GLYCOLYSIS

10/30/91, revd 11/3/93, 11/8/94, 5 Nov 99, 6 Nov 00, 5 Nov 01, 7 Nov 03, 5 Nov 04, 27Oct08, 22Oct10
BKH: pp. 382-401, BKH 5‡: 378-393, bkhb 7": PP229-246

Contrast fermentation with respiration. (Review table 9-1 for energy in bonds.)

Embden & Meyerhof in 1930s: Glycolysis generates ATP without any net oxidation.

Glycolysis also called Embden-Meyerhof pathway. Overview: figure 9-6, p 232

PREPARATION AND CLEAVAGE

phosphorylation Hexokinase (p. 233) Glucose to Glucose-6-PO$_4$ (and other hexoses)

isomerization Phosphoglucoisomerase G-6-PO$_4$ to Fructose-6-PO$_4$ (easy interconversion)

phosphorylation Phosphofructokinase F-6-PO$_4$ to fructose 1,6 bis PO$_4$ (inhibited by x5 ATP)
(allosterically regulated This enzyme is an important control point in glucose catabolism.)

cleavage Aldolase F-1,6,-bis PO$_4$ split into two trioses:
glyceraldehyde-3-PO$_4$
dihydroxyacetone PO$_4$

OXIDATION AND ATP GENERATION:

isomerization Triose phosphate isomerase dihydroxyacetone PO$_4$ converted to glyceraldehyde-3-PO$_4$
(easy interconversion, as with G-6-P to F-6-P above)

oxidation (p 382) Glyceraldehyde-3-phosphate dehydrogenase G-3-PO$_4$ is oxidized via an enzyme-linked thioester (making
NADH) and phosphorylated (add PO$_4$)
Forms a high energy (phosphoanhydride), yields
1,3-bisphosphoglycerate

ATP generation Phosphoglycerokinase Substrate-level phosphorylation: High energy PO$_4$ transferred to ADP, makes
3 phosphoglycerate and ATP

PYRUVATE FORMATION AND ATP GENERATION:

isomerization Phosphoglyceromutase PO$_4$ transferred to #2 carbon to make 2 phosphoglycerate
(To produce a molecule susceptible to dehydration.)

dehydration Enolase produces phosphoenolpyruvate: energy rich, highly unstable, because not only delocalization prevents, but held in stressed enol form instead of relaxed keto form.
I.e., tautomerization is prevented

ATP generation Pyruvate kinase Substrate-level phosphorylation: PEP transfers PO$_4$ to
ADP producing pyruvic acid (tautomerization allowed) and
ATP

Distinguishing feature of high energy bond in PEP: PO$_4$ adjacent to double bond

Here is a good YouTube video presenting the mechanism of the 10 steps:
http://www.youtube.com/watch?v=DJrA64rBhSk