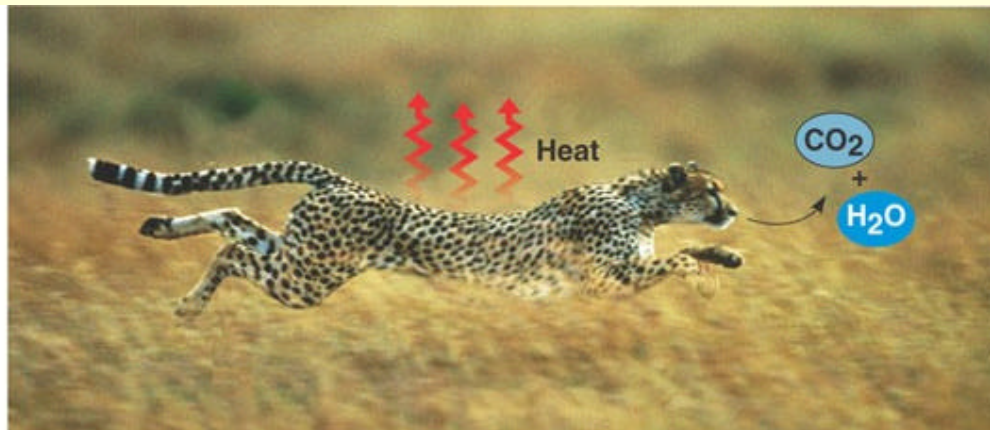
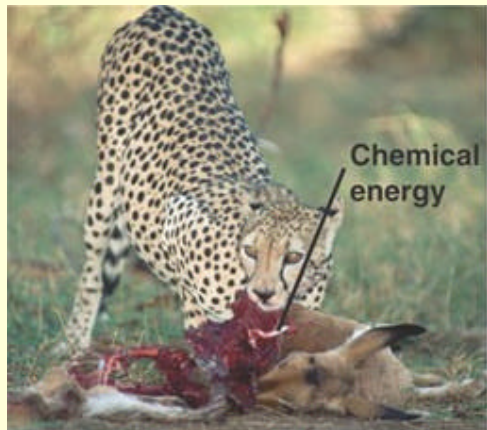


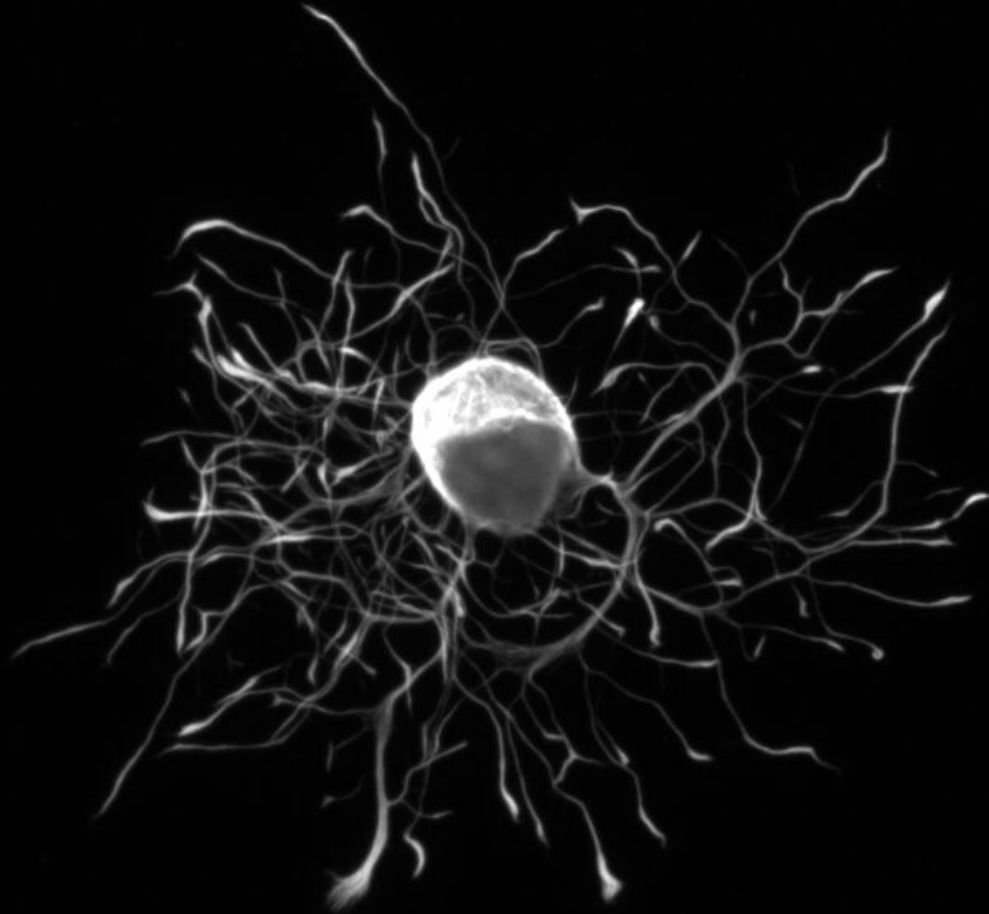
Energy and Metabolism



Energy and Metabolism



Energy and Cellular Work

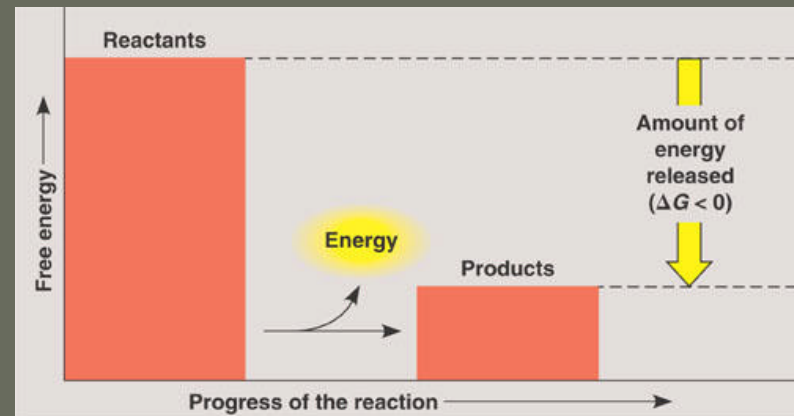


Eukaryotic Cell: Neuron

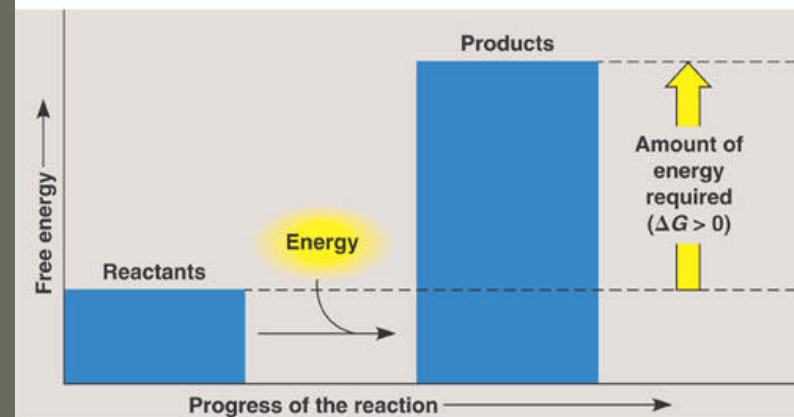
Energy and Metabolism

Endergonic and Exergonic Reactions

- When do our cells perform exergonic reactions?
- When do our cell perform endergonic reactions?

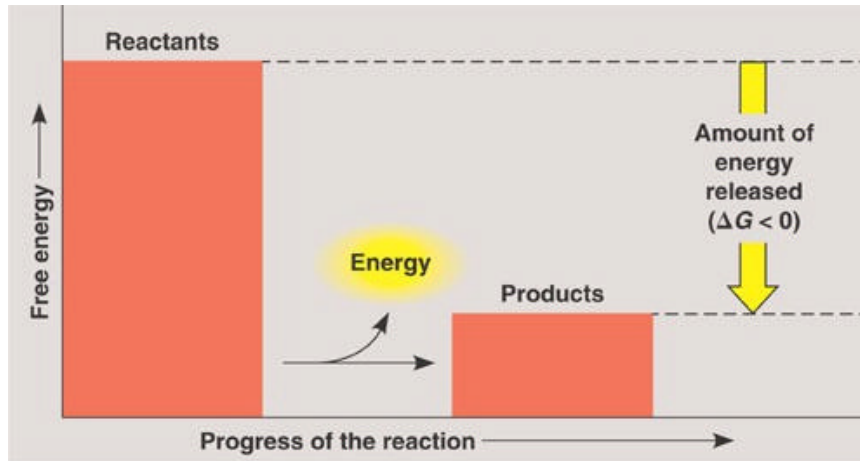


(a) Exergonic reaction: energy released



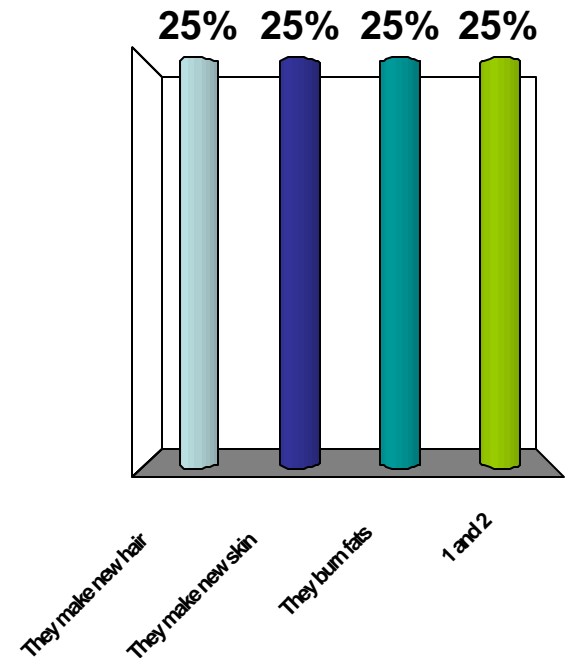
(b) Endergonic reaction: energy required

Our cells perform exergonic reactions when ...

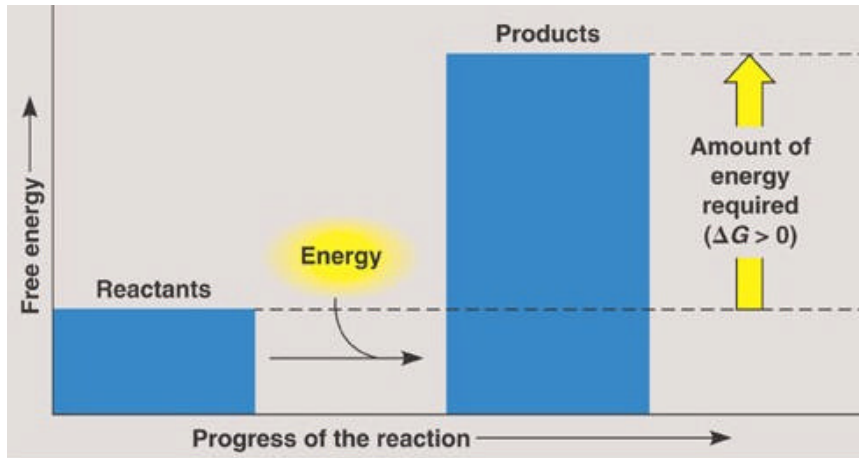


(a) Exergonic reaction: energy released

1. They make new hair
2. They make new skin
3. They burn fats
4. 1 and 2

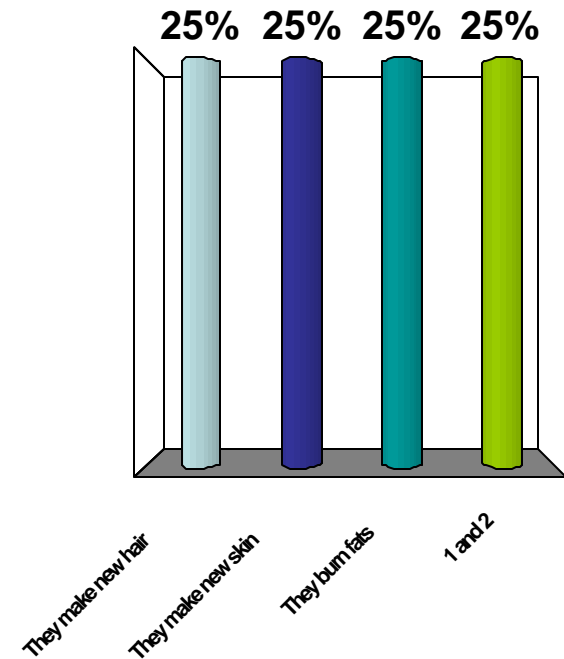


Our cells perform endergonic reactions when ...



b) Endergonic reaction: energy required

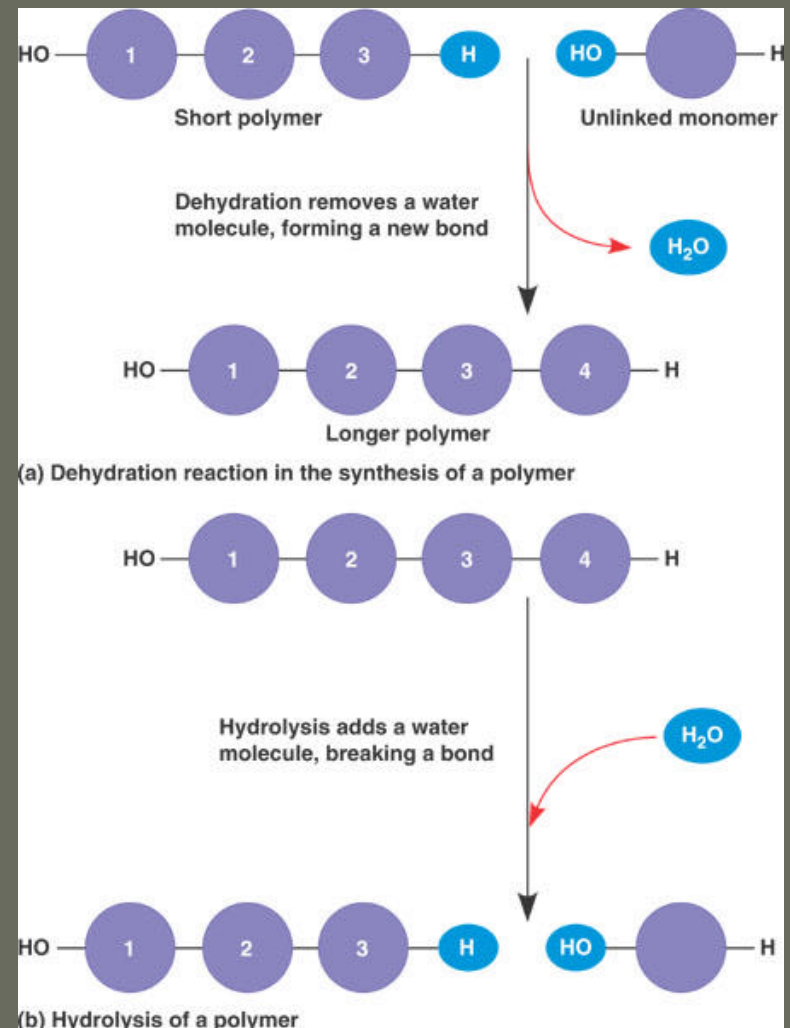
1. They make new hair
2. They make new skin
3. They burn fats
4. 1 and 2



Energy and Metabolism

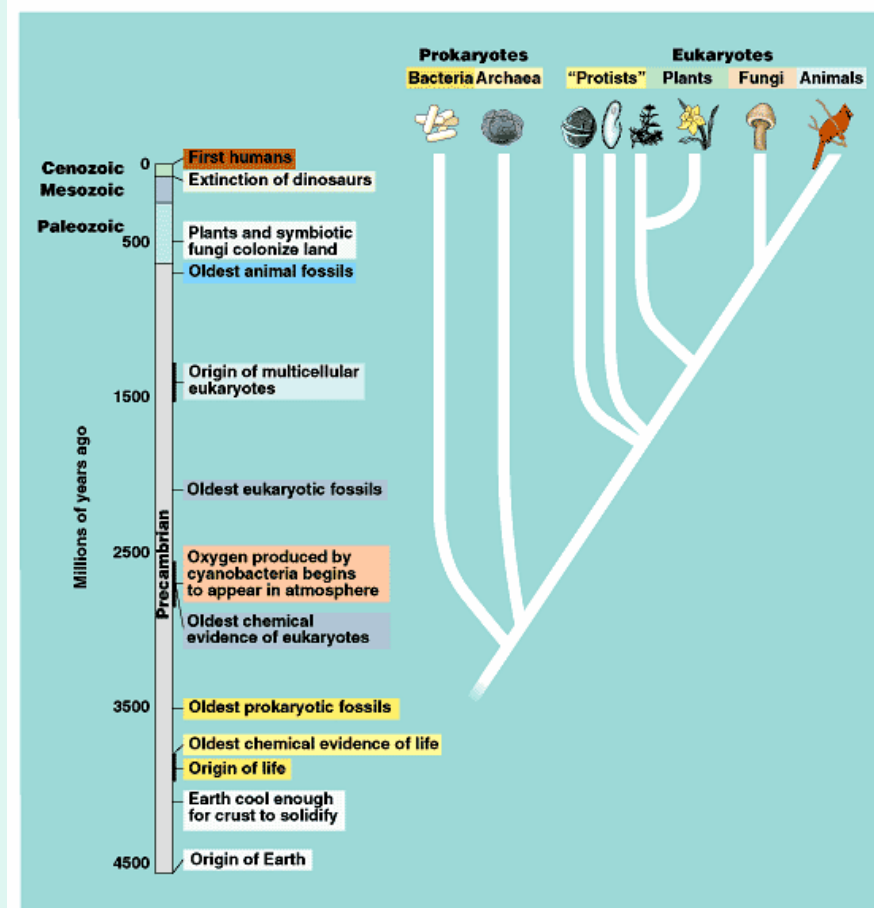
Biosynthetic and Degradative Pathways

- Biosynthetic Pathway: Anabolism
- Degradative Pathway: Catabolism



Energy and Metabolism

All Living Organisms Require Energy Sources



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The Flow of Energy or How Organisms Relate



Producers or Autotrophs (Photoautotrophs)



Consumers or Heterotrophs

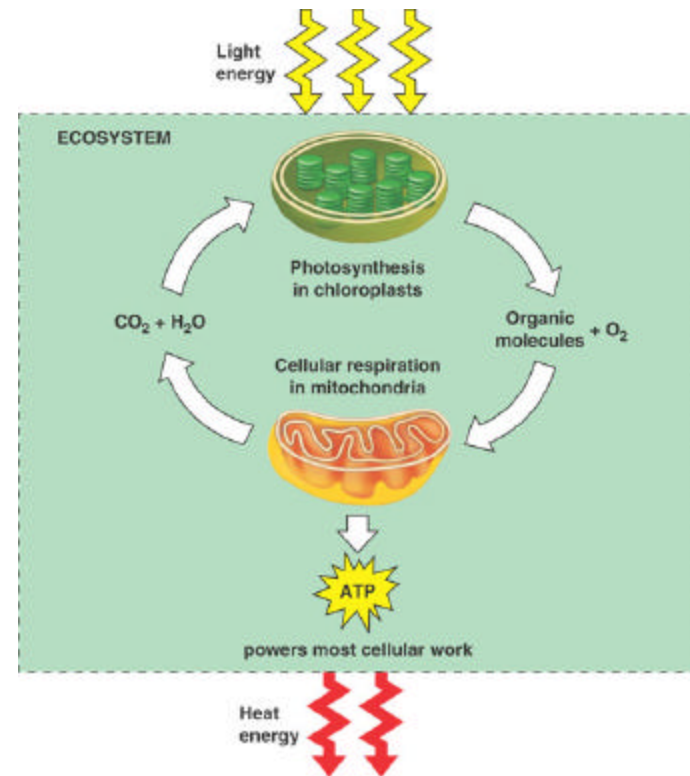


Decomposers



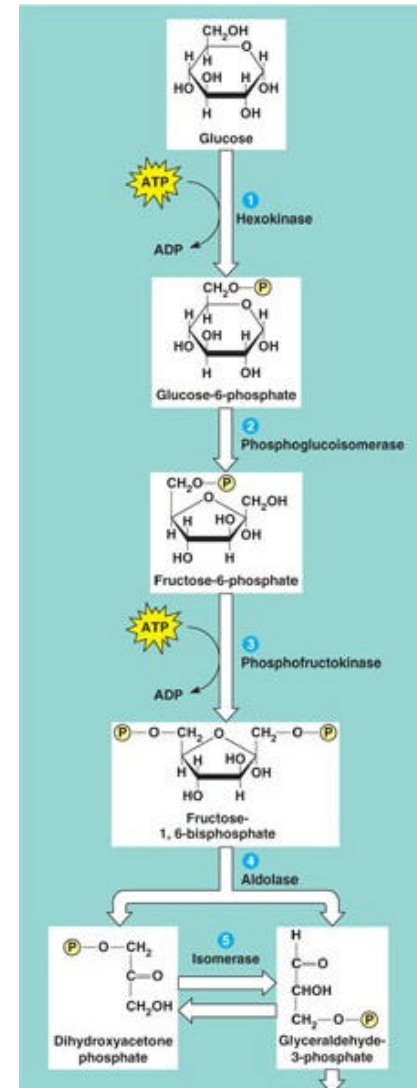
The Flow of Energy or How Organisms Relate

- Photoautotrophs synthesize high energy organic molecules during photosynthesis
- Both photoautotrophs and heterotrophs use such organic molecules to obtain energy (ATP) through cellular respiration for fueling cellular work

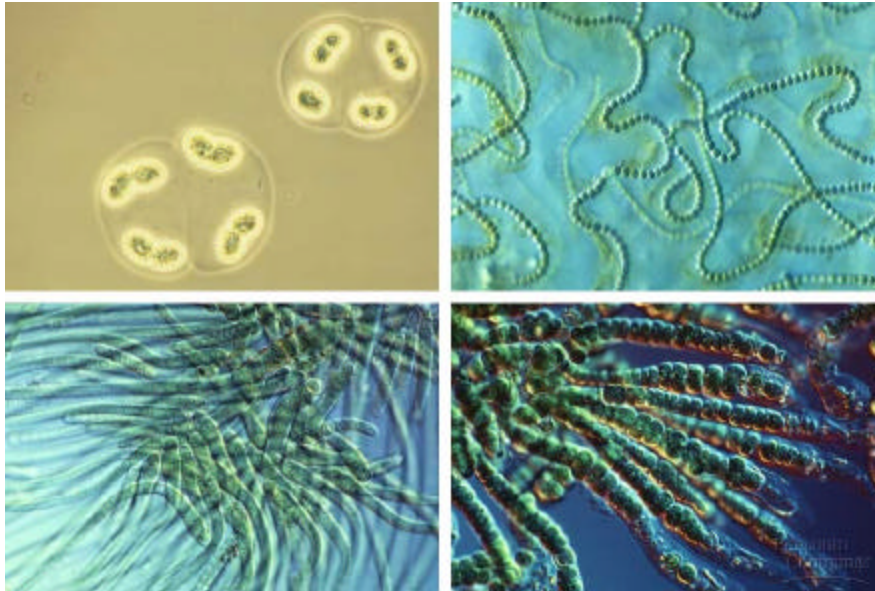


Participants in Metabolic Pathways

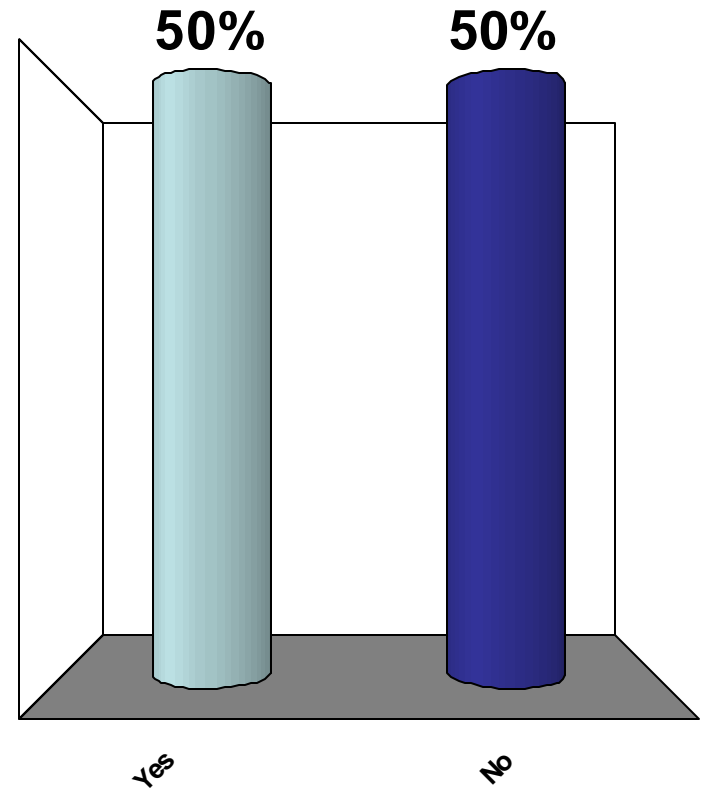
- Substrate:
- Intermediate Product(s):
- End Product(s):
- Enzymes:
- Energy Carriers:



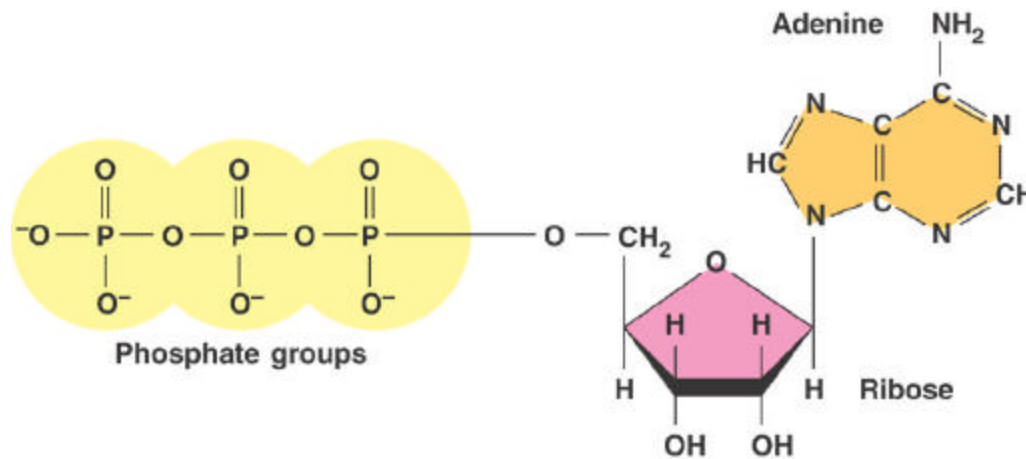
Photosynthetic bacteria are autotrophs because they have the ability to produce their own high energy organic compounds (food). Do you agree?



1. Yes
2. No

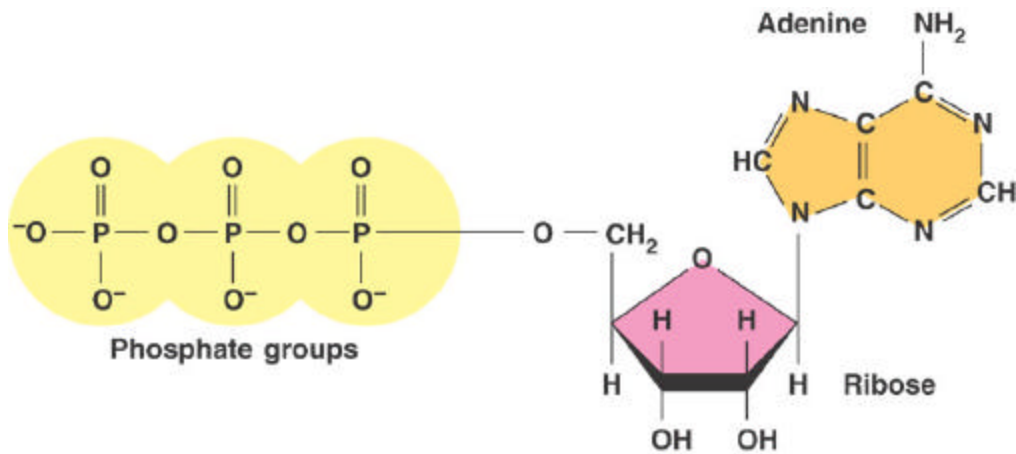


Adenosine 5'-triphosphate (ATP)

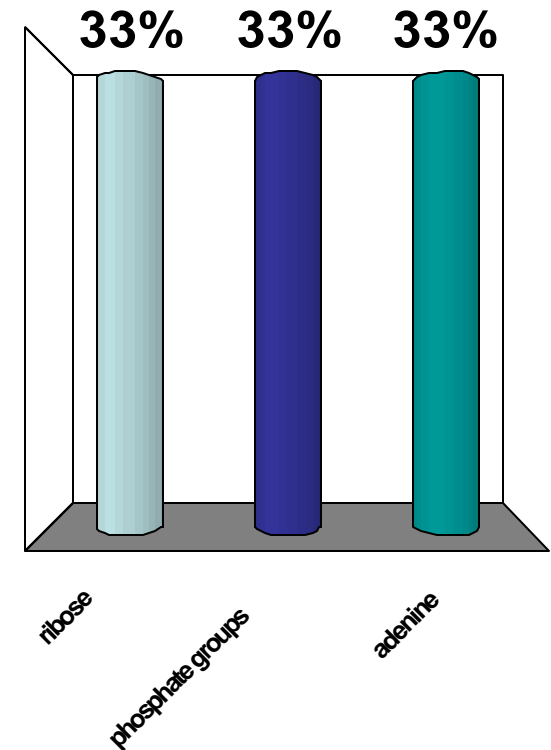


- What part of the molecule is the most electronegative?

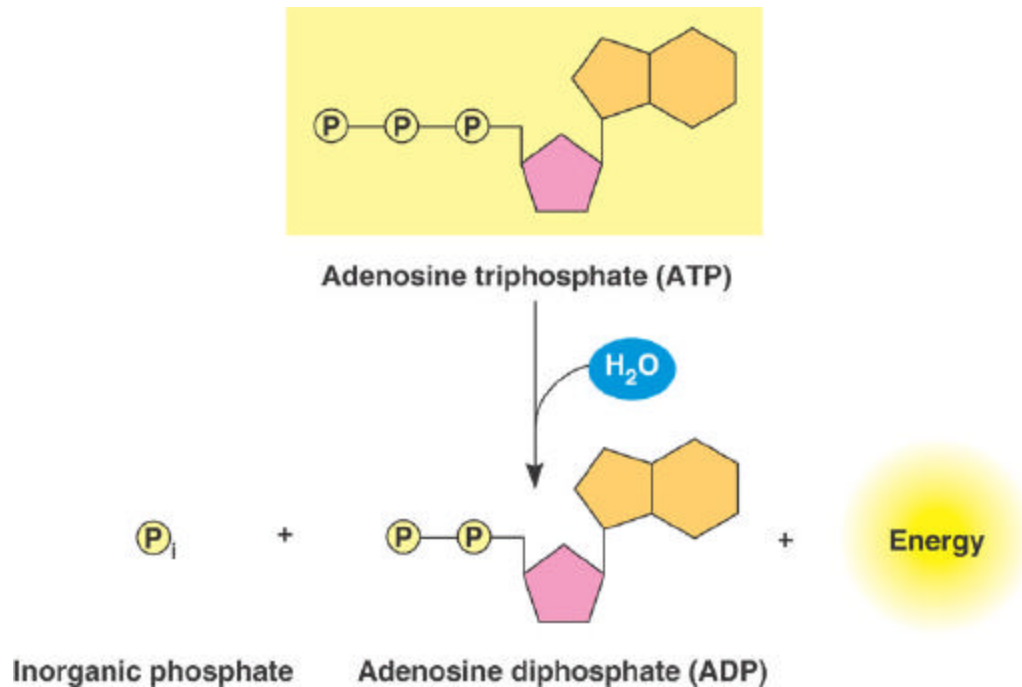
What part of the molecule is the most electronegative?



1. ribose
2. phosphate groups
3. adenine

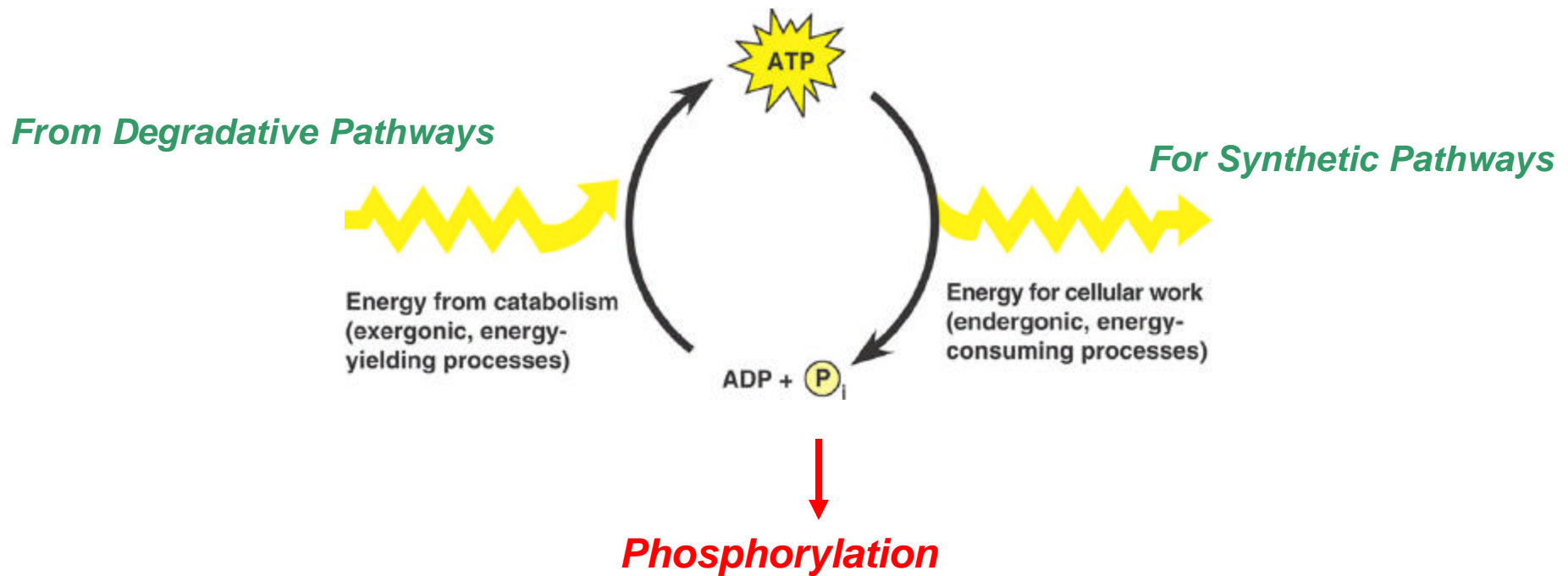


Hydrolysis of ATP into ADP



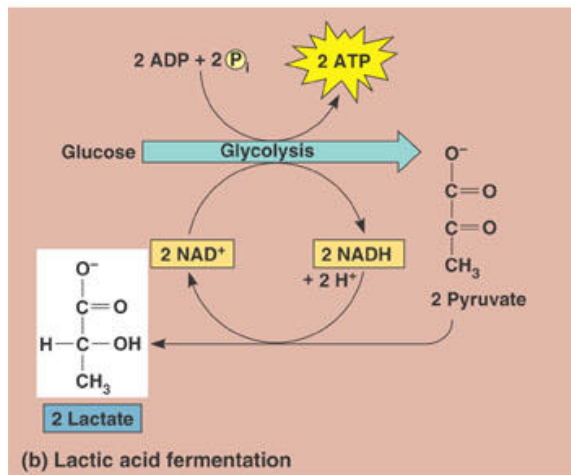
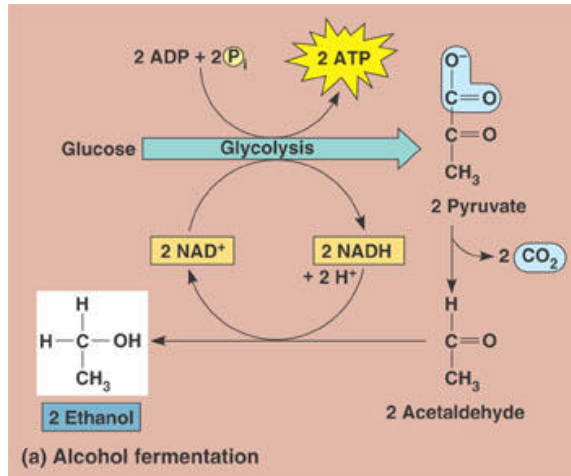
*Energy and inorganic phosphate are released.
What for?*

The ATP/ADP Cycle



Energy Releasing Pathways

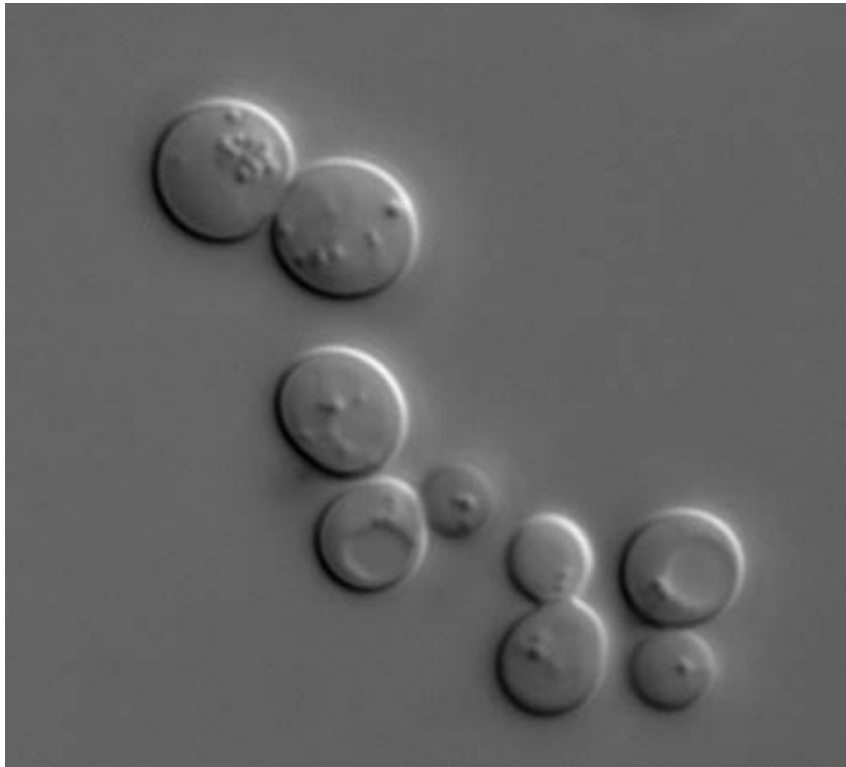
Fermentation



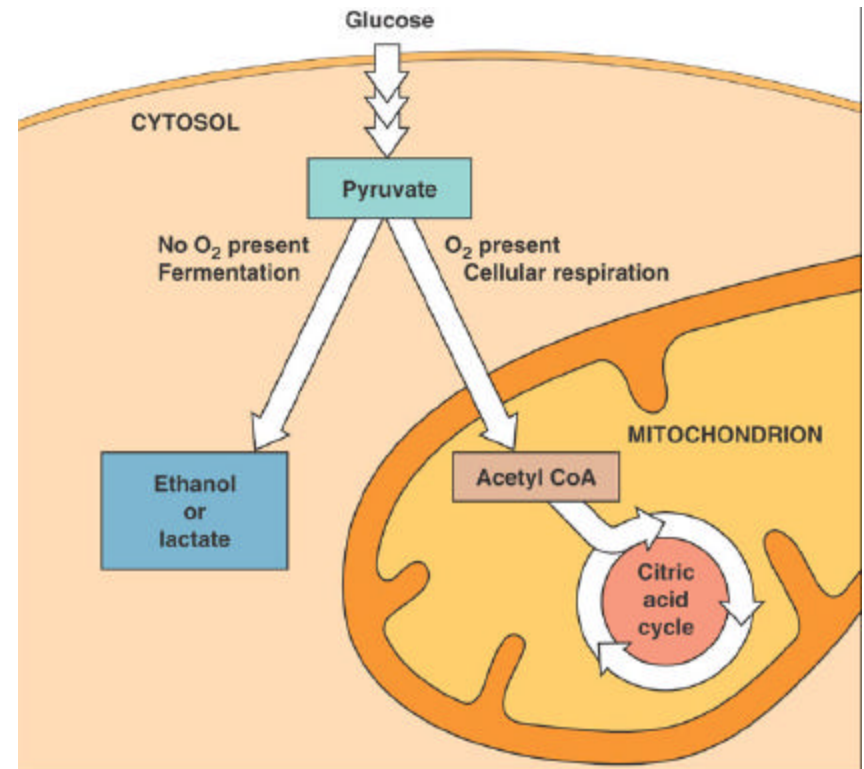
Fermentation (alcoholic and lactic): 2 ATP's produced. www.schmohz.com/beerinfo1.html

Energy Releasing Pathways

Fermentation



Yeast



Energy Releasing Pathways

Anaerobic Respiration

- Anaerobic Respiration: 2 ATP's produced.
- Commonly known diseases caused by anaerobic bacteria include gas **gangrene**, **tetanus**, and **botulism**. Nearly all dental infections are caused by anaerobic bacteria.
- Anaerobic bacteria can cause an infection when a normal barrier (such as skin, gums, or intestinal wall) is damaged due to surgery, injury, or disease. Body sites that have tissue destruction (necrosis) or a poor blood supply are low in oxygen and favor the growth of anaerobic bacteria.
- Anaerobic organisms perform anaerobic respiration



Energy Releasing Pathways

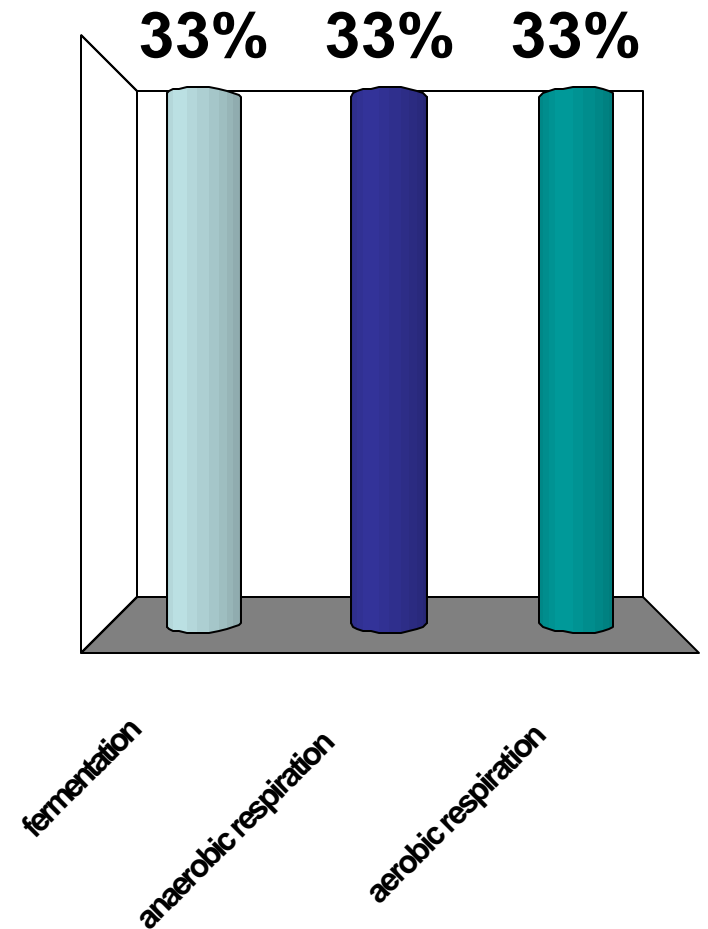
Aerobic Respiration

- Aerobic Respiration: approximately 36 ATP molecules produced
- Aerobic organisms perform aerobic respiration



Which one of the following is the most effective pathway for producing ATP?

1. fermentation
2. anaerobic respiration
3. aerobic respiration

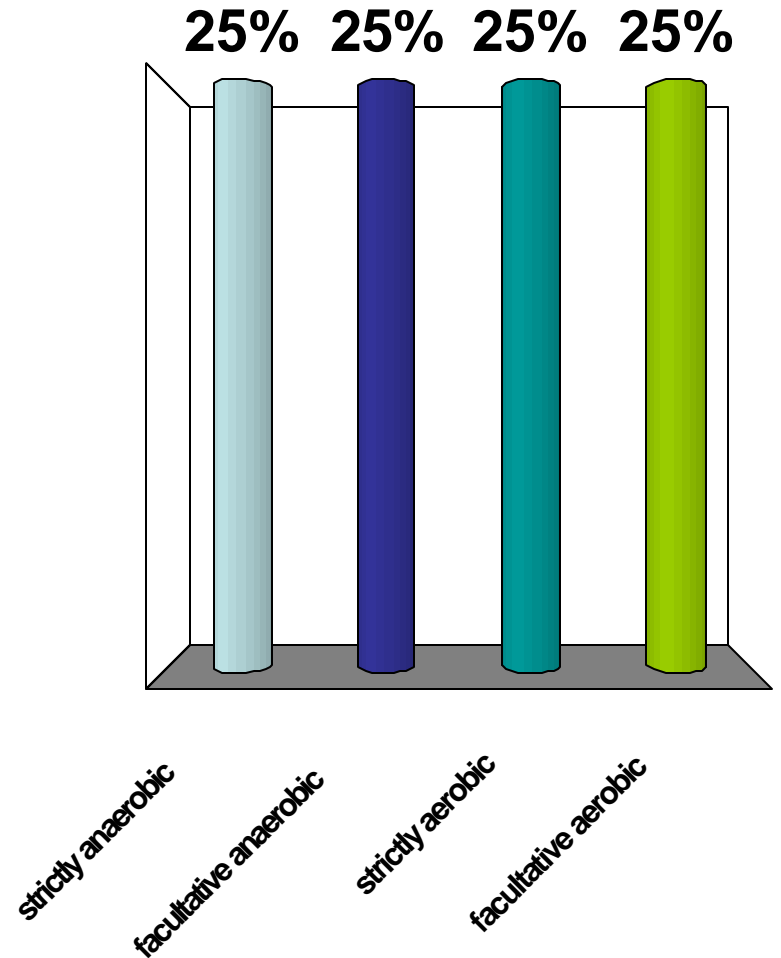


Depending on their oxygen needs, organisms are

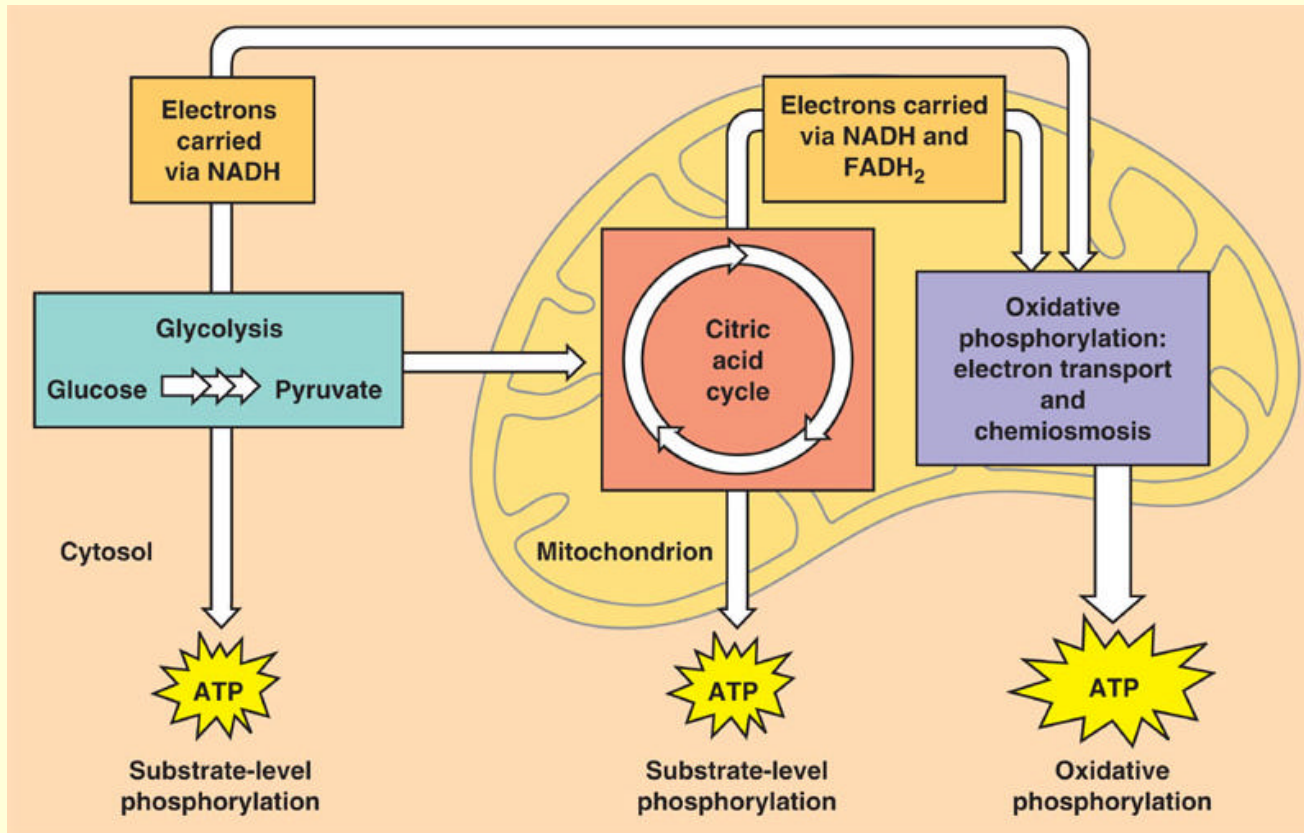
- Strictly Aerobic: require oxygen
- Facultative Aerobic
- Strictly Anaerobic: do not tolerate oxygen
- Facultative Anaerobic

Humans and plants are _____

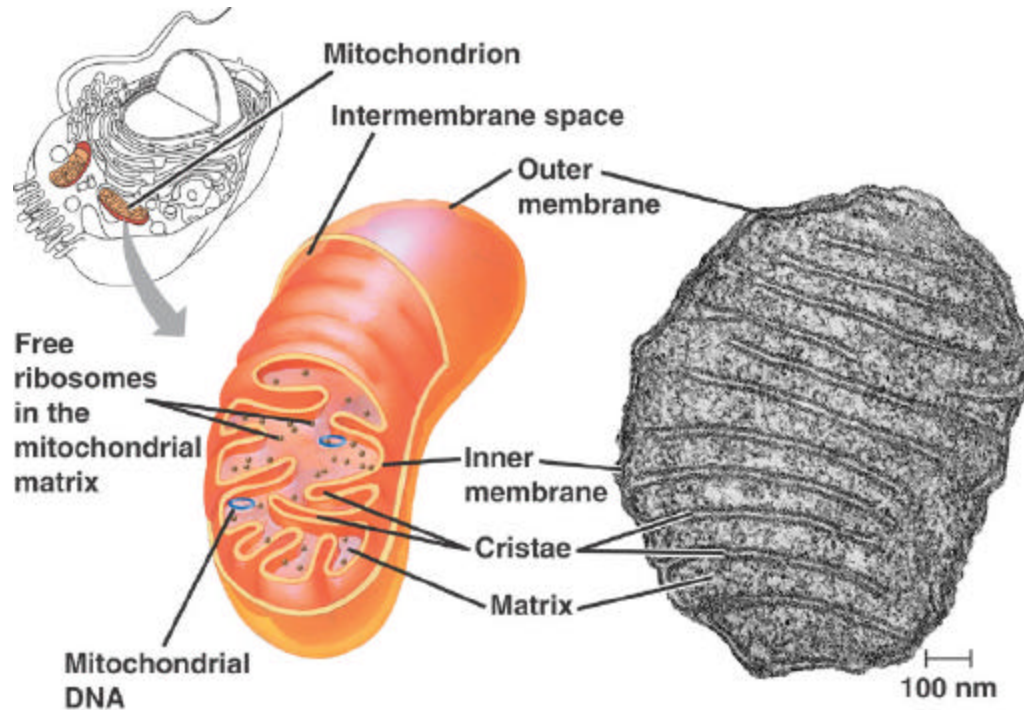
1. strictly anaerobic
2. facultative anaerobic
3. strictly aerobic
4. facultative aerobic



Steps of Aerobic Respiration

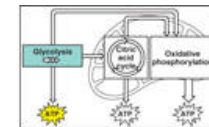
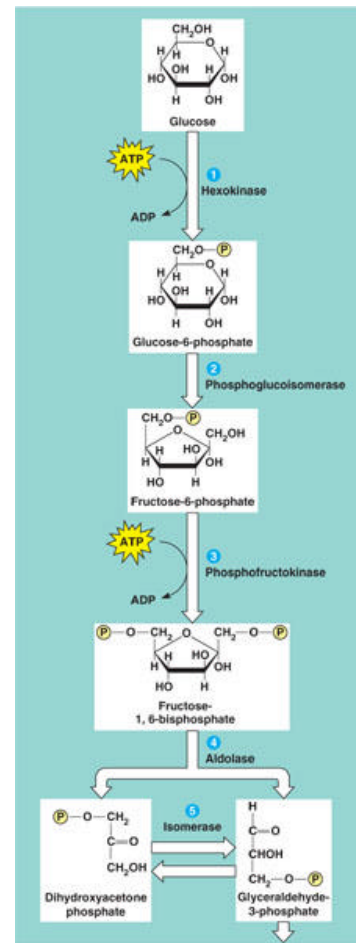


Where does aerobic respiration occur?



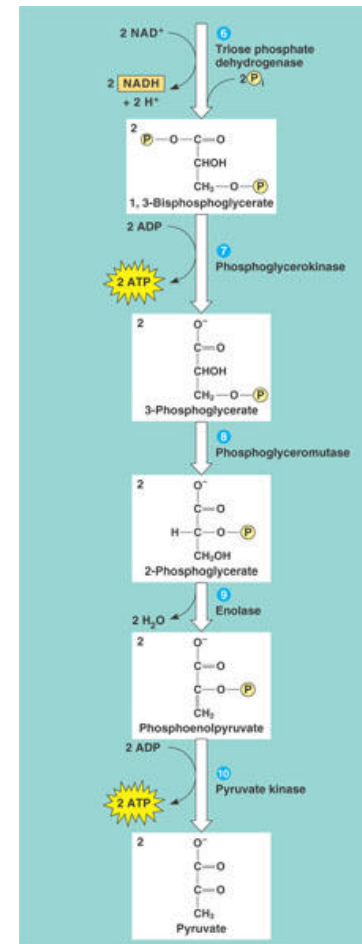
Steps of Aerobic Respiration: Glycolysis

- All organisms (anaerobic and aerobic) break down glucose through the process of glycolysis, which occurs in the cell's cytoplasm
- Only aerobic organisms process the products of glycolysis to obtain further amounts of ATP
- Glucose is actively transported into the cell and phosphorylated (step 1), process that turns on glycolysis



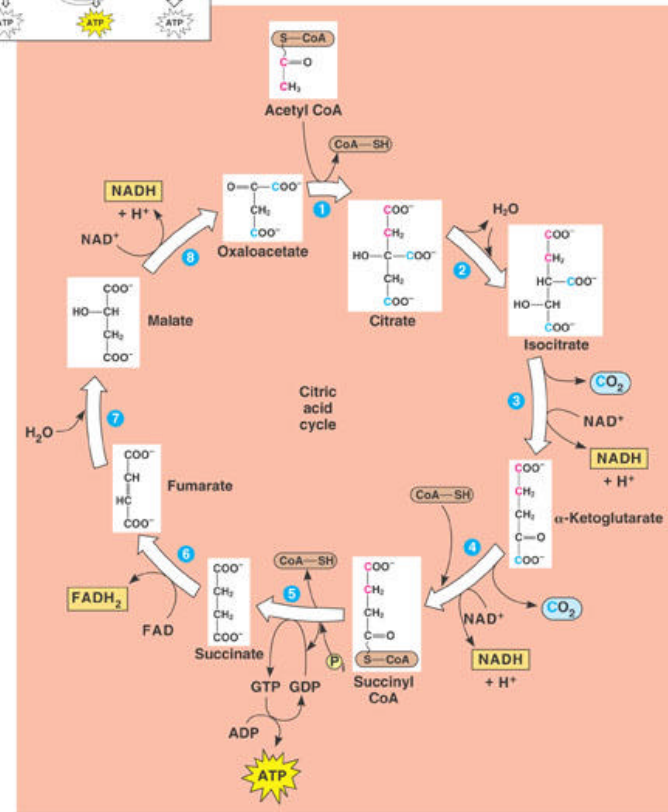
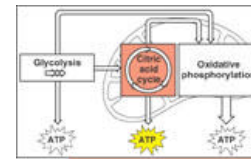
Steps of Aerobic Respiration: Glycolysis

- 2 molecules of pyruvate are produced per molecule of glucose
- A net of 2 ATP per molecule of glucose are produced in glycolysis



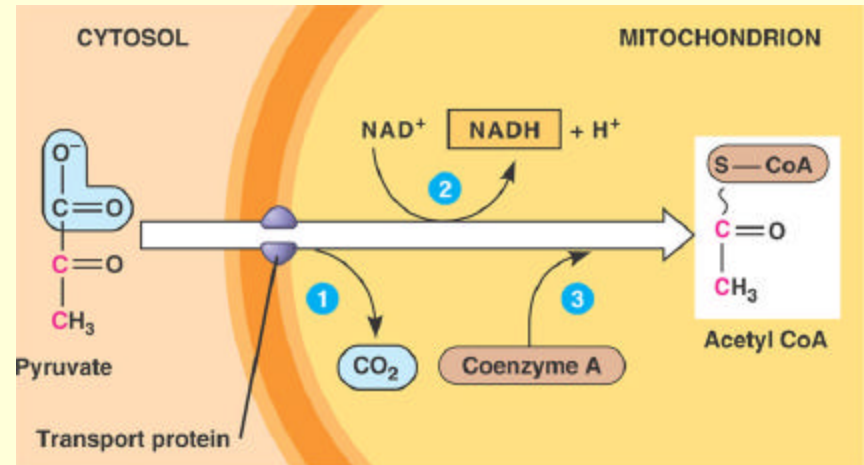
Steps of Aerobic Respiration: Krebs Cycle

- The Krebs cycle accomplishes two important functions: the production of multiple intermediate products, and of electron donors (NADH, FADH₂)

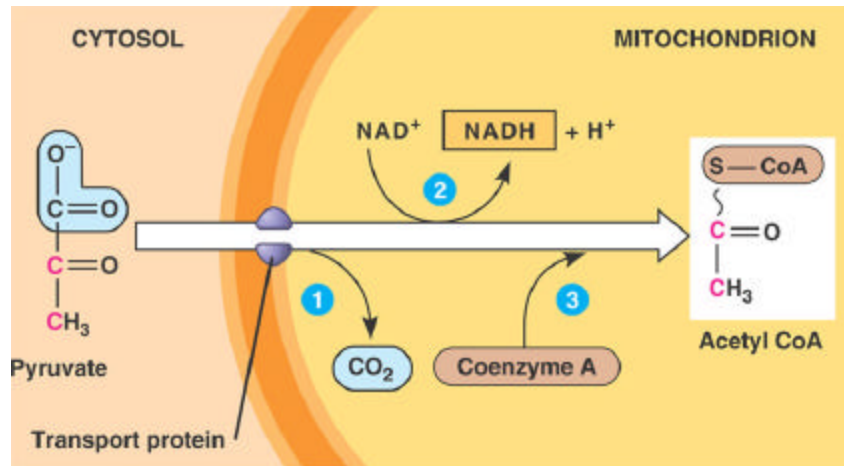


Steps of Aerobic Respiration: Krebs Cycle

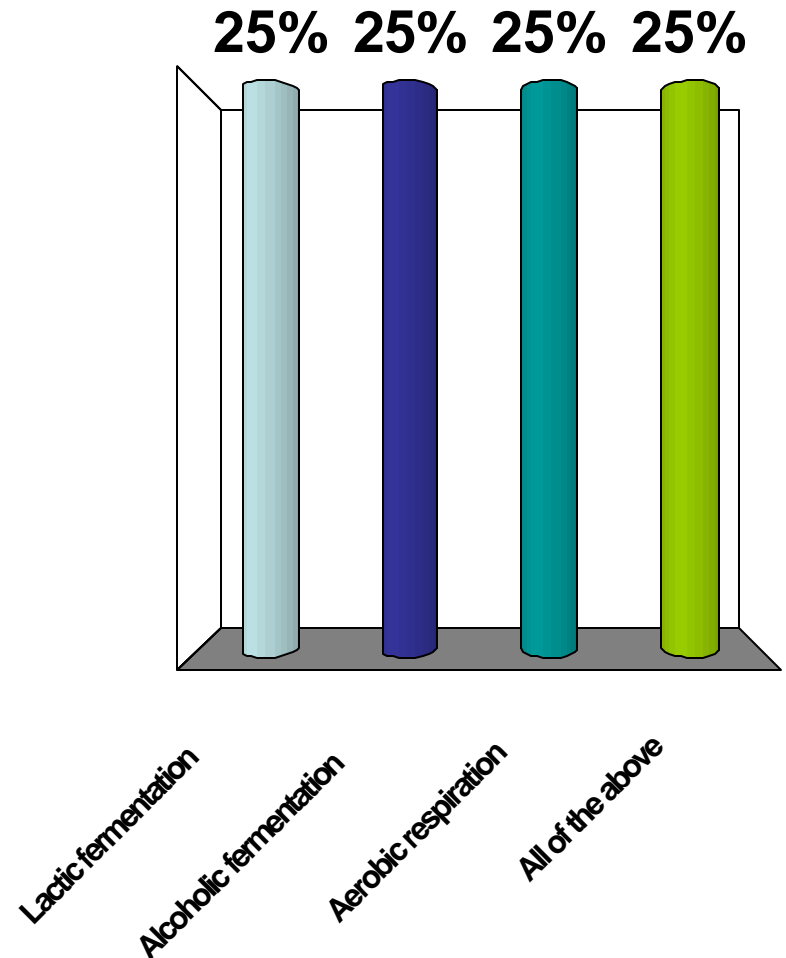
- The Krebs Cycle occurs in the mitochondrial matrix
- It is initiated when one molecule of pyruvate is transported into the mitochondrion by an oxygen dependent transport protein
- Upon entering the mitochondrion, pyruvate is turned into **acetyl CoA**, which initiates the cycle
- CO_2 is produced and will eventually leave the mitochondrial matrix and collect in blood vessels



Where is the pyruvate coming from?

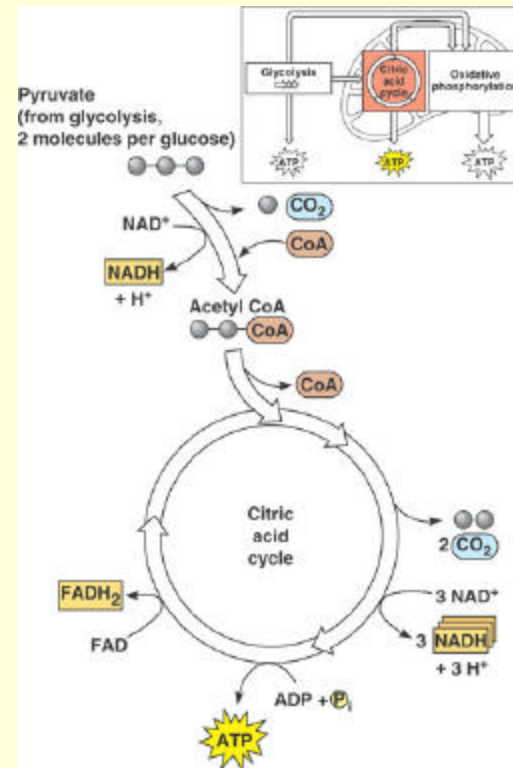


1. Lactic fermentation
2. Alcoholic fermentation
3. Aerobic respiration
4. All of the above



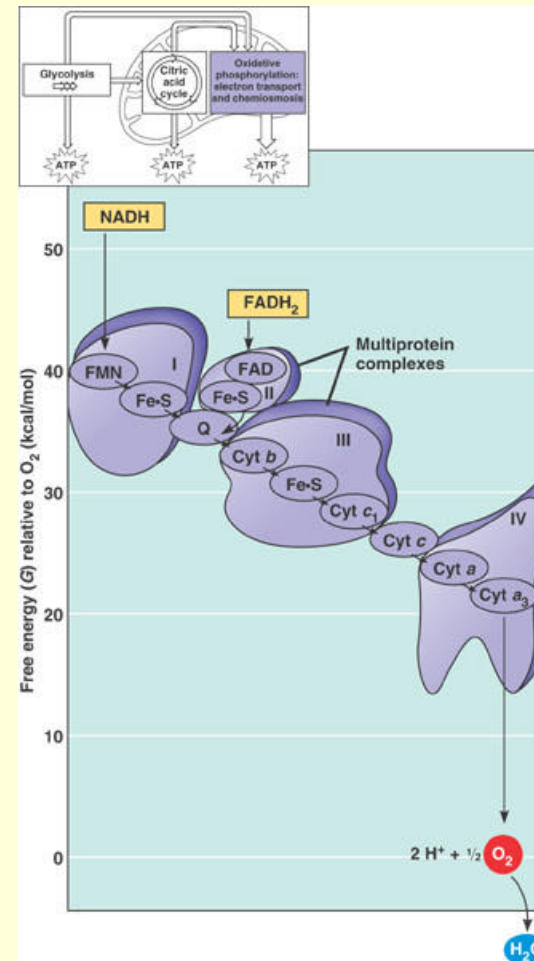
Steps of Aerobic Respiration: Krebs Cycle

- Per molecule of pyruvate, 1 ATP, 1 FADH_2 , 3 CO_2 , and 4 NADH are produced
- NADH and FADH_2 will initiate the last step of aerobic respiration, the electron transport phosphorylation system (ETPS).



Steps of Aerobic Respiration: ETPS

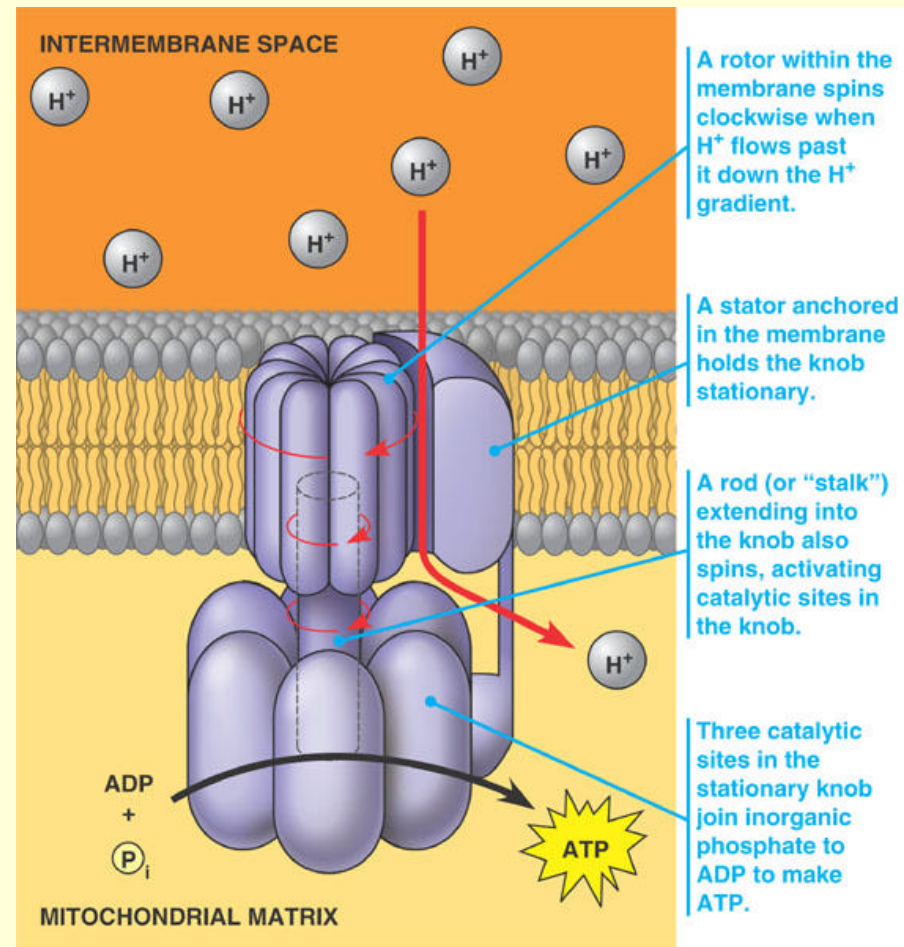
- ETPS consists of a series of proteins located in the inner mitochondrial membrane
- NADH and FADH_2 link glycolysis and the Krebs cycle to the machinery that produces large amounts of ATP
- NADH and FADH_2 turn on the ETPS. Electrons cascade down the chain from one protein to the next until they finally reach the molecule of oxygen, the final acceptor
- As electrons cascade down, protons are released



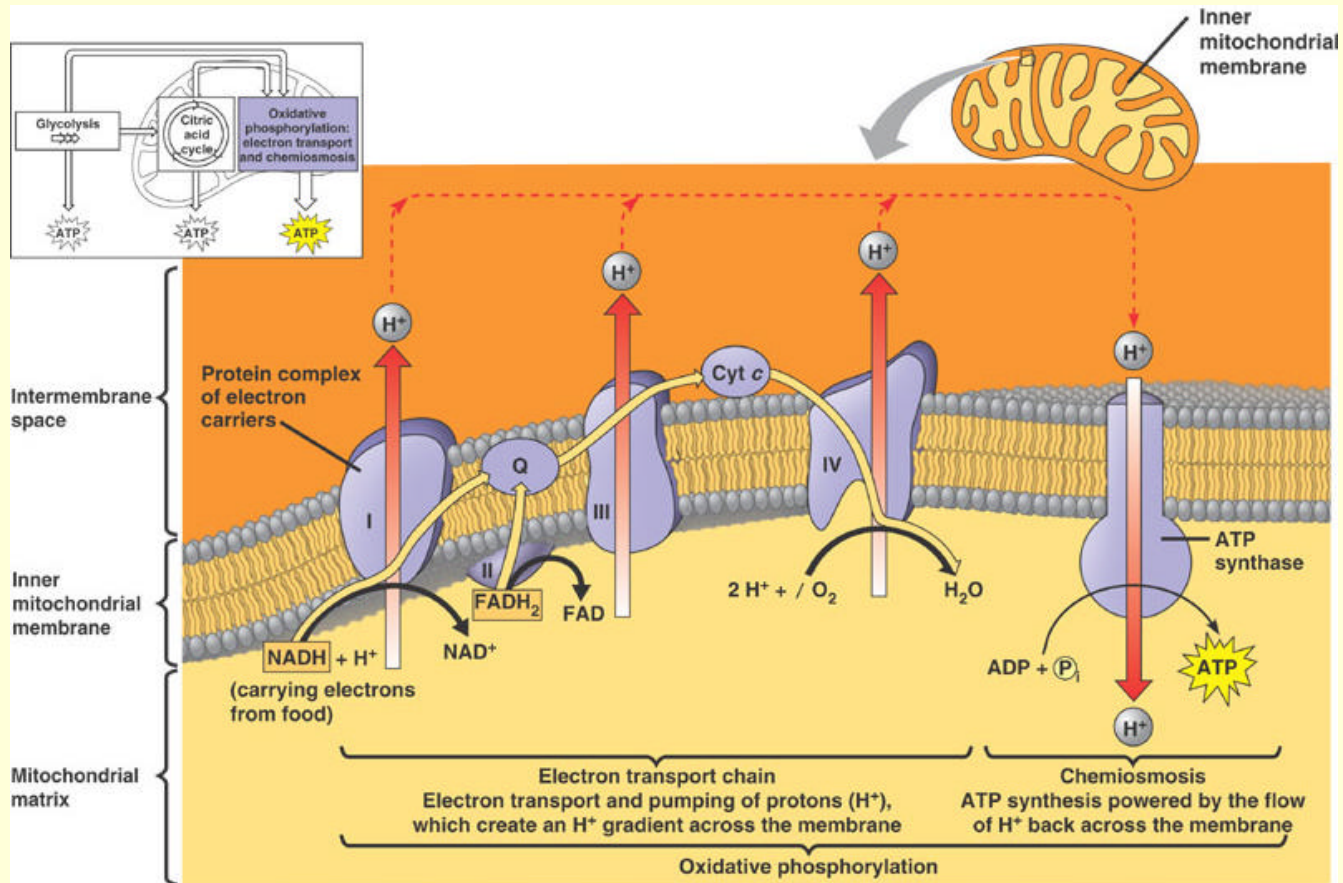
Steps of Aerobic Respiration: ETPS

- As proteins release H^+ in the intermembrane space, they produce a gradient of H^+ , which activates ATP synthase, the enzyme that produces about 32-34 ATP molecules.

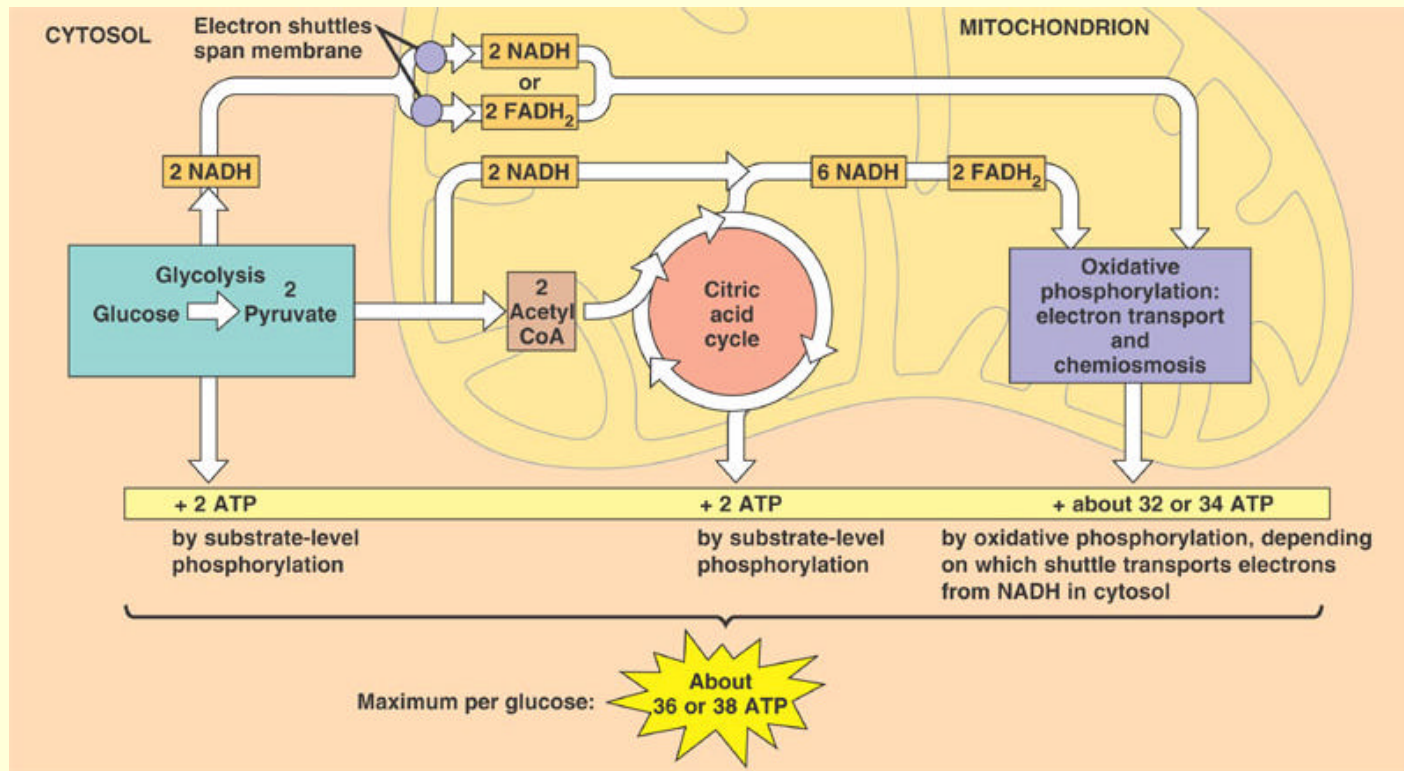
Chemiosmosis refers to the activation of ATP synthase by a H^+ gradient.



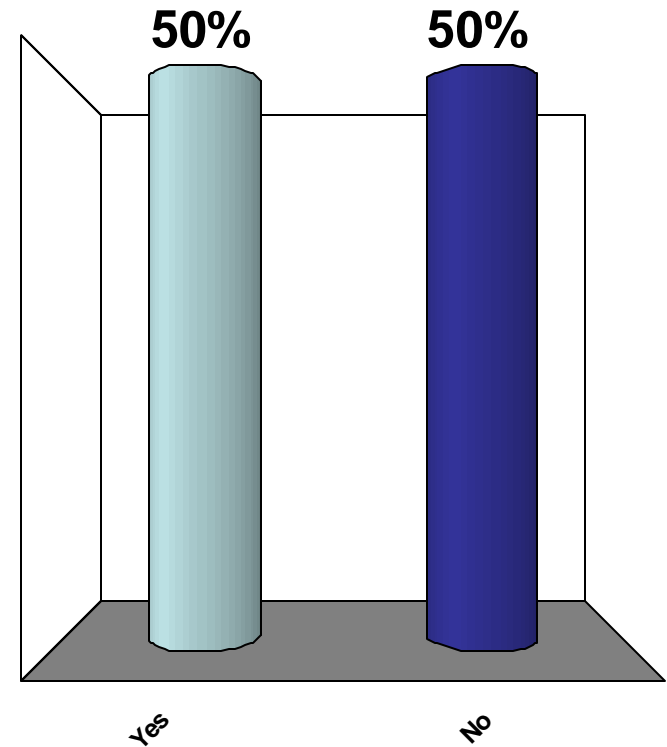
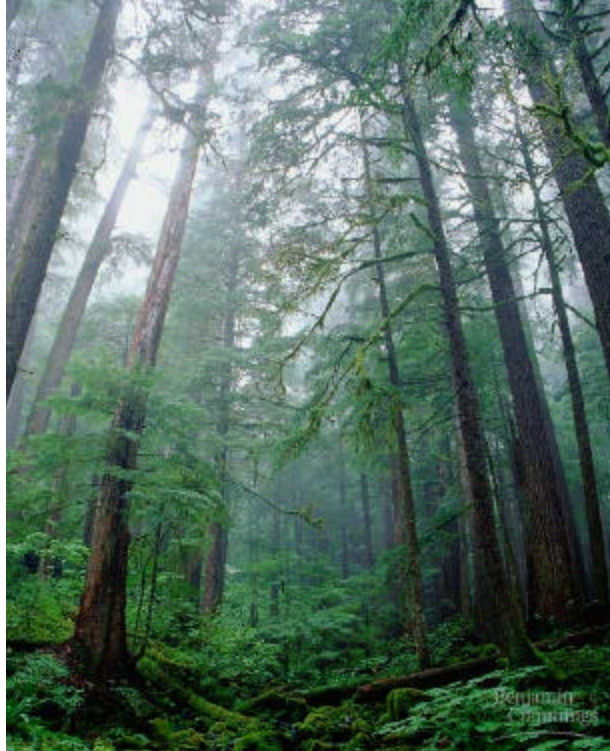
Steps of Aerobic Respiration: ETPS



Aerobic Respiration: What does it produce?



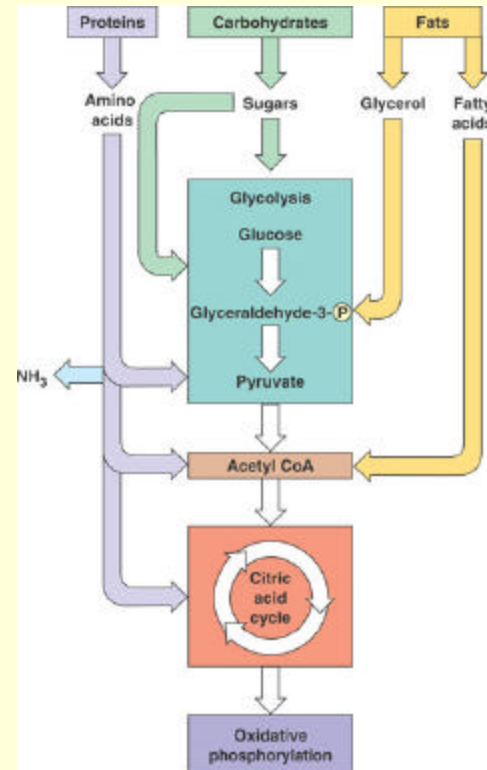
Plants need to burn sugars and fats to obtain ATP. Do you agree?



1. Yes
2. No

Other molecules other than sugars undergo aerobic respiration

- Proteins and fats are used in aerobic respiration for the production of ATP.



Other molecules other than sugars undergo aerobic respiration

