can harbor life.

21st Century Life and Careers

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.

CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Accommodations/Modifications

All instruction, labs, activities, and assessments will be modified and enhanced to adhere to individual student's IEPs and 504s.

Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.

Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).

Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.

Use project-based science learning to connect science with observable phenomena.

Structure the learning around explaining or solving a social or community-based issue.

Provide ELL students with multiple literacy strategies.

Collaborate with after-school programs or clubs to extend learning opportunities.

Summary of Formation of the Solar System: http://lasp.colorado.edu/outerplanets/solsys.php

Tidal Chart to assist students in understanding how liquid water on Earth behaves due to gravity: https://mrnussbaum.com/interactive-tides-chart

Comprehensive Interactive Website that describes properties of the Solar System: https://solarsystem.nasa.gov/

Orbital Simulator which assists students in visualizing planet statistics and allows them to create orbital distance and eccentricity for a hypothetical planet "X": http://lasp.colorado.edu/outerplanets/orbit_simulator/

Unit Resources

Astronomy: A Self-Teaching Guide, 8th ed. Dinah L. Moche, Wiley and Sons

Teacher Generated Presentations

Student Generated Discussion Questions

NAAP Labs: https://astro.unl.edu/naap/

Orbital Motion: https://interactives.ck12.org/simulations/physics/orbital-motion/app/index.html?referrer=ck12Launcher&backUrl=http://interactives.ck12.org/simulations/

Gravity and Orbits: https://phet.colorado.edu/en/simulation/gravity-and-orbits

Create a Solar System: https://phet.colorado.edu/sims/my-solar-system/my-solar-system_en.html

Edge of Solar System: https://youtu.be/6Sd0nwb6dd4

Solar System Simulator: http://mgvez.github.io/jsorrery/

Goldilocks Zone Calculator: http://depts.washington.edu/naivpl/sites/default/files/hz.shtml

Habitable Zone Simulator: https://astro.unl.edu/naap/habitablezones/animations/stellarHabitableZone.html

Habitable Zone Lab: https://docs.google.com/document/d/13zg3BheJv5mn8EbRWm-gCCEzU20bbTHr_1rv14EYbrg/edit?usp=sharing

Interdisciplinary Connections

LA.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LA.WHST.11-12.1	Write arguments focused on discipline-specific content.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting

	quantities.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.S-ID.B.6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.