From Scraps to Sprouts: Composting for a Sustainable Future

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Unit Overview

Target Audience: 5th Grade

Est. Time: 135 minutes

Content Area(s): Science, Technology, Engineering, Mathematics, Environmental Science, Sustainable Agriculture

Abstract:

This unit introduces 5th-grade students to the practice and importance of composting, fostering an understanding of sustainability through hands-on learning. The lessons begin by exploring the science of decomposition and the environmental benefits of composting, emphasizing the role of microorganisms and nutrient cycling. Students then apply engineering principles to design and build model compost systems, focusing on factors like aeration and volume. Finally, students connect the composting process to sustainable agriculture by planning and designing compost-enriched gardens, incorporating mathematical calculations for area and volume. To conclude the unit, students investigate the global impact of composting by modeling its role in the carbon cycle, specifically exploring how carbon sequestration in soil helps reduce greenhouse gas emissions. Throughout the unit, integrated STEM activities provide opportunities for students to apply scientific inquiry, technological tools, engineering design, and mathematical reasoning to real-world problems. This unit aims to cultivate environmentally conscious students who understand the interconnectedness of waste management, soil health, and sustainable food production.

Unit Goals/Objectives:

- Define and Explain Composting (Science): Students will be able to define composting orally and in writing, using scientific vocabulary, explain the underlying biological and chemical processes involved in decomposition, and model the role of microorganisms.
- Classify Compostable Materials (Science): Given a variety of materials, students will be able to classify them as "compostable" or "non-compostable" with 80%

accuracy, justifying their classifications based on the chemical composition and decomposition rates of the materials.

- Design and Model a Compost System (Engineering, Math): Working collaboratively, students will be able to design, construct a model (physical or digital), and present a compost bin system, applying engineering design principles and mathematical concepts of volume, ratio, and heat transfer to meet specific criteria for size, aeration, and insulation efficiency.
- Explain Compost's Role in Plant Growth (Science, Math): Students will be able to conduct experiments, analyze data, and explain how compost contributes to plant growth by providing essential nutrients and improving soil quality, quantifying the relationship between compost application and plant yield.
- Plan a Garden Using Compost (Technology, Math, AFNR): Students will be able to create a detailed garden plan using digital tools, optimizing the layout based on mathematical calculations of area and spacing, and justifying their compost usage and plant selection based on the specific nutrient needs of the plants and principles of sustainable agriculture.
- Reflect on the Composting Process (Science, AFNR): Students will be able to write thoughtful reflections, connecting their experiences with composting to broader concepts of sustainability, environmental science, and agricultural practices, and using scientific evidence and data to support their conclusions.
- Explain Composting's Impact on the Carbon Cycle (Science): Students will be able to explain the concept of carbon sequestration and differentiate between the carbon release in landfills versus the stable storage of carbon in compost-enriched soil.

Lesson Summaries:

- Lesson 1: What is Composting and Why Does it Matter? This lesson introduces the concept of composting and its environmental benefits. Students engage in hands-on activities to categorize compostable materials and create mini-compost cups, fostering an understanding of decomposition and nutrient cycling. Students calculate the initial C:N ratio of their compost cups and learn the importance of microorganisms.
- Lesson 2: Building Your Own Compost System: Students explore various composting systems and apply engineering design principles to create model compost bins. Students research different composting methods and present their findings. They calculate the volume of their models and estimate the scaling of a real compost bin.
- Lesson 3: From Compost to Garden: Planning and Planting: Students connect composting to sustainable agriculture by planning and designing compost-enriched gardens. They research plant nutrient needs, design irrigation

systems, and calculate compost requirements. Students plant seeds, if possible, or create planting plans, solidifying the connection between composting and healthy plant growth.
- Lesson 4: Composting and the Carbon Cycle: In this concluding lesson, students explore the role of composting in the global carbon cycle. They compare how organic waste behaves in a landfill versus a compost system, focusing on greenhouse gas emissions like methane and carbon dioxide. Students learn about carbon sequestration and how creating stable humus "locks" carbon into the soil to support a healthier planet.

Lesson Timeline:

Lesson 1:

What is Composting and Why Does it Matter? (45 minutes)

- 0-10 minutes: Introduction and Pre-Assessment: The lesson begins with a class discussion about trash, recycling, and gardening, followed by open-ended questions about waste and food scraps, and students write down one thing they know about composting; then, the teacher introduces composting and the lesson objectives.
- 10-30 minutes: Instructional Activities: Students participate in the "Compost Detective" sorting activity, grouping materials into compostable and non-compostable categories, and the teacher observes and asks questions; next, students create mini compost cups in the "Compost in a Cup Challenge," document their setups, and calculate the C:N ratio, while the teacher provides guidance.
- 30-35 minutes: Clean up from "Compost in a Cup Challenge": Students will clean up their work areas from the compost cup activity.
- 35-45 minutes: Student reflection and summative Assessment and Wrap-Up: Students draw a diagram of the decomposition process. The lesson concludes with a review and Q&A session if needed.

Lesson 2

Building Your Own Compost System (45 minutes)

- 0-10 minutes: Introduction and Pre-Assessment: The lesson begins with students drawing and sharing composting container ideas, and the teacher introduces building compost systems and the lesson objectives.
- 10-30 minutes: Instructional Activities: Students research different composting systems online and prepare brief presentations, then they design and build

mini-model compost bins, calculate model volume and scaling, present their models, and participate in a peer feedback session.
- 30-35 minutes: Cleanup of building materials: Students will clean up their work areas from the compost bin building activity.
- 35-40 minutes: Summative Assessment: Students submit their 'Building Your Own Composter' worksheet.
- 40-45 minutes: Wrap-Up and Q&A: The lesson concludes with a review and Q&A session.

Lesson 3

From Compost to Garden: Planning and Planting (45 minutes)

- 0-10 minutes: Introduction and Pre-Assessment: The lesson begins with a class discussion about plant needs and garden planning, students list plants and sketch garden layouts, and the teacher introduces the composting and gardening connection and lesson objectives.
- 10-30 minutes: Instructional Activities: Students research plant nutrient needs and growing conditions, then they design garden plots, calculate garden area and compost needs, design irrigation systems, and share their garden plans; if time allows, seeds are planted, or a plan for a take-home planting activity is discussed.
- 30-35 minutes: Cleanup of any materials used: Students will clean up their work areas from the garden planning activity.
- 35-40 minutes: Summative Assessment: Students submit a detailed garden plan, write a reflection on compost benefits, and complete a garden plan checklist.
- 40-45 minutes: Wrap-Up and Q&A: The lesson concludes with a review and Q&A session.

Lesson 4

Composting and the Carbon Cycle

- 0-15 minutes: Introduction and Comparative Analysis: Students read statements comparing landfill decomposition (anaerobic) to composting (aerobic) and discuss the resulting greenhouse gases.

- 15-35 minutes: Instructional Activities: Students participate in the "Carbon Cycle Exit Slip" activity where they draw diagrams to model the path of carbon in both landfill and composting scenarios. They identify the "Fast Carbon Cycle" (atmosphere release) versus the "Slow Carbon Cycle" (soil storage).

- 35-40 minutes: Cleanup of materials: Students organize their worksheets and return any shared instructional materials.

- 40-45 minutes: Summative Assessment and Wrap-Up: Students write a 2-3 sentence explanation of carbon sequestration and its benefits for the planet, using key vocabulary like "humus" and "greenhouse gases".

Standards:

Illinois State Science Standards

- 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.
- 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Illinois State Computer Science Standards

- 3-5.DA.06 Organize and present collected data visually to highlight relationships and support a claim.

International Society for Technology in Education (ISTE) Standards

- 1.3.a Effective Research Strategies: Students use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.
- 1.3.c Curate Information: Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
- 1.3.d Explore Real-World Issues: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.
- 1.4.a Design Process: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 1.4.b Design Constraints: Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

- 1.4.c Prototypes: Students develop, test and refine prototypes as part of a cyclical design process.

Agriculture, Food, and Natural Resources (AFNR) Standards

ESS.04.02. Sustainably manage solid waste in environmental service systems.

- ESS.04.02.03. a. Summarize the benefits and processes of composting.
- ESS.04.02.03. b. Apply scientific principles to explain the benefits and processes of composting.
- ESS.04.02.03. c. Evaluate the appropriateness of composting methods in different situations.

PS.01.04. Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.

- PS.01.04.05. a. Summarize production methods focused on sustainable soil management (e.g., crop rotation, companion planting, cover crops, etc.).
- PS.01.04.05. b. Assess the short-and long-term effects of production methods focused on sustainable soil management.
- PS.01.04.05. c. Devise a plan for sustainable soil management for a selected cropping system.

Performance Expectations (PE)

- 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment (e.g., composting vs. landfilling).

Disciplinary Core Ideas (DCI)

- LS2.B (Cycles of Matter): Matter cycles between the air and soil and among organisms.
- ESS3.C (Human Impacts): Individuals and communities can use scientific knowledge to help protect Earth's resources and environments.

STEM Integration within the Unit:

Integrated STEM through AFNR is an educational approach that intentionally and synergistically combines the principles and practices of science, technology, engineering, and mathematics (STEM) within the context of Agriculture, Food, and

Natural Resources (AFNR). It goes beyond simply teaching the disciplines side-by-side. Instead, it fosters a learning environment where STEM disciplines are interdependent, AFNR provides authentic context, learners engage in problem-solving and innovation, there is an emphasis on inquiry and design, and 21st-century skills are developed. This approach aims to cultivate a deep understanding of both STEM and AFNR, preparing students to address complex global challenges related to food, agriculture, and sustainability.

To further enhance the "From Scraps to Sprouts" mini-unit, the teacher will employ learner-centered teaching (LCT) pedagogies throughout the lessons. These approaches will prioritize student agency through inquiry-based investigations, collaborative group work during the compost bin design challenge, and opportunities for students to make choices in their garden planning. By fostering active participation, encouraging student-to-student interaction, and valuing diverse learning styles, the teacher aims to create an engaging and empowering environment where students construct their own understanding of the interconnectedness between STEM principles and agricultural practices.

The overall STEM integration model of the "From Scraps to Sprouts" mini-unit is reflected across the 3 lessons. Overall, students explore the process of composting, design and build model compost systems, and plan compost-enriched gardens. Students engage in scientific inquiry, engineering design (Dym et al, 2005), and mathematical reasoning (Ojose, 2011) in applying STEM knowledge to understand and implement sustainable waste management and agricultural practices. This model of STEM integration reflects interdisciplinary learning because it combines principles from science, technology, engineering, and mathematics (Dym et al, 2005; McComas et al., 1998; Ojose, 2011) to address real-world environmental and agricultural challenges. Interdisciplinary learning involves connecting knowledge and skills from two or more disciplines to create a new understanding or product (Chandramohan & Fallows, 2009). The mini-unit effectively aligns with my definition of integrated STEM through AFNR. It is designed for 5th-grade students and focuses on composting and its connection to sustainable agriculture. The unit demonstrates a clear attempt to blend STEM disciplines within the context of AFNR, as seen in its objectives, activities, and assessments.

To provide a more detailed analysis of the STEM integration within each lesson, the following sections will delve into specific criteria outlined by the Rubric of Levels of STEM Integration through AFNR (Wang & Knobloch, 2022). Each section will examine a key aspect of STEM integration, providing a rationale for the assigned score to each lesson and highlighting areas of strength and potential improvement. This breakdown will offer a granular perspective on how effectively the 'From Scraps to Sprouts' mini-unit incorporates STEM principles and practices. A table can be found on page 9 as an additional display of the scores and their rationale.

This criterion assesses how well the learning objectives of each lesson integrate STEM disciplines, ranging from Level 1, where objectives create awareness of STEM connections, to Level 3, where objectives apply STEM knowledge to solve problems. In Lesson 1, graded as 1.5, the objectives (define composting, identify benefits, explain decomposition, calculate C:N ratio) introduce STEM concepts (Science, Math) but primarily focus on knowledge acquisition. While calculating the C:N ratio involves math, it's a relatively isolated application. The objectives don't strongly emphasize using this knowledge to solve a problem or make predictions. To move to a higher level, objectives could be revised to have students predict how changes in the C:N ratio affect decomposition rates. Lesson 2 is graded as 3. The objectives (describe systems, design a bin, calculate volume) require students to apply STEM knowledge, particularly engineering design and math, to create a product (a compost bin model). This demonstrates a stronger integration as STEM is used to solve a design problem. However, the objectives could be more explicit about the scientific principles behind the design choices (e.g., optimizing aeration for microbial activity). Lesson 3 is graded as 2. The objectives (design a garden, select plants, calculate needs) integrate AFNR with Science and Math. Students are applying STEM to a real-world task. However, the integration could be enhanced by including an engineering component (e.g., designing an irrigation system) and by having students optimize their plans based on quantitative data (e.g., maximizing yield while minimizing resource use).

This criterion evaluates the extent to which multiple STEM disciplines are present in the lesson content. In Lesson 1, graded as 2, the lesson incorporates Science (decomposition, microorganisms) and Math (C:N ratio). Both disciplines are present, but their presence is somewhat distinct. In Lesson 2, graded as 2, the lesson includes Engineering (design process), Math (volume, scaling), and Technology (for research/presentation). Multiple STEM disciplines are clearly present. In Lesson 3, graded as 2, the lesson covers Science (plant needs), Math (area, volume), and AFNR (garden planning). Again, multiple disciplines are evident. In all three lessons, multiple STEM disciplines are present, indicating a Level 2 rating. To reach Level 3, the lessons would need to demonstrate a more seamless blending of these disciplines, where it's difficult to separate them.

This criterion assesses how STEM content and skills are used within the lesson. In Lesson 1, graded as 2, STEM content is used, but the usage is somewhat basic. Math is used to calculate, and science is used to explain. However, the math isn't deeply integrated into understanding the scientific process. For example, students could use data analysis to connect C:N ratios to decomposition rates. In Lesson 2, graded as

3, STEM is used more actively. Students apply engineering design principles and math to create a functional product, demonstrating a higher level of usage. In Lesson 3, graded as 2, STEM is used to plan a garden, applying scientific knowledge and mathematical skills. However, the usage could be more problem-solving oriented. For instance, students could optimize their garden design based on resource constraints. Lessons 2 and 3 show stronger usage of STEM for application, moving towards Level 3. Lesson 1's usage is more focused on understanding and applying formulas.

This criterion evaluates how learning outcomes reflect the integration of STEM. In Lesson 1, graded as 2, learning outcomes demonstrate scientific understanding and apply math, but the connection could be stronger. Outcomes could focus more on the interdependence of STEM. In Lesson 2, graded as 3, learning outcomes involve applying engineering and math to create a functional model, showing a higher level of application. In Lesson 3, graded as 2, learning outcomes apply STEM to plan a garden, but they could emphasize systems thinking and optimization more. Lessons 2 and 3 have outcomes that are more application-oriented, moving towards Level 3. Lesson 1's outcomes are more focused on knowledge and basic application.

This criterion assesses how AFNR content is used in the lesson. In Lesson 1, graded as 2, AFNR (sustainable waste management) provides a relevant context for learning about composting. In Lessons 2 and 3, graded as 3, AFNR (composting systems, sustainable agriculture) drives the STEM learning by providing real-world problems and applications. The AFNR context is integral to the lesson design. Lessons 2 and 3 use AFNR more effectively to integrate STEM, making it the driver of the learning.

This criterion evaluates the level of cognitive engagement and thinking skills required of students. In Lessons 1 and 3, graded as 2, students engage in analytical thinking, problem-solving, and data interpretation. In Lesson 2, graded as 3, students also engage in creative problem-solving and design thinking, showing a broader range of higher-order thinking skills. Lesson 2 encourages more creative and innovative thinking, pushing it towards Level 3.

In conclusion, the "From Scraps to Sprouts" mini-unit demonstrates a solid foundation for integrated STEM through AFNR education. The unit effectively incorporates multiple STEM disciplines within the context of composting and sustainable agriculture, aligning with the core principles of interdisciplinary learning and real-world application. While the analysis using the Rubric of Levels of STEM Integration through AFNR reveals that the unit primarily operates at Level 2, with some elements of Level 3, it also highlights areas for growth. To further enhance the unit's STEM integration and consistently reach Level 3, future revisions should focus on strengthening the interdependence of STEM disciplines, promoting iterative design processes, fostering systems thinking, increasing the emphasis on quantitative analysis, and explicitly addressing broader contexts such as climate change and food security. By implementing these refinements, the "From Scraps to Sprouts" mini-unit can achieve a more advanced level of STEM integration, ultimately providing students with a richer, more engaging, and more impactful learning experience that prepares them to tackle the complex challenges of the 21st century.

Lesson 1: What is Composting and Why Does it Matter?

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

- Students will be able to define composting orally and in writing, using scientific vocabulary (e.g., decomposition, aerobic/anaerobic, microorganisms).
- Given a list of 10 materials, students will be able to classify them as "compostable" or "non-compostable" with 80% accuracy.
- Students will be able to model and explain, using a visual representation (diagram, chart), at least three environmental benefits of composting.

Standards:

International Society for Technology in Education (ISTE) Standards

- 1.3.d Explore Real-World Issues: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.

AFNR Standards

- ESS.04.02. Sustainably manage solid waste in environmental service systems.
  - ESS.04.02.03. a. Summarize the benefits and processes of composting.
  - ESS.04.02.03. b. Apply scientific principles to explain the benefits and processes of composting.
  - ESS.04.02.03. c. Evaluate the appropriateness of composting methods in different situations.

Assessments

Pre-Assessment

Before the lesson, students will participate in a brief class discussion about what they already know about trash, recycling, and gardening. The teacher will ask open-ended questions like, "Where does your trash go?" and "What happens to food scraps?" Students will write down one thing they think they know about composting. This will allow the teacher to gauge students' prior knowledge and identify any misconceptions.

Formative

Throughout the "Compost Detective" sorting activity, the teacher will observe students' ability to categorize materials and ask clarifying questions. During the "Compost in a Cup Challenge," students will explain their design choices and justify their material selections. The teacher will circulate, providing feedback and prompting students to consider the science of decomposition. Students will participate in a brief class discussion summarizing the benefits of composting. This will allow the teacher to assess student understanding in real-time.

Summative

At the end of the lesson, student will create a simple diagram illustrating the basic steps of decomposition. The teacher will review student work to evaluate their understanding of key concepts. This will provide a comprehensive overview of student learning.

Concept Prerequisites or Background Knowledge Needed:

Students should have a basic understanding of where their trash goes and the concept of recycling. They should be familiar with the terms "solid," "liquid," and "gas." Students should know that living things need food and water to survive. A general understanding of the concept of change over time is helpful. Students should understand that some things break down naturally, while others do not.

Vocabulary:

- Composting: A way to recycle food scraps and other organic materials.
- Decomposition: The process by which organic matter breaks down into simpler substances.
- Nutrients: Substances that provide nourishment for growth and health.
- Organic matter: Materials derived from living organisms, such as food scraps and leaves.
- Carbon to nitrogen ratio: The balance between carbon-rich ("brown") materials and nitrogen-rich ("green") materials in compost.
- Aerobic: A process that requires the presence of oxygen.
- Microorganisms: Tiny organisms, including bacteria and fungi, that break down organic matter.

Materials & Technology Needed:

- Clear plastic cups
- "Brown" materials (dry leaves, shredded paper, etc.)
- "Green" materials (food scraps, grass clippings)
- Water spray bottles

- Sorting materials or sorting cards (Compost Detective.pdf) for "Compost Detective"
- Phones or tablets for photos
- Image editing software (or paper/markers for annotation)
- Compost Detective Sorting Cards KEY
- Compost in a Cup Worksheet
- Compost in a Cup Challenge KEY
- Exit Slip: Decomposition Diagram
- Lesson 1 Summative Assessment Rubric
- PowerPoint Slides: What is Composting and Why Does it Matter.pptx
- OPTIONAL: https://awareanimals.com/wp-content/uploads/2022/05/Little_book_about_composting-1.pdf

Lesson Instructions

Introduction *(Time: 10 minutes)*

1. Begin with a brief class discussion about trash, recycling, and gardening. Asking open-ended questions like, "Where does your trash go?" and "What happens to food scraps?" (Pre-Assessment)
2. Students write down their initial thoughts before having the opportunity to share with the class.
3. Introduce the concept of composting to recycle food scraps and other organic materials. Additionally discuss the importance of bacteria and fungi in this. Reference PowerPoint slides if needed & use Aware Animals Little Book About Composting.

Instructional Activities *(Time: 30 minutes)*

1. "Compost Detective" Sorting Activity (10 minutes):
    a. Divide students into small groups.
    b. Provide each group with sorting cards or real items (leaves, paper, food scraps, plastic, etc.).
    c. Students categorize materials into "compostable" and "non-compostable" categories.
    d. Teacher observes and asks clarifying questions. (Formative Assessment)
2. "Compost in a Cup Challenge" (20 minutes):
    a. Explain the "Compost in a Cup Challenge" and its goal. The Compost in a Cup worksheet will be distributed as it guides students through the activity to best understand carbon to nitrogen ratios.

b. Provide students with clear plastic cups, various "brown" and "green" materials, and water. Students design and create their mini compost cups, considering the carbon-to-nitrogen ratio.
c. Students document their ‘Compost Cups’ with photos and annotations using their tablets or laptops. (Formative Assessment)
d. The worksheet provided will aid in students calculating their approximate carbon to nitrogen ratio.
e. Teacher circulates, providing guidance and asking questions about design choices.

Wrap Up *(Time: 5 minutes)*

1. Students complete summative assessment by drawing a simple diagram of the decomposition process. (Summative Assessment)
2. Briefly review the key concepts of the lesson and answer any remaining questions.

Resources

- Compost Detective Sorting Cards - Compost Detective.pdf
- Compost Detective Sorting Cards KEY
- Compost in a Cup Worksheet
- Compost in a Cup Challenge KEY
- Exit Slip: Decomposition Diagram
- Lesson 1 Summative Assessment Rubric
- PowerPoint Slides - What is Composting and Why Does it Matter.pptx
- OPTIONAL: https://awareanimals.com/wp-content/uploads/2022/05/Little_book_about_composting-1.pdf

Lesson 2: Building Your Own Compost System

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

- Working in groups, students will be able to design a model compost bin that meets specific criteria (e.g., minimum volume, adequate aeration, insulation).
- Students will be able to label a diagram of a compost bin, identifying key components and their functions (e.g., layers, aeration holes, drainage).
- Given three different compost bin designs, students will be able to compare and contrast them, identifying at least two advantages and two disadvantages of each.

Standards:

International Society for Technology in Education (ISTE) Standards

- 1.3.a Effective Research Strategies: Students use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.
- 1.3.c Curate Information: Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
- 1.3.d Explore Real-World Issues: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.
- 1.4.a Design Process: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 1.4.b Design Constraints: Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
- 1.4.c Prototypes: Students develop, test and refine prototypes as part of a cyclical design process.

AFNR Standards

- ESS.04.02. Sustainably manage solid waste in environmental service systems.
    - ESS.04.02.03. a. Summarize the benefits and processes of composting.
    - ESS.04.02.03. b. Apply scientific principles to explain the benefits and processes of composting.

- ESS.04.02.03. c. Evaluate the appropriateness of composting methods in different situations.

Assessments

Pre-Assessment

Students draw a picture of a container for composting to introduce the idea of building a compost system and its importance. Students will share their pictures and discuss what features they think are important. This will allow the teacher to assess students' prior knowledge of design and construction. The teacher will note any common ideas or misconceptions.

Formative

During the research phase, the teacher will observe students using online resources and ask clarifying questions. While students are building their model compost bins, the teacher will circulate, providing feedback and prompting them to consider design challenges. Students will present their model designs and explain their reasoning. The teacher will facilitate peer feedback and discussion. This will provide ongoing feedback and support.

Summative

Students will submit a written explanation of their model compost bin design, including a diagram and justifications for their choices. Students will be guided through this summative assessment using the 'Building Your Own Composter' worksheet. The teacher will review student work to evaluate their understanding of design principles and composting requirements. This assessment will demonstrate their ability to apply knowledge to a practical task.

Concept Prerequisites or Background Knowledge Needed:

Students should have a basic understanding of different types of materials and their properties (e.g., rigid, flexible, porous). Students should be familiar with the concept of volume and how to calculate it. They should understand the importance of air and moisture for living organisms. Basic knowledge of different container types helps. They should understand that a model is a smaller representation of something larger.

Vocabulary:

- Aeration: The process by which air is circulated through a substance. In composting, aeration is crucial for providing oxygen to aerobic microorganisms, which decompose organic matter.
- Insulation: The property of a material to resist heat flow. In composting, insulation helps maintain optimal temperatures within the compost pile, which is essential for efficient decomposition.
- Volume: The amount of three-dimensional space occupied by a substance or enclosed by a container, measured in cubic units. In composting, understanding volume is important for determining the capacity of a compost bin and the quantity of materials it can hold.
- Container: Any receptacle or enclosure for holding a substance. In composting, a container provides a confined space where organic materials can be collected and undergo decomposition.
- Model: A simplified representation of a system or object, typically used to analyze or explain its structure or function. In the context of this lesson, students create a model compost system to understand the factors that influence its design and performance.
- Design: The process of planning the form, function, and aesthetics of an object or system before its construction. In the context of engineering, design involves considering constraints, criteria, and trade-offs to create an optimal solution.
- System: A set of interacting or interdependent components forming a complex whole. In composting, a system includes the organic materials, microorganisms, environmental factors, and the container, all working together to achieve decomposition.

Materials & Technology Needed:

- Recycled materials (cardboard boxes, plastic containers, etc.)
- Tape
- Scissors
- Rulers
- Online resources (videos, images)
- Writing materials
- Calculators
- Blank sheets of paper
- Building Your Own Composter Worksheet
- Building Your Own Composter KEY
- Lesson 2 Summative Assessment Rubric
- PowerPoint Slides - Building Your Own Compost System.pptx

Lesson Instructions

Introduction (*Time: 10 minutes)*

1. Students draw a picture of a container for composting and share (Pre-Assessment) to introduce the idea of building a compost system and its importance.
2. Before the next activity begins, the complex problem of composting must be presented and contextualized to demonstrate the relevance for students both at home and in school (i.e. where you live, what you have access to, etc.)

Instructional Activities *(Time: 30 minutes)*

1. Research and Presentation (10 minutes):
    a. Students, in a small group, use online resources to research different composting systems (bins, tumblers, worm composting, etc.). Students follow the outline presented to ensure they are gathering essential information about their chosen composting systems.
    b. Student groups prepare a brief presentation on one type of system.
2. "Compost Bin Design Challenge (Model)" (20 minutes):
    a. Students work in small groups to design and build a mini model of a compost bin using recycled materials.
    b. They consider factors like ventilation, insulation, and ease of use.
    c. Students calculate the volume of their model and estimate scaling. (Formative Assessment)
    d. Students present their model and explain their design choices. (Formative Assessment)
    e. Peer feedback and discussion. (Formative Assessment)

Wrap Up *(Time: 5 minutes)*

1. Students complete summative assessment by submitting their ‘Building Your Own Composter’ worksheet. (Summative Assessment)
2. Review key concepts and answer any remaining questions.

Resources

- Building Your Own Composter Worksheet
- Building Your Own Composter KEY
- Lesson 2 Summative Assessment Rubric
- PowerPoint Slides - Building Your Own Compost System.pptx

Lesson 3: From Compost to Garden: Planning and Planting

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

- Students will be able to explain, in writing, how compost provides essential nutrients to plants.
- Students will be able to create a garden plan that incorporates compost, specifying the types of plants, the amount of compost needed, and the layout of the garden.

Standards:

International Society for Technology in Education (ISTE) Standards

- 1.3.a Effective Research Strategies: Students use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.
- 1.3.c Curate Information: Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
- 1.3.d Explore Real-World Issues: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.

AFNR Standards

- PS.01.04. Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.
  - PS.01.04.05. a. Summarize production methods focused on sustainable soil management (e.g., crop rotation, companion planting, cover crops, etc.).
  - PS.01.04.05. b. Assess the short-and long-term effects of production methods focused on sustainable soil management.
  - PS.01.04.05. c. Devise a plan for sustainable soil management for a selected cropping system.

Assessments

Pre-Assessment

The teacher will begin with a class discussion about what plants need to grow and how gardens are planned. Students will create a list of plants they would like to grow in a garden. Students will draw a simple sketch of how they envision their garden being laid out. This will allow the teacher to gauge students' understanding of garden planning. The teacher will note any common ideas or misconceptions.

Formative

While students are researching plants, the teacher will observe their ability to identify nutrient needs and suitable growing conditions. During the garden design phase, the teacher will circulate, asking clarifying questions and providing feedback on layout and plant selection. Students will share their garden plans with a partner, providing and receiving feedback. The teacher will facilitate a class discussion about the importance of compost in garden planning. This will provide ongoing feedback and support.

Summative

Students will submit a detailed garden plan, including a list of plants, a layout diagram, and a justification for their design choices. Students will write a short reflection on how compost benefits their garden plan. Students will complete a checklist ensuring that all required components are present in their garden plan. The teacher will review student work to evaluate their understanding of garden planning principles and the role of compost. This assessment will show their ability to apply knowledge to a practical task.

Concept Prerequisites or Background Knowledge Needed:

Students should have a basic understanding of plant needs (sunlight, water, nutrients). They should be familiar with the concept of a garden and how plants are arranged. Knowledge of basic measurement and area is needed. Students should understand that different plants have different needs. They should know that soil is an important part of plant growth. They should understand that compost is a soil amendment.

Vocabulary:

- Companion planting: A method of growing different plants in close proximity to enhance growth, deter pests, or improve nutrient uptake.
- Irrigation: The artificial application of water to the soil to assist in the production of crops.

- Nutrients: Essential elements or compounds that plants absorb from the soil for growth and development.
- Soil amendment: Any material added to soil to improve its physical or chemical properties, such as fertility, texture, or pH.
- Garden layout: The design and arrangement of a garden, including the placement of plants, pathways, and other features.
- Yield: The amount of a crop produced in a given area or time.

Materials & Technology Needed:

- Online garden planning tools (or graph paper)
- Plant information resources
- Rulers
- Writing materials
- Seeds or seedlings (optional)
- Compost-enriched soil (optional)
- ‘Planning a Garden’ Worksheet
- ‘Planning a Garden’ Worksheet KEY
- Garden Plan Evaluation Rubric
- Student Reflections Evaluation Rubric
- PowerPoint Slides - What is Composting and Why Does it Matter.pptx

Lesson Instructions

Introduction (Time: 10 minutes)

1. Class discussion about plant needs and garden planning. (Pre-Assessment)
2. Students list plants they want to grow and sketch a garden layout. (Pre-Assessment)
3. Introduce the connection between composting and gardening.
4. Explain the lesson objectives and how it relates to sustainable food systems.

Instructional Activities *(Time: 30 minutes)*

1. Plant Research (10 minutes):
    a. Students research plant nutrient needs and suitable growing conditions.
2. "Compost Garden Design Challenge" (20 minutes):
    a. Students design a garden plot using online tools or graph paper.
    b. They consider sunlight, water access, and companion planting.
    c. Students calculate the area of their plot and compost needs. (Formative Assessment)
    d. Students design a simple irrigation system.

e. Students share their garden plans and provide feedback. (Formative Assessment)

3. Planting seeds/seedlings in compost enriched soil if time allows, if not, plan for take home activity.

Wrap Up *(Time: 5 minutes)*

1. Students complete a checklist of garden plan requirements & one of the following:
    a. Students submit a detailed garden plan with plant lists and diagrams. (Summative Assessment)
    b. Students write a reflection on compost benefits. (Summative Assessment)
2. Review key concepts and answer any remaining questions.

Resources

- 'Planning a Garden' Worksheet
- 'Planning a Garden' Worksheet KEY
- Garden Plan Evaluation Rubric
- Student Reflections Evaluation Rubric
- PowerPoint Slides - What is Composting and Why Does it Matter.pptx

Lesson 4: Carbon Cycling, Decomposition, and Human Impact

Est. Time**:** 45 minutes

Lesson Learning Goals/Objectives**:**

- Identify the major reservoirs (sinks) of carbon on Earth (atmosphere, biosphere, oceans, lithosphere).
- Describe how carbon moves between these reservoirs through processes like photosynthesis, cellular respiration, and decomposition.
- Explain how composting helps cycle carbon from the biosphere back into the soil, preventing its release into the atmosphere.

Standards**:**

Performance Expectations (PE)

- 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment (e.g., composting vs. landfilling).

Disciplinary Core Ideas (DCI)

- LS2.B (Cycles of Matter): Matter cycles between the air and soil and among organisms.
- ESS3.C (Human Impacts): Individuals and communities can use scientific knowledge to help protect Earth's resources and environments.

Assessments

Pre-Assessment

The teacher will start with an informal poll/discussion. Ask students to quickly write down two places where carbon is stored on Earth (e.g., trees, air, oceans). Then, ask them to describe in one sentence what happens to the carbon in a banana peel when it is thrown away. This allows the teacher to gauge students' existing knowledge of carbon reservoirs and the role of waste in releasing carbon. The teacher will note any common ideas or misconceptions.

Formative

While students are completing the "Carbon Cycle Story" worksheet, the teacher will observe their ability to correctly identify the reservoirs and processes of the cycle (Steps 1-4). During the discussion in Section 3, the teacher will circulate, asking clarifying questions about the difference between Carbon Dioxide and Methane release. Students will share one completed step of their carbon cycle story with a partner, providing and receiving feedback on the accuracy of the process. This will provide ongoing feedback and support.

Summative

Students will submit the complete "Carbon Cycle Exit Slip" and the "Carbon Cycle Story" worksheet. The Exit Slip requires students to visually and verbally compare the fast vs. slow carbon cycles, using key vocabulary like Carbon Sequestration and Humus. The teacher will review student work to evaluate their understanding of the major carbon pathways and their ability to explain the critical role of composting in stabilizing carbon in the soil. This assessment will show their ability to apply knowledge to an environmental science concept.

Concept Prerequisites or Background Knowledge Needed:

Students should have a basic understanding of plant needs (sunlight, water, nutrients). They should be familiar with the concept of a garden and how plants are arranged. Knowledge of basic measurement and area is needed. Students should understand that different plants have different needs. They should know that soil is an important part of plant growth. They should understand that compost is a soil amendment.

Vocabulary:

- Carbon: The basic building block of all living things (plants, animals, and microbes).
- Carbon Cycle: The continuous movement of carbon atoms through Earth's atmosphere, oceans, land, and living things.
- Reservoir (Carbon Sink): A place where carbon is stored for a long period of time, such as the oceans, soil, or the atmosphere.
- Atmosphere: The layer of gasses surrounding the Earth, where carbon is stored as Carbon Dioxide.
- Biosphere: All the places on Earth where life exists, including all plants and animals.
- Photosynthesis: The process plants use to take Carbon Dioxide from the atmosphere and turn it into food (sugars).

- Cellular Respiration: The process living things (plants, animals, and decomposers) use to release energy, which involves breathing out Carbon Dioxide into the atmosphere.
- Decomposition: The process of breaking down dead material (like food scraps) into simpler parts.
- Humus: The dark, stable, nutrient-rich material that is the final product of finished compost.
- Carbon Sequestration: The process of taking carbon out of the atmosphere and safely storing it in another reservoir, like the soil (in the form of humus).
- Methane: A powerful greenhouse gas released when organic materials decompose in places without oxygen, like landfills.

Materials & Technology Needed:

- Computer or tablet with internet access
- “Carbon Cycle Story” Worksheet (digital or printed)
- Paper
- Pencil
- Presentation software (e.g., Google Slides or PowerPoint)
- Video links:
    - Carbon and Nitrogen Cycles: https://www.youtube.com/watch?v=NHqEthRCqQ4
    - The Global Carbon Cycle: Crash Course Chemistry: https://www.youtube.com/watch?v=aLuSi_6Ol8M

Lesson Instructions

Introduction (Time: 10 minutes)

1. Begin by reviewing the previous lesson's focus on decomposition and how compost enriches the garden.
2. Ask students: "When we compost food scraps and yard waste, where does all the stuff they were made of go?" Lead the discussion to the idea of carbon (the building block of life), which is released as carbon dioxide during decomposition (like we saw in Lesson 1's decomposition diagram). Initial Question: What happens to the carbon dioxide released during decomposition, and what happens to the carbon that stays in the compost?

Instructional Activities *(Time: 30 minutes)*

1. Introduce the major carbon reservoirs and the processes that move carbon between them. Use simple visual aids.

a. The atmosphere Carbon Dioxide, the biosphere (in living things like plants and animals), the oceans, and the geosphere/lithosphere (in rocks and fossil fuels).
b. Key Processes:
    i. Carbon moves from the atmosphere to biosphere (plants).
    ii. Carbon moves from the biosphere to atmosphere (when living things breathe).
    iii. Carbon moves from dead biosphere material to atmosphere (fast release if landfilled or burned) OR to lithosphere/soil (slow release if composted).

2. Share a short, engaging animated video explaining the basics of the carbon cycle.
3. Carbon Cycle Story: Distribute the "Carbon Cycle Story" worksheet. Students will trace the path of a single carbon atom through four steps, labeling the process and the reservoir change in each step. (e.g., Starts in Atmosphere to Photosynthesis to Biosphere).
4. Locate decomposition on the diagram. What is the difference between decomposition in a landfill versus decomposition in a compost pile?
    a. The Composting Connection:
    b. Decomposition without oxygen releases Methane and Carbon Dioxide quickly into the atmosphere.
    c. Aerobic decomposition creates stable humus. This humus locks the carbon into the Soil—a process called Carbon Sequestration.
5. Analogy: Reinforce the savings account analogy: Composting is a long-term savings account for carbon in the soil. It keeps carbon stored where it benefits plants instead of releasing it quickly to the air.

Wrap Up *(Time: 5 minutes)*

1. Students complete the "Carbon Cycle Exit Slip."
    a. Part 1 (Draw): Visually compare the fast (Landfill) vs. slow (Compost) carbon movement.
    b. Part 2 (Explain): Write a brief explanation of how composting helps the planet by stabilizing carbon.
2. Congratulate students on completing the unit and understanding how their composting efforts connect to the larger global carbon cycle.

Resources

- Carbon Cycle Story Worksheet
- Carbon Cycle Story Worksheet KEY

- Carbon Cycle Exit Slip
- Carbon Cycle Exit Slip KEY
- Video Links
  - Carbon and Nitrogen Cycles: https://www.youtube.com/watch?v=NHqEthRCqQ4
  - The Global Carbon Cycle: Crash Course Chemistry: https://www.youtube.com/watch?v=aLuSi_6Ol8M
- Carbon Cycle Diagram
  - Center for Science Education: https://scied.ucar.edu/image/carbon-cycle
- NASA Earth Observatory: https://earthobservatory.nasa.gov/features/CarbonCycle

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Additional Materials

Lesson 1

1. Compost Detective Sorting Cards - Compost Detective.pdf
2. Compost Detective Sorting Cards KEY
3. Compost in a Cup Worksheet
4. Compost in a Cup Challenge KEY
5. Exit Slip: Decomposition Diagram
6. Lesson 1 Summative Assessment Rubric
7. PowerPoint Slides - What is Composting and Why Does it Matter.pptx

Lesson 2

1. Building Your Own Composter
2. Building Your Own Composter KEY
3. Lesson 2 Summative Assessment Rubric
4. PowerPoint Slides - Building Your Own Compost System.pptx

Lesson 3

1. 'Planning a Garden' Worksheet
2. 'Planning a Garden' Worksheet KEY
3. Garden Plan Evaluation Rubric
4. Student Reflections Evaluation Rubric
5. PowerPoint Slides - What is Composting and Why Does it Matter.pptx

Lesson 4

1. The Carbon Cycle Story Worksheet
2. The Carbon Cycle Story Worksheet KEY
3. Carbon Cycle Exit Slip
4. Carbon Cycle Exit Slip KEY

Name: ______________________________

Compost in a Cup Challenge

Objective:

To create a mini compost cup and understand the importance of the carbon-to-nitrogen ratio in composting.

Materials:

- Clear plastic cup
- "Brown" materials (e.g., dry leaves, shredded paper)
- "Green" materials (e.g., food scraps, grass clippings)
- Water spray bottle

Get Your Materials Ready:

- Look at the "brown" and "green" materials. What do you notice? <u>List observations below:</u>

Make Your Compost Cup:

1. Put a layer of "brown" in the bottom of your cup.
2. Then, put a layer of "green" on top of the "brown".
3. Keep layering "brown" and "green" until your cup is partly full.
4. Use the water spray bottle to make each layer a little wet. Not too much!

<u>List what you put in your cup:</u>

Figuring Out Our Mix: Calculating the Carbon to Nitrogen Ratio

- Good compost has a mix of "brown" materials and "green" materials. We can measure this mix with a number called the Carbon to Nitrogen (C:N) ratio. "Brown" materials have a C:N value of 30, while "green" materials have a C:N value of 15.
- Look at your compost cup. Think about how much of it is "brown" and how much is "green." This number goes in the “estimated amount” column.
    - (You can use fractions (like 1/4, 1/2, 3/4) or percentages (like 25%, 50%, 75%). For example, if your cup looks half "brown" and half "green," you'd use 1/2 or 50% for each.)

Material	C:N Value	Estimated Amount	Calculation	Result
Brown	30	____________	30 x ________ =	____________
Green	15	____________	15 x ________ =	____________
			Total (add results):	____________
			Ratio: ________:1	

Take Pictures!

- Use a tablet or computer to take pictures of your compost cup. In your pictures, use digital pens to point out the "brown" and "green" layers on your tablet or computer.

Watch and See!

- Let's look closely at our compost cups. What does it smell like? What does it look like? Write down what you see and smell.

Think About This!

- Why do we need both "brown" and "green" materials?

- Why do we add water?

- What do you think will happen to the stuff in our cup?

Bonus Fun!

- Draw a picture of your dream compost bin!

Name: ______________________________

Compost in a Cup Challenge KEY

Objective:

To create a mini compost cup and understand the importance of the carbon-to-nitrogen ratio in composting.

Materials:

- Clear plastic cup
- "Brown" materials (e.g., dry leaves, shredded paper)
- "Green" materials (e.g., food scraps, grass clippings)
- Water spray bottle

Get Your Materials Ready:

- Look at the "brown" and "green" materials. What do you notice? <u>List observations below:</u>

Teacher Guidance:

- *Look for students to observe differences in color, texture, and moisture.*

Possible Student Responses:

- *"Brown materials are dry and crispy."*
- *"Green materials are wet and soft."*
- *"Brown materials are mostly leaves and paper."*
- *"Green materials smell more."*

Make Your Compost Cup:

1. Put a layer of "brown" in the bottom of your cup.
2. Then, put a layer of "green" on top of the "brown".
3. Keep layering "brown" and "green" until your cup is partly full.
4. Use the water spray bottle to make each layer a little wet. Not too much!

<u>List what you put in your cup:</u>

Teacher Guidance:

- *Check that students included both "brown" and "green" materials in their list.*

Possible Student Responses:

- *"Leaves, paper, grass clippings, banana peel"*
- *"Shredded paper, apple core, dry grass"*

Figuring Out Our Mix: Calculating the Carbon to Nitrogen Ratio

- Good compost has a mix of "brown" materials and "green" materials. We can measure this mix with a number called the Carbon to Nitrogen (C:N) ratio. "Brown" materials have a C:N value of 30, while "green" materials have a C:N value of 15.
- Look at your compost cup. Think about how much of it is "brown" and how much is "green." This number goes in the "estimated amount" column.
    - (You can use fractions (like 1/4, 1/2, 3/4) or percentages (like 25%, 50%, 75%). For example, if your cup looks half "brown" and half "green," you'd use 1/2 or 50% for each.)

Example:

Material	C:N Value	Estimated Amount	Calculation	Result
Brown	30	*1/2*	30 x *(1/2)* =	*15*
Green	15	*1/2*	15 x *(1/2)* =	*7.5*
			Total (add results):	*22.5*
			Ratio: *22.5*:1	

Ratio: C:N = 22.5 to 1

Take Pictures!

- Use a tablet or computer to take pictures of your compost cup. In your pictures, use digital pens to point out the "brown" and "green" layers on your tablet or computer.

Teacher Guidance:

- *Ensure students have labeled "brown" and "green" layers in their pictures.*
- *This step is more about the process of documentation.*

Watch and See!

- Let's look closely at our compost cups. What does it smell like? What does it look like? Write down what you see and smell.

Teacher Guidance:

- *Encourage descriptive words.*

Possible Student Responses:

- *"It smells earthy."*
- *"It looks like layers of different colors."*
- *"It's moist."*
- *"I see pieces of leaves and food."*

Think About This!

Why do we need both "brown" and "green" materials?

Teacher Guidance:

- *Look for an understanding that "browns" provide carbon, and "greens" provide nitrogen, which are essential for decomposition.*

Possible Student Responses:

- *"Brown stuff gives food to the tiny decomposers, and green stuff gives them energy." (simplified)*
- *"You need both for it to rot right."*
- *"Browns are like their food, and greens are like their water." (analogy)*

Why do we add water?

Teacher Guidance:

- *Students should recognize that moisture is necessary for the decomposition process.*

Possible Student Responses:

- *"To keep it wet so the bugs can eat it." (simplified)*
- *"It needs to be damp for it to rot."*
- *"The little things that break it down need water to live.*

What do you think will happen to the stuff in our cup?

Teacher Guidance:

- *Accept a range of predictions. The goal is to encourage thinking about decomposition.*

Possible Student Responses:

- *"It will turn into dirt."*
- *"It will get smaller."*
- *"It will change color."*
- *"It will rot and smell different."*

Bonus Fun!

- Draw a picture of your dream compost bin!

Teacher Guidance:

- *This is a creative exercise. Assess for effort and inclusion of basic compost bin features (container, lid, etc.).*

Name: ____________________________

Date: __________________

Exit Slip: Decomposition Diagram

As you create your diagram of the decomposition process, remember these things:

1. Show the Process: Draw and label the steps involved in decomposition. What happens first? What happens next? What are the final products?

2. Key Components: Include the important parts of decomposition: Organic matter (like food scraps, leaves), microorganisms (like bacteria and fungi), and end products (what is left after decomposition).

3. Clarity: Make your diagram easy to understand. Draw neatly, label each part clearly, and use arrows to show the flow of the process.

4. Connections: Show how this relates to what we learned in class: Why is decomposition important? What role do microorganisms play? How does this relate to the compost cup we made?

Use this checklist to make sure you have included everything:

- ◻ I have shown the steps of decomposition.
- ◻ I have included organic matter, microorganisms, and end products.
- ◻ My diagram is clear and easy to understand.
- ◻ I have shown how this relates to what we learned in class.

Lesson 1 Summative Assessment Rubric Student Name: ____________________________

Criteria	Excellent (4 points)	Proficient (3 points)	Developing (2 points)	Needs Improvement (1 point)	Score
Accurate Representation of Decomposition	The diagram accurately and comprehensively illustrates the decomposition process, including all key stages and components (e.g., organic matter, microorganisms, end products).	The diagram accurately illustrates the decomposition process, including most key stages and components.	The diagram illustrates some aspects of the decomposition process but may be missing or misrepresent some key stages or components.	The diagram demonstrates a limited understanding of the decomposition process, with significant inaccuracies or missing components.	
Clarity and Labeling	The diagram is exceptionally clear, well-organized, and labeled with precise scientific vocabulary. All components are easily identifiable.	The diagram is clear, organized, and labeled with appropriate vocabulary. Most components are identifiable.	The diagram is somewhat clear and organized, but labels may be missing, unclear, or use inaccurate vocabulary. Some components may be difficult to identify.	The diagram is poorly organized, difficult to understand, and lacks appropriate labels. Many components are unidentifiable.	
Detail and Completeness	The diagram includes a high level of detail, demonstrating a thorough understanding of the process (e.g., types of	The diagram includes relevant details, demonstrating a good understanding of the process.	The diagram includes some basic details but may be lacking important information.	The diagram lacks essential details, indicating a limited	

	microorganisms, specific end products).			understanding of the process.	
Connection to Lesson Concepts	The diagram demonstrates a clear and accurate connection to the concepts taught in the lesson, such as the importance of microorganisms and the carbon-to-nitrogen ratio.	The diagram demonstrates a connection to the lesson concepts.	The diagram shows a limited connection to the lesson concepts.	The diagram does not demonstrate a connection to the lesson concepts.	
Additional Comments:					**Total Score**

Name: ______________________________

Building Your Own Composter

Objective:

To design and build a model compost bin.

Materials:

- Various building materials (e.g., plastic bottles, cardboard, wood scraps)
- Tools for cutting and joining materials (e.g., scissors, tape, glue)
- Measuring tools (e.g., rulers)
- Optional: materials for ventilation (e.g., straws, mesh)

1. **Research Composting Systems:**

Use your tablet or computer to research different types of composting systems (online or in books). Draw and describe at least two different designs.

Design 1:

Design 2:

2. **Design Your Model:**

Based on your research, design your own model compost bin. Consider these factors:

i. Materials: What will you use to build it?

ii. Size: How big will it be? (Remember, this is a model.)

iii. Ventilation: How will air get in?

iv. Access: How will you add materials and remove compost?

Draw a detailed diagram of your design. Label the different parts and materials.

3. **Build Your Model:**

   Use the provided materials and tools to build your model compost bin. Follow your design diagram as closely as possible. Make sure your model is stable and functional.

4. **Calculate Volume and Scaling:**

   Measure the dimensions of your model (length, width, height). Calculate the volume of your model. If you were building a real-size compost bin, what would its dimensions be? How did you scale it?

5. **Presentation:**

   Present your model to the class. Explain your design choices, the materials you used, and how your model works. Discuss the challenges you encountered and how you solved them.

Name: ____________________________

Building Your Own Composter KEY

Objective:

To design and build a model compost bin.

Materials:

- Various building materials (e.g., plastic bottles, cardboard, wood scraps)
  - o *Check for variety and suitability for model building (e.g., ease of cutting, joining).*
- Tools for cutting and joining materials (e.g., scissors, tape, glue)
  - o *Ensure tools are appropriate for the materials and safe for student use. Adult supervision may be required.*
- Measuring tools (e.g., rulers)
  - o *Ensure rulers are available and that students understand how to use them accurately.*
- Optional: materials for ventilation (e.g., straws, mesh)
  - o *Encourage students to consider creative solutions for ventilation.*

1. **Research Composting Systems:**

Use your tablet or computer to research different types of composting systems (online or in books). Draw and describe at least two different designs.

Students should explore a variety of composting systems (e.g., examples: tumblers, bins, worm composters). Students should identify key features of different systems (e.g., size, shape, aeration, access).

Design 1: Look for labeled sketches with descriptions of how each system works.

Design 2: Look for labeled sketches with descriptions of how each system works.

2. **Design Your Model:**

Based on your research, design your own model compost bin. Consider these factors:

Students should apply their research to create their own unique design.

ii. Materials: What will you use to build it? *Check that the chosen materials are appropriate for building a model.*

iii. Size: How big will it be? (Remember, this is a model.) *Ensure the model's size is manageable and allows for demonstration of key features.*

iv. Ventilation: How will air get in? *Evaluate the effectiveness of the proposed ventilation system.*

v. Access: How will you add materials and remove compost? *Assess how easily materials can be added and compost removed in the design.*

Draw a detailed diagram of your design. Label the different parts and materials.

Look for a clear, labeled diagram with all parts identified and materials specified.

3. **Build Your Model:**

Use the provided materials and tools to build your model compost bin. Follow your design diagram as closely as possible. Make sure your model is stable and functional.

Students should translate their design into a physical model.

Observe students' safe and effective use of tools and materials.

The model should demonstrate the basic functions of a compost bin (e.g., stability, potential for containing materials).

Check how closely the model matches the original design.

4. **Calculate Volume and Scaling:**

Measure the dimensions of your model (length, width, height). Calculate the volume of your model. If you were building a real-size compost bin, what would its dimensions be? How did you scale it?

Students should apply mathematical concepts to their model.

Verify the accuracy of the measurements.

Check the correct application of the volume formula (e.g., V = l x w x h).

**Evaluate the logic and accuracy of the scaling calculation. For example, if the model is 1/10th scale, the real-life dimensions should be 10 times larger. To help students understand scaling, you can use these guiding questions:*

- *What is the ratio between the model compost bin and a real-life compost bin (e.g., 1:10)?*

- *If one part of your model is 2 inches, how long would that part be in a real-life compost bin?*
- *If you know the real-life size of a compost bin is 3 feet long, how long should you make that part in your model?**

5. **Presentation:**

Present your model to the class. Explain your design choices, the materials you used, and how your model works. Discuss the challenges you encountered and how you solved them.

Students should communicate their design process and understanding of composting.

Assess how well students justify their design decisions.

Evaluate the clarity and accuracy of their explanation.

Look for evidence of problem-solving skills and critical thinking.

Assess the clarity, organization, and confidence of their presentation.

Lesson 2 Summative Assessment Rubric

Student Name: ______________________________

Criteria	Excellent (4 points)	Proficient (3 points)	Developing (2 points)	Needs Improvement (1 point)	Score
Understanding of Composting Systems	Demonstrates a comprehensive understanding of various composting systems (e.g., tumblers, bins, worm composters) and their key features (e.g., size, shape, aeration, access).	Demonstrates a good understanding of several composting systems and their key features.	Demonstrates a basic understanding of a few composting systems and some of their key features.	Demonstrates a limited understanding of composting systems and their key features.	
Design and Rationale	Presents a unique and well-justified model design, clearly explaining how design choices (materials, size, ventilation, access) enhance functionality and efficiency. Rationale is supported by research and composting principles.	Presents a functional model design with a reasonable explanation of design choices. Rationale is generally supported by research and composting principles.	Presents a model design with some explanation of design choices, but rationale may be unclear or not fully supported by research and composting principles.	Presents a model design with limited or no explanation of design choices. Rationale is missing or not supported by research and composting principles.	
Model Construction	Constructs a highly stable and functional model that closely adheres to the design diagram, demonstrating skillful use of materials and tools.	Constructs a stable and functional model that generally adheres to the design diagram, demonstrating competent use of materials and tools.	Constructs a model that is somewhat stable and functional but may deviate from the design diagram or show less	Constructs an unstable or non-functional model that deviates significantly from the design diagram	

			skillful use of materials and tools.	and demonstrates limited use of materials and tools.	
Mathematical Application: Volume and Scaling	Accurately calculates the volume of the model and correctly scales it to real-life dimensions, clearly explaining the scaling process and ratio used. Provides accurate measurements and applies the volume formula correctly.	Calculates the volume of the model with minor errors and scales it to real-life dimensions with reasonable accuracy, explaining the scaling process. Measurements are generally accurate, and the volume formula is applied correctly.	Calculates the volume of the model with significant errors or omits the calculation. Scaling to real-life dimensions is attempted but contains inaccuracies or lacks a clear explanation. Measurements may be inaccurate, and the volume formula may be applied incorrectly.	Does not calculate the volume of the model or attempt to scale it to real-life dimensions.	
Presentation and Communication	Delivers a clear, organized, and confident presentation, effectively explaining the design process, materials used, model functionality, challenges encountered, and solutions implemented. Demonstrates strong communication skills and a thorough understanding of the project.	Delivers a generally clear and organized presentation, explaining the design process, materials used, and model functionality. Communicates effectively and demonstrates a good understanding of the project.	Delivers a presentation that is somewhat unclear or disorganized, with some explanation of the design process, materials used, and model functionality. Communication is adequate, and understanding of the project is satisfactory.	Delivers an unclear and disorganized presentation with limited explanation of the design process, materials used, and model functionality. Communication is poor, and understanding of	

				the project is limited.	
Additional Comments:					**Total Score**

Name: ______________________________

Planning a Garden

Section 1: Understanding the Basics

What is Compost?

In your own words, briefly describe what composting is.

Why is composting considered a form of recycling?

Why is Compost Good for Soil?

List two ways compost helps improve soil.

Why is healthy soil important for plants?

What Do Plants Need?

List three basic things plants need to grow.

How does compost help provide these things?

Section 2: Thinking About a Garden System

You have 50 square feet of space to create **two raised garden beds** to grow delicious food for your family! In this activity, you will plan and sketch your two garden beds, thinking carefully about how to arrange your plants for healthy growth and good relationships.

Part 1: Sketch Your Garden Beds

Use the space below to sketch your two raised garden beds. Remember that the total area of both beds combined cannot be more than 20 square feet.

Layout of the Two Raised Beds:

- Draw two rectangles (or other shapes if you prefer) to represent your two garden beds.
- Label the approximate area (in square feet) of each of your garden beds. Make sure the two areas add up to 20 square feet or less.
- Write down the approximate length and width of each of your garden beds. (Remember: Area = Length x Width)

Sketch Area:

Bed 1:

Approximate Area: __________ square feet

Approximate Length: __________ feet

Approximate Width: __________ feet

Bed 2:

Approximate Area: __________ square feet

Approximate Length: __________ feet

Approximate Width: __________ feet

Placement of Different Plants:

1. Choose at least **three different types of food plants** you would like to grow in your two gardens. Write them down here:
   - o Plant 1: _________________________
   - o Plant 2: _________________________
   - o Plant 3: _________________________
2. In your sketch above, draw where you will plant each type of plant within your two beds. Use simple shapes or symbols to represent each plant.
3. Label each type of plant in your sketch.

Consider Plant Relationships (Companion Planting):

1. Think about which of your chosen plants might help each other grow better or keep pests away when planted near each other. Draw arrows or connecting lines between any plants you plan to place together for this reason.
2. If you plan to put certain plants near each other because they are "good neighbors," add a small note or symbol to show this in your sketch.
3. Think about how big your plants will get as they grow. Make sure you leave enough space between your plant symbols in your sketch so they won't be too crowded.

Part 2: Written Reflection

Answer the following questions based on your garden sketch:

1. What three (or more) types of food plants did you choose to grow in your garden?

2. How did you decide to divide the 20 square feet between your two raised garden beds? Why did you choose this division?

3. Explain one example of a plant relationship you considered when planning your garden. Why did you place those plants near or far from each other?

4. Describe one thing you considered about the growth of your plants when deciding where to place them in your garden beds.

Using Compost in a Garden:

Give one simple way compost can be used in a garden.

Why would using compost make the garden system more sustainable?

Reflection

What Did You Learn?

Write one thing you learned about composting and gardening.

How might this knowledge be useful in the future?

Planning a Garden KEY

Section 1: Understanding the Basics

What is Compost?

In your own words, briefly describe what composting is.

Composting is the process of breaking down organic materials like food scraps and yard waste into a nutrient-rich substance called compost. It's like nature's way of recycling these materials.

Why is composting considered a form of recycling?

Composting is considered a form of recycling because it takes materials that would otherwise be thrown away as waste and transforms them into a valuable resource (compost) that can be used to improve soil health and plant growth, effectively closing the loop on these organic materials

Why is Compost Good for Soil?

List two ways compost helps improve soil.

- *It adds essential nutrients to the soil, making them available to plants.*
- *It improves the soil's structure, making it easier for roots to grow and for water and air to move through.*
- *Helps retain moisture.*
- *Improves drainage in clay soils.*
- *Helps balance soil pH.*
- *Introduces beneficial microorganisms.*

Why is healthy soil important for plants?

Healthy soil provides plants with the necessary nutrients, water, and air they need for proper growth, strong roots, and overall health. It also supports beneficial microorganisms that help plants access nutrients and protect them from diseases.

What Do Plants Need?

List three basic things plants need to grow.

1. *Sunlight*
2. *Water*
3. *Nutrients (from the soil)*
4. *Air/carbon dioxide*

5. *Proper temperature*
6. *Support*

How does compost help provide these things?

Compost adds nutrients to the soil, which plants absorb through their roots. It also improves the soil's ability to retain water, making it available to plants over a longer period. The improved soil structure from compost allows for better air circulation around the roots.

Section 2: Thinking About a Garden System

You have 50 square feet of space to create **two raised garden beds** to grow delicious food for your family! In this activity, you will plan and sketch your two garden beds, thinking carefully about how to arrange your plants for healthy growth and good relationships.

Part 1: Sketch Your Garden Beds

Use the space below to sketch your two raised garden beds. Remember that the total area of both beds combined cannot be more than 20 square feet.

Layout of the Two Raised Beds:

- Draw two rectangles (or other shapes if you prefer) to represent your two garden beds.
- Label the approximate area (in square feet) of each of your garden beds. Make sure the two areas add up to 20 square feet or less.
- Write down the approximate length and width of each of your garden beds. (Remember: Area = Length x Width)

Sketch Area:

(Note: The answers to Part 1 will vary depending on the student's sketch. The key should focus on the reasoning and concepts.)

- *Layout of the Two Raised Beds:*
  - o *Approximate Area: (Teacher will check if the sum of the two beds is 20 sq ft or less)*
  - o *Approximate Length & Width: (Teacher will check if Length x Width ≈ Area for each bed)*
- *Placement of Different Plants: (Teacher will check if at least three different plants are chosen and placed in the sketch with labels.)*

- *Consider Plant Relationships (Companion Planting): (Teacher will look for evidence of consideration for companion planting through arrows, connecting lines, or notes.)*
- *Consider Plant Growth and Spacing: (Teacher will assess if there appears to be adequate spacing between plant symbols in the sketch.)*

Bed 1:

Approximate Area: __________ square feet

Approximate Length: __________ feet

Approximate Width: __________ feet

Bed 2:

Approximate Area: __________ square feet

Approximate Length: __________ feet

Approximate Width: __________ feet

Placement of Different Plants:

- Choose at least **three different types of food plants** you would like to grow in your two gardens. Write them down here:
  - Plant 1: _________________________
  - Plant 2: _________________________
  - Plant 3: _________________________
- In your sketch above, draw where you will plant each type of plant within your two beds. Use simple shapes or symbols to represent each plant.
- Label each type of plant in your sketch.

Consider Plant Relationships (Companion Planting):

- Think about which of your chosen plants might help each other grow better or keep pests away when planted near each other. Draw arrows or connecting lines between any plants you plan to place together for this reason.

- If you plan to put certain plants near each other because they are "good neighbors," add a small note or symbol to show this in your sketch.

4. **Consider Plant Growth and Spacing:**

   - Think about how big your plants will get as they grow. Make sure you leave enough space between your plant symbols in your sketch so they won't be too crowded.

Part 2: Written Reflection

Answer the following questions based on your garden sketch:

1. What three (or more) types of food plants did you choose to grow in your garden?

   (Teacher will list the plants chosen by the student.)

2. How did you decide to divide the 20 square feet between your two raised garden beds? Why did you choose this division?

   (Teacher will look for a reasonable explanation, such as wanting more space for a particular plant, dividing based on plant needs like sun exposure, or simply dividing it evenly.)

3. Explain one example of a plant relationship you considered when planning your garden. Why did you place those plants near or far from each other?

   (Teacher will look for a specific example of companion planting and the reasoning behind it, such as deterring pests, attracting beneficial insects, or improving growth.)

4. Describe one thing you considered about the growth of your plants when deciding where to place them in your garden beds.

   (Teacher will look for considerations like the mature size of the plant, whether it needs a trellis, if it will shade other plants, or its root system.)

Using Compost in a Garden:

Give one simple way compost can be used in a garden.

Compost can be mixed into the soil before planting, used as a top dressing around existing plants, or added to planting holes.

Why would using compost make the garden system more sustainable?

Using compost recycles organic waste, reducing the need for synthetic fertilizers and landfill space. It also improves soil health naturally, leading to healthier plants that may be more resistant to pests and diseases, reducing the need for chemical interventions. This creates a more self-sustaining and environmentally friendly system.

Reflection

What Did You Learn?

Write one thing you learned about composting and gardening.

(Teacher will look for a thoughtful reflection on a specific concept learned, such as the benefits of compost, the importance of plant relationships, or the space requirements of plants.)

How might this knowledge be useful in the future?

(Teacher will look for a connection to real-world applications, such as starting their own garden, understanding food production, making informed decisions about waste management, or appreciating the interconnectedness of natural systems.)

Garden Plan Evaluation Rubric

Student Name: ______________________________

Criteria	Excellent (4 points)	Proficient (3 points)	Developing (2 points)	Needs Improvement (1 point)	Score
Garden Bed Layout & Area	Two distinct beds are clearly sketched and labeled with approximate areas that total 20 square feet or less. Accurate length and width are provided for each bed, consistent with the labeled area.	Two distinct beds are sketched and labeled with approximate areas totaling 20 square feet or less. Length and width are provided for each bed, with minor inconsistencies with the labeled area.	Two beds are sketched, but labeling of area, length, and width may be incomplete or significantly inaccurate. The total area may exceed 20 square feet.	The sketch of the garden beds is unclear or missing key elements (e.g., only one bed, no labels for area/dimensions).	
Plant Selection	At least three diverse food plants are clearly listed. Plant choices demonstrate consideration for a home garden.	At least three food plants are listed. Plant choices are generally appropriate for a garden.	Fewer than three food plants are listed, or the choices may not be suitable for a typical garden.	No plants are listed.	
Plant Placement & Labeling	Each chosen plant is clearly represented in the sketch with a distinct symbol or shape and accurately labeled within the corresponding bed(s). Placement appears thoughtful and considers the number of each plant.	Each chosen plant is represented in the sketch and labeled, but some placement may appear crowded or uneven.	Some plants are represented but not consistently labeled, or the placement appears random and does not consider spacing.	Plants are not clearly represented or labeled in the sketch.	

Companion Planting	At least one clear example of companion planting is evident in the sketch with arrows, connecting lines, or notes explicitly indicating the intended benefit (e.g., pest deterrence, attracting beneficial insects, improved growth).	An attempt at companion planting is shown in the sketch, but the reasoning or connection between plants may be unclear or missing the specific benefit.	There is no clear indication of consideration for companion planting in the sketch.	-	
Consideration of Growth & Spacing	The sketch clearly demonstrates consideration for the mature size and/or growth habits (e.g., need for trellis, potential for shading) of the chosen plants through adequate spacing between symbols.	The sketch shows some consideration for plant growth and spacing, but some areas may appear slightly crowded or lack specific attention to growth habits.	Little to no consideration for the mature size or growth habits of plants is evident in the spacing within the sketch.	Plants are drawn with no apparent consideration for their mature size or spacing needs.	
Additional Comments:					**Total Score**

Student Reflections Evaluation Rubric Student Name: ______________________________

Criteria	Excellent (4 points)	Proficient (3 points)	Developing (2 points)	Needs Improvement (1 point)	Score
Plant Choices Rationale	Clearly and logically explains the reasons for choosing three or more specific food plants for their garden.	Provides reasons for choosing three or more food plants, but the explanation may lack detail or strong justification.	Lists three or fewer food plants with minimal or unclear reasons for their selection.	Fails to clearly state or provide reasons for the chosen plants.	
Bed Division Rationale	Provides a well-reasoned explanation for how the 20 square feet was divided between the two beds and the specific reasons behind this division (e.g., space needs of plants, sun exposure considerations, even split).	Explains the division of space between the beds, but the reasoning may be somewhat general or lack specific details.	Describes the division of space with limited or unclear justification.	Does not clearly explain how the space was divided or why.	
Companion Planting Explanation	Clearly explains a specific example of a plant relationship considered, justifying why those plants were placed near or far from each other based on a recognized benefit (e.g., deterring specific pests, attracting pollinators).	Identifies a plant relationship considered but provides a less detailed or somewhat unclear explanation for the placement.	Mentions a plant relationship but provides a minimal or inaccurate explanation for the placement decision.	Does not identify or explain any consideration for plant relationships.	
Growth & Spacing Consideration	Thoroughly describes a specific aspect of plant growth (e.g., mature size, need for support, shading) considered when placing plants and	Describes a consideration related to plant growth and its influence on placement, but	Briefly mentions a growth aspect but provides a vague or unclear explanation of its	Does not describe any consideration for plant growth	

	clearly explains how this influenced their placement decisions in the garden beds.	the explanation may lack depth or specific examples.	impact on plant placement.	when deciding on placement.	
Compost Use & Sustainability	Provides a clear and practical example of how compost can be used in a garden (e.g., mixing into soil, top dressing) and thoroughly explains why using compost makes the garden system more sustainable, explicitly mentioning the reduction of synthetic fertilizers and landfill waste, and the improvement of soil health.	Gives a reasonable example of compost use and explains how it contributes to sustainability in the garden, though the connection to specific benefits may not be fully elaborated.	Offers a basic example of compost use but provides a limited or unclear explanation of its role in sustainability.	Does not provide a clear example of compost use or explain its connection to sustainability.	
Composting & Gardening Learning	Articulates a specific and insightful learning point about composting and/or gardening gained from the activity, referencing concepts like the benefits of compost, plant relationships, or spacing.	States a learning point about composting and/or gardening, but it may be somewhat general or less specific.	Identifies something learned, but it is vague, obvious, or not directly related to the key concepts of the activity.	Fails to articulate a clear learning point from the activity.	
Future Usefulness	Clearly explains how the knowledge gained from this activity might be useful in future situations, providing specific and relevant examples such as starting a garden, making informed waste management decisions, or understanding food production.	Describes potential future uses of the knowledge gained, but the examples may be less specific or fully developed.	Suggests a possible future use of the knowledge, but it is vague or lacks clear connection to the activity's content.	Does not explain how the knowledge gained might be useful in the future.	

Additional Comments:					**Total Score**

Name: ___________________________

The Carbon Cycle Story

Part 1: Carbon's Journey

The following steps describe the journey of a single carbon atom. Use the words below to fill in the blanks, describing where the carbon is (the Reservoir or "Sink") and how it moves (the Process).

Word Bank:

- **Reservoirs:** Atmosphere, Biosphere (Plant/Animal), Soil (in Humus), Oceans
- **Processes:** Photosynthesis, Cellular Respiration, Decomposition, Composting

Step	Starts in Reservoir...	Process	Moves to Reservoir...
1. *Example: A tree takes in carbon dioxide.*			
2. *Example: A bunny eats a leaf from the tree.*			
3. *Example: The bunny runs around and breathes out carbon dioxide.*			
5. *Example: The bunny dies and microorganisms break down its body.*			

Part 2: Composting and Carbon

Read the two statements below and answer the question that follows.

Statement A (Landfill): When food scraps are dumped in a landfill, they are buried without oxygen. This process quickly releases lots of Methane (CH_4) and Carbon Dioxide (CO_2) into the Atmosphere. Both are powerful greenhouse gasses.

Statement B (Composting): When food scraps are composted *with* oxygen, they decompose into stable humus (finished compost). This humus contains carbon that is locked away and stored safely in the Soil for years, improving the soil health for future plant growth.

Question: Which method (Landfill or Composting) is better for keeping carbon out of the atmosphere over the long term, and why? Use the terms Carbon Sequestration, Humus, and Atmosphere in your answer.

Name: ___________________________

The Carbon Cycle Story KEY

Part 1: Carbon's Journey

The following steps describe the journey of a single carbon atom. Use the words below to fill in the blanks, describing where the carbon is (the Reservoir or "Sink") and how it moves (the Process).

Word Bank:

- **Reservoirs:** Atmosphere, Biosphere (Plant/Animal), Soil (in Humus), Oceans
- **Processes:** Photosynthesis, Cellular Respiration, Decomposition, Composting

Step	Starts in Reservoir...	Process	Moves to Reservoir...
4. Plant Intake *Example: A tree takes in carbon dioxide.*	*Atmosphere*	*Photosynthesis*	*Biosphere (Plant)*
5. Food Chain Transfer *Example: A bunny eats a leaf from the tree.*	*Biosphere (Plant)*	*Consumption/ Eating*	*Biosphere (Animal)*
6. Energy Release *Example: The bunny runs around and breathes out carbon dioxide.*	*Biosphere (Animal)*	*Cellular Respiration*	*Atmosphere*
7. Return to Earth *Example: The bunny dies and microorganisms break down its body.*	*Biosphere (Animal)*	*Decomposition*	*Soil*

Part 2: Composting and Carbon

Read the two statements below and answer the question that follows.

Statement A (Landfill): When food scraps are dumped in a landfill, they are buried without oxygen. This process quickly releases lots of Methane and Carbon Dioxide into the Atmosphere. Both are powerful greenhouse gasses.

Statement B (Composting): When food scraps are composted *with* oxygen, they decompose into stable humus (finished compost). This humus contains carbon that is locked away and stored safely in the Soil for years, improving the soil health for future plant growth.

Question: Which method (Landfill or Composting) is better for keeping carbon out of the atmosphere over the long term, and why? Use the terms Carbon Sequestration, Humus, and Atmosphere in your answer.

Answer: *Composting is the better method for the long term. When organic material is composted, the carbon turns into humus, which is very stable. This process is called Carbon Sequestration because it effectively takes carbon out of the Atmosphere and locks it safely away in the soil, where it helps plants grow.*

Name: ___________________________

Carbon Cycle Exit Slip

Part 1: Draw the Difference

Directions: In the boxes below, draw a simple diagram for each scenario showing the path of carbon. Use arrows to show the movement of carbon.

Scenario A: Landfill	**Scenario B: Composting**
Start: Food Scrap (Carbon)	**Start:** Food Scrap (Carbon)

Part 2: Explain

Directions: Explain in 2-3 sentences: **What is the most important thing composting does for the carbon cycle and why is this helpful for the planet?**

Name: ___________________________

Carbon Cycle Exit Slip KEY

Part 1: Draw the Difference

Directions: In the boxes below, draw a simple diagram for each scenario showing the path of carbon. Use arrows to show the movement of carbon.

Scenario A: Landfill	**Scenario B: Composting**
Start: Food Scrap (Carbon)	**Start:** Food Scrap (Carbon)
Expected Diagram: A food scrap with a thick, quick arrow pointing straight up to the Atmosphere (CO2/CH4) This represents the Fast Carbon Cycle.	*Expected Diagram: A food scrap with a stable arrow pointing down into the Soil (labeled Humus). The carbon stays "locked" in the soil. This represents the Slow Carbon Cycle.*

Part 2: Explain

Directions: Explain in 2-3 sentences: **What is the most important thing composting does for the carbon cycle and why is this helpful for the planet?**

Evaluation Focus: Does the student use the key vocabulary (Carbon Sequestration and Humus) to explain the benefit of composting?

Ideal Answer (Key Concepts to Look For): The most important thing composting does is Carbon Sequestration. Composting takes the carbon from organic waste (like food scraps) and turns it into stable humus. This process is helpful for the planet because it *locks the carbon safely away in the soil instead of allowing it to rapidly escape into the atmosphere as greenhouse gasses.*