Life Science	
Module 4	Matter & Energy in Ecosystems
Part 3	Cellular Respiration



## **INVESTIGATION QUESTION:**

What caused carbon dioxide to decrease in the air (abiotic matter) of the biodome?

## **Lessons & Objectives**

#### Lesson 1: Carbon Dioxide in Ecosystems

• I can... make initial claims about why carbon dioxide in the biodome started to decrease.

#### Lesson 2: How Carbon Dioxide Enters the Air

• **I can...** connect the movement of carbon from biotic to abiotic matter with the process of cellular respiration, which organisms perform to release energy.

#### Lesson 3: An Explanation for the Econauts

• I can... apply what I have learned about cellular respiration to the problem in the biodome.

<b>Packet Completion Grading</b> for each section you will earn a grade based on the following criteria				
4	3	2	1	ο
Nothing is missing. Responses consistently meets ALL the criteria for high quality work. Evidence of exemplary effort is evident.	Work is 75-100% complete and accurate. Work/effort misses the criterion for high quality consistently.	Work is 50-75% complete and accurate. Work has evidence of quality but not consistently.	More than 50% of the work in incomplete or incorrect. Work does not meet the expected level of quality.	No work completed.

## LESSON 1: CARBON DIOXIDE IN ECOSYSTEMS

**<u>OBJECTIVE:</u>** I can make initial claims about why carbon dioxide in the biodome started to decrease.

Lesson 1:	At the end of the last lesson, you learned there was not enough carbon dioxide in the biodome's air, which led to a decrease in energy storage molecules inside the biodome.
DO NOW	<u>Record at least one initial claim that answers the question:</u>
	What are some ideas you have about what might have caused the decrease in carbon dioxide?

Last chapter, you discovered that decreased carbon dioxide in the air of the biodome may have prevented producers from making enough energy storage molecules for the ecosystem. However, your work as student ecologists is far from over. The Econauts are now wondering

why the amount of carbon dioxide in the air of the biodome went down. To answer this question and help the Econauts build a better biodome, you'll need to figure out how that carbon dioxide gets into the air in the first place.

#### **Carbon Dioxide in Ecosystems**

Where does carbon dioxide in the air come from?

Goal:

Show your ideas about which parts of an ecosystem give off carbon dioxide and which parts do not give off carbon dioxide.

Do:

Complete the table by placing each card (on presentation) into one of the categories.

Gives off carbon dioxide ( $CO_2$ )	Does not give off carbon dioxide $(CO_2)$

Discuss: 1. Did you pl	lace any parts of the ecosystem in a differe	nt category than your partner? Why?	
2. Were you	or your partner unsure about where to pla	ce any parts of the ecosystem? Why?	
<u>Class Poll:</u> After completing dioxide to the air.	the sorting activity, choose the parts of the decomposers dead ma producers abiotic r consumers	e ecosystem that you think give off carbon atter matter	
The Snail and	the Elodea Experiment		
Do producer Gather ev	Do producers give off or take in carbon dioxide? What about consumers? Can producers and consumers do both?		
<ul> <li><u>Procedure:</u></li> <li>1. Record your predictions for which organisms will give off carbon dioxide in the table below, after watching how the experiment is set up.</li> <li>2. Observe the color of the BTB solution in the video to figure out which organisms give off carbon dioxide.</li> <li>3. Record the results in the table below.</li> <li>4. Answer the discussion questions</li> </ul>			
<u>Organism</u>	<b>PREDICTION:</b> Will the organism give off carbon dioxide during the experiment? (yes or no)	<b>RESULTS:</b> Will the organism give off carbon dioxide during the experiment? (yes or no)	
Snail			
Elodea Plant			
The <u>blue</u> = no o	color of BTB changes depending on how m carbon dioxide $green = low carbon diox$	nt Key: nuch carbon dioxide is added: ide <u>yellow</u> = high carbon dioxide	

**Discussion Questions:** 

- 1. How well did your predictions match the actual results of the experiment?
- 2. Do producers give off or take in carbon dioxide? How do you know?
- 3. Do consumers give off or take in carbon dioxide? How do you know?
- 4. Reflect on what you learned from the video that might help you answer today's Investigation Question: <u>Where does the carbon dioxide in abiotic matter (air) come from?</u>

## A Feast for Decomposers

#### **Introduction**

Imagine you're invited to a feast. When you get there, your host serves you droppings, dry brown leaves, bare bones, feathers, and a fallen tree. But you can't eat that! This is a feast for decomposers, not for humans. Decomposers are fungi, bacteria, worms, and other small organisms that specialize in breaking down dead matter.

Decomposers can eat things that nothing else can. Bones, droppings, and other dead matter may not seem like food, but decomposers can use them for energy because they contain energy storage molecules. Many decomposers process the energy storage molecules in dead material in the same way that other animals process energy storage molecules: through cellular respiration. Like humans and other animals, these decomposers give off carbon dioxide as one of the products of cellular respiration.



Droppings may not seem like food, but to decomposers, they make a good meal.



Decomposers can break down something as large as a fallen tree.

Through the process of cellular respiration, decomposers take the carbon in dead matter and

return it to the air or water.

Without decomposers, this carbon would stay trapped in the dead matter. Decomposers may be small, but they play an important role in any ecosystem.

<u>Revisiting Initial Ideas:</u>

After watching the video experiment and reading the excerpt from A Feast for Decomposers, revisit your first ideas.

### Look back on pg. 1.

Do you agree with how you sorted the parts of the ecosystem?

• If not, move names to reflect your new understanding of which parts of an ecosystem give off carbon dioxide to abiotic matter.

MAIN IDEA: circle or highlight the words that make the following statement true			
The following parts of an ecosystem give off carbon dioxide:			
DECOMPOSERS			
PRODUCERS			
CONSUMERS			
	DEAD MATTER		
ABIOTIC MATTER			
Lesson 1:	Choose one of the articles to learn more about a particular decomposer and how it affects ecosystems. <u><b>Read</b></u> and <u><b>annotate</b></u> the article you chose.		
EXIT SLIP	Find 2 interesting facts in your article. Record them below.   1.   2.		
	Find <b>1 connection</b> to today's class. Record that connection below.		

## LESSON Z: HOW CARBON DIOXIDE ENTERS THE AIR

**<u>OBJECTIVE</u>**: I can connect the movement of carbon from biotic to abiotic matter with the process of cellular respiration, which organisms perform to release energy.

Lesson 2:	In <u>A Feast for Decomposers</u> , you read a bit about <b>cellular respiration</b> . Now, look carefully at the diagram on the board. Write what you think it shows about cellular respiration.
DO NOW	

By now, you've seen that organisms like Elodea plants (producers), snails (consumers), and decomposers all give off carbon dioxide, but how does this happen? Today, you'll use the Sim to look inside a single cell as you search for clues about how living things give off carbon dioxide. Student ecologists, keep investigating! With each step, the Biodome Investigation Team gets closer to finding out why the amount of carbon dioxide in the biodome decreased.

#### Lesson 2 Vocabulary

#### **Decomposer:**

#### **Observing Cellular Respiration in the SIM**

#### Part 1: How do organisms give off carbon dioxide?

- 1. Watch as your teacher presses VIEW CELL for all the different organisms.
- 2. Compare what you see in the Sim to the diagram from the article, using the following questions as a discussion guide:

• What is similar about cells in the Sim a	and the article diagram?
• What is different about cells in the Sim	and the article diagram?
• What do both models tell you about ho	ow organisms give off carbon dioxide?
Lesson 2 Vocabulary	
Cellular Respiration:	
Observing Cellular Respiration in the SI	Μ
Part 2: Does cellular respiration require	energy from the sun?
<ol> <li>Observe your teacher press PLAY to run the</li> <li>Observe the Sim. Which parts of an ecosyste</li> <li>Observe what happens when your teacher to whether the amount of sunlight affects which of an ecosystem perform cellular respiration</li> <li>Discuss the following two questions with your</li> </ol>	e Sim with the default settings. em perform cellular respiration? urns off sunlight in the ecosystem. Observe ch parts n. our partner, and then record your answers
<ul> <li>A. Which parts of an ecosystem perform cellular respiration? Check all the answers you think are correct.</li> <li>decomposers</li> </ul>	B. Does the amount of sunlight affect which parts of an ecosystem perform cellular respiration? (check one)
producers     consumers     dead matter     abjotic matter	yes no

## Connecting Photosynthesis and Cellular Respiration

Both photosynthesis and cellular respiration are processes that take place inside the cell, but		
photosynthesis only happens in	, while cellular respiration	
happens in, ind	cluding producers. In a way these processes	
are opposites:		

Photosynthesis	Cellular Respiration
Through photosynthesis, producers	Through cellular respiration, all organisms
energy storage	these molecules to release
molecules.	energy.

## FUN FACTS ABOUT PHOTOSYNTHESIS!

- 1. The green color of leaves is due to chlorophyll.
- 2. The two main parts of a chloroplast are the grana and stroma.

3. The first stage of photosynthesis captures energy from the sun to break down water molecules.

4. The second stage of photosynthesis is the Calvin cycle.

5. It takes six molecules of water and six molecules of carbon dioxide to make one molecule of glucose during photosynthesis.

- 6. Plants have specialized tissues that aid photosynthesis.
- 7. Glucose molecules join to form more complex molecules used by plants.
- 8. Leaves change color in autumn because plants slow down the process of photosynthesis.
- 9. Plants are not the only organisms that use photosynthesis.
- 10. The reverse process of photosynthesis is cellular respiration.

## Lesson 2 Exit Slip



# The Mulberry Tree and the Silkworm

Producers are the only organisms that can perform photosynthesis, so it can be easy to forget that they also perform cellular respiration. Producers make energy storage molecules through photosynthesis, but the story doesn't stop there—they need to use those energy storage molecules to release energy through cellular respiration so they can do things like grow and reproduce.

However, producers make more energy storage molecules than they need for energy. They don't use all of the energy storage molecules they produce for cellular respiration. Producers use those extra energy storage molecules as building blocks to make their stems, leaves, roots, and other parts. And that's a good thing, because otherwise there wouldn't be any energy storage molecules available to the rest of the ecosystem. Let's look at an example.

Mulberry trees that grow in China are an important food source for silkworms. Mulberry trees perform photosynthesis to produce energy storage molecules that they can use for cellular respiration. Mulberry trees also use energy storage molecules as building blocks to make their stems, leaves and roots. Silkworms eat some of the leaves of the plants and get the energy storage molecules that built those leaves for their own cellular respiration. Mulberry trees make enough energy storage molecules to do cellular respiration and enough to build their leaves and stems, and therefore, enough for silkworms to use as food.

For this to work, mulberry trees must make more energy storage molecules than they use for cellular respiration. Another way to think about this is in terms of carbon: mulberry trees must take in more carbon from carbon dioxide during photosynthesis than they release through cellular respiration.

Lesson 2:	Producers make energy storage molecules during photosynthesis, and then they use them during cellular respiration. Do producers make just enough energy storage molecules for themselves, or do they make enough for the ecosystem?
EXII	Dead the sheet "Mull arms Tues on d the Gills server" article sheets to find out
SLIP	<u>Read the short Mulderry free and the Sikworm article above to find out.</u>
	<ol> <li>Use the information in the article to make a prediction: I think producers do         <ul> <li>a. the same amount of photosynthesis as cellular respiration.</li> <li>b. more photosynthesis than cellular respiration.</li> <li>c. less photosynthesis than cellular respiration.</li> </ul> </li> <li>Explain your answer to question 1.</li> </ol>

## LESSON 3: AN EXPLANATION FOR THE ECONAUTS

**<u>OBJECTIVE</u>**: I can apply what I have learned about cellular respiration to the problem in the biodome.



My Explanation:

Student ecologists, it is almost time to write the next part of your explanation to the Econauts. First, however, you'll need to review some new data about the biodome that Dr. Corry sent. Using the data and some evidence from the Sim, you'll be able to explain to the Econauts why the carbon dioxide in the air of the biodome decreased. Let's get to work!

#### Key Concept

As organisms release energy during **cellular respiration**, carbon dioxide is produced from the carbon in energy storage molecules. This process moves carbon from <u>*biotic*</u> to <u>*abiotic*</u> matter.

#### Connection Question: How does carbon move from abiotic to biotic?

#### **Testing a Claim**

#### **CLAIM**:

A <u>decrease</u> in decomposers led to a <u>decrease</u> in carbon dioxide in the air (abiotic matter) of the biodome.

#### **DIRECTIONS**:

Observe as your teacher uses the **Matter and Energy in Ecosystems Sim** to test the claim above.

- 1. Open the Sim. Run it with default settings for 20 time units.
- 2. After 20 time units, pause the Sim. Use the **KILL** button to remove all decomposers. Press **PLAY**.
- 3. Open the graph. Observe how the decrease in decomposers affects the ecosystem. Be sure **CELLULAR RESPIRATION** and **CARBON DIOXIDE** are selected ON so you can observe these graph lines.
- 4. With your partner, discuss what you observe about **carbon dioxide** in the graph. Note your observations in the box on the following page of your packet. Then, answer the reflection question.

Observations:
Reflection Ouestion:
Explain how your observations are evidence either for or against the claim.

#### Video Notes

## Photosynthesis and Respiration



Answer Chapter 3 question - Lesson 3 Exit Slip				
Use as many of the following vocabulary words as possible to answer the Chapter 2 Question: What caused carbon dioxide to decrease in the air (abiotic matter) of the biodome?				
Possible Vocabulary Words				
Abiotic matter	Carbon dioxide	decomposer	photosynthesis	
Biotic matter	Cellular respiration	ecosystem	producer	
carbon	consumer	Energy storage molecule	system	