Bio-Dome

Biology

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Published by *K20 Center*

Grade Level	9th – 10th Grade	**Time Frame**	195 minutes
Subject	Science	**Duration**	3-4 class periods
Course	Biology		

Essential Question

Can life be sustained in a closed environment/ecosystem?

Summary

In this lesson, students will explore biotic and abiotic factors and the essential elements that are cycled throughout Earth's many ecosystems. Students will determine how the cycling of these elements sustains life and then will create their own closed ecosystems.

Snapshot

Engage

Students watch a video and generate questions about the elements needed to sustain life within a closed ecosystem.

Explore

Students carry out an investigation, collect data, and interpret results about light intensity's effect on the rate at which photosynthesis is performed.

Explain

Students read, synthesize, and summarize an article about the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Extend

Students apply their knowledge of the carbon cycle to construct their own model of a closed ecosystem.

Evaluate

Using evidence to support their reasoning, students complete a Quick Write on how the cycling of carbon can help sustain a closed ecosystem.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD304: Determine how the values of variables change as the value of another variable changes in a simple data presentation
IOD403: Translate information into a table, graph, or diagram
SIN301: Understand the methods used in a simple experiment
SIN401: Understand a simple experimental design
SIN502: Predict the results of an additional trial or measurement in an experiment
SIN702: Predict the effects of modifying the design or methods of an experiment
EMI301: Identify implications in a model
EMI502: Determine whether presented information, or new information, supports or contradicts a simple hypothesis or conclusion, and why
EMI503: Identify the strengths and weaknesses of models
EMI603: Use new information to make a prediction based on a model

Oklahoma Academic Standards (Biology)

B.LS2.5 : Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Attachments

- Carbon Cycle Cornell Notes—Bio-Dome - Spanish.docx
- Carbon Cycle Cornell Notes—Bio-Dome - Spanish.pdf
- Carbon Cycle Cornell Notes—Bio-Dome.docx
- Carbon Cycle Cornell Notes—Bio-Dome.pdf
- Carbon Cycle Slide Instructions and Rubric—Bio-Dome - Spanish.docx
- Carbon Cycle Slide Instructions and Rubric—Bio-Dome - Spanish.pdf
- Carbon Cycle Slide Instructions and Rubric—Bio-Dome.docx
- Carbon Cycle Slide Instructions and Rubric—Bio-Dome.pdf
- Create Your Own Aquarium—Bio-Dome - Spanish.docx
- Create Your Own Aquarium—Bio-Dome - Spanish.pdf
- Create Your Own Aquarium—Bio-Dome.docx
- Create Your Own Aquarium—Bio-Dome.pdf
- Create Your Own Terrarium—Bio-Dome - Spanish.docx
- Create Your Own Terrarium—Bio-Dome - Spanish.pdf
- Create Your Own Terrarium—Bio-Dome.docx
- Create Your Own Terrarium—Bio-Dome.pdf
- Draw an Initial Model—Bio-Dome - Spanish.docx
- Draw an Initial Model—Bio-Dome - Spanish.pdf
- Draw an Initial Model—Bio-Dome.docx
- Draw an Initial Model—Bio-Dome.pdf
- I Notice I Wonder—Bio-Dome - Spanish.docx
- I Notice I Wonder—Bio-Dome - Spanish.pdf
- I Notice I Wonder—Bio-Dome.docx
- I Notice I Wonder—Bio-Dome.pdf
- Lesson Slides—Bio-Dome.pptx
- Photosynthesis and Respiration Game Questionnaire—Bio-Dome - Spanish.docx
- Photosynthesis and Respiration Game Questionnaire—Bio-Dome - Spanish.pdf
- Photosynthesis and Respiration Game Questionnaire—Bio-Dome.docx
- Photosynthesis and Respiration Game Questionnaire—Bio-Dome.pdf
- The Effects of Changing the Carbon Cycle—Bio-Dome - Spanish.docx
- The Effects of Changing the Carbon Cycle—Bio-Dome - Spanish.pdf
- The Effects of Changing the Carbon Cycle—Bio-Dome.docx

- The Effects of Changing the Carbon Cycle—Bio-Dome.pdf

Materials

- Lesson Slides (attached)
- I Notice, I Wonder handout (attached; one half-sheet per student)
- Effect of Light on Photosynthesis With an Oxygen Sensor lab (linked here and in the narrative)
- The Effects of Changing the Carbon Cycle article (attached)
- Carbon Cycle Slide Instructions and Rubric (attached; one per group)
- Carbon Cycle Cornell Notes handout (attached; one per student)
- Draw an Initial Model handout (attached; one per student)
- Create Your Own Terrarium handout (attached)
- Create Your Own Aquarium handout (attached)
- Photosynthesis and Respiration Game Questionnaire (attached; optional)
- White nylon bristle test tube brushes, 8"
- Wireless CO_2 sensor pack
- Wireless oxygen gas sensor
- Wireless temperature sensor pack
- SparkVUE license
- 10-port USB charging station
- BioChamber 250

Objectives

- Construct an explanation for how homeostasis is maintained within an ecosystem.
- Determine what materials exist for the input and output in an ecosystem.

25 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to read aloud the essential question: *Can life be sustained in a closed environment/ecosystem?* Display **slide 4** to go over the lesson objectives. Review these slides with students to the extent you feel necessary.

Pass out a half-sheet from the attached **I Notice, I Wonder** handout to each student. Inform students they are going to use the I Notice, I Wonder strategy as they watch the video on the next slide.

Go to **slide 5** and invite students to take a look at eight scientists who were enclosed in a biosphere for two years in Arizona. Play the video, titled "Inside Biosphere 2: The World's Largest Earth Science Experiment."

Embedded video
https://youtube.com/watch?v=-yAcD3wuY2Q

After students have watched the video and filled out their handouts, ask them to get in groups of 2–3 and discuss what they noticed and wondered. Have each group select one or two responses from each column to share out. First, ask a student from each group to share out an observation from the I Notice column. Then, call on a different student from each group to share out a question from the I Wonder column.

As students share out, write their observations and questions on the board. After students have shared out, ask them whether some students' questions have been answered already by a classmate's observation. Have students consider how they might find answers to the remaining questions.

60 minutes

Explore

Teacher's Note: Lab Preparation

Before beginning this lab, preview the Effect of Light on Photosynthesis With an Oxygen Sensor lab (linked here) and print one copy for each group of 3–4 students (or one copy per student, if you'd prefer). Additionally, be sure to gather all the supplies needed to complete the lab and place them at each lab station.

In this activity, students investigate how light intensity affects the rate at which photosynthesis is performed.

Display **slide 6**. Place students in groups of 3–4 and make sure each group has all the supplies needed to complete the lab. Pass out copies of the **Effect of Light on Photosynthesis With an Oxygen Sensor** lab by Fourier Education. Have students read the instructions and then collect and record data on the lab handout.

After completion of the lab, have students answer the analysis questions on the last two pages of the handout. Then, have students use the R.E.R.U.N. strategy to write a lab report or write a response to the following question:

If you were to create a closed ecosystem, is light a necessary component? Explain your reasoning.

Optional Lab

If you'd like an additional or alternative lab that allows students to see both photosynthesis and respiration occurring in plants, you may choose to use the Photosynthesis and Respiration lab by Vernier. This would require the purchase of the *Biology with Vernier* book. The Photosynthesis and Respiration lab is Experiment 31C in the book.

45 minutes

Explain

Teacher's Note: Activity Preparation

Before beginning this activity, preview the attached article, **The Effects of Changing the Carbon Cycle**. Because students will be divvying up the article to read one of eight sections, you may want to decide ahead of time how many copies to print.

To save paper, you could place each page of the article in a sheet protector and provide erasable markers for students to annotate their assigned section as described below. This way, students can wipe off their markings and allow the next class to complete the activity with the same copies.

Place students in eight groups and pass out copies of **The Effects of Changing the Carbon Cycle**. Inform students they are going to use the Jigsaw strategy to read the article, which is a condensed version of "The Carbon Cycle" by NASA's Earth Observatory.

Assign one of the following sections to each group:

- **The Rates of Cycling Carbon, Part A**
- **The Rates of Cycling Carbon, Part B**
- **Atmosphere, Part A**
- **Atmosphere, Part B**
- **Ocean, Part A**
- **Ocean, Part B**
- **Land, Part A**
- **Land, Part B**

Display **slide 7**. As each group reads, have students use the first part of the CUS and Discuss strategy to mark up their section before discussing what they marked and why.

Teacher's Note: Quiet Time

Be sure to designate quiet time for students to work on the CUS part of the strategy as they read. Provide time for discussion when students are ready.

After students have finished reading and discussing, display **slide 8** and pass out the attached **Carbon Cycle Slide Instructions and Rubric** to each group. Inform students they must create a slide that summarizes their group's assigned section and then present it to the whole class.

Before students begin their presentations, pass out the attached **Carbon Cycle Cornell Notes** handout to each student. As each group presents, have the rest of the class use the Cornell Notes handout to record key information from their peers' presentations, as well as any questions they may have.

60 minutes

Extend

Display **slide 9** and inform students they are going to create their own closed ecosystems, specifically a terrarium or an aquarium.

Pass out the attached **Draw an Initial Model** handout to each student. Ask students to think about what they would need to sustain a terrestrial or aquatic ecosystem. Have students choose between terrarium or aquarium and then draw a model of their closed ecosystem on the handout.

In groups of 4, have students review one another's models and record similarities and differences on their handouts. Based on their group discussion, have students make changes to their models as needed. Then, have each group vote on the model they like best. After groups have chosen their final designs, ask them to share out what they think they need for their terrarium or aquarium.

For students creating a terrestrial enclosure, you may pass out the attached **Create Your Own Terrarium** handout or invite them to watch the following video, titled "How to Make a Terrarium (Closed)."

Embedded video

https://youtube.com/watch?v=uOJrgr3jxRg

As a class, check on and compare everyone's ecosystems each week for a month to determine whose closed ecosystem sustained itself best and why.

Optional Slide and Activity

If you are unable to get the supplies needed for students to create their own closed ecosystems, consider inviting students to participate in Bioman's Photosynthesis and Respiration Game. If you choose to use this interactive game, display **slide 10** and pass out the attached **Photosynthesis and Respiration Game Questionnaire**. As students play through the game, have them answer the questions on the handout.

5 minutes

Evaluate

Display **slide 11**. To assess students' understanding of the lesson, have students complete a Quick Write on how a closed ecosystem can maintain homeostasis through the cycling of carbon.

Resources

- Bioman. (2011, February 7). Photosynthesis and Respiration Game [Interactive]. Bioman Biology. https://biomanbio.com/HTML5GamesandLabs/PhotoRespgames/photorespghtml5page.html
- Candide Gardening. (2020, February 19). How to Make a Terrarium (Closed) [Video]. YouTube. https://www.youtube.com/watch?v=uOJrgr3jxRg
- Fish for Thought. (2020, July 4). Enclosed Ecosphere With Shrimp [Video]. YouTube. https://www.youtube.com/watch?v=aRS88825IYo
- Fourier Education. (2016, May 19). Effect of Light on Photosynthesis With an Oxygen Sensor [Lab]. Issuu. https://issuu.com/einsteinworld/docs/effect_of_light_on_photosynthesis_-
- The Good Stuff. (2015, October 13). Inside Biosphere 2: The World's Largest Earth Science Experiment [Video]. YouTube. https://www.youtube.com/watch?v=-yAcD3wuY2Q
- Kenney, J. (2013). How to Make a Mason Jar Terrarium. The Science Classroom. https://thescienceclassroom.org/how-to-make-your-own-self-contained-ecosystem-biosphere/
- K20 Center. (n.d.). CUS and Discuss. Strategies. https://learn.k20center.ou.edu/strategy/162
- K20 Center. (n.d.). I Notice, I Wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.). Jigsaw. Strategies. https://learn.k20center.ou.edu/strategy/179
- K20 Center. (n.d.). Quick Write. Strategies. https://learn.k20center.ou.edu/strategy/1127
- K20 Center. (n.d.). R.E.R.U.N. Strategies. https://learn.k20center.ou.edu/strategy/819