Section 10.1
Cellular Respiration: An Overview
I Can...

- **LS 1.9** I can compare and contrast aerobic respiration to anaerobic respiration and fermentation.
Key Questions

1. Where do organisms get energy?
2. What is cellular respiration?
3. What is the relationship between photosynthesis and cellular respiration?
Vocabulary

• Calorie
• Cellular respiration
• Aerobic
• Anaerobic
Chemical Energy and Food

• Food molecules contain chemical energy that is released when their chemical bonds are broken.

• Energy that is stored in food is expressed in units of calories.
• A calorie is the amount of energy needed to raise the temperature of 1 gram of water by 1 degree Celsius.
• The Calorie that is on food label is a kilocalorie, or 1000 calories.
Chemical Energy and Food

• The energy stored in macromolecules varies due to their chemical structures.
  • 1 gram of glucose releases 3811 calories of heat energy when burned
  • 1 gram of fat releases 8893 calories of heat energy when burned

• Carbs and proteins = 4000 calories (4 Calories) of energy per gram
• Fats = 9000 calories (9 Calories) of energy per gram
Chemical Energy and Food

• Cells don’t simply burn food and release energy as heat.

• The gradually break down food molecules, capturing chemical energy in steps.

• Cells use the energy stored in food to synthesize compounds, such as ATP, to directly power the cell.
Overview of Cellular Respiration

• **Cellular respiration** is a process of energy conversion that releases energy from food *in the presence of oxygen*.

\[
\text{Oxygen} + \text{Glucose} \rightarrow \text{Carbon Dioxide} + \text{Water} + \text{Energy}
\]

\[
6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}
\]

• If this took place in just one step, all of the energy from glucose would be released at once, and most would be lost in the form of light and heat.
Stages of Cellular Respiration

1. Glycolysis
   - Occurs in cytoplasm
   - Breaks 1 glucose into two pyruvic acid
   - 10% of energy is captured from glucose to make ATP

2. Krebs Cycle
   - Occurs in mitochondrion
   - Small amount of energy is captured

3. Electron Transport Chain
   - Occurs in mitochondrion
   - Bulk of energy is captured
   - Uses oxygen as final electron acceptor
Oxygen and Energy

- **Anaerobic**- does not directly require oxygen
  - Glycolysis

- **Aerobic**- requires oxygen
  - Krebs cycle
  - ETC

- If oxygen is NOT present, glycolysis is followed by fermentation (an anaerobic pathway).
# Comparing Photosynthesis and Cellular Respiration

<table>
<thead>
<tr>
<th>Photosynthesis</th>
<th>Cellular Respiration</th>
</tr>
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<tbody>
<tr>
<td>Requires energy</td>
<td>Releases energy</td>
</tr>
<tr>
<td>Removes carbon dioxide from atmosphere</td>
<td>Releases carbon dioxide into atmosphere</td>
</tr>
<tr>
<td>Releases oxygen into atmosphere</td>
<td>Removes oxygen from atmosphere</td>
</tr>
</tbody>
</table>

\[
6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2
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\]
Section 10.1 Exit Ticket

1. How do different organisms obtain and use energy to survive in their environment?

2. What are the differences between aerobic and anaerobic respiration?