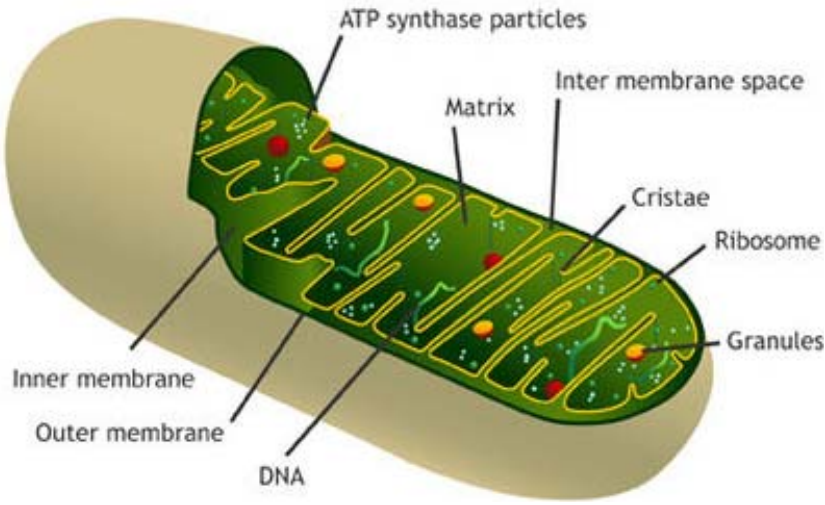
RESPIRATION



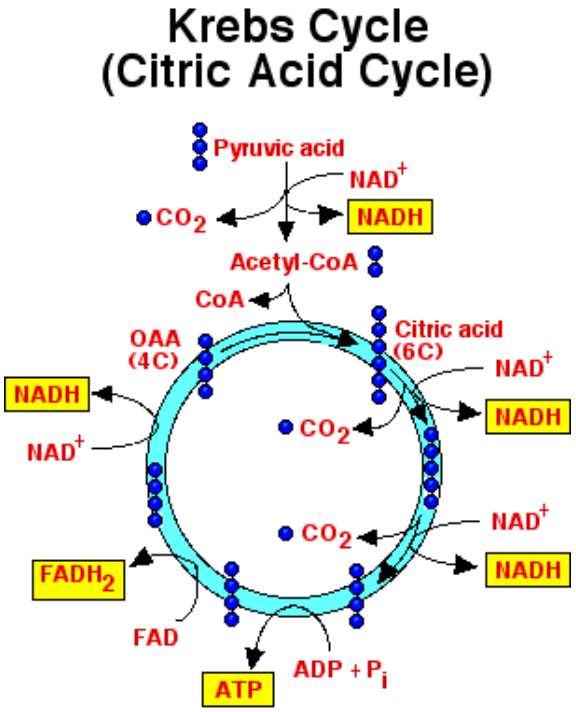
Revised 12 October 2016
B&D p. 275-, BKH 5th: 398-415, Campbell 6th, 160-165, Sadava, pp 144-157
Campbell 10th: 170-177

Metabolism beyond pyruvate occurs in the mitochondrion
stepwise oxidation of organic intermediates by NAD^+ + FAD
34 ATP generated/glucose in mitochondrion
(more are produced from Fatty acids.)

Five steps of **respiratory mechanism**: (page 141)

1. glycolysis to pyruvate (in **cytoplasm**, rest in **mitochond**.)
2. Pyruvate to acetyl CoA, feeds into TCA cycle, makes NADH and $FADH_2$
3. electron transport chain oxidizes NADH and $FADH_2$
4. produces proton gradient by pumping protons (H^+)
5. proton gradient drives phosphorylation of ADP

MITOCHONDRION ["thread granule"] **STRUCTURE:**
Originated by "endosymbiosis" It possesses two membranes: (p 111)
Outer membrane most solutes pass easily, **intermembranous space = cytoplasm**
Inner membrane folded into **cristae** ["tuft or plume"] (increases surface area)
It is rich in **proteins**, especially on the inner face
Matrix: ["mother"] gel-like fluid: contains own DNA, ribosomes, enzymes
Higher numbers in cells with high energy requirements, more cristae
(There are 500-1000 in a hepatocyte ["liver cell"])



LOCALIZATION OF FUNCTIONS:
MATRIX **pyruvate oxidation**, TCA enzymes, catabolism of AA and FA
MEMBRANE **electron transport**
ATP synthase is imbedded in membrane

RESPIRATION: p 169

Synthesis of Acetyl CoA (occurs in mitochondrion):
a: **decarboxylation** (requires TPP) *yields energy, drives the rxn*
b: **oxidizes substrate** at #2 carbonyl, producing NADH
c: **activates two carbon acetyl fragment** by attaching carbonyl to CoASH

CoA: adenine-3-PO_4, 5- pyroPO_4-pantothenic acid-$NHCH_2CH_2SH$ (a thiol)
Forms *thioester*, a high energy bond, capable of donating to substrate (oxaloacetate)

KREBS CYCLE (p 171) dissects an acetyl group, attaching it to oxaloacetate, forms citrate. (TCA)
One cycle using acetyl CoA forms: 3 NADHs, 1 $FADH_2$, 1 ATP, 2 CO_2s

step	**TRICARBOXYLIC ACID CYCLE:** (page 146)	product
1	**acetylation:** Acetyl CoA transfers acetyl group to oxaloacetate (C-4) *via CH_3 end*	citrate
2	**dehydration, rehydration:** citrate **isomerized** to isocitrate, 3° OH to 2° OH, oxidizable	isocitrate
3	**oxidation, first decarboxylation:** 2° OH isocitrate **oxidized**, making **NADH**, creates unstable molecule, **decarboxylates** (drives rxn) yielding α-ketoglutarate. This and the next step require thiamine (vit B1)	α-ketoglutarate
4	**oxidation, second decarboxylation, form thioester:** reaction analagous to synth of acetyl CoA: an α-keto acid oxidation (makes **NADH**), decarboxylation (makes CO_2) and CoA thioester high energy bond (succinyl CoA). All decarboxylations (#3 and #4 here) require thiamine ["sulfur, nitrogen containing"]	succinyl CoA
5	thioester split, energy used to add Pi to ADP: **ATP generated**. Release succinate and CoASH.	succinate
6	**oxidation: Succinate** α,β carbons dehydrogenated**,** forming low energy **$FADH_2$**	fumarate
7	**hydration: fumarate is hydrated** to form malate	malate
8	**oxidation: malate is oxidized** to form oxaloacetate, producing **NADH**.	oxaloacetate

Overview of mitochondrial catabolism:
Glycolysis: http://www.youtube.com/watch?v=O5eMW4b29rg&NR=1
Krebs Cycle: http://www.youtube.com/watch?v=hw5nWB0xN0Y