

Lesson Overview
8.1 Energy and Life

Miller & Levine
Biology

Lesson Overview Energy and Life

THINK ABOUT IT

- Homeostasis is hard work. Organisms and the cells within them have to grow and develop, move materials around, build new molecules, and respond to environmental changes.
- What powers so much activity, and where does that power come from?

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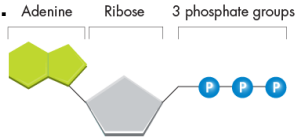
Chemical Energy and ATP

- Energy is the ability to do work.
- Your cells are busy using energy to build new molecules, contract muscles, and carry out active transport.
- Without the ability to obtain and use energy, life would cease to exist.

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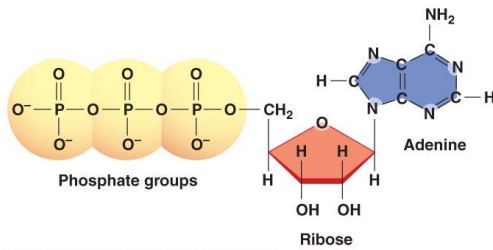
Chemical Energy and ATP

- One of the most important compounds that cells use to store and release energy is **adenosine triphosphate (ATP)**.
- ATP consists of adenine, a 5-carbon sugar called ribose, and three phosphate groups.



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(a) ATP consists of three phosphate groups, ribose, and adenine.



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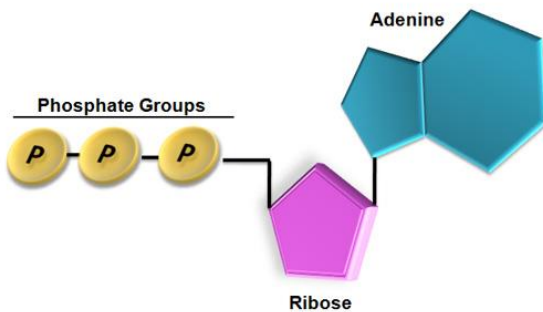
Chemical Energy and ATP

- ☞ Why is ATP useful to cells?
 - ATP is chemical fuel for a living cell
 - Cells use ATP to store and release energy when needed.

Chemical Energy and ATP

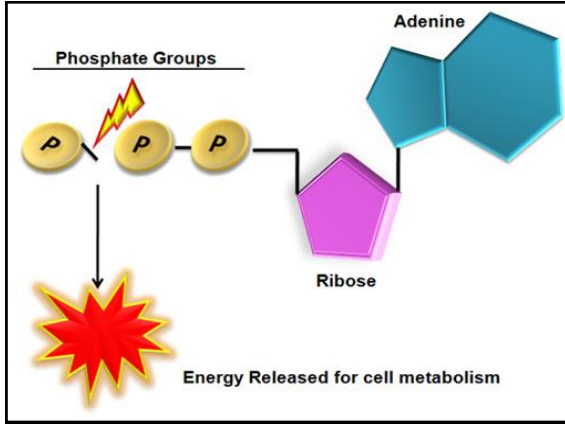
- Why is ATP useful to cells?
- ATP can easily release and store energy by breaking and re-forming the bonds between its phosphate groups. This characteristic of ATP makes it exceptionally useful as a basic energy source for all cells.

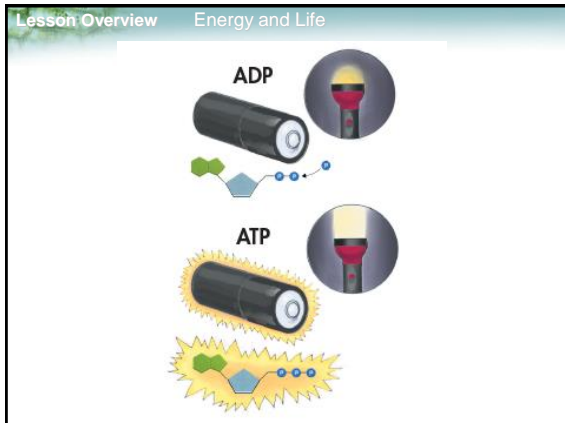
Adenosine triphosphate [ATP]



Storing Energy

- **Adenosine diphosphate (ADP)** looks almost like ATP, except that it has two phosphate groups instead of three. ADP contains some energy, but not as much as ATP.
- When a cell has energy available, it can store small amounts of it by adding phosphate groups to ADP, producing ATP.
- ADP is like a rechargeable battery that powers the machinery of the cell.





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Releasing Energy

Cells can release the energy stored in **ATP** by breaking the bonds between the second and third **phosphate groups**.

Because a cell can add or subtract these phosphate groups, it has an efficient way of storing and releasing energy as needed.

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Using Biochemical Energy

One way cells use the energy provided by ATP is to carry out **active transport**.

Many cell membranes contain **sodium-potassium pumps**. ATP provides the energy that keeps these pumps working, maintaining a balance of ions on both sides of the cell membrane.

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Using Biochemical Energy

ATP powers movement, providing the energy for motor proteins that contract muscle and power the movement of **cilia** and **flagella**.

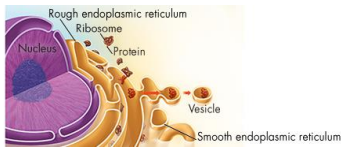
Heterotrophs and Autotrophs

What happens during the process of photosynthesis?

In the process of photosynthesis, plants convert the **energy of sunlight** into chemical energy stored in the bonds of **carbohydrates**.

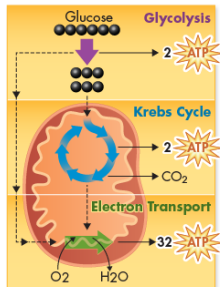
Using Biochemical Energy

Energy from ATP powers the **synthesis of proteins** and responses to chemical signals at the cell surface.



Using Biochemical Energy

- ATP is not a good molecule for storing **large** amounts of energy over the long term.
- It is more efficient for cells to keep only a **small** supply of ATP on hand.
- Most cells only store enough ATP to last for a **few seconds** of activity



Heterotrophs and Autotrophs

- Organisms that obtain food by consuming other living things are known as **heterotrophs**.
- Some heterotrophs get their food by eating plants. (**Primary Consumers**)
- Other heterotrophs, such as a cheetah, obtain food from plants indirectly by feeding on plant-eating animals. (secondary consumers)
- Still other heterotrophs, such as mushrooms, obtain food by decomposing other organisms.

Heterotrophs and Autotrophs

- Organisms that make their own food are called **autotrophs**.
- Plants, algae, and some bacteria are able to use light energy from the sun to produce food.
- The process by which autotrophs use the energy of sunlight to produce high-energy carbohydrates that can be used for food is known as **photosynthesis**.
