Review 12

Part 1: "Carbon Reactions"--result in conversion of carbon backbone of glucose into CO_2, harvesting of hi-E electrons, and manufacture of some ATP

Glycolysis

❶ ***In the CYTOPLASM: Glycolysis***

❷ ***Entry into the MITOCHONDRION: Oxidation of Pyruvic Acid***

❸ ***In matrix of MITOCHONDRION: Kreb's Cycle***

FOR EACH ACETYL-CoA:

acetyl-CoA → 2 CO_2 + 1 CoA

3 ($NAD^+ + H^+$) 3 NADH

1 ($FAD + 2H^+$) 1 $FADH_2$

1 ($ADP + P_i$) 1 ATP

Summary of the carbon reactions:

$C_6H_{12}O_6 \longrightarrow 6\ CO_2$

4 ($ADP + P_i$) 4 ATP

10 ($NAD^+ + H^+$) 10 NADH

2 ($FAD + 2\ H^+$) 2 $FADH_2$

Part 2: "Electron Reactions"--gleaning energy from high-E electrons and using it to form ATP by reconnecting P_i to ADP

❹ ***On cristae of MITOCHONDRION: Mitochondrial Electron Transport***

Mitochondrial Electron Transport via Cytochrome Chains

STEP 1: Electrons transferred to FMN or Coenzyme Q (reoxidation of NADH and $FADH_2$, returning them to NAD^+ & FAD, respectively)

STEP 2: Energy released from high-E electrons as passed from cytochrome to cytochrome of electron transport chain

STEP 3: Released energy ultimately drives formation of ATP:

$ADP + P_i$ --> ATP (3 ATP/pr e^- from NADH; 2 ATP/pr e^- from $FADH_2$)

STEP 4: Low energy electrons combined with O_2 and H^+ to form water

Total ATP production per glucose molecule completely oxidized:

2 ATP from glycolysis

2 ATP from Kreb's Cycle

34 ATP from mitochondrial electron transport = 38 total

-2 ATP to transport 2 NADH from cytoplasm into mitochondria

36 ATP net available for cellular work

Review 12, con't.

Metabolism of other molecules:

- OTHER SUGARS: through glycolysis, etc.
- AMINO ACIDS: converted to various small molecules—pyruvic acid or intermediates of Kreb's Cycle—and metabolized; Kreb's intermediates and pyruvic acid also serve as sources of building blocks for certain AAs
- TRIGLYCERIDES: fatty acids broken down into acetyl-CoA and metabolized through Kreb's Cycle; if in excess, sugars and amino acids can be metabolized to form acetyl-CoA which is then used to build fats