Unit Map: Matter and Energy in Ecosystems: Biodome Collapse (Middle School)

How do all the organisms in an ecosystem get the resources they need to release energy?

Students examine the case of a collapsed biodome, an enclosed ecosystem that was meant to be self-sustaining but which ran into problems. Carbon cycles through an ecosystem due to organisms' production and use of energy storage molecules. Students build an understanding of this cycling-- including the role of photosynthesis-- as they solve the mystery of the biodome collapse.

Students figure out:

1. Why didn't the plants and animals in the biodome have enough energy storage molecules?

Producers make all of the energy storage molecules for an ecosystem through the process of photosynthesis, using carbon dioxide from abiotic matter. The organisms in the biodome did not have enough energy storage molecules because there was not enough carbon in abiotic matter.

How do they figure it out?

They read articles about photosynthesis. They investigate photosynthesis, energy storage molecules, and carbon in the sim. They view a video of a photosynthesis experiment. They get data about the biodome and model their ideas about its collapse.

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

As organisms release energy during cellular respiration, carbon dioxide is produced from the carbon in energy storage molecules. This process moves carbon from biotic to abiotic matter. Carbon dioxide in the biodome decreased because decomposers decreased which means there was a decrease in cellular respiration overall.

How do they figure it out?

They get evidence from the sim and from video of an experiment to determine which organisms do cellular respiration. They read a short article about decomposers and dead matter. They model more complete ideas about the biodome collapse, using evidence about decomposers and dead matter.

3. What happened to the carbon that used to be in the air (abiotic matter) of the biodome?

Since carbon cannot be produced or used up, the total amount of carbon in a closed ecosystem does not change. The decrease in carbon in the abiotic matter and in living things in the biodome means there was an increase somewhere in the system-- in this case in un-decomposed dead matter.

How do they figure it out?

They read about carbon dioxide in the whole Earth system. They use a game-like physical model to investigate carbon cycling. Students model and write their final explanation of the biodome collapse.

Students apply what they learned to solve a new problem: Why does deforestation lead to increased carbon dioxide in the air?

Deforestation, with large areas of forest being replaced with grass and livestock, is leading to more carbon dioxide in the air, and warming of the Earth's climate. Students investigate whether this is primarily due to a decrease in photosynthesis or an increase in cellular respiration.

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Correlations to NGSS and CCSS:
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Next Generation Science Standards

Performance Expectations	MS-LS 1-6; MS-LS 2-3; MS-LS 2-4; MS-LS 1-2; MS-LS2-5
Science and Engineering Practices	Practice 1; 2; 3; 4; 6; 7; 8
Disciplinary Core Ideas	LS1.C; LS2.B; LS2.C; PS3.D; ESS3.D
Crosscutting Concepts	Systems and System Models; Cause and Effect

Common Core State Standards for English Language Arts

Reading Informational Text	CCSS.ELA-LITERACY.CCRA.R.1; CCSS.ELA-Literacy.RST.6-8.1, 6-8.4, 6-8.7, 6-8.9
Writing	CCSS.ELA-LITERACY.CCRA.W.1; CCSS.ELA-LITERACY.WHST.6-8.1A, 6-8.1.B, 6-8.2.D
Speaking and Listening	CCSS.ELA-LITERACY.CCRA.SL.1, 2, 3, 4
Language	CCSS.ELA-LITERACY.CCRA.L.6

Common Core State Standards for Mathematics

Practices	CCSS.MATH.PRACTICE.MP1; 2; 4; 5
Content	CCSS.MATH.CONTENT.6.RP.3; 6.NS.3; 6.EE.9; 7.RP.2; 7.NS.2; 8.F.5

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