SCIENCE

LENGTH OF TIME: One year

GRADE LEVEL: 4

DESCRIPTION OF COURSE:
This course is divided into three units:

1) The Ecosystem Restoration: Matter and Energy in a Rain Forest unit will help students master disciplinary core ideas in physical science while supporting students' development of key science practices such as making arguments from evidence. The unit incorporates an explicit focus on the crosscutting concept of Energy and Matter, with opportunities to address the crosscutting concepts of Systems and System Models; Scale, Proportion, and Quantity; and Cause and Effect.

2) The Earth's Features: Mystery in Desert Rocks Canyon unit will help students master disciplinary core ideas in Earth science while supporting students' development of key science practices such as developing and using models and engaging in argument from evidence. The unit incorporates an explicit focus on the crosscutting concept of Stability and Change, with opportunities to address the crosscutting concepts of Patterns and Cause and Effect.

3) Energy Conversions: Blackout in Ergstown unit will help students master disciplinary core ideas in physical science while supporting students' development of key science practices such as constructing explanations and designing solutions; developing and using models; analyzing data; and obtaining, evaluating, and communicating information. The unit incorporates an explicit focus on the crosscutting concepts of Systems and System Models and Energy and Matter, with opportunities to address Structure and Function as well as Cause and Effect.

All three units provide substantial experience with Pennsylvania's Common Core State Standards (PACCSS) for English Language Arts (ELA) as they relate to reading and writing informational text. The unit includes opportunities to address some PACCSS for Mathematics, with optional extensions that allow further standards coverage.

COURSE STANDARDS:
PA Academic Standards for Science and Technology and Engineering Education (Grades 3, 5, 6, 8)

A. Biological Sciences (3.1)
Students will:

1. Describe how environmental changes can cause extinction in plants and animals (3.1.4.C1)

B. Physical Sciences
Students will:

1. Identify types of energy and their ability to be stored and changed from one form to another. (3.2.4.B2)

2. Demonstrate how light can be reflected, refracted, or absorbed by an object. (3.2.4.B5)
3. Give examples of how energy can be transformed from one form to another. (3.2.4.B6)
4. Understand that objects that emit light often emit heat. (3.2.4.B3)
5. Apply knowledge of basic electrical circuits to the design and construction of simple direct current circuits. (3.2.4.B4)

C.. Earth and Space Sciences (3.3)
Students will:

1. Identify basic properties and uses of Earth's materials including rocks, soils, water, and gases of the atmosphere. (3.3.4.A2)
2. Recognize that fossils provide evidence about what plans and animals that lived long ago and the nature of the environment at that time. (3.3.4.A3)

D. Experience science as inquiry (3.1.4.A9, 3.1.4.C4, 3.2.4.A6, 3.2.4B7, 3.3.4.A7, 3.3.4.B3, 4.1.4.F, 4.2.4.D, 4.3.4C4.4.4.E, 43534.F))

PA Academic Standards for Environment and Ecology (Grades 3-8, 10, 12)
Students will:

2. Describe the roles of producers, consumers, and decomposers with in an ecosystem. (4.1.5.A)
3. Identify how matter cycles through an ecosystem (4.1.4.B)
4. Explain how specific adaptations can help organisms survive in their environment. (4.5.4.D)
5. Explain that ecosystems change over time due to natural and/or human influences. (4.1.4.E)
6. Describe how human activities affect the environment. (4.5.4.C)

PERFORMANCE ASSESSMENTS/EXPECTATIONS

1) Energy Conversions
   - Use evidence to construct an explanation relating the speed of an object to the energy of that object.
   - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
   - Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
   - Obtain and combine information to describe that energy and fuels are derived from renewable and non-renewable resources and how their uses affect the environment.
2) Earth's Features

- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

3) Ecosystem Restorations
   - Support an argument that plants get the materials they need for growth chiefly from air and water.
   - Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment
   - Develop a model to describe that matter is made of particles too small to be seen.
   - Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
   - Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
   - Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
   - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
   - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

TITLES OF UNITS:

1. Energy Conversions — Quarter 1
2. Earth's Features — Quarter 1-2
3. Ecosystem Restoration — Quarter 2

SAMPLE INSTRUCTIONAL STRATEGIES:

Each fourth grade unit contains an extensive selection of varied instructional strategies for the teacher to integrate into the classroom.

MATERIALS:

1. Materials contained in Amplify kits
2. Chromebooks for simulations

METHODS OF ASSISTANCE AND ENRICHMENT:

1. Peer assistance/parent helpers
2. Special projects
3. Cooperative groups

METHODS OF EVALUATION:

1. Completed Investigation Notebook pages
2. Critical juncture assessments

3. End of unit assessment

INTEGRATED ACTIVITIES/CROSS CUTTING CONCEPTS

1) Energy Conversions
   - Do. Students take on several design challenges—including designing an energy converter that will allow a simple electrical system to function—and investigate simple electrical systems built by peers in order to identify the cause of system failure.
   - Talk. Multiple opportunities for student-to-student discourse engage the class in synthesizing evidence they have collected in order to figure out what they can infer about reasons for electrical-system failure. Students come to a deeper understanding of the function of the electrical system.
   - Read. Students read and refer back to five informational texts during the unit. In one book, they read about real-life blackouts that have occurred around the world. As students read, they reflect on what they have learned about energy sources, energy conversion and transfer, and what happens when one part of a system fails. Students then identify what caused each blackout. Students build on this thinking as they investigate the causes and solutions for the blackouts occurring in Ergstown. In addition, students refer to a content-rich reference book for evidence as they design solutions and plan and deliver arguments.
   - Write. Over the course of the unit, students have multiple opportunities to write their understandings about energy as well as write evidenced-based design arguments and explanations of electrical systems, system models, forms of energy, and energy conversion. Students also use graphic organizers to help them understand the functions of various parts of systems.
   - Visualize. Through physical demonstrations and use of images and diagrams, students are able to visualize concepts related to energy, such as what happens when there is not enough energy in a system to power all devices.

   Earth's Features
   - Do. Over the course of the unit, students observe a class sedimentary rock formation model in which layers get thicker, and the environment changes over time.
   - Talk. Multiple opportunities for student-to-student talk engage the class in figuring out how places on Earth may appear to be staying the same over a short period of time but can change over a long period of time.
   - Read. Students read a book about weathering and erosion that shows how various rock formations have changed over long periods of time.
   - Write. During the course of the unit, students write several scientific explanations about the geologic history of Desert Rocks National Park, noting the changes in environment as indicated by the rock layers and fossils present.
   - Visualize. Through developing models, students work to visualize the process of rock formation and discuss how the various models do not depict a realistic timescale. They can also observe the passage of time in the Simulation via an active time line that advances time forward 10,000 years during rock formation.
2) Ecosystem Restoration

- Do. Students use the Ecosystem Restoration Simulation to track matter from one organism to another through an ecosystem. Students use cubes to represent the transformation of matter as molecules go from being an organism's food to being part of an organism's body. Students make a physical model of a food web by using yarn to demonstrate that the matter that ends up as part of a secondary consumer (e.g., an alligator) had to come from a primary consumer (e.g., a frog) and eventually a plant. Students add to their understanding as they model how plants make their own food by taking in carbon dioxide and water and using this matter as well as energy from the sun to grow. Students synthesize their understanding as they trace matter and energy through an ecosystem in the Ecosystem Restoration Simulation and using the Ecosystem Modeling Tool.
- Talk. Multiple opportunities for student-to-student talk engage the class in figuring out where the matter and energy that each organism needs comes from and then putting together each of those transfers to trace matter and energy through the ecosystem.
- Read. Students read the book Matter Makes It All Up and consider that all the organisms in an ecosystem, even though they are different in many ways, are made of matter. Students later read Energy Makes It All Go and reflect on the need for energy that all organisms have and the transfer of matter that allows for the transfer of energy.
- Write. During the course of the unit, students write several scientific arguments about why the organisms in the project area are not growing and thriving. Students draw from data about the amount of matter in different populations and ideas about the flow of matter and energy to support their claims.
- Visualize. Through tracking individual interactions, students work to visualize the path of energy and matter through an ecosystem.