

Chapter 4: Energy



From the sun to you in two easy steps

Learning Objectives

Understand and be able to explain the following:

- ❑ How energy flows from the sun and through all life on earth
- ❑ How photosynthesis uses energy from sunlight to make food

Learning Objectives

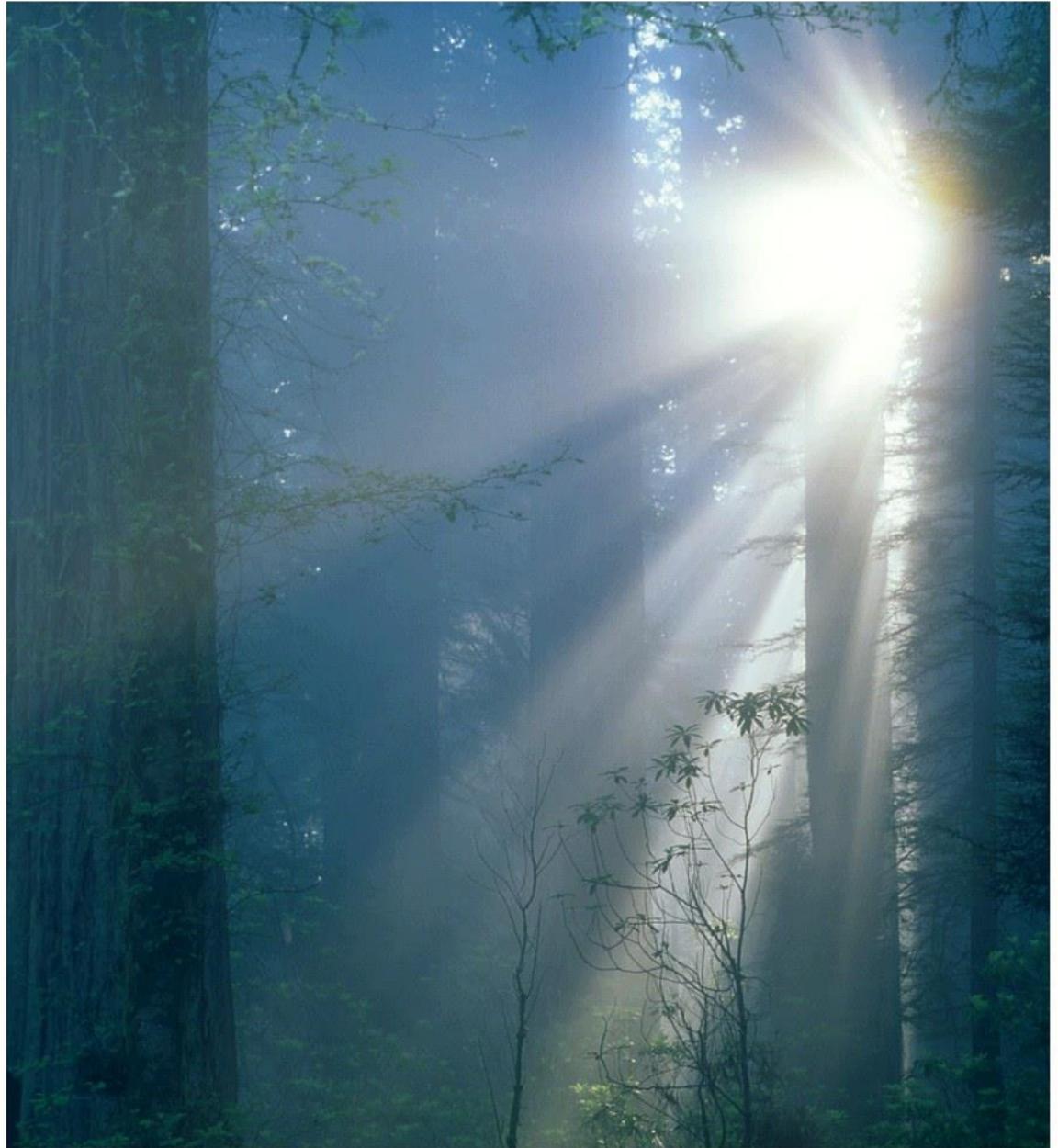
Understand and be able to explain the following:

- ❑ How cellular respiration converts food molecules into ATP, a universal source of energy
- ❑ Alternative pathways to energy acquisition

Do Now

- **Collect Homework.**
- **Watch the video. Do not discuss with your classmates.**
- **On each note,**
 - **List one substance you can see or think that is present.**
 - **Place note in middle of your table.**
 - **All notes must be different – no repeats with your classmates!**
 - **Name the process or reaction that is occurring.**
 - **Work with your group to classify your substances as reactants or products and place in chemical equation form.**
 - **Be ready to share and defend your equation. Student #1 will be the speaker.**

4.1 - 4.4
Energy flows from
the sun and
through all life
on earth.



Energy Conversions

- All life depends on capturing energy from the sun and converting it into a form that living organisms can use.
- Two key processes
 - **Photosynthesis**
 - **Cellular respiration**

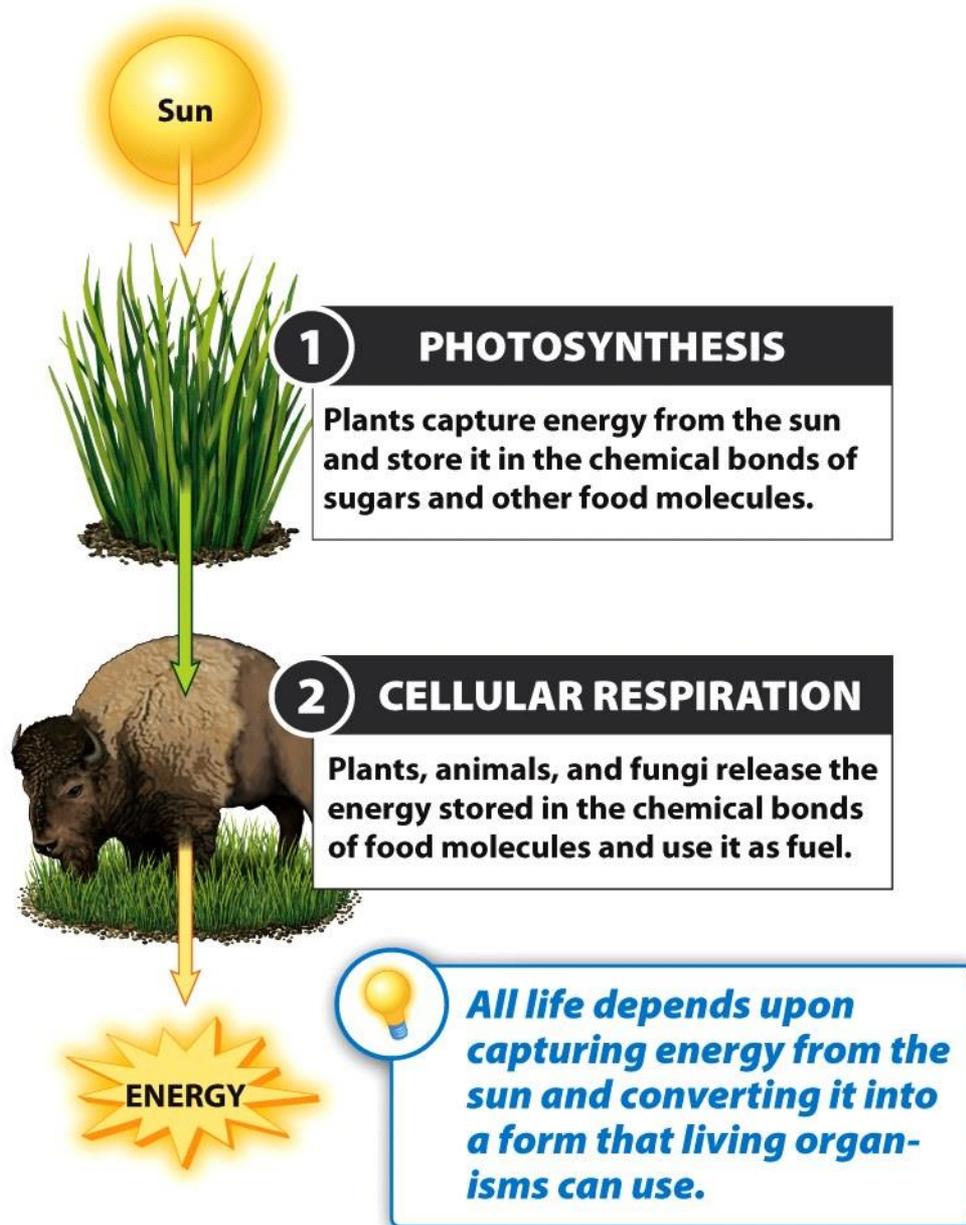


Figure 4-2
What Is Life? A Guide to Biology
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Take-home message 4.1

- The sun is the source of the energy that powers all living organisms and other “machines.”
- The energy from sunlight is stored in the chemical bonds of molecules.

Chemical Energy



Food is a form of chemical energy!

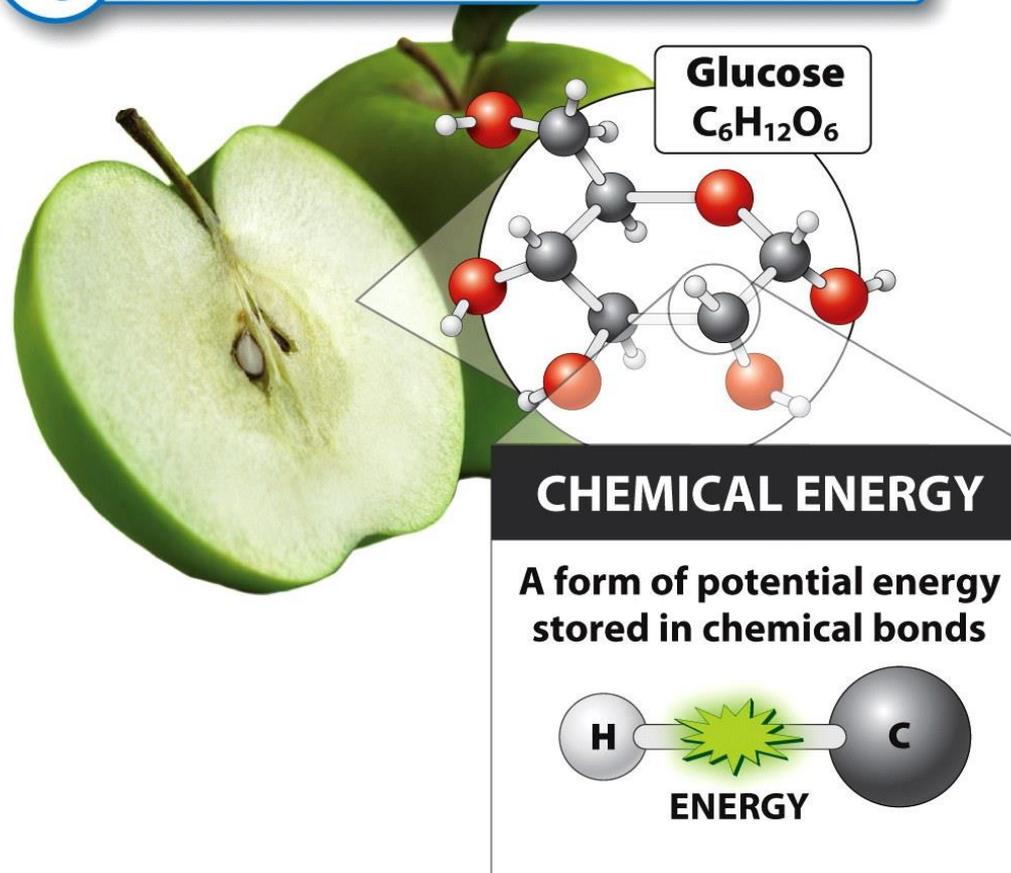


Figure 4-4
What Is Life? A Guide to Biology
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Take-home message 4.1

- When these bonds are broken, energy is released regardless of whether the bond is in a molecule of food, a fossil fuel or a biofuel like the oil in which french fries are cooked.

4.4 ATP molecules are like free-floating rechargeable batteries in all living cells.

How do cells *directly* fuel their chemical reactions?

- *None* of the light energy from the sun can be used *directly* to fuel cellular work.
- First, it must be captured in the bonds of a molecule called adenosine triphosphate (ATP).

Structure of ATP

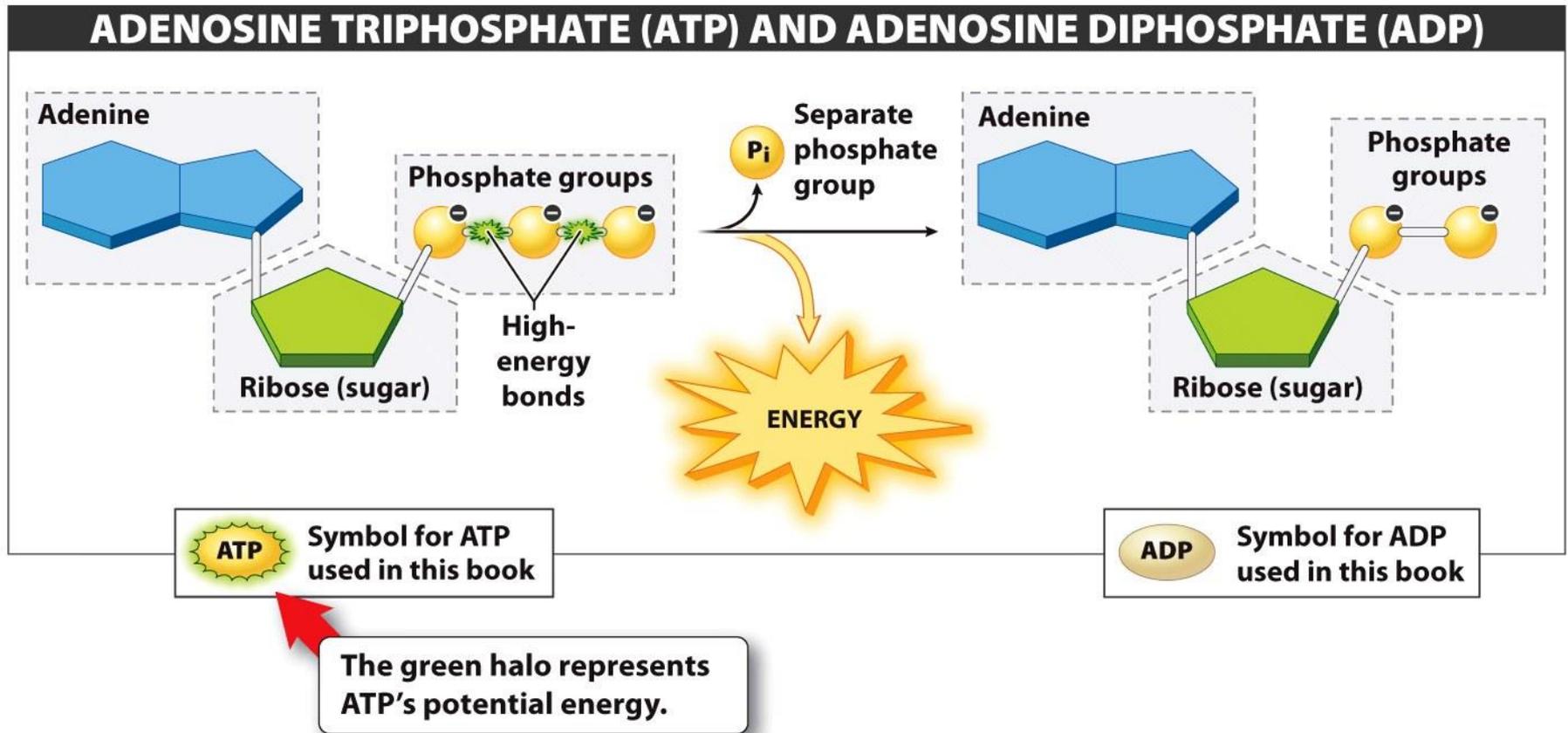


Figure 4-7

What Is Life? A Guide To Biology, Second Edition

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Do Now:

- Draw a picture of a fully charged battery and a drained battery (like Duracell, Energizer Bunny....)
- Label the fully charged battery with the energy molecule discussed in last class. Draw a picture of that molecule.
- Clearly show that the battery is either full or drained of chemical energy.

ATP Molecules

- ❑ Cells cannot use light energy directly to do work.
- ❑ First, the energy has to be converted into chemical energy in ATP molecules.

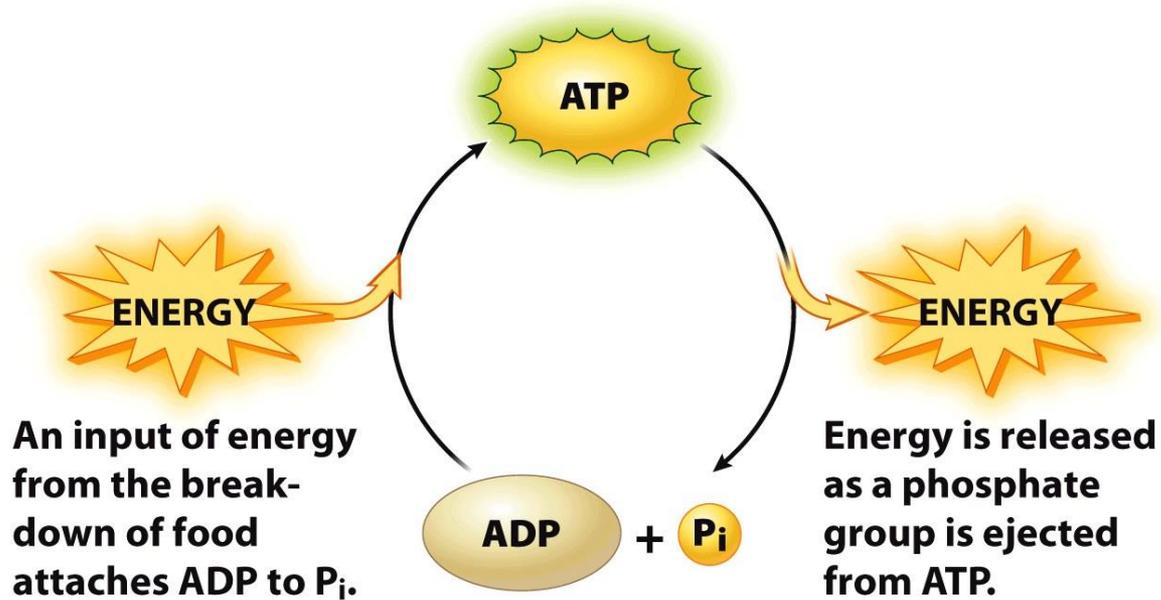
Adenosine Triphosphate

- Pop off the third phosphate group
 - $\text{ATP} \rightarrow \text{ADP} + \text{Phosphate group} + \text{Energy release}$

- Release a little burst of energy!

- Use this energy to drive chemical reactions necessary for cellular functioning.
 - Building muscle tissue
 - Repairing a wound
 - Growing roots

Recycling in the Cell



ATP can be used and recycled hundreds of thousands of times!

Take-home message 4.4

- ❑ Cells temporarily store energy in the bonds of ATP molecules.
- ❑ This potential energy can be converted to kinetic energy and used to fuel life-sustaining chemical reactions.
- ❑ At other times, inputs of kinetic energy can be converted to the potential energy of the energy-rich but unstable bonds in the ATP molecule.