

Secure Your Oxygen Mask First

Energetics / Cell Respiration

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Grade Level	9th – 12th Grade	**Time Frame**	250 minutes
Course	Biology	**Duration**	4-5 class periods

Essential Question

How do cells obtain and use energy?

Summary

Students will learn how to disrupt cell respiration and what happens when cell respiration is disrupted. This is intended for a Pre-AP or AP Biology class, utilizing the respiration lab recommended by CollegeBoard. If selecting this lesson for other groups of students, read through the differentiations to decrease the difficulty of the lesson.

Snapshot

Engage

Students read a case study about cyanide poisoning in Chicago.

Explore

Students perform a cell respiration lab, looking at respiration rates in seeds.

Explain

Students create research posters to share their lab results and participate in a Gallery Walk and discussion.

Extend

Students research other inhibitors of respiration, fermentation, and anaerobic restrictions.

Evaluate

Students present their research to the class.

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
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Oklahoma Academic Standards (Biology)

B.LS1.3.1: Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Outside that range (e.g., at too high or low external temperature, with too little food or water available) the organism cannot survive.

Attachments

- Cell Respiration Lab - Spanish.docx
- Cell Respiration Lab - Spanish.pdf
- Cell Respiration Lab.docx
- Cell Respiration Lab.pdf
- Chicago Cyanide Murders.pdf
- Inhibitors of Cell Respiration - Spanish.docx
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Materials

- Chicago Cyanide Murders case study handout
- Cell Respiration Lab handouts
- Plastic tubs
- Water (3 different temperatures)
- Respirometers
- Cotton balls
- KOH
- Peas
- Thermometers
- Plastic beads
- Tape
- Food coloring
- Poster paper
- Access to the internet

Engage

To begin, pass out copies of the Chicago Cyanide Murders case study for students to read. Have students read in groups of two or three and answer the questions on the case study.

Teacher's Note: Chunking

I like to break up the case study. I usually start by passing out Part I, having students read and discuss in their groups, and then having a whole-group discussion, asking students what they think is going on. I also usually have the students hypothesize if they believe it is poisoning or not. Then I pass out Part II questions 3-5a, have a discussion, pass out Part II 5b-6, and then pass out Part III. This structure helps to check understanding while helping to keep all students on track and focused.

Teacher's Note: This is Real Life!

Students are usually surprised that this case study comes from a real cold case. I like to share that information at the very end of the Engage activity, as it builds excitement for students to come in the next day for the lab.

Optional Differentiation

To decrease difficulty of this lesson, use the questions in the handout and go over the answers in the handout as the Explore and Explain activity. The lab moves to the Extend section.

Explore

Pass out cell respiration lab handouts, which are adapted from the 2001 CollegeBoard AP Biology manual - the current CollegeBoard AP Biology lab manual can be found following the link (The lab itself is on page 188 for the teacher version and page 202 for student of the PDF). Give students time in their lab groups to read the instructions and answer the pre-lab questions. Students will then be assigned a temperature to investigate and will explore the cell respiration rates of peas, so each group will test only one temperature.

Teacher's Note: Getting in the Zone

I like to pass out the lab the day before about 10-15 minutes before the end of class to allow students to read and answer their pre-lab questions. Doing so prepares them to come in the next day and get started on the lab. The lab requires a full 50 minutes to complete. You can break it into two days, but in that case you'll need to repeat the setup both days.

Teacher's Note: Helpful Hint

Add food coloring to the end of the respirometers at the very beginning after calibration to help students more easily track oxygen usage.

Differentiation: To decrease difficulty of the lesson, move this lab to the Extend section, and omit the other Extend activity.

Explain

In their lab groups, have students create a Research Poster related to their cell respiration experiments. On the poster, students should include their research question, hypothesis, data table, graph, and research conclusion. Ask the groups to present their posters to the class. After the presentations, hang up the posters and have a discussion about how the different temperatures affected the rates of photosynthesis and what happened with the different conditions of the peas.

Have students write Claim, Evidence, Reasoning (CER) statements using the prompt: The relationship between temperature and respiration _____. Remind students that complete CER statements do not just have a claim, but also evidence and a reason to justify the claim.

Teacher's Note: Weaving in Replication

I like to explore variations in results between groups that were assigned the same temperature. Having at least two groups assigned to the same temperature can lead to a discussion of why it's important to repeat your experiments.

Optional Differentiation

To decrease the difficulty of the lesson, move this activity to the Evaluate section.

Extend

Have students sign up in groups of 2-3 (different from their lab groups, preferably) to explore a specific inhibitor of cell respiration. A signup sheet with the list of inhibitors is available in the "Inhibitors of Cell Respiration" attachment.

Teacher's Note: Scary Names

Students might be put off by the formal scientific names on the list. Assure them that it's going to be okay and that part of their research will be figuring out what the compound is along with determining its impact.

Ask groups to research their inhibitor and create a 5-10 minute presentation about their inhibitor and how it works. Students should include:

- The name of their inhibitor.
- The type of drug.
- Uses.
- How it works (where it blocks cell respiration).
- Symptoms of ingesting the inhibitor.
- Any known treatments that can reverse the effects of the inhibitor and how quickly the treatment has to be administered.

Teacher's Note: Encourage Creativity

I like to provide students the opportunity to choose their type of presentation. Some students do better creating poster presentations, while others might prefer to create a PowerPoint. Allow them to be creative as long as they have a visual product and all students are able to participate.

Evaluate

Students will present their research from the Extend activity to the class. After the presentations, ask students to write a Two-Minute Paper where they reflect upon how cells use and obtain energy and the ways in which that can be inhibited.

Resources

- AP College Central https://apcentral.collegeboard.org/courses/ap-biology/course/lab-manual-resource-center
- Biology Corner. (n.d.). Chicago cyanide murders: A case study in cellular respiration. Retrieved from https://www.biologycorner.com/worksheets/case_study_cellular_respiration.html
- K20 Center. (n.d.). Claim, Evidence, Reasoning (CER). Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f506fc09
- K20 Center. (n.d.). Research Poster. Strategies. https://learn.k20center.ou.edu/strategy/1643efb18793d632c1f6f6639d0068ed
- K20 Center. (n.d.). Two-Minute Paper. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f506cf73