TOWNGREEN2025
High School Climate Change Curriculum

Lesson 5
Climate Change

Unit Title: **Carbon Cycles through Ecosystems**	
Theme: **Ecosystems & Cycles**	Grade Level: **9-10**
# of sessions for the unit: **class period(s) approximately 3 (~45min each)**	Session #5: **Cellular Respiration**
Date created: **Summer 2017**	Authors: **J. Andrews, J. Lichtenwald, R. Rex, E. Sabo**

Unit Description

Provided in a separate document. *Please see High School Curricumum Overview.*

Standard(s)

HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of sugars and other carbohydrates.

HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.

Unit Goals

Students will understand the causes and effects and possible solutions of climate change with an emphasis on carbon sequestration (capture)

Lesson Objectives & Essential Vocabulary

1. Students will model and understand cellular respiration
2. Students will be able to understand the reactants and products of cellular respiration
3. Students will understand the relationship between Photosynthesis & Cellular Respiration

Essential vocabulary:

- Carbon Dioxide
- Water
- Sunlight
- Exergonic Reaction
- Products
- Reactants
- Yields
- Glucose
- Carbohydrate
- Molecule

NOTE:
If you can predict which students may not be able to achieve the goals, then you need to reduce barriers to maximize learning for all.

Note any potential barriers to the lesson — consider variability

vocab/reading ability — provide scaffolding, diagrams to clarify text, vocab assignments: word splash, etc.

Writing skills: solution provide writing prompts or sentence frames

NOTE:
Provide options — refer to the UDL guidelines as a way to ensure that all learners can demonstrate achievement of goals. For ideas: http://bit.ly/1d5bjtS

Evaluation/Assessment

(directly linked to the goals, i.e., Formative/Ongoing Assessment or Summative/End of Lesson Assessment)

Quick write summary from Elodea/Bromothymol Blue demo. If doing the demo a a lab activity, assess student answers to the guiding and analysis questions, or assess a student generated lab report.

Assess further enrichment lab report if students designed & ran a lab after seeing the demo

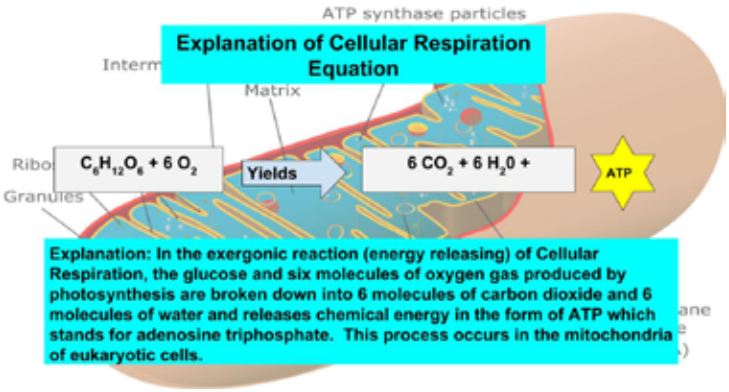
Guiding questions/teacher check ins from gum drop activity

Assess student developed poster linking photosynthesis and cellular respiration as a culminating activity

NOTE: Consider the UDL Guidelines in selecting methods and materials to ensure that you provide options for engagement, representation, and action and expression.

Methods (e.g., Anticipatory Set, Introduce and Model New Knowledge, Provide Guided Practice, Provide Independent Practice)

1. Preteach vocabulary and activate prior knowledge.
2. Hook students lab demo: Elodea & bromothymol blue (can be done as a demo or a lab)
3. Quick write summarizing what happened in the demo listed below. Students will share their summaries in a group then classroom setting. The video link shows the demo: https://youtu.be/T4SzjSEQpPY
4. Elodea and btb lab adapted from teacher web: https://docs.google.com/document/d/1Ip-d-jXcmckVMo-Hsd9ByutI1IYQxqUlLpwBtZFyIqA/edit?usp=sharing
5. For further enrichment, students could work in groups to design and run a lab after seeing the demo and write a lab report based on that lab.
6. Additional enrichment: Burping Yeast lab for MassBioTeach: https://www.massbioed.org/educators/curriculum/14-burping-yeast-investigating-aerobic-respiration
7. Share the chemical equation of cellular respiration with the class on board on worksheet
8. see link to explanation of cellular respiration equation: https://docs.google.com/drawings/d/132_xRbSO6oA4_shQKD6jYgxtgXei9p3FWjKSFqejmNg/edit?usp=sharing



9. Have students model cellular respiration using the gumdrops/toothpicks models created in lesson 4.
10. Teacher will lead discussion that links Photosynthesis with Cellular Respiration and tie this into the carbon cycle. Students will generate a poster project as a culminating activity showing the relationship between photosynthesis (lesson 4) and cellular respiration and its role in the carbon cycle.

Materials

1. Text materials *Miller & Levine Biology chapter 4: Climate* but any Biology or environmental science text would suffice
2. access to online research (chromebooks, laptop cart, library/media center).
3. Bromothymol blue, elodea, test tubes, distilled water, eye dropper, test tube stand
4. colored pencils, gumdrops, toothpicks
5. poster board, markers
6. rubric

Name: Block: Date:

Elodea & Bromothymol Blue Photosynthesis Laboratory Experiment
Climate Change

Background information:

This lab will investigate the process of photosynthesis. This lab uses an aquatic plant called **Elodea** and the chemical **Bromothymol Blue** (which acts as an indicator of CO_2). Bromothymol is able to detect the presence of **CO_2** (a necessary component of photosynthesis) and **O_2** (a waste product released during photosynthesis) in solution.

In a test tube, you will see that:

- **bromothymol blue + CO_2 = green**
- **bromothymol blue + O_2 = blue**

Equation:

Write the equation for photosynthesis. _____

Hypothesis:

_____

_____

_____

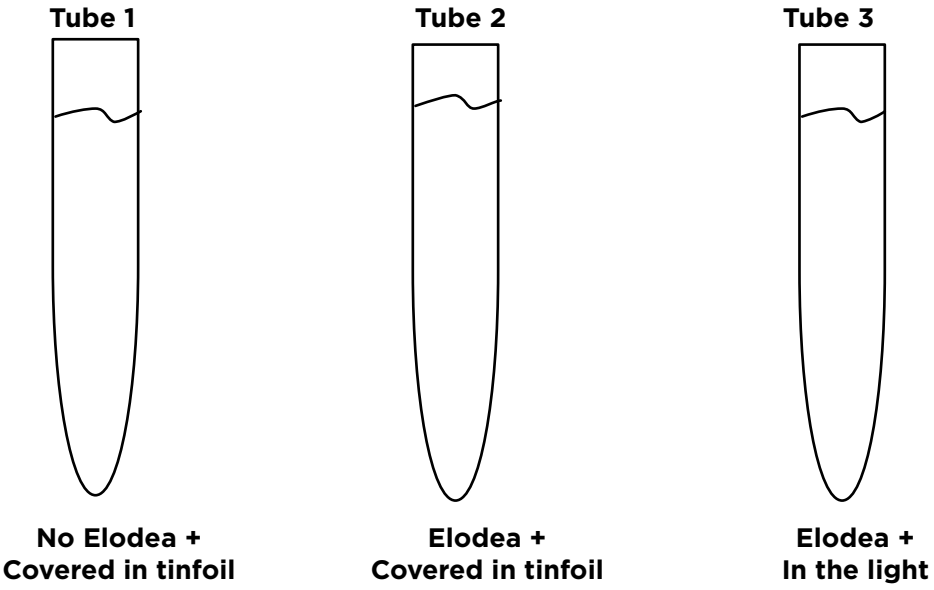
Material Preparation:

If concentrated bromothymol blue (BTB liquid) is available, dilute with water (distilled works best) and test the concentration by adding 10 ml of your BTB solution to 15 ml water and bubbling one lung full of air through a straw into the water. It should turn greenish. (If it stays blue, the BTB is too concentrated; if it turns yellow, the BTB is too diluted.) Adjust your solution as necessary and place in dropper bottles for lab teams to use.

Procedure:

1. Pour 75 mL of water into a 250 mL beaker.
2. Add 2 mL of bromothymol blue to the water. It should be a blue solution.
3. Using a straw, GENTLY blow into the solution causing it to bubble for approximately 1 minute.
4. Label 3 large test tubes: 1, 2, & 3
   - A. Tube 1 will be the control (no Elodea)
   - B. Tube 2 will be the Elodea in the dark
   - C. Tube 3 will be the Elodea in the light
5. Pour 25 mL of the bromothymol blue + water solution into each of the three test tubes.
6. Cover Tube 1 with tin foil (there is no Elodea in Tube 1) and place it in the test tube rack

7. Add a 7 cm piece of Elodea to Tube 2. Using your straw, GENTLY push the Elodea to the bottom of the test tube. Then cover Tube 2 with tinfoil and place it in the test tube rack.
8. Add a 7 cm piece of Elodea to Tube 3. Using your straw, GENTLY push the Elodea to the bottom of the test tube. Cover the test tube with plastic wrap or a stopper. Then place it in the test tube rack.
9. Place the entire test tube rack under a light source and allow to sit overnight.



Pre-Lab Questions:

1. Predict what will happen to the color of the solution when you blow into the straw (causing the bromothymol blue + water solution to bubble). Explain your prediction. _____

_____

_____

2. Predict what color Tube 1 will be after the experiment. _____
3. Predict what color Tube 2 will be after the experiment. _____
4. Predict what color Tube 3 will be after the experiment. _____

Results: Record your results in the table below.

Sample	No Elodea + Tinfoil (Control)	Elodea + Tinfoil	Elodea + Light
Color Before Experiment			
Color After Experiment			

Conclusions: Write 2 to 3 sentences based on your results.

Post-Lab Analysis:

5. What color does the bromothymol blue solution turn after you exhale into it? _____
   Explain your answer. _____

6. What happened to the color in Test Tube 1? Explain why you obtained the results that you did.

7. What happened to the color in Test Tube 2? Explain why you obtained the results that you did.

8. What happened to the color in Test Tube 3? Explain why you obtained the results that you did.

9. What is the purpose of the control? _____

10. Compare the Elodea in the dark to the Elodea in the light. How do you account for any differences in color? _____

11. What gas (or gases) can bromothymol blue serve as an indicator for? _____

12. What gas do you exhale? _____
13. What gas do plants give off? _____
14. List three things that a plant needs to undergo photosynthesis.
    A. _____
    B. _____
    C. _____
15. Write the overall equation for photosynthesis.