IV. Glycolysis and ATP

glycolysis → link reaction → Kreb's cycle → electron transport chain → chemiosmosis

Glycolysis = Sugar Splitting

glucose + 2 ATP + 2 NAD^+ –> 4 ATP + 2 NADH+H^+ + 2 pyruvate

Respiration consists of several different interlinked metabolic pathways.

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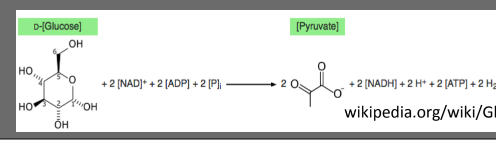
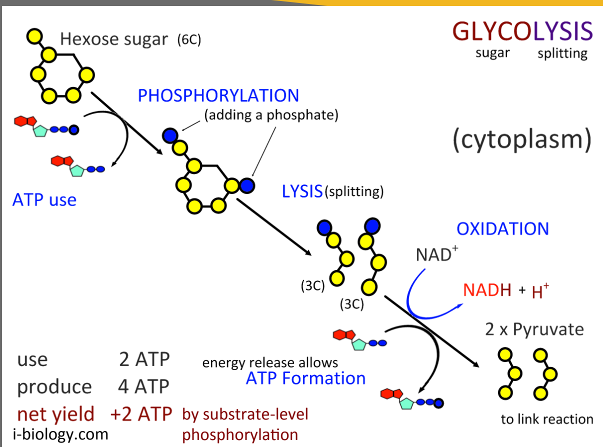
IV. Glycolysis and ATP

A. In glycolysis, glucose is converted to pyruvate in the cytoplasm and Glycolysis gives a small net gain of ATP without the use of oxygen-

1. Glycolysis occurs in cytoplasm
2. Glucose is phosphorylated using 2 ATP
3. The hexose phosphate is then split into two triose phosphates
4. Oxidation occurs removing hydrogen
5. The hydrogen is used to reduce NAD^+ to NADH
6. 4 ATP are produced resulting in a net gain of two ATP
7. 2 pyruvate molecules are produced at the end of glycolysis



wikipedia.org/wiki/Glycolysis



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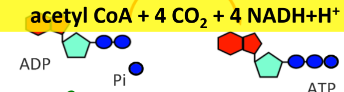
V. The fate of pyruvate and the link reaction

glycolysis → link reaction → Kreb's cycle → electron transport chain → chemiosmosis

Link Reaction (Links Glycolysis to Kreb's Cycle)

2 pyruvate + 4 H_2O + 4 NAD^+ –coenzyme A–> acetyl CoA + 4 CO_2 + 4 NADH+H^+



for each glucose

Respiration consists of several different interlinked metabolic pathways.

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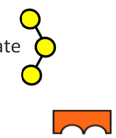
V. The fate of pyruvate and the link reaction

A. In aerobic cell respiration pyruvate is decarboxylated and oxidized and In the link reaction pyruvate is converted to acetyl coenzyme A-
   1. Pyruvate enters the mitochondrion matrix
   2. Enzymes remove one carbon dioxide (decarboxylation) and hydrogen (oxidation) from the pyruvate; oxidative decarboxylation
   3. Hydrogen is reduced by NAD^+ to form NADH
   4. The product is an acetyl group which reacts with coenzyme A
   5. Acetyl CoA enters Krebs cycle

V. The fate of pyruvate and the link reaction

OXIDATIVE DECARBOXYLATION

LINK REACTION (matrix)



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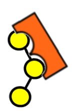
V. The fate of pyruvate and the link reaction

OXIDATIVE DECARBOXYLATION

LINK REACTION (matrix)



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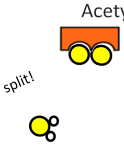
V. The fate of pyruvate and the link reaction

OXIDATIVE DECARBOXYLATION

LINK REACTION (matrix)



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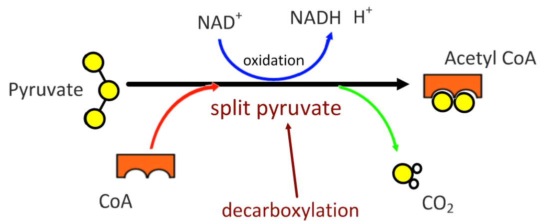
V. The fate of pyruvate and the link reaction

OXIDATIVE DECARBOXYLATION

LINK REACTION
(matrix)
mitochondria



for each pyruvate

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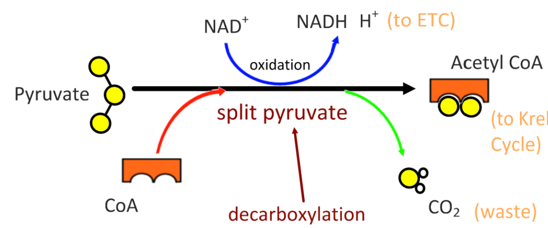
V. The fate of pyruvate and the link reaction

OXIDATIVE DECARBOXYLATION

LINK REACTION
(matrix)
mitochondria



Net yield: 2 Acetyl CoA per glucose molecule
(remember the 6C glucose split into 2 x 3C pyruvate)

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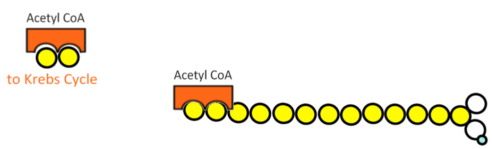
Cell respiration using fatty acids

A. Fatty acids can also be broken down for energy in cell respiration

$CH_3(CH_2)_nCOOH$



Fatty acids have a long chain of carbon atoms. Coenzyme A can oxidize the carbons in the chain breaking it down to acetyl CoA and transferring the energy to the Kreb's cycle.

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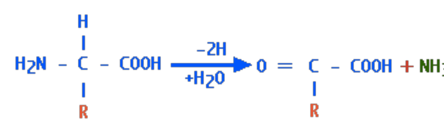
Cell respiration using proteins

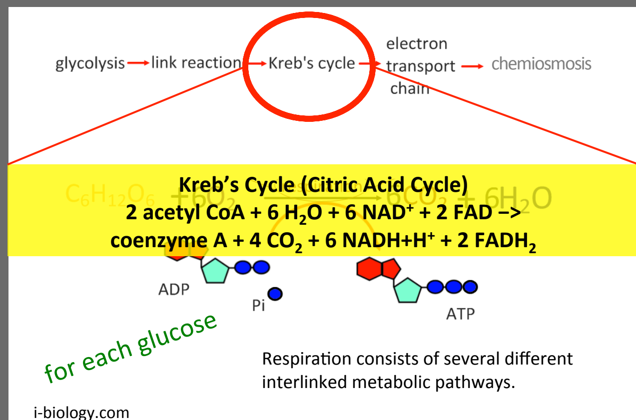
A. Amino acids can also be broken down for energy in cell respiration

$H_2N(R\text{-}CH)COOH$



Amino acids have a few carbon atoms that can be utilized after the amino group has been removed through deamination.
Coenzyme A can oxidize the carbons to acetyl CoA and transferring the energy to the Kreb's cycle.

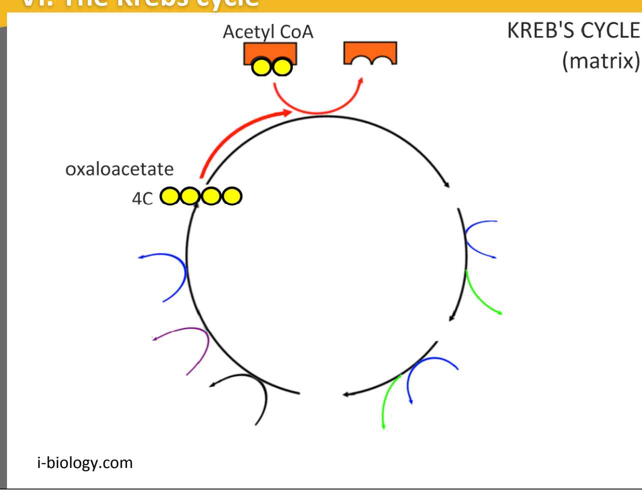
VI. The Krebs cycle



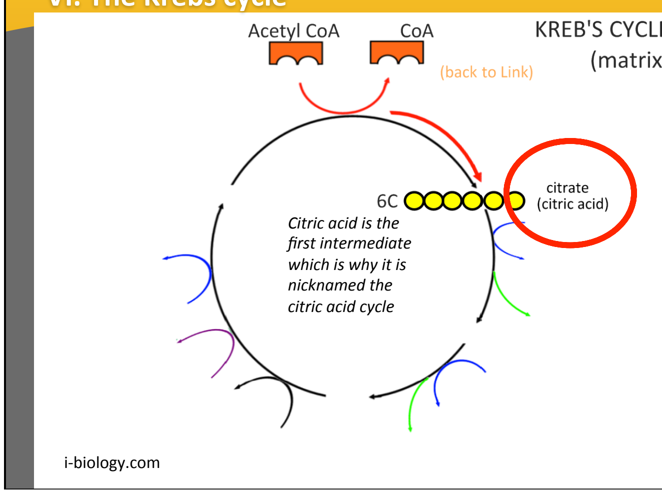
VI. The Krebs cycle

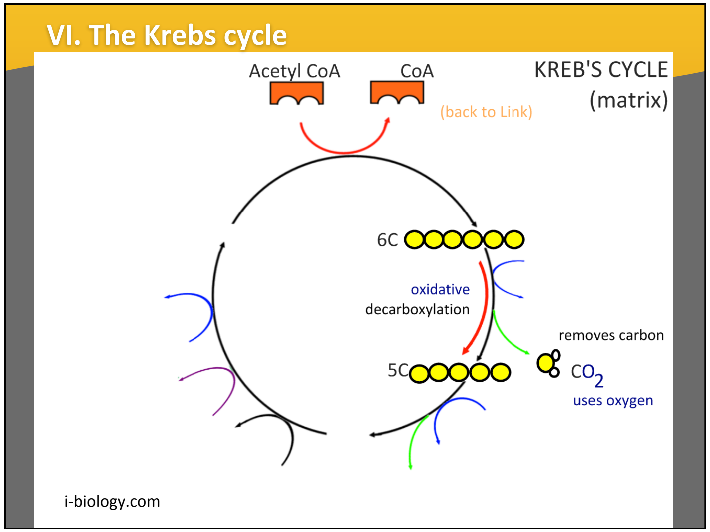
A. In the Kreb's cycle, the oxidation of acetyl groups is coupled to the reduction of hydrogen carriers-
   1. Acetyl CoA enters the Krebs cycle
   2. Acetyl group (2C) joins a 4C sugar to form a 6C sugar
   3. Oxidative decarboxylation occurs twice reducing 3 NAD^+ and FAD to 3 NADH + H^+ and $FADH_2$, and releases 2 CO_2:
      a. A 6C sugar to a 5C compound
      b. A 5C compound to a 4C compound
   4. One ATP is produced by substrate level phosphorylation (from ADP + Pi) per molecule of pyruvate / cycle
   5. NADH and $FADH_2$ provide electrons to the electron transport chain

VI. The Krebs cycle



VI. The Krebs cycle




VI. The Krebs cycle
Acetyl CoA
CoA
KREB'S CYCLE
(matrix)
(back to Link)
6C
oxidative
decarboxylation
removes carbon
5C
CO2
uses oxygen
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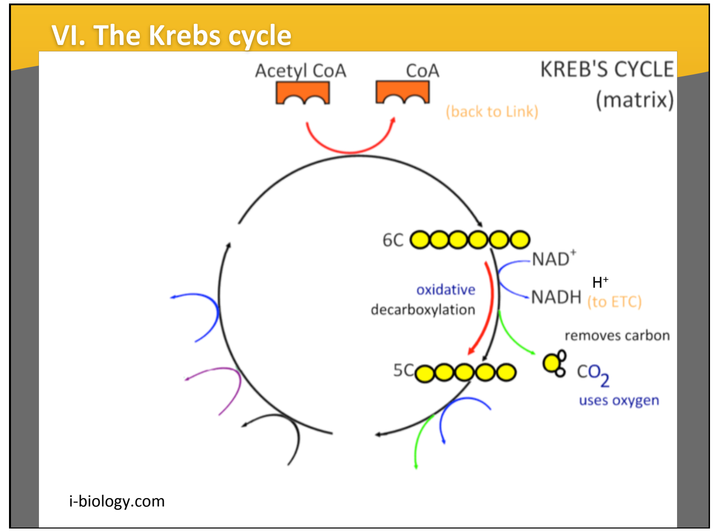
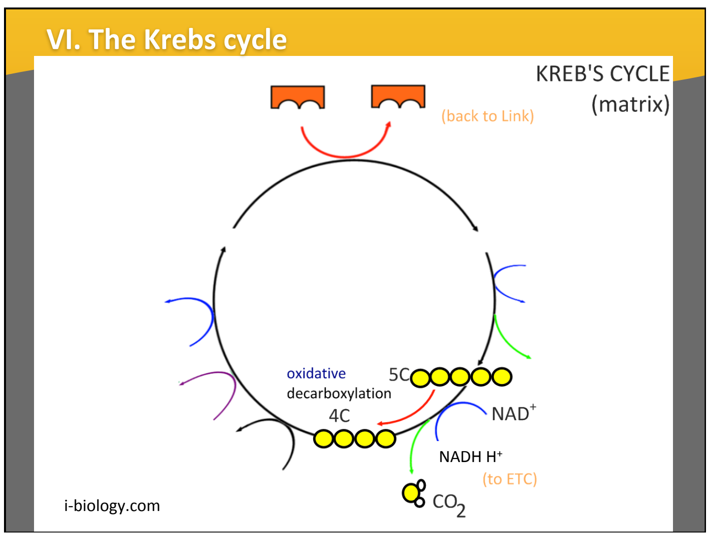

VI. The Krebs cycle
Acetyl CoA
CoA
KREB'S CYCLE
(matrix)
(back to Link)
6C
NAD+
NADH
H+
(to ETC)
oxidative
decarboxylation
removes carbon
5C
CO2
uses oxygen
i-biology.com


VI. The Krebs cycle
KREB'S CYCLE
(matrix)
(back to Link)
oxidative
decarboxylation
5C
4C
NAD+
NADH H+
(to ETC)
CO2
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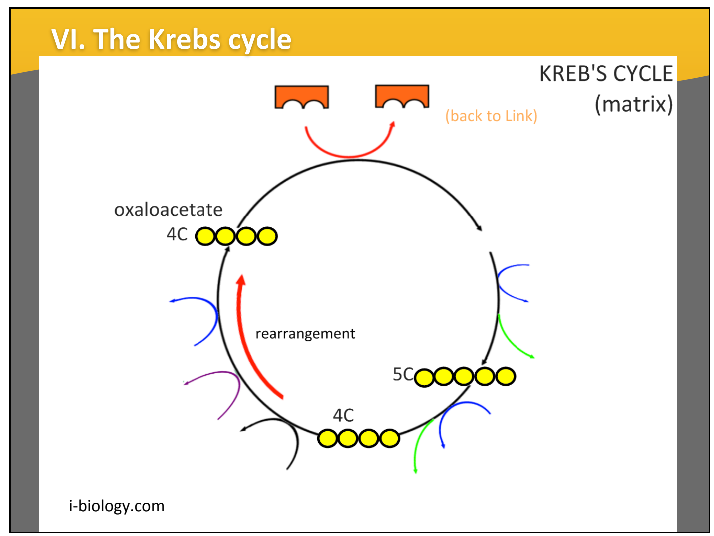
VI. The Krebs cycle
KREB'S CYCLE
(matrix)
(back to Link)
oxaloacetate
4C
rearrangement
5C
4C
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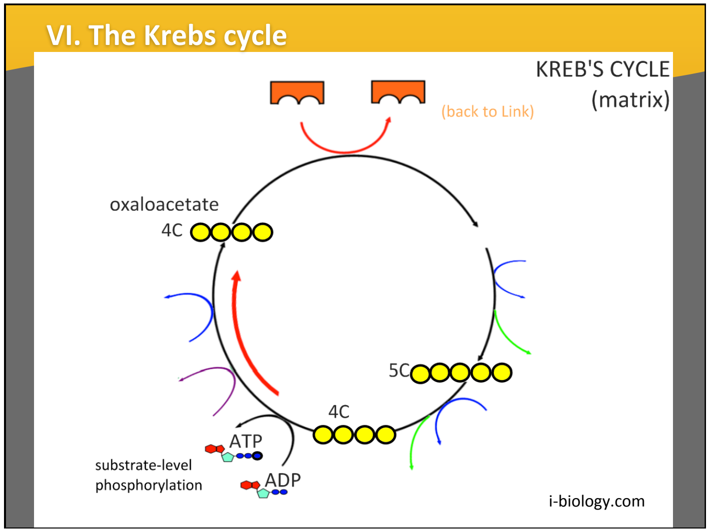
VI. The Krebs cycle
KREB'S CYCLE
(matrix)
(back to Link)
oxaloacetate
4C
5C
4C
ATP
ADP
substrate-level
phosphorylation
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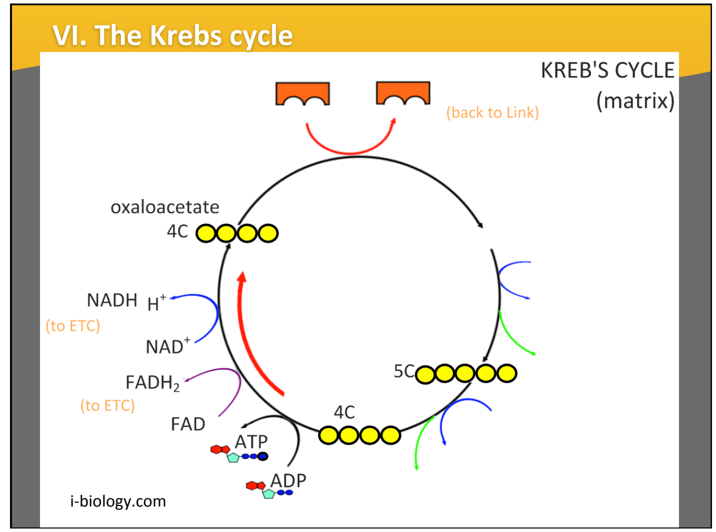
VI. The Krebs cycle
KREB'S CYCLE
(matrix)
(back to Link)
oxaloacetate
4C
NADH H+
(to ETC)
NAD+
FADH2
(to ETC)
FAD
5C
4C
ATP
ADP
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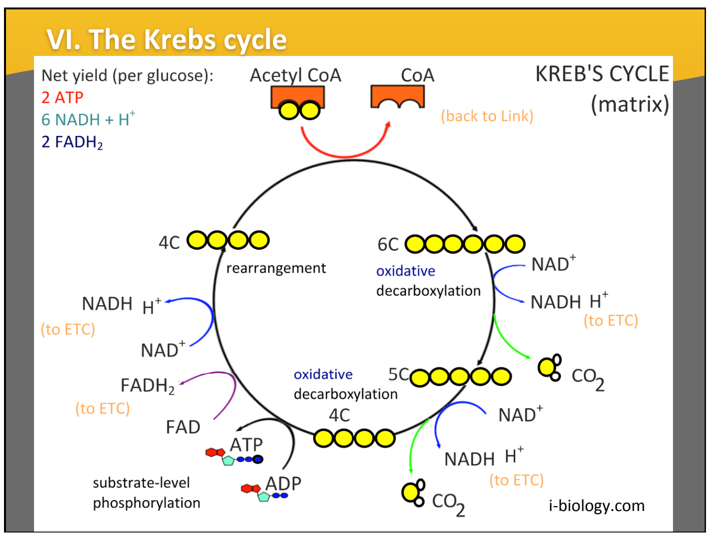
VI. The Krebs cycle
Net yield (per glucose):
2 ATP
6 NADH + H+
2 FADH2
Acetyl CoA
CoA
KREB'S CYCLE
(matrix)
(back to Link)
4C
rearrangement
6C
oxidative
decarboxylation
NAD+
NADH H+
(to ETC)
NADH H+
(to ETC)
NAD+
FADH2
(to ETC)
FAD
CO2
oxidative
decarboxylation
5C
4C
NAD+
NADH H+
(to ETC)
ATP
ADP
substrate-level
phosphorylation
CO2
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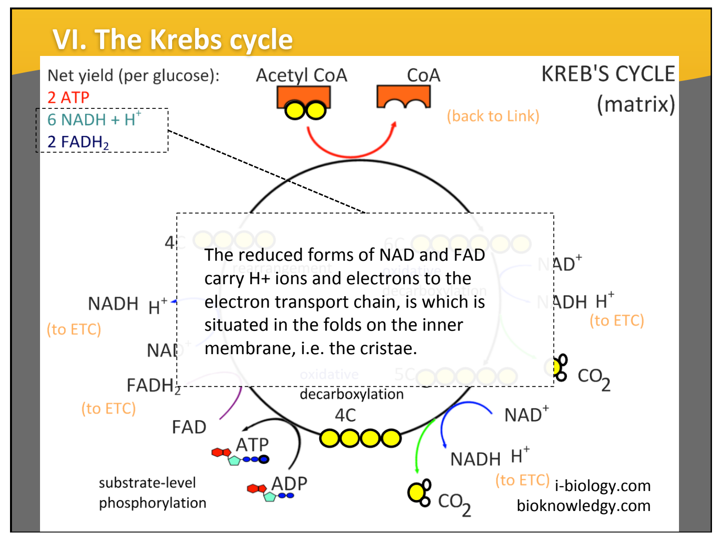
VI. The Krebs cycle
Net yield (per glucose):
2 ATP
6 NADH + H+
2 FADH2
Acetyl CoA
CoA
KREB'S CYCLE
(matrix)
(back to Link)
The reduced forms of NAD and FAD carry H+ ions and electrons to the electron transport chain, is which is situated in the folds on the inner membrane, i.e. the cristae.
NADH H+
(to ETC)
FADH2
(to ETC)
FAD
CO2
decarboxylation
4C
NAD+
NADH H+
(to ETC)
ATP
ADP
substrate-level
phosphorylation
CO2
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