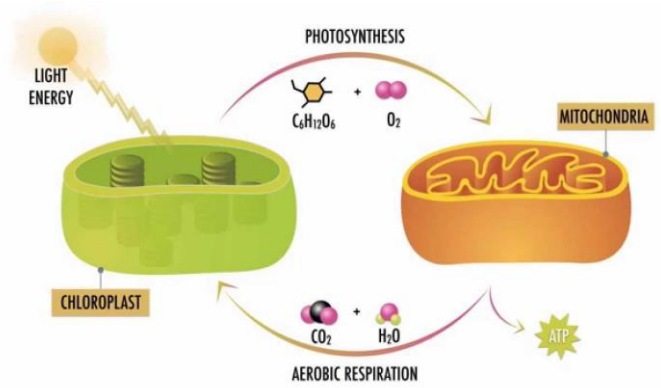


Unit 4 (Cell Energy)

Unit 4 Topic 1: Photosynthesis & ATP

By the end of this topic, you should be able to...

- Describe how ATP is used and broken down
- Describe the purpose of photosynthesis in living things
- Differentiate between characteristics of the light reactions (light dependent reactions) and the dark reactions (light independent reactions/Calvin cycle)
- Summarize the reactants and products of the photosynthesis reaction in words and chemical formulas
- Describe the structure of chloroplasts
- Define and provide examples of autotrophs and heterotrophs
- Explain how the processes of photosynthesis and cellular respiration are like a cycle



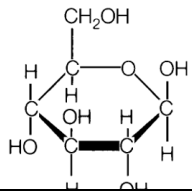
Cell Energy

- Define **Metabolism**: _____
- How do **photosynthesis** and **respiration** relate to metabolism? _____

Two Strategies for Obtaining Nutrients

- **Autotrophs** (auto = self; troph = referring to nutrients)
 Definition: _____
 Example Organisms: _____
- **Heterotrophs** (hetero = different)
 Definition: _____
 Example Organisms: _____

Photosynthesis:

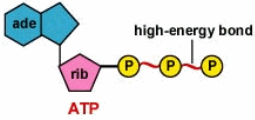
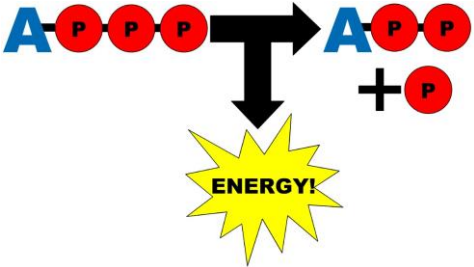
Happens In:	
Goal:	Convert _____ into _____ (glucose)
More Information:	Provide the chemical formula of glucose (a carbohydrate): _____  *What is the function of carbohydrates?* _____

Show the **Photosynthesis Equation** using words. Circle the reactants and box the products.

Show the **Photosynthesis Equation** using chemical formulas. Circle the reactants and box the products.

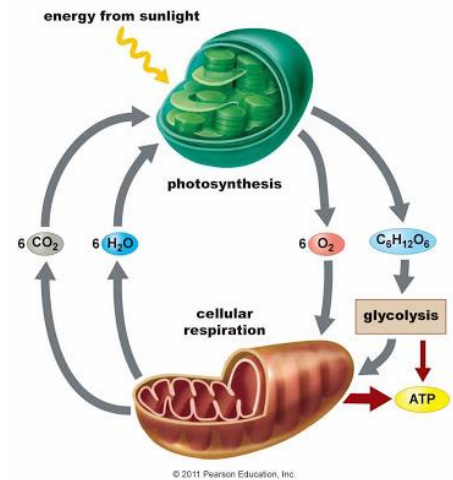
Why are there numbers (coefficients) in front of some of the molecules?

**Unit 4 (Cell Energy)
Cellular Respiration**

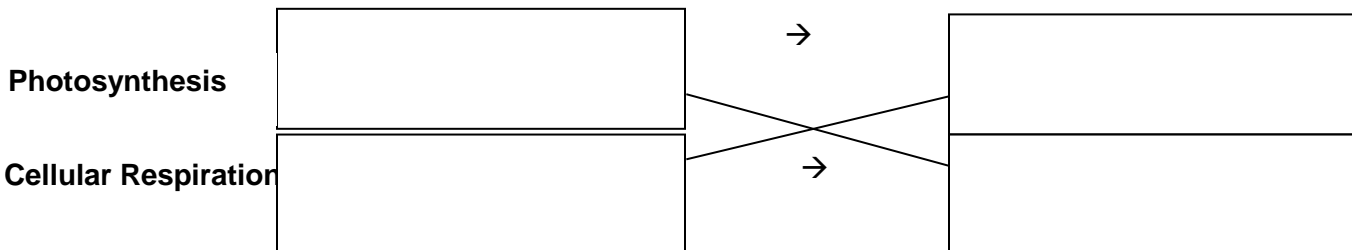
Happens In:	_____ AND _____ (_____)
Goal:	Convert _____ into _____
More Information:	<p>Provide the full name and structure of ATP</p> <p>Why is ATP used as the energy storage molecule?</p> <p>Explain how ATP is broken into ADP (Adenosine Diphosphate) and P (Phosphate)</p>  

Show the **Cellular Respiration** equation using words. Circle the reactants and box the products.

Show the **Cellular Respiration** equation using chemical formulas. Circle the reactants and box the products.



Explain how the photosynthesis and cellular respiration equations **relate** to one another in the space below:



Unit 4 (Cell Energy)

Photosynthesis

- Where on the **plant** does photosynthesis take place? What are **stomata**?

Photosynthesis Location: _____

Stomata: _____

- Where in the **cell** does photosynthesis take place?

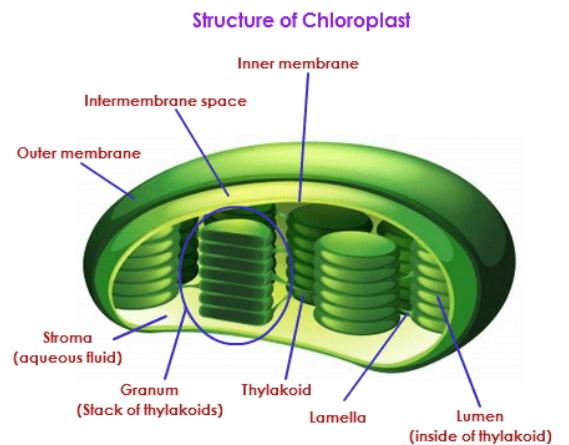
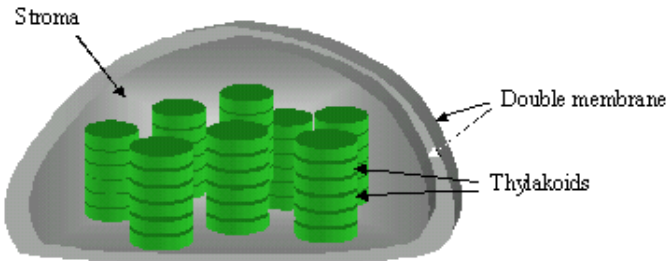
Organelle: _____

- What are the **two main processes** involved in photosynthesis?

1. _____
2. _____

Chloroplasts

- _____ are stacked to form _____
- _____ take place in the thylakoid membrane
- _____ take place in the stroma



Part 1: Light Reactions

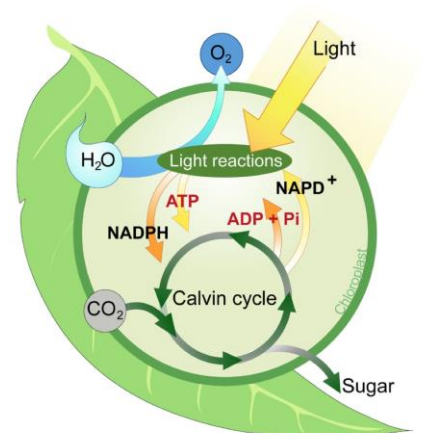
Purpose	
Location in Organelle	
Requirements for process to occur	

****what is NADP+?** _____

How does NADP+ get converted to NADPH (electron carrier)?

Reactants for Light Reactions:

Products from Light Reactions:



Unit 4 (Cell Energy)

Part 2: Calvin Cycle

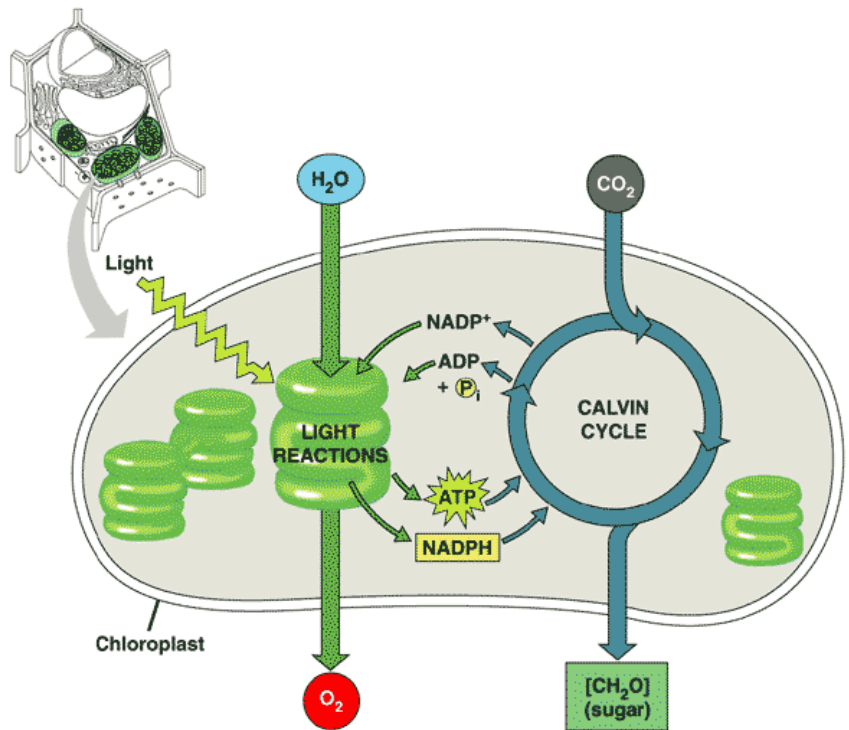
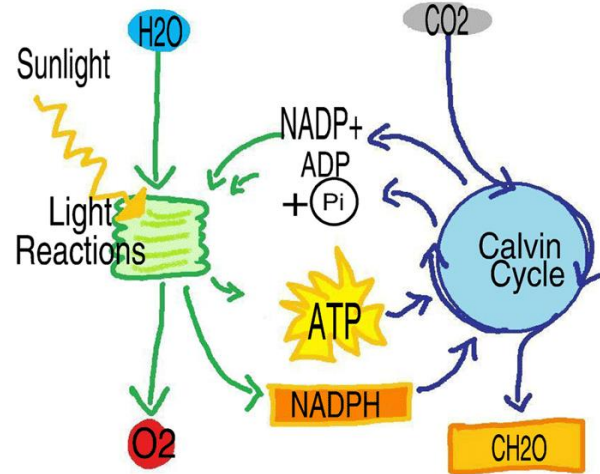
Purpose	Produce _____ from CO ₂
Location in Organelle	
Requirements for process to occur <i>Does not require light directly, but does need products from light reactions!</i>	

Reactants for Calvin Cycle:

Products from Calvin Cycle:

How are **excited electrons and ATP** from the light reactions used in the Calvin Cycle?

What factors affect the **rate (speed)** of photosynthesis? *Explain how these factors play a role.*



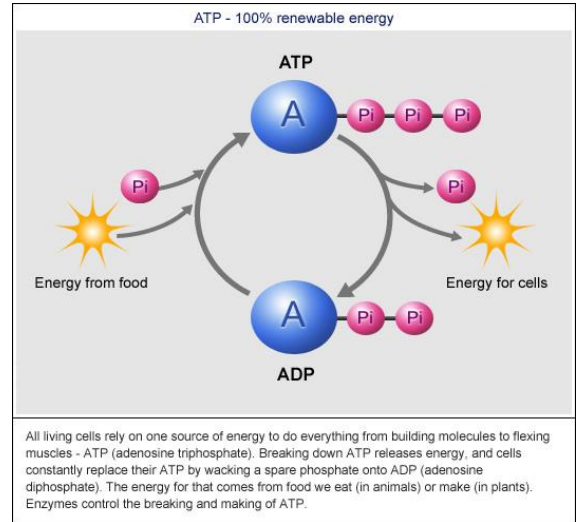
Unit 4 (Cell Energy)

[[Language Targets for Topic 1: I can compare and contrast ATP and ADP molecules; I can write the main purpose of photosynthesis in living organisms; I can describe photosynthesis in detail with the associated sub processes using proper vocabulary terms; I can write the equation for photosynthesis in words and chemical symbols; I can label the parts of a chloroplast on a diagram; I can differentiate between and provide examples of autotrophs and heterotrophs; I can create a flow chart to diagram the processes of photosynthesis and cellular respiration to show the interrelatedness.]]

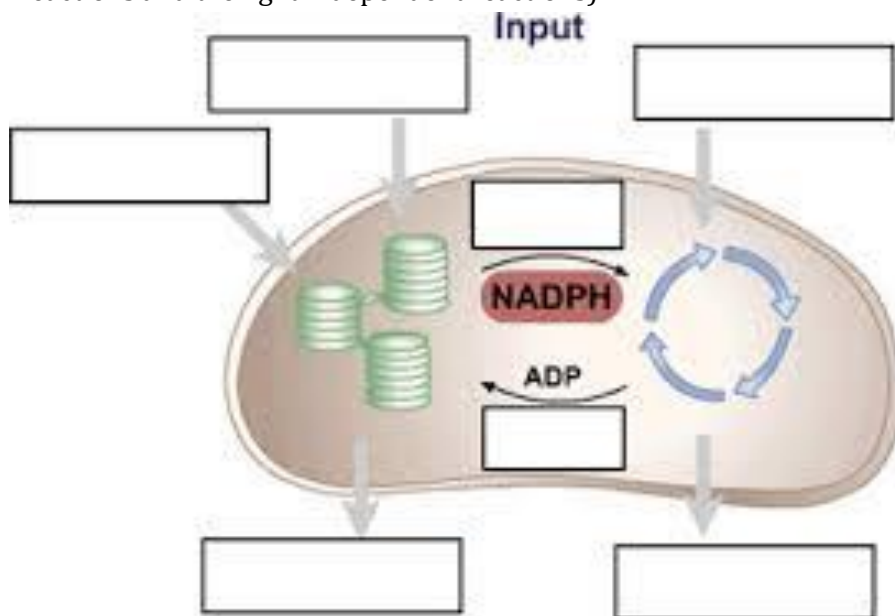
- How are ATP and ADP similar? Discuss what they are made of:

- How are they different?

- Which one contains energy the cell can use? _____
- Not all organisms undergo the process of photosynthesis, but all organisms rely on what is produced in this series of chemical reactions. In autotrophs, what is the purpose of photosynthesis?



- Provide the equation for photosynthesis in both ways: words & chemical formula:
 Words: _____
 Equation: _____
- Label the chloroplast diagram AND illustrate the entire process of photosynthesis (outlining both the light reactions and the light independent reactions):



Which components make up the light reactions?

Which components make up the light independent reactions?

- Define the terms autotroph and heterotroph. Provide examples of each:
 Autotroph: _____
 Heterotroph: _____

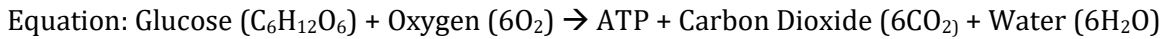
Unit 4 (Cell Energy)

Unit 4 Topic 2: Cellular Respiration

By the end of this topic, you should be able to...

- Describe the purpose of cellular respiration in living organisms
- Compare and contrast glycolysis, Krebs's Cycle, and the electron transport chain
- Summarize the reactants and products of the cellular respiration reaction in words and chemical formulas
- Describe the structure of the mitochondria

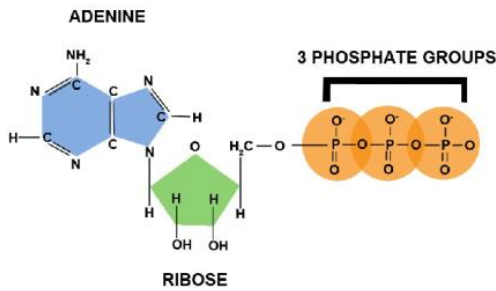
Cellular Respiration: *the process through which cells obtain usable energy (ATP)*



- Where does this process take place in *eukaryotes*? _____
- Where does this process take place in *prokaryotes*? _____
- The goal of cellular respiration is to produce _____ from _____
- What are the three main processes that take place in cell respiration?
 1. _____
 2. _____
 3. _____

ATP (Adenosine Triphosphate)

- Where is energy stored in this molecule? _____



Where in the molecule to the left is the highest energy bond? _____

How is energy released from this molecule? _____

The Mitochondria

Mitochondria Structural Features

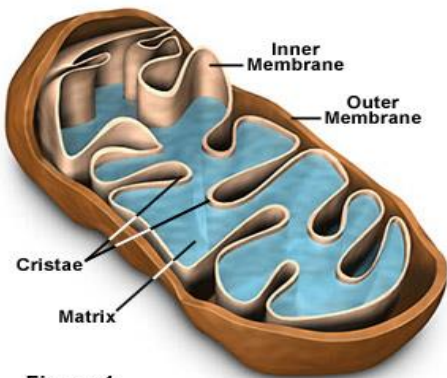
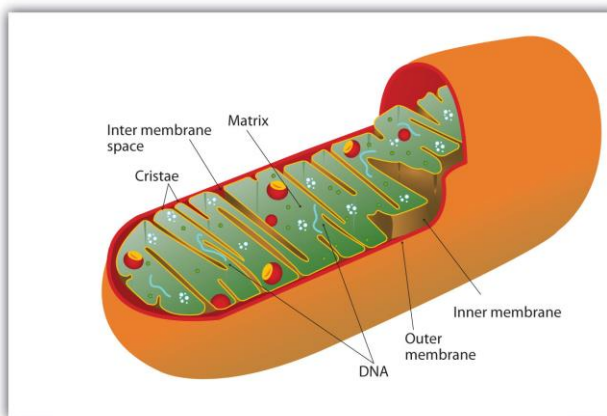


Figure 1



Notice the folds of the inner membrane. Why are these folds important?

The three steps of cellular respiration and where they take place:

Process	Location

**Unit 4 (Cell Energy)
Two Types of Respiration**

Aerobic	Anaerobic
With _____	Without _____
Makes _____ of ATP	Makes _____ ATP
Includes all three processes	Includes _____

Aerobic Cellular Respiration

Part I: Glycolysis

Purpose: Break _____ down into two smaller molecules called _____ (3C) and send electrons to the Electron Transport Chain (ETC)

Occurs in: Aerobic AND anaerobic respiration

Location: _____ of cell

Reactants: _____

Products: _____, _____ (electron carrier), and _____ (4 are produced, but 2 were used to start the process so the gain is TWO molecules)

Part II: Kreb's Cycle (aka Citric Acid Cycle)

Purpose: Pyruvate (3C) is broken down into _____, and electrons are sent to the ETC (via electron carriers)

Occurs in: _____ respiration ONLY

Location: _____ (of mitochondria)

Reactants: _____ (and CoA/coenzyme A)

Products: _____ (electron carrier), _____, and _____ (waste)

Part III: Electron Transport Chain (ETC)

Purpose: Electrons (e-) from _____ are passed to the FINAL electron acceptor, _____, to produce _____

- The enzyme ATP synthase is important here as it is responsible for producing large amounts of ATP

Occurs in: _____ respiration ONLY

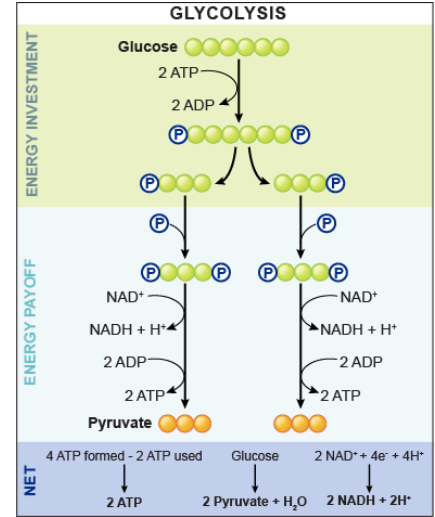
Location: _____ (mitochondria- remember, the folds increase surface area)

Reactants: _____

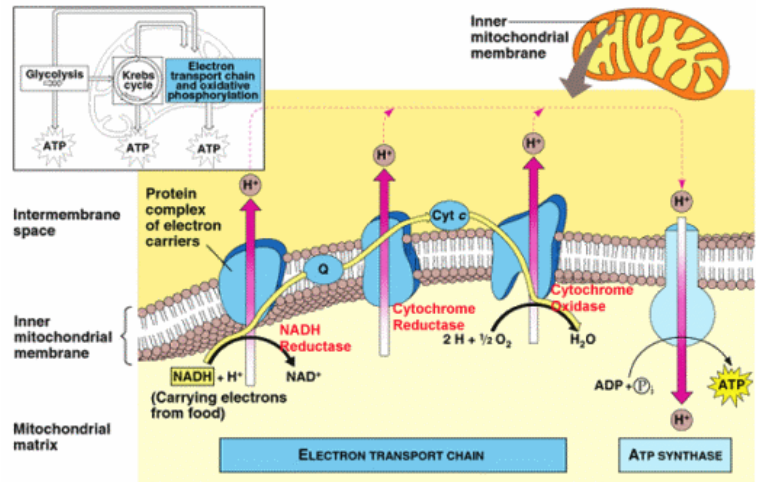
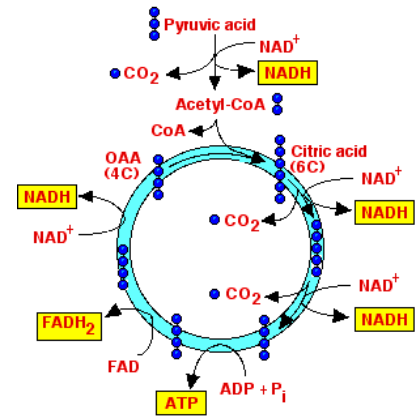
Products: _____ (waste), _____

Energy Yield

Glycolysis	___ ATP
Kreb's Cycle	___ ATP
ETC	___ ATP
TOTAL # ATP:	_____

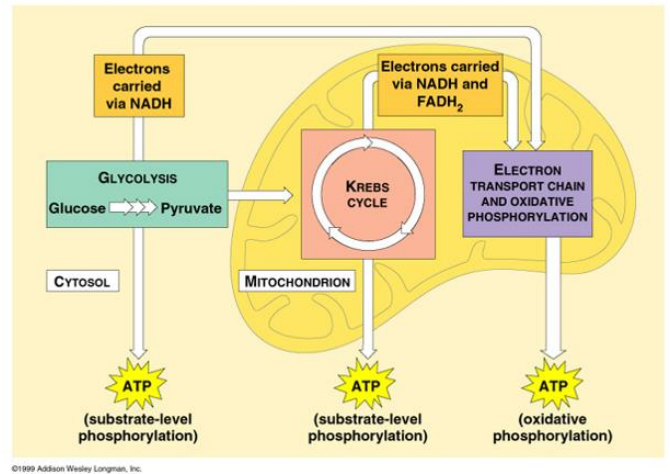


Krebs Cycle (Citric Acid Cycle)



Unit 4 (Cell Energy)

All of this ATP is produced during **AEROBIC** cellular respiration. However, sometimes there is not enough oxygen to carry out this process. When that happens, cellular respiration occurs in the absence of oxygen (think about when you work out and you develop cramps!). This is called anaerobic cellular respiration, or fermentation.



Anaerobic Respiration (fermentation)

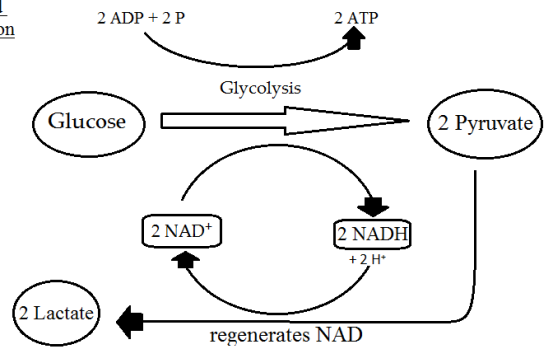
- _____ only (occurs where in the cell? _____)
- Occurs in the absence of _____
- Goal: break _____ down
 - Produce _____ fewer ATP than in aerobic respiration
- Two types: _____ and _____

Lactic Acid Fermentation

- Happens in : _____
- What is produced in addition to ATP?

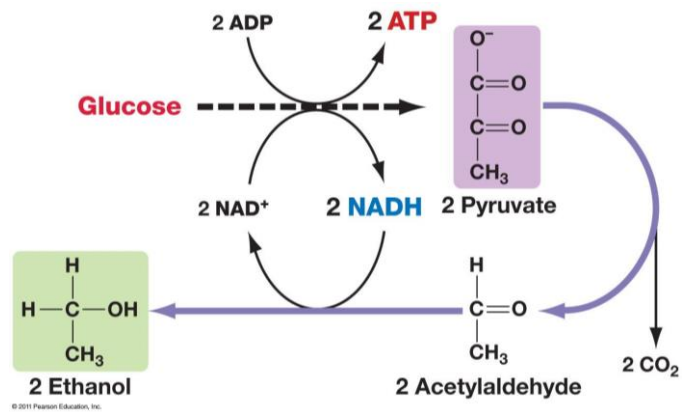
- Examples in everyday life: muscle cells during exercise, yogurt, pickles

Lactic Acid Fermentation



Alcoholic Fermentation

- Happens in: _____
- Produces _____, and ATP
- Examples in everyday life: yeast (causes bread to rise)



Unit 4 (Cell Energy)

[[Language Targets for Topic 2: I can write the main purpose of cellular respiration in living organisms; I can describe cellular respiration in detail with the associated sub processes using proper vocabulary terms; I can write the equation for cellular respiration in words and chemical symbols; I can label the parts of a mitochondria on a diagram; I can create a flow chart to diagram the processes of photosynthesis and cellular respiration to show the interrelatedness.]]

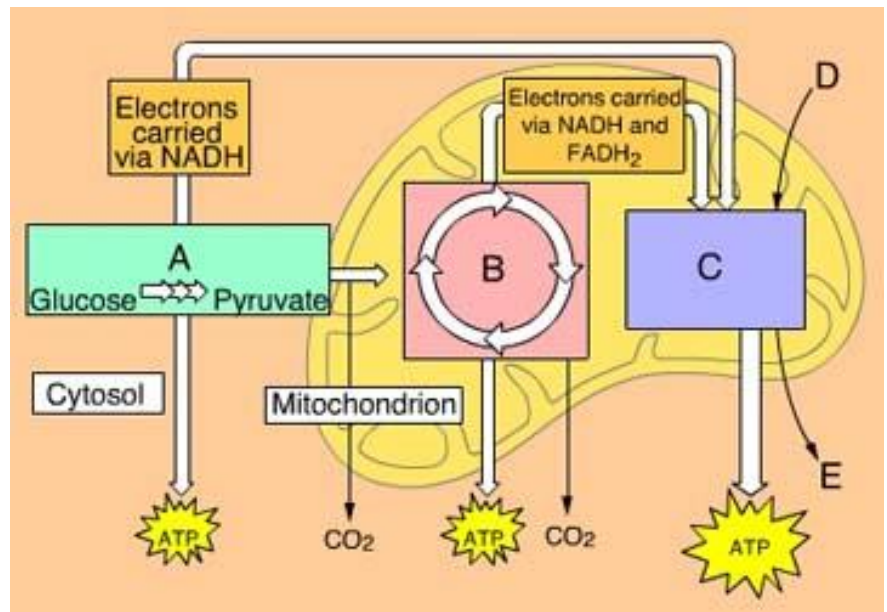
1. Unlike photosynthesis (where not all organisms carry out the process), ALL organisms undergo cellular respiration. Why? Include the purpose of cellular respiration in your response:

2. Provide the equation for cellular respiration in both ways (words & chemical formula):

Words: _____

Equation: _____

3. Label the missing components (A-E) in the mitochondria diagram AND highlight the steps of cellular respiration by including the number of ATP molecules produced in each step:



4. Complete the flowchart linking this unit together: **Word Bank:** Mitochondria, Chloroplast, Photosynthesis, Cellular Respiration, Solar Energy (SUN), ATP, 6CO₂, 6H₂O, C₆H₁₂O₆, 6O₂

CELL ENERGY CHART

