

Unit	Lesson	Lesson Objectives
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**ESS1: Earth's Place in the Universe****The Expanding Universe**

- Describe the big bang theory.
- Describe what astronomers predict about the future of the universe.
- Explain how the solar system formed.

**Stars**

- Explain how a star forms.
- Explain how stars are classified.
- Explain what happens as a star runs out of fuel.
- Identify the physical properties of stars.

**The Sun's Energy**

- Examine how energy is transferred from the core to space.
- Identify and describe the steps of hydrogen fusion.
- Recognize the types of energy emitted by the Sun.

**Nuclear Fission and Nuclear Fusion**

- Explain and compare fission and fusion reactions.
- Relate the role of nuclear fusion to the production of essentially all elements heavier than helium.
- Science Practice: Justify the need for peer review in science.

**Gravity and Motion**

- Explain how Earth and the moon stay in orbit.
- Identify factors that influence the force of gravity between objects.

**Relative Dating**

- Describe the law of superposition.
- Explain how fossils are used to date rocks.
- Explain how geologists determine the relative age of rocks.

**Absolute Dating**

- Explain how geologists determine the absolute age of rocks.
- Explain what happens during radioactive decay.

**Geologic Time**

- Distinguish the units of the geologic time scale.
- Explain how Earth has evolved over geologic time.
- Explain why the geologic time scale is used to show Earth's history.

**Continental Drift**

- Describe evidence that supports continental drift.
- Explain continental drift.

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**ESS2: Earth's Systems****Cycles of Matter**

- Analyze the importance of the nitrogen cycle.
- Examine how carbon cycles through an ecosystem.
- Identify the processes involved in the water cycle.

**Earth's Interior**

- Compare and contrast the three main layers of Earth.
- Explain how geologists learn about Earth's interior.

**Plate Tectonics**

- Distinguish the three types of plate boundaries.
- Explain the theory of plate tectonics.
- Identify the major tectonic plates.
- Relate plate tectonics to the formation of landforms.

**Characteristics of the Seafloor**

- Describe evidence that supports seafloor spreading.
- Describe the process of seafloor spreading.
- Explain what occurs at deep-ocean trenches.

**Lab: Plate Boundaries and Movement**

- Compare and contrast the plate movements that cause earthquakes and volcanic eruptions.
- Describe the role of mantle convection in plate movement.
- Differentiate between the major types of plate boundaries.
- Examine how plate movements cause changes in Earth's surface.

**Weathering and Soil**

- Classify different types of soil.
- Describe the characteristics of soil.
- Distinguish between mechanical and chemical weathering.
- Explain how soil is formed.
- Identify factors that affect the rate of weathering.

**Water and Wind Erosion**

- Describe the effects of wind erosion and deposition.
- Explain how glaciers and waves cause erosion and deposition.
- Identify causes of groundwater erosion.
- Identify features that are formed by water erosion and deposition.

**Factors That Affect Climate**

- Explain how various factors affect weather and climate.
- Explain what causes seasons.

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		<p><b>Lab: Modeling Water Erosion</b></p> <ul style="list-style-type: none"> <li>Identify factors that affect erosion and deposition by rivers.</li> <li>Model stream processes and observe stream behavior.</li> </ul>
		<p><b>ESS3: Earth and Human Activity</b></p> <p><b>Minerals</b></p> <ul style="list-style-type: none"> <li>Describe the properties used to identify minerals.</li> <li>Explain how minerals are formed.</li> <li>Identify uses of minerals.</li> </ul> <p><b>Land Resources</b></p> <ul style="list-style-type: none"> <li>Describe land as a natural resource.</li> <li>Explain how land resources are managed.</li> </ul> <p><b>Weather Forecasting</b></p> <ul style="list-style-type: none"> <li>Describe basic elements of meteorology.</li> <li>Describe what information can be gained from a weather map.</li> </ul> <p><b>Environmental Changes</b></p> <ul style="list-style-type: none"> <li>Identify examples of short-term and long-term environmental changes.</li> <li>Identify the impacts of short-term and long-term environmental changes on organisms and ecosystems.</li> <li>Predict how environmental changes will affect organisms and ecosystems.</li> </ul> <p><b>Climate Change</b></p> <ul style="list-style-type: none"> <li>Explain how human, biologic, and geologic activities can influence climate.</li> <li>Identify events that can cause short-term and global climate change.</li> </ul> <p><b>Energy on Earth</b></p> <ul style="list-style-type: none"> <li>Distinguish between renewable and nonrenewable resources.</li> <li>Identify advantages and disadvantages of various energy sources.</li> <li>Identify renewable and nonrenewable resources.</li> </ul> <p><b>Human Impact on Resources</b></p> <ul style="list-style-type: none"> <li>Compare the costs and benefits of conservation policies.</li> <li>Identify the negative impacts that human activity has had on Earth's resources.</li> <li>Identify the positive impacts that human activity has had on Earth's resources.</li> </ul> <p><b>Lab: Effects of Human Activity on Freshwater Resources</b></p> <ul style="list-style-type: none"> <li>Identify sources of freshwater pollution.</li> <li>Model the effect of pollutants on the quality of freshwater resources.</li> <li>Predict the effect of human activity on the health of a freshwater ecosystem.</li> </ul>

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**LS1: From Molecules to Organisms: Structures and Processes****Characteristics of Life**

Compare and contrast living and nonliving objects.

Describe the characteristics of living organisms.

List the levels of organization within a living organism in hierarchical order.

Science Practice: Examine how two different scientists could use different experimental designs and have the same outcome.

**Macromolecules**

Compare the structures and functions of carbohydrates, lipids, proteins, and nucleic acids.

Identify the structures of the four macromolecules found in living organisms.

Science Practice: Examine careers in science fields.

**Proteins and Nucleic Acids**

Explain the roles of proteins and nucleic acids in living organisms.

Identify the components of proteins and nucleic acids and discuss how they were discovered.

Recognize essential amino acids found in living organisms.

Science Practice: Evaluate the impact of science and technology on society.

**The Function of Organelles**

Describe the functions of each organelle.

Identify the organelles of a cell.

Science Practice: Construct charts, graphs, and tables to organize data.

**Cell Homeostasis**

Describe the importance of homeostasis to living organisms.

Differentiate between diffusion, osmosis, passive transport, and active transport.

Explain how cells maintain homeostasis.

Science Practice: Generate procedures to utilize charts, graphs, and tables to show data.

**Lab: Diffusion Across a Semi-permeable Membrane**

Describe the process of diffusion.

Identify materials that are able to pass across a semipermeable membrane by diffusion.

Science Practice: Apply the scientific method to given scenarios.

**The Process of Photosynthesis**

Explain the importance of photosynthesis to living organisms.

Summarize the process of photosynthesis.

Write the chemical equation for photosynthesis.

Science Practice: Give examples of how hypotheses lead to new experimental methods.

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**Cellular Respiration**

- Compare and contrast aerobic and anaerobic cellular respiration.
- Describe how cellular respiration converts glucose to energy in the form of ATP.
- Explain the importance of cellular respiration to living organisms.
- Science Practice: Organize data using specific grouping methods.

**Mitosis**

- Describe the steps of mitosis.
- Explain the importance of mitosis to living organisms.
- Science Practice: Analyze how new technologies and experiments affect previous scientific explanations.

**Cell Differentiation and Specialization**

- Analyze the effect of changing external conditions on specialized cells.
- Describe specialized cells found within living organisms.
- Explain the role of differentiation in the creation of specialized cells.
- Science Practice: Examine how two different scientists could use different experimental designs and have the same outcome.

**LS2: Ecosystems: Interactions, Energy, and Dynamics****The Cycles of Matter**

- Demonstrate the importance of water, carbon, nitrogen, and phosphorus in ecosystems.
- Describe how water, carbon, nitrogen, and phosphorus are cycled through ecosystems.
- Science Practice: Compare the economic, human, and environmental losses to the benefits of a specific scientific example.

**Relationships Among Organisms**

- Describe the five major types of interactions between organisms.
- Examine how symbiotic relationships can create dependency among species.
- Explain how invasive species affect the environment they occupy.
- Science Practice: Describe various ways evidence can be interpreted or explained.

**Social Behavior**

- Describe examples of social behavior.
- Examine social behavior and its benefits.

**Energy Flow in Ecosystems**

- Distinguish between producers, consumers, and decomposers.
- Explain the energy flow in a food web.
- Illustrate the flow of energy through an ecosystem.
- Science Practice: Locate data on a table and relate that data to a corresponding graph.

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**Population Size and Structure**

- Describe the limiting factors that affect a population in a given environment.
- Differentiate between density-dependent and density-independent factors.
- Explain how birth rate, death rate, immigration, and emigration affect population size.
- Science Practice: Evaluate the impact of science and technology on society.

**Population Growth**

- Compare and contrast exponential and logistic growth models.
- Determine factors that influence a species' carrying capacity.
- Identify factors that affect population growth.
- Science Practice: Predict trends and outcomes based on a given set of data.

**Succession and Extinction**

- Assess the importance of biodiversity in an ecosystem.
- Identify and explain the stages of succession in an ecosystem.
- Identify factors that may disturb ecosystem stability.
- Science Practice: Locate data on a table and relate that data to a corresponding graph.

**Human Impact on the Environment**

- Analyze how human populations affect resources.
- Give examples of human activities that have been beneficial and detrimental to the environment.
- Relate the greenhouse effect to global warming and explain its impact on the environment.
- Science Practice: Give examples of science contributions impacting sustainability.

**LS3: Heredity: Inheritance and Variation of Traits****Meiosis**

- Describe the roles of crossing over and independent assortment in meiosis.
- Explain the importance of meiosis to living organisms.
- Illustrate the steps of meiosis.
- Science Practice: Examine how a scientist's creativity can lead to scientific discovery.

**Genetic Code**

- Describe the relationship between DNA, genes, and chromosomes.
- Describe the role of DNA replication in transmitting genetic information.
- Summarize the experiments that led to the discovery of the genetic code.
- Science Practice: Evaluate the impact of science and technology on society.

**DNA Mutations**

- Analyze the effect of harmful environmental factors on DNA.
- Describe common types of DNA mutations.
- Explain the effects of DNA mutations on the characteristics of living organisms.
- Science Practice: Discriminate scientific claims that are socially accepted but not scientifically based.

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### Introduction to Genetics

- Describe the role of nucleic acids in transmitting genetic information.
- Explain the importance of Gregor Mendel to the field of genetics.
- Science Practice: Give examples of how hypotheses lead to new experimental methods.

### Laws of Inheritance

- Apply the law of independent assortment.
- Describe how the principle of dominance applies to genes.
- Summarize the law of segregation.
- Science Practice: Differentiate scientific hypotheses, theories, and laws.

### Probability of Inheritance

- Determine genotype and phenotype probabilities from Punnett squares.
- Predict possible allele combinations of offspring based on the genetics of the parent.
- Use Punnett squares to create monohybrid and dihybrid crosses.
- Science Practice: Explain how changing the variables, methods, and timing impacts scientific investigation.

## LS4: Biological Evolution: Unity and Diversity

### Darwin's Theory

- Explain how natural selection acts as a mechanism of evolution.
- Summarize the main points of Darwin's theory.
- Summarize the major concepts of natural selection.
- Science Practice: Describe how scientific investigations lead to new scientific questions.

### Lab: Natural Selection

- Identify natural selection as a mechanism for the evolution of a population.
- Science Practice: Decide whether specific questions can be answered using scientific investigation.

### Factors Affecting Genetic Variation

- Describe genetic drift and gene flow as mechanisms of evolution.
- Give examples of how environmental factors affect genetic variation and influence natural selection.
- Science Practice: Predict trends and outcomes based on a given set of data.

### Factors Affecting Biological Diversity

- Examine how directional, disruptive, and stabilizing selection affect biological diversity.
- Explain how new or varied species originate via natural selection.
- Science Practice: Judge claims made by scientific explanations, data, or arguments.

### Biogeographic Isolation

- Analyze how new species are formed by reproductive and geographic isolation.
- Analyze the relationship between biogeographic isolation and the theory of evolution.
- Explain the concept of biogeographic isolation.
- Science Practice: Give examples of how hypotheses lead to new experimental methods.

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### Biological Evidence and the Fossil Record

Assess the comparative anatomies among organisms.

Describe how the fossil record shows common ancestry between organisms.

Distinguish scientific evidence that supports the theory of evolution.

Science Practice: Explain the role of scientific argumentation in evaluating the validity of data, claims, hypotheses, and observations.

### Evolutionary Relationships

Analyze the relationships among organisms based on a variety of shared characteristics.

Explain how understanding evolutionary history impacts classification of organisms.

Interpret evolutionary relationships among organisms on a cladogram.

Science Practice: Describe various ways evidence can be interpreted or explained.

### Biodiversity

Examine ways to protect biodiversity.

Identify how biodiversity contributes to the sustainability of an ecosystem.

Identify some factors that can threaten biodiversity.

Identify the factors that affect biodiversity.

## PS1: Matter and Its Interactions

### Solids and Plasmas

Describe how kinetic-molecular theory explains the properties of plasmas.

Describe how kinetic-molecular theory explains the properties of solids, including compressibility, shape, and volume.

Use kinetic-molecular theory to compare and contrast atomic or molecular motion in solids and plasmas.

Science Practice: Give examples of plasmas in nature and technology.

### Liquids

Describe how kinetic-molecular theory explains the properties of liquids, including compressibility and shape.

Describe how the postulates of kinetic-molecular theory apply to liquids.

Science Practice: Use the kinetic-molecular theory model to explain the behavior of liquids.

### Gases

Describe how kinetic-molecular theory explains the properties of gases, including temperature, pressure, compressibility, and volume.

Describe the postulates of kinetic-molecular theory.

Interpret the behavior of ideal gases in terms of kinetic-molecular theory, including diffusion and effusion.

Science Practice: Identify the limitations of kinetic-molecular theory.

### Changes in Matter

Differentiate between extensive and intensive properties of matter, and give examples of each.

Differentiate between physical changes and chemical changes of matter.

Differentiate between physical properties and chemical properties of matter.

Science Practice: Identify substances based on their chemical and physical properties.

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**The History and Arrangement of the Periodic Table**

Describe the arrangement of the periodic table and relate the properties of atoms to their position in the periodic table.

Outline the historical development of the periodic table.

Use the periodic table to classify elements.

Science Practice: Predict the properties of elements based on their position on the periodic table.

**Electrons and the Periodic Table**

Relate the position of an element in the periodic table to its electron configuration.

Use the periodic table to determine the number of valence electrons available for bonding.

Science Practice: Analyze the relationship between electron configurations and the structure of the periodic table.

**Types of Chemical Bonds**

Compare and contrast ionic, metallic, and covalent bonds.

Relate electronegativity and ionization energy to bond formation.

Science Practice: Create a chart to compare and contrast ionic, metallic, and covalent bonds.

**Writing and Balancing Chemical Equations**

Describe chemical reactions by writing word equations and formula equations.

Use the law of conservation of mass to balance chemical equations.

Science Practice: Identify and use special symbols properly in chemical equations.

**Types of Reactions**

Classify a reaction as synthesis, decomposition, single replacement, double replacement, or combustion.

Identify and characterize the types of reactions, including synthesis, decomposition, combustion, single replacement, and double replacement.

Use the activity series to determine whether a single replacement reaction will occur.

Science Practice: Predict the products of a reaction using the activity series.

**Reaction Rate**

Describe collision theory and how it is related to reactions.

Explain how various factors, including concentration, temperature, and pressure, affect the rate of a chemical reaction.

Explain the concept of reaction rate.

Science Practice: Use the collision theory model to explain how reactions happen.

**Heat**

Describe heat flow in terms of the motion of atoms or molecules.

Distinguish between exothermic chemical processes and endothermic chemical processes.

Relate temperature to the average molecular kinetic energy.

Science Practice: Analyze and interpret information about a reaction to classify the reaction as either an exothermic process or an endothermic process.

**Enthalpy of Reaction**

Apply Hess's law to calculate enthalpy change in a reaction.

Demonstrate how to produce an overall chemical equation from equations for intermediate reaction steps.

Science Practice: Translate quantitative information expressed in words in a text into a visual form by drawing enthalpy diagrams.

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**PS2: Motion and Stability: Forces and Interactions****Newton's Laws of Motion**

Describe Newton's first law of motion and how it relates to inertia.

Explain Newton's third law of motion and how it relates to action and reaction forces.

Identify applications of Newton's three laws of motion.

Use Newton's second law of motion to calculate force, mass, and acceleration.

**Momentum**

Apply Newton's third law of motion to understand what happens to momentum when two objects collide.

Define and calculate momentum.

Explain how momentum is conserved.

Use mathematical representations to show that the total momentum of a system of objects is conserved when there is no net force on the system.

**Gravity**

Describe how gravity affects projectile motion.

Describe Newton's law of universal gravitation.

Explain the concept of free fall.

Identify and describe the factors that affect the gravitational force between two objects.

**Coulomb's Law**

Compare electric force with gravitational force.

Examine the factors that affect the electric force between two objects.

Solve problems using Coulomb's law.

**Lab: Electromagnetic Induction**

Examine how magnetic polarity affects the direction of induced current in a loop of wire.

Recognize that a moving magnet can induce an electric field, causing current to flow in a loop of wire.

**PS3: Energy****Potential and Kinetic Energy**

Calculate the kinetic energy in a system.

Calculate the potential energy in a system.

Distinguish between potential and kinetic energy.

Explain how energy is transferred in a moving system.

**Lab: Kinetic Energy**

Calculate the kinetic energy of objects of different mass.

Determine the kinetic energy of objects at different speeds.

Graph data to illustrate changes in kinetic energy.

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### Energy Transformations

- Explain how energy changes form.
- Identify examples of energy transformations.
- Summarize the law of conservation of energy.

### Lab: Thermal Energy Transfer

- Determine how mass affects the amount of thermal energy transferred.
- Investigate how different materials transfer thermal energy.
- Observe and compare the specific heat of water with the specific heat of other substances.

### Second Law of Thermodynamics

- Apply the second law of thermodynamics to describe how heat engines work.
- Describe how the first and second laws of thermodynamics are related.
- Explain why entropy increases over time.

### Electric Charge

- Analyze the factors that affect the strength of an electric force.
- Describe the electric field due to a charge.
- Determine how electric charges interact.
- Explain how electrons cause objects to become electrically charged.

### Magnets and Magnetism

- Describe Earth's magnetic field.
- Describe the properties of magnets.
- Determine how magnetic poles interact with each other.
- Illustrate the magnetic field around a magnet.

### Lab: Magnetic and Electric Fields

- Demonstrate and describe electric fields.
- Demonstrate and describe magnetic fields.
- Show how magnetic and electric fields are related.

## PS4: Waves and Their Applications in Technologies for Information Transfer

### Properties of Waves

- Calculate the speed of a transverse wave.
- Describe how a wave's amplitude is related to the energy the wave carries.
- Describe the relationship between the frequency and wavelength of a wave.
- Explain why waves travel at different speeds.
- Use mathematical representations to show relationships among the frequency, wavelength, and speed of waves traveling in various media.

### Using Sound

- Describe the uses of ultrasound technology.
- Explain how and why animals use echolocation.
- Summarize the ways in which sound waves are used for communication.