Lesson Title: ***Decomposition and the Transfer of Carbon***

Author: ***Corinne De Keukelaere***

Topic: **Decomposition, Carbon Transfer**

The U.S. generates 292.4 million tons of solid waste a year (2018 data)— around 69 million tons were recycled and 25 million tons were composted- so much garbage isn't recycled or composted so why isn't Earth covered in more waste?

"National Overview: Facts and Figures on Materials, Wastes and Recycling." *EPA*, Environmental Protection Agency, 15 Apr. 2021, www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials.

Thankfully, nature recycles garbage and dead plants and animals all the time. This natural recycling helps return nutrients to the soil for life to grow and flourish. Nature's recyclers are microscopic bacteria and fungi, which are essential for the decomposition process on Earth.

Targeted Grade Level: ***6th- 8th Grades***

Time Needed: 1-2 days to create decomposition chambers, 2-3 weeks to make observations, and research the Carbon Cycle. *2-3 months to view the entire decomposition and extend the lesson to see complete decomposition within the chamber.*

Subject Integration:

Science, Engineering, ELA/ Literacy, Math

Justification: Decomposition for middle school students is often just viewed as something where food goes bad and gets really gross. The objective of these lessons is to observe decomposition first hand over a period of time. During the weeks to view decomposition taking place there is time to explore the Carbon Cycle and start to look at the Energy Pyramid within Food Webs to see how Carbon and Energy are transferred. The students will use their engineering skills to design their own experiment to test the decomposition rate of materials or change the moisture/ temperature within the chamber. While waiting for observable changes to take place in the decomposition chamber the students will participate in lessons to help explain that decomposition is not just gross, but an essential process that involves microorganisms that help return elements to the soil for producers to grow and help transfer energy. The students will use mathematics to make quantitative observations and measure mass and volume of materials they add to the chamber. Finally the students will use ELA/ Literacy skills to make a claim, support it with evidence, and reason their decisions. The students will also present their findings to the class about their group experiment and what they discovered about decomposition.

Standards:

New Jersey Student Learning Standards: https://www.nj.gov/education/cccs/2020/NJSLS-Science.pdf

Next Generation Science Standards: https://www.nextgenscience.org/sites/default/files/MSTopic.pdf

NGSS Performance Expectations

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Developing and Using Models *Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.* *▪ Develop a model to describe phenomena. (MS-LS2-3)* *▪ Develop a model to describe unobservable*	*LS1.C: Organization for Matter and Energy Flow in Organisms ▪ Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)*	***Cause and Effect*** *▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)* ***Energy and Matter*** *▪ Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)*

mechanisms. (MS-LS1-7) ***Analyzing and Interpreting Data*** *Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.* *▪ Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)* ***Constructing Explanations and Designing Solutions*** *Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.* *▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-6)* ***Engaging in Argument from Evidence*** *Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or*	*▪ Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)* *LS2.B: Cycle of Matter and Energy Transfer in Ecosystems* *▪ Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)* ESS3.C: Human Impacts on Earth Systems ▪ Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) ▪ Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are	*▪ Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)* *▪ The transfer of energy can be tracked as energy flows through a natural system. (MSLS2-3) Stability and Change ▪ Small changes in one part of a system might cause large changes* ***Influence of Science, Engineering, and Technology on Society and the Natural World*** *▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-4) ▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3)* --- ***Connections to Nature of Science Science Addresses Questions About the Natural and Material World*** *▪ Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MSESS3-4)*

solutions about the natural and designed world(s). ▪ *Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)* *----------* ***Connections to Nature of Science*** ***Scientific Knowledge is Based on Empirical Evidence*** ▪ *Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)* ▪ *Science disciplines share common rules of obtainIf applicable*	engineered otherwise. (MSESS3-3),(MS-ESS3-4)	

Common Core State Standards:

Math:

MP.2 Reason abstractly and quantitatively. (MS-ESS3-2)

7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS3-3),(MS-ESS3-4)

(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4)6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6),(MS-LS2-3)

ELA:

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.

RH.6-8.7. Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

Measurable Student Learning Objectives:

SWBAT design and investigate the decomposition of different organic materials in a decomposition chamber

SWBAT research different methods used to decelerate the rate at which food spoils

SWBAT diagram the biological and geological carbon cycle.
SWBAT interprets how carbon flows through the biological carbon cycles.

Nature of STEM: Students will create decomposition chambers, make observations of the decomposition over weeks to months, then develop a model to explain how Carbon as well as Energy transfers within the ecosystem. Students will design experiments to compare different organic materials:leaves, grass, food scraps, soil, etc and compare rates of

decomposition based on types of materials, amounts of water, different temperatures. Students will use Science to learn about processes associated with decomposition and Carbon transfer. Students will use Engineering to build models and systems to test and explore the phenomena of decomposition. Students will use Math to measure materials and design their decomposition chambers as well as make quantitative observations about the dependent variables. Finally students will use ELA/ Literacy skills to analyze data and text and write arguments to support claims based on evidence.

Engaging Context/Phenomena:

Fruit and Vegetable Decomposition, Time-lapse: ***https://www.youtube.com/watch?v=c0En-_BVbGc***

The Carbon Cycle or The Circle of Life: *https://www.youtube.com/watch?v=4vJ_1ojjlxw*

The students will be shown the 2 phenomena videos. The first video is a time- lapse video of the decomposition of organic materials to get an idea of how materials break down and generate ideas for what to use in their decomposition chamber. The second video introduces the Carbon Cycle to the Lion King "Circle of Life" song to see how Carbon and energy are transferred from producers to the levels of consumers (primary- herbivores. secondary, tertiary- omnivores, carnivores) and then decomposers which return Carbon and Nitrogen back to the soil to continue the "Circle of Life".

Data Integration: **"The Carbon Cycle."** ***NASA*****, NASA, earthobservatory.nasa.gov/features/CarbonCycle/page2.php.**

Use data from : Earth's Observatory:Carbon Cycle: https://earthobservatory.nasa.gov/features/CarbonCycle/page1.php to get background knowledge of the Carbon Cycle. In the Explain section of the 5E lesson the students will use the Earth's Observatory to read and analyze data about the slow and fast Carbon Cycles to make connections between their decomposition chamber and and how decomposition is a crucial part of the Carbon Cycle to recycle Carbon from living things help transfer it to the soil and the atmosphere.

Differentiation of Instruction: A copy of an observation chart will be provided for students who need assistance with organization and observation. Students will also have modified questions to answer in the Explain and a CER with choices and word bank in the Elaborate sections.

Real-life Connection: Composting and decomposition is something that students and their families can participate in at their homes. Everyone has fruits and vegetables that they can compost with simple materials. Students and their families might also have gardens which could benefit from at home compositing to add to the soil to grow.

Possible Misconceptions: Students don't understand that there may be many pathways in a given cycle. Students don't understand that the carbon cycle is more than one simple cycle, but many cycles that work together to balance the carbon

on Earth. Students don't understand how decomposition returns Carbon and other elements to enrich the soil to continue the cycles of nature.

Lesson Procedure:

5E Model	5E Objectives
Engage ***Students start off with a Focus Question to access prior knowledge. This Focus Question will be a Summative Assessment at the conclusion of this investigation. The 2 phenomena videos are then shown to introduce the content that will be studied in the investigation.***	**Procedure:**The Teacher will begin class with an "anchoring phenomena" activity. This activity is meant to grab the students' attention, develop interest in the lesson, and access prior knowledge. 1. Focus Question 2. Watch Time Lapse Fruit Video & Answer the formative assessment questions listed below 3. Watch Carbon Cycle- Circle of Life video and participate in group activity- see formative assessment below **Modifications: Students are assessed on effort for this part. Students are matched up with peers to encourage participation.** **Standards Addressed:** *MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.* *MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.* **Formative**/Summative **Assessments** *:* ***Focus Question: What are the positive and negative effects of decomposition on Earth?*** ***Watch Time Lapse Fruit Video-answer:*** 1. *Why do some fruits go bad faster?* 2. *How long does this process take in the video ?* ***Watch Carbon Cycle- Circle of Life video:*** *1. In groups students discuss the components of the Carbon Cycle* *2. In groups students discuss and write about what happened to the rabbit and why this is beneficial to the Earth.* **Resources:** ***Fruit and Vegetable Decomposition, Time-lapse: https://www.youtube.com/watch?v=c0En-_BVbGc*** ***The Carbon Cycle or The Circle of Life:*** *https://www.youtube.com/watch?v=4vJ_1ojjlxw*

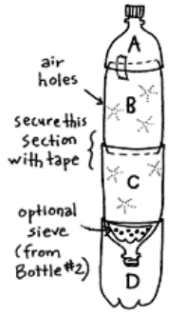
Explore

Decomposition Chamber Models- Proposal & Build. Observation Charts

Procedure: Adapted from Bottle Biology:
Ingram, Mrill, and Amy Kelley. *Bottle Biology: an Idea Book for Exploring the World through Plastic Bottles and Other Recyclable Materials*. Kendall/Hunt Publishing Company, 2014.

Students will be asked in prior weeks to collect 2 liter bottles. Each group of 3-4 students will need 6 bottles. The teacher will aid in the creation of the chamber (cutting the bottles). The students as a group will decide what types of materials to put into their chambers. Students will measure and record how much of the materials they use.

1. Remove labels from all three 2-liter bottles.	
2. Cut the top off bottle #1 2-3 cm below the shoulder so that the cylinder has straight sides.	
3. Cut top off of Bottle #2 2-3 cm above the shoulder. Cut bottom	
4. Invert "C" and stack into base "D." Stack "B" and tape middle seam securely. Poke air holes. Add top "A" with a piece of tape for a hinge to the bottle column.off 2-3 cm below hip so the resulting cylinder has two tapered ends.	

	5. Cut bottom off Bottle #3 1-2 cm above the hip, so the cylinder has a straight end.	
	6. Invert "C" and stack into base "D." Stack "B" and tape middle seam securely. Poke air holes. Add top "A" with a piece of tape for a hinge to the bottle column.	
	7. Design an experiment to compare the decomposition rate of organic or inorganic material. Students may compare organic material- put different materials into each chamber. Students may use the same materials, but change the temperature or amount of water added to the chamber. Students are encouraged to design their own experiment to compare making sure to only change 1 variable and keep detailed observations about color, texture, smell, shape of the materials. Students may also weigh the materials before and after the investigation to see if the mass changes over time. See Proposal and Sample Observation Chart	 **Decomposition**
	_8. Make observations daily for 1 month and may continue beyond 1 month for comparison.	
	Modifications: Students may take pictures of their observations, a printed out copy of an observation chart may be used to fill in. **Standards Addressed:** ▪ *Develop a model to describe phenomena. (MS-LS2-3)*	

	▪ *Develop a model to describe unobservable mechanisms. (MS-LS1-7)* ▪ *Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)* ▪ *Construct a scientific explanation based on valid and reliable evidence obtained from sources* **Formative**/Summative **Assessments** *-Students will design their experiment by first proposing what they will change in the 2 decomposition chambers (1 Independent Variable) and what they want to find out and how they will measure it (Dependent Variable).* *-Students will create an observation chart with dates, materials used,measurements, observations and inferences, detailed list of any external conditions of the decomposition chamber (temperature, light, water added, etc)*

Component	Excellent- Gold Medal (3 Points)	Good- Silver Medal (3 Points)	Ok- Bronze Medal (2 Points)	Needs Improvement (0-1 Point)	Point(s)/ Notes
Proposal for Investigation Independent/ Dependent Variables	Makes an exceptional plan of what will be changed in the investigation and what will be measured. Well organized and thought out with many details. Identifies Independent & Dependent Variables	Makes a good plan of what will be changed in the investigation and what will be measured. Details explain the Independent & Dependent Variables	Makes a plan of what will be changed in the investigation and what will be measured. More details are needed to explain the Independent & Dependent Variables.	Plan is lacking details. Independent & Dependent Variables are not identified.	
Observation Chart	Observation chart is very well organized with exceptional details of the changes taking place in the decomposition chambers. Observations about changes in color, texture, shape,smell of the materials.	Observation chart is organized with good details of the changes taking place in the decomposition chambers. Observations about changes in color, texture, shape,smell of the materials.	Observation chart is somewhat organized with details of the changes taking place in the decomposition chambers. More detail is needed about changes in color, texture, shape,smell of the materials.	Observation chart is is lackin details about color, texture, shape,smell of the materials.	
Effective Use of Class Time — counts 2x	Used all available class time effectively and wisely. The teacher did not have to re-direct student. Worked very well with teammates.	Used most of the class time effectively. The teacher did not re-direct student. Worked well with teammates.	Did not use all available class time wisely. The teacher needed to re-direct student at least once. Could have been a better teammate.	Did not stay on task. Student was repeatedly re-directed by teacher. Let down teammates.	

Resources : Adapted from Bottle Biology:

Ingram, Mrill, and Amy Kelley. *Bottle Biology: an Idea Book for Exploring the World through Plastic Bottles and Other Recyclable Materials*. Kendall/Hunt Publishing Company, 2014.

Explain

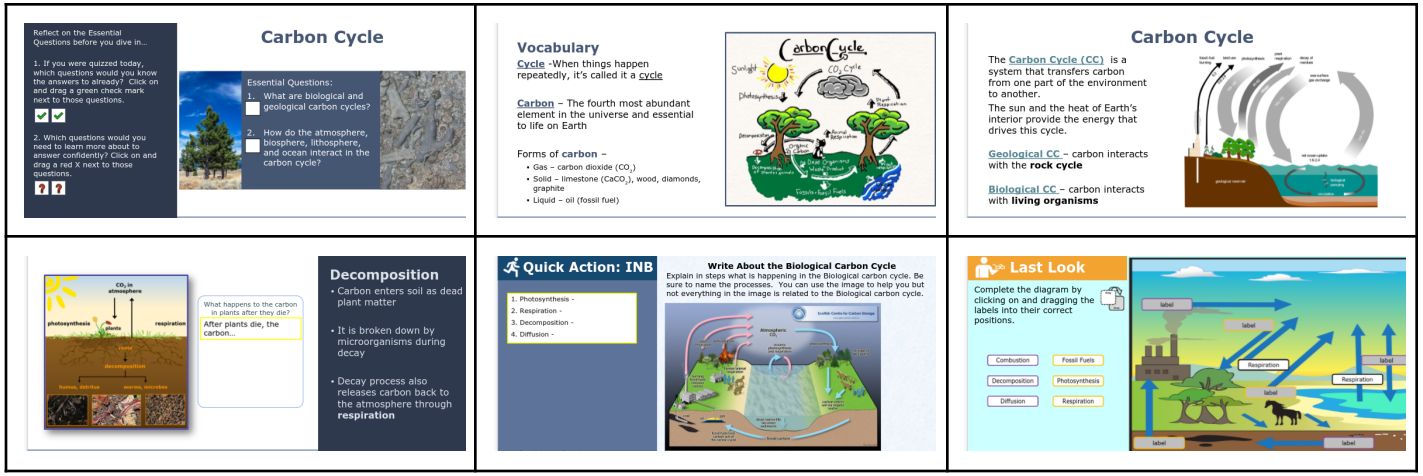
Students take notes, add vocabulary, participate in interactive slides, and integrate data to make connections between the importance of decomposition and the transfer of elements and energy

Procedure: *1. Read https://bottlebiology.org/investigations/decomp_bkgreading.html*

Add vocabulary to notebook: (1 50 minute class period)

succession	Bacteria	Fungi
saprophytes	actinomycetes	Slime molds
Algae	Protozoans	spirogyra

2. Complete interactive "Explain" slides in cooperative groups with class discussion of selected slides and questions answered. (2- 50 minute class periods) from Kesler Science.



3. **Read Data Integration Resource:** (2- 50 minute class periods)
https://earthobservatory.nasa.gov/features/CarbonCycle/page1.php

Compare the Fast and Slow Carbon Cycle. Also choose 1 graph and analyze the data.

Carbon Cycle	Fast Carbon Cycle	Slow Carbon Cycle	Effort Score
Similarities			3- Excellent- lots of effort & details 2- Good- effort & details 1-0- More effort & details needed
Differences			
Graph Analysis- Screenshot a Graph from the Earth Observatory website & describe what the data means			

Modifications: Vocabulary can be matched, Modified "Explain" Slides from Kesler Science

Standards Addressed :
MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Formative/Summative Assessments :
Teacher Observation/ Check of notebook for vocabulary & class discussion of the Kesler Science "Explain" Slides. The Data Integration reading & comparison chart will be collected and graded on effort.

Resources: *"Bottle Biology: Microbiology of Decomposition." Bottle Biology | Microbiology of Decomposition, bottlebiology.org/investigations/decomp_bkgreading.html.*

"The Carbon Cycle." ***NASA*****, NASA, earthobservatory.nasa.gov/features/CarbonCycle/page1.php.**

Kesler Science- Explain Carbon Cycle Interactive Notes

Elaborate *Students will write a Claim- Evidence-Reasoning scientific explanation of the concepts connecting the Carbon Cycle to decomposition.*	**Procedure: CER** (2- 50 minute class periods) Students will use observation charts and data from the "Explain" section for evidence. **Construct a Scientific Explanation** **Do you think decomposition is caused by something too small for us to see? Include a model of how you think Carbon is transferred in your Decomposition Chamber.** **Scientific Explanation = Claim + Evidence + Scientific Reasoning** 1. State your claim 2. Explain the evidence (Research decomposition in the **Explain** so you will have evidence for your reasoning and use evidence obtained from your observations from your Decomposition Chamber) that supports your claim 3. Explain the science concepts that support the evidence 4. Explain the scientific reasoning that links the evidence and science concepts to the claim

	Scientific Explanation **Claim:** **Evidence:** **Reasoning:**
	Modifications :Word/ Phrase Bank bank for students with IEP to help with the reasoning and arguments. **Standards Addressed** : *MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.* *LS2.B: Cycle of Matter and Energy Transfer in Ecosystems*

Formative/Summative Assessments: A Summative Assessment of the process of decomposition

Claims, Evidence and Reasoning Rubric

Name: _____

Category	N/A	Beginning	Approaching	Meeting
Claim A conclusion that answers the original question.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate, but incomplete claim.	Makes an accurate and complete claim.
Evidence Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Evidence is inappropriate or it does not support the claim.	Provides appropriate, but insufficient evidence. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning A justification that links the claim to the evidence. It shows why the data counts as evidence by using appropriate scientific principles.	Does not include reasoning.	Reasoning is not appropriate or does not link the claim to the evidence.	Provides reasoning that links claims to evidence. Repeats evidence and/or includes some scientific principles, but not sufficient.	Provides accurate and complete reasoning that links evidence to the claim. Includes appropriate and sufficient scientific principles.

Adapted from:
McNeill, K.L. & Krajcik, J. (2008). Assessing middle school students' content knowledge and reasoning through written explanations. In Assessing science learning: Perspectives from research and practice, eds. J. Coffey, R. Douglas, and C. Stearns, 101–116. Arlington, VA: NSTA Press

Resources:

Data from the "Explain" section of the lesson plan to be used for the evidence in the CER & observation charts.
Organization for CER Charts

	Rubric- Adapted from: McNeill, K.L. & Krajcik, J. (2008). Assessing middle school students' content knowledge and reasoning through written explanations. In Assessing science learning: Perspectives from research and practice, eds. J. Coffey, R. Douglas, and C. Stearns, 101–116. Arlington, VA: NSTA Press
Evaluate Cooperative groups will contribute to a presentation to explain their investigation to the class	**Procedure:** (3- 50 minute class periods) 1.Groups will prepare a presentation at the conclusion of the Decomposition Chambers 2. Teacher will monitor and make observations about the preparation and the cooperation of the group members 3. The groups are encouraged to have all members participate. 4. Group members will fill out :Collaborative Groups Check 5. Class presentations **Modifications: Cooperative groups with encourage with a Check Rubric** **Standards Addressed** : MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Formative/Summative Assessments: A Summative Assessment of the Investigation

Rubric for Presentation of Decomposition Chambers

Component	Excellent- Gold Medal (3 Points)	Good- Silver Medal (3 Points)	Ok- Bronze Medal (2 Points)	Needs Improvement (0-1 Point)	Point(s)/ Notes
Explanation of Independent/ Dependent Variables	Clearly identifies Independent & Dependent Variables for the group's Decomposition Chamber. Excellent detail and explanation.	Identifies Independent & Dependent Variables for the group's Decomposition Chamber	Somewhat identifies Independent & Dependent Variables for the group's Decomposition Chamber	Independent & Dependent Variables are not identified. The set up of the chambers are explained.	
Explanation of Observation Chart	Observation chart is very well explained. Observations about changes in color, texture, shape,smell of the materials	Observation chart is organized with good details of the changes taking place in the decomposition chambers. Observations about changes in color, texture, shape,smell of the materials.	Observation chart is somewhat organized with details of the changes taking place in the decomposition chambers. More detail is needed about changes in color, texture, shape,smell of the materials.	Observation chart is lacking details about color, texture, shape,smell of the materials.	
Connection to the Carbon Cycle & importance of decomposition	Presentation thoroughly explains the Carbon Cycle and makes excellent connections to what occurred in the decomposition chamber. The importance of decomposition to the "Cycle of Life" is emphasized. What are the positive and negative effects of decomposition on Earth? Is thoroughly answered	Presentation explai... the Carbon Cycle a... makes connections to what occurred in the decomposition chamber. The importance of decomposition to the "Cycle of Life" is explained. What are the positive and negative effects of decomposition on Earth? Is answered	Presentation somewhat explains the Carbon Cycle and makes some connections to what occurred in the decomposition chamber. The importance of decomposition to the "Cycle of Life" is mentioned. What are the positive and negative effects of decomposition on Earth? Is somewhat answered	Presentation mentions the Carbon Cycle , but there is not a clear connection made between the importance of decomposition and the "Cycle of Life" What are the positive and negative effects of decomposition on Earth? Is not addressed.	
Oral Presentation	Exhibits professional attitude Well prepared to narrate presentation Maintains positive attitude Lively creative oral presentation	Exhibits professional attitude sometimes Prepared to narrate presentation Maintains positive attitude sometimes Somewhat lively oral presentation	Does not exhibit professional attitude Somewhat prepared to narrate presentation Attitude seems to be bothered by doing presentation Narrates without much enthusiasm	Laughs during presentation Very little to no oral preparation Poor attitude Monotone and hurries through presentation to finish	

Resources *:* Collaborative Groups Checklist

Extension	➔ Students may want to continue the Decomposition Chambers with a School Compost. A school wide effort to collect organic material and add to compost to create fertilizer to add to school gardens. A campaign to recycle and

Teacher Background:

Carbon is found everywhere.It is an important element of four major spheres of the planet: biosphere, atmosphere, hydrosphere, and lithosphere. Carbon is a component in organisms, atmospheric gases, and rocks. Carbon moves from one sphere to another in the never ending Carbon Cycle. The Carbon Cycle influences critical life processes such as photosynthesis and respiration, contributes to fossil fuel formation, and impacts the earth's climate.

The short-term Carbon Cycle includes photosynthesis, respiration, and predator-prey transfer of carbon. Carbon is taken in by producers during photosynthesis and then flows back to the atmosphere when producers and consumers decompose and go through respiration. In the long term Carbon Cycle rocks contain Carbon go through weathering and erosion, carbon-rich plant and animal material accumulate in sediments, and the sediments change as they go through the Rock Cycle.

Resources & Rubrics:

Proposal for Decomposition Investigation:

Decomposition Chambers	1st Chamber	2nd Chamber
What is your Independent Variable? (What is the 1 variable that is different between the 2 chambers?		
What is your Dependent Variable? How are you going to measure the differences? Rate of decomposition? Mass of materials when finished?		
Materials in the Chamber- List & Include Pictures		
Mass of Materials if applicable		
Temperature of Chamber if applicable		
Amount of Water to be added for moisture- daily? weekly?		

Sample Observation Chart- Decomposition Chambers

Date	**Drawings/ Pictures**	**Observations using senses-** color, texture, smell, shape	**Measurements- any water added for moisture. Temperature. Mass before and after investigation.**

Collaborative Groups Check

	Excellent!	Pretty Good	Unsatisfactory
Contributions	Provided useful ideas when participating in lab discussion.	Did the minimum of what was required of the lab.	Refused to/did not participate.
Working with Others	Listened to, shared with, and supported the efforts of others.	Usually listened to, shared with, and supported the efforts of others.	Rarely listened to others. Disrupted or discouraged others' attempts to participate.
Time-Management	Used time well to ensure things get done on time .	Mostly used time well, completed lab on time.	Procrastinated, did not use school time or schedule provided to get work completed.
Focus on Class Work	Consistently stayed focused on in-class work and what needed to be done. Very self-directed.	Focuses on in-class work and what needs to be done most of the time.	Rarely focuses on class work and what needs to be done.

Organization for CER

Evidence *What are the relevant science observations or data that address the research question?*	**Claim** *What claim can be made based on the evidence? Does the evidence support your hypothesis?*	**Science Concepts** *What scientific concepts are connected to the evidence and help explain the claim?*	**Science Vocabulary** *What scientific terms must be included in this explanation?*

Scientific Reasoning *How do the evidence and scientific concepts link to support the claim? Why does this evidence support the claim? How are the scientific concepts and vocabulary connected to the claim?* Because of (evidence) and (science concepts), then (claim)	**Scientific Reasoning Brainstorm** _____, because _____ _____, so _____ _____, therefore _____

Rubric for Proposal and Observation Chart

Component	Excellent- Gold Medal (3 Points)	Good- Silver Medal (3 Points)	Ok- Bronze Medal (2 Points)	Needs Improvement (0-1 Point)	Point(s)/ Notes
Proposal for Investigation Independent/ Dependent Variables	Makes an exceptional plan of what will be changed in the investigation and what will be measured. Well organized and thought out with many details. Identifies Independent & Dependent Variables	Makes a good plan of what will be changed in the investigation and what will be measured. Details explain the Independent & Dependent Variables	Makes a plan of what will be changed in the investigation and what will be measured. More details are needed to explain the Independent & Dependent Variables.	Plan is lacking details. Independent & Dependent Variables are not identified.	
Observation Chart	Observation chart is very well organized with exceptional details of the changes taking place in the decomposition chambers. Observations about changes in color, texture, shape,smell of the materials.	Observation chart is organized with good details of the changes taking place in the decomposition chambers. Observations about changes in color, texture, shape,smell of the materials.	Observation chart is somewhat organized with details of the changes taking place in the decomposition chambers. More detail is needed about changes in color, texture, shape,smell of the materials.	Observation chart is is lacking details about color, texture, shape,smell of the materials.	
Effective Use of Class Time –- counts 2x	Used all available class time effectively and wisely. The teacher did not have to re-direct student. Worked very well with teammates.	Used most of the class time effectively. The teacher did not re-direct student. Worked well with teammates.	Did not use all available class time wisely. The teacher needed to re-direct student at least once. Could have been a better teammate.	Did not stay on task. Student was repeatedly re-directed by teacher. Let down teammates.	

Claims, Evidence and Reasoning Rubric

Name: _____

Category	N/A	Beginning	Approaching	Meeting
Claim A conclusion that answers the original question.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate, but incomplete claim.	Makes an accurate and complete claim.
Evidence Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Evidence is inappropriate or it does not support the claim.	Provides appropriate, but insufficient evidence. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning A justification that links the claim to the evidence. It shows why the data counts as evidence by using appropriate scientific principles.	Does not include reasoning.	Reasoning is not appropriate or does not link the claim to the evidence.	Provides reasoning that links claims to evidence. Repeats evidence and/or includes some scientific principles, but not sufficient.	Provides accurate and complete reasoning that links evidence to the claim. Includes appropriate and sufficient scientific principles.

Adapted from:
McNeill, K.L. & Krajcik, J. (2008). Assessing middle school students' content knowledge and reasoning through written explanations. In Assessing science learning: Perspectives from research and practice, eds. J. Coffey, R. Douglas, and C. Stearns, 101–116. Arlington, VA: NSTA Press

Rubric for Presentation of Decomposition Chambers

Component	Excellent- Gold Medal (3 Points)	Good- Silver Medal (3 Points)	Ok- Bronze Medal (2 Points)	Needs Improvement (0-1 Point)	Point(s)/ Notes
Explanation of Independent/ Dependent Variables	Clearly identifies Independent & Dependent Variables for the group's Decomposition Chamber. Excellent detail and explanation.	Identifies Independent & Dependent Variables for the group's Decomposition Chamber	Somewhat identifies Independent & Dependent Variables for the group's Decomposition Chamber	Independent & Dependent Variables are not identified. The set up of the chambers are explained.	
Explanation of Observation Chart	Observation chart is very well explained. Observations about changes in color, texture, shape,smell of the materials	Observation chart is organized with good details of the changes taking place in the decomposition chambers. Observations about changes in color, texture, shape,smell of the materials.	Observation chart is somewhat organized with details of the changes taking place in the decomposition chambers. More detail is needed about changes in color, texture, shape,smell of the materials.	Observation chart is lacking details about color, texture, shape,smell of the materials.	
Connection to the Carbon Cycle & importance of decomposition	Presentation thoroughly explains the Carbon Cycle and makes excellent connections to what occurred in the decomposition chamber. The importance of decomposition to the "Cycle of Life" is emphasized. What are the positive and negative effects of decomposition on Earth? Is thoroughly answered	Presentation explains the Carbon Cycle and makes connections to what occurred in the decomposition chamber. The importance of decomposition to the "Cycle of Life" is explained. What are the positive and negative effects of decomposition on Earth? Is answered	Presentation somewhat explains the Carbon Cycle and makes some connections to what occurred in the decomposition chamber. The importance of decomposition to the "Cycle of Life" is mentioned. What are the positive and negative effects of decomposition on Earth? Is somewhat answered	Presentation mentions the Carbon Cycle , but there is not a clear connection made between the importance of decomposition and the "Cycle of Life" What are the positive and negative effects of decomposition on Earth? Is not addressed.	
Oral Presentation	Exhibits professional attitude Well prepared to narrate presentation Maintains positive attitude Lively creative oral presentation	Exhibits professional attitude sometimes Prepared to narrate presentation Maintains positive attitude sometimes Somewhat lively oral presentation	Does not exhibit professional attitude Somewhat prepared to narrate presentation Attitude seems to be bothered by doing presentation Narrates without much enthusiasm	Laughs during presentation Very little to no oral preparation Poor attitude Monotone and hurries through presentation to finish	

Sample Decomposition Chamber Set -UP