

Alignment of PhET Simulations and Middle School NGSS Performance Expectations

[Earth and Space Systems](#)

[Physical Science](#)

[Life Science](#)

[Engineering Design](#)

Earth and Space Systems

Topic	Middle School NGSS (2015) Performance Expectations (PE)		Associated PhET Simulation	Portions of PE Addressed by Simulation (Note: Most simulations will apply to only a part of a lesson designed around an NGSS PE)
Earth's Place in the Universe	MS-ESS1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.	Gravity and Orbits (Flash)	Use Sun, Earth, and Moon to observe the relative positions of each at various times.
Earth's Place in the Universe	MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	My Solar System (Flash)	Vary mass, initial position, and initial velocity and observe orbits. Does NOT show force vectors.
			Gravity and Orbits (Flash)	Vary mass (limited) and observe orbital motion and gravitational force vectors.
Earth's Place in the Universe	MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.	Gravity and Orbits (Flash)	Observer cartoon versus scale models of Earth, Sun, and Moon.
Earth's Place in the Universe	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.	Radioactive Dating Game (Java)	Using tab "Dating Game" examine, estimate age, and interpret fossil evidence in different Earth layers.

Alignment of PhET Simulations and Middle School NGSS Performance Expectations

Earth's Systems	MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	Salts and Solubility	Investigate solubility and concentration to enhance investigation of chemical weathering.
			Friction (HTML5)	Investigate friction as a mechanism of mechanical weathering.
Earth's Systems	MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	Glaciers	Observe glacier properties and movements with resulting changes to land formations.
			Plate Tectonics	Explore features at plate boundaries and plate movements that cause them. Compare with global maps of Earth features.
			Salts and Solubility	Investigate solubility and concentration to enhance investigation of chemical weathering.
			Friction (HTML5)	Investigate friction as a mechanism of mechanical weathering.
Earth's Systems	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.	Plate Tectonics	Explore features at plate boundaries and plate movements that cause them. Compare with global maps of Earth features.
Earth's Systems	MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	Under Pressure (HTML5)	Investigate the relationships among pressure, gravity, and depth in air and water. Apply to air masses.
			Density and Buoyancy (HTML5)	Investigate the relationship between density and buoyancy and apply to air masses.
Earth and Human Activity	MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	The Greenhouse Effect	Use the simulation to investigate the effects of possible solutions to the problem of human impact on the environment.
Earth and Human Activity	MS-ESS3-5	Ask questions to clarify evidence of the factors that have caused the	The Greenhouse Effect	Investigate the factors that contribute to global temperatures to rise.

		rise in global temperatures over the past century.		
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Physical Science

Topic	Middle School NGSS (2015) Performance Expectations (PE)		Associated PhET Simulation	Portions of PE Addressed by Simulation (Note: Most simulations will apply to only a part of a lesson designed around an NGSS PE)
Matter and its Interactions	MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.	Molecule Shapes (HTML5)	Develop models of simple molecules.
Matter and its Interactions	MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	Reactants, Products, and Leftovers (HTML5)	Discuss and determine the different properties of reactants and products. Starts with the familiar (sandwiches), and progresses to chemical reactions. May require outside sources to find properties of elements and products.
			Sugar and Salt Solutions	Examine properties of solutions of different concentrations. Observe solutions at the molecular level.
Matter and its Interactions	MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	State of Matter: Basics	Models particle motion and temperature when thermal energy is added or removed.
Matter and its Interactions	MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	Reactants, Products, and Leftovers (HTML5)	Illustrates that the number of atoms remains constant during a chemical reaction.
			Balancing Chemical Equations (HTML5)	A visual and numeric treatment of conservation of mass during a chemical reaction. Includes a game.

Motion and Stability: Forces and Interactions	MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.	Gravity Force Lab	Observe force vectors of stationary objects on each other. Vary masses and distance between objects.
			Collision Lab	Simulate two objects colliding and look at data from the collision.
			Gravity and Orbits (Java)	Observe gravity force vectors on two orbiting objects (Sun and Earth) to understand Newton's Third Law during orbits. Vary the masses and the distance between objects. Apply learning to collisions.
Motion and Stability: Forces and Interactions	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.	Force and Motion: Basics (HTML5)	Monitor changes in mass of the object and changes in speed to collect evidence about the changes in motion
Motion and Stability: Forces and Interactions	MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	Balloons and Static Electricity (HTML5)	Qualitative introduction to Coulomb forces.
			Electric Field Hockey (Java)	Qualitative introduction to Coulomb forces.
			Faraday's Electromagnetic Lab (Java)	Quantitatively explore magnetic field strength with distance (Bar Magnet and Electromagnet tabs).
Motion and Stability: Forces and Interactions	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.	Gravity Force Lab	Observe force vectors of stationary objects on each other. Vary masses and distance between objects.
			Gravity and Orbits (Java)	Observe gravity force vectors on two orbiting objects (Sun and Earth) to understand Newton's Third Law during orbits. Vary the masses and the distance

				between objects. Apply learning to collisions.
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Motion and Stability: Forces and Interactions	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.	Faraday's Law (HTML5)	Qualitative introduction with evidence that a changing magnetic field can produce an electric current.
			Electric Field Hockey (Java)	Qualitative introduction to electric fields, very fun game for students.
			Charges and Fields (Flash)	Quantitative representation of electrostatic force and fields around charged bodies.
			Faraday's Electromagnetic Lab (Java)	Qualitative or quantitative platform for evidence that an electric current can produce a magnetic field.
			Generator (Java)	Qualitative introduction with evidence that a changing magnetic field can produce an electric current.
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.	Energy Skate Park: Basics	Pie chart and bar graph show changes in energy type (Kinetic, Potential, and thermal). Adjust skater mass to observe the effect.
			Energy Skate Park (Java)	Similar to the above, but includes quantitative graphs.
			Pendulum Lab	Qualitative. Energy changes are shown with bar graphs, relative masses, and relative speeds.
			Masses & Springs	Qualitative introduction to energy changes using bar graphs, relative masses, and relative speeds.

Energy	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.	States of Matter	Includes a tab called, "interaction potential" where potential energy is shown on a graph and changes with distance between two atoms.
			Energy Skate Park: Basics	Pie chart and bar graph show changes in energy type at various heights.
			Energy Skate Park (Java)	Similar to the above, but includes quantitative graphs.
			Pendulum Lab	Qualitative bar graphs show potential energy changes with height of mass.
Energy	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.	Masses & Springs	Qualitative bar graphs show potential energy changes with height of mass.
			Energy Forms and Changes (Java)	Thermal energy investigation. Place objects of various specific heats in contact, then add or remove heat. Measure temperature. (Try iron block on top of brick, thermometer on each, heat the brick from below!)
Energy	MS-PS3-5	Construct, use, and present arguments to support the claim that when the kinetic energy of an	Gas Properties (Java)	Add or remove heat to molecules in a box. Measure temperature. Observe graphs of kinetic energy of particles and speed of particles.
			Energy Skate Park: Basics	Pie chart and bar graph show changes in energy type (Kinetic, Potential, and thermal). Adjust skater mass to observe the effect.

Alignment of PhET Simulations and Middle School NGSS Performance Expectations

		object changes, energy is transferred to or from the object.	Energy Skate Park (Java)	Similar to the above, but includes quantitative graphs.
			Pendulum Lab	Qualitative. Energy changes are shown with bar graphs, relative masses, and relative speeds.
			Masses & Springs	Qualitative introduction to energy changes using bar graphs, relative masses, and relative speeds.
Waves and their Applications in Technologies for Information Transfer	MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	Sound (Java)	Qualitatively explore the relationship between the amplitude and volume of a sound wave.
Waves and their Applications in Technologies for Information Transfer	MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	Wave on a String (HTML5)	Observe waves on a string with a fixed, loose, or no end.
			Bending Light (Java)	Observe the behavior of light waves at boundaries between various materials.
Waves and their Applications in Technologies for Information Transfer	MS-PS4-3	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	Radio Waves & Electromagnetic Fields (Java)	Introduction to analog signals prior to study of digital signals. Examine the production, transmission, and reception of radio waves.

Life Science

Topic	Middle School NGSS (2015) Performance Expectations (PE)		Associated PhET Simulation	Portions of PE Addressed by Simulation (Note: Most simulations will apply to only a part of a lesson designed around an NGSS PE)
From Molecules to Organisms:	MS-LS1-8	Gather and synthesize information that sensory receptors respond to	Color Vision	The PhET simulation shows the person's response to the different color lights.

Alignment of PhET Simulations and Middle School NGSS Performance Expectations

Structures and Processes		stimuli by sending messages to the brain for immediate behavior or storage as memories.		
Ecosystems: Interactions, Energy, and Dynamics	MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	Natural Selection (Java)	Investigate the effect of predators and limited resources on populations.
Ecosystems: Interactions, Energy, and Dynamics	MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	Natural Selection (Java)	Investigate the effect of predators and limited resources on populations.
Ecosystems: Interactions, Energy, and Dynamics	MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	Natural Selection (Java)	Use as a student introduction to biodiversity and ecosystems before they begin to develop design solutions.
Biological Evolution: Unity and Diversity	MS-LS4-1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.	Radioactive Dating Game (Java)	Using tab "Dating Game" examine, estimate age, and interpret fossil evidence in different Earth layers.
Biological Evolution: Unity and Diversity	MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	Natural Selection (Java)	Use the Population Graph to show how natural selection leads to changes in the number of traits over time.

Engineering Design

Topic	Middle School NGSS (2015) Performance Expectations (PE)		Associated PhET Simulation	Portions of PE Addressed by Simulation (Note: Most simulations will apply to only a part of a lesson designed around an NGSS PE)
Engineering Design	MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	The Greenhouse Effect (Java)	Use the simulation to investigate the effects of possible solutions to the problem of human impact on global temperatures.
Engineering Design	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.	Salts and Solubility	Investigate solubility and concentration to identify characteristics leading to a solution to the problem of groundwater pollution (fertilizer, fracking materials).