Unit 2 The Terrestrial Planets

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

Enduring Understandings

Understand the roles of the four processes that shape a terrestrial planet's surface.

Explain how a planet's size, mass, surface gravity, density, and distance from the Sun contribute to its geological characteristics.

Identify the age of a planet's surface from the concentration of craters.

Describ how radiometric dating is used to measure the age of rocks.

Identify the geological evidence for water on the terrestrial planets.

Essential Questions

How have geology and collisions affected the habitability of the terrestrial planets?

How are we able to compute the age of rocks?

How were the terrestrial planets able to cool off and become rocky worlds?

What is the geologic evidence for existance of water on the terrestrial planets?

Why is there no apparent life of the terrestrial planets other than Earth?

Content

Vocab. Terms:

comparative planetology, hydroshpere, lithosphere, tectonism, volcanism, igneous activity, magma, erosion, meteors, meteoroids, meteorites, topographic relief, impact craters, secondary craters, half-life, seismic waves, surface waves, primary waves, secondary waves, hydrostatic equilibrium, differentiation, convection, conduction, paleomagnetism,

Skills

Explain how scientists learn about planets by comparing them.

Describe how tectonism, volcanism, and impact cratering, rough up planetary surfaces and erosion smooths them.

Explain how impacts can melt and vaporize rocks.

Describe how the number of craters on a planets surface indicates the age of the surface.

Discuss seismic waves provide information about a planet's interior.

Explain how diffeentiation of planets shows that they once were molten.

Outline how collisions and radioactive heating made the forming terrestrial planets molten. But as they aged, how they colled off.

Explain how generally, smaller terrestrial planets cool faster than larger terrestrial planets.

Discuss why the lack of magnetic fields on Venus and Mars is a scientific puzzle.

Discuss why most volcanoes and quakes occur along plate boundaries.

Explain why Mercury's surface shrank after it cooled from a molten state.

Discuss how Mars experienced extensive tectonbism in the past.

Explain why the surface of Venus is less than 1 billion years old.

Explain howhow friction between moving plates generates thermal energy and leads to volcanism.

Explain why Mars was once wetter than it is today.

Discuss why water ice probably still exists on Mercury.

Resources

Standards

NGSS: Science Performance Expectations(2014)
NGSS: HS Physical Sciences
HS.Structure and Properties of Matter
Performance Expectations

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.Show details

HS.Energy
Performance Expectations
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

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.Show details

HS.Waves and Electromagnetic Radiation
Performance ExpectationsShow details
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.Show details

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 that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

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.
Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

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

Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.

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 techniques of algebra and functions to represent and solve scientific and engineering problems.

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 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.
Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

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
New technologies advance scientific knowledge.

Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based on empirical evidence.

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

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
Theories and laws provide explanations in science, but theories do not with time become laws or facts.

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.
Mathematical representations are needed to identify some 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.
Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

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.

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.
When investigating or describing a system, the boundaries and initial conditions of the system need to be

defined and their inputs and outputs analyzed and described using models.

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.
Energy drives the cycling of matter within and between systems.

Connections to the Nature of Science: Most Closely Associated with Crosscutting Concepts
Science is a Way of Knowing
Science is a unique way of knowing and there are other ways of knowing.

Science is a Human Endeavor
Scientific knowledge is a result of human endeavor, imagination, and creativity.

NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS1: Earth's Place in the Universe
ESS1.A: The Universe and Its Stars
Other than the hydrogen and helium formed at the time of the BigBang, nuclear fusion within stars produces all atomic nuclei lighterthan and including iron, and the process releases electromagneticenergy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3)

PS1: Matter and Its Interactions
PS1.A: Structure and Properties of Matter
The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HSPS1-2)

PS1.B: Chemical Reactions
In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)

PS2: Motion and Stability: Forces and Interactions
PS2.A: Forces and Motion
Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2)

PS2.B: Types of Interactions
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. (HS-PS2-4),(HS-PS2-5)

SCI.HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
SCI.HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
SCI.HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
SCI.HS-PS1	Matter and Its Interactions