Unit 3 The Birth and Evolution of Planetary System

Content Area: **Science**
Course(s): **Astronomy 1**
Time Period: **November**
Length: **6 weeks**
Status: **Published**

Transfer Skills

Transfer:

Students will be able to explain the formation of planetary systems based on our knowledge of our Solar System and apply this knowledge to newly discovered planetary systems.

They will also be able to connectsurface features to surface processes that are responsible for their formation.

Enduring Understandings

The role that gravity, energy, and angular momentum play in the formation of stars and planets.

How the modern theory of planetary system formation was developed.

That the temperature in the disk that surrounds a forming star affects the composition and location of planets, moons, and other bodies.

The processes that resulted in the inner and outer planets that form the Solar System.

Methods that astronomers use to find planets around other stars and what those discoveries tell us about our own and other solar systems.

Essential Questions

How do planetary systems form?

What role does the law of the conservation of energy play in the formation of Solar Systems.

How typical is the formation and characteristics of our Solar System?

How common are Earth-like planets?

What is the source of the material that now makes up the Sun and the rest of the Solar System.

What happened to all the leftover Solar System debris after the last of the planets formed?

Content

Voc. Terms:

planetary system, nebular hypothesis, meteorites, protostar, conservation of angular momentum, accretion disk, planetesimals, silicates, planet migration, extrasolar planet,

Skills

Explain how stars form and how planets are born.

Understand that the Solar System began with a disk.

Describe how angular momentum is conserved.

Understand how gravity helps planetesimals grow into planets.

Explain the conservation of energy.

Discuss how the inner planets formed differently from the outer planets.

Be able to estimate the size of the orbit of a planet.

Understand that hundreds of extrasolar planets have been discovered.

Resources

Standards

NGSS: Science Performance Expectations(2014)
NGSS: MS Earth & Space Science
MS.Space Systems
Performance Expectations

- MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
- MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.

MS.History of Earth
Performance Expectations

- MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

NGSS: Science and Engineering Practices
NGSS: 9-12
Practice 1. Asking questions (for science) and defining problems (for engineering)
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions to clarify and refine a model, an explanation, or an engineering problem.

Practice 3. Planning and carrying out investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Select appropriate tools to collect, record, analyze, and evaluate data.

Practice 4. Analyzing and interpreting data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical

analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

Practice 5. Using mathematics and computational thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

Practice 7. Engaging in argument from evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

NGSS: Crosscutting Concepts
NGSS: 9-12
Crosscutting Statements
1. Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

2. Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
Changes in systems may have various causes that may not have equal effects.

3. Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
Patterns observable at one scale may not be observable or exist at other scales.

NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS1: Earth’s Place in the Universe
ESS1.A: The Universe and Its Stars
The study of stars’ light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3)

ESS1.B: Earth and theSolar System
Cyclical changes in the shape of Earth’s orbit around the sun,together with changes in the tilt of the planet’s

axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climatechanges. (secondary to HS-ESS2-4)

PS2: Motion and Stability: Forces and Interactions

PS2.B: Types of Interactions

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.(HS-PS2-4)

SCI.HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
SCI.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
SCI.HS-ESS1	Earth's Place in the Universe
SCI.HS-ESS2	Earth's Systems
SCI.HS-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.