GARDENS THAT POP

A 3-5 STEM EXPERIENCE

Created by C.I.T STEM Curriculum Team

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About this Experience

Gardens that Pop! integrates environmental science, art, literacy, and social emotional learning in a comprehensive study of our indelible connection to one another through our connection to and dependence upon plants.

Students will learn about the anatomy of seeds, the life cycle of plants, and how plants communicate. They will have the opportunity to create their own Lego planter to grow mint, which they can take home and share with their families. They will also plant their homemade wildflower seed bombs to add to the biodiversity and to beautify their community. All observations and reflections will be recorded in personalized Science Journals, which students can use to document their learning and growth throughout the program.

The Experience will culminate with a field trip to learn about composting, extending student learning and providing inspiration for future garden projects. By participating in Gardens that Pop!, students will develop essential skills, knowledge, and attitudes related to environmental awareness, plant care, and community engagement.

Note to Activity Specialist

NY Edge is thrilled to have you leading this experience! You will lead students on a journey of discovery, exploring the far-reaching impact of plants around the world.

During this program, students will dive into a variety of plant-related topics, including the anatomy of seeds, plant life cycles, and plant communication. Students will discover that although plants may appear passive and quiet, they actively communicate with one another and with other species. Scientific studies have revealed that they are also quite sensitive to negativity, just like us!

To ensure a smooth experience, please be sure to read all lessons in advance, so you have adequate time to prepare and organize all necessary materials. You will need a laptop or iPad with internet access to display videos and Google slides that are linked in the lessons.

The Essential Question will serve as the guiding theme for the program, and the Enduring Understanding will summarize the core concepts that students will explore throughout each lesson. These tools will help you tailor your instruction to meet the learning objectives and outcomes of the program.

We hope you and the students will enjoy exploring the power of plants through this exciting program. Thank you for your commitment to helping students grow their knowledge and appreciation of the natural world.

Family Letter

Greetings NY Edge Families!

We are thrilled to embark on an exploration of our deep connection to and reliance on plants.

Through hands-on explorations, students will delve into the fascinating world of plants, from planting mint seeds to creating wildflower seed bombs that beautify their community and support vital pollinators such as bees and butterflies.

We will study seed and plant anatomy and examine the different stages of a plant's life cycle, all of which will be recorded in students' personalized science journals.

Plants connect us to one another. They are crucial for our survival. All of our food comes from plants directly, or from animals that eat plants. Plants provide nutrition, medicine, clothing, shelter, fuel, and purify the air we breathe. They also beautify our communities. Plants are also communicators. If we slow down and start listening with greater intention, perhaps we will understand them, ourselves, and the world a little better.

Here are questions to help start conversations at home around plants:

- Why do plants need the sunlight?
- How do plants drink water?
- What do plants need to grow?
- How do plants and animals help each other?
  What are some ways we use plants in our daily lives?

Here are some recommended resources about plants that you might find informative and engaging:

- Cucumber Mint Salad with Lemon Mint Dressing
https://www.youtube.com/watch?v=kI1UdLNNVPo
- Composting Service on Wheels Appears in New York City
https://www.youtube.com/watch?v=EIKGmKZ9Qao
- Make Compost with a Sandwich Bag
https://www.youtube.com/watch?v=QA7GzLYjk64
- What is a Carbon Footprint? What Can You Do About Yours?
https://www.youtube.com/watch?v=YseZXKfT_yY
- NASA Climate Kids
https://climatekids.nasa.gov/menu/big-questions/
- Plants Use an Internet Made of Fungus
https://ed.ted.com/best_of_web/4uORORJx
- Find a Community Park Near You (NYC Parks Dept.)
https://www.nycgovparks.org/greenthumb

We can't wait to get started on what is sure to be an enriching experience. Please do not hesitate to reach out with any questions or concerns. Email: STEM@NewYorkEdge.org

Warmly,
The NY Edge STEAM Team

Materials

Experience Slide Deck

Laptop or iPad to share videos and Google slides
Science journal (one per student)
NYC stickers (1 package per class)
Plant stickers (1 package per class)
Large chart paper
3 different colored packs of post-Its
Lego
Mint Seeds (3 seeds per student)
4" square plastic nursery pot (one per student)
Soil
Compostable plastic spoons (one per student)
Water
Spray bottles
White paper (one piece per student)
Pencils (one per student)
Colored pencils/markers

Seed Bomb Materials: (source)
Wildflower seed mix
Air-dry clay (water-based)
Rolling pins (one per student)
Large heart metal cookie cutter (one per student)
Wax paper (one roll per class
3 large cookie sheets (per class)
3 water sprayers filled wit water

Pop Up Card Materials:
Jewel stickers (one order per class)
Floral stickers (one order per class)
Glitter glue (2 orders per class)
Blue card stock paper (on pack per class)
Green card stock paper (one pack per class)
Colored construction paper (on pack per class)
Markers (one package for every two students)
Scissors (one per student)
Glue sticks (one for every two students)

Ziplock Greenhouse:
Greenhouse template (printed on green card stock;
one Sandwich-sized Ziploc bags (one per student)

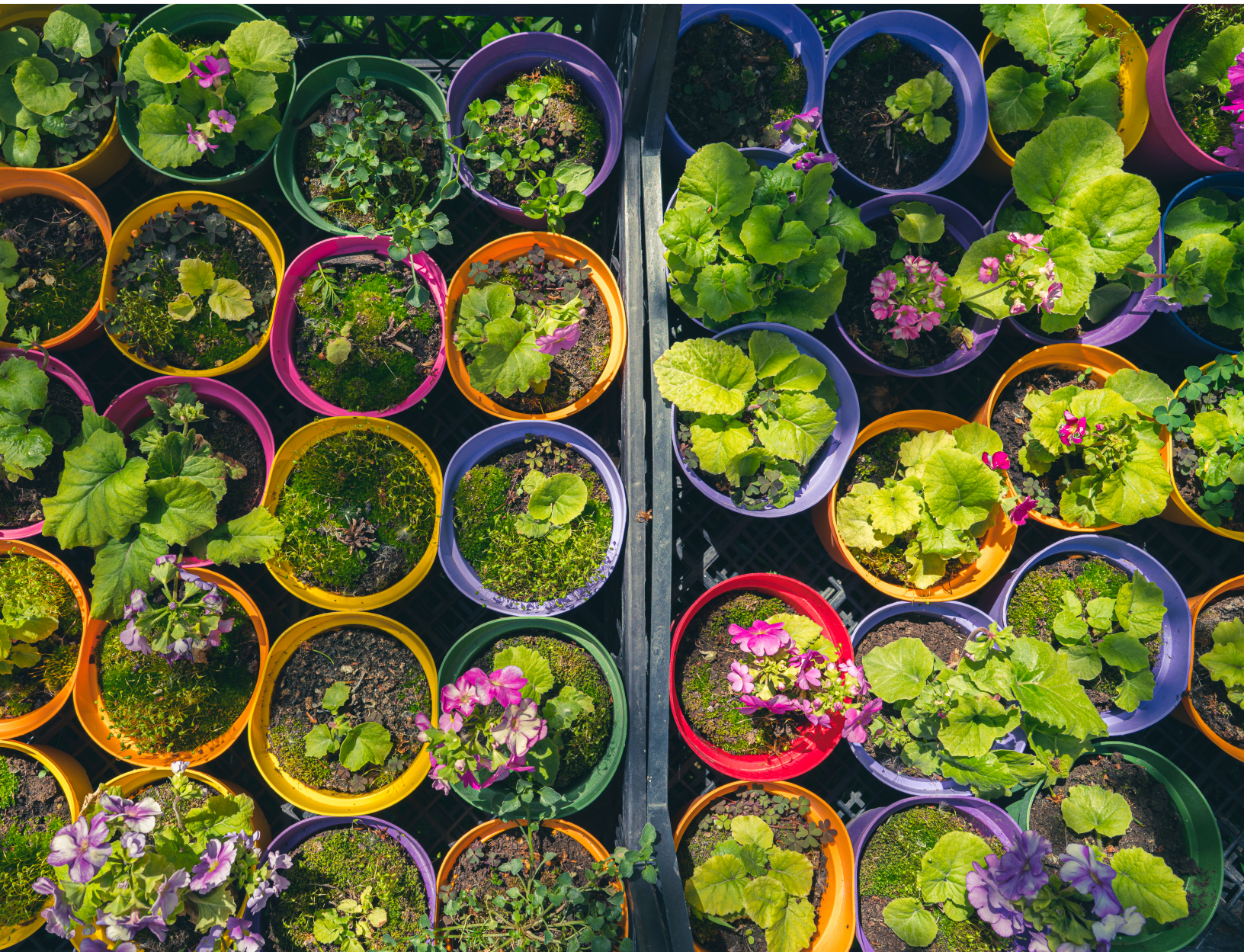
Permanent black markers (one per student)
Lima, pinto, mung, black-eye pea, and lentil
(one legume per student for a total of 5 legumes)
Scotch tape (one roll for every 6 students)
Paper towels (one sheet for every student)
Spray bottle
Water

Essential Question: How do plants connect all life on earth?

Enduring Understanding: Plants are a critical part of the ecosystem, connecting all life on Earth. As primary producers they make food for all living things. Plants help balance the Earth's climate by removing carbon dioxide from the air and releasing oxygen. Plants provide shelter, medicine, building materials, and fuel.

Overview of Lessons:

Week 1 Topic: Exploring the Power of Plants
Week 2 Topic: Decoding the Language of Plants
Week 3 Topic: Crafting Nature's Beauty with Botanical-Themed Pop-Up Cards
Week 4 Topic: Seed Bombing for a Greener Future
Week 5 Topic: Exploring Sustainable Practices through Composting & DIY Greenhouses
Week 6: Field Trip - Exploring the Benefits and Techniques of Composting



Vocabulary

- Adaptation: a characteristic (i.e., a physical trait or behavior) of a living thing that helps it survive in its environment; also, a natural process by which a living thing becomes suited to its surroundings
- Adhesion: the process in which different particles stick together
- Airborne: transported by air; flying
- Biodiversity: the rich variety of life on Earth
- Bullying: hurtful or teasing threat, abuse, aggressive intimidation
- Capillary action: when liquid flows in a narrow space (or within the spaces of a porous material) against the force of gravity due to the forces of adhesion, cohesion, and surface tension
- Climate change: refers to long-term shifts in temperatures and weather patterns; Since the 1800s (Industrial Revolution), these shifts have primarily been driven by human behavior and activities, but also do naturally occur
- Cohesion: particles of the same substance sticking together
- Composting: the natural process that occurs when organic matter breaks down into a granular material; compost is rich in nutrients and is great for organic fertilizer
- Decomposer: an organism that breaks down dead, organic material (i.e., bacteria, fungi, worms, insects)
- Decomposition: to break up into its smaller parts; decay, rot
- Dispersal: the act of spreading something over a large area
- Embryo: tiny, undeveloped plant inside the seed
- Food web: consists of all the interconnected food chains in an ecosystem; includes producers, consumers, and decomposers
- Floral: made of or decorated with flowers
- Germination: the sprouting of a seed (or spore), usually after a dormant period
- Hydroponics: method of growing plants in nutrient solutions without soil
- Landfill: a system of trash disposal in which the garbage is buried
- Leaves: part of a plant attached to a stem; helps plants collect sunlight to make their food through ha process called photosynthesis
- Life cycle: the series of changes in the life of an organism (includes reproduction)
- Microorganism: an organism that can only be seen with a microscope
- Mycorrhiza (plural: mycorrhizae): the symbiotic association between plant roots and fungi; their primary role; permits the plant to get additional moisture and nutrients
- Native: born or raised in a particular place; a local resident (indigenous)
- Network: interconnected system

Vocabulary

- Nitrogen: a colorless, odorless, tasteless gas that makes up most of the Earth's atmosphere and is needed for organisms to survive
- Nutrients: molecules in food (i.e., proteins, fats, carbohydrates, vitamins, minerals) that all organisms need to make energy, grow, develop, and reproduce
- Organic material: matter that comes from the remains of recently living organisms such as plants and animals, and their waste products in the environment
- Oxygen: a colorless, odorless, tasteless gas needed for plant and animal life
- Photosynthesis: the process in which green plants use sunlight to make their own food; necessary for life on Earth; without it there would be no green plants; without green plants there would be no animals
- Pollinator: an insect or animal that transfers pollen from one plant to another to help it reproduce
- Ratio: a comparison of two or more numbers (of the same unit) that indicates their sizes in relation to each other
- Receptor: a cell, or group of cells that receive stimuli (i.e., anything that triggers a physical or behavioral change); sense organ
- Reproduce: the process by which plants and animals produce offspring
- Restoration: to renew; to return to its original form or condition
- Seed coat: hard outside shell of the seed; the seedcoat protects the embryo
- Seedling: a very young baby plant
- Sprout: a small growth on a plant; a new growth from a germinating seed; once the shoot reaches the surface, it becomes a sprout
- Stable: steady, well-balanced
- Storyboard: series of sequenced illustration that map out the important events of a story in order
- Subterranean: underground
- Vibration: tiny, very fast back-and-forth (or up-and-down) movements
- Xylem: tiny pipe-like vessels in a plant that transport water and nutrients from the soil to the stems and leaves

Week 1: Exploring the Power of Plants

Essential Question: How do plants connect all life on earth?

Learning Objectives:

- Students will evaluate the interconnected functions of producers, consumers, and decomposers within a food web of an ecosystem.
- Students will construct a unique Lego planter for cultivating their mint plant in a visually appealing way.
- Students will customize their science journal to record their observations and inquiries.

Materials:

·Experience Slide Deck
Internet access
- Laptop/iPad to show video
- Pencils (one per student)
- Lego compatible 5" X 5" base plates (one base plate per student)
- Lego (assorted bricks)
- Buckets (one bucket of filled with Lego for each group of 4 students)
- Mint seeds (3 seeds per student)
- Potting soil
- Compostable plastic spoons (one per student)
- 4" square plastic nursery pot (one per student)
- Water
- Spray bottles (3 per class)
- Science Journals
- NYC stickers (1 package per class)
- Plant stickers (1 package per class)
- Markers (one package for every two students)

Vocabulary:

- Biodiversity
- Carnivores
- Consumer

- Decomposer
- Drought
- Ecosystem
- Erosion
- Food web
- Herbivores
- Omnivores
- Pollinator
- Producer
- Restoration
- Stable

Instruction Description

Hook

Show students this 1-minute video: *Ecosystems – What are Producers, Consumers, & Decomposers?*

Ask: Are humans classified as producers, consumers, or decomposers? Why?

A: Consumers because we consume or eat food, without any ability to use energy and inorganic materials to produce our own food, or break down dead organic materials, like decomposers.

Ask: What are the 3 types of consumers?

A: Herbivores, carnivores, and omnivores.

Have students classify the organisms in the Google slide show as either a producer, consumer, or decomposer: *Producer, Consumer, or Decomposer?*

Teach/Demonstrate

All food webs include producers, consumers, and decomposers who are dependent upon one another for survival. There are three types of consumers: herbivores (plant eaters), carnivores (meat eaters), and omnivores (eat both plants and animals).

A food web shows uses a diagram with arrows to show the flow of energy through living systems. A food web is made up of many interconnected food chains. These food chains overlap and connect because most living things eat more than one type of plant or animal. For example, a hawk may eat both squirrels and fish, which makes it part of two food chains, or a more complex food web.

Show: *Food Chain vs. Food Web* Google Slides

Ask: What do the arrows in a food web represent?

A: The transfer of energy from one organism to another. For example, an arrow from a carrot to a bunny indicates that the energy from the carrot is transferred to the bunny that eats it.

Ask: Give an example of a natural ecosystem disturbance. Give an example of an ecosystem disrupted by human behavior.

A: (Answers will vary.) Examples of natural ecosystem disturbances: fires, floods, insect/pest outbreaks, droughts, hurricanes, windstorms, avalanches, volcanic eruptions, etc. Examples of human behavior that disrupts ecosystems: burning fossil fuels, overpopulation, pollution, habitat destruction/deforestation, introduction of invasive species (e.g., through cargo shipment, live food trading, traveling and packaging materials, etc.)

Optional Extension Questions for Grade 2:

Ask: Why does a healthy ecosystem need multiple species of different types to remain stable?

A: Ecosystems need biodiversity to remain stable. Biodiversity is all the different life forms you can find in one place. This includes the variety of animals, plants, fungi, and microorganisms like bacteria. Each of the species in an ecosystem work together to maintain balance and support life. If an ecosystem has many different types of species that are adapted to many different conditions, the ecosystem will have a greater chance of surviving disease, extreme weather, and climate change.

Optional Extension for Grade 3: Have students watch the 7-minute read aloud *Tiny Creatures: The Invisible World of Microbes*

Ask: Why is it crucial to protect ecosystem biodiversity?

A: Healthy ecosystems are biodiverse. We depend upon healthy ecosystems to purify the air, clean the water, maintain the soil, recycle nutrients, regulate the climate, and provide us with food. Healthy ecosystems provide the raw materials and resources for medicines.

Ask: What is one thing you could do to contribute to ecosystem restoration?

A: Show students the following 3-minute video: *What is Ecosystem Restoration?*

Examples include: create and protect greenspaces in our city, plant native trees and flowers, plant local fruits and vegetables, use mass transportation, buy locally-grown and in-season food (when possible), purchase sustainable products, Reduce/Reuse/Recycle

…

Today we are going to help restore our local ecosystem by planting mint. Mint attracts beneficial pollinators, including bees, wasps, hoverflies, and tachinid flies. When planted outdoors, its rapid, dense growth helps stabilize the soil, preventing erosion.

Mint not only has a refreshing aroma, but is included in many different types of recipes from around the world. It can be eaten plain to freshen your breath, relieve nausea and headaches, or used to make tea.

Teacher Note: At the front of the room, have:

- 1 large container of potting soil
- 3 spray bottles filled with water
- 1 square plastic nursery pot to each student
- 1 compostable plastic spoon to each student
- 3 mint seeds per student

Call up students in groups of three to take one square plastic nursery pot. Have them use one of the spoons to fill their pot between ¾”-1” below the rim with potting soil.

Have students lightly moisten the soil with a sprayer. Then plant the 3 mint seeds about 2-inches apart from one another, ¼” beneath the soil.

Distribute one bucket filled with assorted Lego pieces to each group of 4 students. Give every student one 5” X 5” Lego compatible base plate on which they will place their potted mint seeds to build a decorative “pot” or encasement around.

Here are examples made with larger Legos (called Duplo) that may serve as inspiration for students: IMAGES

Teacher Note: Students will transplant their seedlings in a sunny outdoor location about 3 weeks after they sprout, or when they have 1-2 sets of leaves.

Optional Information to Share: The invention of Velcro was inspired by the observation of burdock seeds sticking to clothing and fur. In 1941, a Swiss engineer named George de Mestral went on a hunting trip with his dog and noticed that the burrs of the burdock plant stuck to his clothes and his dog's fur. Upon examining the burrs under a microscope, he saw that they had tiny hooks that caught on to the loops of his clothing and his dog's fur.

The engineer was captivated by this natural mechanism and began experimenting with different materials to create a similar fastener. He eventually developed Velcro, which consists of two strips of fabric, one with tiny hooks and the other with loops. When the two strips are pressed together, the hooks catch on to the loops and create a strong bond.

Today, Velcro is used in a wide range of applications, from clothing and footwear to aerospace and transportation. Its ability to securely hold objects together without the need for screws, bolts, or other fasteners make it very useful. For example, Velcro is used to secure seating covers in place in airplanes and other vehicles. It is also used in personal protective equipment, such as helmets, gloves, and boots to provide a secure fit and allow for easy adjustment.

Independent Practice

As scientists, we will observe our planted mint with our sense of sight, smell, touch, and taste. We will record our observations in our Science Journals, to track changes over time. This will help us determine if our mint is thriving, or not doing well. Based on our noticings, we can make informed decisions on how to best care for our mint.

Today you will receive a Science Journal to personalize with drawings and very special stickers around the themes of plants and NYC.

Teacher Note: Distribute Science Journals, markers, and stickers to students. Students decorate their Science Journals.

Share

Students share their unique Lego pots and science journals.

Link

Today you planted mint from seed. Remember to water your mint when the soil is dry to the touch. You will most likely need to water it every 2-3 days. If the soil is dry the day after you watered it, add a bit more water. Throughout our time together, record your observations and inquiries in your science journals.

Exit Ticket: Have students record their response to the prompt in their Science Journal.

In your science journals, use colored pencils to draw a sample food web from a NYC park ecosystem. Include the sun and at least 6 organisms. Draw arrows to show the transfer of energy.

NYS Science Standards

- 5-LS2-1. Develop a model to describe the movement of matter among plants (producers), animals (consumers), decomposers, and the environment.

NYS Social Emotional Learning Standards

- 3A.2a. Demonstrate consideration for the safety and well-being of self and others.

Week 2: Decoding the Language of Plants

Essential Question: How do plants connect all life on earth?

Learning Objectives:

- Students will compare the communication systems of plants and humans.
- Students will storyboard an adventure story featuring a seed character of their own creation.

Materials:

- Experience Slide Deck
- Internet access
- Laptop/iPad for showing video
- Science journals
- Pencils (one per student)
- White paper (one sheet per student)
- Colored pencils/markers

Vocabulary:

- Airborne
- Bullying
- Chemicals
- Receptor
- Storyboard
- Vibration

Instruction Description

Hook

Show students this 2-minute video: Bully a Plant – Say No to Bullying

Ask:

- **What happened to the plants that received insults for one month?**
- **What happened to the plants that received compliments for one month?**

Although larger-scale, repeated experiments would need to be run to establish more solid conclusions, other scientific studies have shown that sound vibrations can trigger a response in plants through one of their receptors (called a mechanoreceptor).

Ask:

- **In what ways might people respond to bullying?**
- **Is it possible that the plants' response to bullying in this experiment has any similarities to the way humans might respond? Explain.**

Teach/Demonstrate

Plants are sensitive to their environment. They seem to be sensitive to the vibrations in our voice and the vibrations from other sounds in nature, including the buzzing of bees. They are also sensitive to the amount of sunlight, water, air, and space they are given.

Ask: What are you sensitive to in your environment?

Ask: Do you think different types of plants have different sensitivities? What about people?

Plants, like people, not only take in information from their environment, they also provide information to their surrounding environment. Plants communicate through odors, some of which we can perceive, and sound signals, which are not detectable by human ears, but are picked up by other plants and animals.

Have you ever smelled freshly cut grass?

The grass releases an odor to signal danger (i.e. the lawn mower) to nearby plants. In response to the grass's cry for help, neighboring plants prepare their own chemical defenses in an attempt to ward off danger. Plants' warning messages may be in the form of odors or sounds (vibrations).

Plants also release gases from its flowers, leaves, and roots, which act as airborne messages to communicate with insects. For example, plants will release a scent that attracts insects to eat pests that are currently munching on them.

Plants can even recognize their siblings through chemical signals! Plants sense nearby plants with whom they compete for resources. Scientists studied a flowering plant called sea rocket.

When grown in pots with relatives, they tended to restrict the growth of their roots, allowing their siblings room to grow. They did not extend the same courtesy when placed in pots with random plants. When planted next to strangers, the sea rockets grew more extensive roots to aggressively compete for resources.

Ask:

- **Can you identify any similarities between plant and human communication?**
- **Can you identify any differences between their systems of communication?**

A: Plants and humans have very different methods of communication, but both are able to communicate with their environment in their own ways.

Similarities:

Both plants and humans are able to perceive and respond to changes in their environment. Plants can detect changes in light, temperature, humidity, and other factors and adjust their growth and behavior accordingly. Similarly, humans are able to sense changes in their environment through their senses and respond in various ways.

Plants communicate using chemical signals. Some evidence suggests that humans can also communicate nonverbally through chemicals called pheromones that may influence social bonding.

Differences:

Plants do not have a nervous system or a brain, so their communication is more limited than that of humans. While plants can detect changes in their environment and respond accordingly, they do not have the capacity for conscious thought or decision-making.

Humans have a highly developed language system, which allows for complex and abstract communication. Plants do not have a language system in the same sense, although some researchers have suggested that they may have a rudimentary form of communication through the transmission of electrical signals.

Human communication is largely based on social interaction, while plant communication is more focused on survival and reproduction. Plants communicate with other organisms in order to attract pollinators, repel predators, or share resources, while humans use communication to establish relationships, convey information, and express emotions.

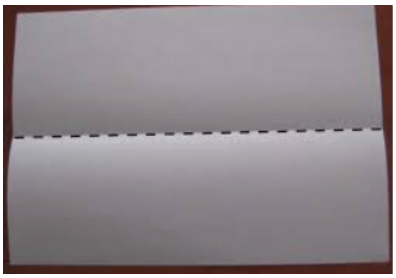
Independent Practice

Give each student:

- one sheet of white paper
- one pencil
- colored pencils/markers

Today we are going to storyboard an adventure of our own seed character. A storyboard is a series of illustrations that map out the most important events of a story in order.

To do this fold your paper in half horizontally.



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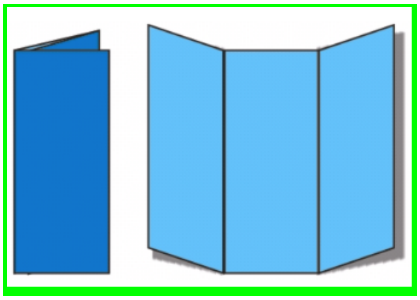
Then we will make a vertical trifold.



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The result of the two types of folds are 6 equal-sized boxes.

Teacher Note: You can watch the first minute of this video to clarify how to fold the paper into 6 equal-sized boxes: 6-box fold

Think about a name you would like for your seed. The name could be the word “seed” in a different language. For example, in Spanish, one word for seed is *semilla*. Then, come up with the 5 most important parts of your story.

You may brainstorm with a partner to develop potential ideas for your seed's adventure. For example, your seed might travel via wind, water, a person, or an animal from NYC to another big city and test out the new terrain to see if it can adapt and thrive. Or, you may want to illustrate the transformation of your seed into a plant and include thought bubbles to indicate what it is thinking at each stage of its transformation.

Once you settle on an idea to flesh out, break your story down into the 5 most important parts. Each part of the story will go in a separate box. There are 6 boxes because the first box is where you will write your title and the author and illustrator's name – that's you! You can also include an illustration in that first box (which would be similar to an illustration on the cover of a book). You can use speech bubbles to capture dialogue, thought bubbles, or captions if the story is in the 3rd person (outside narrator).

Share

Have students share their storyboards.

Link

Today we learned that plants are sensitive to their environment, just like us. They communicate with one another and different species through odors and vibrations. They can be competitive and territorial, but they can also be gracious and voluntarily share their space with relatives.

Next time we will be making 3-dimensional floral pop-up cards to give to a family member or friend.

Exit Ticket: Have students record their response to the prompt in their Science Journal.

Name one advantage of (nonverbal) communication for plants.

NYS Science Standards

- 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

NYS Social Emotional Learning Standards

- 2B.2c. Identify ways to respond when they experience or witness bullying and/or relational aggression, such as seeking support of a trusted adult, or demonstrating courage in speaking up for themself or a peer.

Week 3: Crafting Nature's Beauty with Botanical-Themed Pop-Up Cards

Essential Question: How do plants connect all life on earth?

Learning Objectives:

- Students will observe capillary action using two straws with different diameters in water colored with food coloring.
- Students will create a 3-dimensional floral card to give to a loved one with a meaningful message.

Materials:

- Experience Slide Deck
  - Internet access
- Laptop/iPad to show video
- Science journals
- Pencils (one per student)
- Water
- Food coloring (one bottle of one color)
- One plastic spoon
- Clear cup
- One thin straw
- One regular drinking straw
- One wider straw (used for milkshakes or smoothies)
- Blue card stock paper
- Green card stock paper
- Colored construction paper
- Markers
- Scissors (one per student)
- Glue sticks (one per student)
- Glitter glue
- Jewel stickers
- Floral stickers

Vocabulary:

- Capillary action

- Cohesion
- Xylem

Instruction Description

Hook

Show students this 3 ½-minute video: *Capillary Action in Action: How do Trees Get Water? With Eco Captain*

Teach/Demonstrate

Today we are going to learn how plants "drink" water by capillary action. In plants, capillary action takes place when the water climbs up the roots and stem against gravity due to the water being sticky against the inside surface of the roots and stem.

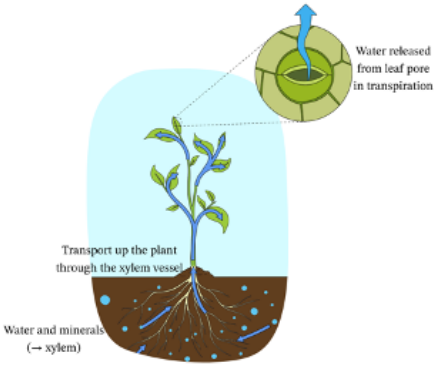
Capillary action depends on two things:

i) Cohesion, when particles of the same substance stick together and
ii) Adhesion, when particles of different substances stick together

When adhesion is strong enough, it can overpower cohesion between water molecules, allowing the water molecules to travel upwards to the top of a tree or plant! Basically, water molecules are attracted and stick to the molecules inside the stem, which helps push the water upwards from the ground to all of the plant's parts.

Without capillary action, trees and plants could not thrive because they would not be able to suck up the water from the roots to the branches and leaves. When excess water evaporates through the leaves, more water is drawn up from the roots.

Teacher Note: This is a diagram that may help you further explain capillary action in plants to students. Capillary action occurs through the plants' specialized tissue (i.e., xylem). These tiny pipe-like structures transport water and nutrients from the soil to the plant's stems and leaves. The blue arrows indicate the capillary action of water and nutrients through the xylem vessels.



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Optional Extension Question Grade 5:

Ask: Name one example of capillary action in everyday life?

A: a sponge absorbing water, dipping paper towels into water, placing a straw into a glass of water (the water will rise inside the straw a little higher than the rest of the water)

Let's observe capillary action in action!

Teacher Note:

Have the following materials at the front of the room:

- Water in a clear glass/beaker
- One tube of food coloring
- Plastic spoon
- 3 straws: one narrow diameter, one regular drinking straw, and one wide diameter

Have students come up to the front of the room with their science journals and a pencil to observe. Ask students to write down their hypothesis to the following question in their science journal:

- **Which straw do you think will draw up the most water through capillary action?**
- **Why do you predict that?**

Procedure:

1. Fill the glass with water.

2. Add 3-4 drops of food coloring.
3. Mix with a spoon.
4. Use scissors to trim all 3 straws to be of equal length.
5. Hold all 3 straws, carefully aligned, in one hand.
6. Place all 3 straws into the water, *without* touching the bottom of the glass for 30 seconds.

Have students record the following in their science journal:
How far up did the water travel in each straw? Was your prediction correct?

Ask:

- **In which straw did capillary action work best?**
- **Why do you think it worked best in that straw?**

A: The water traveled highest in the narrow straw, a little bit up the regular-sized drinking straw, and barely traveled up the widest straw. Capillary action works best when dissimilar substances interact with each other. In our case, the two substances are liquid water and a solid straw. When water molecules make contact with the straw, the water sticks to the inside of the straw. The wider straw makes it more difficult for the water molecules to stick to one another, allowing them to better stick (or adhere) to the inside of the wider straw.

Optional Extension for Grade 5: Show students 6 ½-minute video: *Capillary Action demo and science experiments!*

Independent Practice

Teacher Note: Here is an 11-minute video tutorial to help you teach the kids how to construct a 3-D card: Tutorial

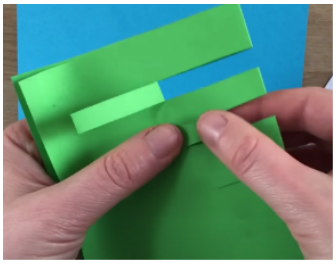
Distribute:

- Jewel stickers
- Floral stickers
- Glitter glue
- Scissors
- Construction paper (to cut out flowers, sun, plants, etc.)
- Glue sticks

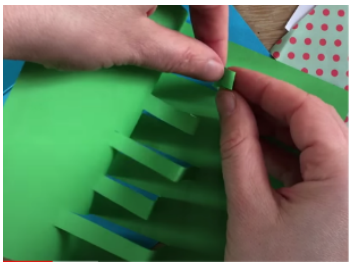
Demonstrate each step with students (It may be helpful to show the tutorial, pausing at each step):

1. Cut your green card stock into a rectangle that is slightly smaller than your full-sized piece of turquoise card stock.
2. Fold the turquoise cardstock in half with a firm crease. Set that paper aside. Fold the green sheet with a firm crease.
3. Keep the green sheet folded as you cut 2 long slits at the edge of the paper (about halfway across the paper). Then cut 2 shorter slits about 1/3 of the way across the paper next to the first two slits, then add 2 long, 2 short, and 2 long slits.

4. Keeping the green paper folded, gently lift the green cuts up and fold them up and back. These will be the 3D stems of the flowers.



5. Open the folded green sheet and turn these stems “inside out.”



6. Glue the green sheet inside the folded turquoise card stock. Keep the stems popping outward.
7. Now cut out flowers and glue them to your 3D stems. Instead of cutting out flowers, you may use floral stickers. I advise placing the sticker on a different piece of

paper, cutting it out, and then gluing it to the pop-up stem, so the sticky part of the sticker does not attach to another part of the card stock.

8. Now it is time to decorate and write a beautiful message inside your card!

Share

Students share their pop-up card creations.

Link

Exit Ticket: Have students record their response to the prompt in their Science Journal.

Explain (or diagram) how plants transport water from beneath the soil to different parts of the plant?

NYS Science Standards

- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.

NYS Social Emotional Learning Standards

- 3A.2a. Demonstrate consideration for the safety and well-being of self and others.

Week 4: Seed Bombing for a Greener Future

Essential Question: How do plants connect all life on earth?

Learning Objectives:

- Students will create wildflower heart-shaped seed bombs out of air-dry clay.
- Students investigate how several different seed adaptations impact their mode of dispersal.

Materials:

- Experience Slide Deck
  - Internet access
- Laptop/iPad to watch videos/Google slides
- Science journals
- Wildflower seed mix
- Air-dry clay (water-based)
- Rolling pins (one per student)
- Large heart metal cookie cutter (one per student)
- Wax paper
- 3 large cookie sheets
- 1 black permanent marker

Vocabulary:

- Adaptation
- Dispersal
- Native

Instruction Description

Hook

Play the first 6 ½-minutes of the video: *How do seeds get around?!*

Teach/Demonstrate

A plant typically produces many seeds. If all of the plants' seeds fell to the ground next to it, many of the seeds would not germinate due to overcrowding and competition for resources (i.e., water and nutrients from the surrounding soil). Seeds have developed adaptations to transport themselves to different locations to prevent this problem.

Seeds have a variety of physical traits that influence how they are transported, or dispersed from one place to another. Some seeds are transported by wind or flowing bodies of water. Some seeds are transported by animals. Some animals carry seeds in their fur or beaks. Others ingest the seed and poop it out in a new location. Others, like squirrels, bury seeds.

Show students the Google slides: *Seed Dispersal: What adaptations help these seeds relocate*?

Teacher Note: See notes in the note section beneath each slide for the name of the seed and how it is transported.

Independent Practice

Today we are going to make a heart-shaped seed bomb out of clay. Once our seed bombs are finished and have had time to fully dry, you can bring them home and choose a place in the community to launch it as a way to beautify your chosen area with wildflowers that will grow from the seeds embedded in your clay hearts. Flowers help bees and other pollinators thrive.

We selected wildflower seeds to put into our seed bombs because they should grow nicely in NYC during the summer. We chose a variety of wildflower seeds, so that we would have a better chance that some of the seeds would grow.

Teacher Note: Have the baking trays (or any type of tray) at the front of the class.

Distribute the following to students:

- A large piece of air-dry clay placed on a 6" X 6" piece of wax paper
(The size of the wax paper does not need to be measured; it is an approximation)
- One heart cookie cutter
- One rolling pin
- About 1 teaspoon of wildflower seeds.

Walk students through each step of the process:

1. Write each student's name in permanent marker in the top right corner of their wax paper.
2. Roll out your clay until it is about ¼-inch thick.
3. Use your heart-shaped cookie cutter to make a heart.
4. Remove the surrounding clay from the outside of the cookie cutter with your fingers.
5. Remove the cookie cutter from the clay.
6. Use your fingers to gently press the wildflower seeds into the surface of the clay heart. (The seeds do not need to be pressed too deeply into the clay – just enough to stick to the clay, without falling off. Students may be generous with the number of seeds they use, as not all of them will grow.)

Collect students' hearts (keeping them on the wax paper) and place them on the baking trays at the front of the room. Allow them to dry.

Share

Have students share where they plan to launch their seed bomb and why they chose that community location to beautify.

Link

Today we constructed seed bombs that we will launch to beautify our community. We purposefully selected seeds that should grow nicely in NYC during the summer. We chose a variety of wildflower seeds, to improve the chances of seed growth.

We did not want to select seeds that are not native to NYC. It can be problematic to introduce non-native plant species into a public space. Certain non-native plant species can become invasive and change a local ecosystem's food web by destroying or replacing native food sources.

Exit Ticket: Have students record their response to the prompt in their Science Journal.

Write the following questions on the board. Have students choose two of the four questions to answer:

1. What is one way that humans disperse seeds?
2. What is one way that animals disperse seeds?

3. What is one example of a seed adaptation that helps it relocate?
4. Do you think it is important for humans to disperse seeds? Why or why not?

NYS Science Standards

- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

NYS Social Emotional Learning Standards

- 3A.2a. Demonstrate consideration for the safety and well-being of self and others.

Week 5: Exploring Sustainable Practices through Composting & DIY Greenhouses

*Teacher Note: This lesson may take two sessions to complete.

Essential Question: How do plants connect all life on earth?

Learning Objectives:

- Students will identify at least three benefits of composting.
- Students will determine which items are compostable using photographs from a Google slideshow.
- Students will construct a Ziploc bag "greenhouse" to sprout various legume seeds.

Materials:

- Experience Slide Deck
  - Internet access
- Laptop/iPad to watch videos/Google slides
- Science journals
- Lima, pinto, mung, black-eye pea, and lentil
(Teacher Note: Students receive one of each legume, for a total of 5 legumes)
- Sandwich sized Ziploc bags (one per student)
- Greenhouse template (one per student)
- Scissors (one per student)
- Markers
- Scotch tape (one roll for every 6 students)
- Paper towels (one roll per class)
- 3 spray bottles
- Water

Vocabulary:

- Climate change
- Composting
- Decomposition
- Hydroponics
- Landfill

- Micro-organisms
- Organic material

Instruction Description

Hook

Show students the 6-minute video: *Beginner's Guide to Composting*

Wow! This organization collects about 8 tons of compostable materials each week. That's about the weight of an Asian elephant, or a T-Rex, or a school bus!

Yet NY residents throw over 14,000 tons of food in the trash every week. That's about 8 cars or 14 walruses! So, there is still a lot more that can be done. Cities across the world are creating more composting programs. Currently, San Francisco, California is the city that composts the most.

Teach/Demonstrate

Composting is simply the natural process of recycling organic matter, such as leaves and food scraps, into nutrient-rich fertilizer for plants, including the fruits and vegetables we eat.

Composting has many benefits, which include:

- *Reduces waste and saves money*

  By reducing the amount of waste sent to landfills, we save money on its pick up and disposal. It also reduces waste because the compost can be used to make our soil healthier for growing food.

  Teacher Note for 2nd graders: In landfills, bacteria chemically break down organic matter without access to much oxygen, which results in the emission of a harmful greenhouse gas called methane. Since compost decomposes organic matter with access to more oxygen, it mostly produces carbon dioxide as a byproduct. Although CO2 is also a greenhouse gas, methane is a much more potent one. Methane traps about 30 times more heat than carbon dioxide. For example, banana peels will break down much slower in a landfill as compared to a compost pile. This means that the emissions from landfills

spread over longer periods of time as compared to compost emissions. Food waste in a landfill gives off three times more carbon than the same waste tossed into compost.

- *Creates healthier, nutrient-rich soil*

Composting can help improve poor-quality soil by encouraging the production of beneficial microorganisms (mostly bacteria and fungi), which help to break down organic matter (like our food scraps) to make the soil filled with more nutrients and able to hold onto more moisture.

- *Reduces the need for chemical fertilizers*

Since composting improves soil structure and the amount of nutrients in the soil, there is less need to add chemical fertilizers.

- *Greater growth of crops*

More crops grow when the soil is healthier, just like we grow and function better when we eat healthy foods.

- *Less plant disease*

Besides helping plants grow, compost can help fight off plant diseases by protecting plants with beneficial microorganisms.

Just like any recipe, your compost is only as good as the ingredients you put into it.

Have students determine which items can and cannot be composted: *Can This Be Composted?*

Compost needs browns, greens, water, and air (oxygen). A basic recipe for compost is a 3:1 ratio of browns to greens. This means that for every 3 parts of carbon-rich browns added, you must add 1 part nitrogen-rich greens. So, if you added 3 buckets of browns, you should add one bucket of greens. If you add 6 buckets of browns, you need to add 2 buckets of greens.

Ask: If you add 12 buckets of browns, how many buckets of greens would you need to add to your compost? (Hint: Remember the ratio of 3 browns:1 greens)

Teacher Note: Examples of browns and greens:

Browns (carbon rich)	**Greens (nitrogen rich)**
Fall leaves, pine needles, twigs	Vegetable & fruit scraps
Straw/hay	Coffee grinds & tea leaves
Cob of corn	Fresh grass clippings, green leaves, flowers
Shredded newspaper & brown paper bags	Crushed eggshells
Wood chips	

"Browns" tend to be drier, woodier plant materials that are older and have been dead longer. "Greens" tend to be wetter materials that died more recently and still have some color left in them.

Independent Practice

Now we are going to sprout several different types of seeds without any soil! We will construct "greenhouses" out of Ziplock bags. Seeds need moisture and heat to germinate. Just like actual greenhouses, our Ziplock bags are sealed, so warm air cannot escape and the temperature inside the greenhouse bag can increase to warm the seed.

Show students some images of greenhouses from around the globe: *Greenhouses from Around the World*

Teacher Note: Play compost song when students are working on their Ziploc greenhouses: *Compost – A Portrait of the NYC Composting Community*

Have 3 spray bottles filled with water at the front of the room.

Distribute the following to each student:

- 1 greenhouse template

- 1 sandwich-sized Ziploc bag
- Black permanent marker
- Scissors
- One of each legume: Lima, pinto, mung, black-eye pea, and lentil
- 1 sheet of paper towel

Guide students through each step of constructing their Ziplock greenhouse, by making your own to keep in the class for future observations.

1. Cut out the shape of the greenhouse.
2. Cut out the gray square from your greenhouse template. This is where our clear Ziploc bag with your beans will be placed shortly.

Teacher Note: Students will most likely need help inserting the scissor into the template to cut out the grey square (which can be recycled).

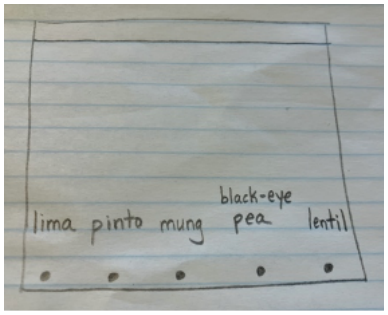
3. Write your name on the black line with a marker.
4. Fold your paper towel in half twice so it can fit into the bottom half of your Ziploc bag.
5. Teacher Note: Call students up to the front of the room in groups of 3-4 to dampen their paper towel with a sprayer. Demonstrate how they should moisten the paper towel without soaking it. The paper towel should not be dripping with water. While other students wait, they may use their black marker to make designs on their house (e.g., bricks, tiny windows, curly cues, etc.)

Use water to moisten the paper towel.

We are using paper towels to germinate (or begin to grow) seeds, but sponges, paper coffee filters, and newspapers also work.

6. Evenly space and place each of the 5 legumes onto the damp paper towel.
7. Carefully place the folded and moistened paper towel with the legumes placed near the bottom of the paper towel into the bottom of the Ziploc bag. Seal the bag.
8. In your science journal, make a sketch of your Ziploc bag and label the order of your seeds to help you keep track of growth.

For example:



9. Use scotch tape to tape the bag to the back of the greenhouse template. *Make sure the beans face front.*
10. Depending on the set up, students can tape their greenhouse to a sunny window at school, or at home. Have students check on the legumes each day to track changes.

In their science journals, have students predict which seeds, if any, will grow without soil.

On the board write the names of the seeds used in the greenhouse Ziploc: lima, pinto, mung, black-eye pea, and lentil.

Then write the prompt on the board: *I predict that the _____ seed(s) will germinate without soil.*

Plants need water, sunlight, carbon dioxide (from the air to use during photosynthesis), and nutrients (typically from the soil) to grow. Plants will grow without soil if they are given the nutrients they need. For example, there is a method of growing plants in nutrient-rich solutions without soil called hydroponics. The nutrients the plants usually get from the soil are instead mixed in a water solution.

Advantages of Hydroponics	**Disadvantages of Hydroponics**
Can grow plants all year long	Expensive to set up
Uses less water	Plants can die if there are power outages
Faster growth	Need constant monitoring and care
More plants grow (higher yield)	Disease can spread through water to other plants

If time permits, show students this 5-minute video: *NYC School Uses Hydroponic Farm to Make Healthy School Lunches*

Share

Students will share their Ziploc greenhouses and their seed predictions.

Link

Today we discussed the benefits of composting and how our city is working to increase its compost programs.

We also made a Ziploc greenhouse to observe the life cycle of several different legume species, including lima, pinto, mung, black-eye pea, and lentil. Once your seeds start to develop roots, transplant them outside about 1-1 ½-inches beneath the soil, so they can access the nutrients they need from the soil. Also, if they are kept in a Ziploc bag too long, mold will start to develop.

Exit Ticket: Have students record their response to the prompt in their Science Journal. Predict which legume in your Ziplock greenhouse will start to sprout first. Draw what you think it will look like once it sprouts. Label your drawing.

NYS Science Standards

- 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

NYS Social Emotional Learning Standards

- 3A.2a. Demonstrate consideration for the safety and well-being of self and others.

Week 6: Field Trip - Exploring the Benefits and Techniques of Composting

1. Tour of NYC Parks' Dept.'s Five Boro Green Roof, or one of their other programs: https://www.nycgovparks.org/learn/ecosystems
2. NYC Compost Project: The NYC Compost Project is a citywide program that works to reduce waste in the city by promoting composting. They offer workshops and classes on composting.
3. Tour a community garden
4. Queens County Farm Museum: The Queens County Farm Museum is an historic farm in Queens that offers educational programs and workshops on sustainable agriculture, including composting. They have a working compost operation on the farm.
5. Brooklyn Grange Rooftop Farm: The Brooklyn Grange Rooftop Farm is an urban farm located on the rooftops of buildings in Brooklyn. They use composting to fertilize their crops and offer tours and workshops on composting and sustainable agriculture.
6. The High Line: This elevated park features a variety of native plants and ecosystems. Kids can learn about the park's unique design and its plants.
7. The Central Park Conservatory Garden: This garden features a variety of plants for kids to explore.

Essential Question: How do plants connect all life on earth?

Learning Objectives:

Materials:

- Science journals

Vocabulary:

Instruction Description

Hook

Teach/Demonstrate

Independent Practice

Share

Link

Exit Ticket: Have students record their response to the prompt in their Science Journal.

What is one surprising thing you learned today?

NYS Science Standards

NYS Social Emotional Learning Standards