

# Carbon Cycle: Am I Made from Recycled Carbon?

<p><b>Unit</b>  <b>Strand 8.3: LIFE SYSTEMS STORE AND TRANSFER MATTER AND ENERGY</b></p> <p>Living things use energy from their environment to rearrange matter to sustain life. Photosynthetic organisms are able to transfer light energy to chemical energy. Consumers can break down complex food molecules to utilize the stored energy and use the particles to form new, life-sustaining molecules. Ecosystems are examples of how energy can flow while matter cycles through the living and nonliving components of systems.</p>	<p><b>Utah SEEd Standard / NGSS Performance Expectation</b></p> <p><b>Standard 8.3.3</b>  <b>Ask questions to obtain, evaluate, and communicate information</b> about how <u>changes</u> to an ecosystem affect the <u>stability</u> of cycling <u>matter</u> and the flow of <u>energy</u> among living and nonliving parts of an ecosystem. Emphasize describing the cycling of matter and flow of energy through the carbon cycle. (LS2.B, LS2.C)</p>	<p><b>Estimated Lesson Time:</b>            45 to 60 minutes</p>
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## LESSON OVERVIEW

### Learning Objective

Students will be able to create a carbon cycle graphic to show mastery of their understanding of matter cycles.

### Anchor Phenomenon

Students will turn bromothymol blue green or yellow when CO<sub>2</sub> is added to the solution (by breathing into a straw).

### Driving Question

Am I made from recycled carbon?

### Lesson Level Performance Expectations

The use of **models** to show that **matter cycles** explain the **interdependence in ecosystems**.

## LESSON SNAPSHOT

LESSON SUMMARY:			
	Estimated Time	Section Overview	How are students answering the driving question or meeting the learning objectives? (Highlight SEPs, DCIs, and CCCs)
<b>Experience the Phenomenon</b>	15 min	Phenomenon: Students will perform or view the bromothymol blue experiment.  Students will write a hypothesis for the change in bromothymol blue.	Students will see how carbon is an essential element for life on Earth by seeing how it cycles through our bodies.
<b>Investigate the Phenomenon</b>	20 min	Students will participate in the carbon activity, moving along an individual path from station to station by drawing cards and/or rolling dice.	Students will gather data as they model the journey of a carbon atom through 10 different “places” in the ecosystem.
<b>Model the Phenomenon</b>	10 min	Students will create a carbon cycle model using the data they collected during the carbon activity.	Students will create a model of the carbon cycle and use it to explain how carbon atoms move through the ecosystem.

DISCIPLINARY CORE IDEAS	SCIENCE & ENGINEERING PRACTICES	CROSCUTTING CONCEPTS
The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.	The transfer of energy can be tracked as energy flows through a designed or natural system. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
Related knowledge and skills from prior grades		
Disciplinary Core Idea: Matter cycles between the air and soil and among organisms as they live and die.	Science and Engineering Practices Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	Crosscutting Concept: Matter flows, and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.



## Materials

Link to all materials on the 3DRST website ([3drst.byu.edu](https://3drst.byu.edu)): <https://3drst.byu.edu/8th-8-3-3-recycled-matter>

Link to all materials on Canvas Commons: <https://tinyurl.com/3DRSTeighth>

Student Materials	Teacher Materials	Lab Materials/Other Resources
Student worksheet Illustrated Vocabulary for Scaffolding	Matter Cycling Cards for the game Model Instruction Sheet Game Instruction Video	Bromothymol Blue Experiment: <ul style="list-style-type: none"> <li>• Stopwatch</li> <li>• Drinking straw</li> <li>• Bromothymol blue solution</li> <li>• 2-250 mL beakers</li> <li>• Graduated cylinder</li> <li>• SAFETY GOGGLES</li> </ul>

## LESSON PREPARATION

### Material Preparation:

Print, laminate, and cut out the Matter Cycles Cards.

### Required Previous Knowledge:

This lesson builds on students' prior understanding of the following DCIs developed in the previous unit involving photosynthesis and cellular respiration for 8<sup>th</sup> grade.

This lesson builds upon the cycling of energy in a food web for 8<sup>th</sup> grade.

### Supports students will need/adaptations:

CER Graphic Organizer

### Vocabulary Definitions:

Use the vocabulary from the "Follow the Flow" Lesson.

## EXPERIENCE THE PHENOMENON/PROBLEM (ENGAGE)

What Students Are Doing	Teacher Tips
Students are engaging in or watching a video of the Bromothymol Blue experiment.  PROCEDURE 1. Fill the beaker with 40 mL of water and 10 mL of bromothymol blue solution.	Review what causes the Bromothymol Blue to change color and how adding carbon can change the color. How do we know we are



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<ol style="list-style-type: none"> <li>2. Assign one person to be the timer, and one person to perform the experiment.</li> <li>3. When the timer says “START”, the experimenter will exhale through the straw into the bromothymol blue solution until the color changes from blue to green.</li> </ol> <p><b><u>Do NOT inhale the solution!</u></b> <b><u>Exhale from your lungs!</u></b></p> <ol style="list-style-type: none"> <li>4. Your partner will stop the time as soon as the color changes.</li> <li>5. Record the time it took for the color change in the observation table below. This is the control group.</li> <li>6. Rinse the beaker, then refill it with 40 mL of water and 10 mL of bromothymol blue solution.</li> <li>7. The experimenter does jumping jacks or a similar exercise for 1 minute. You should feel winded when you are finished!</li> <li>8. Using a new straw, exhale into the solution the same way as in the control group and record how long it takes for the solution to change color.</li> <li>9. Write down the time it took for the color change in the observation table below.</li> </ol>	<p>breathing out carbon? Where did the carbon that we are breathing come from?</p> <ul style="list-style-type: none"> <li>• Walk around and assist with setup and procedure.</li> <li>• Remind students: exhale only; do NOT inhale through the straw.</li> <li>• Facilitate discussion: Ask where the carbon they exhale comes from.</li> </ul>
<p><b>What Teachers Are Doing</b></p>	<p><b>Teacher Tips</b></p>
<p>Walk around and assist the students in the experiment.</p>	<p>Use open-ended questions to stimulate thinking (“How do we know we’re breathing out carbon?”)</p>

<h2 style="margin: 0;">INVESTIGATE THE PHENOMENON (EXPLORE)</h2>	
What Students Are Doing	Teacher Tips
<p><b>Narrative of episode:</b> Students <b>gather information</b> while participating in a Carbon Cycle Activity. They use this knowledge to <b>create a model</b> of their own unique journey through the carbon cycle. Next, they compare their journey with those of other students. Students engage in a discussion where they share what they learned about their journey as an atom of carbon and how it compares to others’ journeys. Through this activity, students can understand the complexity of the carbon cycle, connect it to the Law of Conservation of Matter, and recognize its importance in sustaining life on Earth.</p> <p><i>Gather</i></p> <p>Tell students that they are representing a single carbon atom today. Using a scrap piece of paper, students <b>gather information</b> as they participate in the carbon activity. Students can start at any site they choose, but they must not work in pairs or groups. Each student needs to roll the dice themselves and follow their own journey. The students write a numbered list of the sites they visit as they complete the activity, starting with</p>	<p>Guide students through the card game, ensuring they fill out the table at each station.</p> <p>Walk the students through the first four turns of the carbon cycle game so that they understand the directions.</p> <p>***Note - Do not tell students about the carbon cycle or refer to it as the carbon cycle at this point. ***</p>



<p>the initial point. Each site is listed in the order visited, even if they have been there before. If during the activity a student has to stay at one site for more than one roll of the dice, they should mark that on the list with a tick. When they move to another site, they continue their list. This activity lasts 10 to 15 minutes, depending on your students' needs.</p> <p>The students use the list they have generated to <b>develop a model</b> of their journey as an atom of carbon. The teacher should teach students how to use their list effectively. Otherwise, the students may end up with models that don't truly help them understand the complexity and importance of the carbon cycle. See the model instruction sheet for guidance on how to demonstrate this to students.</p>	<p>You can use the video to illustrate how to play the game.</p>
<p><b>What Teachers Are Doing</b></p>	<p><b>Teacher Tips</b></p>
<ul style="list-style-type: none"> <li>• Guide students through the first four turns as a whole class.</li> <li>• Do NOT mention “carbon cycle” yet—let students discover it through the activity.</li> <li>• Ensure each student works individually and follows their own journey.</li> <li>• Make sure students record each site they visit, including repeats, and mark if they stay at a site for multiple turns.</li> </ul>	<p>Check for understanding throughout – don't just wait until the end.</p>

## MODEL THE PHENOMENON (EXPLAIN)

<p><b>What Students Are Doing</b></p>	<p><b>Teacher Tips</b></p>
<p><i>Reason</i></p> <p>Students compare their models with others in the class, looking for someone with a similar journey. They should note areas of similarity or patterns such as: sites that everyone seemed to visit, sites that others visited but they did not, sites that students appeared to visit and stay at for long periods, etc. This should take 10-15 minutes, depending on your students' needs.</p> <p>The teacher then leads a class discussion about what the students have discovered. Have students share where their journey took them and what they learned when comparing their experiences with other students' journeys. This discussion should generate many interesting points and questions. The teacher should follow the flow of the conversation, asking questions as needed to explore (Energy and Matter/Stability and Change).</p>	<p>It is during the discussion that the students name the cycle. When that happens, they should write a title on their own model of the cycle. I suggest to my students that they call it “My journey through the Carbon Cycle,” but they can choose any title they want as long as it includes “Carbon Cycle.”</p>
<p><b>What Teachers Are Doing</b></p>	<p><b>Teacher Tips</b></p>
<p>Class discussion points:</p> <ul style="list-style-type: none"> <li>• Carbon is not destroyed; it just changes.</li> </ul>	<p>Show the carbon cycle video and go over the instructions for creating a carbon cycle model.</p>

- Carbon moves through many different parts of the world, both organic (living things) and inorganic (non-living things).
- Carbon doesn't follow a specific path; it moves around in whatever way it is needed.
- Much of the movement happens through the processes of photosynthesis and cellular respiration.
- There are places where carbon can get stuck or stored. When this occurs, explain to the students what a carbon sink is. Have the students identify areas that are carbon sinks. Discuss ways they could get out of a sink. Let them know they will learn more about this in Earth Systems in 9th grade.
- The movement of carbon is called the Carbon Cycle.

Monitor students as they create their diagram to correct misconceptions.

## POSSIBLE EXTENSIONS/ALTERNATIVE ADAPTATIONS

Students write an explanation of what they have learned about the carbon cycle. The explanation should include the complexity of the carbon cycle, its relationship to the law of conservation of matter, and why it is crucial to living organisms, including themselves.

This lesson was created by Westen Miller and Maggie Grindstaff



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