WELCOME!

We're so glad you selected the EARTH ecoSTEM Kit!
Here are some tips to help you get started.

What you can do with the EARTH ecoSTEM Kit

Each kit contains supplies to engage a class of 32 students in exciting science and engineering practices as they solve real-world problems and learn about soils, landforms, and earth processes. Here are some of the things students will do, in teams of four:

- Observe phenomena and ask questions about soils
- Create a model using a stream table, that demonstrates earth processes involved in landforms
- Test soil properties and texture
- Identify native plants suited to grow in tested soils
- Conduct a citizen science project on soils and contribute the data
- Design and carry out an investigation about decomposition with a see-through composter
- Design and install drip irrigation system for garden
- Reduce cafeteria waste and enrich soils through a vermiculture project (worm composting)
- Create organic compost with a compost tumbler
- Model relative effectiveness of different soil conservation techniques in schoolyard
- Grow mushrooms and observe decomposition

Packing List

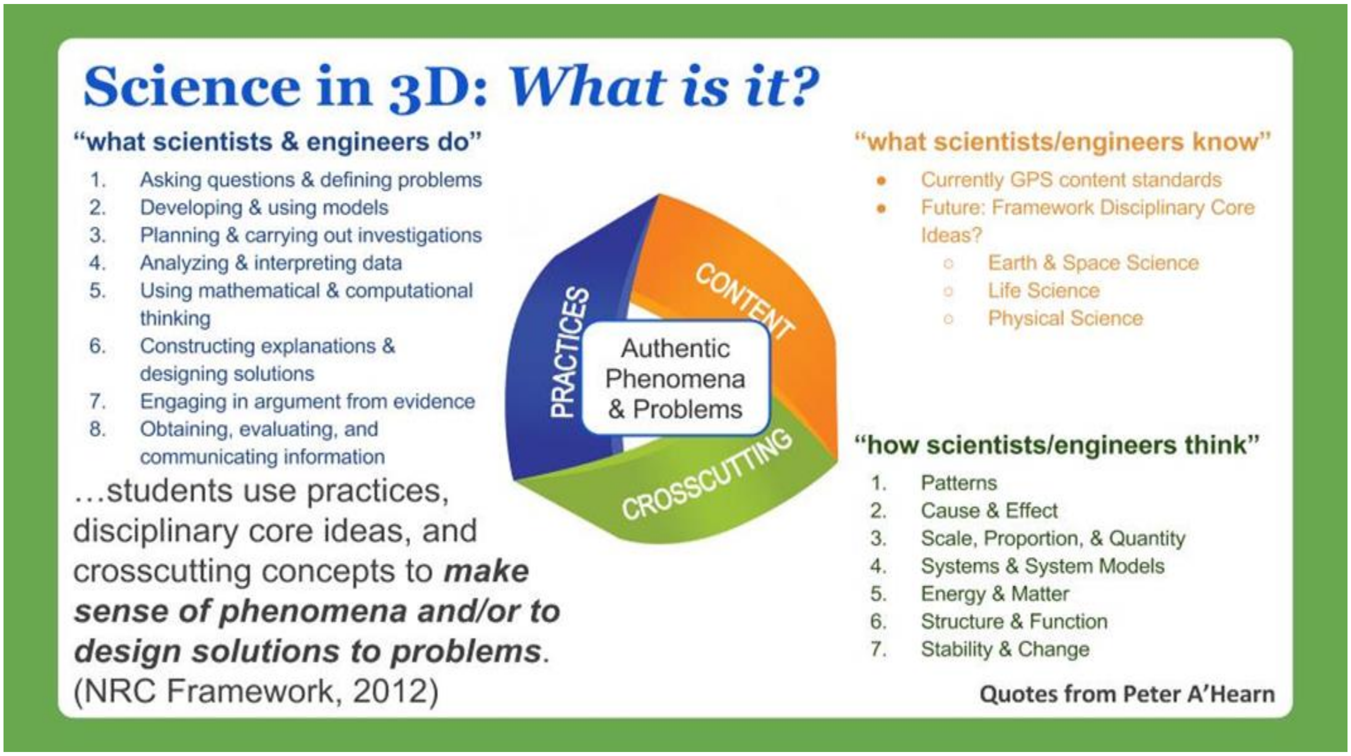
(1) Envelope with vouchers for
- Compost Tumbler
- Worm Bin
- Worms

(8) Soil test kits
(8) Mini Stream Tables
(1) See-through Composter
(1) Drip Irrigation Kit
(1) Box Tea Bags
(1) Pocket Scale (to 0.01)
(8) Trowels
(1) Mushroom Farm Starter

Contact Us

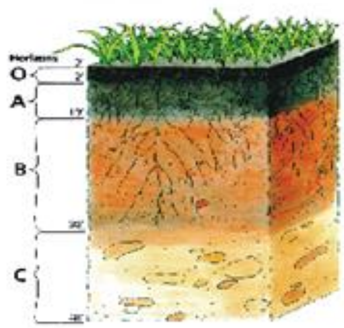
Captain Planet Foundation
info@captainplanetfdn.org
133 Luckie Street
Atlanta, GA 30303
404-522-4270

Access Your EARTH ecoSTEM Kit QuickStart Guide Online



Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Teaching with the EARTH ecoSTEM Kit and QuickStart Guide



Credit: NRCS – USDA.gov

The supplies in this kit are available for teachers and informal educators to use or adapt in any way that fits their situation and teaching approach. Many states have adopted Next Generation Science Standards, and even more have embraced the pedagogy on which NGSS is based (called "three-dimensional learning") while creating their own standards. Therefore, we have arranged the QuickStart Guide to support a 3-D learning approach that can be used in ANY state. If you'd like to know more, download the free Framework for K-12 Science Education or email us to request access to our free online course.

The three dimensions in 3-D Learning are core ideas, science and engineering practices, and crosscutting concepts. The icon of a braided rope is often used to represent this model and symbolize how the components are inextricably combined throughout the learning process. This differs significantly from an "inquiry" approach, which incorporates student exploration into some lessons, but not all.

In order to support 3-D Learning, ecoSTEM Kits provide an observable phenomenon to launch each learning experience. The phenomenon illustrates a mystery that students seek to figure out in the process of their investigations. No background reading, lecture or vocabulary is needed, up front. This approach emphasizes discovery and exploration before explanation, with vocabulary postponed until it appears in context. After observing a phenomenon, students talk about what they noticed and what they wondered, ask additional questions, craft tentative explanations, and conduct their own research or investigations, in small teams.

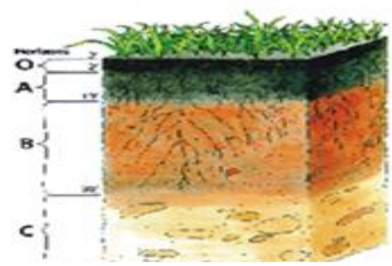
The supplies in the ecoSTEM Kit are designed to actively engage students in science and engineering practices. Each EcoSTEM Kit accommodates a class of 32 working in groups of 4. While investigating, students look for crosscutting concepts such as patterns or cause and effect, to help them make sense of core ideas. After each learning activity, students return to their initial explanations and revise them in light of new knowledge and understanding. Teachers facilitate the learning experience by guiding students in science and engineering practices, providing guardrails, conducting formative assessments, and helping clear up misconceptions.

We hope the arrangement of this QuickStart Guide will help you implement 3-Dimensional Learning, it that is your intent. You are also welcome to use the supplies for direct instruction.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating **Soil Texture** using the EARTH ecoSTEM Kit's Trowels

ENGAGE ***Students Observe this Phenomenon***



GATHER

Construct a Tentative Explanation → **Ask Questions** → **Conduct Student-Selected Research**

EXPLORE ***Kit-supported Learning Experience***

Students will observe and sketch one soil horizon pit (± 12 inches deep) and then use their trowels to dig 4" deep samples from various locations. They will use Earth Learning Ideas' Soil Donuts protocol to feel soil samples in their hands, estimate the texture, and classify it as sand, silt or clay. The Soil Texture by Feel video from University of California Davis is a variation.

REASON

Make a Model of Sand, Silt or Clay Particles → **Modify the model to depict a Loam** → **Revise and Refine the Tentative Explanation**

EVALUATE

Formative assessment: Students should be able make a model which shows that soil is composed of mineral content (broken bits of rocks or 'parent material') as well as water, air, and organic material (living roots or dead and decomposing plants and animals). Differences in texture can be modeled using a jar which student fills with three sized balls (largest = sand; smallest = clay) to represent particle sizes, with spaces between to represent porosity.

ELABORATE

Students can conduct a Jar or Shake Test to calculate soil texture by following this protocol from the Clemson Cooperative Extension. Then they can use their data to identify the proportion of silt, clay and sand in their soil sample, using a Soil Triangle such as this one from Soils4Teachers, where more lessons can be found by grade.

EXTEND

This video from NRCS explains Water Movement in Soils . Students can calculate the porosity (% of space between soil particles) and permeability (the rate at which water flows down into soil through spaces between particles) by doing the How Full is Full? activities from Teach Engineering. This video from Bozeman Science explains Soil Dynamics.

COMMUNICATE

EXPLAIN

Students will try to make sense of the core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the

EMPOWER

Students may propose solutions to compacted or lifeless mineral soils and implement a project to improve soil health.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating Living Soil Components using the EARTH ecoSTEM Kit's Trowels

ENGAGE Students Observe this Phenomenon. . . .

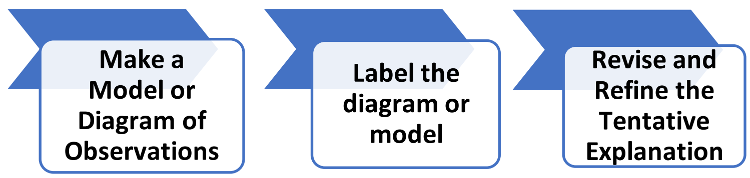
GATHER

https://www.youtube.com/watch?v=Mxp1nnrUG0Q

EXPLORE Kit-supported Learning Experience

Working in teams of four, students will use their trowels to dig 4" deep samples from various locations and spread the soil out on white paper or cloth to identify components. (Do not use potting soil, which has no living organisms). Lenses and jars will help students see insects. Bacteria can be seen microscopically. Return soil to holes afterwards: wash hands!

REASON



EVALUATE - Formative assessment

Given a variety of ingredients, students should be able to design and make an edible soil model and explain that soil is composed of mineral content (broken bits of rocks or 'parent material'), organic content (living organisms and dead / decomposing matter), water and air. Decomposing things include rotting leaves. Living organisms include various animals and the "FBI": Fungi (underground part called mycorrhizae), Bacteria, and Insects in various stages

ELABORATE

Fungi, Bacteria, Invertebrates: Students can find a plant with mycorrhizae, dig it up, cut the roots, and grow a "trap culture" of the soil fungi for 4 months and then "inoculate" other plants to extend their root systems. They can observe these microscopic images of soil bacteria. They can observe insects and other soil macroinvertebrates.

EXTEND

Students can build a Berlese Funnel to make soil macroin-vertebrates emerge from a soil sample. Follow the direction or make this into an engineering design challenge.

This video explains the Soil Food Web, as depicted in this poster. Students can visit The Microbe Zoo to learn more about soil and compost critters.

COMMUNICATE

EXPLAiN

Students will try to make sense of the core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

EMPOWER

Students may propose solutions to mineral soils and carry out a project such as adding mulch to increase soil organisms.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating Soil Fertility (Nutrients & pH) using the EARTH ecoSTEM Kit's (8) Soil Test Kits

ENGAGE Students Observe this Phenomenon

GATHER

1. Construct a Tentative Explanation
2. Ask Questions
3. Conduct Student-Directed Research

EXPLORE Kit-supported Learning Experience

Students, working in teams of 4, will use collect soils samples from the school-yard and then use the LusterLeaf Soil Test Kits to determine pH. Students can use Soils4Teachers' diagram of "pH and Nutrient Availability" to predict soil test results, before testing for N, P and K.

REASON

1. Model
2. Diagram the Model - Add any Missing Components
3. Revise and Refine the Tentative Explanation

EVALUATE

Based on PH, students should be able to identify soils as acidic (<6); basic / alkaline (>7.5); or nearly neutral (6.6 – 7.4) and to use this Plant pH Preference List to match soils with plants that are likely to thrive in the schoolyard without the need for soil amendments. They can then compare those plants to a native plant list like this one or this one, in order to make recommendations about plants.

ELABORATE

Three macronutrients needed by plants are in the atmosphere (carbon, oxygen and hydrogen). The other 14 macronutrients are available only from soil. Students can use this chart to make models of plants affected by soil nutrient deficiencies and then try to identify the deficiencies depicted by the models in a gallery walk.

EXTEND

Students may analyze an unknown soil sample, classify it according to nutrient deficiencies and pH, and prescribe soil amendments and conditioners. Students may also want to test soil samples before and after composting to detect increased fertility after food waste is decomposed.

COMMUNICATE

EXPLAIN

Students will try to make sense of a core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

EMPOWER

Students may propose solutions to poor soils and choose a project to do, e.g. amending soils in the school garden to increase fertility.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating Soil Decomposition using the EARTH ecoSTEM Kit's Tea Bags and Pocket Scale

ENGAGE Students Observe this Phenomenon

GATHER

Construct a Tentative Explanation → Ask Questions → Conduct Student-Directed Research

https://www.youtube.com/watch?v=q9CNZTVLRnk – play without sound

EXPLORE   Kit-supported Learning Experience

Students will weigh, bury, dig up (after 60-90 days), dry, and re-weigh tea bags. Note that Lipton no longer makes the green and rooibos teas in pyramid bags specified for the Tea Bag Index citizen science project, so students will design and do an investigation to compare the decomposition rate of Forest Fruit tea in different types of soils, by modifying this protocol as seen in

REASON

Model Decomposition and Nutrient Cycling → Add any Missing Components → Revise and Refine the Tentative Explanation

EVALUATE

Students should be able to explain that decomposition is the process by which the nutrients in plants (and in animals) are released to the soil through death and decay of that plant, which provides a source of nutrients for other organisms growing in the same soil.

ELABORATE

Students may submit data to the Tea Bag Index citizen science project if they can find Lipton green and rooibos pyramid tea bags to use (though they are discontinued). The purpose of the project is to use decomposition rates to create a proxy soils map of the world.

EXTEND

Students can design and conduct tests to discover the impact of flooding, fertilizers, and temperature on decomposition, and use the results as evidence in constructing an argument about how climate change may influence decomposition rates.

COMMUNICATE

EXPLAIN

Students will try to make sense of a core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

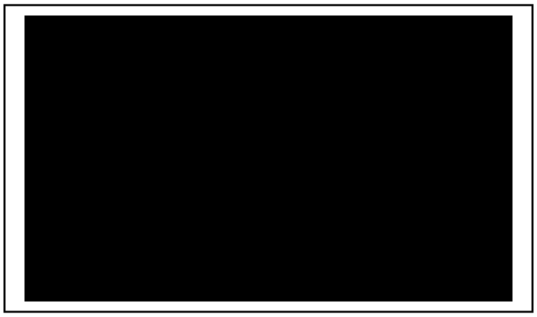
EMPOWER

Students may propose solutions to poor soils and choose a project to do, such as amending soils to improve drainage.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating **Vermicomposting** using EARTH ecoSTEM Kit's Worm Factory & *Worms Eat Our Garbage* Classroom Guide

Students Observe this Phenomenon and then. . . .



GATHER

Construct a Tentative Explanation → Ask Questions → Conduct Student-Selected Research

https://thekidshouldseethis.com/post/vermicomposting-time-lapse-for-kids

EXPLORE Kit-supported Learning Experience:

Students can use the Worm Factory 360 Composter and the Complete Guide to Vermicomposting to set up a classroom vermicomposting project that will decompose lunch and snack foods (other than meats and fats) to make a nutrient-rich compost for the garden or schoolyard.

REASON

Model → Diagram the Model - Add any Missing Components → Revise and Refine the Tentative Explanation

EVALUATE

Students should be able to describe several positive effects of adding vermicompost to garden soil (i.e. improves soil aeration; returns nutrients through the process of eating, digesting and excreting organic matter; improves water-holding capacity; decreases need for chemical fertilizers which can pollute nearby water bodies when washed away in run-off water)

ELABORATE

Students will design and conduct investigations to compare garden or schoolyard soil to vermicompost and to soil in which vermicompost has been mixed, to determine differences in texture, composition, pH and nutrient content (using soil test kits), water-holding capacity and fertility (by comparing plant growth).

EXTEND

The included book***: Worms Eat Our Garbage***, includes many activities about worms and composting. Students may build shoebox worm composters that take into account worm anatomy and behavior. Students may create diagrams to show the cycle of a macronutrient (P, N, or K) through plants, soils, and atmosphere.

COMMUNICATE

EXPLAIN

After making sense of a core idea by engaging in science or engineering practices through the lens of crosscutting concepts, students revise their original explanations of a phenomenon.

EMPOWER

Students may propose solutions to the poor soils and set up a year-round vermicomposting project at school.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating Composting using the EARTH ecoSTEM Kit's See-through Composter, Tumbling Composter & Pocket Scale

ENGAGE - Students Observe this Phenomenon

GATHER

- ***EXPLAIN*** - Construct a Tentative Explanation
- Ask Questions
- Conduct Student-Selected Research

https://www.youtube.com/watch?v=c0En-_BVbGc

EXPLORE

Students will design and conduct investigations using the (included) See-Through Composter, thermometers, and scale to compare effect of type of material, type soils, moisture, air, or temperature on decomposition rate.
How Long until Its Decomposed in the Ocean?
How Long Does Trash Really Last?
What Happens to Trash in a Landfill?

REASON

- Make a time-lapse film of something decomposing in the see thru composter
- Annotate the film
- Revise and Refine the Tentative Explanation

EVALUATE (Formative Assessment)

Students should be able to describe parts of the decomposition process including actions by animals, fungi, bacteria and invertebrates. Decay includes loss of fluids, breakdown of matter into smaller parts, and breaking apart of molecules so that nutrients are released and available for reuse by living organisms. Students should be able to explain that different waste materials break down at different rates, and that temperature and exposure to air also affect the speed of decay.

ELABORATE

Students will read and share articles from Natural Inquirer and Science News for Students, using Jigsaw-style activity.

- Recycling the Dead
- Mealworms Chow Down on Plastics
- Tiny but Might Food Clean-Up Crews
- The Dirt on Soil
- Bacteria are All Around Us and That's Okay
- Chew om This! The Impact of Termites on Forest Wood
- Leaf Me Alone! Cycling of Nutrients between Trees and Soil
- Food for the Soil- Salmon-derived Nutrients
- Compostable vs Biodegradable -Earth 911

EXTEND

Students will use the (included) tumbling composter to establish a compost protocol for the class, grade level or school; educate others about what is compostable; add other types of "browns" and greens as needed to

COMMUNICATE

EXPLAIN

Students will try to make sense of a core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

EMPOWER

Students may propose solutions and choose a project to do, such as setting up a grade-level lunch composting program.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating **Mycoremediation** using the EARTH ecoSTEM Kit's Oyster Mushroom Growing Kit

ENGAGE - Students Observe this Phenomenon

https://www.youtube.com/watch?v=KO1WjFRL_XA play without sound

GATHER

EXPLAIN - Construct a Tentative Explanation → Ask Questions → Conduct Student-Selected Research

EXPLORE - Kit-supported Learning Experience

Students will grow oyster mushrooms in order to design and conduct investigations on their ability to absorb oil and other pollutants. They will also explore the role of mushrooms in providing eco-friendly packaging, products, foods, etc.

REASON

Diagram mushrooms decomposing oil → Investigate and Add any Missing Components → Revise and Refine the Tentative Explanation

EVALUATE (Formative Assessment)

Students should be able to diagram or make a model that shows that mushrooms are fruiting bodies of an underground network of mycorrhizae connected to plant roots. Further, they should be able to explain that plant roots dump sugars into the soil , benefitting mycorrhizae AND that some mycorrhizae can infiltrate plants' root cells and help themselves to the goodies there.

ELABORATE

Students will read and share these articles from Natural Inquirer and others, Jigsaw-style:

- The Morel of the Story
- Spreading Spore-adically: Sudden Oak Disease
- There's a Fungus Among Us: Developing Rust-Resistant Pines
- How Do Mycorrhizae Work
- What are Mycos? Down to Earth Fertiizers
- Zombie Fungus Enslaves Ant Brains
- Technology for Our Future in Mushrooms

EXTEND

This excerpt from a TedTalk explains mycoremediation of oil spills, in less than 3 minutes. And *This American Land* film: Fabulous Filtering Fungi, tells the story of a class that inoculates straw with mushroom spores to absorb oily runoff from a road and stop a fish kill. The Educator Guide contains protocols for replicating this project.

COMMUNICATE

EXPLAIN

Students will try to make sense of a core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

EMPOWER

Students may propose solutions and choose a project to do, such as filtering oil from runoff before it enters nearby creeks.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating Erosion and Deposition using the EARTH ecoSTEM Kit's Mini-Stream Tables and Trowels

ENGAGE Students Observe this Phenomenon

GATHER

Construct a Tentative Explanation → Ask Questions → Conduct Student-Directed Research

https://www.smithsonianmag.com/videos/providence-canyon/ play with no sound

EXPLORE Kit-supported Learning Experience

Working in teams of 4, students will use the included mini-stream tables to explore the processes of erosion, deposition and weathering, in an attempt to recreate the forces and processes that they think formed this canyon and this delta. Then they will research the formation of these two Georgia landscapes: Providence Canyon and the Altamaha River delta, and compare historical accounts to their own explanations or claims.

REASON

Model Erosion and Deposition using Stream Tables → Diagram the Model - Add any Missing Components → Revise and Refine the Tentative Explanation

ELABORATE

Students can complete the Breaking It Down: Weathering and Erosion lesson from public television series ***Nature***, in which they perform a series of experiments to demonstrate and compare mechanical and chemical weathering, erosion, and deposition. They can also explore:

- Explanation of Providence Canyon formation from GA Envir Protection Div
- How rivers erode canyons from Time for Geography
- Explanation of delta formation from Sciencing
- Why rivers have deltas from MinuteEarth

EVALUATE

Students should be able to distinguish among constructive and deconstructive forces (weathering, erosion, and deposition) and to demonstrate understanding by sorting cards with this illustrated quizlet and playing Weathering and Erosion Jeopardy with the class. Reteaching can be done with the Shape it Up interactive game on geological processes from AAAS.

EXTEND

Students can learn more about the Dust Bowl, including its causes and solutions, by exploring resources at the end of CPF's Dust Bowl & the Dirty Thirties lesson. These Best Practices for Soil Conservation provide strategies that students can model in the school garden. Virtual River is an online sumulation challenge.

EXPLAIN

Students will try to make sense of a core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

COMMUNICATE

EMPOWER

Students may propose solutions and choose a project such as identifying erosion and deposition on school grounds and mitigating it.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Investigating Soil Conservation Techniques using the EARTH ecoSTEM Kit's Mr. Landscaper Drip Irrigation Kit

ENGAGE Students Observe this Phenomenon

GATHER

https://www.netafimindia.com/bynder/ABBBBAD8-4824-469C-9B0764E5424FA0A8-netafims-unique-drip-technology-v2.mp4 - select 1st video

EXPLORE Kit-supported Learning Experience

Students can review Mister Landscaper's Drip Irrigation Installation Instructional Video 1 and Video 2. Then they will map the area where drip irrigation is to be installed (using YardMap's online tool or baseline/offset sketch on graph paper), designing the most effective layout to conserve soil and provide enough water to keep the largest number of plants alive, without wasting water to evaporation. Competing plans can be presented and the most effective one implemented by the class.

REASON

ELABORATE

Students can explore permaculture and how it can reverse desertification by watching Allan Savory's Ted Talk; or watch this video to learn about an experiment conducted by Daniel Janzen and Winnie Hallwachs, who dumped 12,000 metric tons of orange peels on barren land.

EVALUATE

Students should be able to explain the value of drip irrigation both in terms of conserving water (by targeting irrigation at roots and reducing evaporation) and conserving soil (by preventing it from drying out and blowing away or flooding and leeching nutrients).

EXTEND

Students may research and explore strategies for reducing wasted water, soil conservation techniques, and soil and water conserving garden systems like hügelkultur and keyhole gardens with compost heaps in the center.

COMMUNICATE

EXPLAIN

Students will try to make sense of a core idea by engaging in science or engineering practices and reflecting on crosscutting concepts; then revise their explanations of the phenomenon.

EMPOWER

Students may propose solutions to conserve soil and water and choose a project from the Extend section to do.

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

Standards for ecoSTEM Earth Quick Start Guides

NGSS

ecoSTEM® EARTH Kit Alignment to Next Generation Science Standards

NGSS Standard	*Grades 3-5*	*Grades 6-8*	*Grades 9-12*	*Learning Activity from the Kit*
LS2.B Cycles of matter and energy transfer in ecosystems	Matter cycles between the air and soil and among organisms as they live and die.	The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.	**See-through Composter Recycling**
ESS2.A Earth materials and systems	Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.	Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.	Feedback effects exist within and among Earth's systems.	**Soil Shake Test Soil Testing for Chemicals**
ESS3.A Natural resources	Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.	Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.	**Tea Bag Index project Drip Irrigation**
ESS3.A Natural resources	Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.	**Reusable food wraps Vermicomposting to reduce cafeteria waste**

Access Your EARTH ecoSTEM Kit QuickStart Guide Online

GA Standards / GSES

Kindergarten

SKE2. Obtain, evaluate, and communicate information to describe the physical attributes of earth materials (soil, rocks, water, and air).
a. Ask questions to identify and describe earth materials—soil, rocks, water, and air.
b. Construct an argument supported by evidence for how rocks can be grouped by physical attributes (size, weight, texture, color).
c. Use tools to observe and record physical attributes of soil such as texture and color

SKP1. Obtain, evaluate, and communicate information to describe objects in terms of the materials they are made of and their physical attributes.
a. Ask questions to compare and sort objects made of different materials. (Common materials include clay, cloth, plastic, wood, paper, and metal.)
b. Use senses and science tools to classify common objects, such as buttons or swatches of cloth, according to their physical attributes (color, size, shape, weight, and texture).
c. Plan and carry out an investigation to predict and observe whether objects, based on their physical attributes, will sink or float.

1st grade

S1L1. Obtain, evaluate, and communicate information about the basic needs of plants and animals.
a. Develop models to identify the parts of a plant—root, stem, leaf, and flower.
b. Ask questions to compare and contrast the basic needs of plants (air, water, light, and nutrients) and animals (air, water, food, and shelter).
c. Design a solution to ensure that a plant or animal has all of its needs met.

3rd grade

S3E1. Obtain, evaluate, and communicate information about the physical attributes of rocks and soils.
a. Ask questions and analyze data to classify rocks by their physical attributes (color, texture, luster, and hardness) using simple tests. (Clarification statement: Mohs scale should be studied at this level. Cleavage, streak and the classification of rocks as sedimentary, igneous, and metamorphic are studied in sixth grade.)
b. Plan and carry out investigations to describe properties (color, texture, capacity to retain water, and ability to support growth of plants) of soils and soil types (sand, clay, loam).
c. Make observations of the local environment to construct an explanation of how water and/or wind have made changes to soil and/or rocks over time. (Clarification statement: Examples could include ripples in dirt on a playground and a hole formed under gutters.)

5th grade

S5E1. Obtain, evaluate, and communicate information to identify surface features on the Earth caused by constructive and/or destructive processes.
a. Construct an argument supported by scientific evidence to identify surface features (examples could include deltas, sand dunes, mountains, volcanoes) as being caused by constructive and/or destructive processes (examples could include deposition, weathering, erosion, and impact of organisms).
b. Develop simple interactive models to collect data that illustrate how changes in surface features are/were caused by constructive and/or destructive processes.
c. Ask questions to obtain information on how technology is used to limit and/or predict the impact of constructive and destructive processes. (Clarification statement: Examples could include seismological studies, flood forecasting (GIS maps), engineering/construction methods and materials, and infrared/satellite imagery.)

Sixth Grade

S6E5. Obtain, evaluate, and communicate information to show how Earth's surface is formed.
a. Ask questions to compare and contrast the Earth's crust, mantle, inner and outer core, including temperature, density, thickness, and composition.
b. Plan and carry out an investigation of the characteristics of minerals and how minerals contribute to rock composition.
c. Construct an explanation of how to classify rocks by their formation and how rocks change through geologic processes in the rock cycle.
d. Ask questions to identify types of weathering, agents of erosion and transportation, and environments of deposition. (Clarification statement: Environments of deposition include deltas, barrier islands, beaches, marshes, and rivers.)
e. Develop a model to demonstrate how natural processes (weathering, erosion, and deposition) and human activity change rocks and the surface of the Earth.
f. Construct an explanation of how the movement of lithospheric plates, called plate tectonics, can cause major geologic events such as earthquakes and volcanic eruptions. (Clarification statement: Include convergent, divergent, and transform boundaries.)
g. Construct an argument using maps and data collected to support a claim of how fossils show evidence of the changing surface and climate of the Earth.
h. Plan and carry out an investigation to provide evidence that soil is composed of layers of weathered rocks and decomposed organic material.

S6E6. Obtain, evaluate, and communicate information about the uses and conservation of various natural resources and how they impact the Earth.
a. Ask questions to determine the differences between renewable/sustainable energy resources (examples: hydro, solar, wind, geothermal, tidal, biomass) and nonrenewable energy resources (examples: nuclear: uranium, fossil fuels: oil, coal, and natural gas), and how they are used in our everyday lives.
b. Design and evaluate solutions for sustaining the quality and supply of natural resources such as water, soil, and air.
c. Construct an argument evaluating contributions to the rise in global temperatures over the past century. (Clarification statement: Tables, graphs, and maps of global and regional temperatures, and atmospheric levels of greenhouse gases such as carbon dioxide and methane, should be used as sources of evidence.)

High School Earth Systems

SES3. Obtain, evaluate, and communicate information to explore the actions of water, wind, ice, and gravity as they relate to landscape change.
a. Plan and carry out an investigation that demonstrates how surface water and groundwater act as the major agents of physical and chemical weathering.
b. Develop a model of the processes and geologic hazards that result from both sudden and gradual mass wasting.
c. Construct an explanation that relates the past and present actions of ice, wind, and water to landform distribution and landscape change.
d. Construct an argument based on evidence that relates the characteristics of the sedimentary materials to the energy by which they were transported and deposited.

SES6. Obtain, evaluate, and communicate information about how life on Earth responds to and shapes Earth's systems.
a. Construct an argument from evidence that describes how life has responded to major events in Earth's history (e.g., major climatic change, tectonic events) through extinction, migration, and/or adaptation.
b. Construct an explanation that describes how biological processes have caused major changes in Earth's systems through geologic time (e.g., nutrient cycling, atmospheric composition, and soil formation).
c. Ask questions to investigate and communicate how humans depend on Earth's land and water resources, which are distributed unevenly around the planet as a result of past geological and environmental processes.
d. Analyze and interpret data that relates changes in global climate to natural and anthropogenic modification of Earth's atmosphere and oceans

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