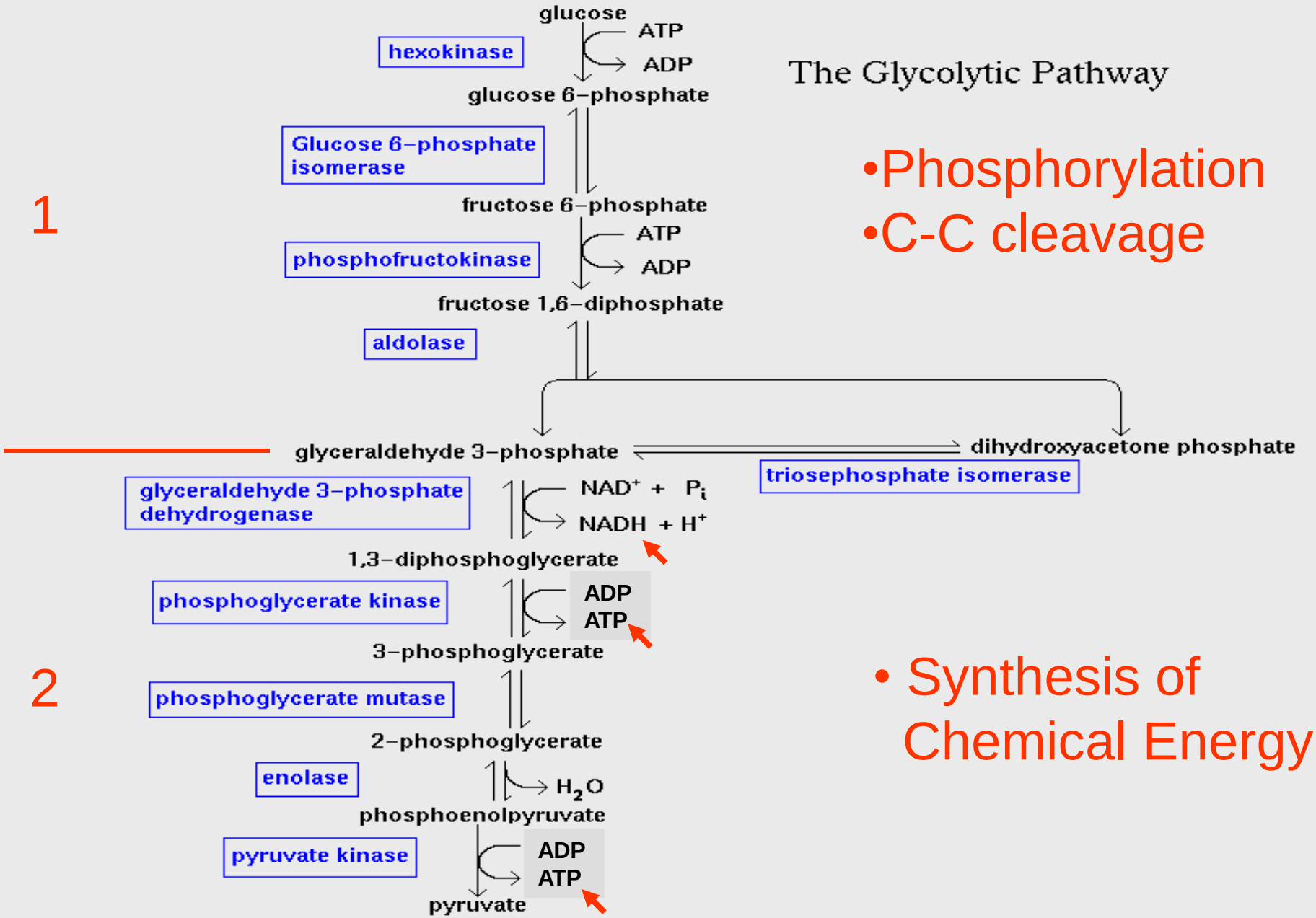
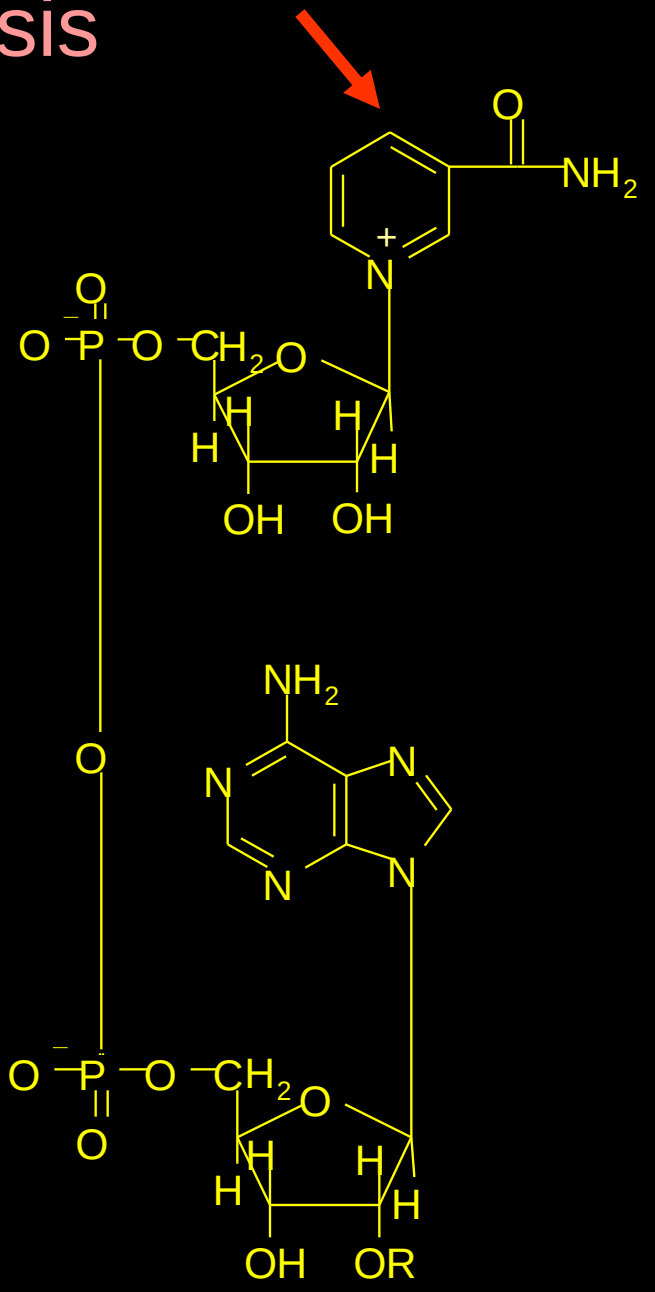
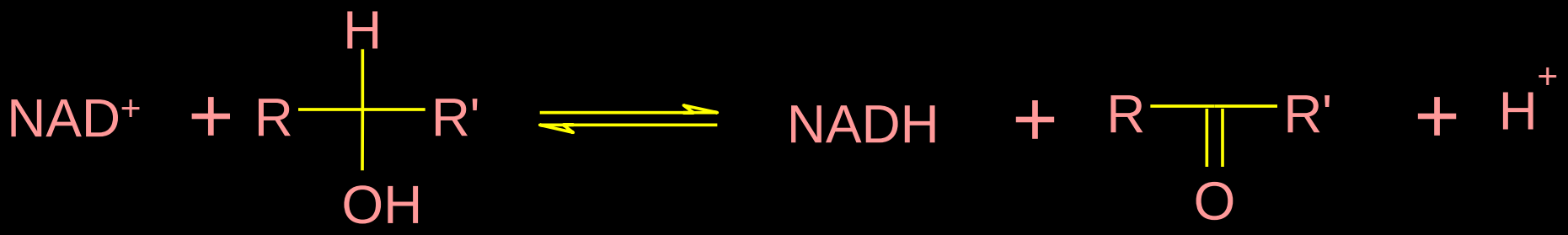

The Glycolytic Pathway
glucose
ATP
ADP
hexokinase
glucose 6–phosphate
Glucose 6–phosphate isomerase
fructose 6–phosphate
ATP
ADP
phosphofructokinase
fructose 1,6–diphosphate
aldolase
glyceraldehyde 3–phosphate
dihydroxyacetone phosphate
triosephosphate isomerase
glyceraldehyde 3–phosphate dehydrogenase
NAD+ + Pi
NADH + H+
1,3–diphosphoglycerate
phosphoglycerate kinase
ADP
ATP
3–phosphoglycerate
phosphoglycerate mutase
2–phosphoglycerate
enolase
H2O
phosphoenolpyruvate
pyruvate kinase
ADP
ATP
pyruvate
1
2
•Phosphorylation
•C-C cleavage
• Synthesis of Chemical Energy

2nd Phase of Glycolysis

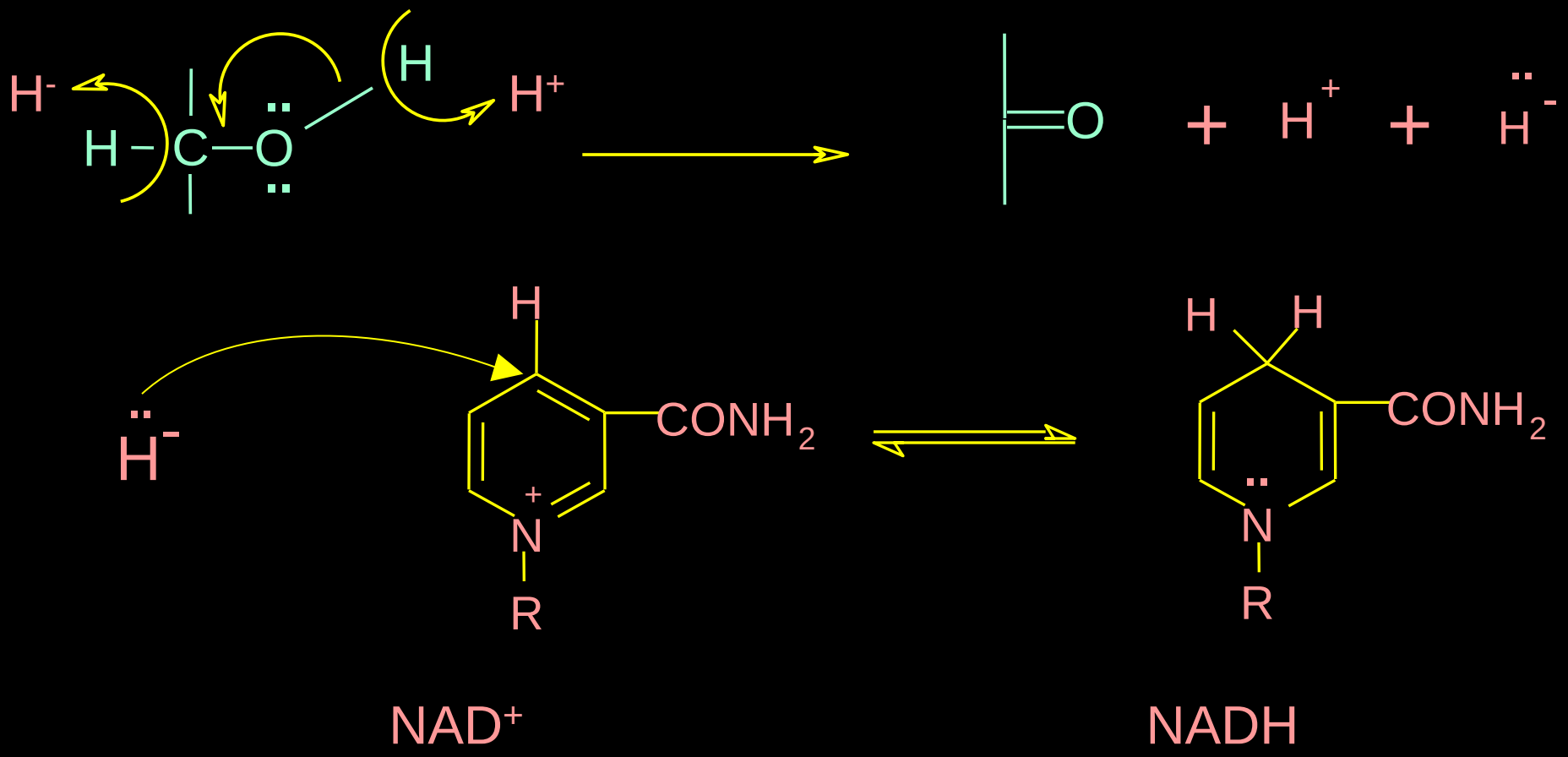
- Generation of ATP
- Biological Oxidations involving NAD^+/NADH (Dehydrogenations)



NAD^+ is the electron acceptor in reactions of the type:



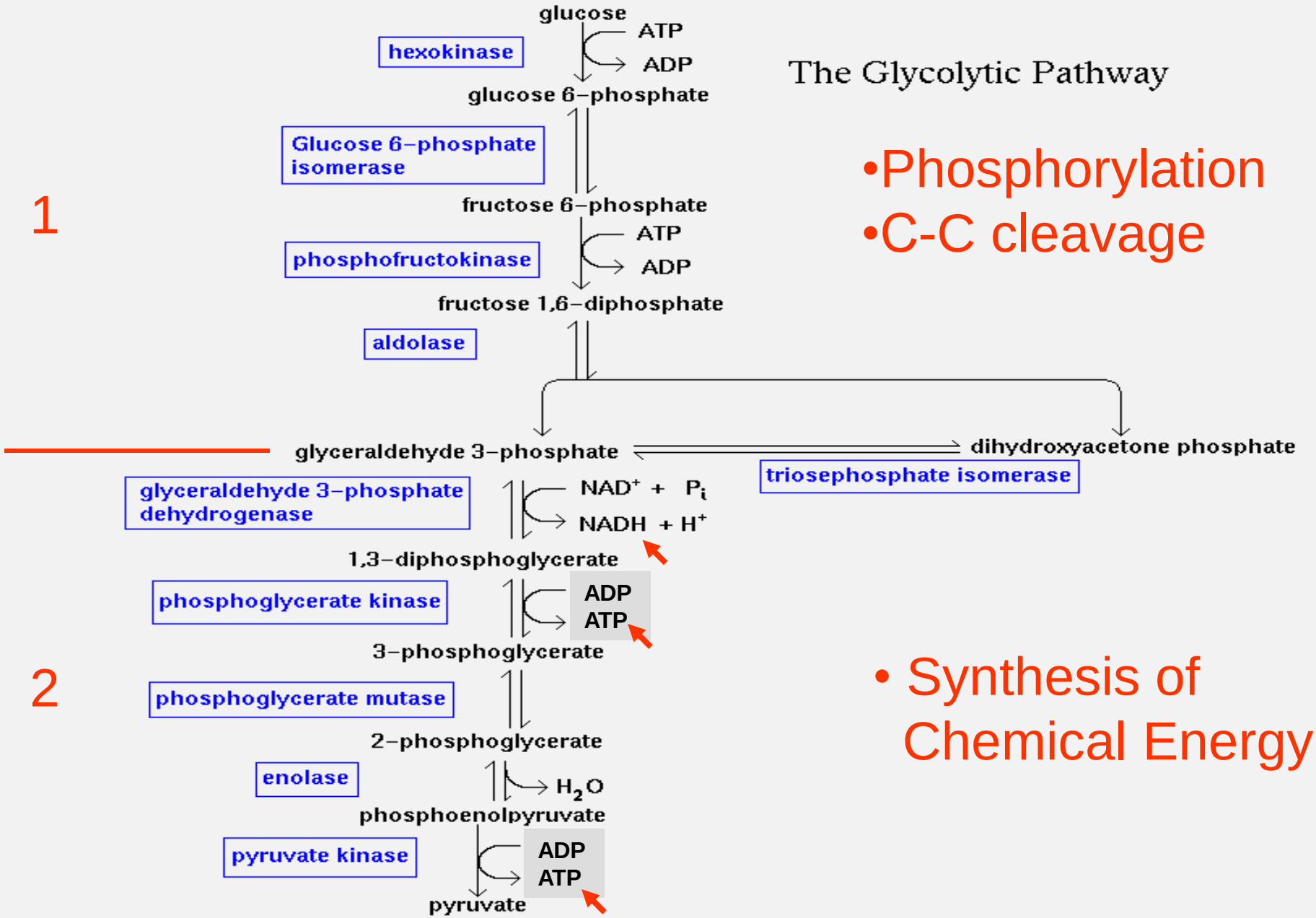
Mechanism



Acid/Base vs. Redox

acid/base $BH \rightleftharpoons B^- + H^+$

redox $NADH \rightleftharpoons NAD^+ + H^+ + 2e^-$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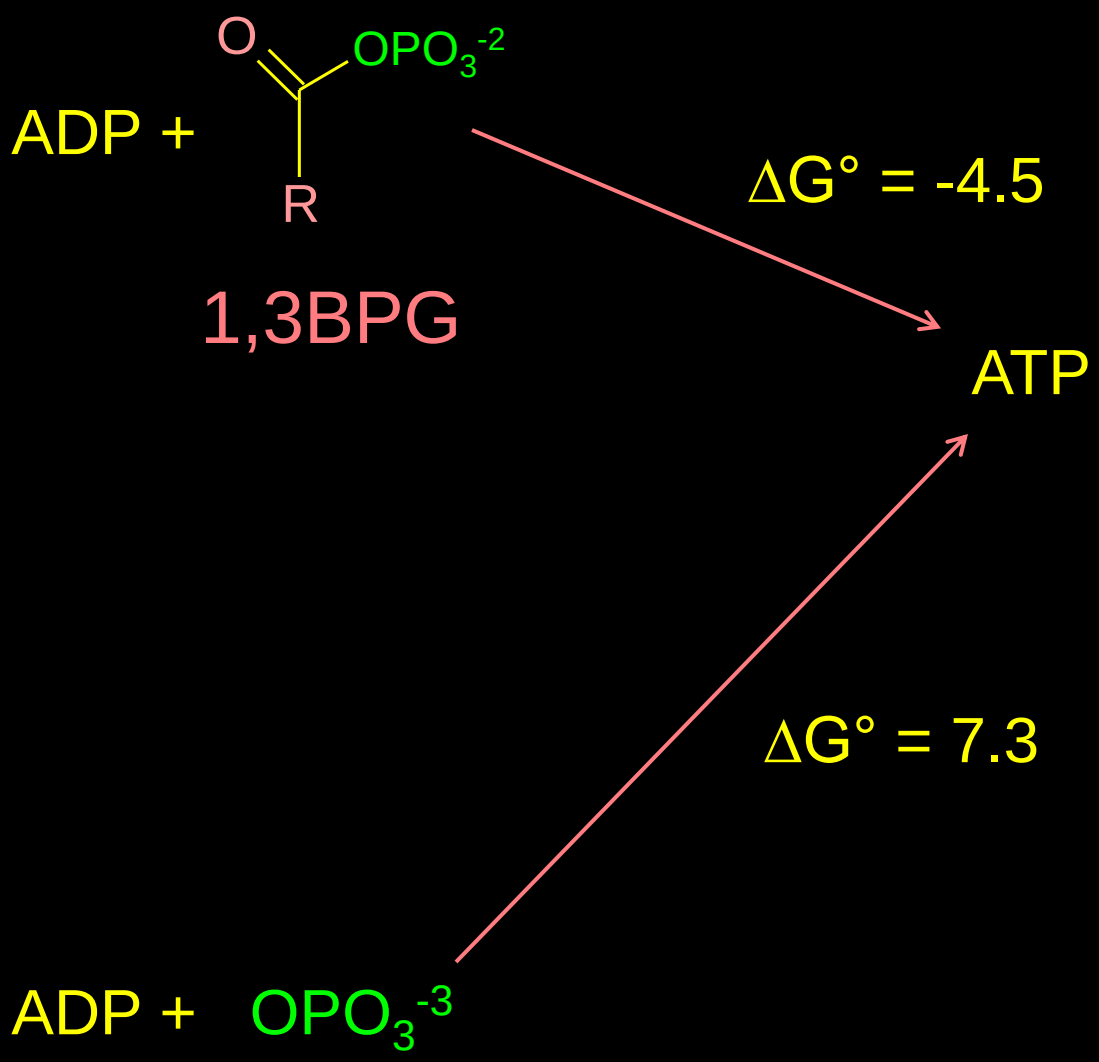
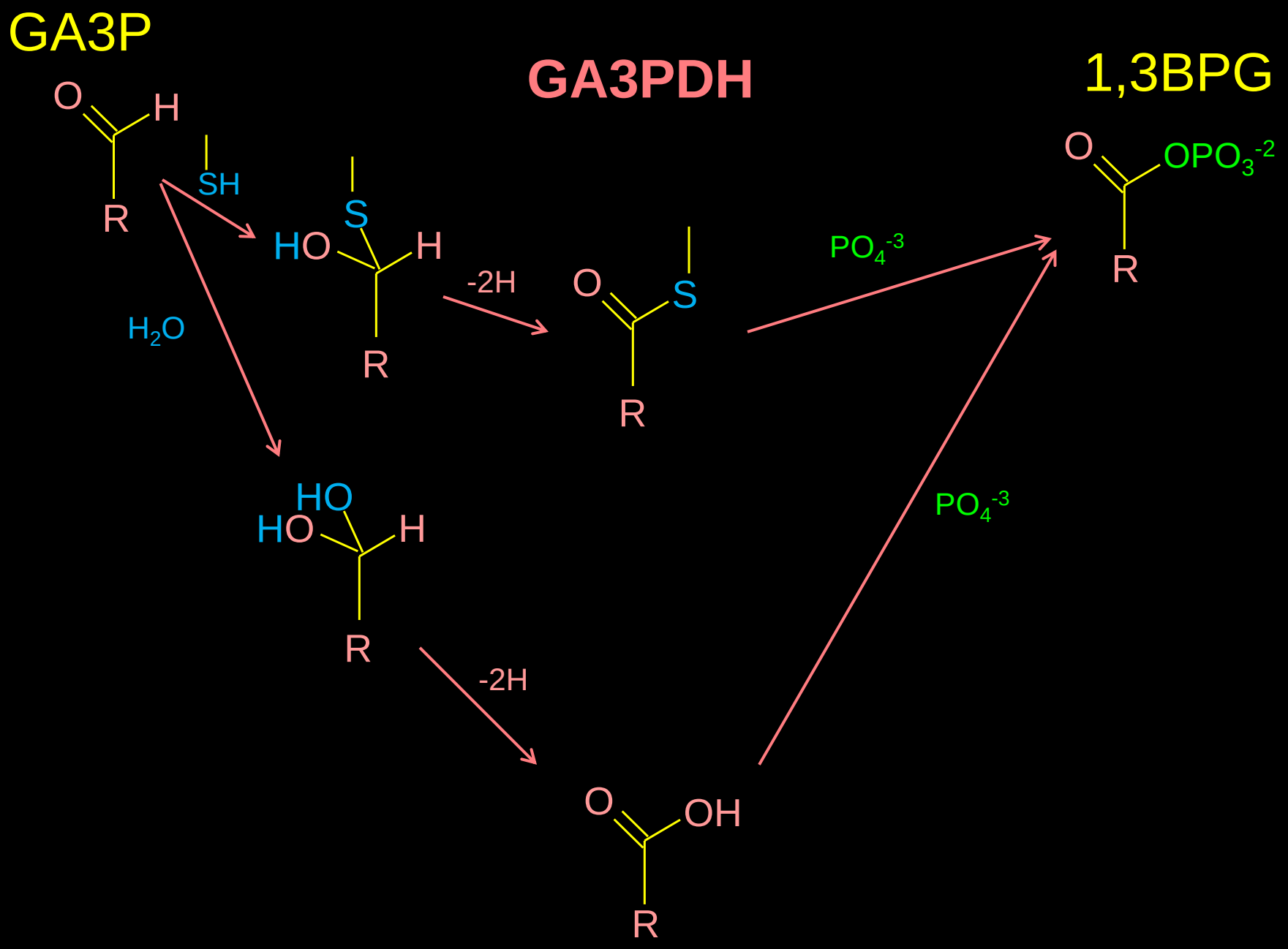
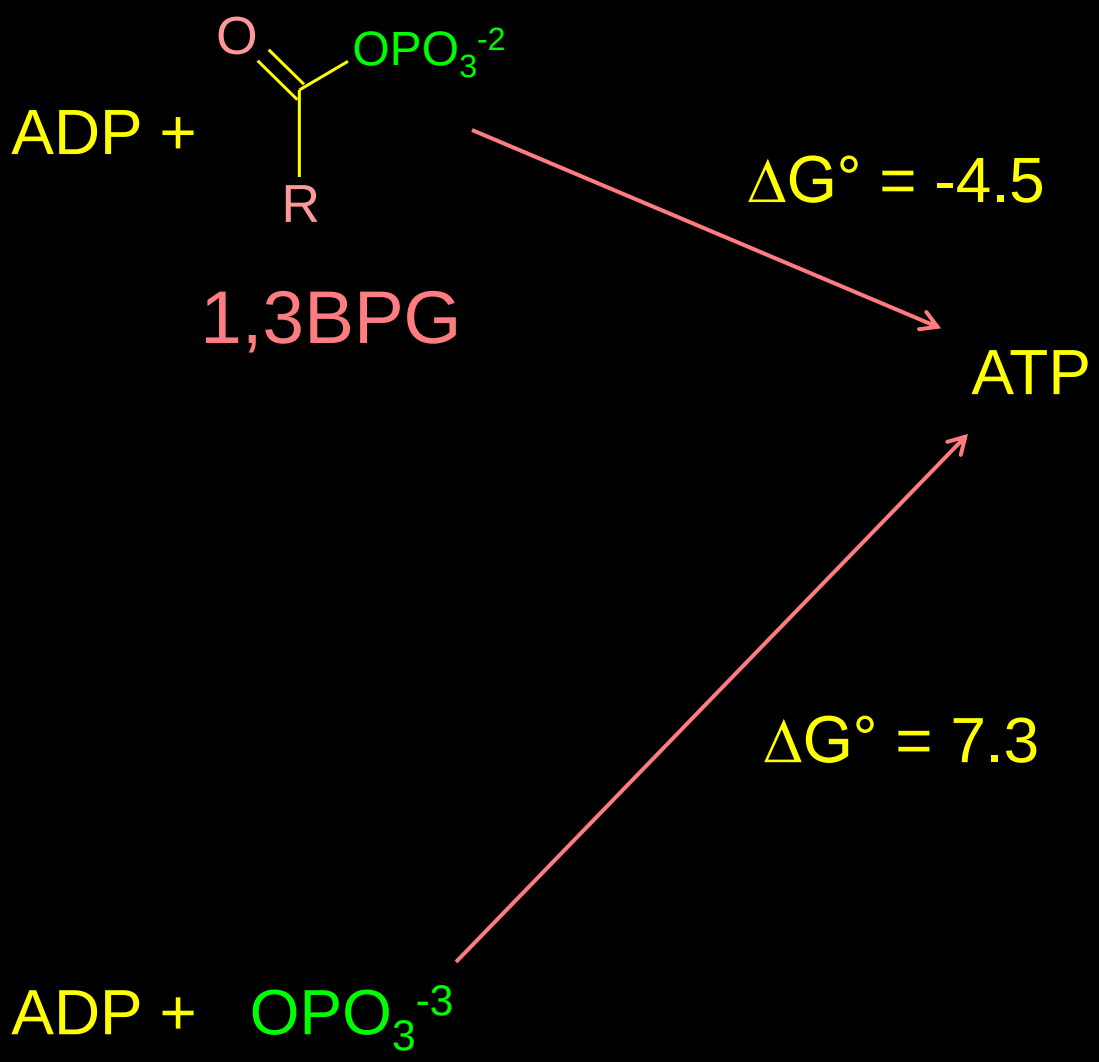
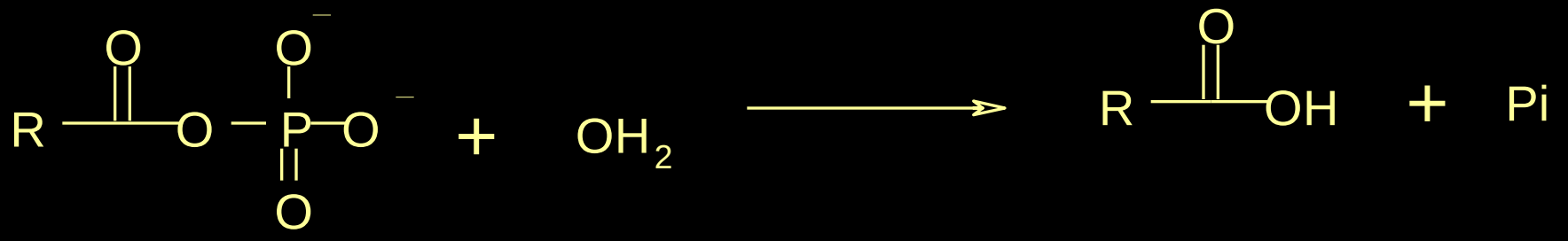

O
OPO_3^{-2}
ADP +
R
1,3BPG
ΔG° = -4.5
ATP
ΔG° = 7.3
ADP + OPO_3^{-3}


GA3P
GA3PDH
1,3BPG
O
H
R
SH
S
HO
H
R
-2H
O
S
R
PO_4^{-3}
O
OPO_3^{-2}
R
H_2O
HO
HO
H
R
-2H
PO_4^{-3}
O
OH
R

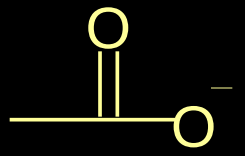

O
OPO_3^{-2}
ADP +
R
1,3BPG
ΔG° = -4.5
ATP
ΔG° = 7.3
ADP + OPO_3^{-3}

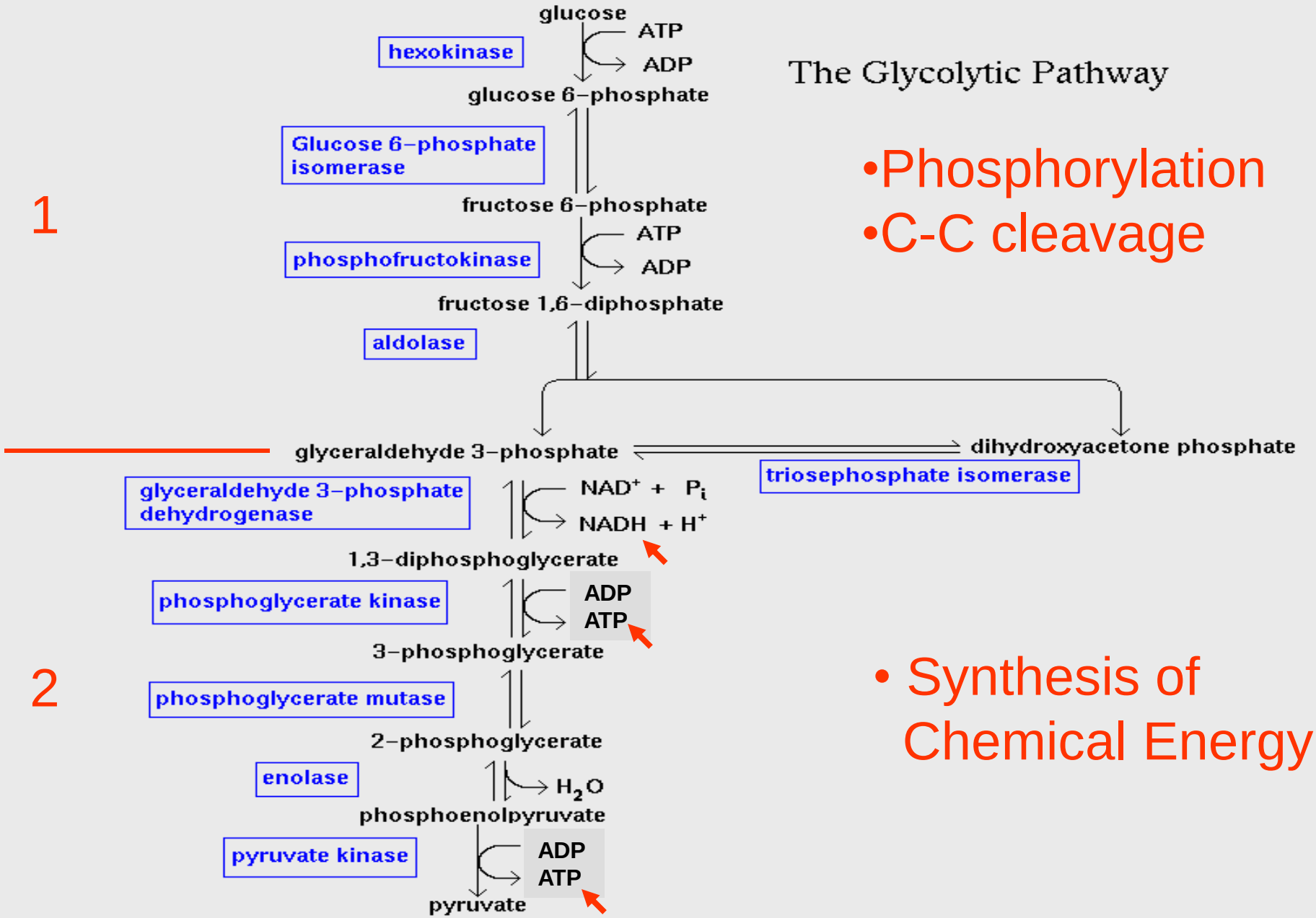
Structural basis for high PO_4-transfer potential of acyl phosphates

$\Delta G° = -11.8$ kcal/mol



Similar reasons as for hydrolysis of ATP:

1. e- withdrawing ability of  group.
2. Differential resonance energies between reactants and products.
3. Charge repulsion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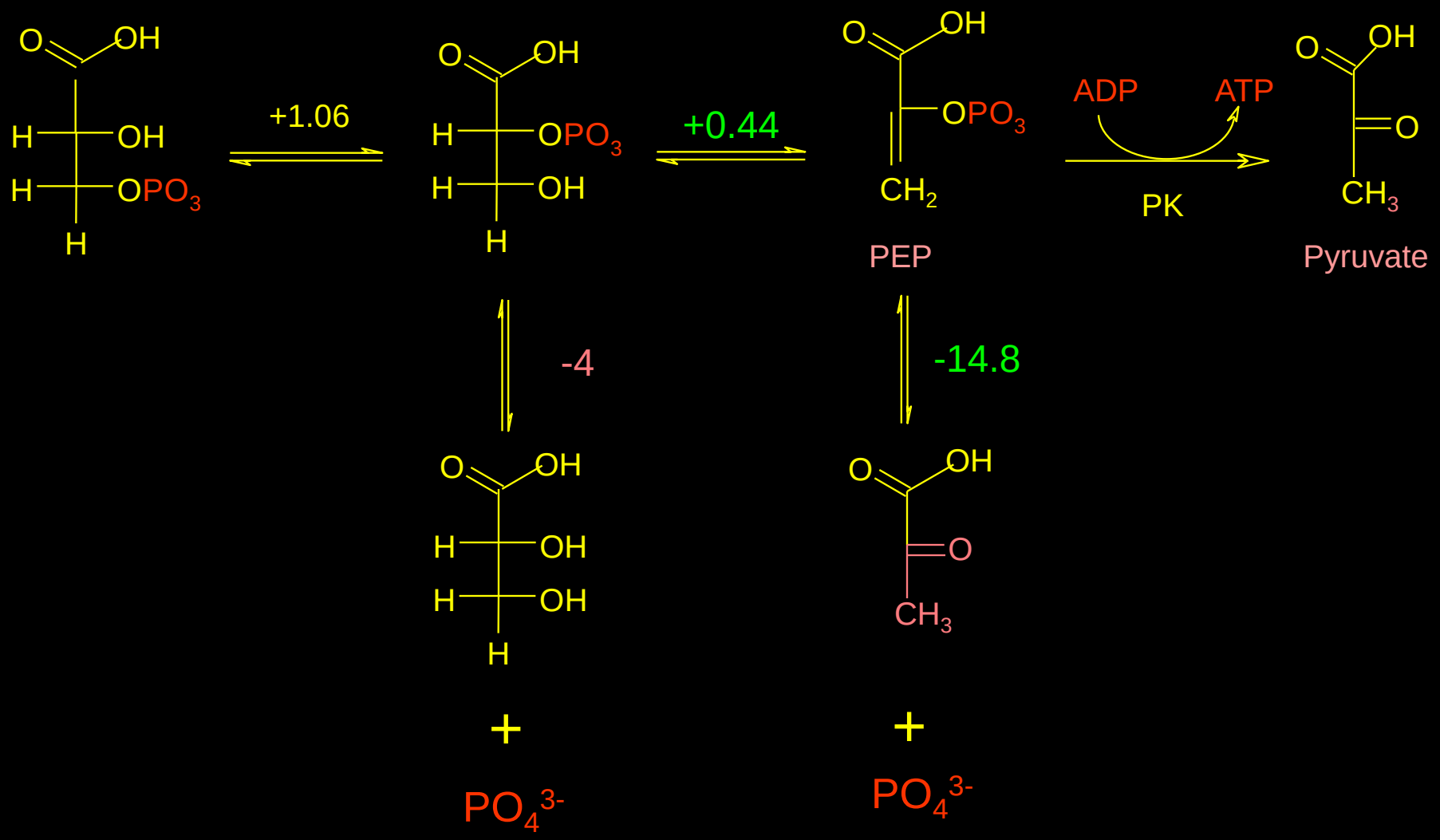
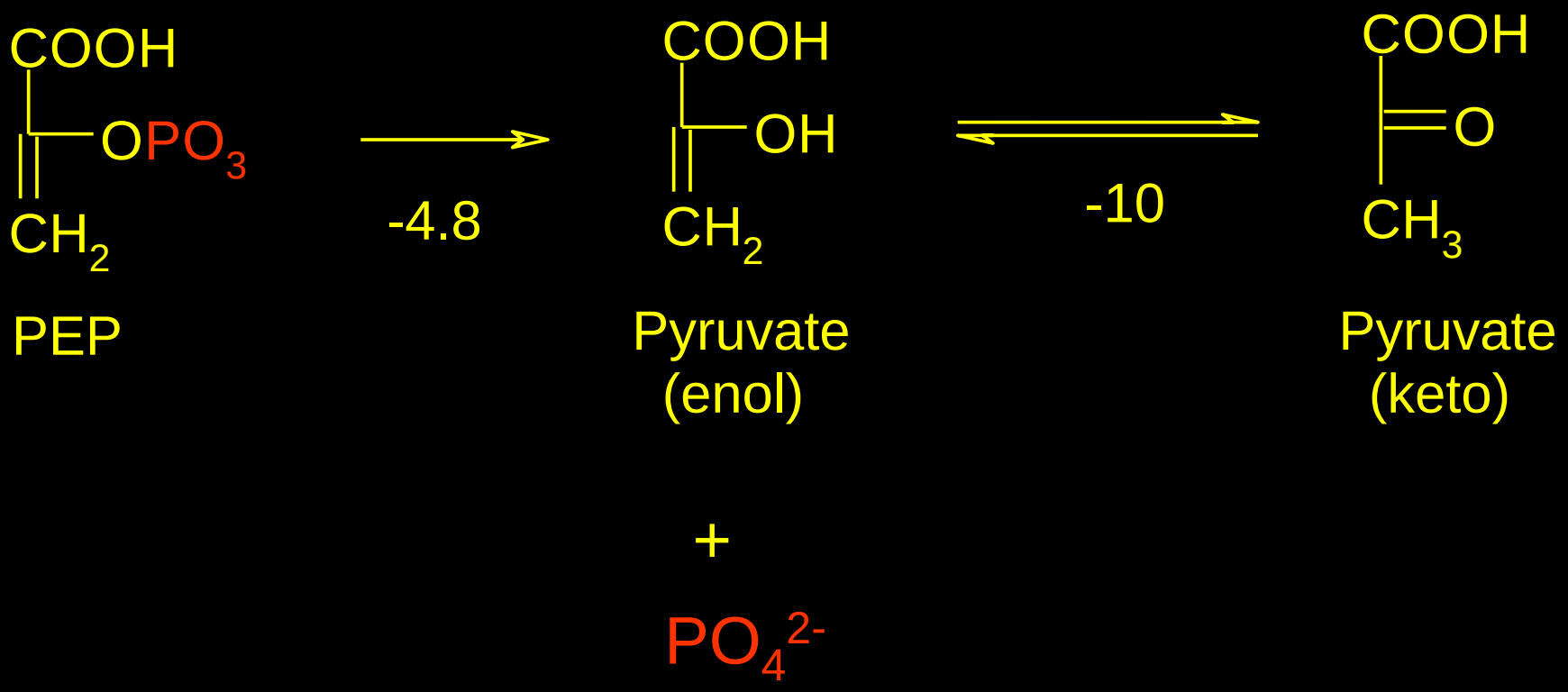
triosephosphate isomerase
glyceraldehyde 3–phosphate dehydrogenase
NAD+ + Pi
NADH + H+
1,3–diphosphoglycerate
phosphoglycerate kinase
ADP
ATP
3–phosphoglycerate
phosphoglycerate mutase
2–phosphoglycerate
enolase
H2O
phosphoenolpyruvate
pyruvate kinase
ADP
ATP
pyruvate
1
2
•Phosphorylation
•C-C cleavage
• Synthesis of Chemical Energy

Phosphorylation of ADP by PEP

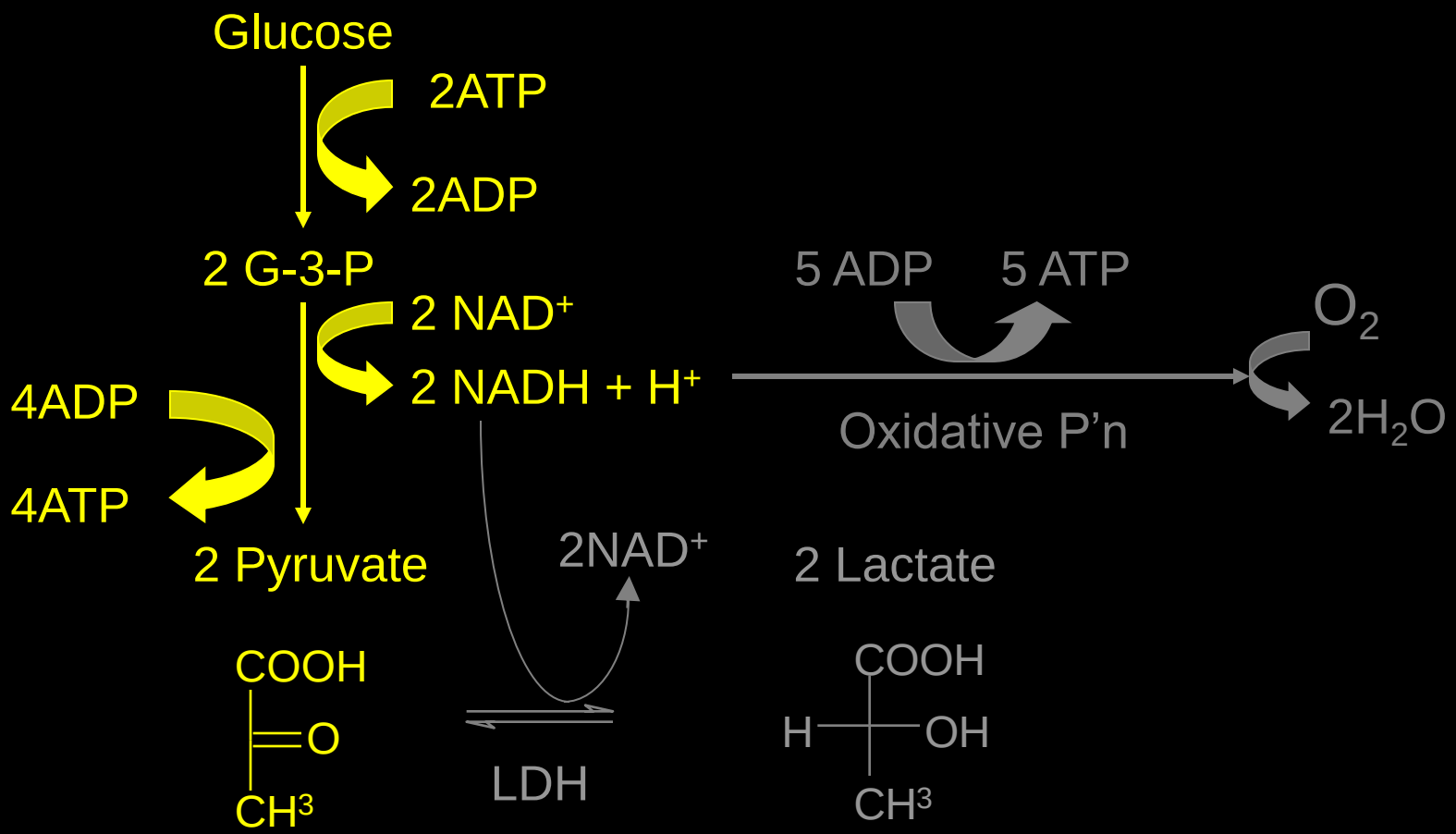


Structural Basis for high PO_4 transfer potential of PEP



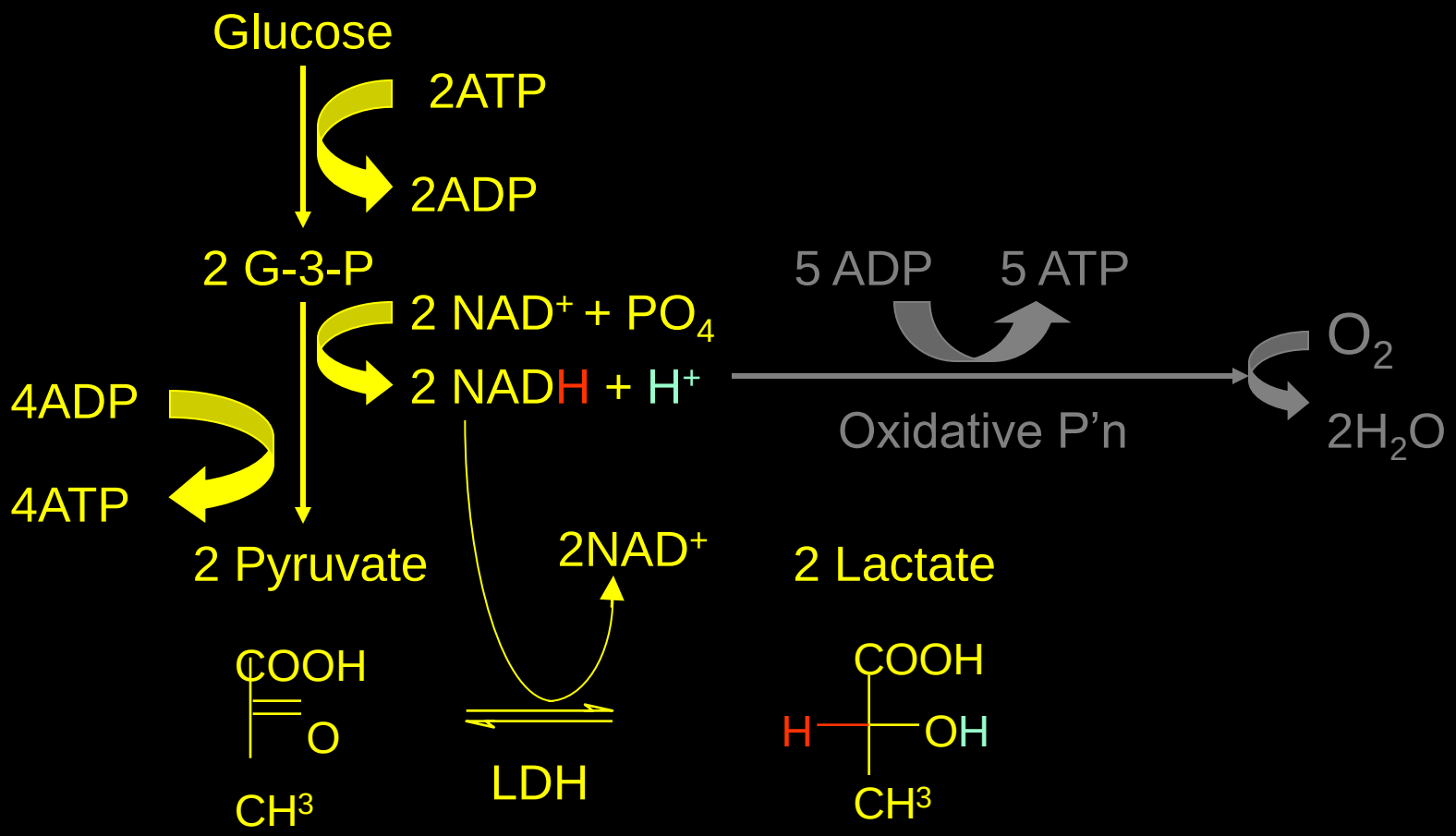
Net Reaction of Glycolysis

Glucose + 2 P_i + 2ADP + 2NAD^+ → 2Pyruvate + 2ATP + 2NADH + 2H^+ + 2H_2O

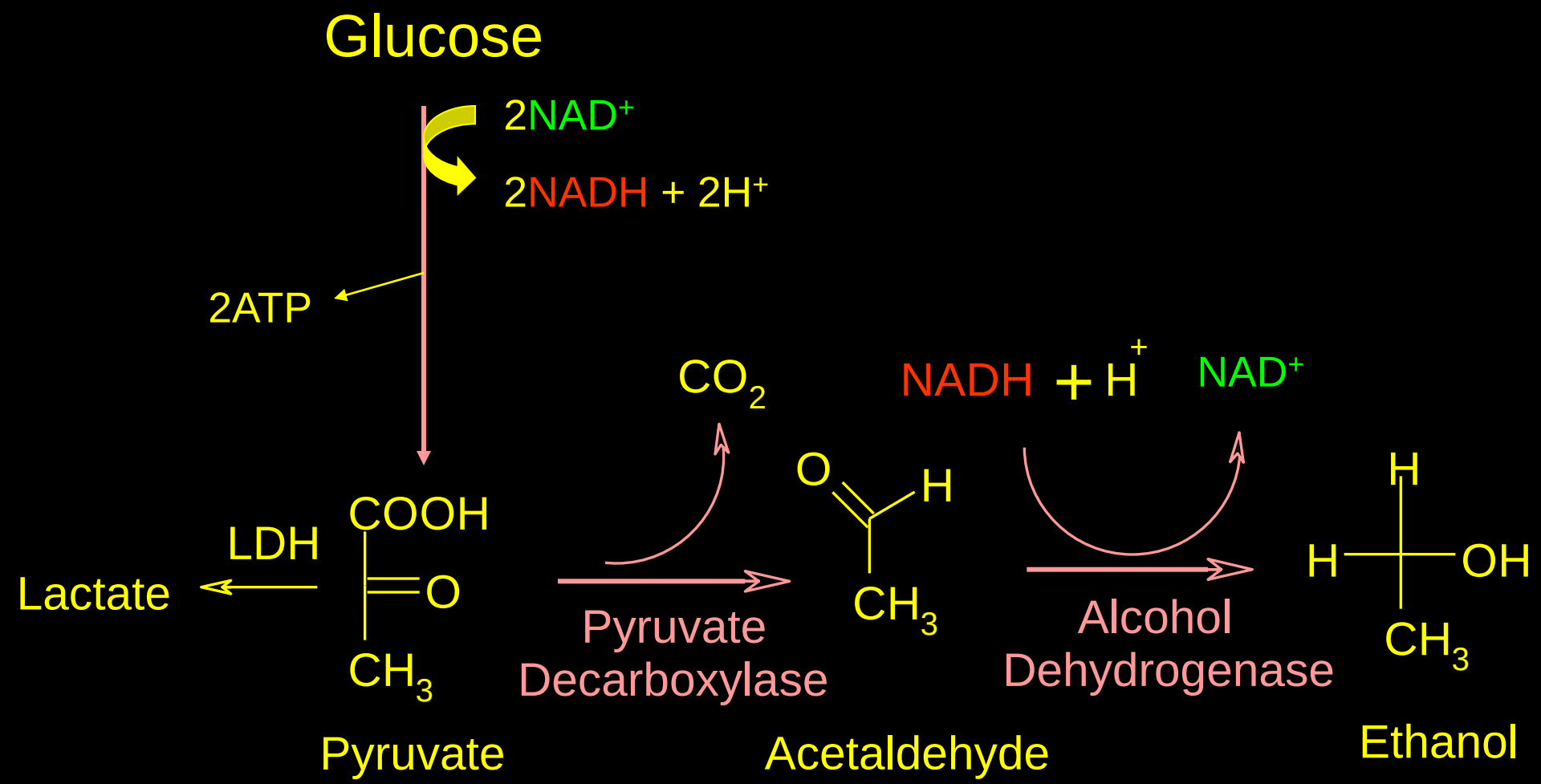


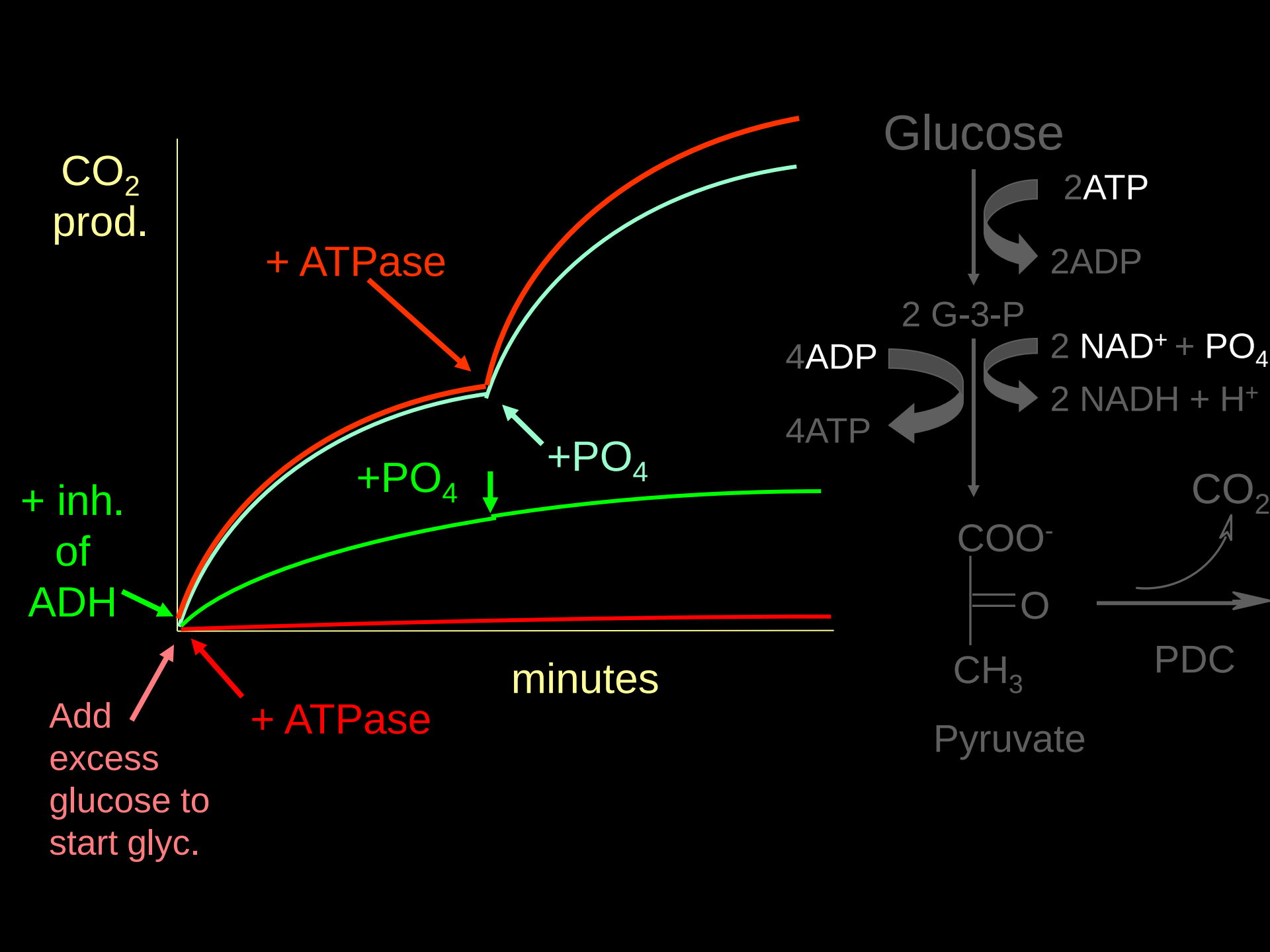
- During exercise, purpose of glycolysis is to deliver energy (ATP) FAST!!!
- Glycolysis generates ATP 100x faster than aerobic pathways (ie. oxidative P'n).
- However, under these conditions, NAD^+ is depleted and NADH builds up.
- NAD^+ must be replenished – by re-oxidation of NADH.

Reduction of Pyruvate to Lactate serves to replenish NAD^+.



Fermentation in Yeast




CO_2 prod.
+ ATPase
+PO_4
$+PO_4$
+ inh. of ADH
minutes
Add excess glucose to start glyc.
+ ATPase
Glucose
2ATP
2ADP
2 G-3-P
4ADP
4ATP
2 NAD^+ + PO_4
2 NADH + H^+
CO_2
COO^-
O
CH_3
PDC
Pyruvate

Fermentation in Yeast