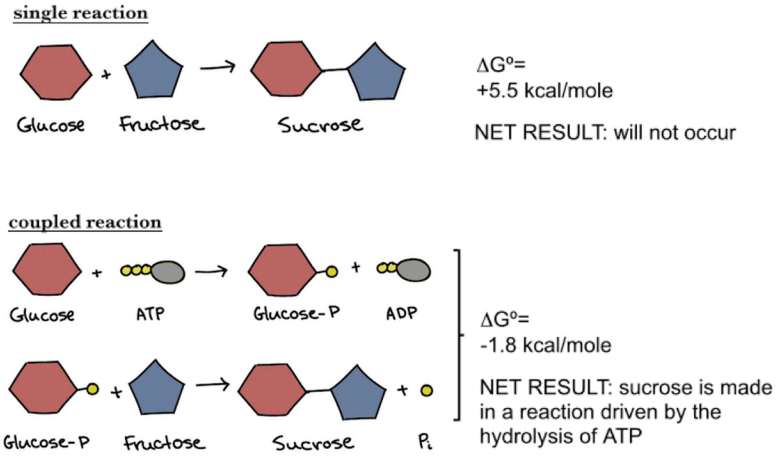
Mitochondria & Generating Energy

How cells generate energy

ATP is used to drive energetically unfavorable reactions (such as molecular synthesis, active transport, motility) in coupled reactions.



(background material in Essential Cell Biology Chap 3)

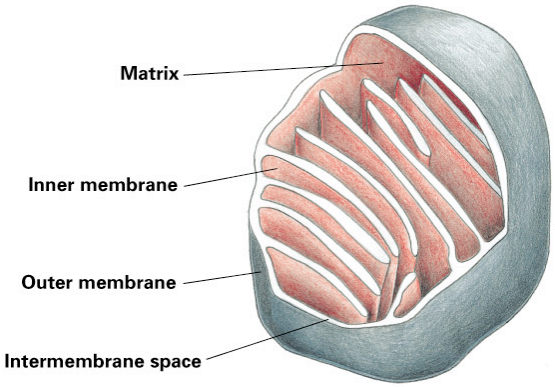
Review 4 major metabolic pathways involved in producing ATP in eukaryotic cells: Glycolysis, Krebs cycle, Electron transport, Oxidative phosphorylation

AEROBIC RESPIRATION

REACTANTS	PROCESS	PRODUCTS
Glucose ADP H^+ NAD^+	**GLYCOLYSIS**	Pyruvate ATP NADH
Pyruvate NAD^+ FAD GDP	**KREBS CYCLE**	CO2 GTP FADH NADH
NADH FADH2 O2	**ELECTRON TRANSPORT**	H2O
H+ ADP	**OXIDATIVE PHOSPHORYLATION**	ATP

Q: How can we determine where in the cell each of these pathways occur?
A: Fractionate cell into cytosol and organelles, add individual reactants for one pathway at a time, and then assay for the production of ATP.

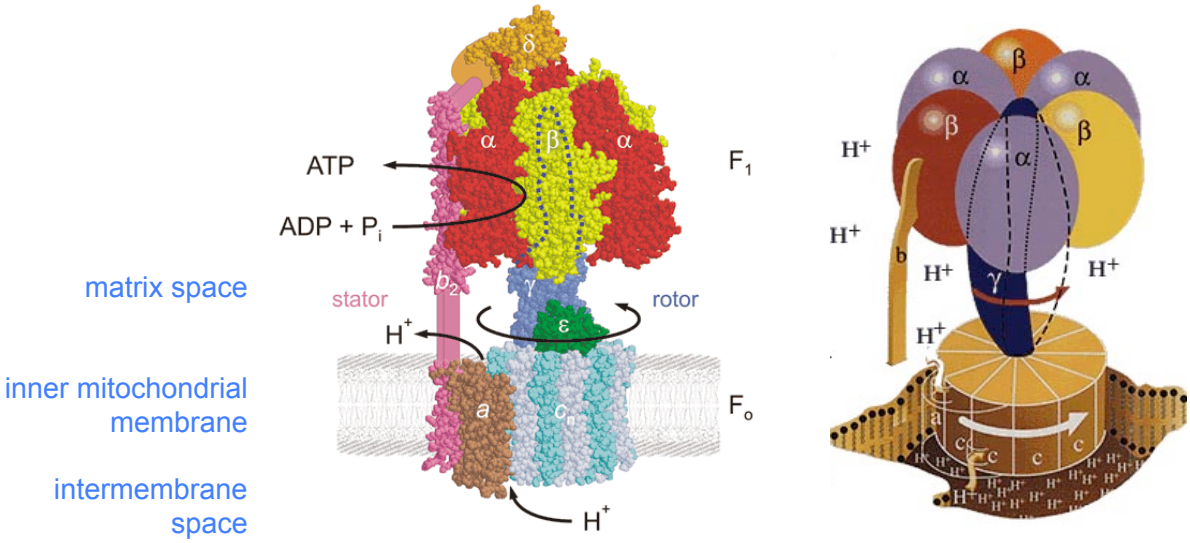
The mitochondrion: contains two membrane-bounded compartments:



(0.5 - 1.0 μm diameter)

Q: How can we determine where in the mitochondrion the Krebs cycle occurs? where electron transport and oxidative phosphorylation occur?

The electron transport chain generates a proton (H^+) gradient across the inner membrane. This proton gradient drives ATP synthesis. The protein that makes this possible is ATP synthase:



Protons flow down their gradient across the inner membrane by passing through a channel in ATP synthase, and this flow causes rotation of part of the ATP synthase. Conformational changes occurring in the rotation are used to phosphorylate ADP, producing ATP.