Lesson 3-1
Do garbage materials change in a landfill bottle at time point 2?

Lesson Overview
1. Timeframe: 1 class period 2. Learning Performance Students carry out an investigation to measure the changes in properties of materials and weight of a landfill bottle system over time in order to track matter in the landfill bottle. **SEP *Planning and carrying out an investigation***: *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.* **DCI *PS1.A***: *Measurements of a variety of properties can be used to identify materials.* **DCI *PS1.A***: *The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.* ***CCC Energy and matter - Flows, cycles, and conservation***: *Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.* 3. Overview • Students observe and record changes in the properties of garbage materials. • Students predict changes in the weight of the landfill bottle systems. • Students record changes in the weight of the landfill bottle systems.

Materials	
For each student: ○ 1 Science and engineering notebook (SEN) ○ 1 Pencil ○ 1 Copy of Investigation 2-1: Landfill Bottles	**For each group:** ○ 1 Landfill bottle ○ 1 Electronic scale
For the class: ○ Optional: camera	

Preparation

You will continue the landfill bottle investigations in subsequent lessons over 2 or more weeks depending on the pace of instruction:

Lesson	Landfill Bottle Investigations
2-1	Time Point 1 - Assembling landfill bottles - Recording properties of garbage materials - Weighing landfill bottles
3-1	Time Point 2 - Observing landfill bottles - Recording properties of garbage materials - Weighing landfill bottles
3-3	Time Point 3 - Observing landfill bottles - Recording properties of garbage materials - Weighing landfill bottles

Safety

- When students make observations of the landfill bottles, instruct them to look through the side of the bottles and waft smell out of the bottles. Students should not place their faces directly over the open landfill bottles.
- Direct students to wash their hands after handling the landfill bottles.

Introducing the Lesson

Carrying Out an Investigation: Reviewing Landfill Bottles and Components

Ask, *What is our driving question that we are trying to figure out?* (What happens to our garbage?) *What investigation are we carrying out to figure out what happens to our garbage?* (We are investigating classroom landfill bottle systems to figure out what happens to garbage in landfills.)

Describe, *Today we will continue our investigation of landfill bottle systems. What sub-question are we investigating in our landfills?* (Do garbage materials change in landfill bottle systems at time point 2?) *We are making our second observation, so we call this time point 2.*

Direct students to take out Investigation 2-1: Landfill Bottles. Remind students of the landfill bottle investigation. Review the components of the system, including garbage materials, soil, and water.

Carrying Out the Lesson

Carrying Out the Investigation: Reviewing Data Collection

Guide students to think about the changing properties of materials and the purpose of observing the properties of materials at time point 2:

- *What kind of data did we collect when we set up the landfill bottle investigation?* (Properties of materials and weight of the landfill bottle systems.)
- *Why are we collecting data?* (We are scientists. We collect data to record what is happening in the landfill bottles.)
- *How do the data we are collecting in the classroom relate to the landfill we saw during the field trip?* (The data we collect can be used to serve as evidence for what most likely happens to materials in the real landfill.)

Observing and Recording Properties of Materials in Landfill Bottles

Direct students to Investigation 2-1: Landfill Bottles. Students bring landfill bottles to their desks.

Students observe and record the properties of the materials. Students record observations in the table provided in Investigation 2-1: Landfill Bottles.

Direct groups to talk about their observations. Ask, *From time point 1 to time point 2, how have the properties of the materials changed?* (e.g., The color of the orange was orange at time point 1 but is brown at time point 2. The plastic spoon has not changed properties, as the spoon was white at time point 1 and is still white at time point 2.)

Teacher Background: Connecting Landfill Bottle Data to Conservation of Matter Idea

 This lesson begins to develop, but does not fully explain, an important DCI for the unit, *PS1.A: The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish*.

Students record properties of materials and the weight of the landfill bottle systems at time point 2. They will do this again at time point 3. At the conclusion of the landfill bottle investigation, students use the weight data to make the following comparisons:

1. **Difference between open and closed systems**: The weight of the open system decreases but the weight of the closed system does not. In the open system, gas particles escape from the bottle, and the amount of matter is not conserved because the system allows for inputs and outputs. Thus, the open system cannot be used to determine if matter is conserved. In comparison, in the closed system, gas particles cannot escape from the bottle, and the amount of matter is conserved. Thus, the closed system can be used to determine if matter is conserved. Once we determine that matter is conserved based on the closed system's data, we can infer that the decreased weight of the open system is due to matter leaving the system as an output.
2. **Similarity between open and closed systems**: The food materials in both the open and closed systems change (rot, grow mold) during the investigation. When the food materials rot, a smell is produced. At first the evidence of smell only comes from the open system. Before opening the closed system bottles, we can only predict whether a smell is produced in the closed system. At the end of the investigation (Lesson 3-3), we will open the closed system bottles to test our prediction.

The data collection and discussions in this lesson should guide students to note the similarities and differences in the open and closed system bottles in order to discuss conservation of matter in future lessons.

SEN Entry: Making Predictions About Weight Changes and Recording Weight of Landfill Bottles

Tell students that they will not open the closed system bottles today but will do so at the end of the investigation.

Prompt students to think about changes in the weight of the landfill bottles. *We recorded the changes in properties of materials. What other data did we collect when we started the landfill bottle investigation?* (Weight)

Tell students to predict the weight of the landfill bottles in the open and closed systems today and give a reason for their prediction in their SEN. *When you weigh the landfill bottles today, do you think the open and closed systems will weigh more than, less than, or the same as last time?*

Direct students to weigh their group's landfill bottle. Allow time for students to record the weight of the landfill bottles.

Tell students to write a sentence to compare their predicted weight to the actual weight. Share sentences in groups. Ask, *Did anything surprise you?*

Possible student responses:

- I thought the open system would weigh the same as last time, but it didn't! The first time, it weighed 1,501 g and now it weighs 1,348 g.
- I thought the closed system would weigh less than last time, because the banana and orange pieces became smaller. But it weighed the same.
- I thought the closed system would weigh more than last time, because there were water drops inside the bottle. But it weighed the same.

Comparing Open and Closed Landfill Bottle Systems

Match each group that has an open system with an investigation partner group that has a closed system.

Direct students, *Enter the weight data from your investigation partner group in Investigation 2-1: Landfill Bottles, then return to your original group.*

Once students are back in original groups, direct them to compare their weight data in the open and closed systems. Ask, *From time point 1 to time point 2, what differences did you notice in the weight data between the open and closed systems?* Have groups report to the class and record their responses on the board (Possible display as T-chart comparing weight data between open and closed systems).

Ask, *How is the open system different from the closed system?* (The open system smells bad. We can't smell anything from the closed system. The open system's weight changed. The closed system's weight did not change.)

If the smell has not been brought up, probe for students' ideas about the connection between weight changes and smell.

Teacher Background: Smell from Landfill Bottle

 Students discuss and draw conclusions about the smell and cause of the smell emanating from the bottle. In some cases, they may provide scientifically accurate conclusions (e.g., the smell is a gas, particles of matter are in the air), but this is not the time to expect accurate conclusions or correct inaccurate ideas.

Throughout this investigation, do not answer students' questions except by asking them further questions to stimulate their thinking about smell.

Closing the Lesson

Asking Questions about Smell from Landfill Bottle and Connecting to Next Question

Summarize or call on students to summarize the discussion of the class. Ask, *What have we figured out today? We have figured out that some of the landfill bottles have changes because we observed changes in some properties. We think the food is rotting because we smell something.*

If no one asks questions about the smell in the summarizing discussion, ask, *What questions do you have about the smell?* Invite students to ask about the nature of the smell and the location of the smell, e.g., how far from the bottle can you smell it? Do not give any answers. Add new questions to the DQ Board.

Teacher suggested prompts:

- *Have you ever smelled something like that before? Where?* (The rotting fruit or rotting food in our community, garbage truck, or landfill smells bad.)
- *Describe the smell from our landfill bottles.*

Continue the class discussion about the smell traveling from its source for a distance. Call on a student far from the landfill bottles:

- *Can you smell the garbage now? But you are far away from the landfill bottle.*
- *How can you smell what's in the landfill bottle across the room?*
- *Is something moving from the landfill bottle to our noses if we can smell it? What is it that moved? Is a smell something or nothing?*

Close the lesson by saying, *We have new questions to answer that connect to our question, Do garbage materials change in a landfill bottle at time point 2? Our new questions are: Why can we smell something? Is a smell something or nothing? What causes the smell of garbage?*

Write the new questions on the DQ Board.

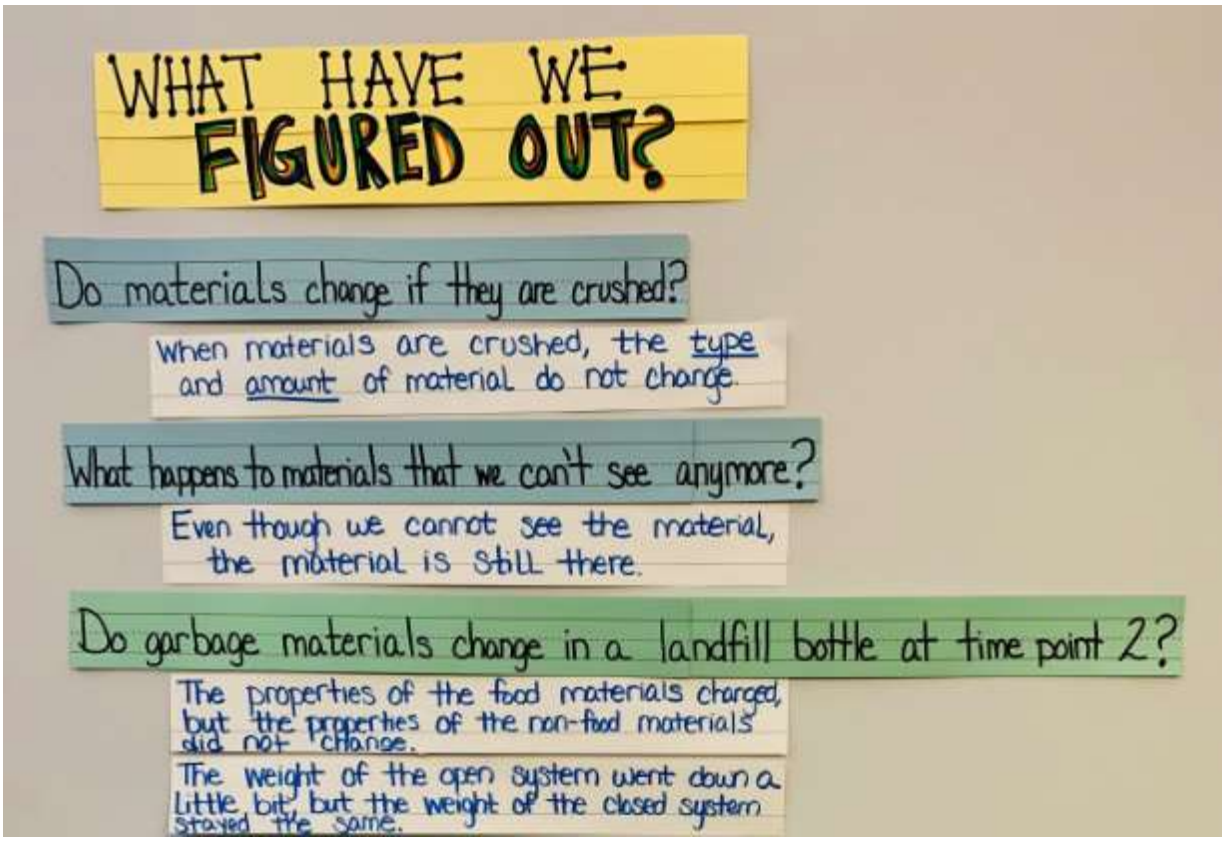
Possible questions added to DQ Board:

- *Why is it that we smell something coming from the open system landfill bottle?*
- *Is smell something or nothing?*
- *What causes the smell of garbage?*

Tracking What We Figured Out (optional)

Guide students to think about the sub-question of the lesson and what they have figured out so far. Create the class visual display using their responses. In addition to the class visual display,

students may complete the individual graphic organizers (located in Lesson 2-2). Students can add to their graphic organizers after each lesson.



Evidence Statement Lesson 3-1

LP3-1. ES (SEN)

- Students identify the purpose of the investigation (i.e., to figure out whether materials change or vanish in a landfill) and the data they are collecting (i.e., properties of materials and weight of landfill bottle systems).
- Students record the properties of materials as evidence that the properties of the food materials have changed but the properties of the nonfood materials have not changed.
- Students record weight data and predict the weight of the landfill bottle after the properties of materials have changed. The weight data serve as evidence that weight changes in the open system but not in the closed system.

Connections to Targeted 5th Grade NGSS Performance Expectations

5-PS1-2 Measure and graph quantities to provide evidence that, regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

5-PS1-3 Make observations and measurements to identify materials based on their properties.

Building Progressions

SEP *Planning and carrying out an investigation*: *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.*

K-2: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

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.*

Middle School: Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

DCI *PS1.A*: *Measurements of a variety of properties can be used to identify materials. The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.*

K-2: Different kinds of matter exist and many of them can be either solid or liquid, depending on the temperature. Matter can be described and classified by its observable properties. Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces.

3-5: *Measurements of a variety of properties can be used to identify materials. The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.*

Middle School: Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

CCC Energy and matter - Flows, cycles, and conservation: *Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.*

K-2: Objects may break into smaller pieces and be put together into larger pieces, or change shape.

3-5: *Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.*

Middle School: Matter is conserved because atoms are conserved in physical and chemical processes. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. The transfer of energy can be tracked as energy flows through a designed or natural system.

Connections to CCSS for English Language Arts-Literacy

W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

SL.5.1.C: Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

L.5.6: Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships (e.g., however, although, nevertheless, similarly, moreover, in addition).

Connection to CCSS for Mathematics

5.NBT.3.B: Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

MP1: Make sense of problems and persevere in solving them.

MP2: Reason abstractly and quantitatively.