THE RESPIRATORY PATHWAY
(How cells harvest energy) JML 2001

Glycolysis:

Summary: Anaerobic Cytoplasm

Net ATP prod. = 2

Glucose (6C) → Glucose-6-phosphate (energized)

→ 2 Pyruvate (3C) + 2 ATP + 4H + heat

Fate?

(if conditions remain anaerobic)

Fermentation:

2 Pyruvate (3C) + 2 ATP + 2 NAD_{red} + heat

→ 2 Lactate (3C) + 2 NAD_{ox}

Fate?

2 Pyruvate (3C) + 2 ATP + 2 NAD_{red} + 2 ADP + 2Pi → 2 Pyruvate + 4 ATP + 2 NAD_{red} + 2 H^{+} + 2 H_{2}O + heat

Transition Reactions:

2 Pyruvate (3C) + 2 Coenzyme A

→ 2 Acetyl-CoA (2C) + 4H + 2 CO_{2} + heat

(active acetate) Fate?

(2 Pyruvate (3C) + 2NAD_{ox} + 2 CoA → 2 Acetyl-CoA (2C) + 2 CO_{2} + 2 NAD_{red} + 2 H^{+} + heat)

Krebs Cycle:

Citrate (6C) → Oxaloacetate (4C)

→ 2 Acetyl-CoA (2C) + 4H + 2 CO_{2} + 6 H^{+} + heat

CO_{2}

alpha-ketoglutarate (5C) → 2H → 1 NAD_{red}

(2 Acetyl-CoA + 4H_{2}O + 2 ADP + 2 Pi → 4 CO_{2} + 2H_{2}O + 16 H + 2 CoA + 2 ATP + heat)

Fate? (6NAD_{red} + 6 H^{+} + 2FAD_{red})

Oxidative Phosphorylation:

(2 NAD_{red} + 2 FAD_{red})

→ ETS (chemiosmosis) + 6 O_{2} + 26 ADP + 26 Pi

ETS (chemiosmosis) + 6 O_{2} + 26 ADP + 26 Pi

→ 12 H_{2}O + 26 ATP

Summary: Aerobic

Mitochondria

Net ATP prod. = 26

----------------- Net Product Summary: 30 ATP, 6CO_{2}, 12 H_{2}O, heat ----------------
Biosynthesis and the Entrance of Other Metabolites into Aerobic Cellular Respiration

Glycolysis:

Glucose (6C)  
\[ \text{Glucose-6-phosphate} \rightarrow \text{Polysaccharides} \]

2 Phosphoglyceraldehyde (PGAL) (3C)  
\[ \text{Glycerol (3C)} \]

2 Pyruvate (3C)

Transition Reactions:

2 Pyruvate + 2 Coenzyme A  
\[ \rightarrow 2 \text{ Acetyl Co-A (2C)} \]

Kreb's Cycle:

Citrate (6C)  
\[ \text{alpha-ketoglutarate (5C)} \]

Proteins  
\[ \text{amino acids} \]

NH₂ + carbon skeleton*  
\[ \text{NH₃} \]

urea  
\[ \text{excreted} \]

Oxidative Phosphorylation:

\[ \text{O}_2 \rightarrow \text{ATP} + \text{H}_2\text{O} + \text{heat} \]

* entrance depends on the number of Carbon atoms in the R group of each amino acid (i.e. what remains after deamination)