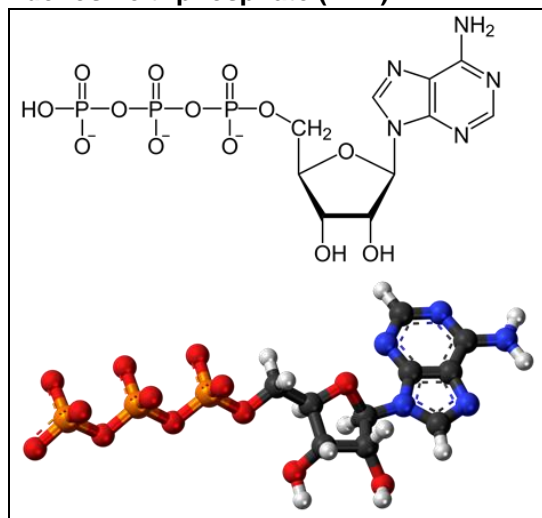


Cellular Energy and Metabolism

Adenosine triphosphate (ATP)



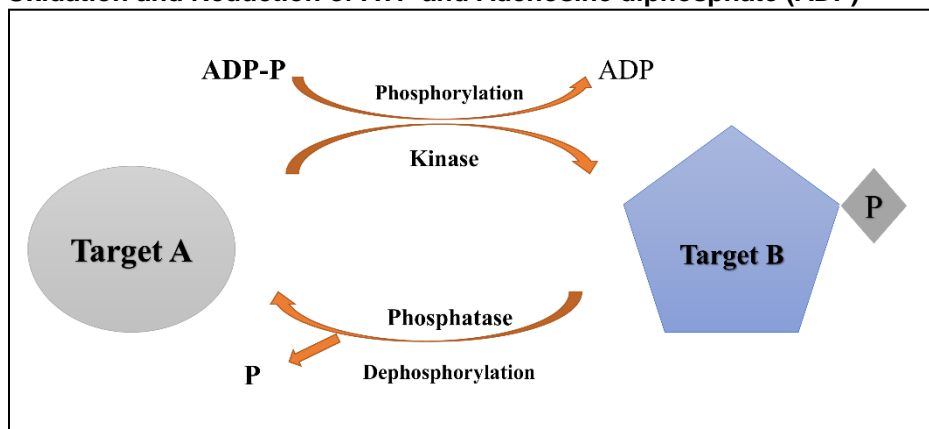
Composed of three (3) groups:

This serves as the currency of cells for energy expenditure and use and contains high-energy (energy that is reduced easily during chemical reactions) bonds in the phosphate tail. This is due to them repelling each other and causing them to be unstable in nature.

Figure 1. Adenosine triphosphate (ATP)

Sources: <http://creative-proteomics.com> and <http://biologydictionary.net>

Oxidation and Reduction of ATP and Adenosine diphosphate (ADP)



Phosphorylation: Reaction produces energy a.k.a. Exergonic reaction

Dephosphorylation: Reaction requires energy a.k.a. Endergonic reaction

Figure 2. ATP-ADP Cycle

Source: *Malaria Parasite Kinome-Phosphatome Resource*

Phosphorylation is the cleavage of a phosphate group from ATP which produces copious amounts of energy (which is utilized by metabolic activities of the cell) and leaves behind adenosine diphosphate and a lone phosphate group. The cleaved phosphate group is now referred to as inorganic phosphate (P_i). Once the energy produced by dephosphorylation is consumed, the inorganic phosphate is released by the target cell that utilized it. Using energy produced from other metabolic activities, the lone phosphate group is reattached to ADP to form ATP. This creates the ATP-ADP cycle.

How and Where is ATP Utilized: Metabolic Pathways

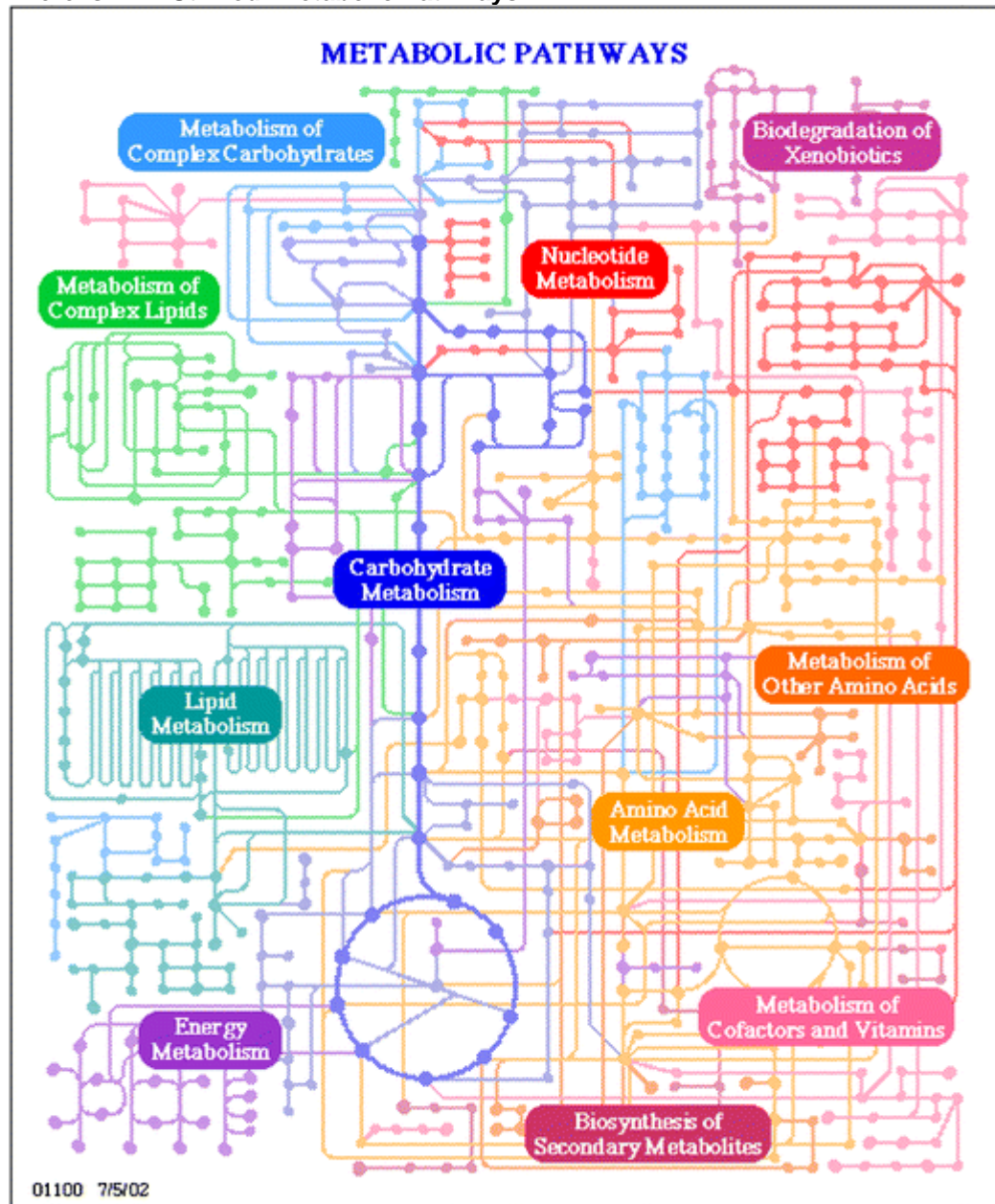


Figure 3. Metabolic Pathways of the Cell

Source: <https://link.springer.com>

Metabolic pathways are chemical reactions and processes that occur within the cell. Its products and reactants maintain the cells structure, function, and viability. Metabolic pathways require the expenditure and production of energy, and often require the assistance of specialized proteins known as enzymes that serve as catalysts and speed up the reaction.

How is Energy Produced: Cellular Respiration

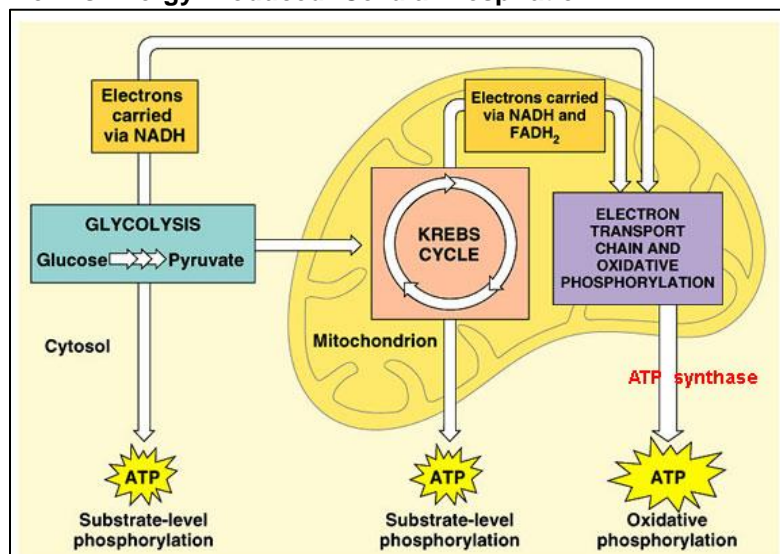


Figure 4. Cellular Respiration Overview
Source: Biology, 2018

Consists of three (3) major processes

Stage 1. _____
Occurs in the _____

Stage 2. _____
Occurs in the _____

Stage 3. _____
Occurs in the _____

Stage 1: Glycolysis

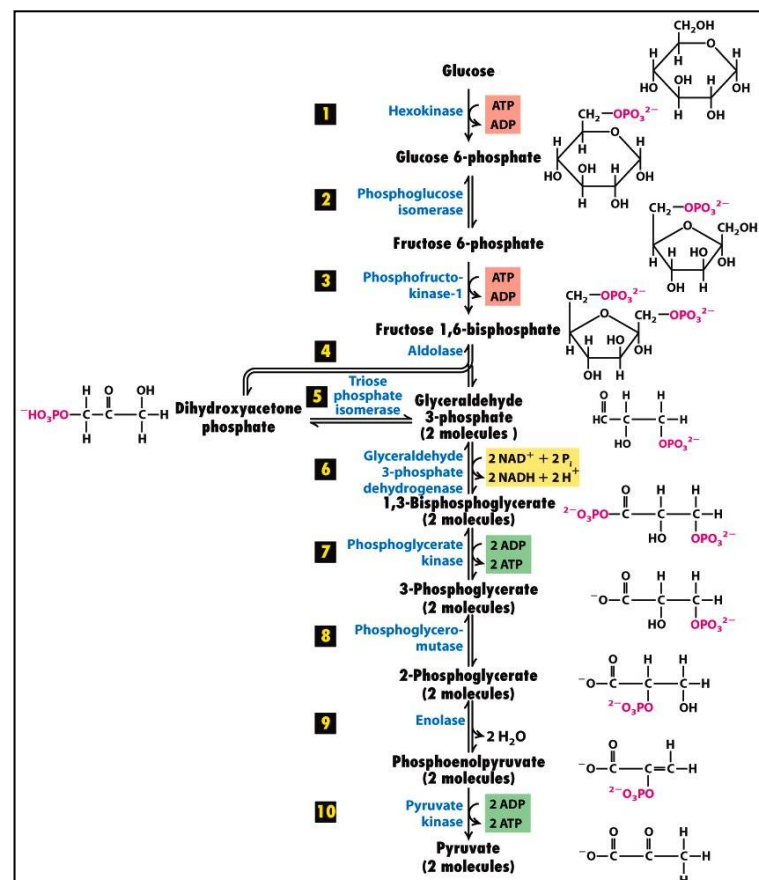


Figure 5. Glycolysis: Splitting of Glucose
Source: Biological Sciences, 2008

Net products of Glycolysis:

There are six (6) key transition molecules from the transformation of glucose (6-carbon) into pyruvate (2-carbon).

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

These are relevant because they are the products formed after an input/output of energy, input/output of molecules, or a conformational change.

Stage 2: Krebs/Citric Acid/Tricarboxylic Acid Cycle

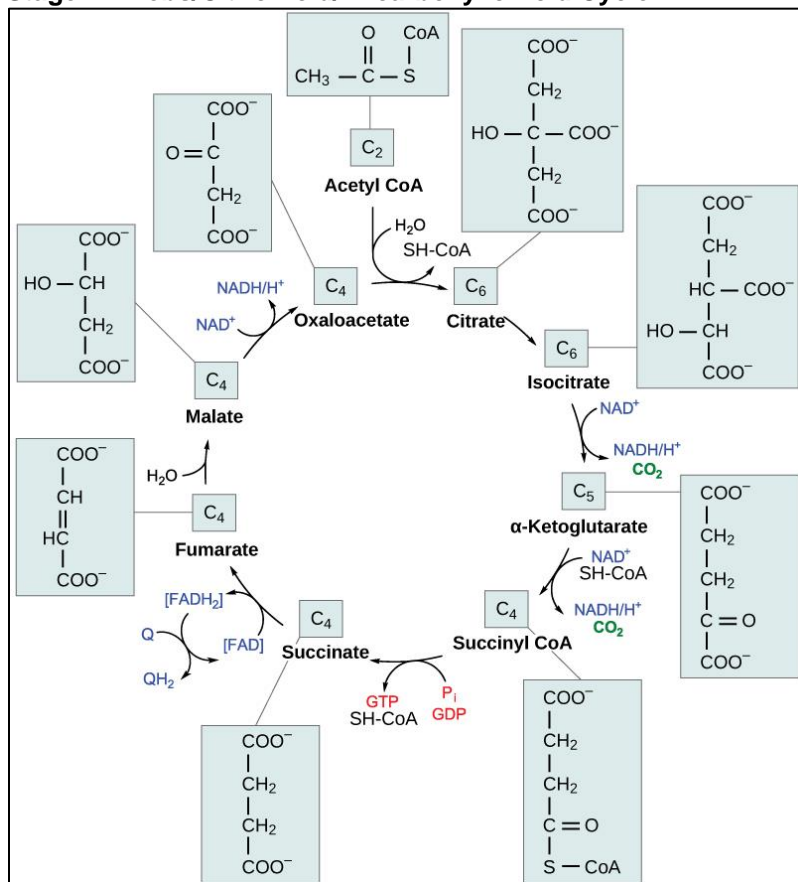


Figure 6. Krebs Cycle

Source: Biology, 2016

Name of the first 6-carbon molecule formed: _____

Precursor: _____

Cause of Formation: _____

By-products: _____

Name of the first 5-carbon molecule formed: _____

Precursor: _____

Cause of Formation: _____

By-products: _____

Name of the first 4-carbon molecule formed: _____

Precursor: _____

Cause of Formation: _____

By-products: _____

Main reason why Krebs Cycle is referred to as a cycle: _____

Molecules being recycled: _____

Net products: _____

Location of this process: _____

Stage 3: Electron Transport Chain (ETC) and Chemiosmosis

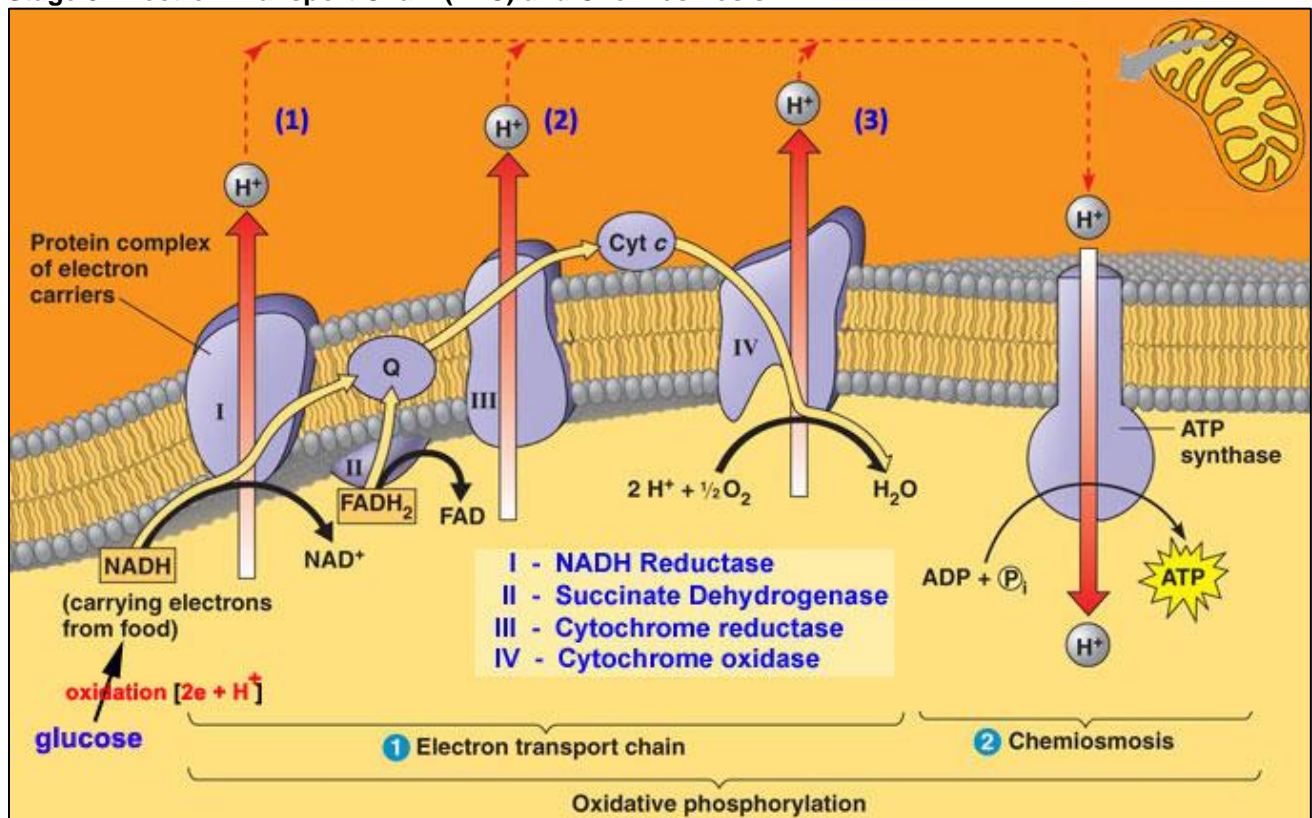


Figure 7. Electron Transport Chain and Chemiosmosis

Source: Biology, 2011

What is NAD, NADH, FAD, FADH₂? _____

Where were they utilized prior to the ETC? _____

Why is the ETC Important?

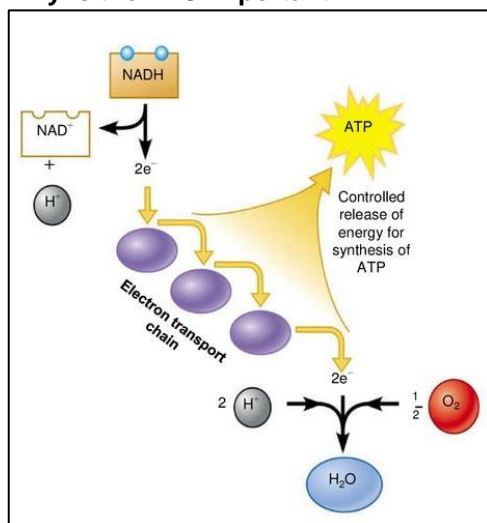


Figure 8. Controlled Release of Energy in the Electron Transport Chain

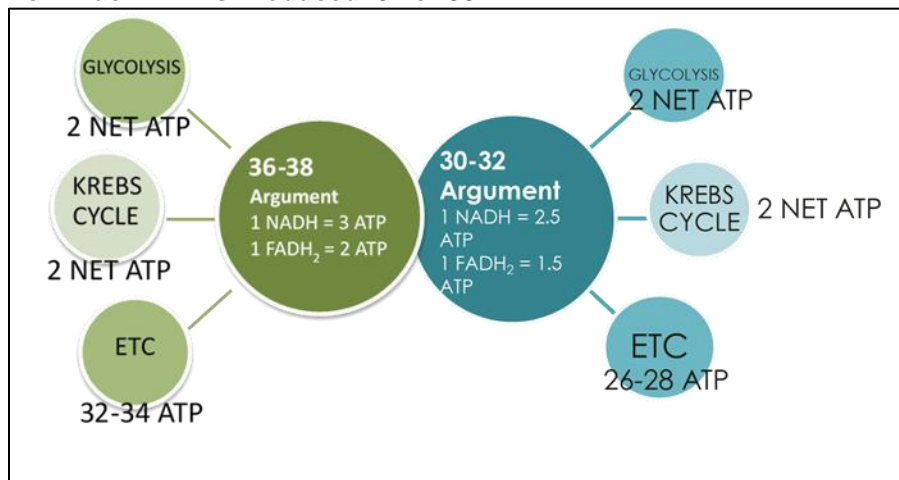
Source: Biology, 2018

Gradual and controlled release of energy

If energy is released in one (1) major reaction, it would cause the cell to _____

What is the final electron acceptor of chemiosmosis?

How Much ATP is Produced: 32 or 38?



What is the main difference between the two (2) arguments?

Which stage produces the highest number of ATP?

Where did NADH and FADH₂ come from?

Which stage produces the highest number of NADH and FADH₂?

Figure 9. Argument of 36 and 38 ATP produced

What Happens if Oxygen is Unavailable?

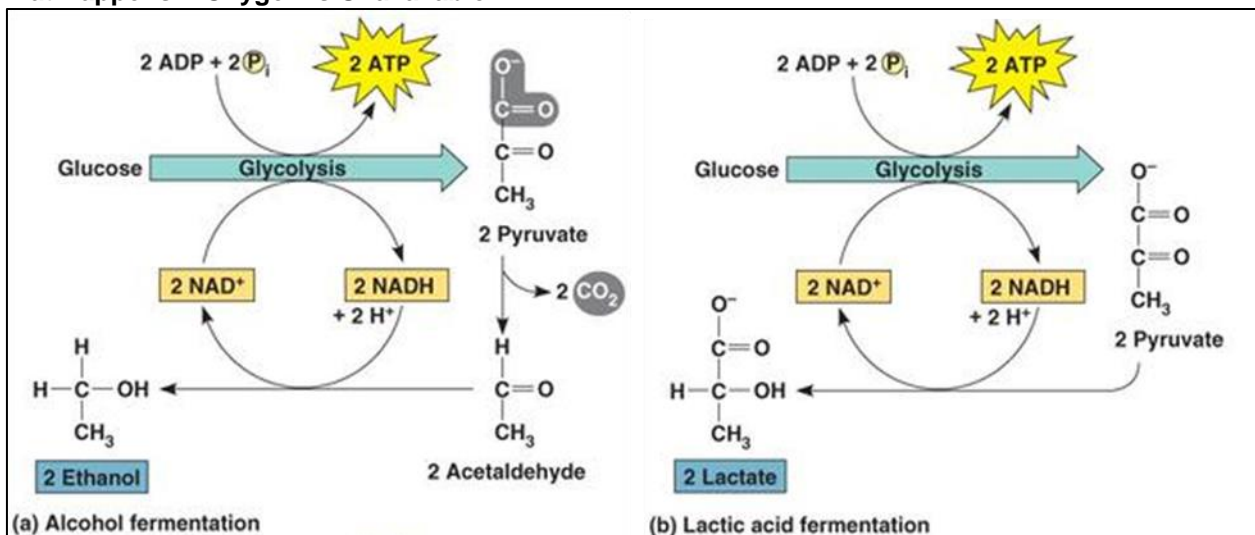


Figure 10. Pathways of Anaerobic Respiration

Source: Biology, 2008

Anaerobic respiration is used by brewing companies to produce beer, wine, and other forms of alcohol. Lactic acid, on the other hand, is the cause of muscle cramps during intense exercise.

Where Does the Fuel Come From? Photosynthesis

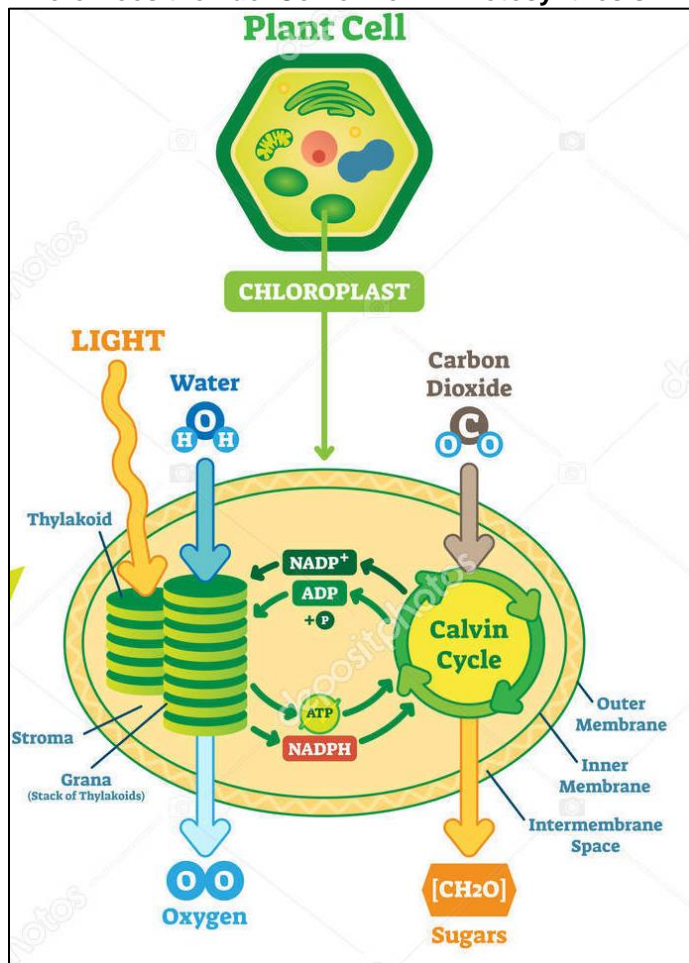


Figure 11. Overview of Photosynthesis

Source: <http://depositphotos.com>

What are the two (2) major processes of photosynthesis?

1. _____
2. _____

Which process takes place in the granum?

Which process takes place in the stroma?

Light-Dependent Reactions

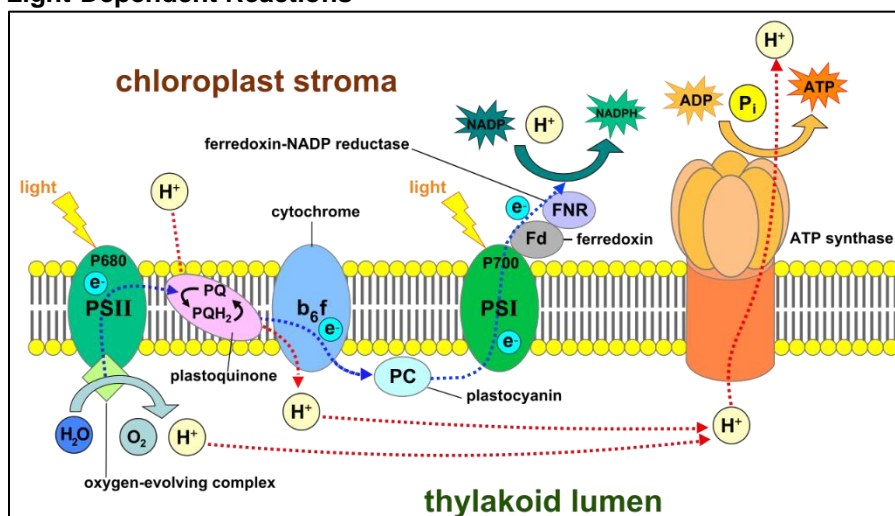


Figure 12. Light Dependent Reactions

Source: Wikipedia.org

Light Independent Reactions

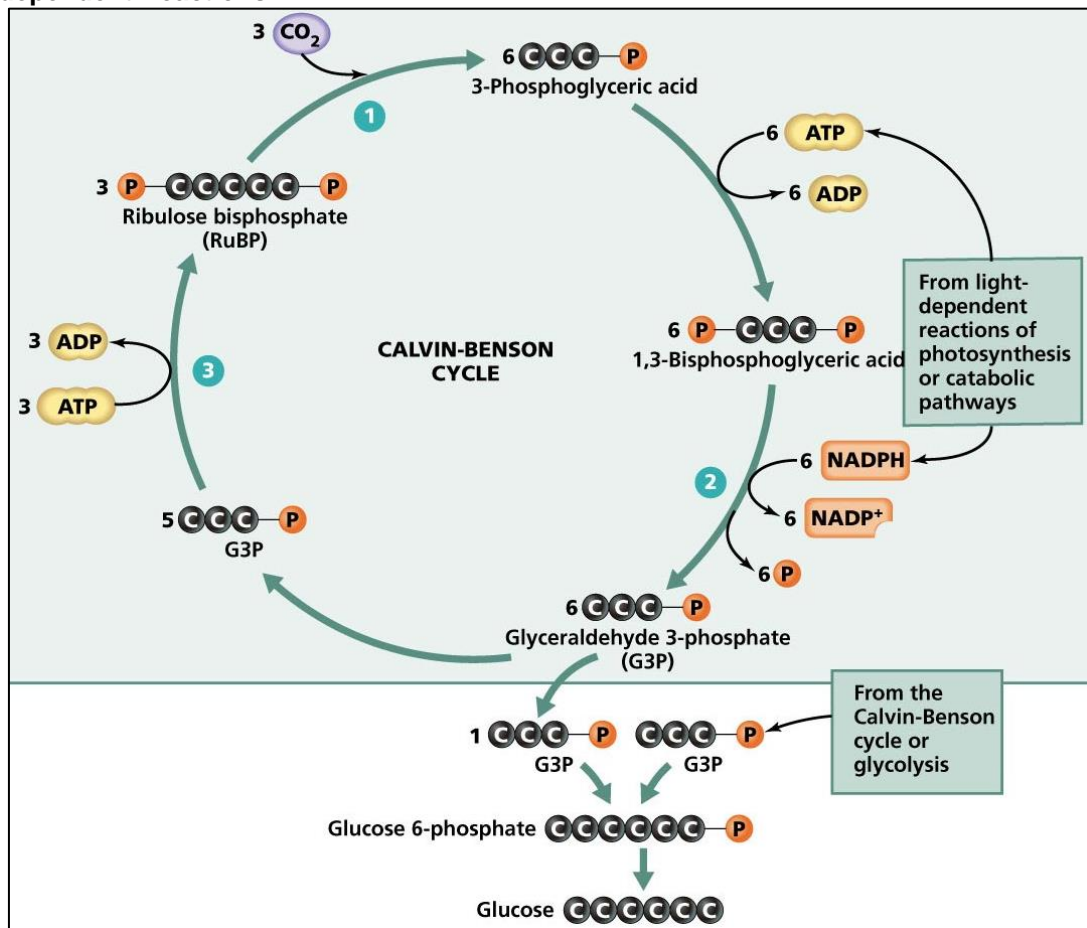


Figure 13. Light Independent Reactions: Calvin Cycle
Source: Biology, 2006

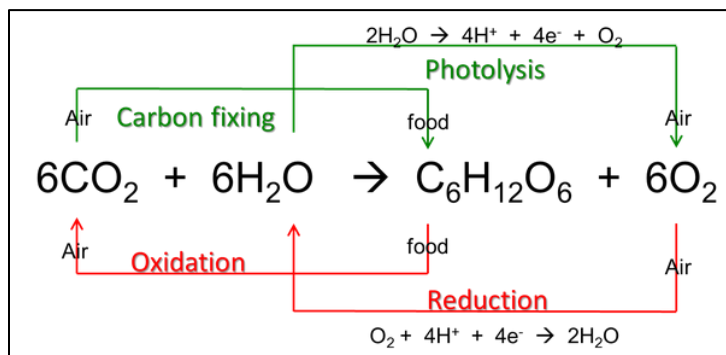


Figure 14. Formula and Relationship of Cellular Respiration and Photosynthesis
Source: <http://ui-ex.com/>

DEFINITIONS BOX

ATP	ADP
RedOx Reaction	Metabolic Pathway
Phosphorylation	Dephosphorylation
Hydrolysis	Inorganic Phosphate
Autotrophs	Heterotrophs
Cell Respiration	Photosynthesis
NAD	NADH
FAD	FADH
Endergonic	Exergonic