Indiana Science Tutorials offer targeted instruction, practice, and review designed to help students develop scientific literacy, deepen conceptual understanding, and apply scientific practices. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By continually honing their ability to apply knowledge in real-world scenarios, students build the depth of knowledge and higher-order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students as they explore the nature of science through focused content, interactive mini investigations, multi-modal representations, and personalized feedback. The Review It offers a high-impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

These Tutorials are built to state standards.

Unit 1: Forces

- **EFFECTS OF FORCES**
  - MS-PS2-1: Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.
  - MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. Clarification Statement: Emphasis is on balanced (Newtons First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.
- **ELECTROMAGNETIC FORCES**
  - MS-PS2-3: Ask questions and design a plan to determine the factors that affect the strength of electric and magnetic forces. Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.
  - MS-PS2-5: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. Clarification Statement: Examples of this phenomenon could include the interactions of magnets,

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electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.

- **GRAVITATIONAL FORCE**
  - MS-PS2-4: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the sun, and orbital periods of objects within the solar system.
  - MS-PS2-5: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.

Unit 2: Energy

- **DESCRIBING ENERGY**
  - MS-PS3-1: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball.
  - MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmates hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.
- **ENERGY TRANSFER AND TRANSFORMATION**
  - MS-PS3-5: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.

Unit 3: Thermal Energy

- **THERMAL ENERGY AND TEMPERATURE**
  - MS-PS3-4: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water

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with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.

- **ENERGY TRANSFER AND TECHNOLOGY**
  - MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.
  - MS-PS3-4: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.

Unit 4: Nature of Life

- **CHARACTERISTICS OF LIFE**
  - MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.
- **CHEMISTRY OF LIFE**
  - MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.

Unit 5: Cells

- **CELL STRUCTURE**
  - MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.
- **CELL NUTRITION AND TRANSPORT**
  - MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.

Unit 6: Multicellular Bodies

- **SPECIALIZED CELLS AND TISSUES**

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- MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

- **ORGANS AND ORGAN SYSTEMS**
  - MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.
- **HUMAN ORGAN SYSTEMS**
  - MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.
  - MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Unit 7: Planet Earth

- **EARTH'S STRUCTURE AND CYCLES**
  - MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.
- **THE ROCK CYCLE**
  - MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.

Unit 8: Earth's Plates

- **DEFORMING EARTH'S CRUST**
  - MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.

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- **PLATE TECTONICS**
  - MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.
  - MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.
  - MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).

Unit 9: Our Changing Planet

- **WEATHERING AND EROSION**
  - MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.
  - MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.
- **GEOLOGIC TIME**
  - MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and

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ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.

- MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).

Unit 10: Human Impact

- **NATURAL RESOURCES**
  - MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).
- **SUCCESSION AND ECOSYSTEM STABILITY**
  - MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Unit 11: Natural Disasters

- **SEVERE WEATHER**
  - MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).
  - MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
  - MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

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- MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

- **EARTHQUAKES AND VOLCANOES**
  - MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).
  - MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
  - MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Unit 12: Humans and Technology

- **WAVES AND TECHNOLOGY**
  - MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **SPACE EXPLORATION**
  - MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

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