Garbology

Key Topics: Decomposition, Decomposers, Composting, Prediction, Organic Matter, Compost, Fertilizer
Grade Levels: K, 2, 5
Inside or Outside

Lesson Overview:

In this lesson students will learn what kinds of things decompose by conducting a simple experiment wherein items are sealed in a bag with soil for a month, observed, and weighed. Students will: observe changes over time due to decomposition; notice patterns and classify materials based on their ability to decompose; explain how matter changes through decomposition; use math to formulate rates of decomposition and demonstrate the principal of Conservation of Matter; discuss how byproducts of human activity such as trash affect our environment and generate solutions to lessen the impact.

Suggested Time Allowance:

Option 1 - Compost in a Bag (45 minutes)
Option 2 - Compost in a Bag Followup (30 minutes)
Option 3 - Compost in a Bag - Conservation of Matter Focus (1 hour)
Done by Classroom Teacher - Monitoring Experiment and Wrap Up: 30 minutes

Suggested Activities and Learning Objectives by Grade:

- K: Compost in a Bag, Compost in a Bag Followup
  - K-ESS3-3 How can humans prevent litter?
- 2: Compost in a Bag, Compost in a Bag Followup
  - 2-PS1-1, 2-PS1-2 Categorize materials based on their ability to decompose.
- 5: Compost in a Bag - Conservation of Matter Focus
  - 5-PS1-2 Is matter conserved during decomposition?
  - 5-PS1-3 Categorize materials based on their ability to decompose.

Essential Question(s) that Connect CCCs and SEPs:

- Can we design an investigation to study what types of things change over time and what stays the same in the presence of decomposers? (Stability and Change; Planning and Carrying out Investigations)
- Do you notice any patterns that relate the certain kinds of changes to the kinds of substances? (*What kinds of things are molding? What kinds of things are staying the same?*) Is there a pattern to this data in decomposition? (Patterns; Analyzing and Interpreting Data)
- What causes some things to change in this system? What causes some things to remain stable, or not change, in this system? Why did some things decompose and some not? (Stability and Change; Cause and Effect; Asking questions and Defining Problems)

- If the data shows that the before and after weight of the entire bag remains the same but the individual items have a change in weight, how can I explain how matter changes in this system? (*the difference between how much the item weighed before going in the bag and how much it weighs after it comes out, will equal the amount it has decomposed.*) What is the math showing us? (Systems; Analyzing and Interpreting Data; Construct Explanations and Design Solutions; Using Mathematics and Computational Thinking)

Materials:

- Compost in a Bag Prediction Sheet
- Compost in a Bag Data Sheet
- Composting with the FBI Fact Sheet
- Clipboards and pencils if doing activity outside
- Large plastic trash bag
- Rubber band to seal bag
- Healthy moist soil
- Spray bottle
- A variety of compostable, recyclable, and disposable items
- String
- Labels
- Tape
- A gram scale

EG Team Support Needed:

- None

Prep:

Every part of this lesson can be done either inside or outside! If doing the activity outside, please have clipboards ready for students to use for filling out their prediction sheets. Removing items from the bag outside is desirable as you may spread some debris and it could be stinky. If raining, pull small groups of students to a covered area outside as you remove items, or lay out ample newspaper inside.

- Ask students to bring in a variety of substances from home. Have them bring things they think will never change, things they think will change, and things they are not sure about. They can also bring solid food, bits of hardware, seeds, cloth, and anything else they think of and can easily obtain. Leftover items from their school lunches would make good samples. Make sure to bring your own variety of compostable, recyclable, and disposable items in case children do not bring enough variety from home.
- Plan to schedule Parts 2&3 as one seasonal activity together one month from the first lesson. You can schedule this with the teacher as you schedule this phenomenal series.
- Connect with classroom teacher and provide them with: Garbology - Monitoring Experiment and Wrap Up. They will be responsible for monitoring the experiment, reviewing the classroom data, and having the final wrap up discussion.

Activity Procedure:

Engage:

Begin with a classroom discussion in the seating area in your garden or in the classroom.

What does it mean when something changes? How do you know something has changed? Can you give examples of changes occurring around you? (*It was sunny this morning, now it is cloudy. I'm 2 inches (5 cm) taller than I was last year. A candle burns down to a puddle of wax. An ice cube melts.*) Can you think of something that never changes? Today we are going to do a decomposition experiment with a variety of items that you brought from home and that I brought with me. Can we design an investigation to study what types of things change over time and what stays the same in the presence of decomposers? What would this look like? (Stability and Change; Planning and Carrying out Investigations)

Write the following underlined questions on your board and record student answers:

What is decomposition? Decomposition is a magical process! It is also called rot. It is the result of billions of microorganisms such as bacteria and fungi, as well as some larger decomposers like worms and bug. These decomposers are often called the "FBI:" fungus, bacteria and invertebrates. The FBI break down some of our waste into smaller particles called compost. Compost is the waste product of decomposers and provides necessary nutrients for plants by building up our topsoil and keeping it healthy. Compost is a natural fertilizer that is part of the nutrient cycle. Without decomposition, dead matter would cover the earth and we wouldn't have the necessary nutrients for new life to grow!

What is a prediction? A guess of what will happen in the future based on observation, experience, or scientific reason.

Explore: Compost in a Bag - Part 1

Action:

1) Divide the students into pairs or small groups. Pass out the Compost in a Bag Prediction Sheets and review them.
2) Tell students they will conduct the experiment as follows:
    a) They will have several minutes to discuss with each other what they think is going to happen to each item in the bag with soil and decomposers. Ask them to recall what happens to old bread and old apples, as well as old plastic and paper bags when it sites around for a long time. Instruct them to use their prior knowledge to help them predict if each item will break down.
    b) Though they are discussing as a group, each student should be able to make her/his own predictions individually. After discussion has ended, each student then writes their predictions on their worksheets.
3) Take the large plastic bag and put in 1-2 gallons of moist soil. It is okay if a few worms are inside. *Note: The soil shouldn't be too wet; it should be the consistency of a wrung-out sponge.*
4) Explain to students that the soil is full of microscopic decomposers like fungi and bacteria that are invisible. Share facts about microorganisms from the Composting with the FBI Fact Sheet. *(Example: There are many "good germs," living all around us and on our bodies, helping clean our skin. Without these microorganisms, nothing could live and grow.)*
5) As you add each item to the bag, have students share their predictions with the class. What is their reasoning? Optional - tie a string and attach a label to each item that goes in the bag to help differentiate items later. Collect prediction sheets. Mix all the items into the soil so they

are distributed throughout the bag. Make sure that each item's string and label dangle out of the bag. Fluff the bag up with air, then seal tightly with rubber band or twist-tie, leaving the labels hanging out.

6) Make a sign for the bag that says, "What will happen?" and list all the items in the bag and the date.
7) Put the bag in an out-of-the-way place for one month. You may use a spray bottle to spritz inside with water every week.

Explain: Compost in a Bag - Part 2 (One Month Later)

Action:

1) One month later, hand out the prediction worksheets and remind students of the experiment and its purpose.
2) Open the compost bag outside. Sift through the contents and look for the original items and any decomposers (worms, mold, fungi, etc). Remove each item from the bag by its string and read the label out loud. *To protect you and your students from inhaling mold spores, do not let students handle items from the bag and do not hold the items close to your face.
3) Bring a master list of all the items, and based on a general consensus of observations from the students, record the degree of decomposition of each.
4) Back in the classroom, have each student compare their predictions with the master record you just completed.
5)  *Comprehension Check*

   Discuss the results and ask students to raise their hands and share:
   Do you notice any patterns that relate the certain kinds of changes to the kinds of substances? (*What kinds of things are molding? What kinds of things are staying the same?*) Is there a pattern to this data in decomposition? (Patterns; Analyzing and Interpreting Data) Which of the substances changed in the way you predicted? Which ones surprised you? Did certain types of substances change while others did not? Do you have any ideas about why the food substances changed? (Part of the decomposition process in the nutrient cycle) What causes some things to change in this system? What causes some things to remain stable, or not change, in this system? Why did some things decompose and some not? (decomposers only break down organic matter.) Did the things that decompose all turn completely into compost? Why not? (Things decompose at different rates. Nevertheless, all things that were once alive will eventually decompose back into compost.) (Stability and Change; Cause and Effect; Asking questions and Defining Problems)

Elaborate: Compost in a Bag - Conservation of Matter Focus

Tell students that they can document how much an item has decomposed not just by looking at it, but also by weighing it! Explain to students that just like many scientists, they are going to conduct the experiment again. Explain that matter is neither created nor destroyed, so the difference between how much the item weighed before going in the bag and how much it weighs after it comes out shows how much matter has cycled into compost.

Action:

1) Follow the same procedure with the students, but this time have them take turns weighing each item on the gram scale before putting it in the bag and record the weight on their worksheet. Have students also measure the weight of the bag with all of the contents inside before and after the experiment to record on their worksheet.
2) At this point, the classroom teacher will take over leading the experiment and discussions. **Please provide teacher with**: Garbology - Monitoring Experiment and Wrap Up. Remind class that after one month, remove the items, weigh them, and instruct students to record the weights on their worksheets. *To protect you and your students from inhaling mold spores, do not let students handle items from the bag and do not hold close to your face.
3) Using the weights recorded on their worksheets, instruct students to calculate the difference between the before and after weight for each item and record it on their worksheet. If the data shows that the before and after weight of the entire bag remains the same but the individual items have a change in weight, how can I explain how matter changes in this system? (*the difference between how much the item weighed before going in the bag and how much it weighs after it comes out, will equal the amount it has decomposed.*) What is the math showing us? (Energy and Matter; Analyzing and Interpreting Data; Construct Explanations and Design Solutions; Using Mathematics and Computational Thinking)

Evaluation:

Ask students to raise their hands to share:

Discuss what the world would be like without decomposers. What would happen to all the garbage and dead stuff if there were no decomposers? (*It wouldn't "disappear" and the planet would be covered with dead things.)*

What should we do with things that don't decompose like an aluminum can, a penny, or a plastic chip bag? (*We should reuse them — like the penny; recycle them — like the aluminum can; or throw them away into the garbage — like the plastic chip bag.)*

Extension Activities:

- Ask students to do research on decomposers, pick their favorite decomposer, and then write and draw a cartoon strip of them hard at work in the compost pile. For inspiration, read: *The Diary of a Worm* by Doreen Cronin.
- Learn about reusing through making recycled paper. You can even include seeds in the mixture so students can plant their paper and feed it into the nutrient cycle. Follow this lesson plan: LifeLab - The Growing Classroom: A Human Paper Factory
- Go out to the garden to observe decomposers.
- Soil to smoothie: How can an apple core turn into a peach? How can some lettuce turn into a sunflower? Find out how through this storytelling activity: Soil to Smoothie Activity Guide and Materials

- Class can adopt a space in the garden and conduct a composting experiment to test if compost helps plants grow. Follow this guide: What Good is Compost? and this student lab sheet: What Good is Compost? Student Lab Sheet

One Cool Earth's Zero Waste Videos:
http://www.onecoolearth.org/zero-waste.html

A few other great videos:
https://www.youtube.com/watch?v=dRXNo7Ieky8
https://www.youtube.com/watch?v=ufsbrz8IRgY
https://www.youtube.com/watch?v=V8miLevRI_o

Cited Curriculum:

Nature Bridge: Compost in a Bag!
LifeLab - The Growing Classroom: Dr. Jekyll and Mr. Hyde