Breakdown of glucose to release energy to recreate ATP

\[ C_6H_{12}O_6 + 6 \text{O}_2 \rightarrow 6 \text{H}_2\text{O} + 6 \text{CO}_2 + E \text{ (686 Kcal/mol)} \]

* if metabolized, energy released in form of some heat but mostly held in high energy electrons
* high energy electrons shuttled within cell by NAD\(^+\) & FAD

\[
\begin{align*}
\text{NAD}^+ + 2 \text{hi-E electrons} + \text{H}^+ & \rightarrow \text{NADH} \\
\text{FAD} + 2 \text{hi-E electrons} + 2 \text{H}^+ & \rightarrow \text{FADH}_2
\end{align*}
\]

- electrons useful directly for a variety of synthetic reactions
- energy stored for later use in form of bond energy in Adenosine Triphosphate (ATP) = "Energy currency" of cell

\[ \text{ATP} + \text{H}_2\text{O} \rightarrow \text{ADP} + \text{P}_i + 7.3 \text{ Kcal energy} \]

\[ \downarrow \]

cellular work

* to maintain reserve of energy, need to continually re-supply cells with ATP by driving reaction in reverse

\[ \text{ADP} + \text{P}_i \rightarrow \text{ATP} + \text{H}_2\text{O} \]

* energy to do this comes from variety of reactions, most notably the breakdown of glucose:

\[ C_6H_{12}O_6 + 6 \text{O}_2 \rightarrow 6 \text{H}_2\text{O} + 6 \text{CO}_2 + \text{energy (686 Kcal/mol)} \]

\[ \downarrow \]

\[ \text{ADP} + \text{P}_i \rightarrow \text{ATP} + \text{H}_2\text{O} \]

Oxidation of glucose to form carbon dioxide & release energy to be used to drive the formation of ATP from ADP & P\(_i\)

Watch for:
* carbon backbone of glucose disposed of as carbon dioxide
* high energy electrons picked up by NAD\(^+\) and FAD
* ATP being made from ADP and P\(_i\)
Review 11, con’t

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

1. **In the CYTOPLASM: GLYCOLYSIS**

   glucose $\rightarrow$ 2 pyruvic acid
   
   2 (ADP+P$_i$) $\rightarrow$ 2 ATP
   
   2 (NAD$^+$+H$^+$) $\rightarrow$ 2 NADH
   
   “coupled reactions”

2. **Entry into the MITOCHONDRION: Oxidation of Pyruvic Acid**

   (as pyruvic acid enters the matrix of the mitochondrion)

   FOR EACH PYRUVIC ACID FROM THE GLUCOSE:

   pyruvic acid $\rightarrow$ acetyl-CoA

   1 Coenzyme A 1 CO$_2$

   1(NAD$^+$ + H$^+$) 1 NADH

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Diagram:

- Inner membrane
- Outer membrane
- Matrix
- Cristae