Compost is Cool!

Grade(s): 5th Grade
Lesson Duration: 3-4, 45-minute class periods
Course Name(s): STEM
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BIG IDEAS

This lesson introduces the concept of composting as a natural process that enriches soil and supports plant growth, demonstrating a constant cycle happening between the biosphere and the geosphere. Students explore how compost is created, focusing on the decomposition process which breaks down organic materials into nutrient-rich matter. The addition of this nutrient-rich matter increased soil quality and nutrients, which are important to plant growth. Students will have the opportunity to experiment with composting by creating composted soil, planting plants in the composted soil, and comparing it with plants grown in regular potting soil. Students will learn about the benefits of compost, including the improvement of soil composition, a way to reduce food waste, and boost plant growth.

EDUCATION STANDARDS

Science Performance Expectations (or state Science standard):		
Science and Engineering Practices: *(SEP elements connected to the PEs or standards)*	Disciplinary Core Ideas: *(DCI elements connected to the PEs or standards)*	Crosscutting Concepts: *(CC elements connected to the PEs or standards)*

• **5-ESS3-1:** Obtain and combine information about ways communities protect Earth's resources and environment. • **5-ESS2-1**: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. • 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. • 5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water.	**LS2.A: Interdependent Relationships in Ecosystems** • **Standard:** *5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.* **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** • **Standard:** *5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.* **ESS3.C: Human Impacts on Earth Systems** • **Standard:** *5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.*	**Energy and Matter** • **Concept:** *Matter is transported into, out of, and within systems.* **Cause and Effect** • **Concept:** *Cause and effect relationships are routinely identified and used to explain change.* **Stability and Change** • **Concept:** *Change and stability are understood through analyzing changes over time.*

MEASURABLE STUDENT LEARNING OBJECTIVES

- Students will be able to identify what plants need to survive.
- Students will be able to define composting and explain its importance.
- Students will be able to identify the key ingredients required for composting.
- Students will be able to describe the process of composting and the role of decomposers in it.
- Students will be able to explain the benefits of composting for plant growth.
- Students will be able to demonstrate how to set up a simple compost bin.
- Students will be able to describe how compost improves soil health and supports plant growth.
- Students will be able to investigate and record the effects of compost on plant growth by planting seeds in composted soil.

MATERIALS NEEDED

- YouTube
- Video clips

- Soil
- Potting containers
- Compostable items
    - Fruit and vegetable scraps
    - Fresh grass clippings
    - Fresh leaves and flowers
    - Coffee grounds (and the filter)
    - Hair from your hairbrush!
    - Finger- and toenail clippings
    - Dry (brown) leaves
    - Small twigs
    - Straw
    - Dried out, brown lawn clippings
    - Shells from nuts
    - Corn cobs
    - Food-soiled paper towels and napkins
    - Shredded newspaper, paper, cardboard boxes, cardboard paper towel and toilet paper tubes
    - Herbs
    - Floor sweepings from your dustpan
    - Cotton, linen, denim fabric
    - Ash from wood
    - Lint from clothes dryer

ENGAGING CONTEXT/PHENOMENON

The engaging context for this lesson centers around students creating compost themselves. Students are engaged with the lesson by seeing different types of plants growing in different soil environments. Students learn that they can make compost at home with kitchen scraps and can help reduce waste by composting.

DATA INTEGRATION

Students will be creating their own data based on their experiment. Students will collect data on plant height, plant color, and observations of plant health for two plants (one grown with composted soil and one grown with regular potting soil).

TEACHER BACKGROUND KNOWLEDGE

Teachers are responsible for knowing about composting and the components that make up a successful compost. Teachers should also know how compost enriches soil and why it is beneficial for plant growth, waste reduction, etc. It is also important for teachers to have an understanding of soil composition and how to use soil to grow certain plants/seeds.

DIFFERENTIATION OF INSTRUCTION

This is an activity that can be adapted at any point for a variety of learners. This lesson is outlined as an individual project but can easily be adjusted to put students in partnerships or even complete the experiment as a whole group. This is also an option for a classroom with limited supplies or space. If a student needs enrichment, the teacher can provide time for additional research components centered around composting, decomposers, waste management, and so on.

REAL-WORLD CONNECTIONS FOR STUDENTS

There are many real-world connections for students and composting. Composting is a simple process for most families to do at home which encourages students to begin composting at home. Composting is a way to reduce food waste and a way for students to have a positive impact on their community. This lesson also talks about how NASA scientists are currently trying to use compost to grow plants in lunar soil because of the nutrients.

POSSIBLE PRIOR or MISCONCEPTIONS

There is always potential for misconceptions. The biggest misconception is that composted soil is just soil. Another misconception is that plants grow well in any type of soil. Another misconception is that composting is a relatively quick process (it is not!) and that composted soil makes things grow overnight.

LESSON PROCEDURE

5E	**Details of 5E Lesson Implementation** *(Visit BSCS to learn more about the 5E instructional model)*

Engage	**Lesson Objective**
	- Students will be able to identify what plants need to survive.
	
	Standards Addressed
	• 5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water.
	
	Materials & Resources: Projector, Computer, Slides
	
	Procedure: At this phase, the teacher is working to “hook” class.
	- Begin with a group discussion on plants and ask students, "what do plants need to grow?"
	- Write down all valid responses on the board, but focus on nutrients, water, and sunlight.
	- Next, show students this image:
	  ○ Photo 1: A full, green garden
	  ○ Photo 2: Barren soil with a dying plant.
	- Begin a discussion by asking:
	  ○ What do you think is the difference between photo 1 and photo 2? Accept all answers.
	  ○ What makes plants grow better in one environment than

	the other? Accept all answers.
	- Tell students that you have a secret recipe that you can add to soil to help plants grow big and strong.
	  ○ Display this picture of food scraps.
	  ○ How do you think this can of food can help plants grow?
	
	Formative/Summative Assessments Teacher should be calling on a variety of different students and not worrying about "wrong" answers. At this stage, teacher should be focused on encouraging participation. Teacher should be circulating during turn/talk time, monitoring for understanding.
	
	Modifications
	Be prepared to pop into students' turn and talk conversations and point out any misunderstandings. Talk to the whole group to ensure understanding before moving on.

Explore	**Lesson Objective**
	
	• Students will be able to identify the key ingredients required for composting.
	• Students will be able to demonstrate how to set up a simple compost bin.
	
	Standards Addressed
	• 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
	• Energy and Matter (Concept: *Matter is transported into, out of, and within systems)*
	
	Materials & Resources
	• Composting materials (see below)
	• Containers to create the compost
	
	Procedure:
	• Students will create their own compost bins to create nutrient rich soil. Begin by talking with students about the many materials that can be added to compost bins.
	  ○ Approved things to put in compost bins:
	
	  ▪ Fruit and vegetable scraps
	  ▪ Fresh grass clippings
	  ▪ Fresh leaves and flowers
	  ▪ Coffee grounds (and the filter)

	▪ Hair from your hairbrush! ▪ Finger- and toenail clippings ▪ Dry (brown) leaves ▪ Small twigs ▪ Straw ▪ Dried out, brown lawn clippings ▪ Shells from nuts ▪ Corn cobs ▪ Food-soiled paper towels and napkins ▪ Shredded newspaper, paper, cardboard boxes, cardboard paper towel and toilet paper tubes ▪ Herbs ▪ Floor sweepings from your dustpan ▪ Cotton, linen, denim fabric ▪ Ash from wood ▪ Lint from your clothes dryer • Gather a few materials or encourage students to bring in their own items from home (only if they are compostable, students may need to come to you to ask) • Have students layer composting "browns" (leaves or shredded paper) and composting "greens" (kitchen scraps) in their containers, then add 1-2 cups of soil. • After their compost and soil are added, saturate the soil and contents inside with water. The compost will change over the course of a week or two. • After students create their compost bins, ask: what do you think will happen to the scraps and leaves over time? **Modifications** • While students are waiting for the materials in their compost bin to decompose, you can have them take daily observations by drawing pictures, taking photos, or writing observations in a journal or science notebook.
Explain	**Lesson Objective** - Students will be able to define composting and explain its importance. - Students will be able to identify the key ingredients required for composting. - Students will be able to describe the process of composting and the role of decomposers in it. - Students will be able to explain the benefits of composting for plant growth.

- Students will be able to describe how compost improves soil health and supports plant growth.

Standards Addressed

- 5-ESS3-1**:** Obtain and combine information about ways communities protect Earth's resources and environment.
- 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- 5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water.

Materials & Resources: Projector, Computer, YouTube videos, magnifying glass

Procedure

Now, teacher will focus on students gaining a clearer understanding of how compost supports plant growth by recycling nutrients back into the soil.

- Class discussion:
  - Start by asking students if they have observed any changes in their compost bins.
  - Using student observations, explain how composting works to benefit plant life.
    - Composting is the process of breaking down organic material to create a nutrient-rich soil.
  - Make the Most of Compost
  - How Compost Is Made: A Field Trip!
- Different types of composting:
  - Aerobic Composting (constantly mixing the pile of compost in order to add oxygen flow)
  - Anaerobic Composting (put everything in a sealed container! Do not turn it or anything. Microorganisms thrive in oxygen-free environments)
  - Vermicomposting (worms! Worms can be added to the organic material in a compost bin. The worms will digest the material and produce waste)
- Show photos of various types of compost or refer back to videos, pausing at photos of compost. Have students make observation with seatmate.
- How does compost become full of nutrients?
  - Composting is a natural process when organic material decomposes into nutrient-rich soil. The nutrients that were released from the organic material help new plants

	grow. • Provide students with magnifying glasses to look closely at their compost bins. See if they are able to observe any of their organic material changing. Focus their attention on the 5 senses – Encourage observations of smells and colors. **Modifications** Make sure that students are comprehending the content from the video by doing frequent check ins.
Elaborate	**Lesson Objective** - Students will be able to identify the key ingredients required for composting. - Students will be able to demonstrate how to set up a simple compost bin. - Students will be able to investigate and record the effects of compost on plant growth by planting seeds in composted soil. **Standards Addressed** • 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. **Materials & Resources** • Small containers or pots • Composted soil (from mini compost bin earlier in lesson) • Regular potting soil • Seeds • Student journals • Rulers • Watering cans/spray bottles • Observation sheet **Procedure** Students will compare the plant growth for seeds grown in composted soil and regular potting soil (no compost) • Each student (or group) will need two planting pots. One pot will be filled with the composted soil created in previous class, while the other will be filled with regular potting soil. This will act as our control pot. • Place seeds in each container, cover with soil, and water. • Place both containers in a sunny location. It is important to tell students that both plants should receive the same amount of light to ensure a fair test. • Have students check their plants daily or at designated times each week. Each time, students should record observations of:

	○ Plant height ○ Leaf color ○ New growth ○ General observations. Is the plant standing tall? Is the plant falling over? • Students should also record general observations and predictions: ○ Which plant seems to be growing faster? ○ Which plant looks healthier? What is your evidence? • Engage in a class discussion: ○ If we added compost to a soil with no nutrients at all, would it help plants grow? What about soil from the moon? ○ Share with students that NASA is researching ways to use compost to help grow plants in lunar soil. Lunar soil doesn't have the nutrients and structure that plants need. Since we know that compost is nutrient-rich, scientists have been exploring if the addition of composted organic matter could help plants grow in lunar soil. ▪ NASA Project ○ Ask: Why do you think compost is important for growing plants on Earth and potentially on the Moon? **Modifications** Modify this stage of the activity for lower learners by giving teacher assistance when building the compost bin. Provide help when measuring plants if necessary.
Evaluate	**Lesson Objective** - Students will be able to define composting and explain its importance. - Students will be able to describe the process of composting and the role of decomposers in it. - Students will be able to explain the benefits of composting for plant growth. - Students will be able to describe how compost improves soil health and supports plant growth. - Students will be able to investigate and record the effects of compost on plant growth by planting seeds in composted soil. **Standards Addressed** • 5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water.

	Materials & Resources Reflection sheet
	
	Procedure
	• At the final class period, have students take the final measurements of their plants in both the composted soil and regular soil. Make final notes in their journals, drawings, or photos.
	• Have students complete a final lab write up with the following questions. These questions should allow students to recap their findings throughout the experiment.
	  ○ Which plant grew taller? What was the height difference between the two plants?
	  ○ Describe what each plant looks like.
	  ○ What caused the differences between the composted and regular soil plants?
	  ○ How could compost benefit plants on Earth and possibly in space?
	  ○ How would you use what you learned from this experiment if you were designing a garden on the Moon?
	
	• Engage students in a group activity:
	  ○ Have students compare their findings to each other to determine whether composted soil helps plants grow more than regular soil by creating a class comparison chart.
	  ○ Ideas:
	  ▪ Have students mark which plant grew more, the plant in composted soil or the control group
	  ▪ Have students chart the total growth for composted plant vs. control group
	  ▪ Post photos of each plant for all groups and visually compare them all.
	  ○ This visual comparison allows students to clearly see patterns and draw conclusions as a group.
	
	Modifications
	Teacher intervention may be needed at this point if students are not able to reflect on their findings in a meaningful way. Some students may be stuck if they measured incorrectly or did not comprehend composting during the lesson. One-on-one support may be needed.

REFERENCES

Center Independent Research & Development: KSC IRAD (n.d.). *Lunar Soil Enrichment for Plant Production: WILD (Waste Improved Lunar Dirt).* NASA TechPort. Retrieved November 6, 2024, from https://techport.nasa.gov/projects/156897

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