

Soil Savers

Educator Guide

Supporting Plants and Animals in our Community

Featuring ecoSPEARS

An Overview of the CreositySpace NGSS/NYSSLS Kindergarten* Sequencing is Provided Below

CreositySpace—Kindergarten Science—Year-at-a-Glance			
Dates	September—December	January—May	June
Unit Title	<i>Draft Dodgers</i> (Force, Motion, and Aerodynamics) Theme: Using the concepts of fast cars and the power of air to explore force and motion.	<i>Soil Savers</i> (Soil—It’s More Than Just Dirt) Theme: Exploring the way that soil supports humans and various ecosystems.	
Assessments	See supporting documentation		
Standards	<p><u>K-PS2-1</u> Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.</p> <p><u>K-PS2-2</u> Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.</p> <p><u>K-2-ETS1-1</u> Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</p> <p><u>K-2-ETS1-2</u> Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</p> <p><u>K-2-ETS1-3</u> Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.</p>	<p><u>K-LS1-1</u> Use observations to describe patterns of what plants and animals (including humans) need to survive.</p> <p><u>K-ESS3-1</u> Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.</p> <p><u>K-ESS2-1</u> Use and share observations of local weather conditions to describe patterns.</p> <p><u>K-ESS3-2</u> Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.</p> <p><u>K-PS3-1</u> Make observations to determine the effect of sunlight on the Earth’s surface.</p> <p><u>K-PS3-2</u> Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.</p> <p><u>K-ESS2-2</u> Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.</p> <p><u>K-ESS3-3</u> Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.</p>	

While the *Soil Savers* unit is appropriate for early elementary students, its official placement within CreositySpace’s comprehensive K–5 NGSS/NYSSLS-aligned curriculum is in Kindergarten.

An Overview of the *Soil Savers* Unit is Provided Below

Overarching Enduring Understanding How does the soil support the plants and animals in our community?	
Number of Lessons* Full unit – 21-26 lessons Supplemental program – minimum 8-10 lessons <i>*Lesson = 30 – 40 min block; 50% of full unit lessons can be delivered in non-science classes</i>	
FLOW OF INSTRUCTION	
<p><u>K-LS1-1</u> Use observations to describe patterns of what plants and animals (including humans) need to survive. <u>K-ESS3-1</u> Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. <u>K-PS3-1</u> Make observations to determine the effect of sunlight on the Earth's surface. <u>K-ESS2-1</u> Use and share observations of local weather conditions to describe patterns. <u>K-ESS3-2</u> Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. <u>K-ESS3-3</u> Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment <u>K-ESS2-2</u> Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. <u>K-PS3-2</u> Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.</p> <p><u>1-LS3-1</u> Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. <u>1-ESS1-2</u> Make observations at different times of year to relate the amount of daylight to the time of year.</p> <p><u>2-PS1-1</u> Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. <u>2-PS1-2</u> Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. <u>2-LS2-1</u> Plan and conduct an investigation to determine if plants need sunlight and water to grow. <u>2-LS4-1</u> Make observations of plants and animals to compare the diversity of life in different habitats.</p>	
<p>Introductory Investigation: What Grows Here? Parts 1 & 2 (hands-on investigation, occurs during weeks 1 and 2) In this introductory investigation students evaluate different types of soil and dirt (e.g., soil, sand, gravel, etc.). They compare what the soil is like (wet vs. dry, big pieces vs. small, etc.) looking at similarities and differences. After this initial discussion students look at pictures (or go outside and look at real-world examples) and identify the types of things that can grow in different types of dirt. (K-LS1-1, K-ESS3-1, 2-PS1-1)</p> <p>Investigation: Weather Watchers (hands-on investigation, occurs during weeks 2 – 7) Throughout the course of this unit, students will track their local weather both individually and as a group. (K-ESS2-1, K-PS3-1, 1-ESS1-2)</p> <p>Investigation: What Do We Need? (hands-on investigation, occurs during weeks 2-7) In this investigation, students will grow plants in different types of soil/dirt and compare the effects of different growing conditions on plant development (sun vs. no sun, water vs. no water, soil vs sand). (K-LS1-1, 2-LS2-1, 2-PS1-2) Throughout this experiment, students will learn about the bigger roles of sun, water, and food and make ongoing observations about the appearance of their growing plants. (1-LS3-1)</p> <p><u>Sun</u> Students will make observations about the sun and the ways that it influences their daily life. (K-LS1-1, K-ESS3-1, K-PS3-1) <u>Water</u> Students will make observations about the water and the ways that it influences their daily life. (K-LS1-1, K-ESS3-1) <u>Food</u> Students will make observations about the water and discuss how different creatures get food. (K-LS1-1, K-ESS3-1)</p> <p>Read-A-Long: Meet Some Soil Savers (read-a-long, occurs during weeks 4 and 5) Students will learn about the entrepreneurs featured in the unit and discuss the innovations they are working on to reduce human impact on the environment. Students are encouraged to come up with their own innovations. (K-ESS3-3)</p> <p>Summative Reflection: Making Connections (week 7) At the conclusion of <i>Weather Watchers</i> and <i>What Do We Need?</i> Investigations, students will connect the changes in weather to what the plants needed to grow, why it is important to understand how that may change, and things humans do to protect themselves against those changes. (K-ESS3-2; K-ESS2-2, K-PS3-2) Students will also reflect upon and make connections to identify similarities in what plants, animals, and humans need to grow & survive. (K-LS1-1, 2-LS2-1, 2-LS4-1)</p> <p>Summative Challenge: What We Need! (summative challenge, occurs during weeks 8+) In this summative challenge students create a picture/collage/song that represents/models the relationships in their ecosystem including sun, water, plants, animals, and humans. (K-ESS3-1, K-LS1-1, K-ESS3-3, 2-PS1-2)</p>	

Welcome to CreositySpace

We're glad you're here.

We know our curriculum may look a little different from what you're used to, but it has been developed with the philosophy that students learn better when what they are learning is put into a context that is relevant to them.

With a focus on **student-led, inquiry-based** discovery, each unit features a variety of real-life STEM entrepreneurs, their personal stories, and details about the businesses they are building and technologies they are developing. With that as our anchor, CreositySpace connects the applications back to the relevant elementary-level science topics and creates lessons that can be delivered in science, ELA, math, social studies, and art classes.

How do we do this?

CONNECT students and their interests, entrepreneurs and their technologies, and the relevant standards through an **overarching phenomenon**.

ENGAGE students through a variety of **introductory activities** designed to spark student interest in the *Soil Savers* unit and enable teachers to assess students' **thinking, interests, and misconceptions**.

TRANSFORM students' self-confidence and proficiency with science as they build **foundational knowledge** through the early lessons and investigations and then **apply** and **demonstrate** their deeper understanding of key concepts through design projects, models, and summative challenges.




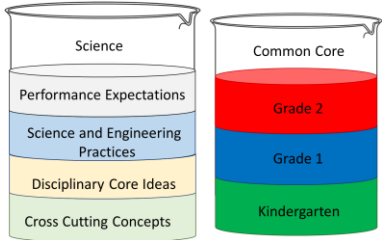
Since one can never predict the exact path a student's mind will explore, the CreositySpace team is always available to provide additional support and content should your students' questions take you down an unfamiliar road.

Integrating STEM and CreositySpace into Your Classroom

The CreositySpace *Educator Guide* is **your resource** to engage your classroom in student-directed inquiry-based discovery. **You decide what exact sequencing works best for your classroom.** We provide the tools and content designed to leverage your students' natural creativity and curiosity, with extra [Background Information](#) and [Additional Resources](#) so that you are supported wherever their inquiries takes you.

To help with **lesson planning options**, the [Lesson Planning Tools](#) and [Pacing Guide Resources](#) sections are there to help with preparation activities, lesson flow and activities, and exit tickets for quick formative assessments. The **design projects and summative challenges** provide an opportunity for your students to demonstrate their knowledge in a variety of ways.

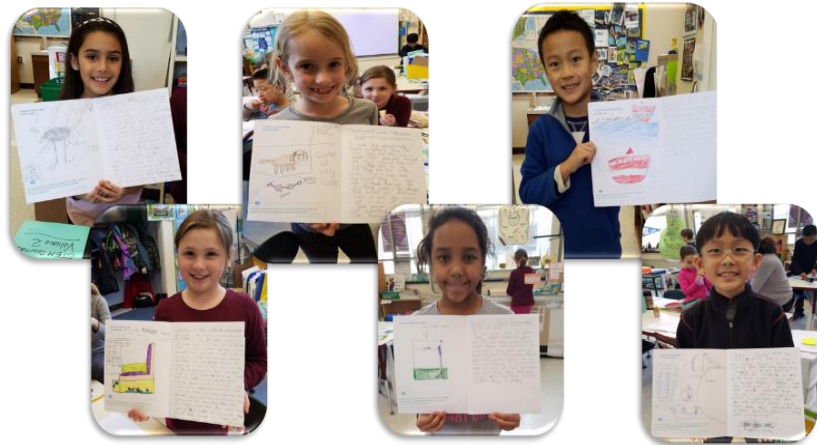
Informational Icons

<p style="text-align: center;">Student Questions</p>  <p>The inquisitive monkey represents the portion of the lesson where students should be given the opportunity to voice or revisit their questions.</p>	<p style="text-align: center;">Student Sense Making</p>  <p>The jubilant tiger represents the portion of the lesson where students should take time to reflect upon and make sense of what they have observed and learned.</p>
<p style="text-align: center;">Time Management</p>  <p style="text-align: center;"> Plug-In (< 30 min) Investigation (multiple periods) Challenge (> 1 week) </p> <p>To support lesson planning, stopwatch icons indicate how much time an activity or investigation is expected to take.</p>	<p style="text-align: center;">Standards</p>  <p>Multicolored beakers highlight the Common Core (CC) and Science standards supported by a given plug-in, investigation, or challenge.</p>

Using Innovation Prompts and the *Book of Ideas* to Create an Environment of Creativity, Communication, and Collaboration in Your Classroom

Getting kids to connect to and see value in their ideas is a key ingredient in teaching STEM and to fostering student confidence. This is why CreositySpace promotes the universal use of innovation prompts and created the *Book of Ideas*.

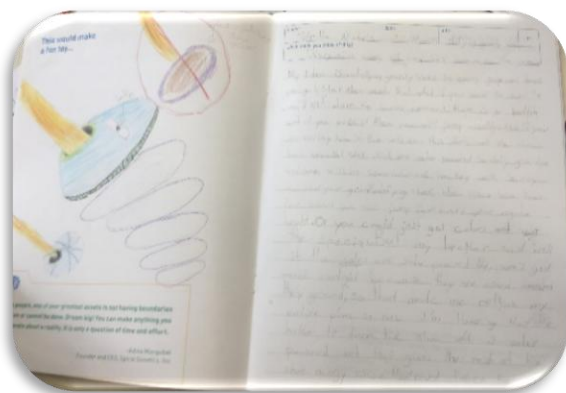
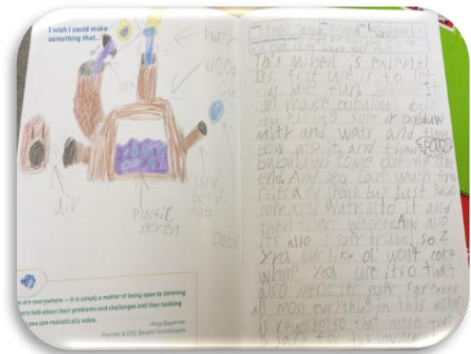
Similar to a real inventor's notebook, the *Book of Ideas* was designed to encourage kids to write down or draw, explore, and discuss their own ideas and inventions. Pages include a title block, quotes from entrepreneurs and innovators, short design prompts and a list of inventions and businesses started by kids.



The *Book of Ideas* is NOT about the right answer, perfect spelling, or fitting into a pre-determined box.

The *Book of Ideas* IS about

- Giving students the opportunity to explore and express their ideas in a way that works for them,
- Providing a forum in which students may work independently, as well as collaboratively, and practice giving and receiving respectful feedback, and
- Offering an exciting way for students to show you the ideas, big wonderings, and solutions on their minds and giving you additional insight on how to engage every learner.



There is no wrong way to use the *Book of Ideas* in your classroom. Above all, it should be considered a conversation-starter and a great way to encourage creativity, communication, collaboration, and curiosity in your classroom.

To learn more about using innovation prompts in your classroom, check out our short online webinar:

<https://youtu.be/C8-t-4KZrUg?si=dhrEMW-Kc-Ghi9ML>

Assessment and Differentiation

Assessments

This Educator Guide provides a number of pre, formative, and summative assessments (a complete list is provided in the Unit Document sub-section of the [Appendix](#)) as well as ongoing opportunities for student self and peer assessment. The [Appendix](#) also contains an outline for the range of acceptable work for many of the formative assessments (e.g., exit tickets, short research activities, etc.) and expected prior knowledge for the specific investigations (see the *My STEM Explorer Notes*[™] sub-sections). A checklist or detailed rubric are provided for the models and summative assessments respectively.

It is not required that students complete **ALL** provided assessments, as there is redundancy built in to give you the flexibility to match assessments to your students' interests and learning styles. However, if your students are struggling with a particular learning objective or concept, unused assessments provide an opportunity for additional practice and/or alternative perspectives.

Differentiation

Group work and peer discussion is encouraged as a strategy to support students with language and learning challenges. **However, all students are expected to maintain their own records in their *My STEM Explorer Notes*[™] notebooks so that educators can assess the learning of individual students.** Drawing and the use of one's native language are acceptable methods to maintain records and demonstrate scientific knowledge. The use of technology to assist challenged learners (e.g., video recording, voice-to-text, Google Translate, etc.) is encouraged if available.

The Detailed Description portion in the [Main Investigation](#) section describes extensions for more advanced students or when using the unit with older students. **These extensions are in bold blue text.**

Ongoing Support

Successful implementation of each CreositySpace unit is important to us, and to that end, our company is committed to providing ongoing support to you—from brainstorming ideas and helping with an activity to answering questions around implementation. Don't hesitate to reach out to us via email or phone.

We hope *Soil Savers* inspires and energizes your classroom to explore the intersection of science with the world around you, and we welcome your feedback on what you like, would like to see, or even change. Feel free to reach out to us Kath@CreositySpace.com.

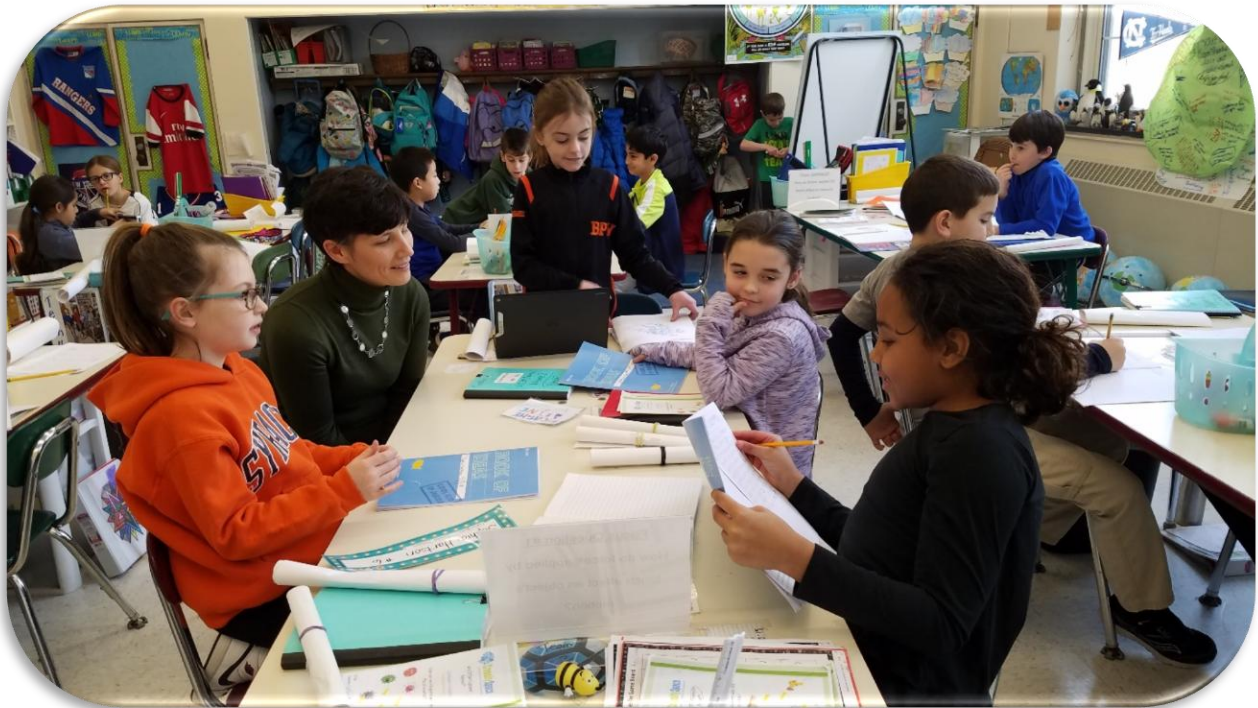


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Introduction

Soil Savers: Unit Connections

Outlined below is the progression of learning objectives for the *Soil Savers* unit. The themes of weather and what plants and animals need to survive is explored through the lens of the soil—what it provides for us and what we can do to support it.

Example pacing guides are provided in the [Pacing Guide Resources](#) section. Blank lesson planning sheets are provided in the [Appendix](#) so you can plan out the specific lesson sequencing that works best for your classroom.

Learning Progression

CONNECT students and their interests, the entrepreneurs and their technologies, and the relevant standards through the **overarching phenomenon**: *How does the soil support the plants and animals in our community?*

ENGAGE students with the **What Grows Here?** introductory activity and discussions.

TRANSFORM students' self-confidence and proficiency with science as they build **foundational knowledge** about soil and weather through the hands-on investigation **What Do We Need?** and the first half of **Weather Watchers**.

Students **APPLY** and **DEMONSTRATE** their deeper understanding of the weather and the interdependence of living and non-living organisms through **Meet Some Soil Savers, Making Connections** and the **What We Need!** summative challenge.

Storyline

Soil—it's more than just dirt or mud. It plays a vital role in nearly every ecosystem. In *Soil Savers*, students explore the themes of weather and the basic needs of plants and animals through a lens that is both familiar and engaging: soil.

The unit begins with an introductory comparison challenge, **What Grows Here?**, during which students observe different types of ground materials—such as sand, soil, gravel, and rocks. They discuss similarities and differences among these materials, building a foundation for understanding how environments vary. Following this discussion, students examine photographs or explore outdoor spaces to identify what types of plants can grow in each kind of ground.

After the introduction, students engage in two parallel investigations: **Weather Watchers** and **What Do We Need?** In **Weather Watchers**, students track local weather patterns both individually and as a group. In **What Do We Need?**, they grow plants in different materials (soil or sand) and under varying conditions (sunlight vs. no sunlight, water vs. no water). Through this hands-on experimentation, students observe how different factors affect plant growth and begin to understand the essential roles of sunlight, water, and nutrients. As the investigation progresses, students connect their observations about plant needs to the needs of people and other animals. By the end of this phase, they also explore how weather changes influence plant survival and discuss why understanding these changes is important, including how humans adapt to and protect themselves from environmental shifts.

Toward the end of the unit, students are introduced to real-world examples in **Meet Some Soil Savers**. They then synthesize their learning through summative activities such as **Making Connections** and **What We Need!**. In these tasks, students create a picture, collage, or song that models the relationships within an ecosystem, including the roles of sun, water, plants, animals, and humans.

Although this unit was originally designed for kindergarten students, it can be easily adapted for higher grade levels through more in-depth discussions and detailed experimental observations. The information provided in this guide is intended to support educators in facilitating these deeper levels of inquiry.

General Expected Prior Knowledge

Students in early elementary grades often bring a wide range of prior knowledge and experience. As a result, Soil Savers is intentionally designed with minimal assumptions about students' prior science and engineering understanding.

That said, when implemented in a Kindergarten classroom, the unit is best taught in the second half of the year, when students are more developmentally ready and have greater familiarity with classroom routines. Specifically, it is expected that:

- Students are more comfortable in the classroom environment, understand behavior expectations, can focus for “extended” periods (15–20 minutes), and are able to follow clear instructions.
- Students have a basic familiarity with the states of matter (solid, liquid, gas).
- Students can make direct observations.


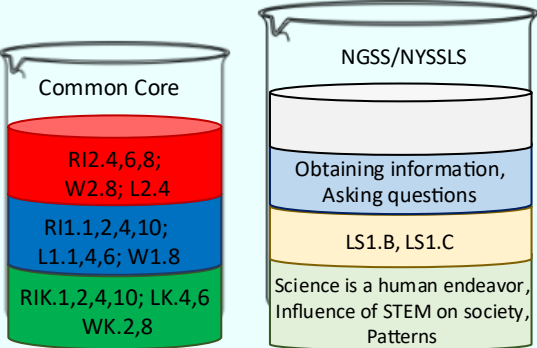
Specific details around prior knowledge expectations, and suggestions on methods to address knowledge gaps, are provided in the detailed investigation description (in the [Lesson Planning Tools](#) section) and in applicable locations throughout the [Appendix](#).

Weekly Goals

The table below summarizes the weekly learning objectives of the *Soil Savers* unit.

Week	Goals
1	<ul style="list-style-type: none">• Determine student interests and prior knowledge about weather and what plants and animals need to survive.• Generate excitement for the <i>Soil Savers</i> unit.• Get students thinking about soil and why it is important. Complete introductory activity What Grows Here?
2 & 3	<ul style="list-style-type: none">• Introduce and start collecting data for the Weather Watchers investigation.• Complete What Grows Here? reflections• Introduce and complete the planning for the What Do We Need? investigation, looking into what plants need to grow.
4 & 5	<ul style="list-style-type: none">• Continue to collect data for the What Do We Need? investigation• Continue collecting data for the Weather Watchers investigation• Introduce and discuss soil entrepreneurs and their innovations designed to reduce our impact on the environment in Meet the Soil Savers
6 & 7	<ul style="list-style-type: none">• Complete the reflections and design project associated with Weather Watchers.• Complete the What Do We Need? investigation.• Complete the Making Connections reflections to help students identify similarities in what plants, animals, and humans need to grow and survive.
8+	<ul style="list-style-type: none">• Complete the What We Need! summative challenge.

Technology Description: Soil

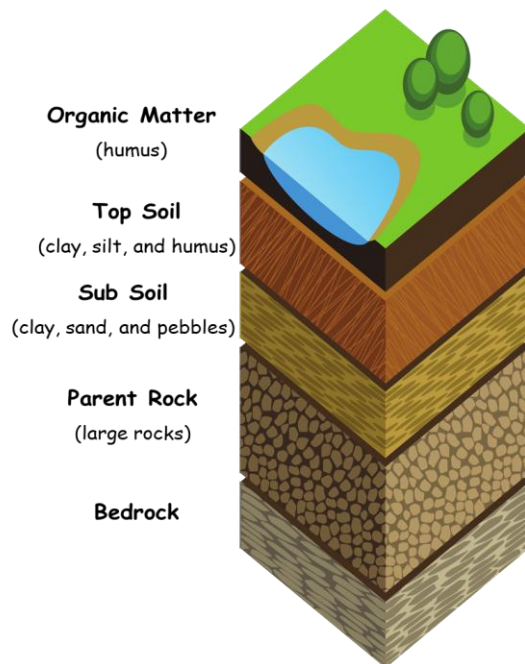
Time	Standards	Description
		<p>The following section is a brief introduction to importance and composition of soil. A simplified version of this text is provided for students as part of the My STEM Explorer Notes™ build-a-notebook. The digital resources contain versions of introductory content at different reading levels, should a different reading level be more appropriate for your group. The Appendix contains additional information for read-along activities.</p>



When we think about soil, often the first thing that comes to our mind is the mess it makes when we, or our pets, track mud into the house.

Soil is so much more than just a mess.

The soil is a mixture of many things. The soil includes organic matter, minerals, gases, liquids and living creatures. The soil keeps all these parts together by balancing the *interactions* with the world around it. For example, when plants are growing, they take nutrients (food) and water from the soil. When plants die, they return the nutrients (organic matter and minerals) and water to the soil through decomposition.




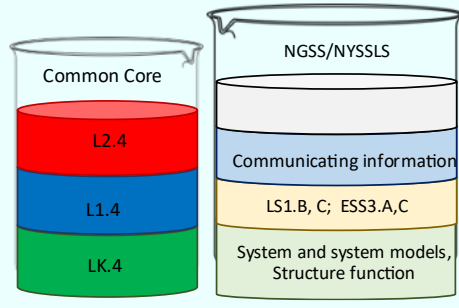
Soil is important to our lives. The soil performs four jobs that are very important to life on Earth.

1. Soil provides a home and food for plants to grow.
2. Soil provides a home, or habitat, for many different living creatures (animals, insects, good bacteria).
3. Soil cleans and stores a lot of Earth's drinkable water.
4. Soil interacts with the atmosphere and helps to balance the amounts of different gases.




Humans interrupt these activities when we remove plants and animals from the soil. One way we interrupt this balance is when we use the space to grow food to feed people and animals. Can you think of how this interrupts the balance? Another way we interrupt the balance with the soil is when we build homes to live in and buildings to work in. Can you think of how this interrupts the balance?

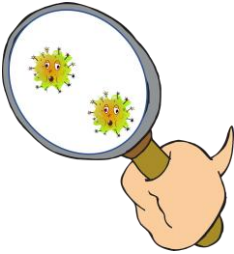

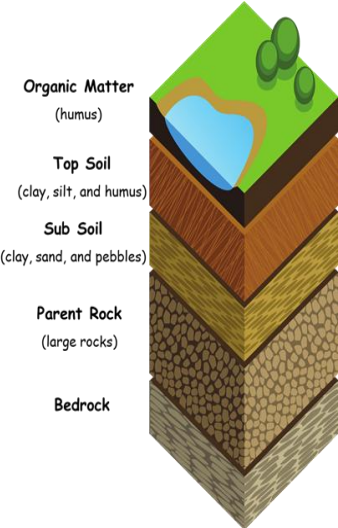
Since we all need food to survive and places to live and work, it is important that we learn new ways to give the soil what it needs to be happy and healthy. Farmers, scientists, engineers and entrepreneurs are all working to develop solutions and technologies that keep the soil strong and nutritious. Throughout this unit you will learn about some of the things people are doing. Some of these activities include new methods of composting, new ideas around crop rotation and design, and the creation of new food for animals that don't require as much land. What ideas can you think of?

Technical Vocabulary: Soil Composition

<p><i>Time</i></p> 	<p><i>Standards</i></p> 	<p><i>Description</i></p> <p>The table below contains key vocabulary words for this unit specifically related to the entrepreneur and application. My STEM Explorer Notes™ build-a-notebook contains the vocabulary words with a place for students to write or draw a definition that works for them. It may be helpful to introduce one or two vocabulary words each day. Guided Language Acquisition Design (GLAD) strategies are also suggested; however, feel free to develop your own or challenge your students to create something that works for them. Note: GLAD is a visual-, auditory-, or movement-based way to help learners remember and understand academic vocabulary. Additional unit vocabulary is provided in the Additional Background Information section.</p>
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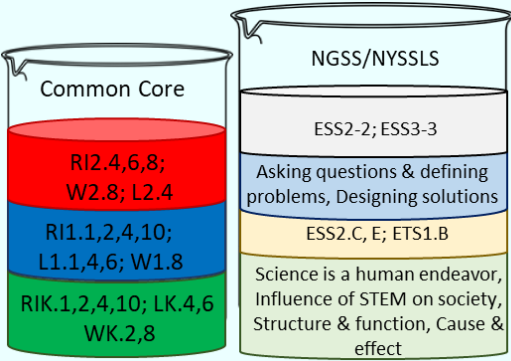
Associated My STEM Explorer Notes™ build-a-notebook pages – 3 & 4

Term	Definition	GLAD Strategy and Gesture	Simplified Picture or Definition
Nutrient	A nutrient is food that gives us energy.	<p><u>GLAD Strategy:</u> Say—A nutrient is food to eat.</p> <p><u>Gesture:</u> Have students pretend to eat food from a plate or bowl.</p>	
Soil	Soil is a special kind of dirt that contains water, air, and nutrients.	<p><u>GLAD Strategy:</u> Say—Soil is special dirt.</p> <p><u>Gesture:</u> Have students pretend to dig in the ground and plant something.</p>	
Organic	Something that is, or was, alive is called organic.	<p><u>GLAD Strategy:</u> Say—Living things are organic.</p> <p><u>Gesture:</u> Have students point to various living things, or once living, in the classroom.</p>	

<p>Microbe</p>	<p>A microbe is a very very small living creature.</p>	<p><u>GLAD Strategy:</u> Say—A microorganism is a super small creature</p> <p><u>Gesture:</u> Have students squint their eyes or look through a pretend magnifying glass.</p>	
<p>Decompose*</p>	<p>Decompose is when things that were living turn into nutrients.</p>	<p><u>GLAD Strategy:</u> Say— Decomposition is when dead things break apart.</p> <p><u>Gesture:</u> Have students pretend to play dead.</p>	
<p>Humus*</p>	<p>Humus is the organic part of soil.</p>	<p><u>GLAD Strategy:</u> Say—Humus is the part of soil with the most food.</p> <p><u>Gesture:</u> Have students</p>	
<p>Topsoil*</p>	<p>Topsoil is the top layer of soil. It has the most humus.</p>	<p><u>GLAD Strategy:</u> Say—Topsoil has food for plants.</p> <p><u>Gesture:</u> Have students pretend to pick up a handful of soil and have it easily run through their fingers.</p>	
<p>Subsoil*</p>	<p>Subsoil is below topsoil. It has more clay, sand and rocks than topsoil.</p>	<p><u>GLAD Strategy:</u> Say—Subsoil has lots of rocks and sand.</p> <p><u>Gesture:</u> Have students pretend to pick out rocks from the soil.</p>	

**Enrichment or above grade-level vocabulary words.*

Your Technology: Soil Quality

Time	Standards	Description
		<p>This section introduces the entrepreneurs, technologies, and businesses that form the anchor applications and phenomena for this unit. These minibiographies of real people developing real technologies make the elementary concepts covered in this unit current, real, and relevant for the students. They help answer the “Why are we learning this?” question before it is even asked. Text to support read along activities and additional reading comprehension questions are provided in the My STEM Explorer Notes™ build-a-notebook and in the Appendix. Digital resources contain more advanced version of the entrepreneur stories should a different reading level be more appropriate for your group.</p>

Enduring Understandings

Students will explore what plants and animals need to survive. Extra emphasis will be placed on how the soil interacts with living organisms.

Students will explore weather patterns and extreme weather events particular to their area.

Meet Your Entrepreneur: Serg Albino, Ian Doromal and ecoSPEARS

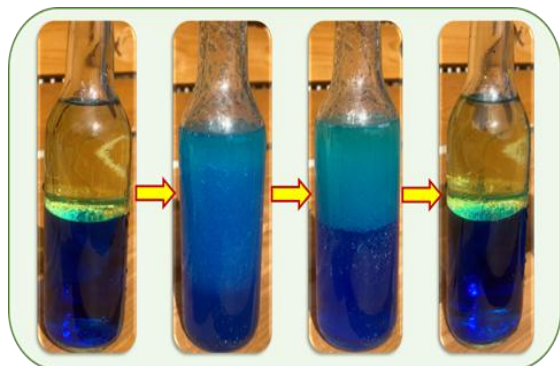
ABOUT SERG AND IAN

Serg Albino was born in the Philippines but grew up in New York City. “I grew up just down the road from the Hudson River. When I learned about the [pollution] in the river, I knew something had to be done,” said Serg. While he was an engineer at NASA Serg met Ian Doromal and realized Ian was also interested in cleaning up pollution from the water supply. Both Serg and Ian describe themselves as serial entrepreneurs and are committed to developing new technologies that will help the environment.



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Photo curtesy of ecoSPEARS

FOUNDATIONAL SCIENCE



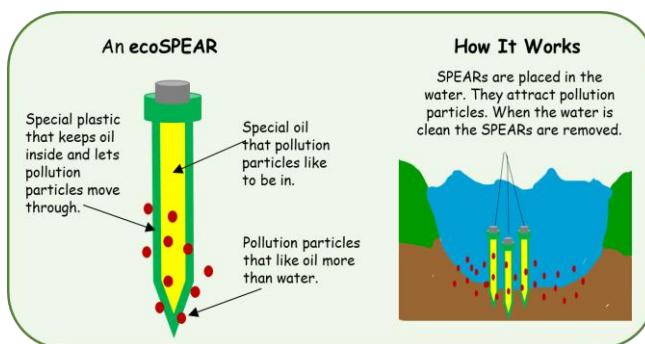
Have you ever tried to mix oil and water? They make a lot of bubbles, but the two liquids never mix. Oil and water do not mix because they are made of two different types of particles. These particles do not like being together. Sometimes, we like to add other particles to liquids, like sugar in our tea.

Some particles really want to be in water; we call these hydrophilic particles. Other particles really want to be in oil; we call these particles hydrophobic.

GAME-CHANGING IDEA

Many harmful chemicals that are in our water supply—such as streams, rivers, and lakes—are hydrophobic. That means those harmful chemical particles would much rather be in oil, not in water. When those chemical particles get into our environment, they are hard to remove.

Imagine trying to put the water from an entire lake through a giant filter! This is where the ecoSPEARS technology can help. Originally designed by a team of engineers at NASA, led by Dr. Jacqueline Quinn, each SPEAR contains a special oil-like liquid that the pollution particles like more than water. The shell of the SPEAR is made from a special plastic that lets pollution particles come in but will not let the oil leak out. Since the pollution particles would rather be in the oil than in the water, they can be pulled out of the stream, river, or lake. After the harmful chemicals have moved into the SPEAR, the SPEAR can be removed, making the environment healthy again!



21st Century Context: Beta Hatch, Pela

Virginia Emery and Beta Hatch

ABOUT VIRGINIA

Virginia was always interested in biology, but it was during college that her love of bugs and insects really took off. She was amused by how human their communities seemed. For example, they communicate with each other, have social groups, and even farm! Virginia also wanted change the belief that insects are bad because she knows they are a critical part of every ecosystem.



FOUNDATIONAL SCIENCE

Insects are important parts of the food webs and life cycles of many living organisms. They are high in fat and protein, making them a delicious meal; and many are important pollinators and/or decomposers. But, like any other living organism, they are sensitive to their environment and their availability will change with a changing climate.

GAME-CHANGING IDEA

Virginia's mission is to cultivate (grow) insects that can be used for animal food reliably. It took her and her team many experiments—over many years—to figure out which insects would be successful in their bug-factory. Today her company, Beta Hatch, provides two products: mealworms (pet food) and mealworm frass (insect poop for fertilizer). In the future they hope to make insects that will be approved for humans to eat!



Jeremy Lang and Pela

ABOUT JEREMY

Growing up on a farm in Saskatchewan, Canada, Jeremy saw flax stocks being burnt and thought What a waste. Later, while on vacation at the beach, he saw all plastic littering the shoreline and thought There needs to be a better way. At that point Jeremy decided he wanted to spend his time solving reducing and reversing some of the harmful impacts humans have on the environment.



FOUNDATIONAL SCIENCE

One thing people do is create a lot of waste (garbage) out of food scraps and food that has gone bad. Most of the time this waste ends up in a landfill where it takes up a lot of space, generates methane gas, and prevents necessary nutrients from getting back into the soil. One thing we can do to disrupt this cycle is composting.


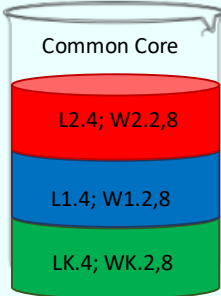
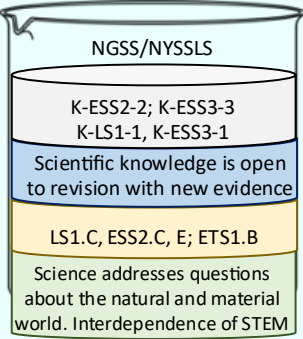
Composting mixes food scraps with dirt, water, and oxygen to make high quality soil. One of the challenges with composting is that it often takes a long time and requires a fair amount of space.

GAME-CHANGING IDEA

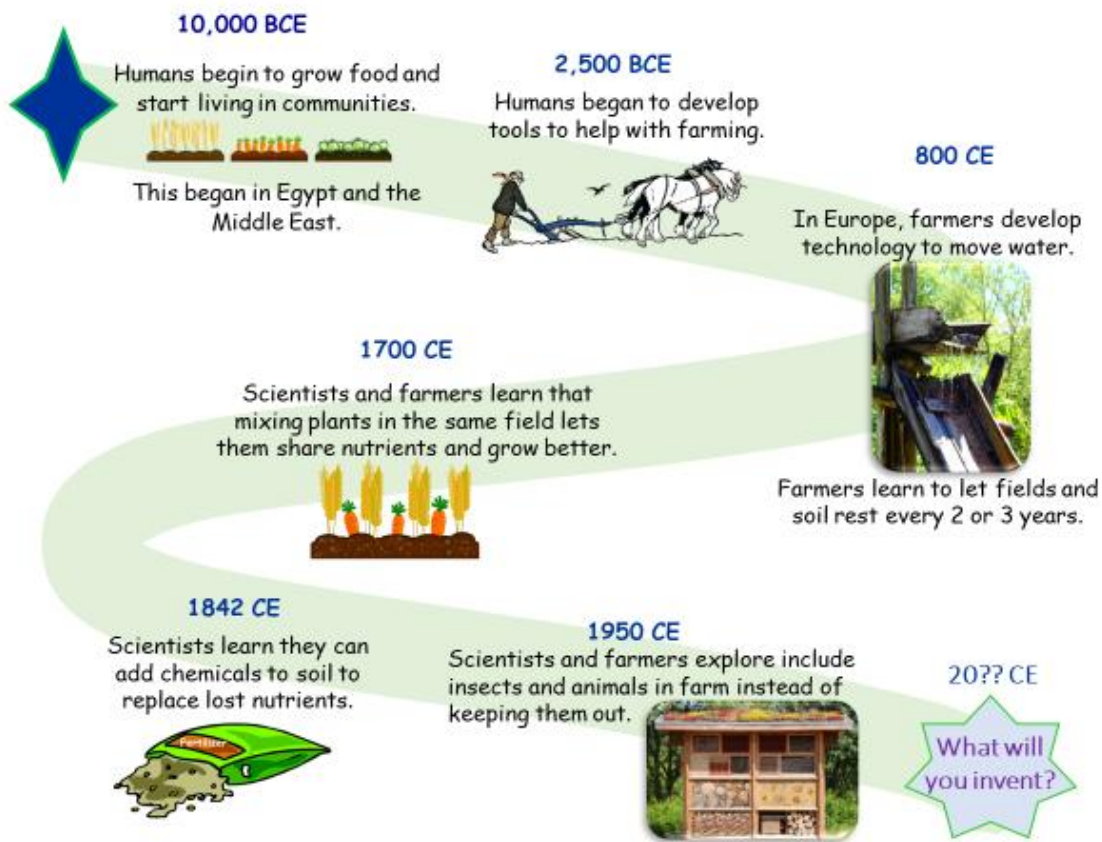
Jeremy started the company Pela, with the lofty goal to create a waste free future. One of the ways they are working towards this goal is with their new composting product, Lomi. A Lomi machine is about the size of a toaster and can turn a gallon of food scraps into nutrient rich soil overnight. The Lomi machine uses a mixture of chopping, heating, water and oxygen to speed up the composting process. This makes it easier for families to use and keeps waste out the landfill and puts it back in the soil.



Technology Historical Timeline: Agriculture

Time	Standards	Description
 		<p>The Technology Historical Timeline is a great tool to use to give your students historical context for what they are learning and to show them how any single scientific discovery or understanding is built from all the discoveries and understandings that came before. In many cases, scientific discoveries only thrived if there was a community need they helped to solve.</p> <p>The Appendix contains a variety of timelines and suggested activities you can use with your class. Many of these activities are a good opportunity for peer-to-peer and teacher-student feedback cycles.</p>

Pages supporting timeline activities are NOT part of the My STEM Explorer Notes™ build-a-notebook and are included as a separate packet.



Background Information

This section contains additional information intended for teachers on the topics of:

- The Engineering Design Process
- Soil
- Weather
- States of matter (gas, liquid, solid)
- Conservation

Links to additional videos, articles, webpages, etc., are provided in the [Additional Resources](#) section, where they are organized by topic area. The [Appendix](#) contains additional copies of worksheets and extra handouts that can be used to support the investigations.

The Engineering Design Process

Despite what the name might suggest, the **engineering design process** is really no different than any creative or iterative process. You would follow the same basic steps if you were writing a story or painting a picture.

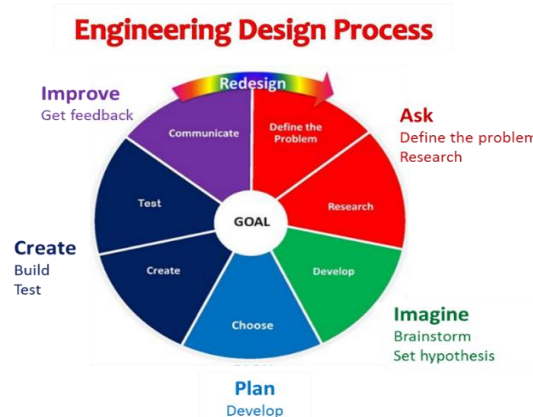
Step 1: Start with a question, problem, or goal.

Step 2: Think about all the possibilities.

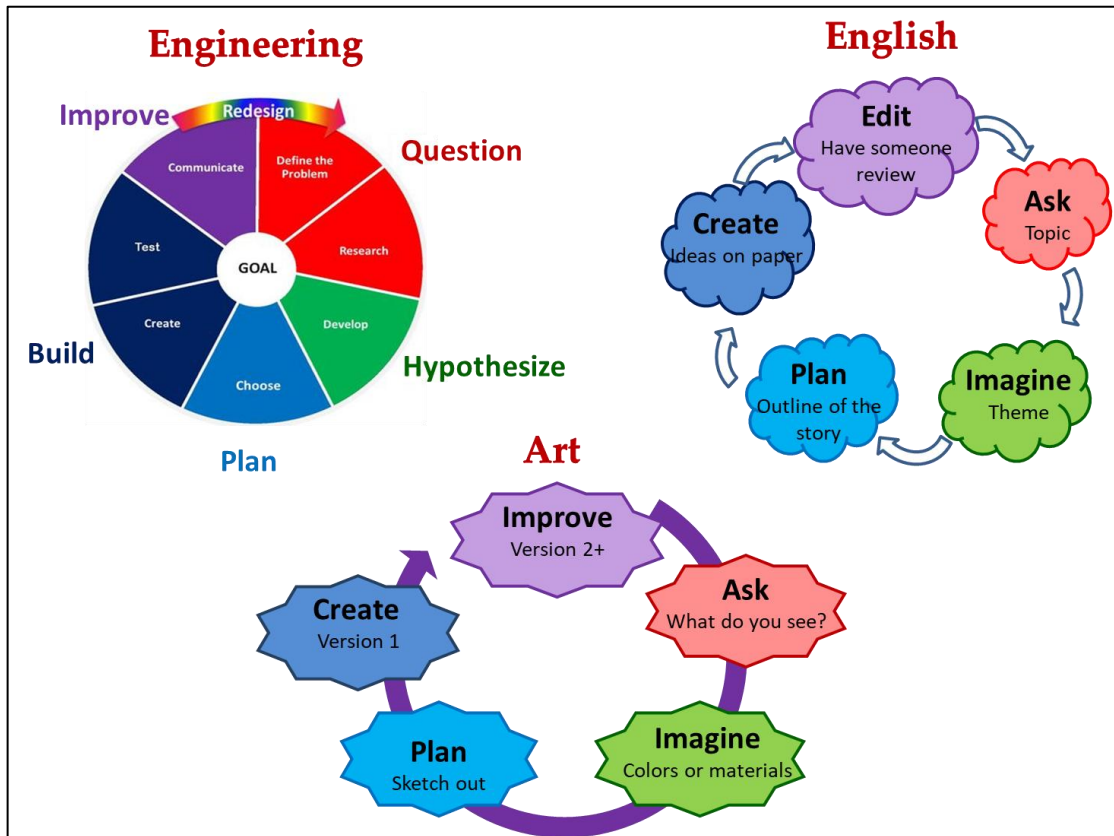
Step 3: Decide which ideas from step 2 you want to use.

Step 4: Create your first draft/prototype/version.

Step 5: Get feedback and improve your design.



Under some circumstances the words used to describe a step might be different, but the general goals of each step are the same.



Additional Vocabulary

Brainstorming

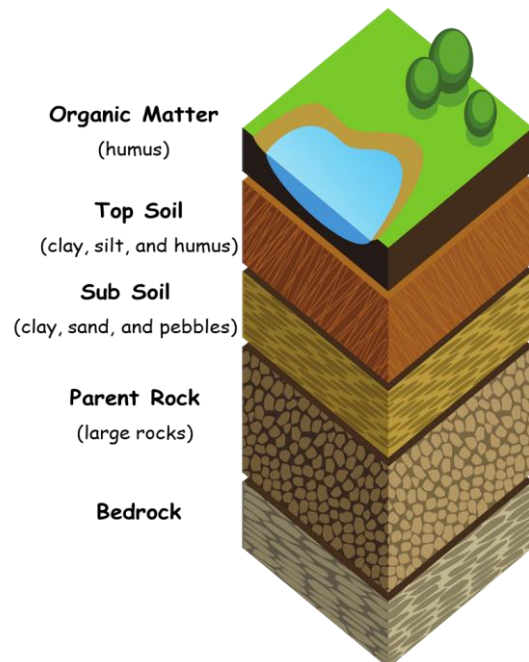
Brainstorming is when a group of people get together and share ideas to solve a problem or challenge (coming up with a lot of ideas).

Prototype

A prototype is an early version of an invention. It can't necessarily do everything the invention is supposed to do, but it allows the inventor to see what things will look like.

Soil

The soil is a mixture of many things. The soil includes organic matter, minerals, gases, liquids and living creatures. The soil keeps all these parts together by balancing the *interactions* with the world around it. For example, when plants are growing, they take nutrients (food) and water from the soil. When plants die, they return the nutrients (organic matter and minerals) and water to the soil through decomposition.



Soil is important to our lives. The soil performs four jobs that are very important to life on Earth.

1. Soil provides a home and food for plants to grow.
2. Soil provides a home, or habitat, for many different living creatures (animals, insects, good bacteria).
3. Soil cleans and stores a lot of Earth's drinkable water.
4. Soil interacts with the atmosphere and helps to balance the amounts of different gasses.

The solid part of soil is composed of two main materials: sediment and nutrients. Soil also contains non-solid materials such as water (liquid) and air (gas).

Most sediment comes from rock that has been broken down by wind, rain, and ice. There are four common sizes of sediment:

- Clay – the smallest size,
- Silt – about the size of ground flour,
- Sand – similar in size to grains of sugar, and
- Gravel – the largest size consisting of pebbles and rocks.

Sediment serves many rolls. The size of the sediment controls how fast the water moves through the soil—too much clay and the water pools on top, too much sand and the water runs right through. The sediment also gives plant roots something to hold on to and provides necessary minerals to the plants.

The other part of soil are the nutrients. These come from decaying organic matter like plants, leaves, and twigs. This decaying matter provides a lot of food and energy for growing plants—it is a main reason people compost for their gardens.

Many creatures live in the soil—like bugs and worms. These creatures help loosen and move the soil around so that air and nutrients can get to the plant roots. Loose soil also makes it easier for the roots to grow by providing them space to grow into.

Weather and Climate

Understanding the difference between weather and climate can be challenging for young learners. Some simple comparative definitions are provided below:

Weather describes what is what is happening outside right now or at a specific point in time (e.g., last night, this afternoon).

Climate describes general patterns in the weather that are typical for a region (e.g., it is colder in the January and December, there is a lot of rain in April but not in the summer).

Both weather and climate are the result of interactions between the sun, air, bodies of water (e.g., lakes and oceans), and land. Throughout the day the sun heats up the air, land, and water. How much things heat up depend on what they area is like (e.g., is it land with a lot of buildings or sand, or is it land with a lot of plants and water) and how close it is to the sun (e.g., it is near the equator or is it near the north or south pole). The difference in temperature of various places—and the air associated with those places—causes the air to move around creating wind. Moving air can take on many forms and the speed at which it moves and the humidity of the air (how much water it contains) results in a lot of the different weather we experiences.

Rain, Snow, or something else?

When the sun warms the water some of the water evaporates into the air. This is what creates humidity. The temperature of the air determines how much water it can hold. When the air has more water than it can hold it must release it back to the ground via precipitation. The temperature in the sky and ground determine the type of precipitation that will fall.

Rain: Rain happens when the temperature in the sky and on the ground is above freezing. Water stays as liquid for the whole time.

Snow: Snow happens when the temperature in the sky and on the ground is below freezing. Water stays solid for the whole time.

Freezing Rain: Freezing rain happens when the temperature in the sky is above freezing but the temperature on the ground is below freezing. Water starts as liquid but then turns solid when it hits the ground.

Hail: Hail happens when high up in the sky the temperature is above freezing but sometime before the water hits the ground the temperature is below freezing. The temperature on the ground can be above or below freezing. In this case the water droplets in the sky turn to solid very quickly and we get frozen water droplets inside of snow (which are solid water crystals).

Hurricanes: Hurricanes happen when a large amount of warm air travels from land to being over warm water. This causes a lot of water to go into the air to make clouds and thunderstorms. Once the storm starts, more wind and more rain are generated. Sometimes, if a storm has enough energy it turns into a hurricane.

States of Matter

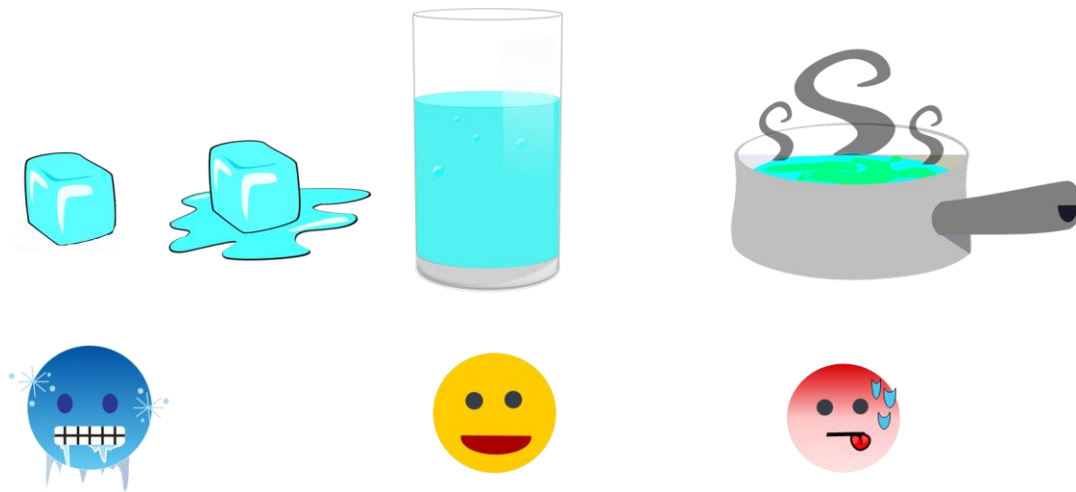
Matter is the general name given to all the “stuff” around us. This includes things created by nature (land, plants, animals, lakes, volcanos) and things created by humans (houses, cars, books, etc.). There are three main forms of matter: gas, solid, and liquid. *(Note: A fourth form of matter – plasma—exists at high temperatures and pressures but that is far outside of the scope of elementary science.)* Some age-appropriate definitions are provided below.

Solid – Something that keeps its shape.

Liquid – Something that takes the shape of what you put it in.

Gas – Something that just floats around.

Materials can change from solid to liquid to gas as the temperature gets hotter. They can change from gas to liquid to solid as the temperature gets cooler.



Conservation and Interactions

Almost everything around us is made from materials that humans have altered or modified from their natural state. In some cases, these changes are relatively small—for example, cutting down a tree to use its wood for building a cabin, or harnessing moving water with a waterwheel to generate electricity. In other cases, the changes are much more extensive, such as separating minerals from rocks to produce computer chips or extracting specific components from oil to create medicines.

All of these processes require energy, generate waste, and may involve materials that can be harmful to humans and the environment. Considering how to use energy efficiently, minimize waste, and understand the impacts on all plants and animals on Earth is central to many efforts in the field of conservation.

Environmental Protection


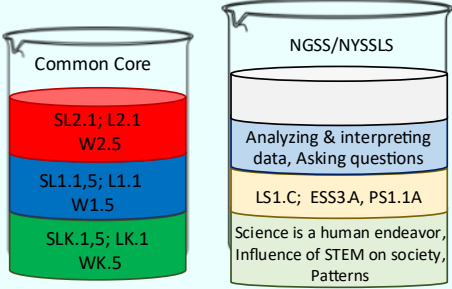
Protecting the environment is everyone's responsibility. Everything you use, want, or need comes from plants, animals, soil and water. That also means we take what we need to from another habitat where plants and animals live. Think about what you use each day and how much you use it or need it. Make sure everyone—people, animals and plants—has what they need to make their home, get the food they need, and to safely raise their offspring.

Less Waste

When thinking about the environment, it is always good practice to think about making less waste. Waste comes in many forms, including making unwanted side products (unwanted extra products), getting less out for what you put in (lower yields), and using extra energy. All of that waste means more inputs—ingredients, energy, etc.—are used to make each product or output.

Lesson Planning Tools

Topic Introduction Tools

Time	Standards	Description
		<p>The following few pages outline some topic introduction tools you can use with your students to get them excited to be thinking about motion, forces, and the air around them.</p> <p><i>Pick the tools that work for you!</i></p> <p>You do not need to use all of these introductory tools, but instead pick the ones that enable you to get a feel for what your students know and what they are interested in. These introductory tools and activities are also a good way to check in with your students throughout the unit to see how they are doing, what concepts they may be struggling with, and/or how their interests are developing.</p>

Associated My STEM Explorer Notes™
build-a-notebook pages – 1 – 2

Phenomenon

How does the soil support the plants and animals in our community?



Topic Bundle/Big Idea

In this unit, students explore environmental factors that affect living organisms, including weather and soil. Throughout the unit, they learn what plants and animals need to survive and how those needs are met by their surrounding environment.

Essential Questions/Sub-Phenomena

Topical essential questions are used to help provide the “why” around each concept or standard students are learning. Also included are *bigger wonderings* to inspire deeper reflection and discussion.

Topical Essential Questions

- What common things do plants and animals need to survive?
- What are common patterns in the weather?
- How do we interact with the sun every day?
- Why is soil important?
- What can we do to support our environment?
- How do plants and animals change their environment to help them survive?

Big Wonderings

- How does the weather influence our lives?
- Given Earth’s limited resources, how can we use technology to help the Earth and all the creatures that live there?

OWL and Pictorial Input Charts

OWL (observe, wonder, learn) charts and pictorial input charts (PIC)—also known as anchor charts—are a great way to get students thinking about a topic area and give you a chance to see where they are with current understanding and possible misconceptions. Depending on your students you may choose to complete one or more of these activities with you leading the discussion or have the students work together in small groups.

A few possible starting prompts for OWL charts are:

- What can you describe about the weather?
- What do you think plants need to grow?
- Do you have any pets? What do you do to keep them safe?



An OWL chart template is provided in the [Appendix](#).

A couple possible themes for PIC or anchor charts are:

- What do you know about soil? Can you draw a labeled diagram?
- Can you describe some patterns you see in the sky?
- How does what you wear change during the year?
- What happens to water when it gets cold? How about when it gets hot?

Note: A PIC is a great way to create a model of a concept that students can use as a reference throughout the unit.

Reference PIC for the above questions are provided in the [Appendix](#).

What Do You See? What Do You Know? What Do You Want to Know?



What do you see? What do you know? What do you want to know? is another great way to get the students thinking and excited about a new topic. With this activity each day starts with a picture or object that you share with the class

(examples provided in the [Appendix](#)). As a class you should discuss what the students see, what they know about what they are looking at, and what questions it sparks in their minds. While there is no “right” answer to these questions, you should guide the students to think about the needs of plants and animals and how the conditions observed in the picture may be helping or hurting them.



Introductory Videos

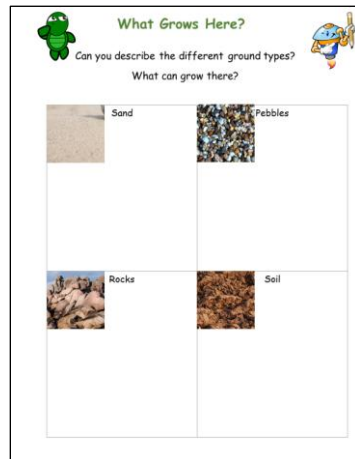
Both videos refer to the layers as Horizons but also use the common names described in the Educator Guide and student notebooks.

<https://www.youtube.com/watch?v=bgqea0E2eAY> (3:59 Dr. Binocs Show). We suggest stopping at the 2:59 minute mark. The last minute introduces some concepts that are not covered in this unit.

<https://www.youtube.com/watch?v=if29mjcd5bc> (3:43) What’s the Dirt on Dirt? This is a good intro video but is quite fast paced. As the presenter is introducing the four main components of soil we suggest pausing after each one for a short discussion with the class.

Introductory Investigation: What Grows Here? Part 1

The introductory investigation is designed to be an activity the students can work on with very little guidance or introduction from you, the teacher. The goal is that the students have a chance to think about things independently and in peer groups, without reliance on the adults in the room. **Your role as the teacher is to help the students stay motivated and on task, without providing them with the answer.** Often encouragement to explore their line of thinking is all that they need.



During the **What Grows Here?** introductory investigation (associated *My STEM Explorer Notes™* build-a-notebook page 2) students examine different types of ground materials (e.g., soil, sand, pebbles). They should compare physical characteristics such as wet vs. dry and large pieces vs. small pieces, identifying similarities and differences. Following this initial discussion, students analyze images—or observe real-world examples outdoors—to identify the kinds of plants that can grow in different types of ground materials.

This introductory investigation is expanded upon during the first two weeks as students begin to reflect upon how the different types of ground support the plants and animals that live there.

Main Investigations

The following investigations are suitable for students in grades K–2. The Detailed Description section describes extensions for more advanced students. [These extensions are in bright blue text.](#)

Safety Considerations


Warning: This kit contains materials that may be harmful if used incorrectly. Please read all instructions before beginning. Failure to follow these instructions and warnings could result in serious consequences.

- Kit components are scientific and engineering equipment—not toys. While we have worked to supply the most robust kit components possible, aggressive use can cause damage.
- Remind students to use materials only as instructed by the teacher.

Kit Contents

Printed materials	Trade Book
Educator Guide (1) <i>My STEM Explorer Notes™ build-a-notebook (30 sets)</i> 3-pronged folders (30) Timeline sheets (1 set)	<ul style="list-style-type: none"> • <i>All About Weather: A First Weather Book for Kids</i> • <i>Worm Weather</i> • <i>National Geographic Kids, Jump into Science: Dirt</i>
Provided equipment and materials	Digital Resources
6 sets of soil and dirt samples – (includes soil, sand, gravel and rocks). 18 small planting cups, seeds and craft sticks Soil, sand – 1 quart each Sunshade construction materials Poster-sized <i>Weather Watchers</i> data recoding sheet Outdoor thermometer	Electronic copies of printed materials ¹ How-To videos for investigations ¹ Easy-to-use links to publicly available videos and other information.
Common equipment and materials required but not provided	
Sharpie Water	

Investigation: Weather Watchers

Time 

Standards

Description

Common Core	NGSS/NYSSLS
SL2.1,6; L2.1 W2.2,5,8	K-ESS2-1; K-PS3-1; 1-ESS1-2
SL1.1,5,6; L1.1 W1.2,5,5	Planning and carrying out investigations; Analyzing data, Engaging in argument from evidence
SLK.1,5,6; LK.1 WK.2,5,8	ESS2.D; ESS1.A; PS3.B
	Patterns, Cause and effect, Systems and system models,

Associated My STEM Explorer Notes™
build-a-notebook pages – 5 – 12

In this activity, the class will track the daily weather characteristics to look for bigger picture patterns. While recognizing familiar seasonal patterns may seem simple, identifying patterns within datasets is a fundamental aspect of scientific and engineering research and development. Using a system like the seasons to help young students practice finding patterns builds both confidence and a powerful foundational skill

Note (Digital Version): See [Education Standards](#) section for detailed evidence statements for K-ESS2-1, K-PS-3-1, 1-ESS1-2.

This investigation should be started as soon as possible when starting the unit and is expected to be done concurrently with *What Grows Here?* and *What Do We Need?*

Objective

Students will track their local weather both individually and as a group to identify patterns in amount of sunlight and weather.

Materials


My STEM Explorer Notes™ build-a-notebook (pages 5 – 12), outdoor thermometer and poster-sized weather tracking chart.

General Description

Note: It's best to start this investigation as early on as possible in the unit so that students can be involved with as much data collection as possible.

Begin this investigation with a group discussion about the weather (an OWL chart works great here). Some questions to ask include:

- What different types of weather have you experienced?
- What questions do you have about the weather?



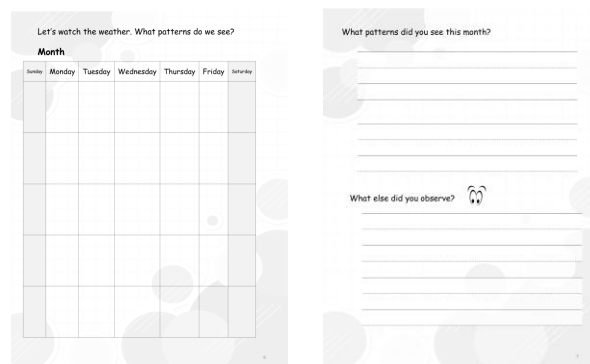
Investigation
Weather Watchers

What types of weather do you know about?

We are going to watch the weather.
We are going to look for patterns in the weather.

For the next 6 – 8 weeks use the provided sheets to keep track of the weather as often as possible by collecting the following data:

- Outdoor temperature (it's best to assess temperature at the same time each day)
- Time for sunrise and sunset
- General weather description (e.g., sunny, rainy, windy, etc.)
- A comment on how they feel or what clothes they should wear



Let's watch the weather. What patterns do we see?

Month

Month	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

What patterns did you see this month?

What else did you observe?

As students complete their individual charts (pages 6–11 in their Build-a-Notebook), the teacher should also update the poster-sized classroom chart. This should be done daily as a group, even on days when students are not collecting individual data.


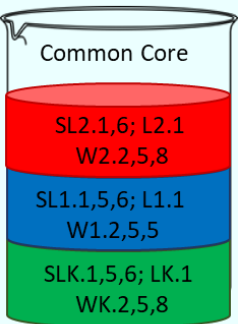
At the end of each month, students should review the data to identify patterns. Depending on the time of year, they will observe that the amount of daily sunlight either increases or decreases, along with changes in overall temperature.

Historical data and Reflection

Since you will only have time to collect 6 - 8 weeks of daily weather data, you will need to use historical data so that the students can reflect upon a full year of weather patterns. We suggest taking a full science period to choose some historical dates as a class and fill them out (you can find historical weather information for your area online using any number of online websites including <https://www.wunderground.com/history>). We only suggest doing a couple of dates with your students—so that they understand where the data is coming from—and then filling out the rest of the dates on your own.

As a reflection activity, ask students to identify big-picture patterns in the historical data. They should notice cyclical changes as weather shifts with the seasons. While recognizing familiar seasonal patterns may seem simple, identifying patterns within datasets is a fundamental aspect of scientific and engineering research and development. Using a system like the seasons to help young students practice finding patterns builds both confidence and a powerful foundational skill.

Investigation: What Grows Here? Part 2

Time	Standards	Description
	 <p>Common Core</p> <p>SL2.1,6; L2.1 W2.2,5,8</p> <p>SL1.1,5,6; L1.1 W1.2,5,5</p> <p>SLK.1,5,6; LK.1 WK.2,5,8</p>	<p>NGSS/NYSLS</p> <p>K-LS1-1; K-ESS3-1</p> <p>Analyzing & interpreting data, Asking questions; Developing and using models</p> <p>LS1.C; ESS3.A</p> <p>Systems and system models, Patterns</p> <p><i>In the continuation of the introductory investigation, What Grows Here? Part 1, students make connections between the properties of different ground materials (e.g., soil—small and wet; sand—small and dry; rocks—large and dry) and why certain plants or animals live or grow in those environments. In other words, students connect different ground types to how they meet—or don't meet—the needs of plants and animals for survival</i></p>

Associated *My STEM Explorer Notes™*
build-a-notebook pages 13 – 18.

Note (Digital Version): See [Education Standards](#) section for detailed evidence statements for K-LS1-1, K-ESS3-1.

If you haven't completed the *What Grows Here?* introductory activity, have your students do it now. This will likely take a full class period.

Objective

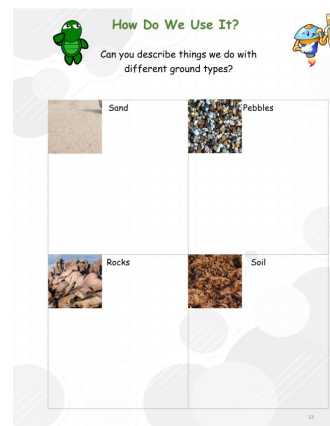
In the continuation of the introductory investigation, *What Grows Here? Part 1*, students make connections between the properties of different ground materials (e.g., soil—small and wet; sand—small and dry; rocks—large and dry) and why certain plants or animals live or grow in those environments. In other words, students connect different ground types to how they meet—or don't meet—the needs of plants and animals for survival.

Materials

Ground materials (soil, sand, pebbles, rocks), landscape pictures, *My STEM Explorer Notes™* build-a-notebook page 13, National Geographic book *Dirt*

Detailed Description

Begin this investigation by guiding your students through a refresher discussion on the different ground materials (soil, sand, pebbles, rocks) and some of the properties of these materials. After this discussion hand out page 13 of the *My STEM Explorer Notes™* build-a-notebook.




As students look through the ground materials have them think and discuss things that can be done with different materials (e.g., sand—sandbox, pebbles—walking path, etc.). You can use the provided pictures, or pictures from around the school, to help provide inspiration for the discussion. End the discussion talking about **soil**. Ideally students have noticed that plants grow mostly in soil and that some insects and bugs also live in soil. After an initial discussion, hand out pages 14 – 17 of the *My STEM Explorer Notes™* build-a-notebook and read together about soil.



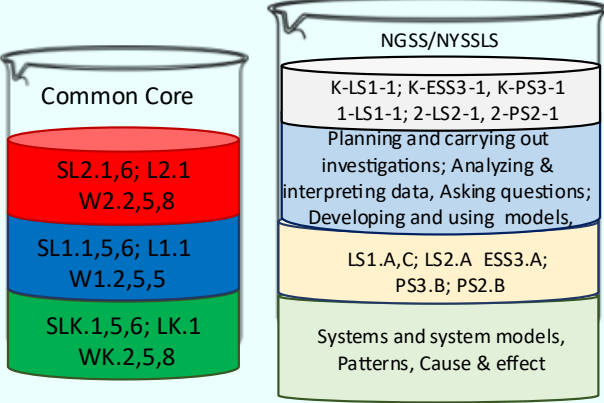
To help reinforce concepts about soil, take time during a subsequent science or ELA lesson to read the National Geographic’s *Dirt* book (included in the unit). As you are reading pause to highlight some of the important things about soil. Either as you are reading, or as a group activity after reading, the class should complete *What make soil special?* and the labeled soil diagram on page 18 of the *My STEM Explorer Notes™* build-a-notebook.

Investigation: What Do We Need?

Time



Standards



Description

In this investigation, students grow plants in different types of soil and compare how varying conditions—such as sunlight vs. no sunlight, water vs. no water, and soil vs. sand—affect plant development. Throughout the experiment, they explore the broader roles of sunlight, water, and nutrients in supporting life.

Associated *My STEM Explorer Notes™*
build-a-notebook pages 19 – 27.

Note (Digital Version): See [NGSS Education Standards](#) section for detailed evidence statements for K-LS1-1; K-ESS3-1, K-PS3-1, 1-LS1-1; 2-LS2-1, 2-PS2-1.

Objective

In this investigation, students grow plants in different types of soil and compare how varying conditions—such as sunlight vs. no sunlight, water vs. no water, and soil vs. sand—affect plant development. Throughout the experiment, they explore the broader roles of sunlight, water, and nutrients in supporting life.

At the conclusion, students connect what they have learned about plant survival to the needs of other living organisms, including animals and humans.

Materials

Planting cups, craft sticks, soil, sand, pebbles, seeds, *My STEM Explorer Notes™* build-a-notebook pages 19 – 27

Detailed Description

The first step in this investigation is to have students consider what plants need to grow. Use page 19 in their *My STEM Explorer Notes™* build-a-notebook to help guide this initial discussion. Record student ideas on a whiteboard or large chart paper. Avoid evaluating whether responses are right or wrong at this stage—the investigation itself will help students explore and refine their thinking. At the end of the discussion, have students write or draw their response to the question: What do you think plants need to grow?

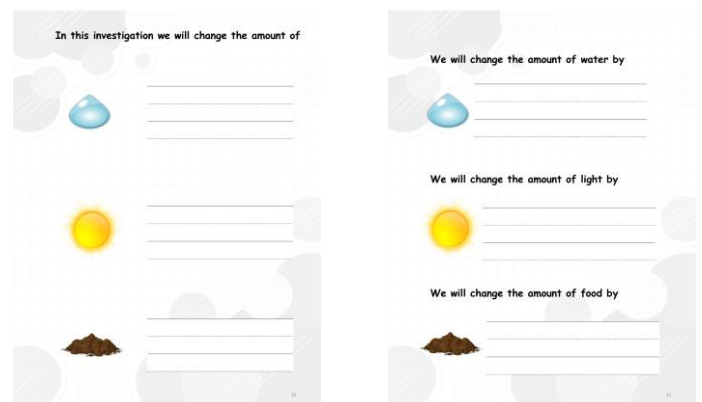


After the class has discussed their ideas and made their initial guesses (i.e., hypotheses), have students turn the pages 20 and 21 to begin planning the investigation. In this activity, they will vary water, light (sun), and food (soil type). These factors—food, water, and light—serve as the variables in the investigation.

As a class, decide how each variable will be changed. Typically, the variables are set as follows:

- In sunlight vs. in the dark
- Watering 2 times a week vs. no watering
- Planted in soil vs. planted in sand

The baseline set of growing conditions should be **in soil, with sunlight, and watering twice a week.** It is best if you only change one variable at a time.



For the investigation the class should be divided into at least six groups. If you have more than six groups that is ok, as you can have two groups growing their plants under the same set of conditions. It is best to have two or three plants growing under each condition as there is always the possibility that a seed won't grow even under ideal conditions.

Once groups have been established, have students record their experimental conditions on page 22. Be sure to decide how long the plants will be grown and on which days observations will be made (students should circle the appropriate days). Finally, have students create a labeled diagram of their experimental setup.


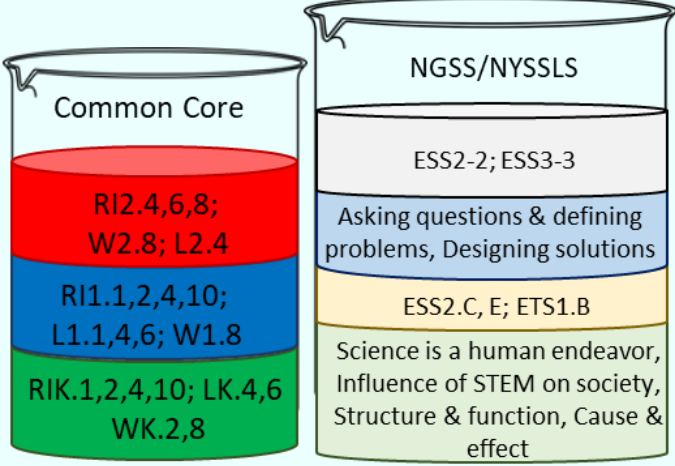
Over the course of the next 3-4 weeks have students make observations of how their plants are growing and fill out the tables on pages 23 – 25.

Conclusion and Reflection

At the conclusion of your growing period gather all the plants together and fill out the conclusion table on page 26. As a class draw and label the biggest plant. Discuss how each part of the plant interacted with the variables in the experiment (e.g., the leaves collected the sunlight, the roots collected the water and food, the stem moves things between the two).

As a reflection exercise have students discuss what they need to survive (food, water, shelter, air, etc.) and what other common animals need to survive. Ask them to identify if there are common needs among all three groups and help them see how those commonalities extend to all living organisms.

Read-Along: Meet the Soil Savers

Time	Standards	Description
		<p>Students will learn about the entrepreneurs featured in the unit and discuss the innovations they are working on to reduce human impact on the environment. Students are encouraged to come up with their own innovations and to see themselves as problem-solvers.</p>

Associated *My STEM Explorer Notes™*
build-a-notebook pages 28 – 33.

Note (Digital Version): See [Education Standards](#) section for detailed evidence statements for K-ESS2-2 and K-ESS3-3.

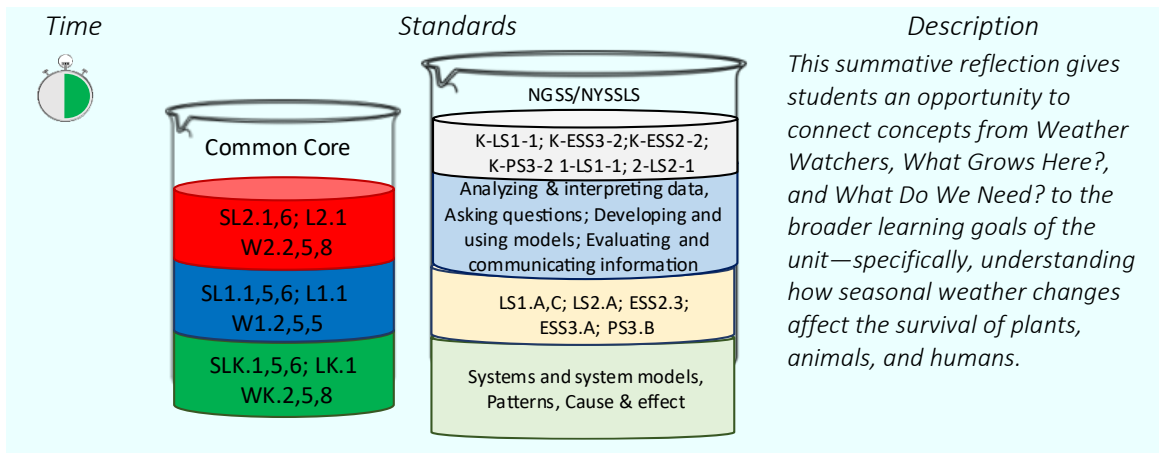
Objective

Students will learn about the entrepreneurs featured in the unit and discuss the innovations they are working on to reduce human impact on the environment. Students are encouraged to come up with their own innovations and to see themselves as problem-solvers.

Detailed Description

Pages 28–33 in the *My STEM Explorer Notes™* build-a-notebook feature the origin stories of ecoSpears, Beta Hatch, and Lomi. Read about these companies—and the entrepreneurs who founded them—with your class to reinforce key concepts related to soil, ecosystems, conservation, and sustainability. The build-a-notebook content provides simplified versions of these stories, while more advanced, higher-reading-level versions are available in the digital materials.

Summative Reflection: Making Connections



Note: See [Education Standards](#) section for detailed evidence statements for K-LS1-1; K-ESS3-2; K-ESS2-2; K-PS3-2 1-LS1-1; 2-LS2-1

Objective

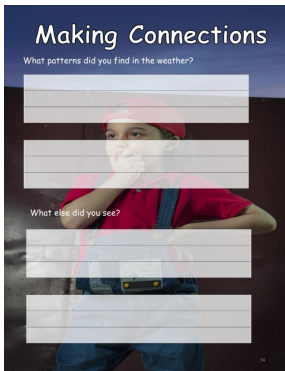
This summative reflection gives students an opportunity to connect concepts from **Weather Watchers**, **What Grows Here?**, and **What Do We Need?** to the broader learning goals of the unit—specifically, understanding how seasonal weather changes affect the survival of plants, animals, and humans.

As an extension, encourage discussion about how historical weather patterns may differ from those observed today, the potential impacts of these changes on living organisms, and the kinds of innovations people might develop to help support life on Earth.

Materials

My STEM Explorer Notes™ build-a-notebook (pages 34 – 37), sunshade building materials (rope, cloth, tape, etc.)

Detailed Description



What does the sun do?

What does the rain do?


Can you have too much rain?

Can you have too much sun?

Upon completing *Weather Watchers* and *What Do You Need?*, have the class discuss the reflection prompts on pages 34–35, focusing on weather patterns, general observations, and the impact of sun and rain. Students may work in small groups or engage in a whole-class discussion.

Additionally, students should begin to consider what plants and animals need to survive. This is an ideal opportunity to encourage them to combine insights from both investigations and think about how weather conditions might make it challenging for plants and animals to survive.

What do plants and animals need to survive?


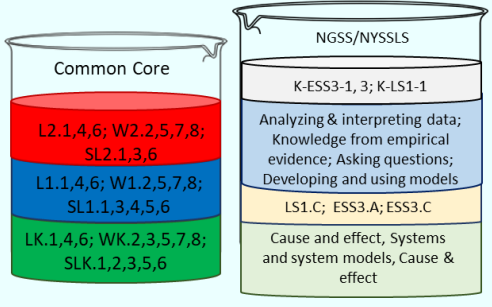
 How might the weather make it hard for plants and animals?

Can you design a device to help with too much sun?

As a final reflection activity, students design a structure to protect plants from excessive sunlight. If time permits, they should also build a prototype of their design; if not, a labeled diagram is sufficient.

Students may choose from a variety of materials for their structures and should explain the reasoning behind their selections—for example, how much light or water each material allows to pass through. An assortment of materials is included in the kit, but you are encouraged to supplement these with additional items from your school’s art room or makerspace.

Summative Challenge

Time	Standards	Description
 		<p>Summative challenges provide students with the opportunity to apply the concepts they have learned and practiced during the investigations to a broader and deeper project. To complete this activity, they must not only know the specific standards but also understand why that knowledge is useful and how they can apply it to a new problem or application. <u>Students should work in teams of three or four to complete one of the following projects and, if time allows, present their findings to the class.</u></p>

What We Need!

Note (Digital Version): This summative challenge is a required component of the curriculum. See [Education Standards](#) section for detailed evidence statements K-ESS3-1, K-ESS3-3, K-LS1-1.

In groups of three to four, have students create a drawing, song, story, or collage that illustrates the relationships among the sun, water, plants, animals, and humans. In it they must include:

- At least two examples of relationships involving animals (A)
- At least two examples of relationships involving plants (B)
- At least one relationship involving sun and one relationship involving water (C)

Examples of above must be clearly identified—e.g., they can be circled in a picture or students can orally describe their picture clearly identifying the relevant examples.

Note: Pictures to support the collage options are provided in the [Appendix](#).

Rubric

Score	A	B	C	Teamwork
3	Two well-identified examples of relationships with animals	Two well-identified examples of relationships with plants	Two well-identified examples where one includes sun and the other includes water	In addition to below, members worked to encourage and teach each other
2	One example of a relationship with animals	One example of a relationship with plants	An example that includes either sun or water	Team functioned well with all members contributing
1	NA	NA	NA	Team functioned well most of the time but some members were more engaged than others
0	No examples of animal relationships	No examples of plant relationships	No examples that include sun or water	Team required a lot of adult intervention to ensure all members contributed/were included

Super Soil

(Note: The following summative challenges are intended to be used in grades 1 and 2 classes that may be using Soil Savers as a supplemental curriculum. In some cases, portions of these activities may be appropriate as enrichment activities for some kindergarten students.)

1. Have students create a poster, brochure, or presentation to educate the public about the following things:
 - What are the different components of soil? (A)
 - Why is soil so important and how can soil become depleted over time? (B)
 - How can composting help improve soil quality? What are two other things that can be done to improve soil quality? (C)

Rubric

Score	A	B	C	Teamwork
3	Students describe (in words or a labeled diagram) the layered structure and the key components of soil.	Students describe why soil is important AND how it can become depleted over time	Students discuss composting and two other ways to improve soil quality.	In addition to below members worked to encourage and teach each other
2	Students describe (in words or a labeled diagram) soil as a mixture with some details but not all.	Students describe why soil is important OR how it can become depleted over time.	Students discuss composting and one other way to improve soil quality.	Team functioned well with all members contributing
1	Students describe (in words or a labeled diagram) soil as a mixture without any details.	NA	Students discuss composting but no other way to improve soil quality.	Team functioned well most of the time but some members were more engaged than others
0	No description (in words or a labeled diagram) of soil is included.	Students do not discuss why soil is important and how it can become depleted over time.	Students do not discuss how to improve soil quality.	Team required a lot of adult intervention to ensure all members contributed/were included

Ongoing Cross-Curricular Activities

The cross-curricular activities provided in the next few pages are just some suggestions on how you can continue the discussion on soil quality and key relationships in your local ecosystem.

Creative Writing



- Set aside 15 minutes each week to work in the *Book of Ideas*
- Have the students write a story using all the vocabulary words

Reading Comprehension Formative Assessment Suggestions

The topic introduction, personal biographies, and company information can all be used as informational text reading. Depending on reading level and age of students it might be useful to read the passage as a group and then have the students answer the questions individually, in pairs, or orally as a group. Text and questions can be found in the *My STEM Stories™* notebooks. There is additional space to write answers if there are other questions you would like to ask.

1. Read the introduction in the *My STEM Stories™* notebook with the students and then answer the following question.
 - a. List two things soil does to support plants or animals.
 - b. List two things that can be found in soil?
 - c. What impact does growing food have on soil and soil quality?
2. Read the entrepreneurs' stories to the students and have them answer the following questions. (Note: Answer could be a discussion, drawing, writing, etc.)
 - a. How are Ian, Serg and Ecospears using technology to help clean up soil? What human-made problem are they helping to solve?
 - b. How are Virginia and BetaHatch using insects to help protect the soil?
 - c. How are Jeremy and Lomi using technology to help put nutrients back into soil?



Additional Writing or Drawing Prompts

1. What did you learn that you find interesting? Why do you think it is interesting?
2. What is something that surprised you? Why did it surprise you?
3. How does composting improve soil quality?
4. How does composting reduce the amount of garbage we send to the landfill?
5. What type of people worry about soil quality?
6. Why is soil quality important for plants? animals? humans?
7. What are three ways we can protect soil quality?
8. How can the type of ground material protect plants and animals when there is a lot of rain?



Social Studies

- Have students complete one of the suggested timeline activities (see the [Appendix](#) for suggestions).

Math

Shared Counting and Comparison



- Set up a big chart at the front of the room and keep track of the number of sunny versus cloudy days. Be sure to make your observation at the same time each day. Include a tally mark and a picture of the number. At the end of the month compare the two numbers.

Variations and extensions

- Compare sunny and cloudy days across a number of months.
- Pick two times of day to make observations and compare the numbers.
- [Create a line graph to compare across days or different periods of time.](#)

Pacing Guide Resources

The next few pages contain some sample pacing guide outlines for you to use as a resource when planning out how best to teach this unit for your class. It contains suggested sequencing, cross-curricular integration, external resources, and quick assessments to monitor ongoing student understanding. The last page in this section has been intentionally left blank for you to use to develop the outline of your own lesson plans. You should feel free to make modifications to this curriculum in response to your students' interests and needs. If you need additional support or guidance in making modifications while making sure you are still addressing all the concepts covered in the standards, please feel free to reach out the CreositySpace curriculum development team by emailing Kath at kath@creosityspace.com.

Guiding notes for teachers as you are developing your lesson plans and pacing guides

- Review Learning Progression (p.12), Weekly Goals (p.15), and essential questions (p. 35).
- Use provided lesson planning sheets (pp. 66, 131-138) to outline lesson flow and highlight connections to learning objectives you have in other subjects, especially math, ELA, and social studies.
- Determine specific introduction strategy for your class (week 1). **Begin collecting daily weather data as a class if possible.**
- Review how-to videos and safety section for hands-on investigations. Determine any **additional safety precautions** you should highlight to keep ALL students safe during the investigations.
- Review the suggested videos and discussion prompts online.
- Discuss the **Making Connections** (week7) and **What We Need!** summative challenge (week 8) with the art/music teacher if you would like to perform that activity collaboratively.
- Review Ongoing Cross-Curricular Activities (Lesson section) and [Additional Resources](#) for implementation throughout the unit and year in general.
- Each week has several suggested Exit Tickets that can be used in various ways (e.g., journal entries, writing prompts, recap videos, small group discussions, etc.) as an ongoing formative assessment of student understanding.
- **Note:** *All links were confirmed as working at the time this Educator Guide was created. If you find a link that doesn't work, please let us know.*
- **A composition journal that students can use as a STEM notebook (to support brainstorming, inquiry, research, writing, etc.) is strongly suggested.**



Primary Curriculum

This week-by-week guide is intended for folks using *Soil Savers* as a primary curriculum with a focus on weather and what plants and animals need to survive. Depending on the extent to which you integrate the concepts from this unit into your ELA, math, social studies and art classes, this unit could take between **six to 10 weeks** to complete.

In order to fully support standards derived from the NRC K-12 National Framework students will need more exposure to science concepts than typically allocated in an elementary school day. In order to address this challenge, **nearly 50% of CreositySpace lessons are suitable for instruction during ELA, social studies, math, or art classes**. While these lessons can certainly be delivered during science instructional time, they are intentionally designed to reinforce key ELA, math, social studies and art learning objectives **in addition to teaching the intended science concepts**.

The following lesson list and pacing guide describe a suggested unit sequencing with activities intended for a science class presented in **black text** and lessons suitable for an ELA or other instruction block presented in **purple text**. In general, activities can easily be shifted in order or, in some cases, substituted by other content provided in the [Introduction](#) and [Lesson Planning Tools](#) sections so that you are able to design a unit flow tailored to the interests and needs of your students.

The standards associated with each activity can be found preceding the detailed description of the specific activity in the [Introduction](#) and [Lesson Planning Tools](#) sections as well as in the summary table on page 3.

If you would like some additional support setting up a lesson schedule that fits your needs, please don't hesitate to reach out to us at Kath@CreositySpace.com.

Please put **Request for lesson support** in the subject line.

Lesson List

Lesson	Lesson Description ¹	Instructional blocks ²	Non-Science Standards ³
Introduction (notebook pages 1 – 4)			
1	Introductory investigation What Grows Here?	Science	W.K.2, SL.K.1
2	Discuss introductory phenomena and create an OWL chart to assess student interests, and prior knowledge on soil and what plants need to grow.	ELA, Science	SL.K.1, 3
3	Group discussion (OWL or PIC chart-based, include weather and initial vocabulary) to assess student interests, and prior knowledge on the weather and/or what plants need to grow.	ELA, Science	W.K.2, SL.K.1,5
Hands-On Investigation: Weather Watchers (notebook pages 5 – 12)			
4	Read <i>Worm Weather</i> and lead group brainstorming around weather different types of weather. (p. 5)	ELA, Science	W.R.1, SL.K.1
5+	Collect weather data daily for 6 weeks (not a full lesson) (concurrent with lessons 6 – 17) (pp. 6 – 12)	Science	MD.4
15	Read <i>All About Weather</i> and collect historical weather data as a group.	Science, ELA	W.R.1, RI. K.10
What Grows Here: Part 2 (notebook pages 13 – 18)			
6	Refresher discussion from What Grows Here?; additional discussion around key characteristics of different ground types. (p.13)	Science	W.K.2, SL.K.1
7	Read the <i>Soil</i> introduction (pp. 10 – 17)	ELA, Science	RI. K.10
8	Read <i>Dirt</i> and discuss key characteristics of soil (p. 18)	ELA, Science	RI. K.10
Hands-On Investigation: What Do We Need? (notebook pages 19 – 27)			
9,10	Plan out the investigation, begin the investigations (pp. 19 – 22)	Science	W.K.2
11+	Collect plant growth data over 3 weeks (not a full lesson) (pp. 23 – 25)	Science	2.MD.1-4
16, 17	Complete growing summary (pp 26 – 27), draw the biggest plant and discuss conclusions.	Science, Math, Art	2.MD.1-4

Reading Comprehension: Meet Your Soil Savers (notebook pages 28 – 33)			
12	Read about Serg, Ian, and ecoSPEARs. Watch the video, discuss the discussion prompts.	ELA, Social Studies, Science	RI.K.10
13	Read about Virginia and Beta Hatch. Read about Jeremy and Lomi. Discuss how all four entrepreneurs are helping soil.	ELA, Social Studies, Science	RI.K.10
14	<i>(optional) Have students work together to come up with an idea of how to help the soil.</i>	Social Studies, Science	SL.K.6
Making Connections (notebook pages 34 – 37)			
18	As a class talk through the making connections prompts. (pp. 34 - 36).	Science	SL.K.1, SL.K.6
19,20	Design and build device to decrease sun (pp. 37,38).	Science, Art	SL.K.6
Summative Challenge: What We Need!			
21	Introduce the summative challenge	Science	SL.K.1,
22	Have students decide their approach to their final work (song, collage, etc.)	Art, Science	SL.K.5
23/24	Have students work to identify the key relationships	Science	SL.K.6, W.K.5
25+	Students compile their final collage, practice their story or song.	Art, ELA, Science	SL.K.5

¹In general, lesson objectives can be achieved in a 30–40-minute instructional block. However, lessons can easily be extended across multiple instructional blocks if more time is allocated for student-directed inquiry, discussion, and research. Tips on how to facilitate longer discussions are provided within the [Lesson Planning Tools](#) section.

²While all lessons are suitable for delivery in a science instructional block, lessons that are also suitable for delivery in an ELA-, math-, social studies-, or art-focused instructional block are identified here.

³The most relevant common core ELA and math standards have been identified. In many cases state-specific social studies or art standards may also be applicable.

Week	Goals
1	<ul style="list-style-type: none"> Determine student interests and prior knowledge about weather and what plants and animals need to survive. Generate excitement for the <i>Soil Savers</i> unit. Get students thinking about soil and why it is important. Complete introductory activity What Grows Here?
2 & 3	<ul style="list-style-type: none"> Introduce and start collecting data for the Weather Watchers investigation. Complete What Grows Here? reflections Introduce and complete the planning for the What Do We Need? investigation, looking into what plants need to grow.
4 & 5	<ul style="list-style-type: none"> Continue to collect data for the What Do We Need? investigation Continue to collect data for the Weather Watchers investigation Introduce and discuss soil entrepreneurs and their innovations designed to reduce our impact on the environment in Meet the Soil Savers
6 & 7	<ul style="list-style-type: none"> Complete the reflections and design project associated with Weather Watchers. Complete the What Do We Need? investigation. Complete the Making Connections reflections to make connections between the similar things plants, animals and humans need to grow and survive.
8+	<ul style="list-style-type: none"> Complete the What We Need! summative challenge.

Week	Class Activities
Week 1	<p>Week 1 Goals</p> <ul style="list-style-type: none"> • Determine student interests and prior knowledge about weather and what plants and animals need to survive. • Generate excitement for the <i>Soil Savers</i> unit. • Get students thinking about soil and why it is important. Complete introductory activity What Grows Here? <p>Lessons</p> <ul style="list-style-type: none"> • Introduce <i>Soil Savers</i> <ul style="list-style-type: none"> ○ Complete the introductory activity What Grows Here? ○ Assess student interest in, and prior knowledge about, soil and what plant need to grow through an OWL chart. • Discuss introductory phenomenon: <ul style="list-style-type: none"> ○ Introduce initial vocabulary: Have students draw a picture or figure out an action that describes soil and nutrient. ○ <i>How does soil support the plants and animals in our community?</i> (alt – <i>Why is soil important for plants and animals?</i>) <p>Exit Ticket Name one important thing soil provides?</p>

<p>Week 2 & 3</p>	<p>Week 2 and 3 Goals</p> <ul style="list-style-type: none"> • Introduce and start collecting data for the Weather Watchers investigation. • Complete What Grows Here? reflections • Introduce and complete the planning for the What Do We Need? investigation, looking into what plants need to grow. <p>Lessons</p> <ul style="list-style-type: none"> • Introduce weather concepts. <ul style="list-style-type: none"> ○ Have a group discussion (OWL chart supported) to assess student interests and prior knowledge about the weather. ○ Read <i>Worm Weather</i> and have the following group discussion add to the above OWL chart. • Start collecting daily weather data for Weather Watchers. • Complete the What Grows Here reflection activities. <ul style="list-style-type: none"> • Lead a refresher discussion on observations from the What Grows Here? introductory investigation • Complete a group/guided reading of the introductory text about soil (in the student notebook). • Read and discuss the content the book <i>DIRT</i> • Discussion Prompt: What makes soil special? • Begin the What Do We Need? investigation <p>Exit Tickets</p> <p>Name or draw two important things soil provide.</p> <p>Describe (in pictures or words) two different types of weather.</p>
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<p>Weeks 4 and 5</p>	<p>Weeks 4 and 5 Goals</p> <ul style="list-style-type: none"> • Continue to collect data for the What Do We Need? investigation • Continue collecting data for the Weather Watchers investigation • Introduce and discuss soil entrepreneurs and their innovations designed to reduce our impact on the environment in Meet the Soil Savers <p>Lessons</p> <ul style="list-style-type: none"> • Continue collecting weather data for Weather Watchers <ul style="list-style-type: none"> ○ Read <i>All About Weather</i> and collect historical weather data as a group • Continue monitoring plant growth for What Do We Need? • Complete Meet the Soil Savers: <ul style="list-style-type: none"> ○ Read about Serg, Ian, and ecoSPEARs. Watch the video, discuss the discussion prompts. ○ Read about Virginia and Beta Hatch. Read about Jeremy and Lomi. Discuss how all four entrepreneurs are helping soil. ○ (optional) Have students work together to come up with an idea of how to help the soil. <p>Exit Tickets</p> <p>What is something you can wear or use when it is cold?</p> <p>What is something you can wear or use when it is raining?</p> <p>What is something you can wear or use when it is sunny?</p>
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<p>Weeks 6 and 7</p>	<p>Weeks 6 and 7 Goals</p> <ul style="list-style-type: none"> • Complete the What Do We Need? investigation. • Complete the Making Connections reflections: <ul style="list-style-type: none"> ○ Weather ○ Similarities between what plants, animals, and humans need to survive. ○ Design project <p>Lessons</p> <ul style="list-style-type: none"> • Complete the What Do We Need? investigation <ul style="list-style-type: none"> ○ Complete growing summary and draw the biggest plant and discuss conclusions. • Making Connections: <ul style="list-style-type: none"> ○ As a class talk through the making connections prompts. ○ Design and build device to decrease sun. <p>Exit Tickets</p> <p>What is something animals do to protect themselves from the hot or cold (pick the temp depending on the location and season)?</p> <p>Name two things that plants need to grow.</p>
<p>Week 8+</p>	<p>Week 8+ goals</p> <ul style="list-style-type: none"> • Complete the What We Need! summative challenge. <p>Lessons</p> <ul style="list-style-type: none"> • Introduce the summative challenge • Have students decide their approach to their final work (song, collage, etc.) • Have students work to identify the key relationships • Students compile their final collage or practice their story or song. <p>Exit Tickets</p> <p>Name two things the sun provides.</p> <p>Why is it important to think about the weather?</p>



Supplemental Program

This 10-day guide is intended as an example for folks using *Soil Savers* as a supplemental curriculum with a focus on **soil**. It is designed to be used as a guide as you weave this STEM subject matter across all the courses you teach. All activities described can be a part of your science class; however, several lessons are also suitable for instruction during ELA and, to a lesser extent, social studies, art, or math classes. *Lessons that are suitable for an ELA-, social studies-, art-, or math-focused instruction block are presented in purple text.*

Please refer to the [Introduction](#) or [Lesson Planning Tools](#) sections for detailed list of the science standards associated with each activity.

Day	Class Activities
<p>Topic Introduction Section Preparation Activities</p> <ul style="list-style-type: none"> • Review Storyline, Your Technology, and Background Information to orient yourself within the unit’s content. • Review Topic Introduction Tools and select the ones that work for your class. • Review Ongoing Cross-Curricular Activities (Lessons section) for implementation throughout the unit and year in general. 	
<p>Days 1 & 2</p>	<p>Activities</p> <ul style="list-style-type: none"> • Introduce the topic area of soil <ul style="list-style-type: none"> ○ Complete the introductory activity What Grows Here? ○ Assess student interest in, and prior knowledge about, soil and what plant need to grow through an OWL chart. • Discuss introductory phenomenon: <ul style="list-style-type: none"> ○ Introduce initial vocabulary: Have students draw a picture or figure out an action that describes soil and nutrient. ○ <i>How does soil support the plants and animals in our community? (alt – Why is soil important for plants and animals?)</i>

Applications and Hands-On Activities	
<i>Preparation Activities</i>	
<ul style="list-style-type: none"> Review Main Investigations and plan out the timing that works well for your class. Read Entrepreneur vignettes and pick the best reading level for your group (reading levels available with digital resources). 	
Day 3	<p>Intended activities</p> <ul style="list-style-type: none"> Read the Soil introduction in the build-a-notebook Plan out the investigation and begin What Do We Need? <p>Exit Ticket Name or draw two important things soil provides.</p>
Day 4	<p>Intended Activities</p> <ul style="list-style-type: none"> Monitor plant growth. Water according to experimental plan. Read and discuss the content the book <i>DIRT</i> Discussion Prompt: What makes soil special?
Continue monitoring growth and water according to the experimental plan.	
Days 5	<p>Intended Activities</p> <ul style="list-style-type: none"> Continue collecting plant data Introduce vocabulary words organic and microbe. Read about Jeremy and Lomi. <p>Optional Activity</p> <ul style="list-style-type: none"> Do a Technology Historical Timeline activity.
Day 6	<p>Intended Activities</p> <ul style="list-style-type: none"> Continue collecting plant growth data Read about Serg, Ian, and ecoSPEARs. Watch the video, discuss the discussion prompts. Read about Virginia and Beta Hatch. Discuss how all three entrepreneurs are helping soil. <p>Exit Ticket What are some ways we can help the soil?</p>
Days 7, 8	<p>Intended Activities</p> <ul style="list-style-type: none"> Continue collecting plant growth data (optional) Have students work together to come up with an idea of how to help the soil. Innovation prompt: Design a structure that provides plants with shade. At the conclusion of the experiment, students should determine the biggest plant and assess the best growing conditions. <p>Exit Ticket What conditions grew the biggest plant?</p>
Ongoing Connections/Summative Challenge	
Days 9, 10	<ul style="list-style-type: none"> Have students work on the summative challenge of their choice.

Blank Pacing Guides

Use this page to summarize your plans for using *Draft Dodgers*. Pages for weekly lesson planning are provided in the Appendix.

Introduction:

Lesson Flow:

Summative Assessment:

Education Standards

Don't see the standards for your school district? Contact us at Kath@CreositySpace.com and we will determine the appropriate standards alignment for your district.

Next Generation Science Standards/NY State Science Learning Standards Grade K-2

Performance Expectations

- K-LS1-1** Use observations to describe patterns of what plants and animals (including humans) need to survive.
- K-ESS3-1** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
- K-PS3-1** Make observations to determine the effect of sunlight on the Earth’s surface.
- K-ESS2-1** Use and share observations of local weather conditions to describe patterns.
- K-ESS3-2** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.
- K-ESS3-3** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment
- K-ESS2-2** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
- K-PS3-2** Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
- 1-LS3-1** Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.
- 1-ESS1-2** Make observations at different times of year to relate the amount of daylight to the time of year.
- 2-PS1-1** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-PS1-2** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- 2-LS2-1** Plan and conduct an investigation to determine if plants need sunlight and water to grow.
- 2-LS4-1** Make observations of plants and animals to compare the diversity of life in different habitats.
- NGSS Big Idea and Topic Bundle:** In this unit, students explore environmental factors that affect living organisms, including weather and soil. Throughout the unit, they learn what plants and animals need to survive and how those needs are met by their surrounding environment.

<u>Science and Engineering Practices</u>	<u>Disciplinary Core Ideas</u>	<u>Crosscutting Concepts</u>
<p>Asking questions/defining problems; planning and carrying out investigations; analyzing and interpreting data Investigations have students asking questions, making observations, and using their observations to provide the evidence for their explanations and solutions.</p> <p>Building models The sun shade design challenge and various PIC have students creating models of real-world systems</p> <p>Constructing explanations/designing solutions Students use evidence from the investigations to construct explanations on what plants need to grow.</p> <p>Obtaining, evaluating, and communicating information Various discussions throughout the unit have students obtaining, evaluating and communicating information.</p> <hr/> <p>Connections to Nature of Science Scientific investigations use a variety of methods; scientific knowledge is based on empirical evidence Entrepreneur stories and hands-on investigations illustrate how scientific investigations are conducted and how that information is put to use.</p>	<p>PS1.A Structure of matter The discussion about different types of ground material highlights a variety of physical characteristics.</p> <p>PS3.B: Conservation of Energy and Energy Transfer</p> <p>LS1.A: Structure and Function</p> <p>LS1.C: Organization for Matter and Energy Flow in Organisms</p> <p>LS2.A: Interdependent Relationships in Ecosystems What Do We Need? Investigation and entrepreneur stories highlight the connected nature of ecosystems as well as what plants need to grow.</p> <p>LS4.D: Biodiversity and Humans What Grows Here? Highlights the range of plants (and animals) that can live in different ecosystems.</p> <p>ESS2.D: Weather and Climate</p> <p>ESS1.B: Earth and the Solar System Weather tracking activities highlight weather and climate as well as seasonable changes in sunlight and temperature.</p> <p>ESS3.A: Natural Resources</p> <p>ESS3.B: Natural Hazards</p> <p>ESS3.C: Human Impacts on Earth Systems Entrepreneur stories highlight both the positive and negative impacts humans can have on Earth System – either depleting or replenishing resources.</p>	<p>Cause and effect Investigations have students analyzing the cause and effect for a variety of growing conditions.</p> <p>Patterns Students look for patterns as they track weather across a number of weeks.</p> <p>Systems and system models Investigations explore different systems and individual plants and the small sun shade are models for a bigger system.</p> <p>Structure and function Evaluation of different ground materials explore structure-function relationships. The entrepreneur stories also highlight a variety of structure-function relationships.</p> <hr/> <p>Connections to Nature of Science Science is a way of knowing; science addresses questions about the natural and material world Activities give firsthand experience in questioning, observing, and concluding.</p> <p>Science is a human endeavor Entrepreneur story and historical timeline highlight the human aspect of science and engineering.</p> <hr/> <p>Connections to Engineering, Technology, and Applications of Science Interdependence of science, engineering, and technology; influence of engineering, technology, and science on society and the natural world Summative challenge, readings, historical timeline, and entrepreneur stories highlight above interactions, interdependencies, and influences.</p>
<p>Connections to Common Core State Standards See previous Common Core Standards section for the ELA and Math standards addressed by these activities.</p>		

Overarching Enduring Understanding

How does the soil support the plants and animals in our community?

Number of Lessons*

Full unit – 21-26 lessons

Supplemental program – minimum 8-10 lessons

**Lesson = 30 – 40 min block; 50% of full unit lessons can be delivered in non-science classes*

FLOW OF INSTRUCTION

K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.

K-ESS3-1 Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

K-PS3-1 Make observations to determine the effect of sunlight on the Earth's surface.

K-ESS2-1 Use and share observations of local weather conditions to describe patterns.

K-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

K-ESS3-3 Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment

K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

K-PS3-2 Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.

1-LS3-1 Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.

1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.

2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.

Introductory Investigation: What Grows Here? Parts 1 & 2 (hands-on investigation, occurs during weeks 1 and 2)

In this introductory investigation students evaluate different types of soil and dirt (e.g., soil, sand, gravel, etc.). They compare what the soil is like (wet vs. dry, big pieces vs. small, etc.) looking at similarities and differences. After this initial discussion students look at pictures (or go outside and look at real-world examples) and identify the types of things that can grow in different types of dirt. (K-LS1-1, K-ESS3-1, 2-PS1-1)

Investigation: Weather Watchers (hands-on investigation, occurs during weeks 2 – 7)

Throughout the course of this unit, students will track their local weather both individually and as a group. (K-ESS2-1, K-PS3-1, 1-ESS1-2)

Investigation: What Do We Need? (hands-on investigation, occurs during weeks 2-7)

In this investigation, students will grow plants in different types of soil/dirt and compare the effects of different growing conditions on plant development (sun vs. no sun, water vs. no water, soil vs sand). (K-LS1-1, 2-LS2-1, 2-PS1-2) Throughout this experiment, students will learn about the bigger roles of sun, water, and food and make ongoing observations about the appearance of their growing plants. (1-LS3-1)

Sun Students will make observations about the sun and the ways that it influences their daily life. (K-LS1-1, K-ESS3-1, K-PS3-1)

Water Students will make observations about the water and the ways that it influences their daily life. (K-LS1-1, K-ESS3-1)

Food Students will make observations about the water and discuss how different creatures get food. (K-LS1-1, K-ESS3-1)

Read-A-Long: Meet Some Soil Savers (read-a-long, occurs during weeks 4 and 5)

Students will learn about the entrepreneurs featured in the unit and discuss the innovations they are working on to reduce human impact on the environment. Students are encouraged to come up with their own innovations. (K-ESS3-3)

Summative Reflection: Making Connections (week 7)

At the conclusion of *Weather Watchers* and *What Do We Need?* Investigations, students will connect the changes in weather to what the plants needed to grow, why it is important to understand how that may change, and things humans do to protect themselves against those changes. (K-ESS3-2; K-ESS2-2, K-PS3-2) Students will also reflect upon and make connections to identify similarities in what plants, animals, and humans need to grow & survive. (K-LS1-1, 2-LS2-1, 2-LS4-1)

Summative Challenge: What We Need! (summative challenge, occurs during weeks 8+)

In this summative challenge students create a picture/collage/song that represents/models the relationships in their ecosystem including sun, water, plants, animals, and humans. (K-ESS3-1, K-LS1-1, K-ESS3-3, 2-PS1-2)

NGSS Evidence Statements

Please reference the digital version of the Educator Guide for the detailed NGSS evidence statements.

Common Core ELA Standards

Kindergarten

Reading Informational Text:

[CCSS.ELA-LITERACY.RI.K.1](#) With prompting and support, ask and answer questions about key details in a text.

[CCSS.ELA-LITERACY.RI.K.2](#) With prompting and support, identify the main topic and retell key details of a text.

[CCSS.ELA-LITERACY.RI.K.3](#) With prompting and support, describe the connection between two individuals, events, ideas, or pieces of information in a text.

[CCSS.ELA-LITERACY.RI.K.4](#) With prompting and support, ask and answer questions about unknown words in a text.

[CCSS.ELA-LITERACY.RI.K.8](#) With prompting and support, identify the reasons an author gives to support points in a text.

[CCSS.ELA-LITERACY.RI.K.10](#) Actively engage in group reading activities with purpose and understanding.

Writing:

[CCSS.ELA-LITERACY.W.K.1](#) Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic.

[CCSS.ELA-LITERACY.W.K.2](#) Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.

[CCSS.ELA-LITERACY.W.K.3](#) Use a combination of drawing, dictating, and writing to narrate a single event or several loosely linked events, tell about the events in the order in which they occurred, and provide a reaction to what happened.

[CCSS.ELA-LITERACY.W.K.5](#) With guidance and support from adults, respond to questions and suggestions from peers and add details to strengthen writing as needed.

[CCSS.ELA-LITERACY.W.K.7](#) Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).

[CCSS.ELA-LITERACY.W.K.8](#) With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Speaking & Listening:

[CCSS.ELA-LITERACY.SL.K.1](#) Participate in collaborative conversations with diverse partners about *kindergarten topics and texts* with peers and adults in small and larger groups.

[CCSS.ELA-LITERACY.SL.K.1.A](#) Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).

[CCSS.ELA-LITERACY.SL.K.1.B](#) Continue a conversation through multiple exchanges.

[CCSS.ELA-LITERACY.SL.K.2](#) Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.

[CCSS.ELA-LITERACY.SL.K.3](#) Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

[CCSS.ELA-LITERACY.SL.K.5](#) Add drawings or other visual displays to descriptions as desired to provide additional detail.

[CCSS.ELA-LITERACY.SL.K.6](#) Speak audibly and express thoughts, feelings, and ideas clearly.

Language:

[CCSS.ELA-LITERACY.L.K.1](#) Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

[CCSS.ELA-LITERACY.L.K.4](#) Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on kindergarten reading and content.

[CCSS.ELA-LITERACY.L.K.6](#) Use words and phrases acquired through conversations, reading and being read to, and responding to texts.

Grade 1

Reading Informational Text:

[CCSS.ELA-LITERACY.RI.1.1](#) Ask and answer questions about key details in a text.

[CCSS.ELA-LITERACY.RI.1.2](#) Identify the main topic and retell key details of a text.

[CCSS.ELA-LITERACY.RI.1.3](#) Describe the connection between two individuals, events, ideas, or pieces of information in a text.

[CCSS.ELA-LITERACY.RI.1.4](#) Ask and answer questions to help determine or clarify the meaning of words and phrases in a text.

[CCSS.ELA-LITERACY.RI.1.8](#) Identify the reasons an author gives to support points in a text.

[CCSS.ELA-LITERACY.RI.1.10](#) With prompting and support, read informational texts appropriately complex for grade 1.

Writing:

[CCSS.ELA-LITERACY.W.1.2](#) Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.

[CCSS.ELA-LITERACY.W.1.5](#) With guidance and support from adults, focus on a topic, respond to questions and suggestions from peers, and add details to strengthen writing as needed.

[CCSS.ELA-LITERACY.W.1.8](#) With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Speaking & Listening:

[CCSS.ELA-LITERACY.SL.1.1](#) Participate in collaborative conversations with diverse partners about *grade 1 topics and texts* with peers and adults in small and larger groups.

[CCSS.ELA-LITERACY.SL.1.1.A](#) Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).

[CCSS.ELA-LITERACY.SL.1.1.B](#) Build on others' talk in conversations by responding to the comments of others through multiple exchanges.

[CCSS.ELA-LITERACY.SL.1.1.C](#) Ask questions to clear up any confusion about the topics and texts under discussion.

[CCSS.ELA-LITERACY.SL.1.2](#) Ask and answer questions about key details in a text read aloud or information presented orally or through other media.

[CCSS.ELA-LITERACY.SL.1.3](#) Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.

[CCSS.ELA-LITERACY.SL.1.4](#) Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.

[CCSS.ELA-LITERACY.SL.1.5](#) Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.

[CCSS.ELA-LITERACY.SL.1.6](#) Produce complete sentences when appropriate to task and situation. (See grade 1 Language standards 1 and 3 [here](#) for specific expectations.)

Language:

[CCSS.ELA-LITERACY.L.1.1](#) Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

[CCSS.ELA-LITERACY.L.1.4](#) Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grade 1 reading and content*, choosing flexibly from an array of strategies.

[CCSS.ELA-LITERACY.L.1.6](#) Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using frequently occurring conjunctions to signal simple relationships (e.g., *because*).

Grade 2

Reading Informational Text:

[CCSS.ELA-LITERACY.RI.2.2](#) Identify the main topic of a multiparagraph text as well as the focus of specific paragraphs within the text.

[CCSS.ELA-LITERACY.RI.2.3](#) Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

[CCSS.ELA-LITERACY.RI.2.4](#) Determine the meaning of words and phrases in a text relevant to a *grade 2 topic or subject area*.

[CCSS.ELA-LITERACY.RI.2.6](#) Identify the main purpose of a text, including what the author wants to answer, explain, or describe.

[CCSS.ELA-LITERACY.RI.2.8](#) Describe how reasons support specific points the author makes in a text.

[CCSS.ELA-LITERACY.RI.2.10](#) By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2-3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

Writing:

[CCSS.ELA-LITERACY.W.2.1](#) Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., *because, and, also*) to connect opinion and reasons, and provide a concluding statement or section.

[CCSS.ELA-LITERACY.W.2.2](#) Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

[CCSS.ELA-LITERACY.W.2.5](#) With guidance and support from adults and peers, focus on a topic and strengthen writing as needed by revising and editing.

[CCSS.ELA-LITERACY.W.2.7](#) Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

[CCSS.ELA-LITERACY.W.2.8](#) Recall information from experiences or gather information from provided sources to answer a question.

Speaking & Listening:

[CCSS.ELA-LITERACY.SL.2.1](#) Participate in collaborative conversations with diverse partners about *grade 2 topics and texts* with peers and adults in small and larger groups.

[CCSS.ELA-LITERACY.SL.2.1.A](#) Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).

[CCSS.ELA-LITERACY.SL.2.1.B](#) Build on others' talk in conversations by linking their comments to the remarks of others.

[CCSS.ELA-LITERACY.SL.2.1.C](#) Ask for clarification and further explanation as needed about the topics and texts under discussion.

[CCSS.ELA-LITERACY.SL.2.2](#) Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.

[CCSS.ELA-LITERACY.SL.2.3](#) Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

[CCSS.ELA-LITERACY.SL.2.6](#) Produce complete sentences when appropriate to task and situation in order to provide requested detail or clarification. (See grade 2 Language standards 1 and 3 [here](#) for specific expectations.)

Language:

[CCSS.ELA-LITERACY.L.2.1](#) Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

[CCSS.ELA-LITERACY.L.2.4](#) Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 2 reading and content, choosing flexibly from an array of strategies.

[CCSS.ELA-LITERACY.L.2.6](#) Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using adjectives and adverbs to describe (e.g., *When other kids are happy that makes me happy*).

Common Core Math Standards (Grades K–2)

Grade K

MP.1 Make sense of problems and persevere in solving them.

MP.2 Reason abstractly and quantitatively.

K.CC.1,3. Know number names and the count sequence.

K.CC.4,5. Count to tell the number of objects.

K.G.2. Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).

Grade 1

MP.1 Make sense of problems and persevere in solving them.

MP.2 Reason abstractly and quantitatively.

1.G.1 Reason with shapes and their attributes.

Grade 2

MP.1 Make sense of problems and persevere in solving them.

MP.2 Reason abstractly and quantitatively.

2.G.2 Reason with shapes and their attributes.

Additional Resources

Note: All links were confirmed as working at the time this Educator Guide was created. If you find a link that doesn't work, let us know so we can find a suitable—and working—link.

On Soil, Soil Protection and Composting

<https://www.soils4kids.org/> Soils 4 Kids offers fun soil games, soil experiments, and information about soil science careers.

<https://kids.britannica.com/kids/article/soil/390622> Additional, young student-friendly explanation about soil.

<https://web1.pima.gov/deq/ecokids/soil.html> Desert-soil focused information

<https://www.globe.gov/web/elementary-globe/overview/soils> Additional elementary-aged soil instructional materials.

<https://www.globalsoilbiodiversity.org/> is a great website with information about soil for all ages. Specifically check out <https://www.globalsoilbiodiversity.org/educational-resources> for educational resources.

Video - <https://www.pbs.org/video/science-trek-soil/> A 30-minute PBS video about soil for students.

Additional lesson resources from Science Trek about soil - <https://sciencetrek.org/topics/soil/resources>

<https://www.herbsociety.org/hsa-learn/intro-to-herbs/hsa-gardening-for-kids/composting-for-kids.html> A website with additional information on composting from the Herb Society of America.

<https://www.pbs.org/parents/crafts-and-experiments/make-a-composter> Instructions for making your own experimental composter.

<https://www.nationalgeographic.com/family/article/your-guide-to-composting-with-kids> Additional information from National Geographic on composting

<https://compostfoundation.org/> A website from the Compost Foundation with a lot of interesting information for all ages. Specific pages for teacher and students include - <https://compostfoundation.org/icaw-for-teachers/>

On Weather and Natural Disasters

<https://www.wunderground.com/history> A website to track and record historical data.

<http://www.weatherwizkids.com/> Great general site for weather-related information.

<https://www.youtube.com/watch?v=HaEmlakO7f4> Longer video on natural disasters—a little younger but featuring the Dr. Binocs character who is often quite engaging for students.

<https://www.nationalgeographic.com/environment/natural-disasters-weather/> This is a National Geographic website that has photos and videos about weather related natural disasters. It may be a bit graphic for younger students so we recommend being selective about which photos you share and that you share them in a class discussion format so that you can monitor your students' reactions.

<https://www.nps.gov/articles/wildfire-causes-and-evaluation.htm> Forest fires—most are started by humans.

Books

DK Eyewitness Books: *Natural Disasters: Confront the Awesome Power of Nature from Earthquakes and Tsunamis to Hurricanes* by Claire Watts

Natural Disasters: Understanding Weather Just for Kids! by KidCaps

Tropical cyclones (a.k.a. hurricanes, cyclones, and typhoons)

<https://www.cnn.com/2017/09/11/us/hurricanes-landfall-by-state-trnd/index.html> Where hurricanes hit most often in the United States.

<https://www.youtube.com/watch?v=uw-ts4TvcsY> Good introduction to hurricanes.

<https://www.youtube.com/watch?v=2kLwbb0ggFU> More detailed introduction to hurricanes.

https://www.youtube.com/watch?v=J2_Bk4dVS0 Younger video about hurricanes—Dr. Binocs.

<https://video.nationalgeographic.com/video/101-videos/00000165-c429-de15-afef-c73da3c90000> National Geographic video on hurricanes. The vocabulary isn't great for kids but may be good for teachers.

Tsunamis

<https://oceanservice.noaa.gov/facts/tsunami.html> General information on tsunamis from NOAA.

<https://www.nationalgeographic.com/environment/natural-disasters/tsunamis/> General information on tsunamis from National Geographic.

Tornadoes

http://www.weatherwizkids.com/?page_id=60 General information on tornados from Weather Wiz Kids.

<https://www.nationalgeographic.com/environment/natural-disasters/tornadoes/> General information on tornadoes from National Geographic.

<http://www.weatherwizkids.com/weather-tornado.htm> Good information on tornadoes.

Landslides

http://www.weatherwizkids.com/?page_id=1326 General information on landslides from Weather Wiz Kids.

Flooding

<https://www.puroclean.com/blog/top-10-states-most-at-risk-for-flooding/> List of top 10 states most prone to

flooding.

http://www.weatherwizkids.com/?page_id=66 Flooding information from Weather Wiz Kids.

Interesting Companies

<https://betahatch.com/> uses insects to help meet the demand for animal feed and crop fertilizer

<https://lomi.com/> Pela Earth makes a new high-efficiency composter

<https://ecospears.com/> EcoSpears is removing harmful chemicals from soil.

[Living Ink](https://livingink.co/) makes ink algae that can be printed onto papers, greeting cards, and more. <https://livingink.co/>

[bioMASON](https://biomason.com/) uses bacteria to make bricks. <https://biomason.com/>

[Modern Meadow](http://www.modernmeadow.com/) uses collagen (a protein) to make leather. <http://www.modernmeadow.com/>

[Bolt Thread](https://boltthreads.com/) is developing super strong silk threads. <https://boltthreads.com/>

[Evrnu](https://www.evrnu.com/) is developing a new process to recycle fabric. <https://www.evrnu.com/>

Appendix

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Electronic copies of the Educator Guide, student notebooks, and other worksheets can be found on the unit website.

Accessing Online Content

To better support you in the implementation of this curriculum we suggest the following:

- Please review our short tutorial video at <https://creosityspace.com/resources/>
- To access the digital materials, please register your unit by emailing kath@creosityspace.com with registration code provided in the front page of this educator guide. At that point you can also schedule a complimentary online information session to support implementation of the *Soil Savers* unit in your classroom.

Science Safety and Behavior Contract

<p>I know the class emergency plan</p> <ul style="list-style-type: none"> • If anything happens, the first thing you need to do is tell the teacher. • If something dangerous happens, we will walk outside into the hall to make sure everyone is safe. 	<p>I will follow directions</p> <ul style="list-style-type: none"> • Make sure that you know what to do before you do it. Ask any questions BEFORE you begin. <div style="text-align: center;">  </div>
<p>I will wear goggles if I am told to</p> <div style="text-align: center;">  </div>	<p>I will tell the teacher if I have an accident or injury</p> <ul style="list-style-type: none"> • Even if it seems small, please let the teacher know if an accident or injury happens.
<p>I will listen carefully</p> <div style="text-align: center;">  </div> <p>I understand I will be removed from the science investigations area by the teacher if I am preventing others from learning.</p>	<p>I will not touch any materials unless I have been given permission</p> <div style="text-align: center;">  </div>
<p>I will wash my hands after science investigations</p> <div style="text-align: center;">  </div>	<p>I will not eat, taste, drink, or inhale anything we use in science</p> <div style="text-align: center;">  </div>

I have read the attached safety rules and have been present when they were discussed in class.

Student's Name _____

Date _____

I have read and discussed the laboratory safety rules with my child.

Parent signature _____

Date _____

This student has allergies/sensitivities to:

Topic Introduction Tools

Phenomenon, Big Ideas, Topic Bundle

How does the soil support the plants and animals in our community?

- How does the weather influence our lives?
- Given Earth’s limited resources, how can we use technology to help the Earth and all the creatures that live there?

In this unit students learn about various environmental factors that affect living organisms—weather and soil. Throughout the unit they will learn about what plants and animals need to survive and how they can get those needs met by their surrounding environment.

Essential Questions/Sub-Phenomena

Topical essential questions are used to help provide the “why” around each concept or standard students are learning. Also included are *bigger wonderings* to inspire deeper reflection and discussion.

- What common things do plants and animals need to survive?
- What are common patterns in the weather?
- How do we interact with the sun every day?
- Why is soil important?
- What can we do to support our environment?
- How do plants and animals change their environment to help them survive?

OWL and Pictorial Input Charts

OWL (observe, wonder, learn) charts and pictorial input charts (PIC)—otherwise referred to as anchor charts—are a great way to get students thinking about a topic area and give you a chance to see where they are with current understanding and possible misconceptions. Depending on your students you may choose to complete one or more of these activities with you leading the discussion or have the students work together in small groups.

A few possible starting prompts for OWL charts are:

- What can you describe about the weather?
- What do you think plants need to grow?
- Do you have any pets? What do you do to keep them safe?

A couple possible themes for PIC or anchor charts are:

- What do you know about soil? Can you draw a labeled diagram?
- Can you describe some patterns you see in the sky?
- How does what you wear change during the year?
- What happens to water when it gets cold? How about when it gets hot?

Note: A PIC is a great way to create a model of a concept that students can use as a reference throughout the unit.



What do you...

O.

Observe

W.

Wonder

L.

Learn

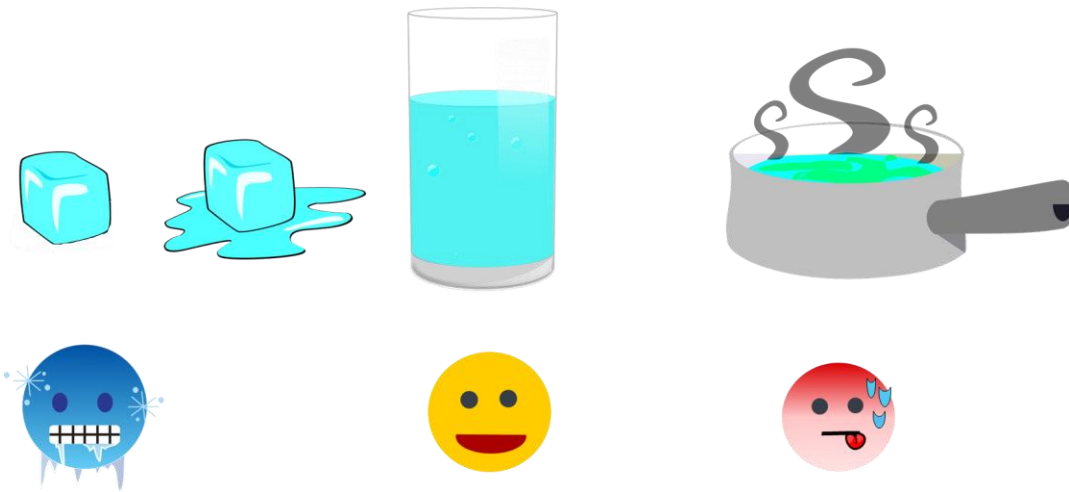
- What do you know about soil? Can you draw a labeled diagram?



- How does what you wear change during the year?



- What happens to water when it gets cold? How about when it gets hot?



What Do You See? What Do You Know? What Do You Want to Know?

Here are some sample pictures you would use for a What do you see? What do you know? What do you want to know? exercise with the *Soil Savers* unit.





Introductory Activity






What Grows Here?



Can you describe the different ground types?

What can grow there?

 <p>Sand</p>	 <p>Soil</p>
 <p>Rocks</p>	 <p>Pebbles</p>



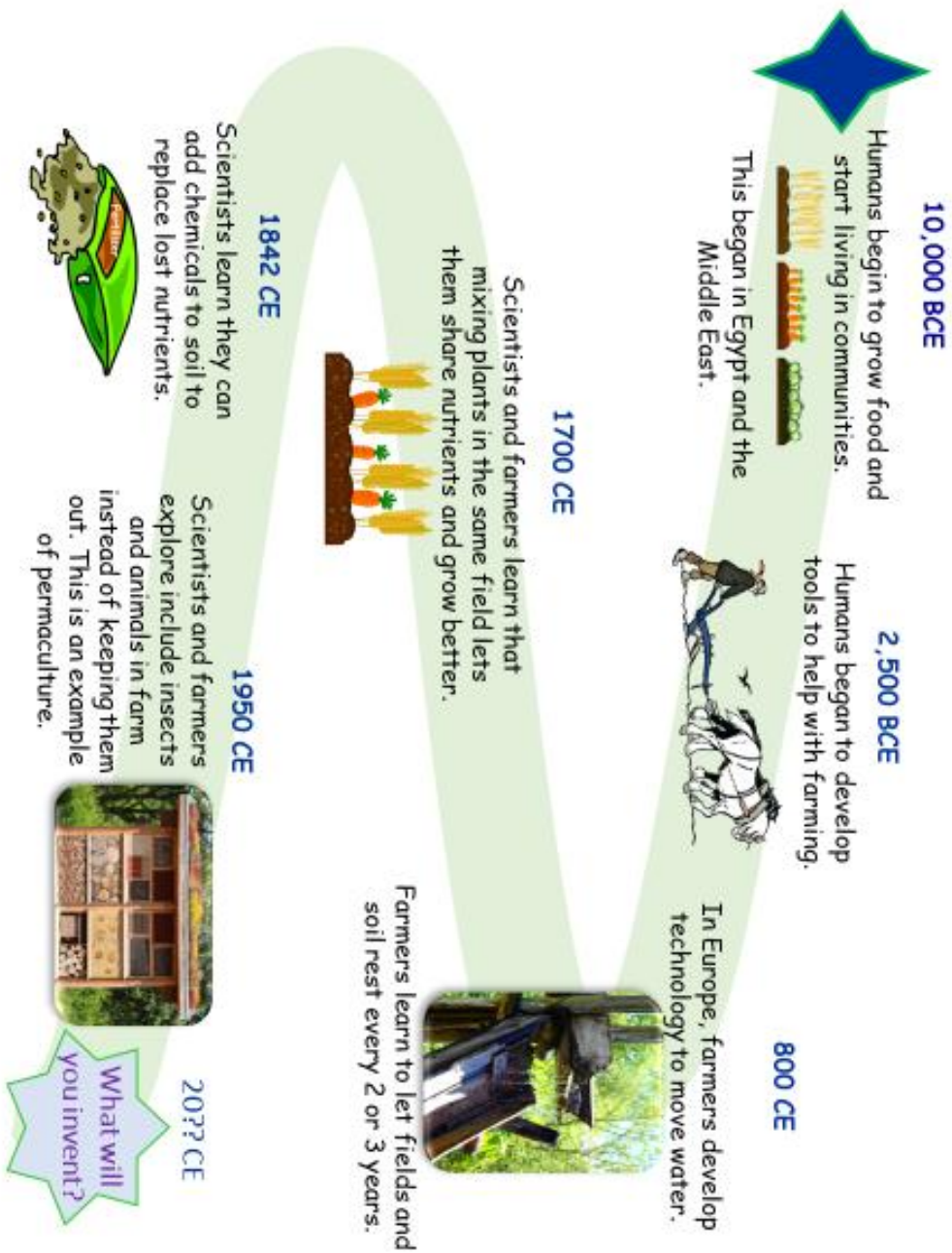
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Technology Historical Timeline

The Technology Historical Timeline is a great tool to use to give your students historical context for what they are learning and to show them how any single scientific discovery or understanding is built from all the discoveries and understandings that came before. In many cases, scientific discoveries only thrived if there was a community need they helped to solve.

The following worksheets contain several versions of the timeline you can use with your class.

- The completed timeline is one we think links critical events in the history of agriculture. As an activity you could have your students pick the top three events they think are most important on the timeline and then explain why they think those ones are important.
- Have your students pick one event on the timeline (e.g., moving water) and create another timeline that includes that invention. Some examples could be:
 - Different technologies to move and store water
 - Different tools that help with farming
- Print out the individual picture timeline events and have the students put them in order.
- You could take the blank timeline and have the students pick a different technology about which to create their own timeline.
- Use the sets of related events and ask your students to propose which one came first and why.





1950 CE

Scientists and farmers explore include insects and animals in farm instead of keeping them out.



0?? CE

what will you invent?



1842 CE

Scientists learn they can add chemicals to soil to replace lost nutrients.



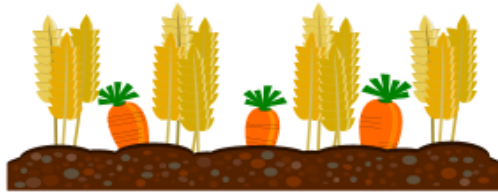
0?? CE

what will you invent?



1700 CE

Scientists and farmers learn that mixing plants in the same field lets them share nutrients and grow better.



1700 CE

What will you invent?



800 CE

In Europe, farmers develop technology to move water.



Farmers learn to let fields and soil rest every 2 or 3 years.

800 CE

What will you invent?

~ 2,500 BCE

Humans began to develop tools to help with farming.



20?? CE

What will you invent?

10,000 BCE

Humans begin to grow food and start living in communities.



This began in Egypt and the Middle East.

20?? CE

What will you invent?

Which tool came first?



Tractor and Plow

or

Horse and Plow



20?? CE

What will you invent?

Which technology came first?



Moving Water

or

Chemicals for Plants



20?? CE

What will you invent?

Which event came first?



Mixed Plants

or

Insect Hotel



20?? CE

What will
you invent?

Exit Ticket Support

Exit tickets are a great method for quick formative assessments. In some cases, they can also be used as a quick pre-assessment or a conversation starter.

How you use exit tickets for students in kindergarten depends significantly on the abilities of your specific group of students. A picture bank or agree/disagree statements* are a way to have all students complete the formative assessment at the same time. Additionally, a small group discussion is also a method that can be used to assess understanding.

For the higher grades, as a formative assessment strategy, students should hand you their completed exit tickets as they are transitioning to another activity (e.g., lunch, recess, gym, etc.). Exit tickets can be completed on index cards, half-sheets of paper, etc. and should only take about five minutes for students to complete.

Exit tickets help you assess if students have understood the main concepts from the preceding lessons. If not, you may choose to have an additional discussion or to repeat portions of the lesson so that students have additional time to explore and practice key concepts.

The list on the following page contains the Exit Tickets for this unit and some guidance on the type and range of student answers you should expect.

* Using agree/disagree statements.

Set up one side of the room with a sign that says “I agree” and a thumbs up sign, and the other side of the room with have a sign that says “I disagree” and a thumbs down sign. Then read the exit ticket in the agree/disagree format. Give students about 15 – 30 second to think about whether they agree or disagree with the statement and then ask them to move to the side of the room that matches their decision.


1. Name one important thing the soil provides.
2. Name or draw two important things the soil provides.
 - a. Some things that soil provides are nutrients, water, minerals, structural support, and temperature regulation.
3. Describe (in pictures or words) two different types of weather.
 - a. Types of weather include sunny, rainy, snowing, cold, foggy and windy.
4. Describe one thing that plants MIGHT need to grow?
 - a. Some things most plants need to grow are water common nutrients come on air, sunlight.
5. What is something you can wear or use when it is cold?
 - a. Some examples include hats, scarf, jacket, mittens, sweater, etc.
6. What is something you can wear or use when it is raining?
 - a. Some things you can wear or use include a raincoat, rain boots and an umbrella.
7. What is something you can wear or use when it is sunny?
 - a. Some things you can wear include sunglasses, a hat with a wide brim light clothing or sunscreen.
8. What is something animals do to protect themselves from the hot or cold (pick the temp depending on the location and season)?
 - a. From the hot:
 - i. Shed their thick fur coats, sit in the shade, find water
 - b. From the cold:
 - i. Hibernate, eat more, grow thick fur coats.
9. Name two things that plants need to grow.
 - a. Plants need water and sunlight. Many plants also need nutrients.
10. Name two things the sun provides.
 - a. The sun provides light and heat.
11. Why is it important to think about the weather?
 - a. Thinking about the weather helps you prepare, stay warm, and grow plants.

My STEM Explorer™ Student Notebook

The next few pages contain the version of the My STEM Explorer Notes™ build-a-notebook included in your kit.

The digital content contains two versions of the My STEM Explorer Notes™ build-a-notebook that are differentiated based on expected reading and writing ability of the students. The A version maps roughly to the kindergarten level and the B version maps roughly to grades 1 or 2. The general content and page numbering is similar across both versions, with the main difference being in word density per page and writing space.

Your curriculum pack comes with the B version, but pages from the A version can easily be printed out and substituted where needed. Each curriculum pack comes with a class set of the A version. The online content webpage contains electronic copies of both versions that can be printed out in needed. Upon request, printed copies of the B version can be provided instead of the A version.





B

My STEM Explorer Notes™


Soil—It is more than just DIRT!

Soil Savers





How does the soil support the plants and animals in our community?



What Grows Here?



Can you describe the different ground types?
What can grow there?

 <p>Sand</p>	 <p>Pebbles</p>
 <p>Rocks</p>	 <p>Soil</p>

2

Vocabulary

Word	Definition	A Picture or Simplified Definition
Nutrient	A nutrient is food that gives us energy.	
Soil	Soil is a special kind of dirt that contains water, air, and nutrients.	
Organic	Something that is, or was, alive is called organic.	
Microbe	A microbe is a very very small living creature.	

3

Extra Vocabulary

Word	Definition	A Picture or Simplified Definition
Decompose	To decompose is when things that were living turn into nutrients.	
Humus	Humus is the organic part of soil.	
Topsoil	Topsoil is the top layer of soil. It has the most humus.	
Subsoil	Subsoil is below topsoil. It has more clay, sand and rocks than topsoil.	

4

Investigation

Weather Watchers



What types of weather do you know about?

We are going to watch the weather.

We are going to look for patterns in the weather.

5

Let's watch the weather. What patterns do we see?

Month

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

6

What patterns did you see this month?

Handwriting practice lines consisting of a solid top line, a dashed middle line, and a solid bottom line. There are four sets of these lines for writing.

What else did you observe?



Handwriting practice lines consisting of a solid top line, a dashed middle line, and a solid bottom line. There are four sets of these lines for writing.

9

Let's watch the weather. What patterns do we see?

Month

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

10

What patterns did you see this month?

Handwriting practice lines for the question "What patterns did you see this month?". The page features a grid background and decorative circular patterns. The writing area consists of six sets of horizontal lines, each set including a solid top line, a dashed middle line, and a solid bottom line.

What else did you observe?



Handwriting practice lines for the question "What else did you observe?". The page features a grid background and decorative circular patterns. The writing area consists of six sets of horizontal lines, each set including a solid top line, a dashed middle line, and a solid bottom line.

11

Weather Watchers Reflections

What temperature, sunlight and weather patterns happen each year?

Handwriting practice lines for the question "What temperature, sunlight and weather patterns happen each year?". The page features a grid background and decorative circular patterns. The writing area consists of ten sets of horizontal lines, each set including a solid top line, a dashed middle line, and a solid bottom line.

12



How Do We Use It?



Can you describe things we do with different ground types?



Sand



Pebbles



Rocks



Soil

13

What Is Soil?



Soil is not just dirt.



Soil is very important!

14

Soil is a mixture of many things.



The soil includes organic matter, minerals, gases,
liquids and living creatures.

Soil provides a home and food for plants to grow.



15

Soil provides homes for worms, bugs and helpful
microbes.



Soil helps to collect and clean water.



Soil also collects air.

16

Growing plants take nutrients and other good things out of the soil.



It is important to protect the soil. Farmers, scientists, engineers and entrepreneurs all work to keep the soil strong and nutritious.



Composting is one way people can help the soil. Composting adds nutrients back to the soil.

17

What makes soil special?

Soil is very important. Can you write about or draw a picture showing why soil is important?

- ✓ Humus
- ✓ Topsoil
- ✓ Subsoil
- ✓ Water
- ✓ Nutrients

18



Investigation

What Do We Need?

What you need

- ✓Cups
- ✓Soil
- ✓Seeds
- ✓Marker
- ✓Water



What do you think plants need to grow?

19

In this investigation we will change the amount of









20

We will change the amount of water by



We will change the amount of light by






We will change the amount of food by




21

My Experimental Conditions **Date:** _____

		
_____	_____	_____
_____	_____	_____
_____	_____	_____

We will watch our plants grow for _____

We will make observations on: 

Monday Tuesday Wednesday Thursday Friday

This is a picture of my experiment at the start.

- Include**
- ✓ Container
- ✓ Soil or sand
- ✓ Seeds

22

Date: _____

Date	What I Did	What I Saw

23

Date: _____

Date	What I Did	What I Saw

24

Date: _____

Date	What I Did	What I Saw

25

Date: _____

Class Observations

Use the table below to draw pictures or write about the plants grown under different conditions.

26

Conclusions

Draw and label the biggest plant.

Include

- ✓ Leaf
- ✓ Stem
- ✓ Roots
- ✓ Seeds

Discussion

What do you need to survive?

What does a dog or cat need to survive?

27

Meet Serg Albino and Ian Doromal,
Co-Founders of *ecoSPEARS*

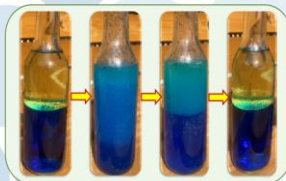
ABOUT SERG AND IAN



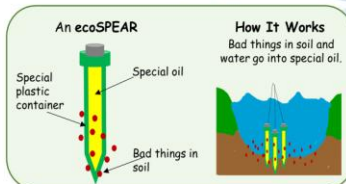
Serg was an engineer at NASA when he met Ian. They both wanted to help the environment.

BASIC SCIENCE

Oil and water do not mix.



GAME-CHANGING IDEA



The ecoSPEARS pull the bad things out of the soil. This cleans the soil.

28

How does ecoSPEARS help soil?



Why does the soil need to be cleaned?



29

Meet Virginia Emery, Co-Founder of Beta Hatch

ABOUT VIRGINIA



Virginia loves bugs and insects.

BASIC SCIENCE

Growing plants to feed farm animals removes a lot of nutrients from the soil.



GAME-CHANGING IDEA



Virginia grows insects, instead of plants, to feed farm animals to help protect the soil.

30

How does Beta Hatch use bugs to protect soil?



31

*Meet Jeremy Lang,
Co-Founder of Pela and Lomi*

ABOUT JEREMY



When Jeremy was young he saw how much food people wasted.

BASIC SCIENCE

Food waste has nutrients that would help soil but it often ends up in the garbage.



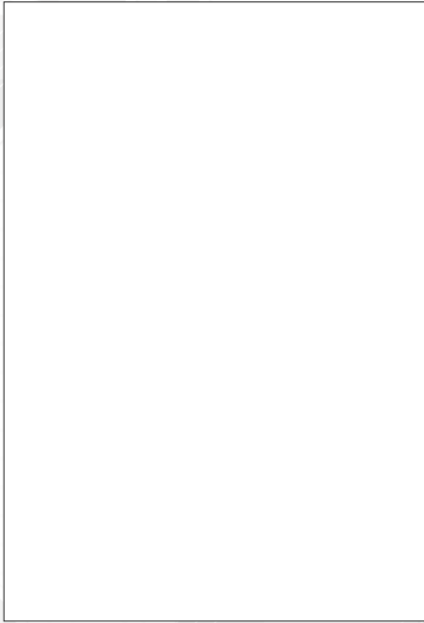
GAME-CHANGING IDEA



Jeremy and his team invented a fast-composting machine that can turn food waste into soil overnight.

32

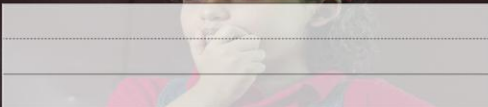
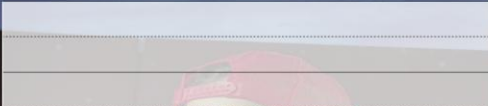
How do Jeremy and Lomi put nutrients back into the soil?



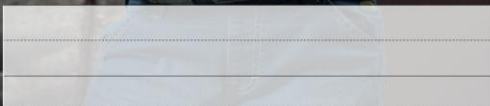
33

Making Connections

What patterns did you find in the weather?



What else did you see?



34

What does the sun do?

What does the rain do?

Can you have too much rain?

Can you have too much sun?

35

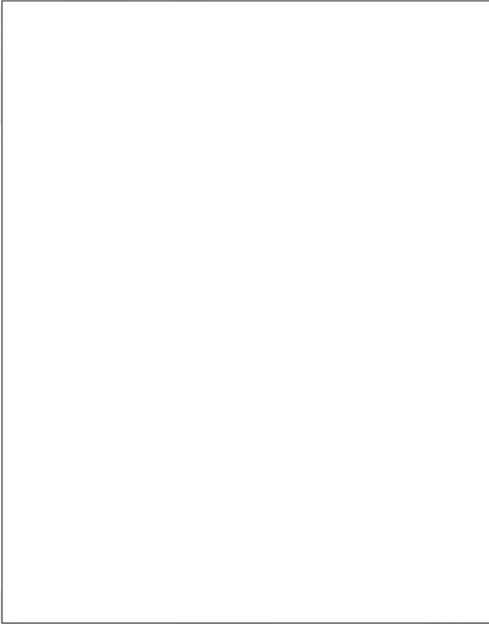
What do plants and animals need to survive?



How might the weather make it hard for plants and animals?

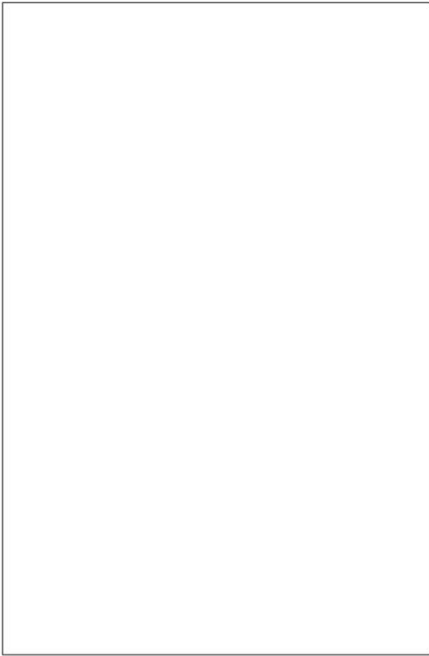
36

Can you design a device to help with too much sun?



37

Need more space? Draw a second version here.



Summative Challenge Support

The following pictures can be cut out and used in support of a **What We Need**.







Teacher Support Documents

The following resources have been recommended to us by a number of teachers who are a part of our CreositySpace community. While many of them are freely available via a quick internet search, we have included them here for your use. Where possible, we have given credit to the resource's creator.

1. Useful phrases for having constructive discussions
2. Cooperative learning strategies (A. Venegas)
3. ELPS scaffolds (N. Balayan, 2019)
4. Multidimensional strategies that support English language development
5. Claim-Evidence-Reasoning (C-E-R) student graphic organizer (A. Venegas)
6. Supporting students so that they will be more successful at constructing evidence-based explanations (A. Venegas)

Useful Phrases for Having Constructive Discussions

Kindergarten specific

Asking Clarifying Questions

- Can you give an example?
- Can you please explain your thinking?
- Could you say that one more time?

Adding to an Idea

- I would like to add to that idea.
- I agree with _____ and, would like to add _____.
- I know that too because _____.

Respectfully Disagreeing with an Idea

- Could you explain, because I have a different idea?
- I disagree with that idea because _____.

General

Asking Clarifying Questions

- Can you be more specific?
- Can you explain your answer further?
- Can you give an example?
- Can you please explain your thinking?
- Can you repeat what you said?
- Could you rephrase that?
- Could you say that one more time?
- Did I hear you correctly what you said ... ?
- Did I hear you say ... ?
- Did I understand you when you said ... ?
- Is this what you said: _____ ?

What do you mean by _____?

What's another way you might ... ?

What is your evidence?

What resources were used for this project?

Adding to an Idea

I agree with _____ because _____.

I agree with _____.

I agree with _____, but I also think _____.

I agree with _____, but would like to add _____.

I agree, but I have an addition: _____.

I believe this is true because _____.

I know that too because _____.

I have something to add; _____.

I think you are right, but I also think _____.

I would like to add to that idea.

This reminds me of _____ because _____.

Yes, that makes sense, but I would also like to add _____.

Respectfully Disagreeing with an Idea

Could you explain, because I have a different idea.

I disagree with that idea because _____.

I disagree with your reasoning because _____.

I disagree with _____ because _____.

I have completely different opinion on that.

I respect your opinion but _____.

I respect your point, but in my opinion _____.

I respectfully disagree because _____.

I see your reasoning but disagree with some of the idea because _____.

That's a good point, but _____.

Cooperative Learning Strategies

There are some popular strategies that can be used with all students to learn content (such as science, math, social studies, language arts, and foreign languages). However, they are particularly beneficial to ELLs for learning English and content at the same time. Most of these strategies are especially effective in teams of four.

1. Round Robin
Present a category (such as names of mammals) for discussion. Have students take turns going around the group and naming items that fit the category.
2. Roundtable
Present a category (such as words that begin with b). Have students take turns writing one word at a time.
3. Write-Around
For creative writing or summarization, give a sentence starter (for example, if you give an elephant a cookie, he's going to ask for...). Ask all students in each team to finish that sentence. Then, they pass their paper to the right, read the one they received, and add a sentence to that one. After a few rounds, four great stories or summaries emerge. Give children time to add a conclusion and/or edit their favorite one to share with the class.
4. Numbered Heads Together
Ask students to number off in their teams from one to four. Announce a question and a time limit. Students put their heads together to come up with an answer. Call a number and ask all students with that number to stand and answer the question. Recognize correct responses and elaborate through rich discussions.
5. Team Jigsaw
Assign each student in a team one fourth of a page to read from any text (for example, a social studies text), or one fourth of a topic to investigate or memorize. Each student completes his or her assignment and then teaches the others or helps to put together a team product by contributing a piece of the puzzle.
6. Tea Party
Students form two concentric circles or two lines facing each other. You ask a question and students discuss the answer with the student facing them. After one minute, the outside circle or one line moves to the right so that students have new partners. Then pose a second question for them to discuss. Continue with five or more questions.

After each cooperative learning activity, you will want to debrief with the children by asking questions such as: What did you learn from this activity? How did you feel working with your teammates? If we do this again, how will you improve working together?

ELPS Scaffolds

Level 1	Level 2	Level 3	Level 4	Level 5
WHOLE CLASS:	WHOLE CLASS:	WHOLE CLASS:	WHOLE CLASS:	WHOLE CLASS:
Minilesson: <ul style="list-style-type: none"> - Visuals (video) - Stop and ask questions - Wait time - Private reasoning - Clarify vocab - Graphic organizer - Collecting feedback - TPR/realia - Modeling (verbally, in writing, ELMO) - Multiple representations - Analyzing sample work 	Minilesson: <ul style="list-style-type: none"> - Visuals (video) - Stop and ask questions - Wait time - Private reasoning - Clarify vocab - Graphic organizer - Collecting feedback - TPR/realia - Modeling (verbally, in writing, ELMO) - Multiple representations - Analyzing sample work 	Minilesson: <ul style="list-style-type: none"> - Visuals (video) - Stop and ask questions - Wait time - Private reasoning - Clarify vocab - Graphic organizer - Collecting feedback - TPR/realia - Modeling (verbally, in writing, ELMO) - Multiple representations - Analyzing sample work 	Minilesson: <ul style="list-style-type: none"> - Visuals (video) - Stop and ask questions - Wait time - Private reasoning - Clarify vocab - Graphic organizer - Collecting feedback - TPR/realia - Modeling (verbally, in writing, ELMO) - Multiple representations - Analyzing sample work 	Minilesson: <ul style="list-style-type: none"> - Visuals (video) - Stop and ask questions - Wait time - Private reasoning - Clarify vocab - Graphic organizer - Collecting feedback - TPR/realia - Modeling (verbally, in writing, ELMO) - Multiple representations - Analyzing sample work
DIFFERENTIATION:	DIFFERENTIATION:	DIFFERENTIATION:	DIFFERENTIATION:	DIFFERENTIATION:
Group/pair work: <ul style="list-style-type: none"> - Intentional grouping - Graphic organizer - Structured talk - Sentence frames - Translations - Pictures - Word bank - Multiple pathways Individual work: <ul style="list-style-type: none"> - Translations - Sentence frames - Graphic organizer - Vocabulary - Different ways to show what they know - Extended time - Making connections between representations 	Group/pair work: <ul style="list-style-type: none"> - Intentional grouping - Graphic organizer - Structured talk - Sentence frames - Translations - Pictures - Multiple pathways Individual work: <ul style="list-style-type: none"> - Translations - Sentence frames - Vocabulary - Graphic organizer - Different ways to show what they know - Making connections between representations 	Group/pair work: <ul style="list-style-type: none"> - Intentional grouping - Graphic organizer - Structured talk - Sentence frames - Multiple pathways Individual work: <ul style="list-style-type: none"> - Graphic organizer - Vocabulary - Making connections between representations 	Group/pair work: <ul style="list-style-type: none"> - Intentional grouping - Graphic organizer - Structured talk - Multiple pathways Individual work: <ul style="list-style-type: none"> - Graphic organizer - Making connections between representations 	Group/pair work: <ul style="list-style-type: none"> - Intentional grouping - Graphic organizer - Structured talk - Multiple pathways Individual work: <ul style="list-style-type: none"> - Graphic organizer - Making connections between representations

Multidimensional Strategies That Support English Language Development

When planning for instruction, use a variety of strategies, techniques, and materials for making grade-level core curriculum accessible for English language learners while at the same time promoting their English language development. The chart below provides examples of sensory, graphic, and interactive supports for English language development within each lesson. Use at least one strategy from each column daily (for example, when showing videos, use the graphic organizer to take notes in addition to providing students with an opportunity to turn and talk with partners).

Sensory Support	Graphic Support	Interactive Support
Real-life objects	Charts	In pairs or partners
Scientific instruments	Graphs	Small groups
Measurement tools	Tables	Whole group
Physical models	Number lines	Using cooperative group structures
Natural materials	Timelines	Using the internet or software programs
Actual substances	Advanced organizers	In student's native language
Organisms or object of investigation	Drawing	With mentors
Posters/illustrations of processes or cycles	Models	Other
Illustrations and diagrams	Graphic organizers (Venn diagram, T-chart, cycles, cause and effect, semantic web)	
Pictures, icons, and symbols	Other	
Videos and films		
Interactive investigations		
Photographs		

Support is an instructional strategy or tool used to assist students in accessing content necessary for classroom understanding or communication. Support may include teaching techniques, such as modeling, feedback, or questioning. Other types of support involve students using visuals or graphics, interacting with others, or using their senses to help construct meaning of oral or written language. We believe that support is important for all learners to gain access to meaning through multiple modalities, but it is absolutely essential for ELL.

Claim-Evidence-Reasoning (C-E-R) Student Graphic Organizer

Question: _____

<p style="text-align: center;">C (Claim)</p> <p>Write a statement that responds to the question.</p>	
--	--

<p style="text-align: center;">E (Evidence)</p> <p>Provide scientific data to support your claim. Your evidence should be appropriate (relevant) and sufficient (enough to convince someone that your claim is correct). This can be bullet points instead of sentences.</p>	
--	--

<p style="text-align: center;">R (Reasoning)</p> <p>Use scientific principles and knowledge that you have about the topic to explain why your evidence (data) supports your claim. In other words, explain how your data proves your point. (Use paragraph format.)</p>	
--	--

Need help with your reasoning?

Follow this path....

Step 1

- Restate your claim.

Step 2

- Provide some scientific principles/knowledge that you already have about the topic.

Step 3

- Provide data from the investigation/research that connects to the scientific principles/knowledge you mentioned in step 2. Show that your data/information/evidence can be used to prove or support (justify) your claim.

Step 4

- Wrap up your reasoning with a conclusion sentence that begins with a word such as “Therefore,” “Hence,” “Thus,” or “So,” and then restate your claim.

Supporting Students So That They Will Be More Successful at Constructing Evidence-Based Explanations

Setting students up for success

To help students successfully construct evidence-based explanations, it is imperative that you provide support in time for formulating ideas before you ask students to formally talk or write about their final explanations in front of “high-stakes” audiences such as you and the whole class. The following steps have helped me ensure that students have the ideas, skills, language, and confidence necessary for success in my science classes. Everything I've included here came from 10 years of collaboration with numerous specialist at schools where I've worked. When you have a student with special needs or ELL students, I recommend talking about specific strategies that you can try in your classroom. No strategy will work like magic, but overtime you will find ways to support learning for every student.

Step 1: Structured rehearsal time to prethink and prewrite

[This usually last for two to three days about a week before I expect students to have a polished version of their explanations to share publicly.]

STRUCTURED PRETHINKING AND PREWRITING

Students need lots of structure, scaffolding, and time to think about their ideas and to write or draw their ideas in small pieces.

- Prompt students to write or draw their explanation in narrative form like a storyboard. Students should be telling or showing their ideas about the beginning, middle, and end of the phenomenon. For example:

Beginning:	Middle:	End:

WRITING SCAFFOLDS

Use writing scaffolds to support students’ writing in the bottom row of their storyboard. I provide a mixture of generic writing scaffolds that students can use in any explanation for any science idea and specific writing scaffolds are only useful in the context of one particular assignment . For example:

1. Sentence starters—help students by giving them a running start for some sentences.
 - a. Examples: “The rollerblader starts his gliding motion by....” “One reason this happens is because....” “This made me think that....”

2. Sentence idea banks—help students by prompting specific science ideas for a particular explanation.
 - a. Examples: “In your explanation, be sure to use these ideas: push, drag, normal force, friction force,....”
3. Sentence transition phrases—help students by providing connecting words/phrases characteristic of academic writing.
 - a. Examples: “In addition,....” “Therefore,....” “But another possibility is....” “Because....”
4. Science concept cards—help students utilize science terminology while writing.
 - a. Examples: Students build a collection of cards with terms, drawings, and student-generated definitions. Students are free to use these cards whenever they are working on tasks in class or on homework assignments. A Word Wall can serve a similar function.

STRATEGIC PARTNERSHIPS

This prethinking or prewriting task can be done individually or in pairs where the partners have been strategically selected to support the specific needs of certain students. The goal when planning strategic thinking or writing partnerships is to distribute the cognitive load across two people without totally removing the cognitive load from either student. It takes time to build a culture where two students have learned how to be good partners. As students develop throughout the year, this scaffolding can be reduced and eventually removed.

- Consider pairing two same language ELL students where one student has developed slightly more advanced English language skills so that students could switch back and forth between languages. Consider allowing ELL students to communicate in a language other than English and work on translating into English later. However, I would not want students to be excluded from using English or excluded from hearing academic English (students need to use and hear academic English in order to learn academic English). Use these pairings sparingly—introduce this practice as students progress throughout the year.
- Consider pairing certain special needs students with patient and helpful students who can serve as sounding boards, writing tutors, or reminders to stay focused. However, remember that there is a lot to consider here:
 - Students won’t learn to develop literacy skills (like writing) if they are never allowed to write so I wouldn’t have a student serve as the scribe for another student with learning disabilities unless an IEP specifically directed me to do so.
 - I would have Student Services scribe for a student with a physical disability (like when I had a student with cerebral palsy who is unable to write or draw for himself).

Step 2: Rehearsing evidence without adding more writing

[This usually takes one more day.]

Once you have a student-generated artifact representing students' explanatory models, you can ask them "How do you know this part works this way?" and see if students can connect the "parts" of their story to some specific experiences. Students can add these connections to experience and evidence by placing a sticky note with a short phrase on their story board. When working with students who have typically struggled in school, it is important to pay attention to your tone of voice and social cues when asking questions like "How do you know?" Students can interpret this as a challenge or a put down, which can cause them to shut down or become defensive. Instead, explained to students that you want them to figure out how they learned about parts of their explanation and then pose your question.

Step 3: More rehearsal and time to rethink and rewrite

[This usually takes one more day.]

After each student has worked out their ideas, then students should be ready to communicate with a partner or very small group. However, it's probably not safe to try to have vulnerable students try to communicate in front of a whole group yet, so don't skip this step. Pair-sharing or very small group sharing time allows students to do two things: (1) rehearse their own ideas and language with a small audience and (2) grab ideas and language from their peers as well. You should build in some time for students to add to their storyboards, to delete or change their ideas after hearing from their peers.

Step 4: The big performance—talking in front of the whole class and the teacher

Now students might be ready to engage in the official dialogue as outlined in this steps of discourse tool 3. If you have done the prep work described here, students will have already formulated and rehearsed their ideas, gathered their thoughts, and tried out some language. When they are now asked to say things out loud (to you or to the whole group) it's not about trying to think on their feet or speak off the top of their head, it's about telling a story that has been rehearsed a little bit over the previous days of class time. Timeframes for all of these steps will condense of it as students become more proficient and comfortable over the year.

Step 5: The final product—contstructing a polished version of an evidence-based explanation

After all of this, you could ask students to polish up their work from the previous week and write or draw a final draft of their evidence-based explanation.

I often work with colleagues from literacy and language classes to develop science writing, paragraph writing, and essay writing support that is consistent across students' subject areas. Many schools use a writing model to assist students when writing paragraphs and essays.

Lesson Planning

The remaining pages are provided for you to use for lesson planning.

Preparation:

Day/Week	Class Activities

