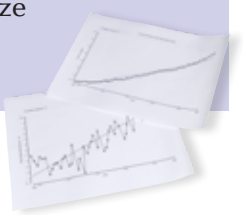
Climate Change

OVERVIEW

The 2007 Intergovernmental Panel on Climate Change (IPCC) Report describes causes, effects, and ways of dealing with climate change resulting from global warming. In *Climate Change*, students are introduced to the IPCC Report. They learn the effect of carbon dioxide and other greenhouse gases on global temperature increase. Then, they use graphing, polynomials, and matrices to analyze data from the report and develop possible carbon mitigation strategies.



STUDENT OBJECTIVES

- Learn factors causing climate change.
- Explore effects of climate change on weather, people, and ecosystems.
- Use software to create graphs of temperature and CO_2 change.
- Learn to add, subtract, multiply, and divide polynomials.
- Set up polynomial equations describing factors causing global warming.
- Measure albedo of different colored surfaces.
- Measure and graph rates of ice melt and water-level rise.
- Learn addition, subtraction, and scalar multiplication of matrices.
- Use matrices and polynomials to describe possible carbon mitigation strategies.

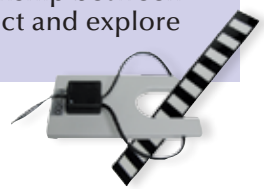
ACTIVITIES

Students complete three performance assessments: 1) Data Analysis – show polynomials describing factors that cause global warming and show and explain graphs of temperature and CO_2 change with time; 2) Rates of Change – calculate rates of change and show graphs of data collected on ice melt and water-level rise; and 3) Polynomials – solve polynomial equations, add and subtract matrices, and explain their own carbon mitigation solution.

Gravity of Algebra

OVERVIEW

In *Gravity of Algebra*, students investigate the force of gravity and its effects on objects as they fall. Students perform various free-fall experiments, gather data from the experiments, and interpret the data by applying mathematical concepts such as direct and inverse variations, scatter plots, and slope. They use the point-slope and y-intercept forms of a line to create a mathematical representation of the data and calculate the acceleration due to gravity on Earth. Students also use graphing skills to learn the relationship between the kinetic and the potential energy of a falling object and explore the Law of Conservation of Energy.



STUDENT OBJECTIVES

- Explore direct and inverse variations through experiments in force and motion.
- Create scatter plots and determine types of correlations for data gathered from a free-fall activity.
- Write linear equations in slope-intercept and point-slope form to describe the motion of falling objects.
- Explore the relationships between potential and kinetic energy of falling objects.
- Graph linear equations that represent the energy of a falling object.
- Use the Universal Law of Gravitation to calculate the acceleration due to gravity on Earth.

ACTIVITIES

Students complete three performance assessments: 1) Scatter Plots – plot data points on a scatter plot, draw a line of fit to represent the data, and determine the type of correlation the scatter plot represents; 2) Slope and Acceleration – calculate the slope of a line on a velocity versus time graph and explain how this slope is related to the acceleration of the object; and 3) Linear Equations – write and graph equations of lines in both point-slope and slope-intercept forms.

Lenses & Optics

OVERVIEW

In *Lenses & Optics*, students use the focal length of a lens to solve rational equations. Students gather information by performing an activity to determine lens' optic measurements and then graph the measurements. Students perform an experiment to discover the relationship between the object height and the image height, which are used to define the magnification ratio. Students create a slide projector and discover how lenses are used to correct vision problems.

STUDENT OBJECTIVES

- Solve simple rational equations.
- Use cross multiplication to solve formulas.
- Learn about direct and inverse variation.
- Graph the lens' optic measurements.
- Solve the magnification formula by using cross multiplication.

ACTIVITIES

Students complete three performance assessments: 1) Slide Projector – determine focal length of a lens by experimentation, determine magnification, and successfully set up a slide projector; 2) Images – use the lens formula; explain the relationships between image size, image distance, object size, object distance, and focal length; and explain a real and virtual image; and 3) Vision – define *nearsightedness* and *farsightedness*, explain how lenses correct vision, and calculate the diopter of a lens.

Nuclear Energy

OVERVIEW

In *Nuclear Energy*, students explore the various components of nuclear energy. Students utilize the graphing calculator to graph and explore equations related to the theory of relativity, rational functions related to Coulomb's Law, exponential equations related to nuclear fission generation times, and rational equations related to radioactivity. Students use the *Nuclear Power Plant* software to run a reactor simulation where the goal of the simulation is to not have a nuclear meltdown.

STUDENT OBJECTIVES

- Define *energy* and learn about the various characteristics of energy and its sources.
- Learn about atomic structure, including subatomic particles.
- Be introduced to the periodic table, chemical formulas, isotopes, and elements involved in a nuclear reaction.
- Explore the relationship between mass and energy, isotopes and binding energy, and nuclear bonding.
- Define *fission* and learn about uranium's role in fission, fission reactions, and energy yields.
- Examine the components of a nuclear reactor.
- Investigate a nuclear reactor's core temperature.
- Define *radioactivity* and learn about radioactive exposure, various radioactive particles, and radioactive half-life.

ACTIVITIES

Students complete three performance assessments: 1) Graphing Calculator – input and graph a rational equation correctly by using a graphing calculator; 2) Tables – produce and evaluate data in table form by using a graphing calculator; and 3) Slope-intercept Form – input an equation correctly into a graphing calculator in slope-intercept form, or y = mx + b form, produce a graph, and evaluate the data.

Population Perspectives

OVERVIEW

Demography, the study of human populations, is very much a "numbers game." It illustrates connections between math and the real world and also provides an example of a career field in which math is not only important, but essential. In *Population Perspectives*, students learn about quadratic and exponential functions and polynomials and use these algebra concepts to solve population-related problems.

STUDENT OBJECTIVES

- Spotlight population growth in various countries.
- Solve problems by using population growth rate equations.
- Define and identify functions, including exponential growth and decay functions.
- Use the graphing calculator to graph exponential growth and decay functions.
- Construct and solve polynomials related to population characteristics.
- Define *quadratic equations* and solve them using several methods.
- Define *carrying capacity* and *demographic transition*.
- Review population problems in more- and less-developed countries.
- Make recommendations for dealing with future population growth.

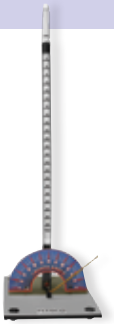
ACTIVITIES

Students complete three performance assessments: 1) Exponential Growth – contrast linear and exponential growth, explain the exponential growth equation, and graph it on a graphing calculator; 2) Polynomials – use Algebra Tiles to construct and solve a polynomial equation and use given data to construct a polynomial expression describing age cohorts of a population; and 3) Quadratic Functions – graph a quadratic function on the graphing calculator and use the calculator to solve it by using the Quadratic Formula.

Projectile Motion

OVERVIEW

In *Projectile Motion*, students build and launch straw rockets in order to observe how flying objects follow a curved path called a parabolic path. Students predict the launch angle that will make the straw rocket travel the greatest horizontal distance, and they test their predictions. Students learn the general form of a quadratic equation, identify the coefficients in a quadratic equation, and use the coefficients in a quadratic equation to predict the shape of a parabola. Students predict where the straw rockets will land by using a quadratic equation that describes the straw rocket's path.



STUDENT OBJECTIVES

- Observe graphs of quadratic equations.
- Learn to recognize the parts of a parabola.
- Identify the coefficients in a quadratic equation.
- Determine the x-coordinate and y-coordinate of the vertex.
- Graph quadratic equations by using a graphing calculator.
- Identify the roots of a quadratic equation.
- Practice using the Quadratic Formula.
- Complete a three-ring challenge in which a straw rocket will fly through three rings that have been placed along the rocket's parabolic path.

ACTIVITIES

Students complete three performance assessments: 1) Parabolas – describe a parabola, define *vertex* and *line of symmetry*, and create a straw rocket; 2) Graphing Equations – demonstrate how to enter and graph equations, identify the a, b, and c coefficients in an equation, and identify the x- and y-coordinates of a vertex; and 3) Three-Ring Challenge – find the roots of a quadratic equation, demonstrate how to use the TRACE function on a graphing calculator, and use algebra to successfully fly a straw through three hula hoops.

Sports Statistics

OVERVIEW

In *Sports Statistics*, students explore the role of mathematics in sports statistics. Students use various data representation techniques to find trends and make predictions using actual sports statistics. Students will also collect and analyze data from their own tabletop sports and use this data to create scatter plots, frequency tables, histograms, and box-and-whisker plots. They explore many different mathematical concepts including matrices, graphing, factorials, permutations, and combinations.

STUDENT OBJECTIVES

- Write sports data in matrix format and manipulate the data by adding, subtracting and multiplying matrices.
- Create scatter plots and determine the line of best fit to represent sports data trends.
- Create frequency tables and histograms and then use the histograms to interpret statistical information.
- Create a box-and-whisker plot by calculating the range, quartiles, median, and outliers.
- Explore and learn to apply the fundamental counting principle to sports-related issues.
- Explore factorials, permutations, and combinations and how they relate to sports statistics.

ACTIVITIES

Students complete three performance assessments: 1) Matrices – explain how to add, subtract, and perform scalar multiplication on matrices; 2) Fundamental Counting Principle – define the fundamental counting principle and explain how to use this principle to determine the number of outcomes for a given sports situation; and 3) Permutations and Combinations – explain the difference between permutations and combinations and solve problems related to each.

Supply & Demand

OVERVIEW

In *Supply & Demand*, students learn about the Law of Supply and Demand and how it affects their lives. Given data, they write equations that represent supply and demand and then use graphing skills to graph linear supply and demand equations. Students also learn multiple methods of solving systems of equations, including graphing, substitution, elimination, and using a graphing calculator, to determine the equilibrium price and quantity of a given product. Finally, students use their ability to solve systems of equations to manage a simulated business.

STUDENT OBJECTIVES

- Explore the relationship between supply and demand and factors that affect each.
- Solve linear equations that represent supply or demand.
- Use a given data set to write linear equations that represent data trends.
- Graph equations that represent supply and demand to find the solution to the system of equations.
- Use substitution and elimination to solve systems of equations.
- Explore solving a system of equations with a graphing calculator.

ACTIVITIES

Students complete three performance assessments: 1) Supply & Demand Chart – explain the steps in solving a supply and demand system of equations through substitution and calculate the equilibrium point of a system; 2) Supply & Demand of Labor – use elimination to solve a system of equations that represents the supply and demand of labor with three unknowns; and 3) Company Cafeteria – solve systems of equations to help make pricing and supply decisions to run a simplified business.

The Universe

OVERVIEW

To study a topic as big as *The Universe*, you need big numbers! In this title, students use positive and negative exponents to calculate star magnitudes and scientific notation to calculate sizes and distances of the stars and galaxies beyond our own solar system. They also explore concepts of probability to consider the likelihood of other planets containing life and civilization.

STUDENT OBJECTIVES

- Use an Astroscan telescope and calculate focal length and magnification.
- Calculate light intensities and distances to stars based on their magnitudes.
- Use scientific notation to calculate distances in the universe.
- Measure the speed of light and convert it into different units.
- Make a scatter plot of star luminosities and compare it to the H-R diagram.
- Explore life cycles of stars and compare stellar luminosities.
- Calculate distances between galaxies in light-years and parsecs.
- Consider the age and origin of the universe, including the Big Bang Theory.
- Learn concepts of probability and relate them to the Drake Equation.

ACTIVITIES

Students complete three performance assessments: 1) Powers and Roots – define *power*, *exponent*, and *root* and use the calculator to show changes in light intensity given star magnitudes; 2) Scientific Notation – use scientific notation to calculate distances between stars and explain the process for measuring the speed of light; and 3) Probability – explain the Big Bang Theory and give evidence to support it, and explain how the Fundamental Counting Principle relates to the Drake Equation.

Unsolved Mysteries

OVERVIEW

In *Unsolved Mysteries,* students use functions and coordinate graphing to determine who committed a fictional crime. Using cell phone records and coordinate graphing, students identify an area in which a stolen cell phone was last operated. Students use functions to estimate the time of the robbery as well as the approximate height of the suspect. Students link algebra skills to a real-world career in forensic science.

STUDENT OBJECTIVES

- Learn some of the basics of forensic science.
- Use coordinate graphing to graph locations of calls made from the stolen cell phone on a map of the city.
- Identify x- and y-intercepts.
- Determine the cooling rate of a liquid and graph the data on a graphing calculator.
- Identify functions and relations and determine equations for functions.
- Determine the heights from which several drops of liquid fell and graph the data on a graphing calculator.
- Use data collected over the course of the activities to identify a prime suspect.

ACTIVITIES

Students complete three performance assessments: 1) Coordinate Graphing – explain coordinates, identify quadrants, and explain predictions that can be made based on the locations; 2) Functions – explain functions, relationships, domain, and range and determine the function for the cooling rate of a liquid; and 3) Data Tables – determine whether or not data is representative of a function and create an equation to represent a given data table.

Water Quality

OVERVIEW

In *Water Quality*, students complete an internship with the fictitious company Scientific Laboratory Services (SLS). As part of their internship, students analyze various standards and regulations relating to water quality and use. Through laboratory testing and activities, students experience real-world applications of inequalities and learn to solve and graph simple, multistep, and compound inequalities by using both paper and pencil and a graphing calculator.

STUDENT OBJECTIVES

- Identify inequalities and compound inequalities.
- Match graphs for inequalities.
- Solve simple inequalities.
- Solve inequalities with two variables.
- Create a T-chart and graph inequalities on a coordinate plane.
- Graph a linear system of inequalities on a graphing calculator.
- Define and graph absolute value inequalities.

ACTIVITIES

Students complete three performance assessments: 1) Simple Inequalities – identify situations in which inequalities are used in the real world and explain rules for graphing inequalities on a number line; 2) Multistep Inequalities – define *multistep inequality*, explain how to solve one, and identify how to multiply or divide an inequality containing negative numbers; and 3) Systems of Inequalities – demonstrate the steps for solving a system of inequalities using the graphing calculator, perform a water test to measure dissolved oxygen, and correctly complete a Water Analysis Report.

Where in the World

OVERVIEW

In *Where in the World*, students learn how to simplify expressions and solve equations involving radicals. Students use a wall-sized map and the Pythagorean Theorem to search for a sunken treasure. The Distance Formula and a software application are used to plan a trip around the world. An introduction to the concepts of trilateration and geocaching provides the basis for a review of adding, subtracting, simplifying, and reducing radical expressions, as well as solving radical equations. As an added bonus, students learn about map projections and how they relate to math.

STUDENT OBJECTIVES

- Learn to simplify radical expressions by using the Product and Quotient Properties of Square Roots.
- Determine how the Distance Formula is related to the Pythagorean Theorem and how it can be used to find the distance between two cities.
- Add and subtract radical expressions.
- Convert radical expressions to decimals.
- Plan a trip around the world by using the Distance Formula and a software application.
- Design a zip line course by using radical expressions and the Pythagorean Theorem.
- Relate various map projections to math.
- Complete a geocaching expedition around the world by using mathematical applications learned throughout *Where in the World*.

ACTIVITIES

Students complete three performance assessments: 1) Radical Expressions – simplify radical expressions using both the Product Property and the calculator and locate the sunken treasure; 2) Using Operations with Radical Expressions – add, subtract, and rationalize the denominator of radical expressions and use the Distance Formula to complete two geographic activities; and 3) GeoMath – learn how map projections differ geographically and mathematically and complete a mock geocaching activity to solve for the location of each cache.