Chloroplasts vs. Mitochondria

Grade Range: Middle School        Lesson Time: 40 minutes

Key Terms

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<tr>
<th>Adenosine triphosphate</th>
<th>Mitochondria</th>
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<td>Cellular respiration</td>
<td>Photosynthesis</td>
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<tr>
<td>Chloroplast</td>
<td>Products</td>
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<tr>
<td>Eukaryote</td>
<td>Prokaryote</td>
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<td>Glucose</td>
<td>Reactants</td>
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Activity Overview

How did simple prokaryotes evolve into complex eukaryotes? According to some scientists, they did so by consuming each other! In this activity, students will compare photosynthesis and cellular respiration as chemical reactions. Then, students will examine the structures and functions of chloroplasts and mitochondria.

Essential Questions

1. How are photosynthesis and cellular respiration similar? How are they different?
2. What are the similarities and differences between the structures inside the chloroplast and the mitochondrion?
3. In which types of eukaryotic cells are chloroplasts and mitochondria found?

Objectives

- Compare the internal structures of the chloroplast and the mitochondrion
- Compare the reactants and products of photosynthesis and cellular respiration
- Differentiate animal cells from plant cells based on the absence or presence of chloroplasts

Introduction

Before beginning this activity, students will need a working knowledge of plant and animal cell structure. In VIVED Science, two activities are available that will aid in building this knowledge: Plant Cell Structures and Animal Cell Structures.

zSpace Activity

Activity Questions Provided in Studio

Answers may vary. Sample answers are provided below.

1. Chloroplasts and mitochondria are two of the most important organelles in the eukaryotic cell. Let’s look at the chloroplast first. Use Dissect mode to closely examine the chloroplast. Make observations of the physical features inside the chloroplast.

   The thylakoids are stacked up vertically.
2. Use Dissect mode to closely examine the mitochondrion. Make observations of the physical features inside the mitochondrion. 

*The inner membrane of the mitochondrion is compressed and folded.*

3. Observe the structure of the chloroplast and mitochondrion. State one similarity and one difference.

*Chloroplasts and mitochondria both have internal membranes. Chloroplasts organize their membranes as discs, whereas mitochondria fold their membrane inside of the organelle.*

4. The endosymbiotic theory hypothesizes that the first eukaryotic cells formed when larger prokaryotic cells consumed smaller prokaryotic cells. Although the smaller prokaryotic cells were consumed, they maintained their DNA and individual functions, and eventually evolved into the chloroplasts and mitochondria. Name one similarity between these organelles and a prokaryotic cell.

*These organelles and a prokaryotic cell both have an outer membrane and they have DNA.*

5. Chloroplasts allow organisms to perform photosynthesis, a chemical reaction vital to supporting life on earth. Chloroplasts contain the pigment chlorophyll, which absorbs light energy and uses it to produce food. Photosynthesis uses light energy with carbon dioxide and water molecules to form glucose, a basic sugar molecule. Through this process, oxygen gas is released as waste. Use the Notes to label all the molecules, then list the reactants and the products. Then take a photo.

*Photo. The reactants are carbon dioxide and water. The products are glucose and oxygen.*

6. Mitochondria allow eukaryotic cells to perform cellular respiration, a chemical reaction that releases energy from food. Cellular respiration, basically the reverse reaction of photosynthesis, breaks down glucose molecules into carbon dioxide, water, and energy in the form of adenosine triphosphate (ATP). This process uses oxygen gas during the reaction. Take a photo of just the reactants of cellular respiration. How does this compare to the products photosynthesis?

*Photo. The products of photosynthesis are the reactants of cellular respiration.*

7. Eukaryotic cells are usually categorized as either animal cells or plant cells. One defining difference between the animal cell and plant cell is the organelles present. Observe the animal cell and plant cell. Which has chloroplasts? Which has mitochondria? Do either of the cells have both organelles?

*Animal cells only have mitochondria, whereas plant cells have both mitochondria and chloroplasts.*

8. Why would plant cells have both mitochondria and chloroplasts?

*Plant cells have chloroplasts to produce sugar and mitochondria to break down that sugar into useable energy.*

9. The reactions that occur inside chloroplasts and mitochondria are related to each other. What is similar between photosynthesis and cellular respiration? What is different?

*Photosynthesis and cellular respiration are similar because they both involve the same molecules. However, they’re different because one’s reactants are the other’s products and vice versa.*

**Closing**

**Cell Reactions Presentations**

Have students create presentations about the light/dark cycles in photosynthesis; glycolysis, the Krebs cycle, or other reactions involved in cellular respiration; or anaerobic fermentation.

**Differentiation**

- Group students heterogeneously to allow students with a strong command of the English language to assist in reading or interpreting questions
- Provide paper copies of diagrams for students to use as a reference
- Provide a handout with a list of vocabulary terms and definitions that will appear in the activity
- Allow students to provide answers that are handwritten, typed, or verbal
- Give students a variety of presentation styles to choose from (using charts/graphs, PowerPoint, making 3D presentations, creating videos/movies, making posters)
- Have students work as partners or in small groups (younger children could partner with older buddies)
- Enrichment: Students could change an additional variable in the activity and look for patterns
- Enrichment: Students could find real-world problems involving the concept and design solutions to those problems
- Enrichment: Students could research similar topics and create presentations
- Enrichment: Students could build a model of a key concept

Resources