Unit 3 The Gas Giants

Content Area: **Science**
Course(s): **Astronomy 2**
Time Period: **April**
Length: **6 weeks**
Status: **Published**

Enduring Understandings

Distinguish the gas giant planets from each other and from the terresterial planets.

Explain how the atmosphere on each of the gass giants determines that planets weather patterns and how they compare with the weather/climate on Earth.

Unbderstand how gravitational energy turns into thermal energy and how that process affects the temperatures of the gas giant planets.

Be able to compare and contrast the interiors of the gas giant planets and explain why they are different.

Be able to describe the magnetospheres of each of the gas giants and how that affects each planet.

Essential Questions

Did the migration of the early gas giant planets affect the orbits of the inner planets?

Why di the gas giant planets orbit much further from the sun than the terrestrial planets?

Why do the gas giant planets have multiple moons and complex ring systems while the inner terrestrial do not ?

How are we able to measure wind speeds on distant planets?

How does internal thermal energy heat the gas giant planets?

Content

<u>Vocab. Terms:</u>

stellar occultations, solar abundance, inert gases, oblateness, obliquity, photochemical, vortex, megabars, synchroton radiation, torus, radiation belts, flux tube, auroras, thermal energy, Jovian planets, heavy elements, Great Red Spot, jet streams

Skills

- Explain why Jupiter and Saturn are gas giants while Uranus and Neptune are ice giants.
- Discuss why giant planets orbit much farther from the Sunn than do the terrestrial planets.
- Explain how stellar occultations reveal a planet's diameter.
- Describe how a planets mass can be found from the motions of its moons.
- Discuss why Jupiter's chemical composition is similar to the Sun's.
- Explain how the Great Red Spot is a giant anticyclonic system.
- Explain why Saturn has jet streams similar to Earth.
- Summarize why different volatiles produce different clouds at different heights.
- Explain how thermal energy drives powerful convection on the giant planets.
- Explain why the magnetospheres of the giant planets are enormous.
- Discuss why radio signals broadcast a planet's true rotational period.

Resources

Standards

NGSS: Science Performance Expectations(2014)
NGSS: HS Physical Sciences
HS.Structure and Properties of Matter
Performance Expectations
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS.Forces and Interactions
Performance ExpectationsS
HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of

objects is conserved when there is no net force on the system.

HS.Energy
Performance ExpectationsShow details
HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS.Waves and Electromagnetic Radiation
Performance ExpectationsShow details
HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

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.

Practice 2. Developing and using models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

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.

Practice 6. Constructing explanations (for science) and designing solutions (for engineering)
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

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.

Practice 8. Obtaining, evaluating, and communicating information
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.
Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

Connections to the Nature of Science: Most Closely Associated with Practices
Scientific Investigations Use a Variety of Methods
Science investigations use diverse methods and do not always use the same set of procedures to obtain data.

Scientific Knowledge is Based on Empirical Evidence
Science disciplines share common rules of evidence used to evaluate explanations about natural systems.

Science includes the process of coordinating patterns of evidence with current theory.

Scientific Knowledge is Open to Revision in Light of New Evidence
Scientific explanations can be probabilistic.

Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.

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.
Empirical evidence is needed to identify patterns.

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.
Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.

4. Systems and System Models – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
Systems can be designed to do specific tasks.

5. Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of,

and within that system.

7. Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
Much of science deals with constructing explanations of how things change and how they remain stable.

Connections to Engineering, Technology and Applications of Science
Influence of Engineering, Technology, and Science and the Natural World
Analysis of costs and benefits is a critical aspect of decisions about technology.

Connections to the Nature of Science: Most Closely Associated with Crosscutting Concepts
Science is a Way of Knowing
Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review.

Science Addresses Questions About the Natural and Material World.
Not all questions can be answered by science.

Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.

NGSS: Disciplinary Core Ideas
NGSS: 9-12
PS1: Matter and Its Interactions
PS1.C: Nuclear Processes
Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption ofenergy. The total number of neutrons plus protons does notchange in any nuclear process. (HSPS1-8)

PS3: Energy
PS3.B: Conservation of Energy and Energy Transfer
Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HSPS3-4)

PS4: Waves and Their Applications in Technologies for Information Transfer
PS4.B: Electromagnetic Radiation
When light or longer wavelength electromagnetic radiation is absorbed inmatter, it is generally converted into thermal energy (heat). Shorterwavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) canionize atoms and cause damage to living cells.(HS-PS4-4)

PS4.C: Information Technologies and Instrumentation
Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.(HS-PS4-5)

ETS1: Engineering Design
ETS1.B: Developing Possible Solutions
Both physical models and computers can be used in various ways toaid in the engineering design process. Computers are useful for avariety of purposes, such as running simulations to test differentways of solving a

problem or to see which one is most efficient oreconomical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)(secondary to HS-LS4-6)

SCI.HS-PS2	Motion and Stability: Forces and Interactions
SCI.HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
SCI.HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
SCI.HS-PS3	Energy
SCI.HS-PS4	Waves and Their Applications in Technologies for Information Transfer
SCI.HS-PS1	Matter and Its Interactions
SCI.HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
SCI.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.