Compost Investigation

GRADE LEVEL 3rd-5th, Supporting PE 5-LS2-1
SUBJECTS Life Science, Carrying Out Investigations
DURATION Preparation: Varies Activity: 1.5 hours weekly, for 8 weeks
SETTING Classroom

OBJECTIVES

Students will be able to:
1. observe that organic and inorganic waste break down at different rates.
2. explain the role decomposers such as fungi, microorganisms, and insects have in decomposition.

Essential Question:
How do different objects change over time?

MATERIALS

- ☐ 1 Weekly Observation Template for each student
- ☐ 1 science notebook for each student
- ☐ 12 clear yogurt containers or mason jars
- ☐ Soil, enough to fill the 12 containers (from outside, not store-bought, so that it has microorganisms in it)
- ☐ 2 sets of the following (or similar) items: Apple, Bagel, Leaf, Plastic spoon, Paper plate, Tinfoil
- ☐ Optional: A third set of the same items, to use as a control set (keep this set out of soil).

SCIENTIFIC TERMS FOR STUDENTS

(wait until Week 5 to introduce this conceptual vocabulary)

» **decompose:** to separate into components or elements
» **decomposer:** an organism that breaks down the cells of dead plants and animals into simpler substances
» **compost:** a mixture of decayed or decaying organic matter used to fertilize soil
» **microorganism:** Micro=small, Organism=living thing. A living thing so small that it can only be seen with a microscope.

BACKGROUND FOR EDUCATORS

In 2013, the average American generated 4.4 pounds of trash a day. On average, we composted or recycled 34.3% of that trash (EPA 2016). San Francisco has one of the most successful recycling and composting programs in the country, with approximately 60% of trash diverted away from landfills to recycling and composting facilities (Samantha MacBride, 2013). Although this is a highly successful program, lots of trash still needlessly ends up in a landfill. More thorough recycling and composting could keep almost all our residential waste from the landfills.

There are two main types of trash that humans generate: organic and inorganic. Organic waste consists of plant and animal material, such as uneaten food and lawn scraps. This is the same type of waste that is generated in natural ecosystems, when plants and animals die. In nature, the plants and animals decompose, or break down into their principal nutrients with the help of insects, bacteria, and other microorganisms. These creatures are called decomposers and they play an extremely important role in nature; without them the Earth would be piled high with dead things. Once decomposition occurs, the nutrients are absorbed back into the soil where they play an important part in soil health. This nutrient-rich soil is then available to nourish new plants, which in turn nourish animals. Thus the "waste" is recycled into new life. This is considered a full-loop life cycle because the materials are constantly recycling themselves through the ecosystem. When humans throw their organic waste into the trash, it ends up in a landfill where it is unable to complete its life cycle. It will eventually break down, but it will not return its nutrients to the soil. One way that we enable organic waste to complete its full-loop life cycle is through composting. When we throw our organic waste into a composting pile, it decomposes and turns back into nutritious soil that can in turn

be used to nourish plants. This is a great way to add healthy nutrients to the soil and conserve valuable landfill space at the same time.

Inorganic waste is trash composed of items not derived from plant and animal sources, and which cannot be broken down by decomposers. Examples of inorganic waste are plastics and metals. This type of waste does not decompose quickly. Plastic and metal will spend thousands of years in a landfill, and although they may breakdown into smaller pieces over time, with the help of sun and water, they will not provide nourishment for new life to grow. Inorganic waste has what we call a linear life cycle, because the life of the material ends when it is thrown away.

"Municipal Solid Waste." EPA. Environmental Protection Agency, 29 Mar. 2016. <https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/>.

MacBride, Samantha. "San Francisco's Famous 80% Waste Diversion Rate: Anatomy of an Exemplar." Discard Studies. 11 Dec. 2013. <https://discardstudies.com/2013/12/06/san-franciscos-famous-80-waste-diversion-rate-anatomy-of-an-exemplar/>.

TEACHER PREP

» Collect all necessary materials.
» Collect soil from an outdoor location.
» Print enough single-sided copies of the composting workbook for each student to paste into their science notebook.
» Optional: Set up a control bin, and place a third set of objects in it, with no soil.

PREDICTIONS AND INITIAL OBSERVATION

1. Introduce the focus question for the investigation: How do different objects change over time?
2. Show the students each object and have them share "I notice" observations out loud.
3. Have students hypothesize (on their own) how each item will change when placed in soil for seven weeks, and record their predictions on the first page of the Weekly Observation Template.
4. Have each student record initial observations of each object. Make sure they include size (length, width, and height), color, shape, and a simple sketch. They should include the date.

WEEKLY OBSERVATIONS AND VOCABULARY BUILDING

1. Have table captains each retrieve one object, in its container of soil. This object will remain on their table throughout the observation session.
2. Instruct students to complete a detailed, labeled sketch of each object in the appropriate place in their Weekly Observation Templates. They can switch tables/objects at their own pace. Give them regular timing reminders so they can be sure to complete all six observations in the allotted time.

Teacher Tip: *As students record observations, they will need vocabulary to describe what they are seeing. Create an anchor chart of "Words for describing objects" that you will add to over the course of the seven weeks, based on what students are observing.*

NGSS SCIENCE AND ENGINEERING PRACTICES CONNECTION: This portion of the lesson connects to the Practice of Planning and Carrying Out Investigations because students learn how to change one variable (time) while holding everything else constant. They also learn to make observations and measurements that will serve as the basis for an explanation of why certain items decompose more quickly than others.

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COMPARE AND CONTRAST

Every few weeks, give students a chance to take stock of how the items are changing. It helps if each student zooms-in on one item. Give them two minutes to think silently about that item and review their sketches/notes. Then, instruct them to turn and talk with a partner, using the sentence frames provided (see below). Finally, let them expand their thinking in their notebooks, including both their own and their partner's ideas. Here are some detailed suggestions for comparing/contrasting in weeks 2, 4, and 6:

1. After students complete their weekly observations for **Week 2**, instruct them to compare one object at the start of the investigation to the same object in Week 2. Provide the following sentence-frames for students to paste into their notebooks:
   - When I started observing the _____, I noticed that...
   - After two weeks in the soil, I notice that..
2. After students complete their weekly observations for **Week 4**, instruct them to compare one object in the soil to the same object out of the soil (the control). Provide the following sentence-frames for students to paste into their notebooks:
   - There are some similarities between the _____ that is in soil and the one that is not in soil:
   - There are some differences, too. I noticed..
3. After students complete their weekly observations for **Week 6**, instruct them to compare one object from the start of the investigation to the same object in Week 6. Provide the following sentence-frame for students to paste into their notebooks:
   - After 6 weeks of observations, I noticed the following changes in the _____:

ACTIVE READING

1. **After 6 weeks** of observations, introduce an appropriate level text to your students that describes the process of decomposition, and the role that microorganisms play.
2. Have students take notes after they read, recording in their own words what they understand about decomposition and microorganisms.

Teacher Tip: *Wait until nearly the end of the investigation to deliver this content, rather than frontloading these concepts at the beginning. By waiting, you allow students to develop a context and a need for the content. The curiosity that has grown in students during the hands-on experiment will lend meaning and purpose to the reading.*

NGSS CROSSCUTTING CONCEPTS CONNECTION:
This portion of the lesson connects to the Crosscutting Concept of Energy and Matter because students will learn how decomposers break down matter from dead plants and animals into simpler substances.

MAKING SENSE

1. **After 7 weeks** of observations, have students return to their original hypotheses and make a chart where they note, for each item, whether their hypothesis was correct. What evidence can they find in their notebook to support this claim?
   - For example, "My hypothesis that the apple would rot was correct. My evidence is it changed colors, it shrunk, and a fuzzy mold grew on it."
2. Give students a final prompt to drive home the meaning of the investigation:
   - Using what you've learned about microorganisms and waste, what are the benefits of composting?
3. Brainstorm a class list of lingering questions. Ask: What are you still wondering about?

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STANDARDS ADDRESSED

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations **3-5:** Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	**LS2.A: Interdependent relationships in ecosystems** The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1).	**Energy and Matter** **3-5:** Energy can be transferred in various ways and between objects. **3-5:** Matter is transported into, out of, and within systems

RELATED PERFORMANCE EXPECTATIONS

Remember, performance expectations are not a set of instructional or assessment tasks. They are statements of what students should be able to do after instruction. This activity or unit is just one of many that could help prepare your students to perform the following hypothetical tasks that demonstrate their understanding:

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.