Life Sciences 11

LG 3 - Energy Transformation
Part 1 Cellular Respiration

Energy in Living Systems

Energy is essential for life. For organisms to survive, energy must be transformed from one form into another. For example, when you eat, the chemical energy stored in food is converted into a molecule called **ATP** (adenosine triphosphate). ATP is the usable form of energy in your body, it powers processes like muscle contraction. In other words, the chemical potential energy stored in the bonds of food molecules (and later ATP) can be converted into the kinetic energy of movement.

But how exactly does your body convert food into ATP? In **Part 2 of Learning Guide 1**, you'll begin exploring the process of **cellular respiration**. This process involves a series of highly exothermic chemical reactions that occur inside the **mitochondria**, the "powerhouses" of the cell. Cellular respiration is such a *breath-taking* process!

Activity: Cellular Respiration and Energy Transformation

In this activity, you will explore how cells transform energy to sustain life. The focus will be on understanding **cellular respiration**, the role of the **mitochondria**, and the importance of **ATP** as the energy currency of the cell. Use your textbook and the internet to research the process of cellular respiration and answer the following questions, you will also create diagrams to help illustrate your findings. **Read pages #123-129** in your Life Sciences 11 textbook.

1. **Exothermic Reactions**
   Define the term *exothermic*. Then, provide a clear example of an exothermic reaction that occurs either in daily life or in biological systems.

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2. **Cellular Respiration**
   Write a short paragraph defining *cellular respiration*. In your explanation, be sure to use the terms **glycolysis**, **Krebs cycle**, and **electron transport chain**.

3. **The Mitochondrion**
   Draw a large, clear diagram of a single mitochondrion. Label the **outer membrane**, **inner membrane**, **matrix**, and **cristae**. On your diagram, also indicate the locations where the **Krebs cycle** and the **electron transport chain** take place.

4. **ATP – The Energy Currency of the Cell**
   Define *ATP (adenosine triphosphate)* and explain its role in living systems. Then, draw and label the basic structure of an ATP molecule.

5. **Energy Concepts**
   Define *energy*. Explain the difference between **kinetic energy** and **potential energy**, and give one biological example of each (e.g., muscle contraction vs. energy stored in glucose).

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Part 2 Photosynthesis

The Source of Life's Energy

All of the food we eat can ultimately be traced back to the sun and the process of **photosynthesis**. Photosynthesis is a series of chemical reactions in which plants, algae, and some bacteria capture the energy of sunlight and convert it into **glucose**, a simple sugar that stores chemical energy. Unlike cellular respiration, this process is **endothermic**, meaning it requires an input of energy to occur. Photosynthesis is basically plants saying, 'Let me turn this light snack into an actual snack'. This LG is gonna leaf you speechless!

Instructions: Photosynthesis and Energy Transformations
In this activity, you will explore the structure of the chloroplast, the process of photosynthesis, and its important relationship to cellular respiration. You will also compare molecules involved in capturing and storing energy in living systems. Use your textbook by **reading pages # 113-123** and online resources to research photosynthesis and complete the following tasks to help you understand how energy is transformed during this process:

1. **The Chloroplast**
   Draw a large, detailed diagram of a chloroplast. Label the following structures clearly: **outer membrane, inner membrane, stroma, lamella, thylakoid,** and **granum**.

2. **The Process of Photosynthesis**
   Research and write a well-developed paragraph explaining the process of photosynthesis. In your explanation, be sure to include the terms **chlorophyll, light reactions, photophosphorylation,** and **Calvin cycle**.

3. **Comparing Equations**
   Write the full chemical equation for **photosynthesis** and then write the equation for **cellular respiration** underneath it. Compare the two equations and explain what you notice about their relationship. Finally, identify which process is **endothermic** and which is **exothermic**, and explain why.

4. **Molecules of Life**
   Draw the molecular structure of **chlorophyll** and of **glucose**. For each, state whether it is an **organic** or **inorganic** molecule, and explain your reasoning.