Lesson 2-1
Do garbage materials change in a landfill?

Lesson Overview

1. Timeframe: 3 class periods

2. Learning Performance
   Students carry out an investigation to measure the changes in properties of materials over time in a landfill bottle system.

   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.B*: *No matter what reaction or change in properties occurs, the total weight of the substances does not change.*

   DCI *PS1.A*: *Measurements of a variety of properties can be used to identify materials.*

   CCC *Systems and system models*: *A system can be described in terms of its components and their interactions.*

3. Overview
   In this lesson students plan and set up an investigation using landfill bottles to answer the question, *Do garbage materials change in a landfill bottle?* They also collect initial data that they will later use as evidence for observing changes in the properties of materials and for establishing conservation of matter. In Lesson 3-3, as students analyze the data from the investigation, they use the data as evidence for chemical changes in materials and conservation of matter.

   Day 1
   - The lesson introduces the practice of planning an investigation as students, guided by the teacher, plan an investigation using landfill bottles to answer the question, *Do garbage materials change in a landfill bottle at time point 1?*
   - Students, guided by the teacher, decide which components to include in their landfill bottles (soil, water, garbage materials) as well as the data they will record (properties of materials and weight).

   Day 2
   - In groups, students prepare the bottles and record initial observations of the properties of the materials and the weight of the landfill bottles.

- Half of the groups close their landfill bottles, creating a comparison between the open and closed systems.
- Students make predictions about what will happen to the properties of the materials and the weight of the landfill bottles over time.

Day 3

- Groups develop models for the open and closed landfill bottle systems.

Materials

For each student:

- 1 Science and engineering notebook (SEN)
- 1 Pencil
- 1 Copy of Investigation 2-1: Landfill Bottles (All days)
- 1 Copy of Exit Slip 2-1 (Day 3)

For each group:

- 1 Mason jar
- 1 Sticky note or piece of masking tape to label the group landfill bottle
- 1 Plastic cup (any size, approx. 10 oz for water
- 1 Graduated cylinder (preferably 250 mL) to measure the amount of water
- 2-4 Small pieces (3-6 cm) of food materials (e.g., banana or orange with peel removed)
- 2 Pieces of non-food materials (e.g., foil, plastic spoon or fork)
- 1 Piece of chart paper (folded into fourths)
- 1 Electronic scale
- 1 Piece of paper towel (for food materials)

For the class:

- Water source
- Paper towels
- Optional: camera to take pictures of landfill bottles

Preparation

- Ensure that each student has a chance to perform some part of the investigation.
- Prepare food materials: Cut into 3-6 cm pieces. (Note: We selected fruit because it decomposes more quickly than other food materials. If using fruit, peel the fruit and include both the peel and fruit pieces in the landfill bottles).
- Prepare other landfill bottle items (e.g., aluminum foil and plastic spoon or fork).
- Place the soil bag in a central supply area for students to access with a cup for scooping out the soil.
- Identify a location for landfill bottles to rest during the timeframe of this investigation (see teacher apple below).

You will continue the landfill bottle investigation in three 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.
- If a student has a known mold allergy or severe asthma, store the open landfill bottle outside the classroom. Consult with the school nurse.
- Direct students to wash their hands after handling the landfill bottles.

Introducing the Lesson

Connecting to Prior Knowledge of Planning and Carrying out an Investigation

Direct students to the questions posted on the DQ Board from the previous lesson, Lesson 1-1. Remind students of the DQ, *What happens to our garbage?*

Guide students to think about the question, *Our driving question is a big question. In our discussion, we found that the big question has sub-questions connected to it. One sub-question is, Do garbage materials change in a landfill?*

Inform students that to explain the phenomenon of garbage and what happens to garbage, the class will plan and carry out an investigation to find the answer to this sub-question, *Do garbage materials change in a landfill? We have identified various types of garbage. Now we are going to set up some tests of what happens to a material if it is put in the soil.*

Elicit students' prior knowledge by asking them what they know about how scientists find answers to questions. Ask students to share in partners if they have ever experienced working like a scientist.

Teacher suggested prompts:

- *How do scientists find answers to questions they are wondering about?*
- *How do scientists keep records of what they find out?*

Tell students that they will be doing a scientific practice, planning and carrying out an investigation, to answer the sub-question, *Do garbage materials change in a landfill?*

Teacher Background: Progression of Introducing and Using Scientific Terms

 In the SAIL curriculum, scientific terms are used after students have experienced and developed an understanding of science ideas. Through their engagement in science, students communicate their ideas. As their thinking becomes more sophisticated, students communicate their ideas with increasing precision and explicitness. Scientific terms, such as matter and gas, are important because of the precision and explicitness they afford. To introduce scientific terms, model how to use them in context for your students. The introduction of DCI terms is intentional to promote progression from everyday/colloquial to specialized/disciplinary language. This progression of language use occurs in tandem with progression of science understanding over the course of the unit.

Scientific terms are introduced and used in this lesson and subsequent lessons, as follows:

In Lesson 1-1, everyday terms come first (e.g., materials). Lesson 2-1 introduces the specialized term *matter*. In Lesson 3-1, everyday terms come first (e.g., smell). Lesson 3-2 introduces the specialized term *gas*.

Now that students have experienced garbage materials in previous lessons, use the term *matter* in context in this lesson and continue using it throughout the unit.

Matter is a generic term that encompasses anything that has weight, regardless of what form it takes (i.e., solid, liquid, or gas). Do not further define the term matter. Conventional definitions of matter lead to student misconceptions. For example, the definition that a solid retains its shape leads to a student misconception that clay is not a solid because it changes its shape readily.

Carrying Out the Lesson

Teacher Background: Planning the Landfill Bottle Investigation

To fully engage in the practice of planning and carrying out investigations, it is important that students "make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon."

We have used Mason jars to create the landfill bottles, but your class might decide on something different. It is important that the container has a lid so students can create both open and closed systems.

In the landfill bottle investigations, students will need food and non-food materials to make observations about properties and decomposition. It is important that students include the same materials in the open and closed landfill bottle systems to make controlled observations.

From the K-2 grade band, students have experience planning and conducting investigations collaboratively. In 5th grade, students should be given more autonomy when planning the investigation and collecting data. Allow students to decide which food and non-food materials they will put into their landfill bottles. For clarity throughout the lessons, we refer to a banana and an orange as the food materials and a plastic spoon and aluminum foil as the non-food materials. In your classroom, select materials that your students want to investigate.

Planning an Investigation in the Classroom

Inform students that scientists ask a question, plan an investigation to answer the question, and then carry out the investigation.

As scientists, we have a question we want to answer, Do garbage materials change in a landfill? To answer our question, we will investigate garbage materials in our classroom. Let's think about what investigations we can do in the classroom to find out what happens to different types of garbage in the landfill. How could we make a "test landfill" without making a big mess in our classroom? *What different materials should we investigate? Consider what you know, what you observed about garbage in class, and what you observed in the video.*

Allow students time to talk in small groups. Then ask each group to share their suggestions. Write a list of suggestions on the board. Make sure each group has a chance to suggest something.

Describe that the students have many good suggestions for investigations and add, *A good investigation will compare different versions of a carefully designed system that can help us understand what happens in a landfill.*

CLASS CHECK! Garbage Disposal System Follow-Up

Review systems (including components and interactions), as needed, based on students' SEN responses from Lesson 1-1. If the class would benefit from additional examples of systems, ask students who answered the extension question to share examples of components and interactions in other systems.

Come to a class consensus about how the class could make a test landfill. In this unit, we use a Mason jar to represent the landfill, but your class might use something different (e.g., 2 Liter plastic bottle.)

Planning Landfill Bottle Investigation: Identifying Landfill Bottle Components to Include

Tell the class, *We will begin with a plan for our investigation. As scientists, we decided to build a test landfill to conduct an investigation about what happens to different materials over time. Our class decided to use Mason jars and call them landfill bottles. In our landfill bottles, we can test what happens in the real-life landfill system.*

Guide students in a class discussion to plan the landfill bottle investigation together. Ensure that students are a part of the planning of the investigation.
Planning our investigation will help us figure out what components to include in a landfill bottle system:

- *What do we put in each landfill bottle?*
- *What things do we change to compare different landfill bottle systems?*

Building on students' responses, summarize the components of the classroom landfill bottles *Just like the real-life landfill, our classroom landfill bottles are a system with components. We decided to include the following components:*

- Soil

- Water
- Garbage materials (food and non-food materials chosen by students)

Teacher Background: Changes in Properties of Materials and Conservation of Matter

 The data of changes in properties and weight collected from the landfill bottle investigation serve as evidence to address the following DCIs in the unit:

PS1.A: Measurements of a variety of properties can be used to identify materials.
Students record the properties of the garbage materials at each time point, as some materials change while others remain the same. Comparisons of the properties across the 3 time points provide evidence that materials either stay the same or the materials change.

PS1.B: No matter what reaction or change in properties occurs, the total weight of the substances does not change.
Students record the weight of the landfill bottles at each time point, observing that the weight decreases in the open system but remains the same in the closed system.

In both the open and closed systems:

- Chemical reactions of decomposing food produce gases.
- Water evaporates. In the closed system, some of the evaporated water may condense on the inside of the bottle. In the open system, some of the evaporated water will leave the bottle.
- Matter is conserved. In the closed system, the gases cannot leave the landfill bottle so the landfill bottle weighs the same. In the open system, the gases leave the bottle (in addition to the evaporated water leaving the bottle) so the landfill bottle weighs less.

Planning Landfill Bottle Investigation: Deciding What Data to Record (Properties and Weight)

Tell students that these landfill bottles will help them investigate the question, *Do garbage materials change in a landfill bottle at time point 1? We agreed that we will set up the landfill bottles and include soil, water, and garbage materials. The soil, water and garbage materials are examples of matter. Scientists use the term matter to refer to materials, or anything that has weight. As scientists, we will decide what data to record that will help us answer the question, Do garbage materials change in a landfill bottle at time point 1? How are we going to decide?*

Guide students in a discussion to prompt them to think about properties as data.

1. *How can we identify a material?* (by its properties, such as color, texture, reflectivity, and smell)
2. *How will we know if a material has changed?* (Properties of the material will change. We keep track of any changes in properties.)

Guide students in a discussion to prompt them to think about weight as data.

1. *How do we know if a material has vanished*? (We cannot see it anymore. We check the weight of the landfill bottle system and compare the weight over time. We record the weight of the landfill bottle as data in order to keep track of materials vanishing.)
2. *What does the weight tell you about the material*? (Weight shows us something is there. Materials have weight. Weight shows us the amount of the material.)

To answer our question, we will record changes in the properties of the garbage materials and the weight of the landfill bottle systems. Direct students to look at the property and weight data tables in Investigation 2-1: Landfill Bottles. Ask students to describe how the data tables are organized and how the data tables may be helpful in answering the investigation question (The first data table allows us to record the properties of the materials at each time point. This will help us figure out whether the materials change over time. The second data table allows us to record the weight of the materials at each time point. This will help us figure out whether the materials vanish over time. The second data table also has separate columns for the open and closed systems so that we can make comparisons between these conditions).

Recording Investigation Plan in Investigation 2-1

Direct groups to record the investigation plan in Investigation 2-1: Landfill Bottles (Questions 1-4). Circulate as groups complete the investigation plan, guiding students as needed.

Break – end of class period 1

Resume during the next class period:

Teacher Demonstration: Setting Up Teacher Landfill Bottle

Tell the class, *Last class we planned our investigation to answer the question, Do garbage materials change in a landfill bottle at time point 1? Our investigation plan is to:*

- Assemble the landfill bottle.
- Identify and record the properties of the garbage materials.
- Measure and record the weight of the landfill bottle.

Assemble an example landfill bottle using the directions in Investigation 2-1: Landfill Bottles. Describe the components as you assemble the teacher landfill bottle.

Carrying Out an Investigation: Assembling Student Landfill Bottles

Direct students to take out Investigation 2-1: Landfill Bottles and assemble their landfill bottles.

At this point, each group bottle should include:

Soil	Water	Garbage Materials
1 Baggie	70 mL	- Small pieces of food materials - Non-food materials - Aluminum foil - Plastic spoon or fork

Optional: Photograph the landfill bottle to document the initial properties (size and appearance) of the garbage materials in the landfill bottle systems.

Planning Open and Closed Systems (Half of the Groups Close Their Landfill Bottles)

To introduce open and closed systems, tell the class, *We will make observations and record data about the garbage materials in the landfill bottles over time to answer the question, Do garbage materials change in a landfill bottle at time point 1? When scientists make observations and record data, they often set up different conditions to make comparisons. We have assembled our landfill bottles, which we can think of as systems with different components. Our current landfill bottles are all open systems.*

Ask, *After we have added the soil and water, how can we control the matter going into and out of the landfill bottle? Matter going into the landfill bottle system is called input. Matter coming out of the landfill bottle is called output.* Student responses will vary, but some students may suggest closing the bottles.

Based on student responses, say, *In our investigation, we will close some of our landfill bottles to make them closed systems. That way we can make comparisons between the open and closed systems.*

Direct half of the groups to close their landfill bottles. Emphasize that these closed systems will remain closed until the end of the investigation.

Recording Properties and Weight

Direct students to:

- Record the properties of the materials in their landfill bottles in Investigation 2-1: Landfill Bottles
- Record the weight of their landfill bottles in Investigation 2-1: Landfill Bottles

Making Predictions about Open and Closed Systems

Say, *Now that we have recorded our first set of data, we have to wait. What do you think will happen to the different garbage materials over time? Why do you think that?*

Have students talk in partners about their predictions. Then, tell students to write their predictions and reasons for their predictions in Investigation 2-1: Landfill Bottles (Question 4).

Break – end of class period 2

Resume during next class period:

Developing a Group Model of the Landfill Bottle System

Tell students, *We want to represent the landfill bottle on paper to show our current thinking about the system. We are trying to show every component of the system, and how the components interact. What are the components of the landfill bottle system that you will include? How do these components interact?*

Solicit student responses to the landfill bottle as a system:

- Components of the system: bottle, soil, garbage materials, water
- Open or closed system

What we are doing today is different than a drawing you might do in art class. In art class, we might focus on making the drawing exactly like what we see. In science, we focus on details that are important to our investigation. We use symbols and a key to represent components of the system. For example, in art class we would draw a real looking banana, but in science we could use a symbol of a circle to represent a banana and a symbol of a square to represent the aluminum foil. Both of these symbols should appear in your key if you use them.

Pass out a piece of pre-folded chart paper (folded into 4 quadrants) to each group. Have groups set up their chart paper. See sample picture:

Inform students that they will develop a sequence of models to tell the story of what is going on in each landfill bottle system and record components of the system at each time point of observation. Today, they will be describing the system at the beginning of the investigation in the top box.

Tell students to write a group prediction on the model about what will happen to the garbage materials in the landfill bottle. Have students open their SEN and talk about their initial predictions to prompt discussion about the group prediction.

Allow time for groups to work. As you circulate to each group, remind students to label, use a key for symbols, and include the important components of the system.

Teacher Background: Pass the Marker Strategy for Group Work


Everyone in the group contributes ideas to the group work. An example is the "pass the marker strategy." In each group, while the person with the idea is talking, another student represents the idea of the talking student and asks, *Is this what you mean?* Then the marker is passed to another student in the group to represent the idea of a different talking student. This exchange of marker and talker keeps one student from dominating the group work. The rule is that the student with the pen is trying to represent what another student in the group is saying.

Sharing a Group Model

As groups finish, select a group to share their model and prediction as an example. Choose an example that is not necessarily the best, but one that is representative of many groups and will generate discussion.

Call the class to attention and ask a group member to name a feature of the example (e.g., components, symbols, inputs). Point out how the feature is a good example for the class, but do not to correct the student's idea.

Tell the class, *When you represented your thinking today, you made a model. Scientists use models to help describe, explain, and predict. Models are tools for thinking.*

Inform the class, *Right now our investigation is just starting. We have developed a model of each landfill bottle at time point 1. Later we will use our models as one way of keeping track of how the system changes at each time point. We will see if our observations match our prediction. When we are ready, we will use the models to support our explanations and predictions about the landfill system.*

Allow more time for groups to continue working after the discussion. Collect the models and save them for Lesson 3-1.

Closing the Lesson

Connecting to the Next Question

Close the lesson by:

1. Reminding students that they will be collecting investigation data for several weeks.
2. Directing students to the other questions on the Driving Question Board. Pull one student question that is similar to "What happens to materials when they are crushed in the landfill?" and ask the student to share their thinking:
   - *Where did you observe materials being crushed?* (landfill video, when the garbage gets picked up from my home, when I crush my soda can before throwing it away)
   - *How could we investigate this question in our classroom?* (we could crush some materials and make observations)
   - *What materials should we crush in our classroom?* (soda can, cookie, paper)

Make sure you bring the suggested materials for the crush investigation the following class period.

Exit Slip 2-1

CLASS CHECK! Planning the Landfill Bottle Investigation

Have students work on Exit Slip 2-1 individually. They do not need to answer in complete sentences. Collect the exit slips and use the key to assess students' responses and determine what aspects of planning an investigation may need additional review. You could also use responses to identify which students may need additional support in the upcoming lessons.

Evidence Statement Lesson 2-1

LP2-1. ES

- Students plan and set up an investigation to observe the properties of garbage materials in the landfill bottles over time.
- Students identify, measure, and record the properties of materials and the initial weight of the landfill bottles.
- Students develop an initial model of the landfill bottle with the components of the system. Each material's initial properties are identified and labeled.

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.B*: *No matter what reaction or change in properties occurs, the total weight of the substances does not change.*

K-2: Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

3-5: *No matter what reaction or change in properties occurs, the total weight of the substances does not change.*

Middle School: Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substance are regrouped into different molecules that have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change.

DCI *PS1.A*: *Measurements of a variety of properties can be used to identify materials.*

K-2: Matter can be described and classified by its observable properties. Different properties are suited to different purposes.

3-5: *Measurements of a variety of properties can be used to identify materials.*

Middle School: Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

CCC *Systems and system models**: A system can be described in terms of its components and their interactions.*

K-2: Systems in the natural and designed world have parts that work together.

3-5: *A system can be described in terms of its components and their interactions.*

Middle School: Systems may interact with other systems; they may have sub-systems and be part of larger complex systems. Models can be used to represent systems and their interactions – such as inputs, processes and outputs – and energy and matter flows within systems.

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.B: Follow agreed-upon rules for discussions and carry out assigned roles.

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.

Name _____ Date _____

Investigation 2-1: Landfill Bottle Systems
Do garbage materials change in landfill bottle systems?

1. Summarize the plan for the investigation.

_____

_____

_____

_____

_____

2. What components are we including in our landfill bottles?

_____

_____

_____

_____

_____

3. What data are we observing and recording?

_____

_____

_____

_____

_____

4. Make a prediction:

   a. What do you think will happen to the properties of different garbage materials over time?

Material	What will happen over time?
_____	
_____	
_____	
_____	

   b. What do you think will happen to the weight of the open and closed landfill bottle systems over time? Why?

_____

_____

_____

_____

_____

Setting Up Our Landfill Bottles

Investigation Plan		✓
1	Gather supplies for the group: ☐ 1 Mason jar ☐ 1 Baggie of soil (1 cup) ☐ 1 Water supply cup, filled with water ☐ 1 Graduated cylinder ☐ 1 Electronic scale ☐ 1 Piece of paper towel (to place fruit on) ☐ 2-4 Pieces of food materials, 3-6 cm ☐ 2 Pieces of non-food materials ☐ 1 Sticky note OR 1 Piece of masking tape (for labeling) ○ Optional: 1 Permanent marker (for labeling)	
2	Pour the baggie of soil into the Mason Jar. 	
3	Add the food materials.	
4	Add the non-food materials.	
5	Pour 70 mL of water into the Mason jar. ☐ Fill the graduated cylinder with 70 mL of water from the water supply cup. ☐ Look at the graduated cylinder at eye level to make sure the water is at 70 mL. ☐ Pour the water from the graduated cylinder into the Mason jar. 	

6	Use a sticky note or a piece of masking tape to label the completed landfill bottle with your group number.	
7	Weigh the completed landfill bottle on the electronic scale: □ Place the scale on a flat surface. □ Press the power button to turn on the scale.  □ Make sure the scale unit is in grams (using the kg/lb button).  □ Calibrate the scale by pressing the “0.0 TARE” button.  □ Place the completed landfill bottle on the scale. □ Record the weight of the completed landfill bottle in the table.	

Is your landfill bottle system open or closed? _____

Properties of Materials in Landfill Bottle Systems

Is your landfill bottle an open or closed system? _____

Material	Time Point	Properties			
_____		Smell	Color	Texture (Rough or Smooth)	Reflectivity (Shiny or Dull)
	Time Point 1				
	Time Point 2				
	Time Point 3				
_____		Smell	Color	Texture (Rough or Smooth)	Reflectivity (Shiny or Dull)
	Time Point 1				
	Time Point 2				
	Time Point 3				

Material	Time Point	Properties			
_____		Smell	Color	Texture (Rough or Smooth)	Reflectivity (Shiny or Dull)
	Time Point 1				
	Time Point 2				
	Time Point 3				
_____		Smell	Color	Texture (Rough or Smooth)	Reflectivity (Shiny or Dull)
	Time Point 1				
	Time Point 2				
	Time Point 3				
_____		Smell	Color	Texture (Rough or Smooth)	Reflectivity (Shiny or Dull)
	Time Point 1				
	Time Point 2				
	Time Point 3				

Questions to answer at Time Point 2:

1. Properties of materials in landfill bottle systems:

    a. Describe the property changes between time point 1 and time point 2.

_____

_____

_____

_____

_____

Questions to answer at Time Point 3:

1. Properties of materials in landfill bottle systems:

    a. Describe the patterns in property changes between time point 1 and time point 3.

_____

_____

_____

_____

_____

b. What do the patterns tell you about what happens to materials in landfill bottle systems over time?

_____

_____

_____

_____

_____

Arguing from Evidence

Question: Do materials change in a landfill bottle?	
Claim: _____	
Evidence:	**Why did you use these data?**

Weight of Landfill Bottle Systems

Is your landfill bottle an open or closed system? _____

	System Weight	
Time Point	**Open System Weight** (grams)	**Closed System Weight** (grams)
Time Point 1		
Time Point 2		
Time Point 3		

Questions to answer at Time Point 2:

1. Weight of landfill bottle systems:

    a. Describe the weight changes in the open and closed systems between time point 1 and time point 2.

_____

_____

_____

_____

_____

Questions to answer at Time Point 3:

1. Weight of landfill bottle systems:

    a. Describe the patterns in weight changes in the open and closed systems between time point 1 and time point 3.

_____

_____

_____

_____

_____

b. What do the patterns tell you about what happens to weight in the open and closed systems?

_____

_____

_____

_____

_____

Arguing from Evidence

Question: Does the amount of matter change in a landfill bottle?	
Claim: _____	
Evidence:	**Why did you use these data?**
Reasoning: _____	

Teacher Feedback:

	Comments
Claim	
Evidence	
Reasoning	

Investigation 2-1 ANSWER KEY

1. Summarize the plan for the investigation.
   We plan to make a landfill in the classroom using a jar. We will put in soil, water, fruit, a plastic spoon, and aluminum foil. We will make observations over time.

2. What components are we including in our landfill bottles?
   Soil, water, garbage materials

3. What data are we observing and recording?
   Properties of materials and weight of landfill bottle systems

4. Make a prediction:
   a. What do you think will happen to the properties of different garbage materials over time?
      Answers will vary.
   b. What do you think will happen to the weight of the open and closed landfill bottle systems over time?
      Answers will vary.

Questions to answer at Time Point 2 (Properties):

1. Properties of materials in landfill bottle systems:
   a. Describe the property changes between time point 1 and time point 2.
      At time point 1 the banana was yellow, but at time point 2 it is brownish. The plastic spoon did not have any property changes from time point 1 to time point 2.

Questions to answer at Time Point 3 (Properties):

1. Properties of materials in landfill bottle systems:
   a. Describe the patterns in property changes between time point 1 and time point 3.
      The foods changed color; at time point 1 the banana and orange were normal colors, but at time point 3 they were brown and mushy and smelled. The plastic spoon and the aluminum foil did not have any changes to their properties from time point 1 to time point 2.
   b. What do the patterns tell you about what happens to materials in landfill bottle systems over time?
      Some properties change over time, but others do not. The materials that are food change properties, but the materials that are not food (plastic, foil) do not change properties. What happens to materials over time in landfill bottle systems depends on the type of material and its properties.

Questions to answer at Time Point 2 (Weight):

1. Weight of landfill bottle systems:

a. Describe the weight changes in the open and closed systems between time point 1 and time point 2.
The weight of the open system decreased, but the weight of the closed system stayed the same. At time point 1 the open system weighed 1524 g and the closed system weighed 1560 g. At time point 2 the open system weighed 1491 g and the closed system weighed 1559 g.

Questions to answer at Time Point 3 (Weight):

1. Weight of landfill bottle systems:
   a. Describe the patterns in weight changes in the open and closed systems between time point 1 and time point 3.
   The open system's weight went down between time point 1 and time point 3. The closed system's weight stayed the same between time point 1 and time point 3.
   b. What do the patterns tell you about what happens to weight in the open and closed systems?
   The patterns tell me that the weight decreases in open systems but the weight stays the same in closed systems.

Name _____ Date _____

Lesson 2-1 Exit Slip

1. What is the system we are investigating?	2. What are the initial components of the system?
3. What data are we collecting?	4. What questions about garbage will this investigation help us answer?

EXTENSION: Why is it important that the open and closed systems in our investigation have the same materials?

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Name _____ Date _____

Lesson 2-1 Exit Slip ANSWER KEY

1. What is the system we are investigating?	2. What are the initial components of the system?
Landfill bottle system	- *soil* - *water* - *garbage materials (orange, banana, aluminum foil, plastic spoon/fork)*
3. What data are we collecting?	4. What questions about garbage will this investigation help us answer?
- *Properties of materials in landfill bottle systems* - *Weight of landfill bottle systems*	- *Do materials change in a landfill bottle?* - *Does the amount of material change in a landfill bottle?*

EXTENSION: Why is it important that the open and closed systems in our investigation have the same materials?

We want to make sure that any changes to the properties or amount of materials is due to the difference between the systems (i.e., open vs. closed). If we put different types of material in each system (e.g., a banana in the closed system and an orange in the open system), we would not know if the changes were due to the difference between the systems or between the types of material.