Middle Grades Science Toolkit

The Middle Grades Instructional Focus Toolkit has been created to assist teachers with planning instruction. This toolkit is not intended to replace your district's curriculum, but rather to enhance understanding of the Next Generation Sunshine State Standards (NGSSS), support instruction with resources that are well aligned to the benchmarks and to clarify how the information will be assessed on the Grade 08 Statewide Science Assessment.

The middle grades science content can be broken down into four bodies of knowledge as assessed on the Grade 08 Statewide Science assessment with a corresponding weight. Bodies of knowledge can further be broken down into Big Ideas.

Nature of Science (19%)

- Big Idea #1 The Practice of Science
- Big Idea #2 The Characteristics of Scientific Knowledge
- Big Idea #3 The Role of Theories, Laws, Hypotheses, and Models
- Big Idea #4 Science and Society (Not Annually Assessed)

Earth Science (27%)

- Big Idea #5 Earth in Space and Time
- Big Idea #6 Earth Structures
- Big Idea #7 Earth Systems and Patterns

Physical Science (27%)

- Big Idea #8 Properties of Matter
- Big Idea #9 Changes in Matter
- Big Idea #10 Forms of Energy
- Big Idea #11 Energy Transfer and Transformations
- Big Idea #12 Motion of Objects (Not Annually Assessed)
- Big Idea #13 Forces and Change in Motion

Life Science (27%)

- Big Idea #14 Organization and Development of Living Organisms
- Big Idea #15 Diversity and Evolution of Living Organisms
- Big Idea #16 Heredity and Reproduction
- Big Idea #17 Interdependence
- Big Idea #18 Matter and Energy Transformation

Within each of these Big Ideas, there are essential standards that help build the unit and provide the foundation for development of the content. These standards are annually assessed and often contain additional supportive standards beneath them (indicated as "also assesses" on the assessment documents). For example, 8.N.1.1 also assesses 6.N.1.1, 6.N.1.3, 7.N.1.1, 7.N.1.3, 7.N.1.4, 8.N.1.3 and 8.N.1.4. This information is also provided in the Test Item Specifications for the Grade 08 Statewide Science Assessment. The Big Ideas and their corresponding standards may be enhanced with hands-on inquiry opportunities, text resources, Model Eliciting Activities (MEAs), animations and tutorials. The activities provided have been selected to enhance these Big Ideas and standards.

Model Eliciting Activities (MEAs) are open-ended, interdisciplinary, problem-solving activities closely aligned with the standards. CPALMS has integrated these Science, Technology, Engineering and Mathematics (STEM) activities into the lesson resources available to educators. In an MEA lesson, teachers act as facilitators as student teams work to solve a problem. For more information about MEA construction and implementation, please visit http://www.cpalms.org/cpalms/mea.aspx.

To assist students with achieving the proper level of complexity in their content development, the activities in this toolkit have been selected to provide opportunities for moderate and high levels of thinking. Complexity levels and percentage of questions in each of the complexity levels are provided in the test item specifications. Please note that on the Grade 08 Statewide Science Assessment, over 80 percent of all standards are assessed at the levels of moderate to high.

These Big Ideas with corresponding classroom activities may be used as a basic foundation for classroom investigations aligned tightly to the standards. Each of these activities are pulled from CPALMS. The resources listed below represent a small sample of those available on CPALMS. In order to review the additional resources available, simply click on the standard links below. The resources will be accessible on the right side of the standard page.

A study tool for students can be found at Floridastudents.org. Florida Students is an interactive site that provides educational resources aligned closely with the middle grades science standards. Students have access to the resources with no need of a user name and password. The introduction video on the home page explains in a simple manner how students and parents can utilize the website. For parents, it will take the mystery out of how to support their child when studying. Educators can have confidence that the support received on this site is aligned with the standards.

Big Ideas and Supportive Activities

Big Idea #1: The Practice of Science

Benchmark SC.8.N.1.1

Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions**.**

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.N.1.1, SC.3.N.1.3, SC.4.N.1.1, SC.4.N.1.6, SC.5.N.1.1, SC.5.N.1.2, SC.5.N.1.4 and SC.5.N.1.5.

Students will:

- Evaluate a scientific investigation using evidence of scientific thinking and/or problem solving.
- Identify test variables (independent variables) and/or outcome variables (dependent variables) in a given scientific investigation.
- Interpret and/or analyze data to make predictions and/or defend conclusions.
- Distinguish between an experiment and other types of scientific investigations where variables cannot be controlled.

Also Assesses:

SC.6.N.1.1 Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.6.N.1.3 Explain the difference between an experiment and other types of scientific investigation, and explain the relative benefits and limitations of each.

SC.7.N.1.1 Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.7.N.1.3 Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation.

SC.7.N.1.4 Identify test variables (independent variables) and outcome variables (dependent variables) in an experiment.

SC.8.N.1.3 Use phrases such as “results support” or “fail to support” in science, understanding that science does not offer conclusive ‘proof’ of a knowledge claim.

SC.8.N.1.4 Explain how hypotheses are valuable if they lead to further investigations, even if they turn out not to be supported by the data.

Resources:

Ancient Archery: Scientific Method and Engineering (Model Eliciting Activity)

Students must assist an archaeological research team to determine which material ancient archers likely used to string their bows. Students must design an experiment to test various materials for power, precision, and durability. After the data is collected, they must develop a system to determine which material would have been most desirable for the ancient archers.

This MEA is a multifaceted lesson designed to address both the processes of discovery through scientific investigation and problem-solving through engineering. The full-scale MEA involves the development of a complete experiment and a proper lab report and then an application of the collected data to address the problem-solving requirement of the MEA.

Dissolving Gobstoppers Using Controls and Variables (Lesson Plan)

Students will conduct a simple laboratory experiment that practices the proper use of controls and variables.

Elements of Experimental Design (Lesson Plan)

Understanding the process of experimental design. It is a process that is structured in order to control variables, maintain consistency, incorporates a hypothesis or a prediction and is testable. The design of the experiment specifies that it must be repeated 3-5 times in order to validate findings.

Experiences and Experiments - There is a Difference (Lesson Plan)

Students have had many experiences in science and have participated in and designed simple investigations. This lesson directs students in identifying the steps of experimentation. While microorganisms are the topic and the subject of the experimentation, the emphasis and learning should center on scientific steps and processes of scientific experiments.

Designing and conducting an experiment involves an integration or combining of science process skills.

Benchmark SC.7.N.1.2

Differentiate replication (by others) from repetition (multiple trials).

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.N.1.2, SC.3.N.1.5, SC.4.N.1.2, SC.4.N.1.5, SC.5.N.1.3 and SC.5.N.2.2.

Students will:

- Differentiate between replication and repetition.
- Explain why scientific investigations should be replicable.
- Compare methods and/or results obtained in a scientific investigation.
- Evaluate the use of repeated trials or replication in a scientific investigation.

Also Assesses:

SC.6.N.1.2 Explain why scientific investigations should be replicable.

SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

SC.8.N.1.2 Design and conduct a study using repeated trials and replication.

Resources:

Whirligig – The Importance of Repetition and Replication in Experiments (Lesson Plan)

Students write a procedure and conduct an investigation that helps them to differentiate replication from repetition. Students drop the whirligig 3-5 times and record how long it takes to fall to the ground.

Electronics May Confuse a Bird's "Compass" (Text Resource)

This informational text resource is intended to support reading in the content area. Scientists are finally able to support the hypothesis that electromagnetic radiation from human electronic equipment can confuse a bird's sense of direction; the radiation impacts the orientation necessary for birds' migration. When shielded by an aluminum screen (a Faraday cage), this interference is eliminated and birds can orient themselves properly.

Benchmark SC.7.N.1.5

Describe the methods used in the pursuit of a scientific explanation as seen in different fields of science such as biology, geology, and physics.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary and middle grade benchmarks: SC.3.N.3.2, SC.3.N.3.3, SC.4.N.3.1 and SC.6.N.3.4.

Students will:

- Describe and/or analyze common methods and/or models used in different fields of study.
- Identify the benefits and/or limitations of the use of scientific models.
- Identify how technology is essential to science**.**

Also Assesses:

SC.7.N.3.2 Identify the benefits and limitations of the use of scientific models.

SC.8.N.1.5 Analyze the methods used to develop a scientific explanation as seen in different fields of science.

SC.8.E.5.10 Assess how technology is essential to science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information.

Resources:

Finding Impact Craters with LandSat (Lesson Plan)

Students examine and write about the effects extraterrestrial collisions might have on the land, atmosphere, water, and living things. Students then read descriptions of the actual effects of impact events and the evidence these leave behind. To demonstrate their understanding of the role of impact events in shaping the Earth, students write a series of guidance questions for a field expedition to determine whether or not a given landform is an impact crater.

Native "Snot" (Text Resource)

This informational text resource is intended to support reading in the content area. The article describes how an algae species previously thought to be invasive is actually a “hidden” native species that blooms when environmental conditions change. It describes those conditions as well as the algae’s ecological impact on other populations. The article concludes by connecting that human impact is causing algae blooms to become more and more common.

From Flowers to Freckles: Mendel's Mighty Model (Original Tutorial)

By the end of this tutorial you should be able to explain how scientists use models to simplify and understand the world around us. You should also be able to explain the benefits and limitations of scientific models.

Bird Research Methods: Art and Scientific Influence of John James Audubon (Perspectives Video)

Listen as this modern-day bird researcher paints a picture of how naturalists conducted research in the past. Produced with funding from the Florida Division of Cultural Affairs.

Big Idea #2: The Characteristics of Scientific Knowledge

Benchmark SC.6.N.2.2

Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.N.1.7, SC.4.N.1.3, SC.4.N.1.7, SC.5.N.1.5, SC.5.N.1.6 and SC.5.N.2.1.

Students will:

- Explain that scientific knowledge may change as new evidence is discovered or new scientific interpretations are formed.
- Explain that scientific explanations are based on empirical evidence, logical reasoning, predictions, and modeling.
- Identify instances in the history of science in which scientific knowledge has changed as a result of new evidence.

Also Assesses:

SC.7.N.1.6 Explain that empirical evidence is the cumulative body of observations of a natural phenomenon on which scientific explanations are based.

SC.7.N.1.7 Explain that scientific knowledge is the result of a great deal of debate and confirmation within the science community.

SC.7.N.2.1 Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered.

SC.8.N.1.6 Understand that scientific investigations involve the collection of relevant empirical evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations and models to make sense of the collected evidence.

Resources:

Think like a Scientist (Lesson Plan)

Students will read a fun article about a caveman named Fred and his journey to discover gravity. They will trace the evidence and then conflicting evidence as he explores the world around him. Students will then research obsolete scientific theories to discover the conflicting evidence that led to changes in real scientific knowledge.

A Change is Going to Come! (Lesson Plan)

This lesson is about Charles Darwin and the theory of evolution through natural selection. Students will explore the theory of evolution using anecdotal imagery (evolution of technology - pagers/phones, cars, computers, watches) that will help them understand how fossil evidence in biological systems is vital to mapping out the origin and development of life through time.

Reflect It, Refract It, or Absorb It (Lesson Plan)

While working in groups, students will be provided various materials to design models that illustrate the refraction, reflection and absorption of light.

Moon Crash, Splash (Text Resource)

This resource is intended to support reading in the content area. This article describes how NASA sent a Centaur rocket attached to a mother craft (LCROSS) to the moon. The rocket detached, crashed and stirred up a plume of debris. The mother craft flew through the debris plume, took pictures and analyzed the plume's contents. The measurements revealed the presence of water in significant quantities.

Scientific Knowledge Changes (Original Tutorial)

By the end of this tutorial students should learn how scientific knowledge can change when new evidence is discovered or new ideas are developed. Students will take a step back in science history to see some great examples of how scientific knowledge has changed when new evidence or ideas were incorporated into what was once thought to be true.

What is Science? (Presentation/Slideshow)

Provides a succinct overview of the nature of science; what science is and is not. Information includes the aims of scientific pursuits, principles, process and thinking.

Big Idea #3: The Role of Theories, Laws, Hypotheses, and Models

Benchmark SC.7.N.3.1

Recognize and explain the difference between theories and laws and give several examples of scientific theories and the evidence that supports them.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following sixth grade benchmarks: SC.6.N.3.2 and SC.6.N.3.3.

Students will:

- Explain the difference between theories and laws.
- Identify examples of theories and/or laws.
- Explain why theories may be modified but are rarely discarded.

Also Assesses:

SC.6.N.3.1 Recognize and explain that a scientific theory is a well-supported and widely accepted explanation of nature and is not simply a claim posed by an individual. Thus, the use of the term theory in science is very different than how it is used in everyday life.

SC.8.N.3.2 Explain why theories may be modified but are rarely discarded.

Resources:

Cricket Songs (Lesson Plans)

Using a guided-inquiry model, students in a math or science class will use an experiment testing the effect of temperature on cricket chirping frequency to teach the concepts of representative vs random sampling, identifying directly proportional relationships, and highlight the differences between scientific theory and scientific law.

Laws and Theories in Nature (Lesson Plan)

This lesson begins with a presentation to discuss the major differences between hypotheses, theories and laws in science and society and identify several examples of laws and theories. The students will then go outside and make/write down/photograph examples of nature supporting these laws/theories.

Obsolete and Superseded Theories (Lesson Plan)

Students will research obsolete or superseded theories to understand how these theories have been modified into the current scientific theories known today.

Was the Moon Once Part of Earth? (Text Resource)

This text supports reading in the content area. This article explores the theories behind the origin of the moon and how scientists' understanding of the moon's origin is evolving based on new research.

Scientific Laws and Theories (Original Tutorial)

By the end of this tutorial students should be able to recognize and explain the difference between theories and laws and give several examples of scientific theories and the evidence that supports them.

Big Idea #4: Science and Society (Not Annually Assessed)

Benchmark SC.8.N.4.1

Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels.

Benchmark SC.8.N.4.2

Explain how political, social, and economic concerns can affect science, and vice versa.

Resources:

Clean Up, Collect Data and Conserve the Environment! (Lesson Plan)

Students will explore the use of mean and median in finding the ratio of a set of data. They will collect this set of data by doing a trash pick-up service learning project and then weighing the trash collected in bags. The students will discuss the use of mean and median in finding the relationship between the independent and dependent variables of the data collected. They will also look at the positive and negative correlations of this relationship, as displayed on a scatter plot they created. In comparison, they will then look at the data collected from the coastal cleanup report and compare this with their own data. Finally, students will use the data to help determine interventions at the local, state and national level regarding environmental issues.

Will My Plastic Bag Still Be Here in 2507? (Text Resource)

This informational text resource is intended to support reading in the content area. In this text, scientists conduct experiments to determine the decomposition rate of plastic bags.

Cool Jobs: Repellent Chemistry

This informational text resource is intended to support reading in the content area. Part of the Cool Jobs series, this article features examples of STEM careers. The text highlights research into super-repellent chemicals. Teams of scientists inspired by nature are working on solving problems that would enhance society. These innovations include ultra-repellent fabric, mesh to clean up oil spills, de-fogging surfaces, and coatings that reduce drag on ships.

Structures and Storms (Tutorial)

This tutorial is designed to help secondary science teachers learn how to integrate literacy skills within their curriculum. This tutorial focuses on identifying and evaluating the different text structures authors use to organize information in informative texts. The focus on literacy across content areas is designed to help students independently build knowledge in different disciplines through reading and writing. (Click "View Site" to open a full-screen version).

Big Idea #5: Earth in Space and Time

Benchmark SC.8.E.5.3

Distinguish the hierarchical relationships between planets and other astronomical bodies relative to solar system, galaxy, and universe, including distance, size and composition.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.5.E.5.1, SC.5.E.5.2 and SC.5.E.5.3.

Students will:

- Compare and/or contrast the relative distance, relative size, and general composition of astronomical bodies in the universe.
- Describe distances between objects in space in the context of light and space travel.
- Describe that the universe contains billions of galaxies and stars.

Also Assesses:

SC.8.E.5.1 Recognize that there are enormous distances between objects in space and apply our knowledge of light and space travel to understand this distance.

SC.8.E.5.2 Recognize that the universe contains many billions of galaxies and that each galaxy contains many billions of stars.

Resources:

Space Telescope: Optics and the EM Spectrum (Model Eliciting Activity)

In this MEA, students will:

• identify and compare characteristics of the electromagnetic spectrum such as wavelength, frequency, and energy.

• understand the benefits of studying astronomy using the electromagnetic spectrum and appreciate the amount of knowledge available through data and observations such as planetary images and satellite photographs.

• assess the value of technology in science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information.

• be able to describe the vast distances between objects in space using an understanding of light and how it travels.

- be able to analyze scientific texts and support their findings with textual evidence.

Earth Science (Lesson Plan)

Students will understand relative distances between objects (planets, stars and galaxies) in the universe and that a light-year (also light year, symbol: ly) is a unit of length (distance), not time.

Amazing Galaxies (Lesson Plan)

In this activity, students will gain basic knowledge of the different types of galaxies. There is a presentation via Prezi, guided practice and an activity. To measure their understanding, they will create a travel brochure for a galaxy. Students will need two classes or one 90 min. block to complete.

Expanding the Universe (Lesson Plan)

Students will draw three dots on an unblown balloon to represent three different galaxies. They will measure the distance between these "galaxies" and then blow up the balloon in three stages, measuring the distance between the "galaxies" at each stage.

A "Goldilocks" World? (Text Resource)

This informational text resource is intended to support reading in the content area. The article describes how astronomers have found a new exoplanet, Kepler-186f, orbiting a distant star. Research suggests that this planet is in the habitable "Goldilocks" zone—not too close and not too far—from the red dwarf star it orbits. If the planet is in the habitable zone, it mimics the earth/sun relationship we have and astronomers believe liquid water might be present on this planet. Water, of course, is the key to (extraterrestrial) life.

Benchmark SC.8.E.5.5

Describe and classify specific physical properties of stars: apparent magnitude (brightness), temperature (color), size and luminosity (absolute brightness).

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.E.5.1, SC.3.E.5.2, SC.3.E.5.3 and SC.5.E.5.1.

Students will:

- Describe and/or classify physical properties of stars: apparent magnitude, temperature (color), size, and absolute brightness.
- Evaluate models of solar properties and/or explain solar characteristics, including rotation, structure of the Sun, convection, sunspots, solar flares, and prominences.

Also Assesses:

SC.8.E.5.6 Create models of solar properties including: rotation, structure of the Sun, convection, sunspots, solar flares, and prominences.

Resources:

Stars: HR Diagram & Classification (Model Eliciting Activity)

In this Model Eliciting Activity (MEA), students will categorize a list of stars based on absolute brightness, size and temperature. Students will analyze astronomical data presented in charts and plot their data on a special graph called a Hertzsprung - Russell diagram (H-R Diagram). Using this diagram, they must determine the proper classification of individual stars. Using their data analysis, students completing this MEA will develop two short essay responses to a professional client indicating which stars are Main Sequence Stars and which ones are White Dwarfs, Giants or Supergiants.

Desktop Constellations (Lesson Plan)

Students will draw constellations on their desktops with dry erase crayons. They will identify the stars' absolute magnitudes for the brightest stars in the constellation. Students will explore the meaning of absolute magnitude vs. apparent magnitude in a 3D environment. Students will write explanations for how the stars in a constellation can appear to be of similar magnitude and similar distances away from the observer even if their true data shows they are very different.

Star Scatter Plots (Lesson Plan)

In this lesson, students plot temperature and luminosity data from a provided star table to create a scatter plot. They will analyze the data to sequence the colors of stars from hottest to coolest and to describe the relationship between temperature and luminosity. This lesson does not address differentiation between absolute and apparent magnitude.

The Most Popular Stars (Text Resource)

This informational text resource is intended to support reading in the content area. This article discusses how stars are classified, especially the different types of dwarf stars. It is still under debate how some star-like objects, like brown dwarfs, should be classified. The text also describes the life cycle of stars, explaining how they change in size and mass over time and eventually expand and die.

Hertzsprung-Russell diagram Virtual Lab (Virtual Manipulative)

This interactive lab explores the Hertzsprung-Russell diagram in areas of spectrum, classification, luminosity and temperature. The simulator plots stars according to the areas students chose to explore.

Benchmark SC.8.E.5.7

Compare and contrast the properties of objects in the Solar System including the Sun, planets, and moons to those of Earth, such as gravitational force, distance from the Sun, speed, movement, temperature and atmospheric conditions.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.E.5.4, SC.5.E.5.2 and SC.5.E.5.3.

Students will:

- Compare and/or contrast the characteristics of objects in the Solar System.
- Identify and/or explain the role that gravity plays in the formation and motion of planets, stars, and solar systems.
- Compare and/or contrast various historical models of the Solar System.

Also Assesses:

SC.8.E.5.4 Explore the Law of Universal Gravitation by explaining the role that gravity plays in the formation of planets, stars, and solar systems and in determining their motions.

SC.8.E.5.8 Compare various historical models of the Solar System, including geocentric and heliocentric.

Resources:

Quest for Life: Space Exploration (Model Eliciting Activity)

Students must decide the destination of a multi-billion dollar space flight to an unexplored world. The location must be selected based on its potential for valuable research opportunities. Some locations may have life, while others could hold the answers to our energy crisis. Students must choose the destination that they feel will be most helpful to human-kind.

Scientific Calculations from a Distant Planet (Lesson Plan)

Students will act as mathematicians and scientists as they use models, observations and space science concepts to perform calculations and draw inferences regarding a fictional solar system with three planets in circular orbits around a sun. Among the calculations are estimates of the size of the home planet (using a method more than 2000 years old) and the relative distances of the planets from their sun.

Why Isn't Pluto A Planet? (Text Resource)

This Frequently Asked Question page can be used by educators and students as a scientific resource to answer the question, "Why isn't Pluto a planet?" From the International Astronomical Union, the definitive answer from the governing body that classified Pluto as a dwarf planet.

Tiny Planet Mercury Shrinks Further

This informational text resource is intended to support reading in the content area. The text explains why the planet Mercury has actually been shrinking in diameter, as well as how scientists have proved it through observation. The article details their observations and then compares Mercury to Earth to show why our planet is not shrinking as well.

A Close Call (Text Resource)

This informational text resource is intended to support reading in the content area. On November 8, 2011, an asteroid flew by Earth at a distance closer to us than our moon. Scientists have known about

the close call for years and were excited about the opportunity to view an asteroid and look for chemical evidence of the young solar system. Scientists are still watching tens of thousands of asteroids that potentially threaten Earth, and contingency plans exist should one of them threaten us.

Center Stage: Models of the Solar System (Original Tutorial)

By the end of this tutorial students should be able to compare and contrast the heliocentric and geocentric models of the Solar System. Students will see how some people used to think that the Earth was the center of the universe and the solar system and how that has changed over time.

Properties of the Solar System (Tutorial)

This website contains numerous interesting facts, images and activities intended to support greater understanding of properties of our solar system.

How Fast do Objects Move in the Solar System? (Virtual Manipulative)

This interactive demonstrates the impacts of the gravitational force of the sun on motion of objects in the solar system.

The Origin of the Moon (Teaching Idea)

Most planetary scientists expected that lunar samples brought to Earth at the end of each of the six Apollo missions would confirm one of three leading hypotheses of the Moon's origin. Instead, samples left all three explanations unconfirmed, requiring the development of a new hypothesis for how the Moon formed. This video segment adapted from NOVA shows Apollo 15 astronauts collecting a type of rock that would help change our understanding of the Moon's--and Earth's--earliest history.

Benchmark SC. 8.E.5.9

Explain the impact of objects in space on each other including:

1. The Sun on the Earth including seasons and gravitational attraction

2. The Moon on the Earth, including phases, tides, and eclipses, and the relative position of each body.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.4.E.5.1, SC.4.E.5.2, SC.4.E.5.3 and SC.4.E.5.4.

Students will:

- Explain the effect of astronomical bodies on each other including the Sun’s and/or the Moon’s effects on Earth.

Resources:

Exposing a common misconception: The distance the Earth is from the Sun causes seasons, right? (Lesson Plan)

This lab exposes a common misconception: that the distance the Earth is from the Sun causes the change in seasons. In this lab experience, students will start with an exploratory lab to model the distance between the Earth and Sun during aphelion and perihelion. To dispel this misconception, students then engage in one of two suggested labs that address the true cause for the seasons, Earth's tilt. During both of these labs, students will learn that the tilt of the Earth causes one hemisphere to receive more direct sunlight than the other. Earth's axis doesn't tilt in its orbit, but as the Earth progresses through its orbit, the hemispheres receive varying amounts of direct and indirect sunlight.

The Attractive Moon (Lesson Plan)

Students will create a tidal range graph for one month worth of data and compare it to the moon phases for that month to see the connection between the moon phase and the tidal range.

The Impact of the Sun and Moon on Tides (Lesson Plan)

The student will use models to demonstrate the relative positions of the Earth, Sun and Moon and their impact on tides. Students will explain the impact and relative positions of the Earth, Moon and Sun on tides.

Titanic Sunk by "Supermoon" and Celestial Alignment? (Text Resource)

This informational text is intended to support reading in the content area. This news article describes an astronomer's theory that a particularly strong series of tides contributed to an abundance of icebergs and may have resulted in the sinking of the Titanic. It is complete with the evidence behind the theory and a contrary opinion from another astronomer.

Seasons and Temperatures (Tutorial)

Spring, summer, fall and winter. Many places on the Earth have seasons. Others do not. What causes the seasons? This tutorial discusses seasonal changes and describes that they are caused by the movement of the Earth around the sun, the tilt of the Earth and how high the sun will get in the sky.

Seasons and Ecliptic Simulator (Virtual Manipulative)

Students will be able to use this manipulative to:

- Observe the orbit of the earth around the sun and its relationship to seasons
- Understand the factors affecting Earth's climate
- Observe the effect of Earth's tilt on the seasons

Big Idea #6: Earth Structures

Benchmark SC.7.E.6.2

Identify the patterns within the rock cycle and relate them to surface events (weathering and erosion) and sub-surface events (plate tectonics and mountain building).

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.4.E.6.1, SC.4.E.6.2, SC.4.E.6.3, SC.4.E.6.4, and SC.4.E.6.6.

Students will:

- Identify and/or describe steps of the rock cycle and relate them to surface and sub-surface events.
- Describe and/or explain how Earth's surface is built up and torn down through the processes of physical and chemical weathering, erosion, and deposition.
- Identify different types of landforms commonly found on Earth.
- Describe similarities and/or differences among landforms found in Florida and those found outside of Florida.

Also Assesses:

SC.6.E.6.1 Describe and give examples of ways in which Earth's surface is built up and torn down by physical and chemical weathering, erosion, and deposition.

SC.6.E.6.2 Recognize that there are a variety of different landforms on Earth's surface such as coastlines, dunes, rivers, mountains, glaciers, deltas, and lakes and relate these landforms as they apply to Florida.

SC.7.E.6.6 Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

Resources:

A Rocky Adventure (Lesson Plan)

Rocks are continually changing. Forces inside the Earth bring them closer to the surface, and forces on the earth sink them back down. Students pretend to be a rock and move through the rock cycle, recording what is happening to them as they go.

An Investigative Look at Florida's Sinkholes (Lesson Plan)

This inquiry lab lesson allows students to model what factors affect sinkholes, along with weathering and erosion.

Creating a River System (Lesson Plan)

After researching and creating a blueprint, students create a river system using common household materials.

Florida Landforms (Lesson Plan)

Students will identify pictures of various landforms on Earth's surface. They will watch a brief video about Florida's geologic history. After the students review a Florida state map, they will design and create a relief map of Florida that includes various landforms such as mountains and hills, lakes, rivers, deltas, dunes and coastline.

Sinkholes (Text Resource)

Sink your teeth into learning about how sinkholes form. In the video clip, three students investigate sinkholes to determine their cause and then construct a functioning model. Directions for replicating this model, text and student activities are included.

Weathering, Erosion, and the Rock Cycle (Original Tutorial)

By the end of this tutorial students should be able to sequence surface events that lead to the formation of sedimentary rock.

Benchmark SC. 7.E.6.4

Explain and give examples of how physical evidence supports scientific theories that Earth has evolved over geologic time due to natural processes.

Prior Knowledge: This benchmark grouping is foundational. These concepts have not been introduced in the NGSSS prior to this grade-level grouping.

Students will:

- Identify examples of and/or explain physical evidence that supports scientific theories that Earth has evolved over geologic time due to natural processes.
- Identify and/or describe current scientific methods for measuring the age of Earth and its parts.

Also Assesses:

SC.7.E.6.3 Identify current methods for measuring the age of Earth and its parts, including the law of superposition and radioactive dating.

Resources:

Radioactive Dating: Half-Life & Geologic Time (Model Eliciting Activity)

In this MEA, students must use their knowledge of radioactive dating and geologic time to select an effective elemental isotope to be used to date three rare specimens. This decision requires an understanding of the concept of a half-life and the benefits and limitations of radiometric dating.

Students must complete mathematical calculations involving equations and operations with fractions and percentages. Students completing this MEA must develop two essays that respond in a professional manner to a client in the scientific industry.

Back to the Past with the Geologic Time Scale (Lesson Plan)

This lesson introduces the geologic time scale and the concept of time segments being divided by major events in Earth's history. It gives students an opportunity to place various fossils into appropriate periods, observe the change in the complexity of fossils and draw conclusions regarding the change. Students complete a brace map including the eras and periods showing their understanding of parts to the whole within the geologic time scale. On day two, students research an organism of their choice and trace it back to their most basic relative. Students then create a final product, such as a brochure, timeline or a poster, demonstrating the change of the organism over time. Students will be provided with a rubric that will guide them while they work on the final product.

Layers and Laws (Lesson Plan)

Students will identify patterns in fossils and explain their understanding of how rock layers are deposited. They will use the evidence from the activity to make inferences about what the Earth was like during the time the fossils existed. Students will develop an understanding of how fossils give scientists clues as to what the early Earth was like in the past. Students will also show how fossils can be used to relatively date rock layers using the Law of Superposition and index fossils.

A Ghost Lake (Text Resource)

This informational text resource is intended to support reading in the content area. Through the author's personal experience and observations made by scientists, this article describes how the study of an extinct lake's history can be used to make predictions about how warming temperatures may affect the future of current lakes. From analyses of the shoreline, soil, algal growth and minerals coated on rocks, the article offers evidence and clues that the desert was once under water.

Seeking a Break in a 252 Million-Year-Old Mass Killing (Text Resource)

This informational text resource is intended to support reading in the content area. The text describes how scientists are attempting to use several pieces of evidence to pinpoint when a mass extinction event occurred at the end of the Permian Period. The text points to a connection between increasing volcanic eruptions, an increase of carbon dioxide in the atmosphere, and their relationship to mass extinctions before alluding to the signs of how human activity could be pushing Earth towards one.

Hey Rock, How Old Are You? (Original Tutorial)

By the end of this tutorial, students should be able to identify sedimentary rock from other types of rock formations and use the Law of Superposition to determine the relative age of rock layers.

Digging for Clues: Effective Vocabulary Strategies (Tutorial)

This tutorial is designed to help secondary science teachers learn how to integrate literacy skills into their science curriculum. This tutorial will demonstrate a number of strategies teachers can impart to students to help them use context clues to determine the meaning of unfamiliar words within science texts. It will also help them teach students how to select the appropriate definition from reference

materials. The focus on literacy across content areas is intended to help foster students' reading, writing, and thinking skills in multiple disciplines. (Click "View Site" to open a full-screen version).

Benchmark SC.7.E.6.5

Explore the scientific theory of plate tectonics by describing how the movement of Earth's crustal plates causes both slow and rapid changes in Earth's surface, including volcanic eruptions, earthquakes, and mountain building.

Prior Knowledge: This benchmark grouping is foundational. These concepts have not been introduced in the NGSSS prior to this grade-level grouping.

Students will:

- Describe the scientific theory of plate tectonics and/or how the movement of Earth's crustal plates and the flow of heat and material cause various geologic events to occur.
- Identify and/or describe the layers of Earth.

Also Assesses:

SC.7.E.6.1 Describe the layers of the solid Earth, including the lithosphere, the hot convecting mantle, and the dense metallic liquid and solid cores.

SC.7.E.6.7 Recognize that heat flow and movement of material within Earth causes earthquakes and volcanic eruptions, and creates mountains and ocean basins.

Resources:

Earthquake! Where in the World Will the Next One Strike? (Lesson Plan)

Using real-time data, students will discover information about earthquakes. They will use this data to design, build and test a structure.

Edible Plate Tectonics (Lesson Plan)

Using the 5E lesson plan template, students will explore the theory of plate tectonic movement by creating models with food to demonstrate the movement of the plates in plate tectonics.

The Origins of Plate Tectonics - a complex text lesson (Lesson Plan)

This is a complex text reading lesson dealing with continental drift and plate tectonics.

Digging Deep into the Earth (Lesson Plan)

This lesson will help students conceptualize the location and enormity of the layers of the Earth. Students will be able to identify both the physical and chemical properties of each layer and be able to describe the functions or processes of each. This will lay the foundation for the study of plate tectonics and the rock cycle. This lesson plan is intended to take 2 - 3 class periods but may be modified to meet the needs of individual classrooms.

World's Biggest Volcano Is Hiding under the Sea (Text Resource)

This informational text resource is intended to support reading in the content area. Scientists have recently identified the largest volcano on Earth. Tamu Massif is found below the surface of the Pacific Ocean. Due to its underlying geology, the volcano is mostly found below the ocean floor, at the edge of two tectonic plates. It formed when magma emerged as the plates pulled apart. The article compares Tamu Massif to other giant volcanoes on Earth and on other planets.

Mantle Convection and Earth's Features (Original Tutorial)

This tutorial covers movement of material within the Earth and the geologic processes and features associated with this movement.

Journey to the Center of the Earth (Original Tutorial)

By the end of this tutorial, students should be able to label each layer of the Earth and identify each layer's physical characteristics. That includes the layers of solid earth: the lithosphere, hot convecting mantle, dense metallic liquid and solid cores.

Big Idea #7: Earth Systems and Patterns

Benchmarks SC.6.E.7.4

Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.5.E.7.1, SC.5.E.7.2, SC.5.E.7.3, SC.5.E.7.4, SC.5.E.7.5 and SC.5.E.7.6.

Students will:

- Differentiate and/or explain interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere.
- Describe and/or explain how the cycling of water and global patterns influence local weather and climate.
- Differentiate between weather and climate.
- Describe the composition and structure of the atmosphere and/or how the atmosphere protects life and insulates the planet.

Also Assesses:

SC.6.E.7.2 Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate.

SC.6.E.7.3 Describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation.

SC.6.E.7.6 Differentiate between weather and climate.

SC.6.E.7.9 Describe how the composition and structure of the atmosphere protects life and insulates the planet.

Resources:

Bottle Earth (Lesson Plan)

Students will learn about Earth's five spheres (geosphere, hydrosphere, cryosphere, atmosphere, and biosphere) and how they interact with one another. First, they will watch two short videos. Then, they will create a graphic organizer while viewing a PowerPoint presentation. Finally, in small groups, they will create a closed terrarium (in a bottle) to represent the biosphere of the Earth. They will investigate how ecological systems achieve balance over time.

Changing Albedo in Antarctica (Lesson Plan)

This lesson is an interactive puzzle activity utilizing albedo to explore interactions of the five spheres in Antarctica.

Global Climate Change and Sea Level Rise (Lesson Plan)

In this activity, students will practice the steps involved in a scientific investigation as they learn why ice formations on land (and not those on water) will cause a rise in sea level upon melting. This is a discovery lesson in ice and water density and displacement of water by ice floating on the surface as it relates to global climate change.

3D Model of a Water Cycle (Lesson Plan)

Students will be able to show the movement of energy in the water cycle in each of the specified locations and be able to explain how it is related to the temperature and precipitation in each city each month. The research and 3D model that has been done on the water cycle will apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate in their specific city.

Modeling Ocean Currents (Lesson Plan)

This is a highly engaging, student-centered inquiry lesson plan to teach students the concepts behind ocean currents. Students will collaborate and use Levels 3 and 4 extended thinking, and create models to teach their peers their individual group's concept.

Help Save Atreyu! (Lesson Plan)

In this activity students will analyze data about the relationship between water, temperature and relative humidity in an artificial habitat of a hermit crab. Their conclusions will lead them to understand how water and temperature affect the environment.

Tree-mendous Choice for Erosion Prevention (Lesson Plan)

This activity provides students with an open-ended, realistic problem for which students will research, discuss and present the characteristics of eight trees based on characteristics, type of wood and suitability for growth in wet or dry climate with current weather patterns. Their objective is to promote the soil erosion prevention. Students support claims with clear reasons and relevant evidence, as they produce clear and coherent writing to describe the project of their structure in development, organization and style are appropriate to task, purpose and audience.

Earth's Blanket (Lesson Plan)

In this lesson, students will learn the layers of the atmosphere and key properties of each. The students will then investigate the greenhouse effect and will model how the atmosphere holds heat for the Earth.

Bacteria Living in 'Cloud Cities' May Control Rain and Snow Patterns (Text Resource)

This resource is intended to support reading in the content area. This article describes how ice crystals in clouds grow around tiny particles such as dust, pollen and even bacteria. Some bacteria contain proteins that cause freezing to occur at higher-than-normal temperatures, which may aid in snow production. In addition, a lack of vegetation on land may cause the "weather-gifted" bacteria to decline, which in turn would decrease rainfall (if in fact these bacteria are needed to "seed" clouds).

For Already Vulnerable Penguins, Study Finds Climate Change Is another Danger

This informational text resource is intended to support reading in the content area. Survival for Magellanic penguins has always been a challenge due to predation and starvation, but the influence of climate change is now making survival even more difficult for them. The study cited in this article is one of the first to show a direct impact of climate change on the population of seabirds. Increased storm activity and warmer temperatures are two factors impacting penguin populations in Argentina.

Water in Our World (Original Tutorial)

By the end of this tutorial, students should be able to explain the process of the water cycle on earth and how it affects the weather and climate on the planet.

Atmospheric Blanket (Original Tutorial)

By the end of this tutorial, students should be able to describe how our atmosphere both insulates our Earth and protects life on Earth.

Benchmark SC.6.E.7.5

Explain how energy provided by the sun influences global patterns of atmospheric movement and the temperature differences between air, water, and land.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmark: SC.3.E.6.1.

Students will:

- Explain how energy provided by the Sun influences global patterns of atmospheric movement and/or the temperature differences among air, water, and land.
- Differentiate among radiation, conduction, and convection in Earth's systems.

Also Assesses:

SC.6.E.7.1 Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through Earth's system.

Resources:

Cool Special Effects (Model Eliciting Activity)

In this MEA, students will apply the concepts of heat transfer, especially convection. Students will analyze factors such as temperature that affect the behavior of fluids as they form convection currents.

Conduction, Convection, Radiation! What's the Breeze Now? (Lesson Plan)

In this lesson, students will be exploring how radiant energy causes the temperature of different Earth materials to rise at different rates. Students will observe that this difference in temperature has direct effect on air movement. Students will reach to conceptual understanding of future trends.

Global Winds and the Coriolis Effect (Lesson Plan)

This lesson uses a variety of strategies to assist students with understanding the role the Sun plays in the formation of global winds and helps students understand how the Earth's rotation affects these global winds.

Hot, Hot, Hot! Earth's Surface Heating (Lesson Plan)

Students will explore the concept of the uneven heating and cooling of Earth's surfaces by the Sun by collecting and analyzing data. Outside the classroom, students from several classes will record data points to be analyzed collectively to explore rates of heating and cooling related to time and material properties for air, water and soil. Students will use mathematical techniques to help answer scientific questions.

Hurricanes (Text Resource)

This informational text resource is intended to support reading in the content area. This interactive online text explains how a hurricane forms, what storm surge is, when hurricane season starts and ends,

how hurricanes are named, and more. It has animations of storm surge and a link to a storm tracking map. The article also includes a glossary and fantastic tables and diagrams.

Atmospheric Processes – Radiation (Teaching Idea)

After a brief discussion of heat transfer processes in general, this activity will focus on radiation. Students will investigate how different surfaces absorb heat and apply their experience with the surfaces to interpret real-world situations.

Big Idea #8: Properties of Matter

Benchmark SC.8.P.8.4

Classify and compare substances on the basis of characteristic physical properties that can be demonstrated or measured; for example, density, thermal or electrical conductivity, solubility, magnetic properties, melting and boiling points, and know that these properties are independent of the amount of the sample.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.P.8.1, SC.3.P.8.2, SC.3.P.8.3, SC.3.P.9.1, SC.4.P.8.1, SC.4.P.8.2, SC.4.P.8.4, SC.5.P.8.1, SC.5.P.11.1, and SC.5.P.11.2.

Students will:

- Classify and/or compare substances on the basis of their physical properties and/or explain that these properties are independent of the amount of the sample.
- Describe density and/or calculate and compare the densities of various materials using the materials' masses and volumes.

Also Assesses:

SC.8.P.8.3 Explore and describe the densities of various materials through measurement of their masses and volumes.

Resources:

Determining the Density of Regular and Irregular Objects (Model Eliciting Activity)

This MEA provides students with opportunities to practice solving one-step equations while learning about density. Students will calculate density of regular and irregular objects.

Density of Solids and Liquids (Lesson Plan)

In this lab, students create their own definition for the term density and calculate the densities of different substances-solids and liquids. Students will learn that every substance has its own unique density, depending on how tightly atoms or molecules of the materials are packed. Students gather data about known samples to infer the identity of an unknown sample. Note: This lesson will only cover the density portion of benchmark SC.8.P.8.4

Crime Scene Density Lab (Lesson Plan)

Students will learn about the practical application of density measurement in the context of conducting a crime scene investigation of a break-in at the school.

Discovering Density (Lesson Plan)

In this lesson students will be asked to measure the volumes and masses of objects to determine their densities. Along the way students are expected to gain a greater understanding of the concept of density and the fact that it is a property of a material independent of an object's shape or volume.

Heat-Resistant Makeup (Text Resource)

This informational text resource is intended to support reading in the content area. Scientists have developed a new type of camouflage "makeup" for soldiers that can help prevent burns from nearby explosions. They have chemically swapped out flammable materials for a new heat-resistant polymer to create a makeup with applications well beyond the military.

Will the World's Newest Lightest Material Be Instrumental in Cleaning Up Toxic Oil Spills? (Text Resource)

This informational text resource is intended to support reading in the content area. Chinese researchers recently created a new "lightest solid," an aerogel of carbon nanotubes with a density of 0.16 mg/cm3. Unlike its aerogel predecessors, the substance has practical applications and may prove extremely helpful in cleaning up toxic oil spills.

Classifying & Comparing Physical Properties (Original Tutorial)

By the end of this tutorial, students will be able to identify physical properties, compare and contrast substances based on their physical properties, specifically density, and determine whether physical properties have the ability to change.

Measuring Amounts of "Stuff": Exploring Density (Original Tutorial)

By the end of this tutorial, students should be able to find the density (how many g/cm3) of three different objects and explain what that number means.

Benchmark SC.8.P.8.5

Recognize that there are a finite number of elements and that their atoms combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.5.P.8.2 and SC.5.P.8.3.

Students will:

- Describe how elements combine in a multitude of ways to produce compounds that make up all living and nonliving things.
- Describe the motion of particles in solids, liquids, and/or gases.
- Explain that elements are grouped in the periodic table according to similarities of their properties.
- Explain that atoms are the smallest unit of an element and are composed of subatomic particles.
- Identify common examples of acids, bases, and/or salts.
- Compare, contrast, and/or classify the properties of compounds, including acids and bases.
- Differentiate among pure substances, mixtures, and solutions.

Also Assesses:

SC.8.P.8.1 Explore the scientific theory of atoms (also known as atomic theory) by using models to explain the motion of particles in solids, liquids, and gases.

SC.8.P.8.6 Recognize that elements are grouped in the periodic table according to similarities of their properties.

SC.8.P.8.7 Explore the scientific theory of atoms (also known as atomic theory) by recognizing that atoms are the smallest unit of an element and are composed of sub-atomic particles (electrons surrounding a nucleus containing protons and neutrons).

SC.8.P.8.8 Identify basic examples of and compare and classify the properties of compounds, including acids, bases, and salts.

SC.8.P.8.9 Distinguish among mixtures (including solutions) and pure substances

Resources:

Periodic Table - Atoms and Bonding (Model Eliciting Activity)

In this MEA, students will use their knowledge of the organization of the periodic table and the basic properties of atoms to determine which elements should be used to develop compounds with two atoms of different elements. Students must determine the number of protons, neutrons and electrons in a neutrally charged atom of an element using the periodic table. They must also determine which elements will likely bond together using their location on the periodic table. Students completing this MEA will develop two short essay responses to a client in the scientific industry.

All the Small Things (Lesson Plan)

Students will observe and analyze visual representations. Students will sort, classify and compare their findings to known characteristics of pure substances (elements and compounds) and mixtures. Students will differentiate matter into pure substances (elements and compounds) and mixtures on a basic molecular level. Students will use hands-on card sorting to create a rule for sorting matter. The definitions of pure substance, mixture, element and compound will be introduced.

Element Most Wanted Poster (Lesson Plan)

Students will research an element from the Periodic Table of Elements and produce a Most Wanted poster allowing students to creatively detail the chemical and physical properties of a particular element.

Stable Atom, Ion, or Isotope? (Lesson Plan)

This lesson will teach the concept of differences between stable atoms, ions and isotopes. The students will take their knowledge of the atomic theory and will build models of varying atomic forms.

Mixtures and Solutions Uncovered (Lesson Plan)

This lesson is a hands-on approach to SC.8.P.8.9 that the students enjoy and are engaged in. The main activities cover making anchor charts (teacher lead) that will assist them in completing activities that cover vocabulary and a breakdown of characteristics for mixtures. There are four group activities that will guide the students to an understanding of the standard outlined. This is a two-day lab that adds teacher demonstration and allows for collaborative group and student-talk sessions.

Tungsten vs. Lead in the Snowball Derby (Text Resource)

This informational text resource is intended to support reading in the content area. Stock car driver Chase Elliott would have won the Snowball Derby; however, he broke the “no tungsten” rule. Race cars are only allowed to have ballasts made from lead, not the heavier element tungsten.

Atoms Make Up Everything (Original Tutorial)

By the end of this tutorial, students should be able to demonstrate that there are a finite number of elements that combine to form all existing compounds, whether living or non-living, and in any state of matter.

Your Ice Cream Is Moving (Original Tutorial)

By the end of this tutorial, students should be able to sequence a series of diagrams to create a model of a substance transitioning from a solid state to a liquid state.

Cooking with Chef Ragu: Acids, Bases, & Salts (Original Tutorial)

Join Chef Ragu as he learns about acids, bases and salts while he cooks up something special. By helping Chef Ragu throughout this tutorial, students will be able to compare and classify the properties of compounds that are acids, bases and salts and identify basic examples of these compounds.

Big Idea #9: Changes in Matter

Benchmark SC.8.P.9.2

Differentiate between physical changes and chemical changes.

Prior Knowledge:

Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.4.P.9.1 and SC.5.P.9.1.

Students will:

- Differentiate between physical and chemical changes.
- Explain that mass is conserved when substances undergo physical and chemical changes, according to the Law of Conservation of Mass.
- Describe how temperature influences chemical changes.

Also Assesses:

SC.8.P.9.1 Explore the Law of Conservation of Mass by demonstrating and concluding that mass is conserved when substances undergo physical and chemical changes.

SC.8.P.9.3 Investigate and describe how temperature influences chemical changes.

Resources:

Lord of Fries Conservation (Model Eliciting Activity)

This is an 8th grade MEA. This MEA will ask students to investigate different types of hamburger patties and choose the one that is best for a restaurant. Some of the areas that students will examine is how the hamburger patties undergo a chemical change, but mass is not lost only changed into different substances. They will also investigate how the hamburger patties are chemically changed due to a

change in temperature. Students will also be exposed to how the Law of Conservation of Mass is used in our daily lives. For example, cooking a hamburger patty, the mass is not lost but sometimes the juices are separated from the meat. Also, in French fries, matter is not created but cooking oil is absorbed by the fries.

Change or Not - Same Mass (Lesson Plan)

The students make observations and take the mass of various structures constructed by the teacher. They rearrange the structures and measure the mass again. During the whole class discussion, the students come to understand that during a chemical or physical change, the mass is conserved.

Balancing Chemical Equations Using a Visual Aid (Lesson Plan)

Students will use this kinesthetic activity to further their knowledge regarding balancing chemical equations.

Timing is everything for Reactions! (Lesson Plan)

This predict, observe and explain lesson allows students to investigate the influence of temperature on the rate of reactions. Students will have the opportunity to perform a lab activity that will help them discover that as temperature increases, so does reaction rate. This lesson includes a reaction rate demonstration, probing questions throughout the lesson, a meaningful class discussion and a final product. Students will use what they've learned in the lab to apply it everyday examples where reaction rates are influenced by temperatures.

Tranquilizer Chemistry - Temperature and Reaction Rates (Lesson Plan)

Students must select a tranquilizer dart to be used by the US Fish and Wildlife Service for researching large animals. Next, they must help the US Geological Survey choose a new drilling device. Each projectile has varying characteristics based on the temperature of the chemicals inside. Students must select which temperature lends itself to a reaction suitable for service in animal research or geological studies. Other factors due to temperature come into play as well, such as density and melting point.

Physical and Chemical Changes (Original Tutorial)

By the end of this tutorial, students should be able to distinguish a physical change from a chemical change.

Conservation of Mass Tutorial (Original Tutorial)

By the end of this tutorial, students should be able to demonstrate that mass is conserved when substances undergo physical and chemical changes in a closed system.

Hot on the Trail (Original Tutorial)

Investigate how temperature affects the rate of chemical reactions.

Big Idea #10: Forms of Energy

Benchmark SC.7.P.10.1

Illustrate that the sun's energy arrives as radiation with a wide range of wavelengths, including infrared, visible, and ultraviolet, and that white light is made up of a spectrum of many different colors.

Prior Knowledge:

This benchmark grouping is foundational. These concepts have not been introduced in the NGSSS prior to this grade-level grouping.

Students will:

- Identify, compare and/or contrast the variety of types of radiation present in radiation from the Sun.
- Identify and/or compare characteristics of the electromagnetic spectrum.
- Identify common uses and/or applications of electromagnetic wave**s.**

Also Assesses:

SC.8.E.5.11 Identify and compare characteristics of the electromagnetic spectrum such as wavelength, frequency, use, and hazards and recognize its application to an understanding of planetary images and satellite photographs.

Resources:

Stations of Light (Lesson Plan)

Student groups rotate through four stations to examine light energy behavior: refraction, magnification, prisms and polarization.

Wave after Wave: The Properties and Applications of Electromagnetic Radiation

Students will explore the range of wavelengths that comprise the electromagnetic spectrum of radiation from the sun and associate wavelength with frequency and energy. Students will also be able to identify common uses of Electromagnetic Radiation.

Electromagnetic Spectrum Poster Project (Lesson Plan)

In this lesson, students conduct a brief review on frequency and wavelength. Students are then assigned a specific region of the Electromagnetic Spectrum to research in small groups. Posters representing their assigned region are created following specific guidelines. Posters will include frequency, wavelength, energy level and applications of their assigned radiation. Students will then display their posters during a class gallery walk with guiding questions. This allows students to compare the research they conducted with that of fellow classmates.

Spectra and Stars (Lesson Plan)

This lesson expands students' understanding of how electromagnetic waves are used to reveal information from imagery taken in space by using c-spectra or spectroscopes, light sources and colored gel filters.

Understanding Medical Radiation (Open Resource Page)

This informational text resource is intended to support reading in the content area. The text explains the different kinds of radiation, as well as its sources, benefits and risks, and goes on to discuss the history of medical radiation.

Sun Sibling Spotted (Text Resource)

This informational text resource is intended to support reading in the content area. Scientists may have found a star created from the same nebula that produced our sun. The spectrograph composition data, the motion of the star through the Milky Way, and its age all suggest that it is a "sibling" to our Sun.

Benchmark SC.7.P.10.3

Recognize that light waves, sound waves, and other waves move at different speeds in different materials.

Prior Knowledge:

Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.P.10.1, SC.3.P.10.3, SC.3.P.10.4, SC.4.P.10.1, SC.4.P.10.3, and SC.5.P.10.1.

Students will:

- Describe and/or explain that waves move at different speeds through different materials.
- Explain that light waves can be reflected, refracted, and/or absorbed.

Also Assesses:

SC.7.P.10.2 Observe and explain that light can be reflected, refracted, and/or absorbed.

Resources:

Concert Venue Building Materials (Model Eliciting Activity)

Students will analyze sets of data to determine what construction company proposal would be best suited for building an outdoor concert venue. Students will need to consider sound quality to the concert patrons, disturbances to the local community and safety.

5E Refraction Inquiry Lab (Lesson Plan)

In this lesson plan, students learn about the property of light: refraction. The lesson begins with an engage demo placing a pencil in a glass of water. The students will be able to witness the effects of refraction. After answering a few questions, the students are split into partners for the explore portion of the lesson. The students place a penny on the bottom of an opaque cup then step back until they cannot see the penny. The partner then slowly pours water into the cup until the penny comes into sight (record data). The teacher leads the class in a classroom discussion about their findings. The teacher then explains what refraction is and why it happens. For the elaborate portion of the lesson, students are asked to explain how to spearfish from a riverbank. There is a short quiz that may be used for a summative assessment.

Why is the sky blue? (Lesson Plan)

Students explore how light and sound waves travel in different materials.

Light Wave Interaction with Matter (Lesson Plan)

Light travels at an incredible fast speed and it allows us to see everything around us. It travels as a wave which interacts with different types of matter in a different way. This lesson is designed for 7th grade students to investigate the different ways in which light waves interact with matter. The type of matter depends on which state the object is in-solid, liquid or gas.

Feeling the Heat?? (Lesson Plan)

In this lesson, students will investigate how the various surfaces have different albedo values. Students will analyze the difference between radiation, conduction and convection, the three mechanisms by which heat is transferred through Earth's system. Students will engage in collecting data, graphing their measurements and presenting their findings to the class.

Big Idea #11 Energy Transfer and Transformations

Benchmark SC.7.P.11.2

Investigate and describe the transformation of energy from one form to another.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.P.11.2 and SC.5.P.10.4.

Students will:

- Identify and/or describe the transformation of energy from one form to another.
- Differentiate between potential and kinetic energy.
- Identify and/or explain situations where energy is transformed between kinetic energy and potential energy.

Also Assesses:

SC.6.P.11.1 Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

SC.7.P.11.3 Cite evidence to explain that energy cannot be created nor destroyed, only changed from one form to another.

Resources:

Building a Motor (Lesson Plan)

Students will be able to demonstrate the Law of Conservation of Energy by building a miniature motor. They will demonstrate that the chemical energy in the battery is converted to electromagnetic energy (with the electrons moving up the metal clips on the side), and then mechanical energy (with the copper enamel wire spinning in the center).

CATAPULTS! (Lesson Plan)

After learning about Energy Transformations and the Law of Conservation of Energy, students will be tasked with building a catapult that is capable of demonstrating these relationships. In addition, students will be able to gather data of distance traveled for the projectiles (marble and large marsh mellow) to traverse the predetermined trajectory. Once data is tabulated, students will then graph, analyze and report their results.

Family on the Go (Lesson Plan)

Students will need to rank the best hybrid car for the family to buy which shows the most fuel efficient, highest safety rating, best price and most comfortable car for a family of four. The family is interested in a hybrid. Students will then be asked to look over their finding and evaluation checklist and change the four-passenger vehicle to an SUV in order to fit grandma and grandpa who will soon be moving in. The students will be given new data set that includes all SUV's currently on the market. They will use the ranking formula they devised to figure out the best SUV for the family. Next, they write a letter to the family explaining their findings and the reasons for their choice.

Bouncing Balls in Kinetic and Potential Energy Transformations (Lesson Plan)

This lesson uses tennis balls to explain how potential energy can be converted to kinetic energy and how kinetic energy can be converted to potential energy.

Conservation of Energy (Original Tutorial)

In this tutorial, students will learn about the Law of Conservation of Energy. This law states that energy can't be created or destroyed, instead it is transformed from one form to another.

Benchmark SC.7.P.11.4

Observe and describe that heat flows in predictable ways, moving from warmer objects to cooler ones until they reach the same temperature.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.P.9.1, SC.3.P.11.1, SC.4.P.11.1, and SC.4.P.11.2.

Students will:

- Describe how heat flows in predictable ways.
- Explain that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.

Also Assesses:

SC.7.P.11.1 Recognize that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.

Resources:

Frozen Treats Storage Dilemma (Model Eliciting Activity)

In this MEA, students must work as a team to design a procedure to select the best storage cooler for their frozen treats. The main focus of the MEA is to apply scientific knowledge and describe that heat flows in predictable ways. Students will analyze data in order to arrive at a scientifically sound solution to the problem.

Let's Heat Things Up! (Lesson Plan)

How do things heat up? Help students relate thermal energy to their daily lives. This is a two-day entertaining lesson explaining thermal energy the transfer of energy between the phases of matter. It includes two activities for the students along with two teacher demonstrations. Also included is a PowerPoint and small quiz.

Saving the Veggies! (Lesson Plan)

Students explore how light travels, how heat moves and how it all affects temperature. Students will determine which type of panel to choose for a fictitious greenhouse, glass or plastic, and how much light, heat and moisture is best to let in.

The Direction of Heat Flow (Lesson Plan)

Students will describe how heat flows from warmer objects to cooler ones until they reach the same temperature.

The D'Fence Project (Lesson Plan)

This activity will help students with practicing critical thinking. Calculating density will reinforce Physical Properties of Matter and will lead them to understand the role of heat in the changes of the state of matter.

Heat Almighty! (Lesson Plan)

This lab experiment was designed to allow students a visual, hands-on and real life experience with the concept of the effects of heat transfer in a closed system. It will work very well as a unit or lesson introduction but can be used at any point during a unit on heat transfer. Students will be observing the behavior of water molecules as heat is added to a closed system. In addition, students will be predicting and estimating the amount of evaporation that occurs when water is heated in a sealed flask by measuring the amount of condensation that is collected in a second, connected flask.

Heat and States of Matter (Original Tutorial)

By the end of this tutorial, students should be able to demonstrate that adding heat to a system can result in a change in state.

Big Idea #12 Motion of Objects (Not Annually Assessed)

Benchmark SC.6.P.12.1

Measure and graph distance versus time for an object moving at a constant speed. Interpret this relationship.

Resources:

How fast can Dominoes Travel in a Chain Reaction? (Lesson Plan)

The students will complete an inquiry activity using dominoes to determine what variables affect the speed of the chain reaction. Students will have to consider and decide on the best spacing between dominoes to achieve the fastest travel time and ensure the spacing remains constant by carefully measuring the distance between each domino. They will set up five dominoes at a time to set off a chain reaction alongside another five dominoes spaced differently. Students can create a bar graph to show how the spacing affects the speed. Students can have fun while learning or reinforcing their understanding of potential and kinetic energy, measuring distance, measuring elapsed time, recording data, making and interpreting graphs and using the distance formula to calculate the rate of speed.

Are You Faster Than A Middle Schooler? (Lesson Plan)

Students will record and graph motion of objects and calculate average speed. Lesson plan, rubrics, and sample data sheet are included.

Tracking Distance over Time (Original Tutorial)

By the end of this tutorial, students should be able to measure, graph and interpret the relationship of distance over time of a sea turtle moving at a constant speed.

Big Idea #13 Forces and Changes in Motion

Benchmark SC.6.P.13.1

Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.5.P.10.3 and SC.5.P.13.1.

Students will:

- Identify and/or describe types of forces.
- Describe the relationship among distance, mass, and gravitational force between any two objects.
- Differentiate between mass and weight.

Also Assesses:

SC.6.P.13.2 Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.

SC.8.P.8.2 Differentiate between weight and mass recognizing that weight is the amount of gravitational pull on an object and is distinct from, though proportional to, mass.

Resources:

Robots Get a Job (Model Eliciting Activity)

In this MEA, students will select the robots that are more efficient at doing a certain type of job. They will have to analyze data tables that include force, force units, mass, mass units and friction.

The Amazing Balloon Rocket (Lesson Plan)

Students will investigate Newton's Three Laws of Motion as it relates to rocketry by constructing a balloon rocket. They will collect data, calculate velocity of the balloon as it races across the string and

calculate velocity and acceleration. Students will construct a Distance-Time graph and a Velocity-Time graph. Students will find the slope of the Distance-Time graph and will explain why this slope represents the velocity of the balloon. Students will further explain why the slope of the Velocity-Time graph represents the acceleration.

Electrical Conductors and Insulators (Lesson Plan)

Students will identify substances capable of carrying an electric charge and those that do not. Students will be able to identify and diagram the parts of a basic series circuit, though the concepts of series and parallel circuits have not be developed yet.

Hot or cold: Magnets Always Rock! (Lesson Plan)

This lesson uses a hands-on-approach to investigate one of the three non-contact forces. Teachers can use this lesson plan to have students explore and investigate how temperature can have an effect on the magnetic strength of a magnet.

Down with Gravity Inquiry and IMRaD Lab Report (Lesson Plan)

This is an inquiry lesson that explores gravity and mass. It also provides a format and practice for writing a lab report in the IMRaD (introduction, methods, results and discussion) format.

Why Don't I Fall Out When a Roller Coaster Goes Upside Down? (Text Resource)

This informational text resource is designed to support reading in the content area. This short article was written to answer the question, "Why don't I fall out when a roller coaster goes upside down?" The answer to the question results in an interesting article that combines scientific information about the physics of roller coasters, along with some fun facts and photographs.

Mass and Weight, What's the Difference (Original Tutorial)

Students will differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object and is distinct though proportional to mass.

Benchmark SC.6.P.13.3

Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.P.10.2, SC.4.P.10.2, SC.4.P.10.4, SC.4.P.12.1, SC.4.P.12.2, SC.5.P.10.2, SC.5.P.13.2, SC.5.P.13.3, and SC.5.P.13.4.

Students will:

- Describe and/or explain that an unbalanced force acting on an object changes its speed and/or direction.
- Interpret and/or analyze graphs of distance and time for an object moving at a constant speed.

Also Assesses:

SC.6.P.12.1 Measure and graph distance versus time for an object moving at a constant speed. Interpret this relationship.

Resources:

Balanced or Not (Lesson Plan)

This lesson will help students clarify the difference between balanced and unbalanced forces, and the students will be able to demonstrate the forces through the game tug-a-war. Students will be engaged in whole group discussion about their prior knowledge. They will also be engaged in small group discussion sharing examples they created and described about balanced and unbalanced forces. This lesson will allow the students to collect and record data from the different grouping scenarios of tug-a-war and answer conclusion questions based on the data collected. Students should gain a solid foundation about these concepts after the completion of this lesson.

Cosmic Nose Cones (Lesson Plan)

Students will design specific nose cones for a water bottle rocket. They will test them to find out and rate which one is most effective in terms of accuracy, speed, distance and cost effectiveness. This information will be used as criteria for a company that designs nose cones for orbiter missions.

Crash Test Dummies (Lesson Plan)

Students will investigate inertia and Newton's laws of motion by completing an engineering challenge. Students will first investigate how mass affects the inertia of a person riding in a car that comes to a sudden stop. After analyzing the data and discussing the results, students will be asked to design a seat belt that will keep their clay person in the car without sustaining an "injury."

Baseball: From Pitch to Hits (Text Resource)

This informational text resource is intended to support reading in the content area. The text describes the science behind baseball by analyzing an actual pitch that took place in a Royals vs. Tigers game. The text describes how Newton's First Law affects the pitch and then describes how energy is transferred from ball to bat. Finally, the text explains how scientists use several methods to analyze the physics of a pitch.

Tracking Distance over Time (Original Tutorial)

By the end of this tutorial, students should be able to measure, graph, and interpret the relationship of distance over time of a sea turtle moving at a constant speed.

Big Idea #14 Organization and Development of Living Organisms

Benchmark SC.6.L.14.1

Describe and identify patterns in the hierarchical organization of organisms from atoms to molecules and cells to tissues to organs to organ systems to organisms.

Prior Knowledge: This benchmark grouping is foundational. These concepts have not been introduced in the NGSSS prior to this grade-level grouping.

Students will:

- Identify and/or describe patterns in the hierarchical organization of organisms, from atoms to molecules, to cells, to tissues, to organs, to organ systems, to organisms.

Resources:

Life Exposed (Lesson Plan)

STEM-u-lating science! What are living things composed of? Students will dig deeper into the building blocks of life by researching, designing, and creating a layered transparency book.

Life is a Hierarchy (Lesson Plan)

Through a variety of hands-on and visual manipulatives, students will discover the building process from a single atom to a complete, independently functioning organism. Students will start with the smallest component and work their way up to the largest and most complex.

We are a good fit (Lesson Plan)

This lesson helps guide the student in understanding the relationship from atoms to molecules and cells to tissues, to organs, to organ systems, to organisms. It is an introduction to the concept that all living things share certain characteristics.

Levels of Organization (Text Resource)

A short, concise text resource explaining levels of organization (from cells to organisms) that also includes photo examples.

Levels of Organization (Original Tutorial)

By the end of this tutorial students should be able to describe the hierarchical organization of living things from the atom, to the molecule, to the cell, to the tissue, to the organ, to the organ system and to the organism.

Benchmark SC.6.L.14.2

Investigate and explain the components of the scientific theory of cells (cell theory): all organisms are composed of cells (single-celled or multi-cellular), all cells come from pre-existing cells, and cells are the basic unit of life.

Prior Knowledge: This benchmark grouping is foundational. These concepts have not been introduced in the NGSSS prior to this grade-level grouping.

Students will:

- Identify, describe, and/or explain the components of cell theory.
- Describe how cells undergo similar processes to maintain homeostasis.

Also Assesses:

SC.6.L.14.3 Recognize and explore how cells of all organisms undergo similar processes to maintain homeostasis, including extracting energy from food, getting rid of waste, and reproducing.

Resources:

Cell Theory Tic-Tac-Toe (Lesson Plan)

This is a digital resource in which students will be able to choose three activities to demonstrate their mastery of cell theory.

It's ALIVE! (Lesson Plan)

This is a 5E style investigation of living and non-living things. Students will use their understanding of "living" to draw conclusions about how a flame should be classified and why. In the extension, students use resources to classify a virus as living or non-living. Their conclusion must be supported by evidence from the sources used. This is an introductory lesson that would be needed to completely cover the cell theory.

Small but Mighty: The Progression of the Cell Theory (Lesson Plan)

The cell theory has had a major impact on modern science, from the development of the theory to the present day. This lesson will examine strategies students can use to deepen their knowledge and understanding of the development of the cell theory.

Here's Hoping for Homeostasis! (Lesson Plan)

Students will examine the importance of homeostasis and how the cell membrane helps the cell maintain homeostasis through a mini-demonstration, gummy bear lab activity, a video and a vocabulary exercise.

Passive vs. Active (Lesson Plan)

Students will explain and contrast how passive and active transport occur within a cell to maintain homeostasis. Creating an anchor chart which includes a labeled diagram, students will be introduced to the passive and active transport in relation to keeping a cell in homeostasis.

The Cell as a System (Lesson Plan)

This is a complete lesson plan designed to deepen student understanding of the major organelles of animal cells and the way in which cells function as individual systems. The lesson plan develops the analogy of cells as factories in order to achieve this understanding. Detailed supplemental student reading materials are included in this lesson plan as is a worksheet for students to complete.

The Cell Theory (Original Tutorial)

By the end of this tutorial, students should be able to identify and explain the three parts of an important concept in science called the cell theory, which states that all living things are made up of one or more cells, the cell is the basic unit of life and that all cells come from other living cells.

Benchmark SC.6.L.14.4

Compare and contrast the structure and function of major organelles of plant and animal cells, including cell wall, cell membrane, nucleus, cytoplasm, chloroplasts, mitochondria, and vacuoles.

Prior Knowledge: This benchmark grouping is foundational. These concepts have not been introduced in the NGSSS prior to this grade-level grouping.

Students will:

- Compare and/or contrast the structure and/or function of major organelles of plant and animal cells.

Resources:

"Me & My Cells: An Introductory Look at Plant & Animal Cells" (Lesson Plan)

This lesson is intended to make students more knowledgeable about plants and animals, their functions and their relevance in our everyday lives. Additionally, a tactile exploratory exercise is presented to reinforce knowledge acquisition.

A Day in the Life as Oscar the Organelle (Lesson Plan)

In this lesson, students will create a story as if they are a cell organelle going through its day. In this activity, they will show how they interact with their own organelle family or other organelles in a cell. In this two-day lesson, students will create a labeled model of a plant and animal cell and write a story.

Animal Cells and Plant Cells: Just How Different Are We? (Lesson Plan)

This resource provides students with a web-based interactive animal cell and plant cell which they use to learn about the different parts of each cell. Students will summarize information about the structure and function about the organelles required for this standard which are: cell wall, cell membrane, cytoplasm, nucleus, chloroplast, vacuole and mitochondria.

Cell Parts and "The Real World" Collage (Lesson Plan)

In this activity, students will identify organelles of an animal cell; state the function of each organelle; identify each structure on a visual cell diagram; and relate each part to a functioning object in the real world.

Cell Structure (Tutorial)

This tutorial introduces cell structure. The three cells that this unit covers are prokaryote, animal and plant cells. With this tutorial, the learners will be able to recognize the differences between prokaryotic and eukaryotic cells.

Benchmark SC.6.L.14.5

Identify and investigate the general functions of the major systems of the human body (digestive, respiratory, circulatory, reproductive, excretory, immune, nervous and musculoskeletal) and describe ways these systems interact with each other to maintain homeostasis.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.5.L.14.1 and SC.5.L.14.2.

Students will:

- Identify and/or describe the general functions of the major systems of the human body.
- Identify and/or describe how the major systems of the human body interact to maintain homeostasis.
- Identify, compare, and/or contrast the types of infectious agents that affect the human body.

Also Assesses:

SC.6.L.14.6 Compare and contrast types of infectious agents that may infect the human body, including viruses, bacteria, fungi, and parasites.

Resources:

Body Systems and Homeostasis MEA with Dr. Homeostasis (Model Eliciting Activity)

This MEA is based on a 6th grade life science standard. Using a doctor's report, students will create a checklist and system of identifying organs and body systems affected by the patient’s symptoms.

Circulatory System Lesson (Lesson Plan)

The lesson will begin with the teacher engaging the students with a presentation of "How the Blood Gets around the Body" following a think quest presentation that covers the parts and functions of the circulatory system, including the brain, veins and arteries, heart and blood. Students will explore blood vessels by watching a short video clip, conducting a hands-on investigation about blood pressure. Next the teacher will lead a discussion and explain about the human heart and will use a "Map of the Human Heart" to show the class exactly how the heart pumps blood throughout the body and learn facts about the human heart. Students will get a chance to elaborate by creating a color picture of blood flow to, through and from the heart in their notebooks. Students may be evaluated by watching a short video clip about the circulatory system and taking the accompanying quiz.

Motion and Position of the Human Body (Lesson Plan)

In this lab, students will explore the interactions of the muscular and skeletal systems and how they contribute to homeostasis. Students will collect data based on their own body movements and identify how movement occurs through muscles, tendons, joints and bones. Finally, students will conclude that temperature maintenance, cell production and nutritional factors are all variables controlled, in part, by these body systems for the purpose of homeostasis.

Out of this World Workout: Exercise in Space to Prevent Bone Loss (Lesson Plan)

Students will learn how exercise is helping astronauts decrease bone and muscle loss during extended stays in micro-gravity. They will be asked to design an exercise program that utilizes both aerobic and muscle-building workouts while using the three exercise machines currently in use on the International Space Station. Then, the students will learn that current research suggests that more intense, short bursts of exercise may be more effective at decreasing bone and muscle loss, and they will be asked to redesign their workout prescription accordingly.

Communicating About Communicable Disease (Lesson Plan)

In this "tried and true" investigation, students use a commercially available product (Glo-germ) and a black light to demonstrate how germs are spread (glitter can be substituted). Students then write a public service announcement, including statistics, about the preventing the spread of a communicable disease.

The Fizz Virus (Lesson Plan)

This is a lesson on viruses and a simulation on how diseases can spread.

Bones: They're Alive! (Text Resource)

This informational text resource supports reading in the content area. The text explains how our bones do much more than just hold us up and keep us moving—they play many other important roles in the body.

New "Heartland" Disease Emerges in U.S. Midwest (Text Resource)

This informational text resource is intended to support reading in the content area. In June 2009, two men were admitted to a Missouri hospital with severe flu-like symptoms. After lack of response to

treatment and extensive blood analysis, it was determined that the men had a phlebovirus—the first seen in the U.S. With the help of the CDC, the virus was tracked to a species called the Lone Star tick. There is currently no vaccine or treatment for this dangerous disease.

Return of the Giant Zombie Virus (Text Resource)

This informational text resource is intended to support reading in the content area. The article discusses the amazing discovery of an ancient virus found frozen in the Russian permafrost after 30,000 years. The virus is huge in size and only infects amoebas. Amazingly, the virus is still infectious after remaining frozen for so long.

How You Breathe (Tutorial)

This tutorial will help students understand the process of breathing. Students will be able to visualize how the lungs expand when they take in air and return to the resting state as the air leaves the lungs when they breathe out.

Big Idea #15 Diversity and Evolution of Living Organisms

Benchmark SC.6.L.15.1

Analyze and describe how and why organisms are classified according to shared characteristics with emphasis on the Linnaean system combined with the concept of Domains.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.L.15.1, SC.3.L.15.2 and SC.5.L.14.2.

Students will:

- Analyze and/or describe how and/or why organisms are classified.

Resources:

Alien Attributes (Lesson Plan)

Students play the role as astronaut/biologist and are sent to an alien planet where they must identify and classify new species based on their external attributes. This is a creative and fun way to explain the Linnaean system after students create their own aliens, not knowing their purpose.

Classification and Binomial Nomenclature (Lesson Plan)

In this lesson, students will explore the classification system and investigate why organisms are classified together. Students will also gain an understanding of binomial nomenclature by creating a fictional organism and naming their new creature.

I Am a Part of a Kingdom? (Lesson Plan)

This lesson is designed to help students describe how and why living things are classified using the Linnaean system of classification. They will be able to observe similar characteristics of organisms to determine if they are related.

Fun with Taxonomy and Dichotomous Keys (Lesson Plan)

Students will be introduced to the taxonomy of living things created by Linnaeus. They will learn how to use binomial nomenclature to create and solve dichotomous keys.

Classifying Living Things (Original Tutorial)

By the end of this tutorial, students will be able to describe how and why living organisms are classified.

Benchmark SC.7.L.15.2

Explore the scientific theory of evolution by recognizing and explaining ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.5.L.15.1 and SC.5.L.17.1.

Students will:

- Identify and/or explain ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.
- Identify and/or explain ways in which fossil evidence is consistent with the scientific theory of evolution.
- Identify and/or explain how a species' inability to adapt may contribute to the extinction of that species.

Also Assesses:

SC.7.L.15.1 Recognize that fossil evidence is consistent with the scientific theory of evolution that living things evolved from earlier species.

SC.7.L.15.3 Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

Resources:

5E Natural Selection Module (Lesson Plan)

This resource uses a variety of techniques to address the factors that contribute to natural selection. Included in the lesson is a hook to engage students, a web lab exercise, a poster activity for expression and a hands-on simulation.

Walking Whales! (Lesson Plan)

Whales had legs?! What?!!! Use this well researched and easily understood set of resources to explore the evidence for evolution in a way that is both non-threatening and engaging. Use a combination of article excerpts and videos, along with other activities, to show evidence for the clear progression of whales from land dwellers to sea masters.

Can You See Me Now? (Lesson Plan)

In this lesson, students will be introduced to the relationship between environmental changes and the effects they have on various species. Polar Bears and Peppered Moths will be used as examples during the lesson. Students will engage in a hands-on simulation that will generate data for students to analyze. Students will also engage in guided reading in the content area as they read about the peppered moth and its changing environment. The concepts of adaptation, changing environments and extinction will be evaluated throughout the lesson.

Discovering Fossils: Fossil Tools & Resources (Text Resource)

Fossil enthusiasts Roy Shephard and Luci Algar combined their professional skills in media and education to develop this informative and entertaining website. Designed to be educational and accessible to children, this site presents a wide variety of information about fossils found in Great Britain. The site contains a nice collection of images and diagrams; and includes a fossils guide for beginners, information on preparing fossils, a collection of fossil myths, information on ammonites and more. The site also contains a 'Games & Activities' section for teachers and students, a glossary of fossil terms, a diagram depicting the evolution of life on our planet, and even some free fossil desktop images.

Fossils: Evidence of Evolution (Original Tutorial)

By the end of this tutorial, students should be able to recognize that fossil evidence is consistent with the scientific theory of evolution, that living things evolved from earlier species.

Do or Die: Extinction in a Changing World (Original Tutorial)

By the end of this tutorial students should be able to explain that the environment on Earth is constantly changing and that organisms must adapt to this change by evolving via natural selection. Otherwise, they will go extinct.

Evidence for Evolution (Web quest)

PBS has developed a unit on evolution including activities, video clips and games that lead a student through the mechanisms that lead to evolution, evidence that supports evolution and scientific discoveries.

Big Idea #16 Heredity and Reproduction

Benchmark SC.7.L.16.1

Understand and explain that every organism requires a set of instructions that specifies its traits. This hereditary information (DNA) contains genes located in the chromosomes of each cell, and that heredity is the passage of these instructions from one generation to another.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.4.L.16.1, SC.4.L.16.2 and SC.4.L.16.3.

Students will:

- Describe and/or explain that every organism requires a set of instructions that specifies its traits.
- Identify and/or explain that hereditary information (DNA) contains genes located in the chromosomes of each cell and/or that heredity is the passage of these instructions from one generation to another.
- Use Punnett squares and pedigrees to determine genotypic and phenotypic probabilities.
- Compare and/or contrast general processes of sexual and asexual reproduction that result in the passage of hereditary information from one generation to another.

Also Assesses:

SC.7.L.16.2 Determine the probabilities for genotype and phenotype combinations using Punnett Squares and pedigrees.

SC.7.L.16.3 Compare and contrast the general processes of sexual reproduction requiring meiosis and asexual reproduction requiring mitosis.

Resources:

A Taste of DNA (Lesson Plan)

"A Taste of DNA" is an activity-based lesson intended to be used as a reinforcement of the concepts associated with the structure of DNA and building DNA. It covers information pertaining to base pairing, DNA shape and structure, cellular organelles, and the function of DNA. In this lesson, students will have

the opportunity to move around the classroom, build a long strand across the science floor and create their own strand with the knowledge they've gained.

Dog DNA - A Recipe for Traits (Lesson Plan)

Students will discover how DNA will "code" for traits by performing a lab activity where segments of paper DNA (genes) are picked at random, a list of traits is made and a dog is drawn featuring its genetic traits.

Frankenstein Foods--GMO (Lesson Plan)

Students will read "Your Genes, Your Choices." They will explore the impact of Biotechnology and create a brochure that represents what they have learned. By the end of the lesson, students will have a better understanding of DNA, GMOs and Biotechnology.

Discovering Genotype and Phenotype (Lesson Plan)

This lesson primarily addresses students discovering the concept of dominant and recessive alleles by examining how genotype determines phenotype through a structured inquiry. Punnett squares are also introduced as an extension of the primary activity.

Can I be just exactly like you, Mom or Dad? (Lesson Plan)

This lesson was designed to help students understand the differences between sexual and asexual reproduction. It includes multi-media resources and hands-on activities that reveal the benefits and limitations of both. The student will ultimately determine the likelihood of a genotype resulting in a specific phenotype.

Wanted: Your Undivided Attention! Mitosis vs. Meiosis (Lesson Plan)

In this lesson, students will be doing numerous engaging activities in order to successfully address and target the standard of comparing/contrasting the general processes of mitosis and meiosis. The activities are designed to introduce mitosis and meiosis in an engaging way. Food and hands-on activities are a motivator in this lesson plan, which includes modeling and differentiating mitosis and meiosis.

Where Native Americans Come From (Text Resource)

This informational text resource is intended to support reading in the content area. The article describes how scientists have found that Native Americans have ancestral roots in Asia using DNA evidence from a 12,600 year old toddler skeleton from the Clovis culture in Montana.

Heredity (Original Tutorial)

Explore the inheritance of genetic information and its relationship to traits in offspring.

From Flowers to Freckles: Mendel's Mighty Model (Original Tutorial)

By the end of this tutorial, students should be able to explain how scientists use models to simplify and understand the world around us. Students should also be able to explain the benefits and limitations of scientific models.

The Story of Our Start (Original Tutorial)

In this tutorial, students will compare and contrast asexual and sexual reproduction.

Big Idea #17 Interdependence

Benchmark SC.7.L.17.2

Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.4.L.17.2, SC.4.L.17.3 and SC.4.L.17.4.

Students will:

- Compare and/or contrast relationships between organisms, such as mutualism, predation, parasitism, competition, and commensalism.
- Describe and/or explain the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
- Identify and/or describe various limiting factors in an ecosystem and their impact on native populations.

Also Assesses:

SC.7.L.17.1 Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.

SC.7.L.17.3 Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation and nesting sites.

Resources:

Pythons in the Everglades (Model Eliciting Activity)

In this MEA, students will investigate the introduction of a non-native, i.e. invasive, species to the Florida Everglades: the Burmese Python. Students will investigate the complex predator-prey relationship and learn why this could damage the ecosystem permanently. Students will analyze a set of data to determine which method of eradication would be best and most effective, considering factors such as cost, the amount of man-power necessary to implement it, the effect it would have on the python population and its impact on other species.

Frenemies, Bros, and Killers: A Lesson in Symbiosis (Lesson Plan)

Students will participate in pairing organisms and explaining and debating the relationship between the two living things in terms of symbiosis. Students will collaborate with classmates to explore and explain different symbiotic relationships using known relationships, and then elaborating to new organism relationships. Students will be able to compare and contrast the symbiotic relationships of mutualism, predation, commensalism and parasitism through several discovery activities.

Fishy Forms - Adaptations Tell Us Lifestyles (Lesson Plan)

In this lesson, students explore morphology (body shape) of fish and how they can indicate the fish's lifestyle.

Interrelationships of Organisms (Lesson Plan)

In this activity the students will be learning unit specific vocabulary and then bring it to life by creating a classroom ecosystem. They will each play a role in the ecosystem and be cycled in and out as appropriate. The ecosystem will look at the relationships amongst organisms (commensalism, parasitism and mutualism) and how a singular event can crash an interdependent ecosystem.

"Wanted: Dead or Delicious"- The food chain of the Lion Fish (Lesson Plan)

This lesson is designed to get students to understand how a food chain works using an invasive species like the Lionfish. It is timely, and students here on the Gulf Coast can relate to the problem.

Energy Transfer with Producers, Consumers, and Decomposers (Lesson Plan)

Students learn about producers, consumers and decomposers while playing a game. After the game, students will work in groups to create food webs that show how energy is transferred though an ecosystem.

Corals and Coral Reefs (Text Resource)

This site from the Sea World Education Department provides an overview of corals and the reefs that they form. Many aspects of these invertebrates are covered, including descriptions, their scientific classification, their habitat and distribution, reef ecosystem, and the conservation of coral reefs worldwide.

Virginia Acts to Reduce Population of Wild Pigs, the 'Most Invasive Animal' in U.S. (Text Resource)

This informational text resource is intended to support reading in the content area. The article describes the extreme population growth and range expansion of wild pigs, as well as how this invasive animal is damaging local ecosystems.

Hopping into Central Ideas (Tutorial)

This tutorial is designed to help secondary science teachers learn how to integrate literacy skills within their science curriculum. This tutorial will demonstrate a series of steps that teachers can teach students to help them determine the central ideas of a science text. The focus on literacy across content areas is designed to help students independently build knowledge in different disciplines through reading and writing.

Antarctic Food Web Challenge (Original Tutorial)

Help Brian solve the mystery of the declining krill population by exploring energy transfer in his ecosystem.

Where Have All the Scrub-Jays Gone? (Original Tutorial)

Florida is home to a wide variety of plants and animals. Some of these species are rare, and some are found nowhere else on Earth. The ecosystems that are home to these organisms are unusual and often fragile. How do changes to an ecosystem affect the limiting factors found there? How do limiting factors affect the organisms that live in an ecosystem? By the end of this tutorial, students will have investigated the limiting factors of a Florida ecosystem and will be able to describe how these limiting factors affect one native Florida population.

Big Idea #18

Benchmark SC.8.L.18.4

Cite evidence that living systems follow the Laws of Conservation of Mass and Energy.

Prior Knowledge: Items may require the student to apply science knowledge described in the NGSSS from lower grades. These standards are foundational and necessary for mastery of the middle grades content. This benchmark builds upon knowledge from the following elementary grade benchmarks: SC.3.L.17.2, SC.4.L.17.2 and SC.4.L.17.3.

Students will:

- Explain that living systems obey the Law of Conservation of Mass and the Law of Conservation of Energy.
- Describe and/or explain the general processes of photosynthesis or cellular respiration.
- Describe how matter and energy are transferred in the carbon cycle.
- Describe the role of light, carbon dioxide, water, and/or chlorophyll in the process and products of photosynthesis.

Also Assesses:

SC.8.L.18.1 Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water and chlorophyll; production of food; release of oxygen.

SC.8.L.18.2 Describe and investigate how cellular respiration breaks down food to provide energy and releases carbon dioxide.

SC.8.L.18.3 Construct a scientific model of the carbon cycle to show how matter and energy are continuously transferred within and between organisms and their physical environment.

Resources:

Modeling the Law of Conservation of Mass in the Environment (Lesson Plan)

This lesson provides a power point on the four main cycles of matter and how they follow the Law of Conservation of Mass. The instruction is followed by time for the student to build their own models and explain how they demonstrate the Law of Conservation of Mass.

Bubbling with Excitement over Photosynthesis (Lesson Plan)

Light is necessary for photosynthesis to occur. In this activity students will expose aquatic plants to varying amounts of light and record the amount of bubbles produced as a result.

The Link between Photosynthesis and Cellular Respiration (Lesson Plan)

This is a lesson that addresses standards and misconceptions associated with Big Idea 18 about Matter and Energy Transformations as related to photosynthesis and cellular respiration. The lesson also embeds a review of other related standards for which the students possesses prior knowledge. The lesson is vertically aligned to review classification of organisms, taxonomy, and build from related introductory activities into learning about cell types, organelles and their structures and functions, with an emphasis on chloroplasts and mitochondria and their role in photosynthesis and cellular respiration. The lesson scaffolds text coding, note taking and charting, answering media dependent questions and culminates in a summative written essay assessment. An alternative short response exam has been included which could be used as a summative assessment or the questions could be used as formative questions throughout the lesson.

Cellular Processes: Aerobic and Anaerobic Respiration (Lesson Plan)

This lesson is an introduction lesson that provides students with the basics concepts of aerobic and anaerobic respiration. The lesson centers on a reading passage and lab activity. By the end of the lesson, students should be able to complete a concept map to compare and contrast aerobic and anaerobic respiration.

A Timeline of a Hypothetical Carbon Atom with a Narrative (Lesson Plan)

This lesson is designed to have students investigate the possible path that a hypothetical atom of carbon could have taken before it ended up in them. The students, in groups, will first brainstorm all the information they know about carbon. They will then be given twenty flash cards. The students will be asked to depict five placements of the carbon longitudinally through time, with approximate dates, until it ends up in them in present day. The students will gather information from class discussion and the cards themselves in order to portray the possible path. After the timeline is completed, the students will be asked to compose a narrative from the perspective of the hypothetical carbon atom that will describe each of the events in the timeline.

Getting the Dirt on Carbon (Text Resource)

This informational text resource is intended to support reading in the content area. Carbon, an essential part of life on Earth, exists in a never-ending cycle. It is continually moving back and forth between living

and non-living factors, as well as from organism to organism. Soil, with its ability to "lock up" carbon, plays a major role in the carbon cycle. Atmospheric CO_2 levels are linked to climate change, so ways of keeping carbon locked in soil are of great interest to scientists.

Changing Seas (Text Resource)

This informational text resource is intended to support reading in the content area. This text explains how carbon dioxide from the atmosphere is changing the oceans. The text describes ocean acidification and ocean warming. The text gives examples of ecosystems that are changing as a result.

Photosynthesis (Original Tutorial)

By the end of this tutorial, students will learn about the process of photosynthesis and ways that plants convert energy from the sun into glucose.

Conservation of Mass and Energy in Living Systems (Original Tutorial)

By the end of this tutorial, students should be able to describe how matter and energy are continuously transferred within and between organisms and their physical environment and cite evidence that living systems follow the Laws of Conservation of Mass and Energy.

Knights of the Round and Round Table - The Carbon Cycle (Original Tutorial)

Follow the quest to learn how carbon is cycled on earth.