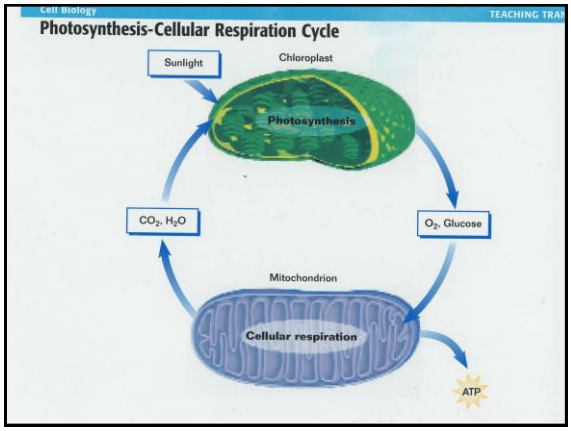
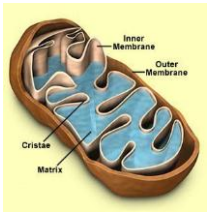
CELLULAR RESPIRATION

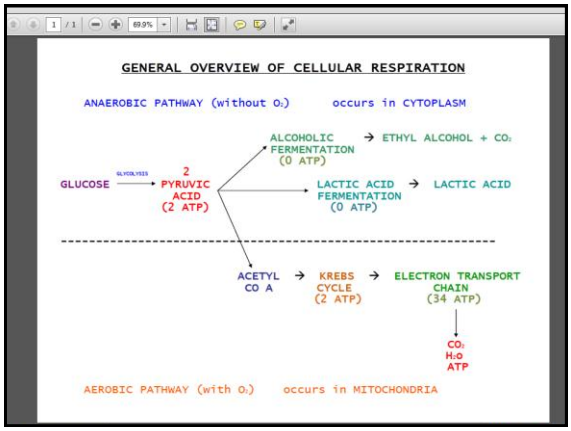


Cellular Respiration

complex process whereby cells make ATP by breaking down organic compounds

location: mitochondrial cristae





Glycolysis

(Glucose/breaking)

Process where one molecule of GLUCOSE (6 C) is broken down into 2 molecules of PYRUVIC ACID (3 C)

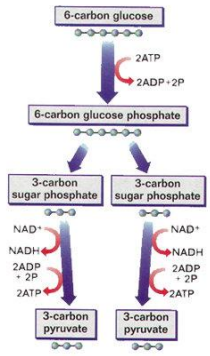
- occurs in cytoplasm
- occurs before respiration or fermentation

Glycolysis: 4 Major Steps

1. Unstable 6C glucose is formed
2. This molecule breaks down into 2 3C compounds
3. phosphate group is added to each 3C molecule
4. **PYRUVIC ACID and ATP** is formed

End products

2 pyruvic acid + 2 ATP



2 Possible Pathways for 2 Pyruvic Acid

If O2 present	If no O2 present
respiration	fermentation
(aerobic)	(anaerobic respiration)
mitochondria	cytosol

If no oxygen is present the 2 pyruvic acid will go into anaerobic respiration (fermentation)

FERMENTATION

1. **Lactic Acid Fermentation** (animals)
   - A. as O2 is consumed in aerobic respiration, it becomes scarce
   - B. cyclical process where NAD+ returns to glycolysis
   - C. lactic acid forms

   causes muscle pain and soreness

2. **Alcoholic Fermentation** (yeasts, plant cells, microorganisms)
   - A. converts pyruvic acid to ethyl alcohol
   - B. NAD+ is formed (returns to glycolysis)

causes alcohol in beer and wine, air bubbles in bread, beer and wine**

NO ATP FORMED IN FERMENTATION

PURPOSE OF FERMENTATION:
TO REGENERATE NAD+ FOR GLYCOLYSIS

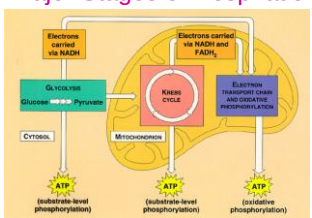
RESPIRATION (aerobic)

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ H_2O + 6\ CO_2 + 36\ ATP$

Process of breakdown of pyruvic acid in the presence of oxygen

- prokaryotic cells: occurs in cytosol
- eukaryotic cells: occurs in mitochondria
- much more efficient than anaerobic respiration

2 Major Stages of Respiration



1. **krebs cycle (2 ATP made)**
   - breakdown of glucose is completed
   - NAD+ is converted to NADH

2. **electron transport chain (34 ATP made)**
   -location where most ATP is made

KREBS CYCLE
(1st major stage)

2 pyruvate (from glycolysis)

go into Krebs cycle

Acetyl Co A

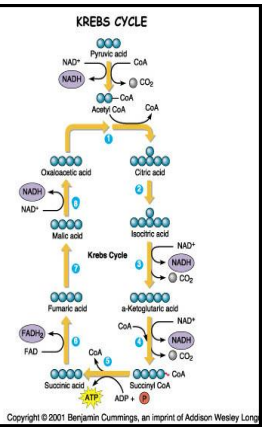
Citric Acid

CO2 given off (waste product)

ATP, NADH, FADH2 made

original molecule is made to start cycle over again

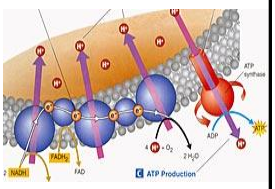
NADH AND $FADH_2$ drive the ETC



ELECTRON TRANSPORT CHAIN
(2nd major stage)

Process of extracting ATP from NADH and FADH2

- Occurs in mitochondrial cristae
- Electrons are passed down chain of electron accepting molecules and lose energy
- This process produces ATP



NET ATP PRODUCTION:
36 ATP/ 1 glucose molecule

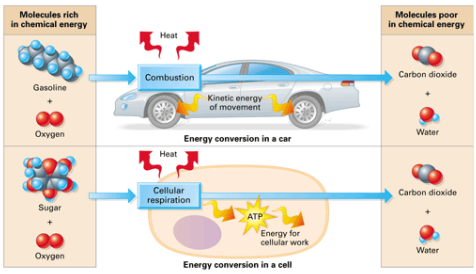
Remember...
photosynthesis and respiration are exact opposite processes.

Look at the general equations for both…….what do you notice?

$6\ CO_2 + 6\ H_2O + \text{light energy} \rightarrow C_6H_{12}O6 + 6\ O_2$

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ H_2O + 6\ CO_2 + 36$ ATP

Both are needed for all of life's activities.



Both engines and cells use oxygen to convert the potential energy in complex molecules to energy that can be used for work.