

### The Mitochondria

**Mitochondria** are the powerhouses of the cell because they "burn" or break the chemical bonds of glucose to release energy to do work in a cell. Remember that this energy originally came from the sun and was stored in chemical bonds by plants during photosynthesis. **Glucose** and other **carbohydrates** made by plants during photosynthesis are broken down by the process of **aerobic cellular respiration** (requires oxygen) in the mitochondria of the cell. This releases **energy (ATP)** for the cell. The **more active a cell** (such as a muscle cell), the more mitochondria it will have. The mitochondria are about the size of a bacterial cell and are often peanut-shaped. Mitochondria have their **own DNA** and a **double membrane** like the **nucleus and chloroplast**. The **outer membrane** is smooth, while the **inner membrane** is convoluted into folds called **cristae** in order to **increase the surface area**.

1. Why are mitochondria called the powerhouse of the cell?

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2. What cell process occurs in the mitochondria? \_\_\_\_\_

3. Why do some cells have MORE mitochondria? Give an example.

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4. What simple sugar is broken down in the mitochondria? \_\_\_\_\_

5. Where does the energy in glucose come from ORIGINALLY? \_\_\_\_\_

6. Where is this energy stored in glucose? \_\_\_\_\_

7. Why is cellular respiration an aerobic process?

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\_\_\_\_\_

8. What energy is released when the chemical bonds of glucose are broken?

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9. Name two other organelles besides the mitochondria that contain DNA and have a double membrane. \_\_\_\_\_

10. Describe the outer membrane of the mitochondria.

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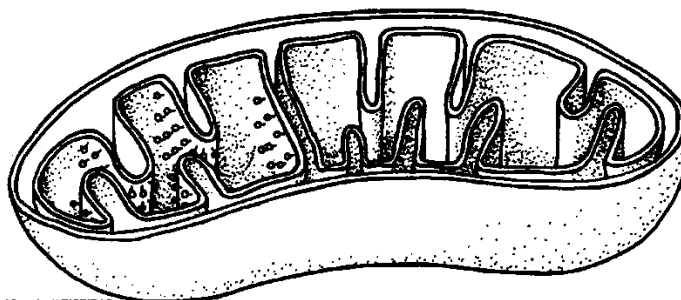
11. Why is the inner mitochondrial membrane folded?

\_\_\_\_\_

12. What are the folds called? \_\_\_\_\_

*Color and label* the **outer membrane** pink and the **cristae** red on figure 1. This greatly increases the surface area of the membrane so that carbohydrates (simple sugars) can combine with oxygen to produce ATP, **adenosine triphosphate** (the energy molecule of the cell). The **electron transport chain** takes place across the membranes of the **cristae** (*crista*, singular). Inside the folds or cristae is a space called the **matrix** that contains enzymes needed for the **Kreb's Cycle**? *Color and label* the matrix yellow on figure 3.

FIGURE 1 - MITOCHONDRIA

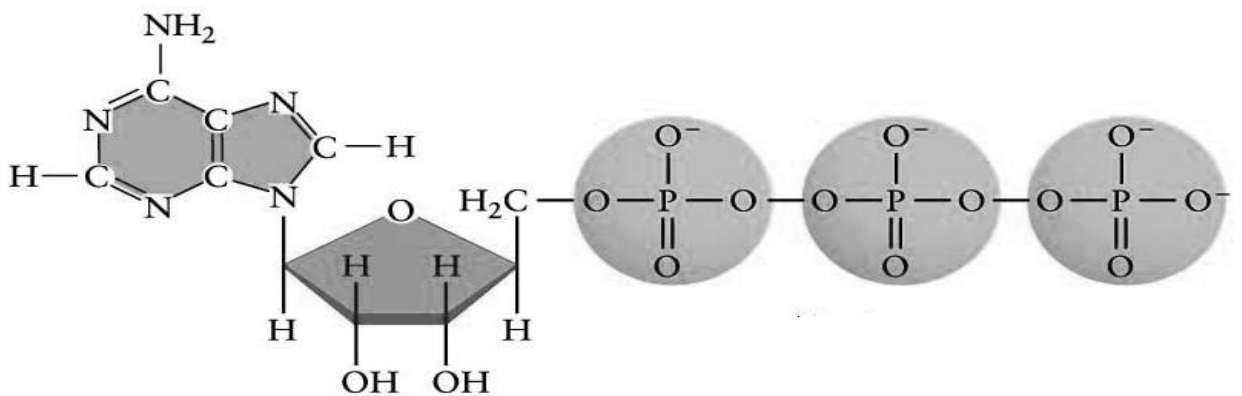


**Adenosine triphosphate (ATP)** is the energy molecule used by all cells to do work. It is a nucleotide consisting of a **nitrogen-containing base** (adenine, thymine, cytosine, or guanine), a 5-carbon **sugar**, and 3 **phosphate groups**. ATP is able to store and transport chemical energy within cells. The **LAST TWO** phosphate groups (PO<sub>4</sub>), are joined by **HIGH-ENERGY** bonds. When these bonds are broken, energy is released for cells to use and ADP forms. Enzymes help to break and reform these high-energy bonds.

13. What does ATP stand for? \_\_\_\_\_
14. What three main things make up an ATP molecule? \_\_\_\_\_
15. How many high-energy bonds does ATP contain? \_\_\_\_\_
16. Where are these high-energy bonds found in ATP? \_\_\_\_\_
17. What helps weaken these bonds so energy can be released and then later help reform them? \_\_\_\_\_
18. When ATP loses a phosphate group \_\_\_\_\_ is released for cells and a molecule of \_\_\_\_\_ forms.

In Figure 2, **COLOR** the 5-carbon sugar **RED** and **LABEL** it **RIBOSE**. **COLOR** and **LABEL** the nitrogen-base **DARK BLUE**. **COLOR** and **LABEL** the 3 phosphate groups **YELLOW**, and **COLOR** & **LABEL** the 2 high-energy bonds **GREEN**.

**FIGURE 2 - ATP MOLECULE**



**Questions:**

19. What is the energy molecule of the cell called?  
\_\_\_\_\_
20. What macromolecule made by plants is "burned" in the mitochondria?  
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21. How would the number of mitochondria in an insect's wing compare to the amount found in other cells in an insect's body? Explain your answer.  
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22. What is the advantage of having a folded inner membrane in the mitochondria?  
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