Applied Physics

OVERVIEW

In this title, students learn about the wonderful forces of nature that they must control and learn to live with to make their lives more enjoyable. Using an air track, students learn about motion by calculating the velocity and acceleration of air track cars using a photogate timer. Students study data transmission using a laser. Students also learn about radio waves, light, and heat and do experiments using mathematics.

STUDENT OBJECTIVES

- Define and calculate velocity and acceleration.
- Explain the relationship between gravity and acceleration.
- Define the relationships among frequency, pitch, amplitude, and loudness.
- Experiment with different sound waves and list the steps necessary to hear sound.
- Define *hypothesis* and make and test a hypothesis regarding heat transfer.
- List the steps of the scientific method.
- Differentiate between an insulator and a conductor.
- Discover how light waves travel.
- Explore various uses of lasers.

ACTIVITIES

Students complete three performance assessments: 1) Heat Experiment – explain a hypothesis, list the steps of the scientific method, and set up and complete an experiment; 2) Light Filter Experiments – set up and conduct light experiments and verbalize how tinted sunglasses filter light; and 3) Laser Experiments – demonstrate the proper care and use of a laser and utilize one or more mirrors in the transfer of sound through a laser and photocell.

Changing Oceans

OVERVIEW

Changing Oceans first introduces students to general characteristics of oceans (such as salinity, depth, and layers) and to the variety of ocean organisms and their habitats. Then, students look at specific ocean-related problems and crises, including overfishing; ocean pollution; global warming; and exploitation of ocean minerals, metals, and energy. In addition to describing the problems, *Changing Oceans* concentrates on two factors: relating the problem directly to students and brainstorming current or potential solutions to the problem.

STUDENT OBJECTIVES

- Identify Earth's oceans according to salinity, depth, and other characteristics.
- Explore major types of ocean habitats and ocean organisms.
- Review the history and current status of ocean fisheries and explain changes.
- Explore types of ocean pollution, including effects on ocean organisms, food webs, and people.
- Describe global warming and explain its effects on ocean temperature and acidity.
- Explain effects of global warming on ocean ecosystems and organisms.
- Use problem-solving techniques to brainstorm solutions to a chosen ocean problem.

This title content focuses on green education.

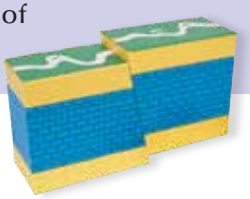
ACTIVITIES

Students complete three performance assessments: 1) Ocean Fisheries – explain changes in fisheries in the last 50 years, give reasons for the changes, and describe effects on human populations; 2) Ocean Pollution – list types of ocean pollution and their general locations and describe the Great Pacific Garbage Patch and where it came from; and 3) The Future of Oceans – list expected ocean-related changes in the next 50 years and explain how global warming is currently affecting oceans and the consequences to oceans if current trends continue.

Dynamic Earth

OVERVIEW

In *Dynamic Earth*, students gain a scientific understanding of the processes that shape our planet. Students construct a scale model of Earth's interior, calculate the epicenter of an earthquake, create and read a topographic map, and use a shaker table to simulate an earthquake's destructive force. They explore the history and evidence behind continental drift and the theory of plate tectonics.



STUDENT OBJECTIVES

- Examine Earth as it relates to the universe.
- Discover factors that give Earth its unique ability to support life.
- Use calculated data to design a two-dimensional scale drawing of Earth's interior.
- Become familiar with the history behind the theory of plate tectonics.
- Learn that evidence suggests Earth's magnetic poles vary.
- Distinguish among the three main types of plate boundaries.
- Perform an experiment that simulates a convergent plate boundary.
- Use models to simulate different types of faults and landforms that faulting can create.

ACTIVITIES

Students complete three performance assessments: 1) Scale Model – use dimensional analysis to convert units; make a two-dimensional scale drawing from a three-dimensional Earth model; 2) Plate Tectonics – explain plate tectonics and describe three types of tectonic plate boundaries; and 3) Locations and Faults – describe normal and reverse faults and the type of force acting on each.

Eco-Architecture

OVERVIEW

Eco-Architecture enables students to explore sustainable construction methods that designers and engineers use currently. Students learn how to evaluate the benefits and drawbacks of building materials based on the Six-Question Sustainability Test. They learn the importance of building for sustainability and learn why we need to reduce, reuse, recycle, and rethink when planning for new construction. Ultimately, students design and create their own Eco-home that represents choices they have made about designing with the environment in mind.

STUDENT OBJECTIVES

- Evaluate building materials based on the Six-Question Sustainability Test.
- Review LEED classifications that are used for green construction.
- Demonstrate how insulation works, including the benefits of green roofs.
- Create a thermal wall to understand the process of heat transfer.
- Explain the water cycle and how this is an integral part of Earthship design.
- Explore the benefits of straw bale, earth-sheltered, rammed-earth, and Earthship construction methods.

This title content focuses on green education.

ACTIVITIES

Students complete three performance assessments: 1) Passive Solar – demonstrate how winter and summer sunlight differ and explain the benefits of passive solar design; 2) Thermal Mass – explain the process for creating rammed-earth walls and how a thermal wall is used for heating and cooling; and 3) Eco Choices – name two things all homeowners can do to make their landscaping more environmentally friendly and explain three construction choices they would make when designing their own Eco-home.

Ecology

OVERVIEW

In *Ecology*, students explore basic concepts and processes underlying the function of natural ecosystems. They consider biotic and abiotic factors; energy flow through food webs; nutrient cycles; population interactions including population growth, carrying capacity, and predator-prey interactions; biodiversity; and humans as part of ecological systems.

STUDENT OBJECTIVES

- Use a water test kit to measure abiotic factors in a river-tank ecosystem.
- Dissect a barn owl pellet and construct a barn owl food web.
- Relate the laws of thermodynamics to the energy pyramid in an ecosystem.
- Describe the process and importance of nutrient cycling in an ecosystem.
- Explore different types of adaptive interactions within a community.
- Explore population growth and carrying capacity and estimate population size.
- Simulate a predator-prey interaction.
- Explore biodiversity in ecosystems and calculate a diversity index.
- List ecosystem services provided to humans and consider human effects on ecosystems.

ACTIVITIES

Students complete three performance assessments: 1) Energy Flow – dissect a barn owl pellet and use the results to construct a food web and explain how energy travels through an ecosystem; 2) Biodiversity – use a sampling technique to measure biodiversity and use the data to calculate a diversity index; and 3) Population Growth – draw and explain the difference between exponential and logistic growth curves and explain the mark-recapture method for estimating population size.

Environmental Issues

OVERVIEW

In *Environmental Issues*, students use multimedia and hands-on activities and experiments to explore pollution, loss of habitats and biodiversity, resource use, waste management, global climate change, and human population growth. They learn statistics related to these issues and do activities relating to acid rain, paper recycling, resource use, oil-spill cleanup, and global warming.

STUDENT OBJECTIVES

- Conduct and analyze an experiment on the effects of acid rain.
- Distinguish among nonrenewable, renewable, and perpetual resources.
- Do a mining activity to demonstrate depletion of a nonrenewable resource.
- Explore causes of pollution and do an oil-spill cleanup activity.
- Explore the solid waste problem and do a paper-recycling activity.
- Distinguish between the greenhouse effect and global warming.
- Demonstrate the greenhouse effect.
- Compare logistic and exponential growth and explore human population growth.
- Conduct a cost-benefit analysis of an environmental issue.

ACTIVITIES

Students complete three performance assessments: 1) Resource Use – demonstrate and explain the effects of mining on the availability of nonrenewable resources; 2) Paper Recycling – demonstrate and explain the process of paper recycling and discuss advantages of recycling; and 3) Population – explain the growth equation and create a concept map describing impacts of human population growth.

Forces

OVERVIEW

In *Forces*, students explore forces and how they affect the motion of objects. Students learn to describe and measure the motion of objects by completing distance, time, speed, and velocity measurement activities. Students use examples they already find relevant to learn about various forces. They describe and measure the changing motion of accelerating objects and observe the direction of motion and how radius affects centripetal acceleration.

STUDENT OBJECTIVES

- Calculate the force of gravity on a massive object in the metric unit of newtons.
- Experiment with balanced and unbalanced forces acting on an object.
- Observe a moving object and determine if the force acting on it is balanced or unbalanced.
- Explain the difference between speed and velocity.
- Experiment with and explain Newton's three laws of motion.
- Determine that all accelerating objects are experiencing an unbalanced force.
- Explain the difference between mass and weight.
- Learn that gravity is an attractive force between objects.
- Recognize and identify the presence of frictional forces in everyday activities.

ACTIVITIES

Students complete three performance assessments: 1) Speed and Velocity – use an air table, inclined ramp, and photo gates to study objects moving at nearly constant speed and velocity; 2) Acceleration – measure the changing motion of accelerating objects due to the force of gravity; and 3) Falling Objects – study Newton's three laws of motion to learn how gravity affects a variety of falling objects.

Green Machines

OVERVIEW

According to the Best Foot Forward group, the average American's carbon footprint shows 34% of the emissions produced are accounted for by personal travel. In *Green Machines*, the effects of personal travel and the transportation of goods on the environment are examined. While it would be unrealistic to imagine eliminating travel from our society, we can make smart buying choices regarding cars and fuel. Car types, car companies, fuel types, and alternative methods of travel are identified and examined. The focus of this title is environmental health.

STUDENT OBJECTIVES

- Explore the history of transportation.
- Identify types of pollution and how transportation contributes to these.
- Explore alternative fuel vehicles such as hybrids, fuel cell, electric, and solar, and list the advantages and disadvantages of each.
- Describe how biodiesel is created and used.
- Compare methods for minimizing the environmental impacts of transportation.
- Identify methods for increasing the fuel efficiency of a vehicle.
- Build and operate a maglev train.

This title content focuses on green education.

ACTIVITIES

Students complete three performance assessments: 1) Emissions – identify various emissions that come from automobiles, explain how these may contribute to global warming, and list alternative methods for decreasing automobile emissions; 2) Fuel Efficiency – explain how to calculate fuel efficiency and list methods for increasing the fuel efficiency of a car; and 3) Eco-tourism – explain the eco-tourism concept, compare the advantages and disadvantages of transportation methods in the tourism industry, and plan an environmentally friendly trip.

Music & Sound

OVERVIEW

Frequency, pitch, waves, amplitude, Fibonacci numbers, and ratios are concepts covered in *Music & Sound*. Students learn music history and explore the creation of music. They investigate the science and math behind the components of sound and are introduced to music theory. Students apply their skills to create rhythms on an electric drum pad and melodies on an electric keyboard. Students utilize software to record their melodies.

STUDENT OBJECTIVES

- Analyze the structure of a sound wave and compare noise and music.
- Investigate sound through amplitude and volume.
- Experiment with frequency and pitch and compare frequency of musical notes.
- Determine a specific frequency using mathematical ratios.
- Explore the Fibonacci sequence and its relationship to music.
- Play notes on the keyboard and use software to record audio in a digital format.
- Use a metronome, electronic drum pads, and an electronic keyboard to explore rhythm.

ACTIVITIES

Students complete three performance assessments: 1) Exploring the Monochord – identify the pitch of a note on the monochord and explain string length and frequency; 2) Musical Scales and Sequences – understand the Fibonacci sequence and the golden ratio or golden proportion; and 3) Reading a Musical Score – define *rhythm* and *beat*, demonstrate a 3-4 beat rhythm written to accompany a melody, and explain the relationship between tempo and beat.

Natural Disasters

OVERVIEW

In *Natural Disasters*, students briefly explore various categories of natural disasters. They learn the scientific concepts underlying the cause and the general effects of each disaster, as well as locations in the US and around the world where each type of disaster is most likely to strike. They do activities to demonstrate both scientific concepts and methods of measuring and tracking the process. Finally, they develop a school disaster plan based on given conditions.

STUDENT OBJECTIVES

- Demonstrate types of faults and locate major tectonic plates on a world map.
- Use a tabletop seismograph to demonstrate seismic waves.
- Make and compare different types of lava and compare types of volcanic rocks.
- Demonstrate effects of wave action and demonstrate how a tsunami is produced.
- Summarize causes and effects of weather extremes.
- Study circular storms, such as hurricanes and tornadoes, and track a hurricane.
- Learn the scales used to measure earthquakes, hurricanes, and tornadoes.
- Using concepts such as risk analysis and probability, develop a school disaster plan.
- Observe examples of specific natural disasters through video and slide shows.

ACTIVITIES

Students complete three performance assessments: 1) Earthquakes – explain how fault lines and plate boundaries relate to earthquakes, demonstrate the use of a seismograph, and explain the Richter scale; 2) Waves – illustrate parts of a wave, demonstrate wavelength and frequency, and compare tsunami waves to wind waves; and 3) Circular Storms – compare hurricanes and tornadoes, plot a hurricane's path, and demonstrate hurricane wind fields.

Rocketry & Space

OVERVIEW

In *Rocketry & Space*, students learn about the development of rocketry and the United States space program and its history. The principles of rocket design, propulsion, and certain scientific principles that are fundamental to successful rocket flight are important concepts in this title. Students construct and launch a model rocket as a means of bringing application to the scientific concepts presented.

STUDENT OBJECTIVES

- Actively participate in the process of designing and constructing a model rocket.
- Understand the history of US space exploration.
- Comprehend certain scientific principles as they relate to rocketry and space flight.
- Construct and paint a model rocket.
- Observe rocket aerodynamics and flight by launching a rocket.
- Measure the altitude of a model rocket while in flight.

ACTIVITIES

Students complete three performance assessments: 1) Lift-off Game – identify how to access shuttle program terminology and information and verbalize information gained about the shuttle program; 2) Rocket Kit Assembly – attach fins to the body tube, cut out and assemble the parachute, install the engine mount, and assemble the rocket; and 3) Rocket Painting – demonstrate the proper way to complete the painting portion of the rocket kit assembly.

Rocks & Resources

OVERVIEW

In *Rocks & Resources*, students study the rock cycle and learn characteristics of the three basic rock types. They learn and observe properties of minerals, including hardness and fluorescence, in more detail. They review examples of how rocks and minerals are used as nonrenewable resources. They review different types of mining and learn why mining is essential to civilization. They also learn how it affects the environment, using Picher, Oklahoma, as a case study. Finally, they look at potential future mining trends, including deep-sea mining.

STUDENT OBJECTIVES

- Describe the rock cycle.
- Identify and compare characteristics of the three rock types.
- Distinguish among rocks, minerals, and ores.
- Identify properties of minerals and fluorescent minerals.
- Use Mohs' hardness test to determine mineral hardness.
- Explore uses of rocks, minerals, and metals as nonrenewable resources.
- Describe types of mining, including undersea mining.
- Review environmental impacts of mining.

This title content focuses on green education.

ACTIVITIES

Students complete three performance assessments: 1) Rocks and Minerals – name and identify examples of the three types of rocks, distinguish between rocks and minerals, and explain Mohs' hardness test; 2) Rocks as Resources – give examples and uses of metallic and nonmetallic resources and explain the life cycle of a manufactured product; and 3) Land Mining – define *ore* and explain ore grade, distinguish between surface and underground mining, and explain the importance and environmental impacts of mining.