CELL RESPIRATION 1977: L. PETERSON/AP BIOLOGY

Explain how the molecular reactions of cellular respiration transform the chemical bond energy of Krebs Cycle substrates into the more readily available bond energy of ATP. Include in your discussion the structure of the mitochondrion and show how it is important to the reactions of the Krebs Cycle and the Electron Transport Chain.

STANDARDS: 1/2 point for each of the following

___Krebs and ETS occur within mitochondria
___Krebs - enzymes freely present in matrix fluid
___ETS - respiratory chain (respiratory assembly) arranged in order inner membrane of mitochondria (Diagram OK)
___more active cells - more respiratory assemblies & more cristae
___Aerobic - O_2 necessary as final H acceptor (-> H_2O) (most eukaryotic cells all of the time)
___Glycolysis is 1st required (outside mitochondria)
___Glucose (6C) is broken down into 2 Pyruvic Acid (3C) molecules
___Phosphorylation must 1st occur
___Net production: 2 ATP & 2 NADH

MITOCHONDRIA

___Pyruvic Acid & 2NADH enter mitochondria
___2 NADH will transfer H (electrons) into ETS
___yields 2 x 2 ATP = 4 ATP (some loss due to point of entry into ETS)

KREBS CYCLE SUBSTRATES

___2 Pyruvic Acid loses CO_2 & H -> 2 NADH & combines w/CoA -> Acetyl CoA
___(2C) Acetyl CoA + (4C) Oxaloacetic Acid -> (6C) Citric Acid
___Citric Acid -> Isocitric Acid
___(6C) Isocitric Acid - DEHYDROGENATION & loss of CO_2 -> (5C) Ketogluatric Acid
NAD -> NADH
___(5 C) Ketoglutaric Acid - DEHYDROGENATION & loss of CO_2 -> (4C) Succinic Acid
NAD -> NADH
___(4C) Succinic Acid - DEHYDROGENATION -> (4C) Malic Acid
FAD -> $FADH_2$
___(4C) Malic Acid - DEHYDROGENATION -> Oxaloacetic Acid
NAD -> NADH
___specific mention of 2 x 3 NADH & 2 x 1 $FADH_2$ produced during Krebs
___**ATP (1) produced in Krebs**

ETS RECEIVES THE FOLLOWING: NADH or $FADH_2$ WHICH RESULTS IN ATP PRODUCTION

___Glycolysis -> 2 NADH x 2 ATP = 4
___Pyruvic Acid -> Acetyl CoA + 2 NADH x 3 ATP = 6
___Krebs -> 8 NADH ($FADH_2$) x 3 ATP = 24
Total = 34

___34 ATP gained through ETS
___Respiratory Assembly: CoQ, cytochromes b, c, a, a3
___Ring Compounds w/Fe (porphyrin ring)
___Changing Oxidation states as "go down" assembly
___Fe III -> Fe II change ionic state as accept electrons
___Release energy in "packets" - small amounts sufficient to produce ATP (about 7 kcal/mole)
___Occurs at 3 places in the chain for each NADH, $FADH_2$
___mention of various hypotheses: Chemiosmotic, Conformational, Chemical Coupling
___O_2 final acceptor (-> H_2O)

CELLULAR RESPIRATION QUESTION 1982: L. PETERSON/AP BIOLOGY