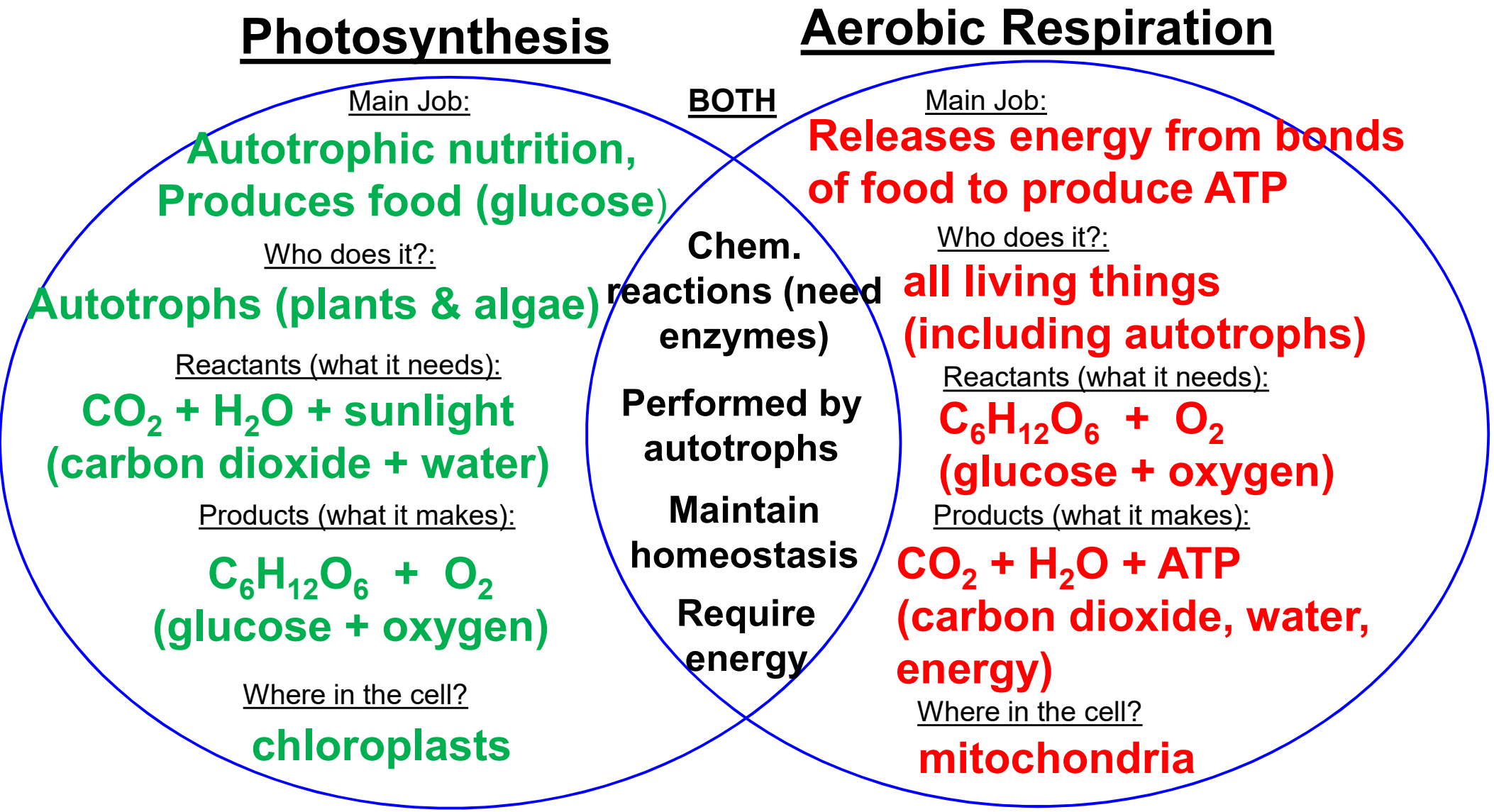
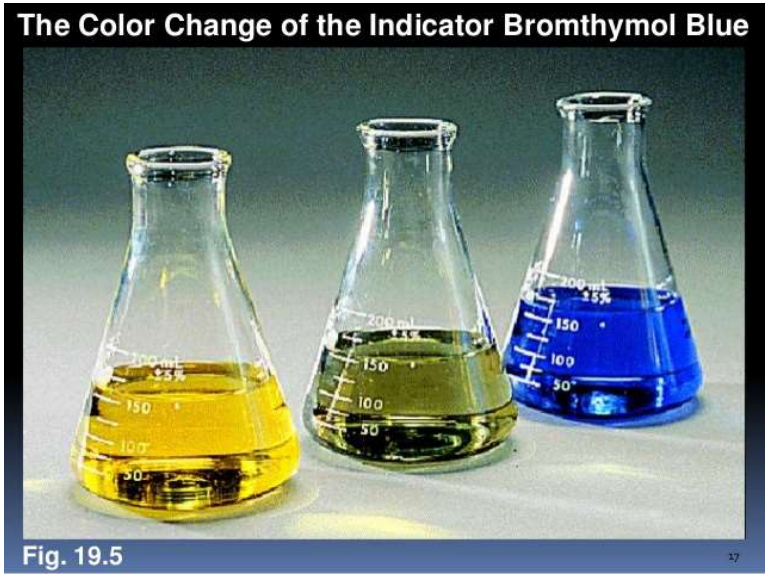
Lesson

SAT II – Aerobic Cellular Respiration
3 sets of reactions detail

HONORS ONLY


Photosynthesis
Main Job:
Autotrophic nutrition, Produces food (glucose)
Who does it?:
Autotrophs (plants & algae)
Reactants (what it needs):
$CO_2 + H_2O$ + sunlight
(carbon dioxide + water)
Products (what it makes):
$C_6H_{12}O_6 + O_2$
(glucose + oxygen)
Where in the cell?
chloroplasts
BOTH
Chem. reactions (need enzymes)
Performed by autotrophs
Maintain homeostasis
Require energy
Aerobic Respiration
Main Job:
Releases energy from bonds of food to produce ATP
Who does it?:
all living things (including autotrophs)
Reactants (what it needs):
$C_6H_{12}O_6 + O_2$
(glucose + oxygen)
Products (what it makes):
$CO_2 + H_2O$ + ATP
(carbon dioxide, water, energy)
Where in the cell?
mitochondria

Bromothymol Blue Demo



What substance is Bromothymol blue an indicator for?

Carbon Dioxide (CO_2)

Review of Aerobic Cellular Respiration

OXYGEN is required!

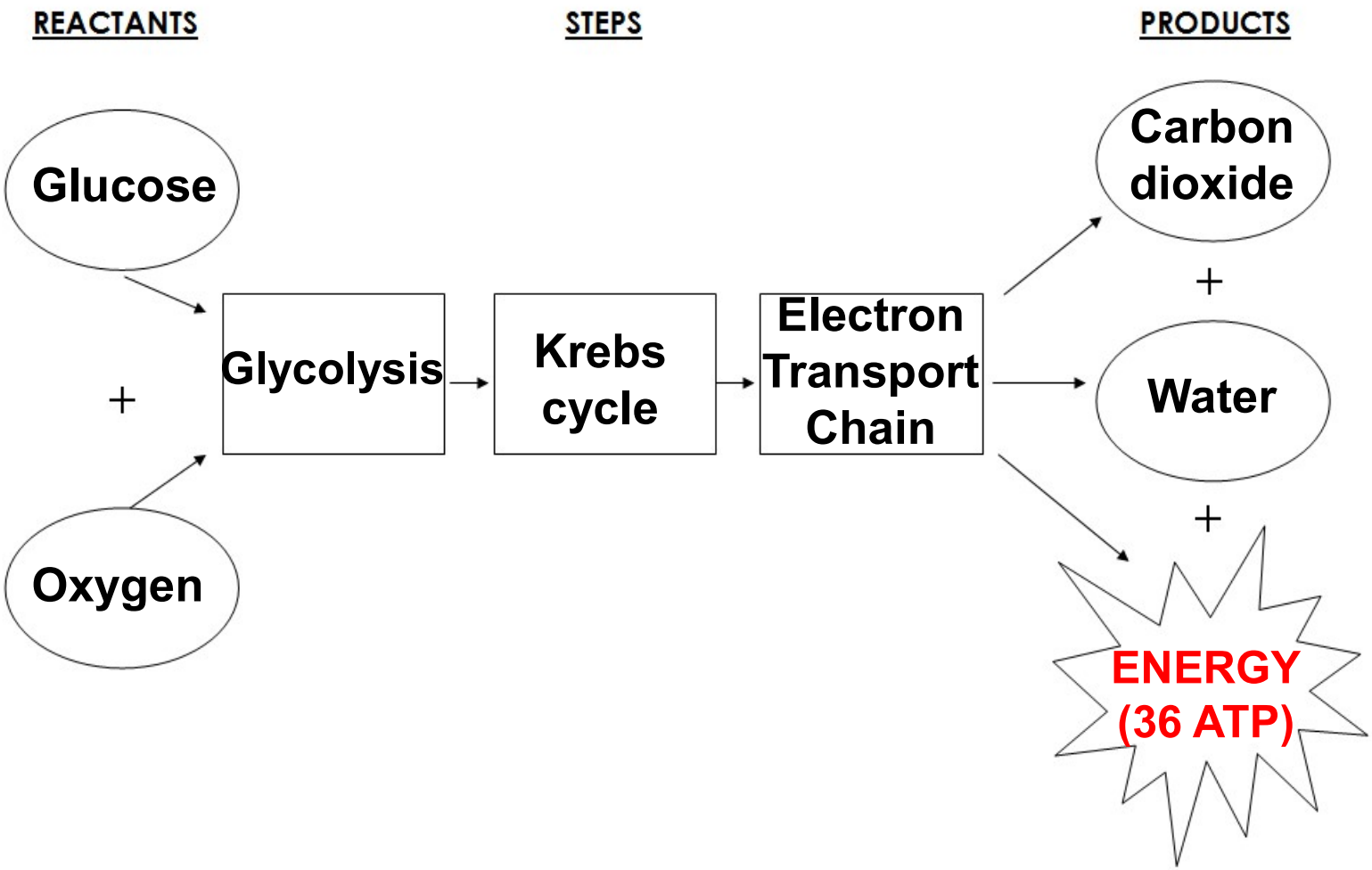
Equation:

Glucose + Oxygen → Carbon dioxide + Water + ENERGY

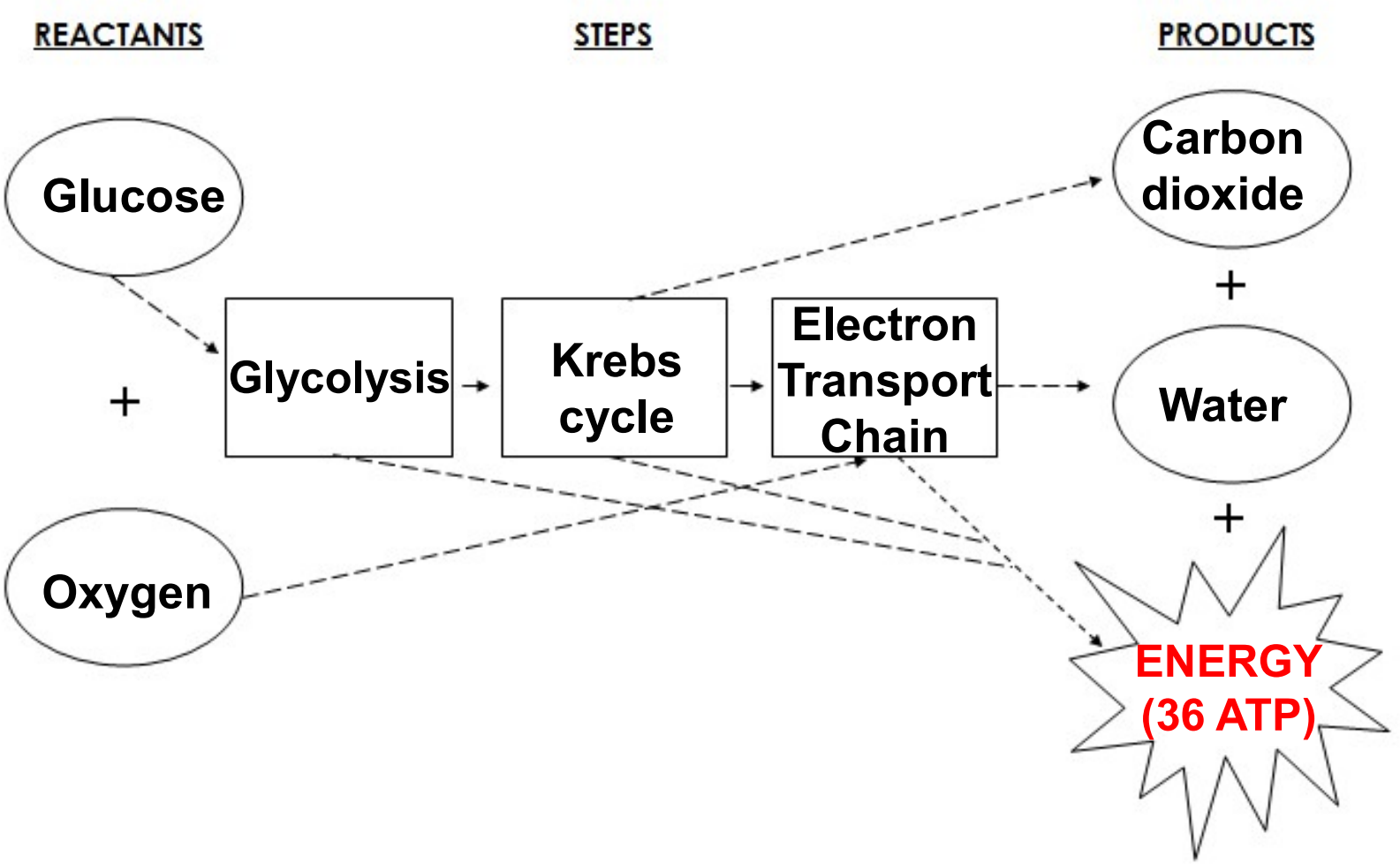
$C_6H_{12}O_6$ + 6 O_2 → 6 CO_2 + 6 H_2O + 36 ATP

- Yields a net gain of 36 ATP for each glucose molecule broken down
- Energy is released a little at a time through a complicated set of reactions

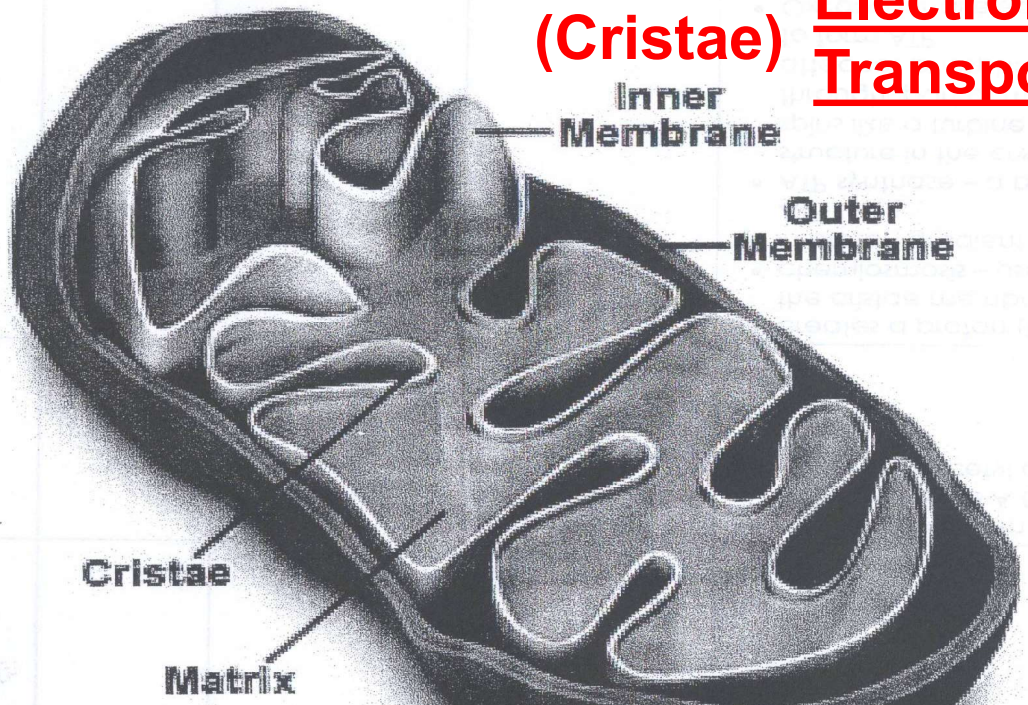
Aerobic Respiration Flowchart



Aerobic Respiration Flowchart



Structure of a Mitochondrion



Cytoplasm

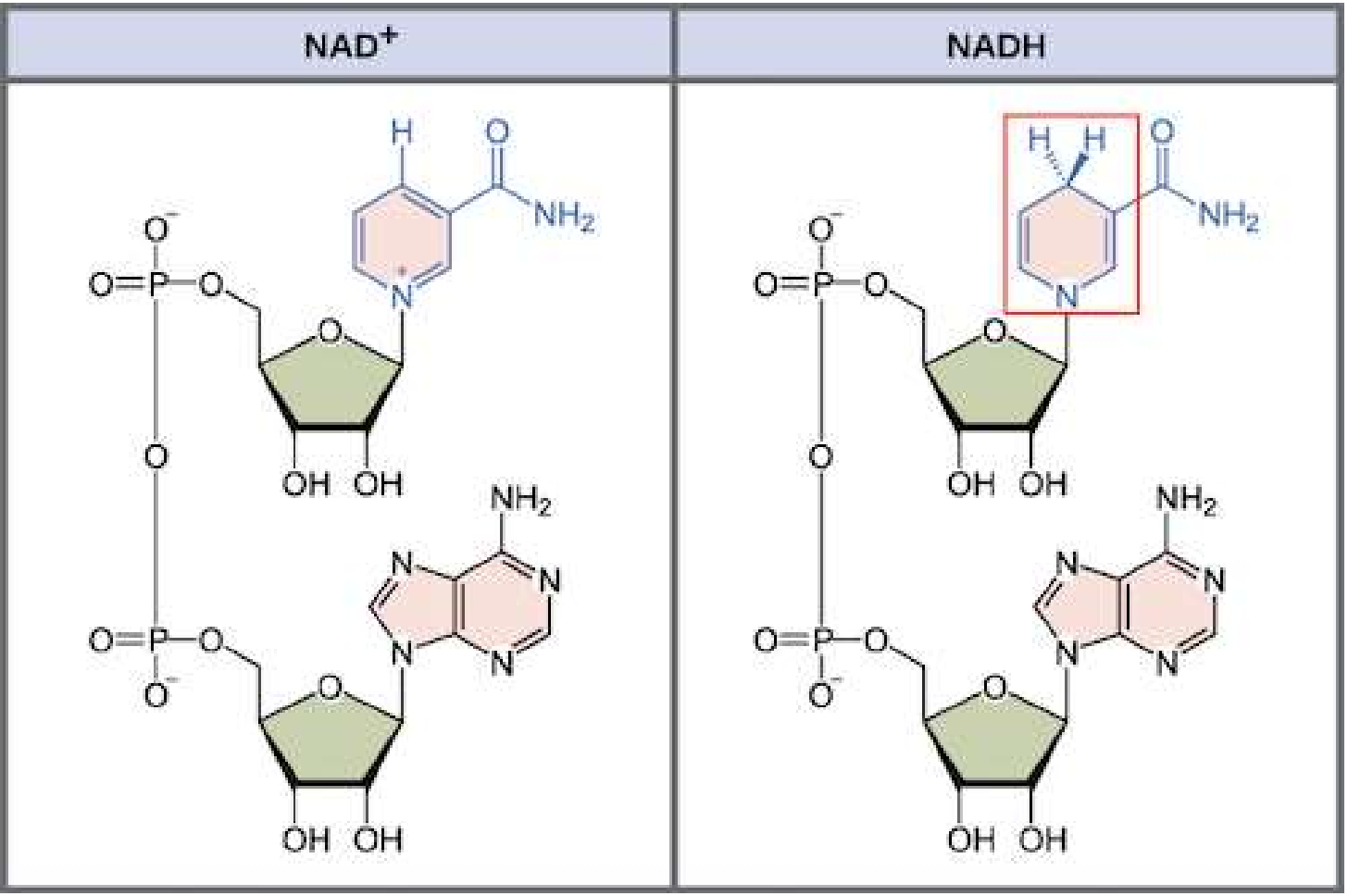
Glycolysis

(Cristae) Electron Transport Chain

Innermost space of the mitochondria KREBS CYCLE

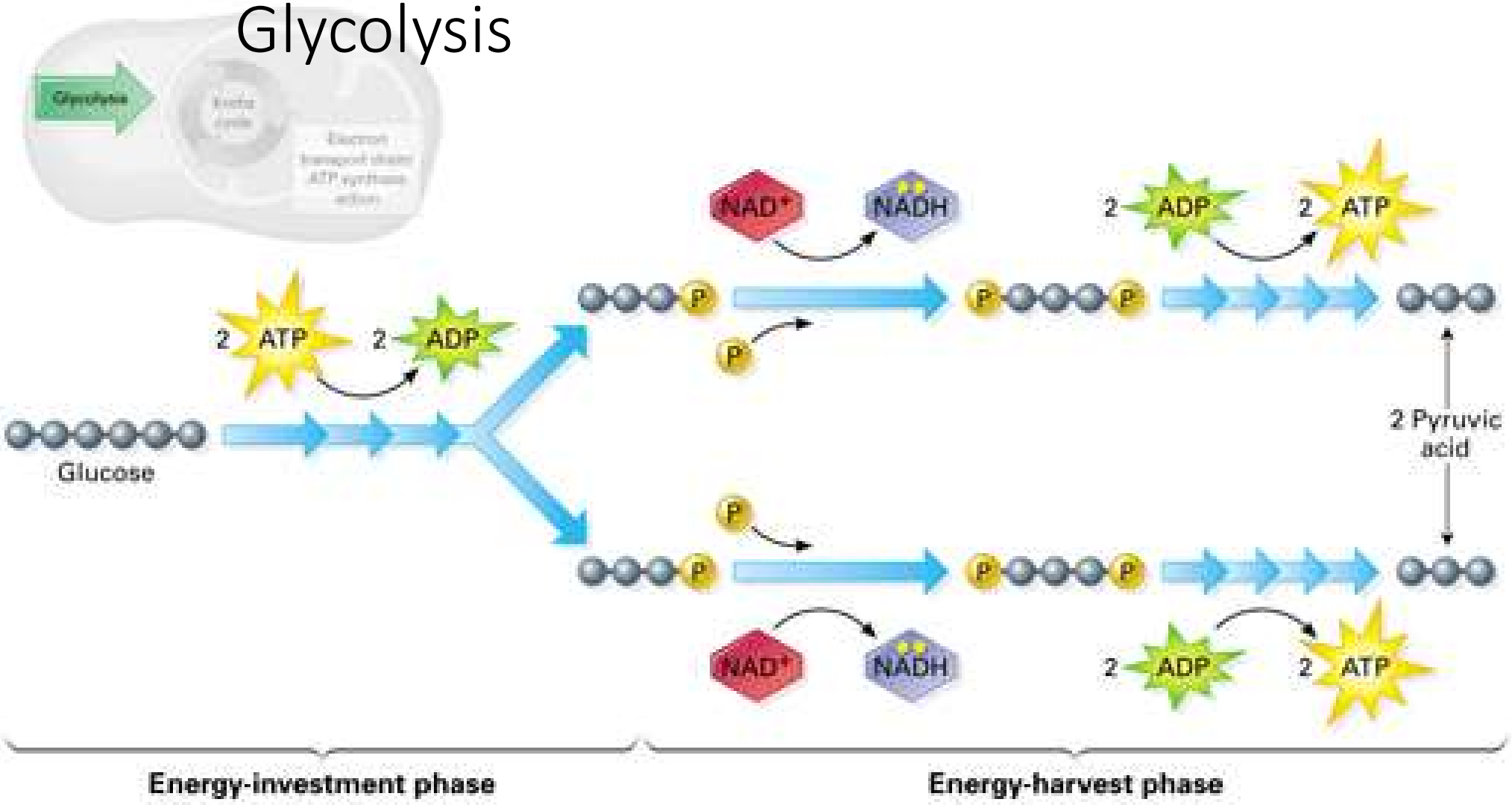
Video - Cell Respiration Bioflix (overview of 3 sets of reactions)

Electron Carrier Molecules



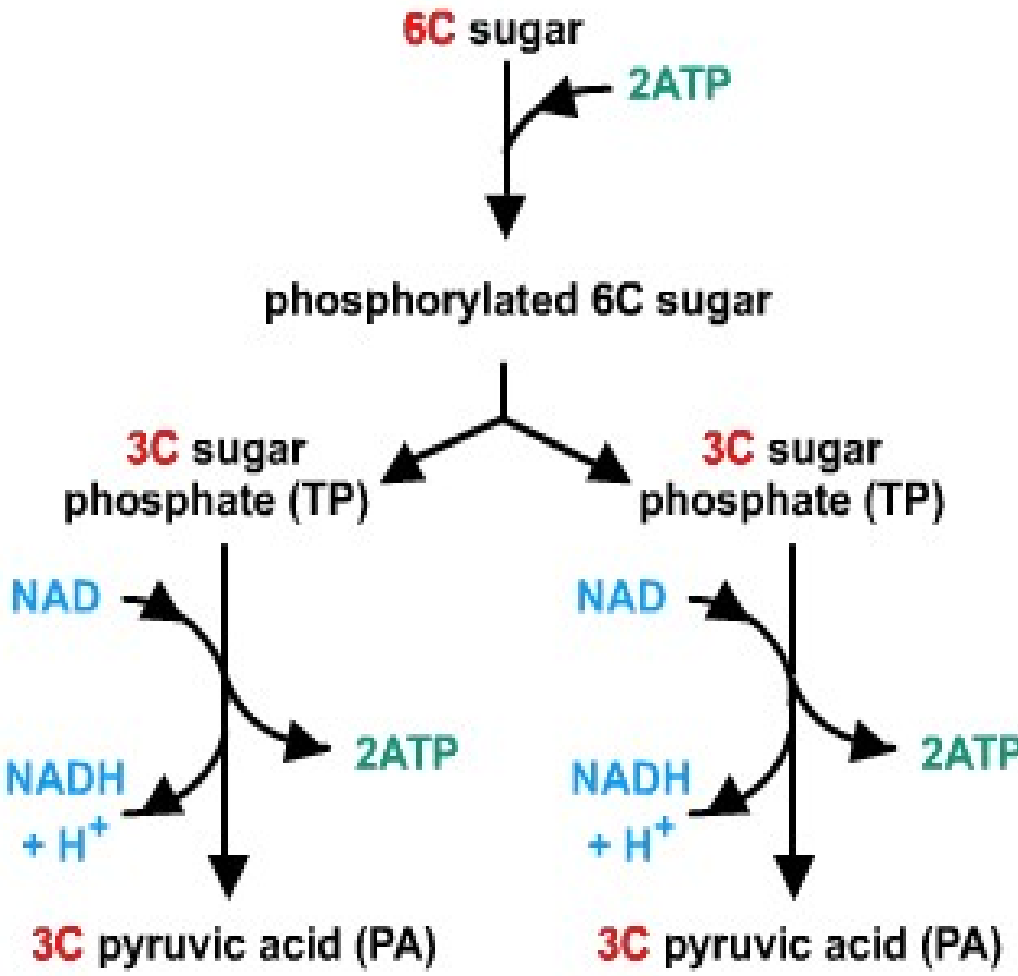
- pick up electrons from one molecule and drop them off with another
- **NAD+** (nicotinamide adenine dinucleotide, shown)
- **FAD** (flavin adenine dinucleotide)

Glycolysis


Glycolysis
NAD+
NADH
2 ADP
2 ATP
2 ATP
2 ADP
P
Glucose
2 Pyruvic acid
NAD+
NADH
2 ADP
2 ATP
Energy-investment phase
Energy-harvest phase

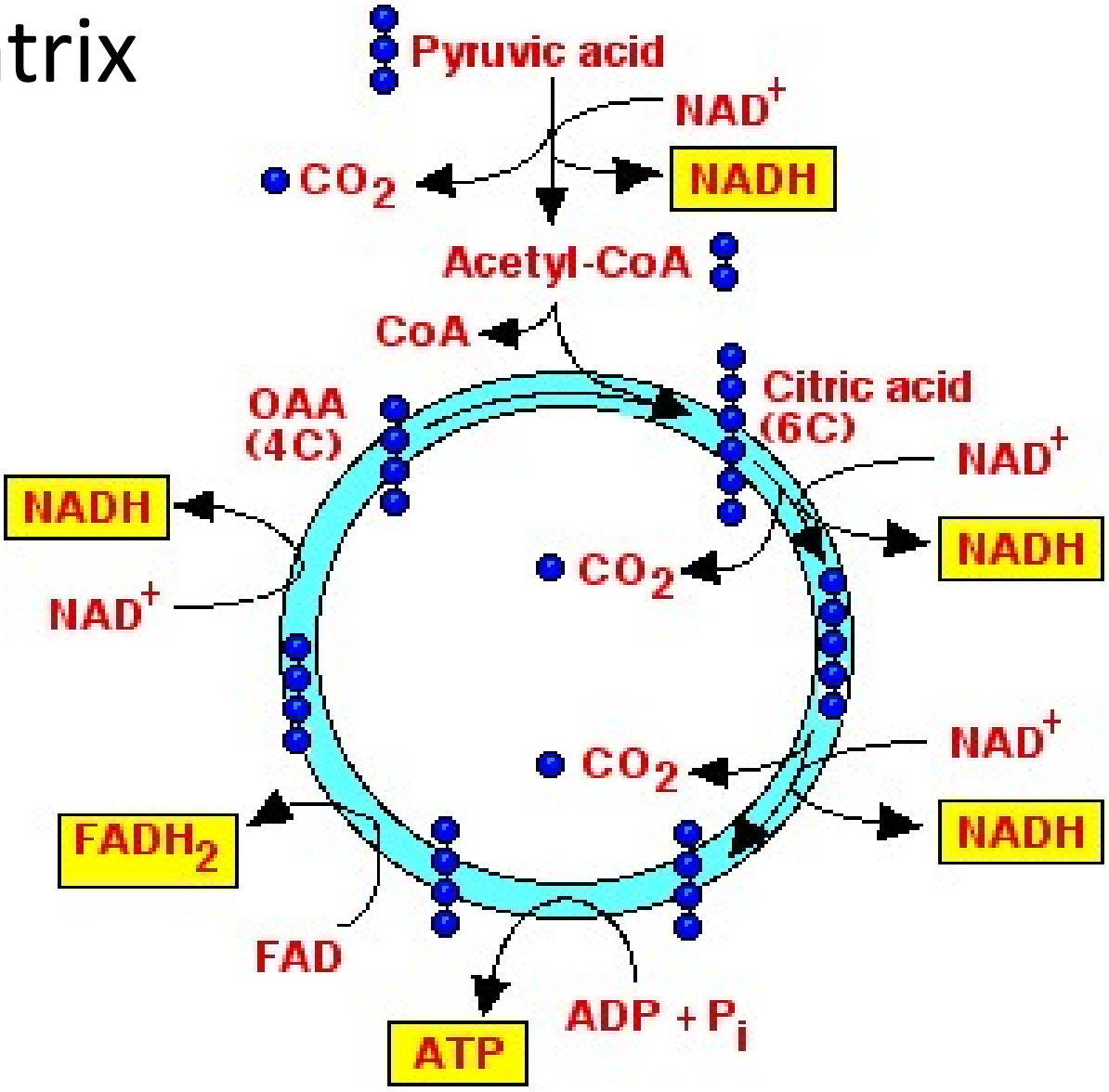
Glycolysis – in cytoplasm

- glycol = sugar, lysis = split
- produces 2 molecules of pyruvic acid
- has a net gain of 2 ATP
  - (4 are made, 2 are needed to start the reaction)
- no oxygen needed yet (anaerobic)



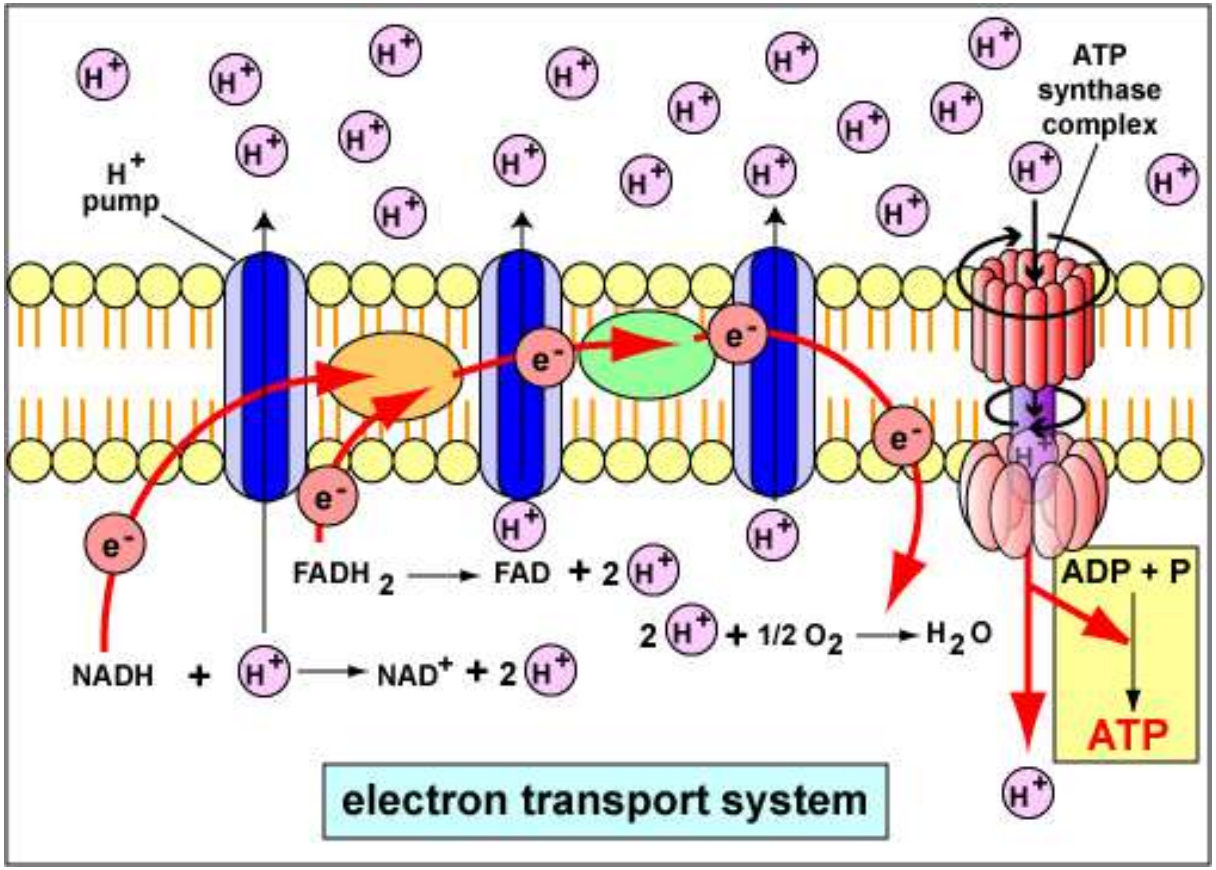
Kreb's Cycle – in matrix

- breaks down pyruvic acid (from glycolysis) producing CO_2 (waste)
- produces electron carrier molecules NADH & $FADH_2$
- AKA the citric acid cycle



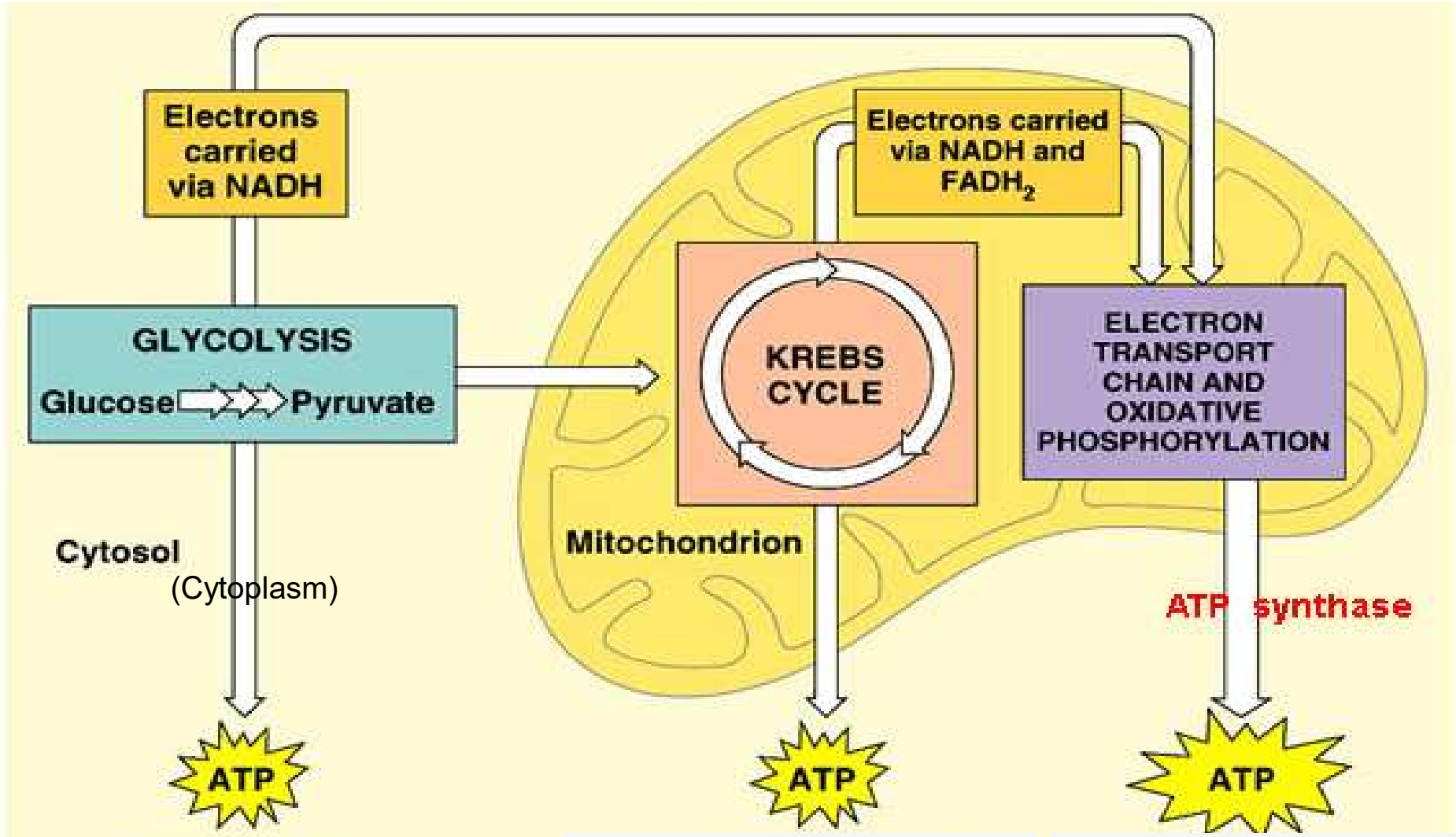
Electron Transport Chain (ETC) – cristae membrane

- uses high energy electrons from the Krebs cycle's electron carrier molecules
- converts ADP into ATP
- water is produced (byproduct)



Video - Gradients (ATP Synthase) Video - Electron Transport Chain

Process	Location	Aerobic or Anaerobic	Reactants (Inputs)	Products (Outputs)	Highlights
Glycolysis **"splitting glucose"**	**Cytoplasm**	**Anaerobic uses NO oxygen** **All cells can do it!**	**Glucose** **2 ATP needed for activation**	**2 pyruvic acids** **NADH** **4 ATP (net gain of 2 ATP)**	▪ small energy yield but fast process **Evolved first!**
Krebs Cycle **AKA citric acid cycle**	**Matrix of mitochondria**	**Aerobic (needs O_2)**	**2 Pyruvic Acids → acetyl coA)**	**CO_2 (waste)** **NADH & $FADH_2$** **2 ATP**	▪ pyruvic acid (from glycolysis) combines with coenzyme A (made from Vitamin A) forming acetyl coA
Electron Transport Chain	**Across the Cristae (mitochondria inner membrane)** ***In some prokaryotes, occurs across cell membrane**	**Aerobic (needs O_2)** **(occurs in plants, animals, algae, & some bacteria)**	**NADH** **$FADH_2$** **Oxygen (*final electron acceptor)**	**The most ATP (32)** **Water (waste)**	▪ creates a proton (H+) gradient across the cristae membrane ▪ chemiosmosis – uses the stored energy in proton gradient to convert ADP to ATP ▪ ATP synthase – a proton channel structure in the cristae membrane that spins like a turbine, as protons move through, part of molecule turns and attaches phosphates to ADP molecules to form ATP ▪ Oxygen (final electron and proton receptor in ETC) pulls electrons through the ETC, then combines with protons and electrons to form water (waste)



Glycolysis Song (very detailed)

Krebs Cycle song (very detailed)

Electron Transport Chain song (very detailed)