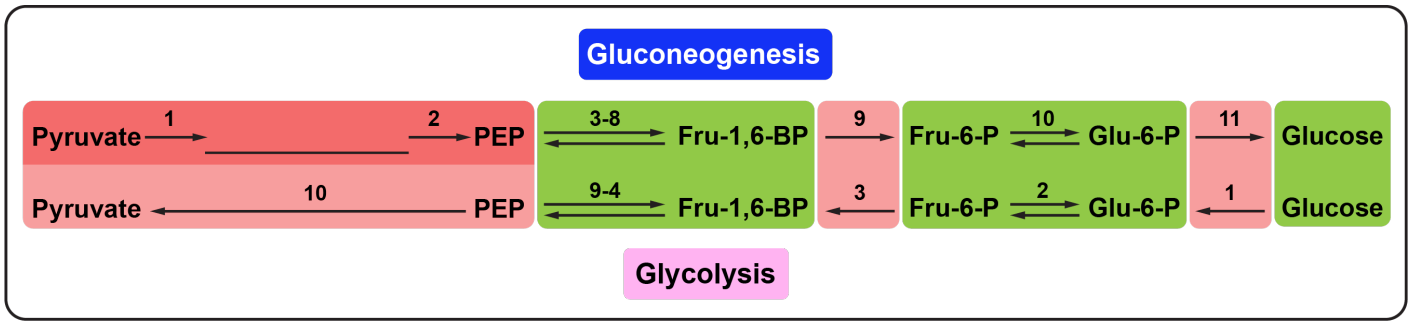
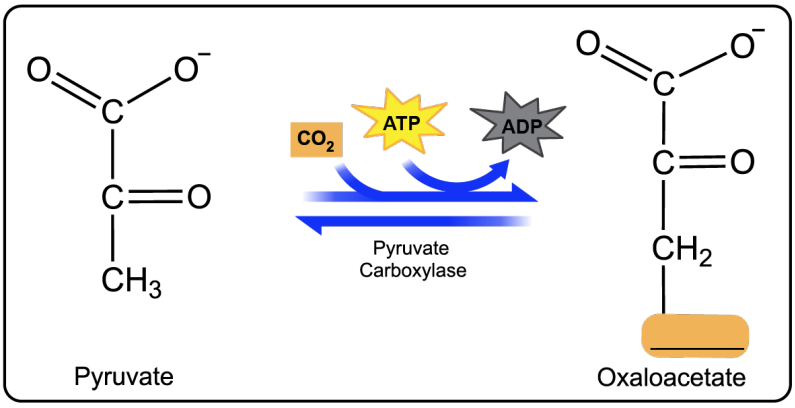
CONCEPT: GLUCONEOGENESIS

- Gluconeogenesis is a sequence of ____ biochemical reactions with 2 pyruvates as the starting metabolites.
  - □ Reactions _____, & ____ are different from glycolysis, the rest are the **same**.



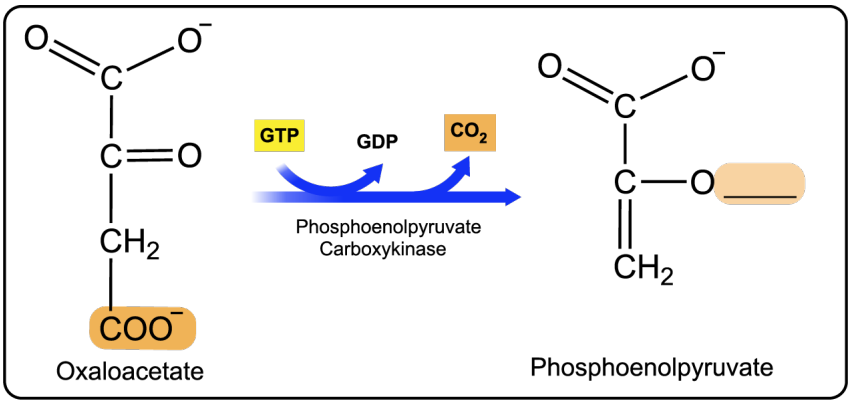
1 Oxaloacetate Formation x 2: CO_2 is added to pyruvate by pyruvate _____lase to produce oxaloacetate.

- □ ATP is converted to _____.
- □ **Note:** _____ acids can enter as either pyruvate or oxaloacetate.



2 Decarboxylation & Phosphorylation x 2: PEP carboxy_____ removes CO_2 and adds ____ group.

- □ GTP is converted to GDP.
- □ 1 C atom is lost as CO_2.



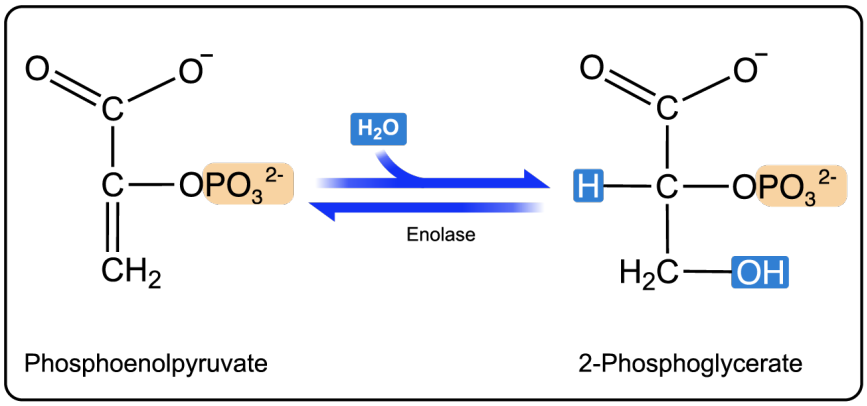
EXAMPLE: How many total carbon atoms are lost in the first 2 reactions of gluconeogenesis?

a) 0 b) 1 c) 2 d) 4

CONCEPT: GLUCONEOGENESIS

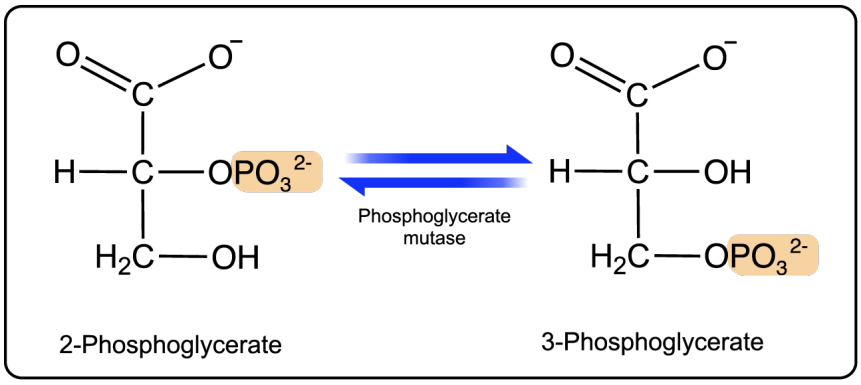
3 **Hydration x 2:** PEP undergoes hydration to produce 2PG.

□ Catalyzed by enzyme _____.



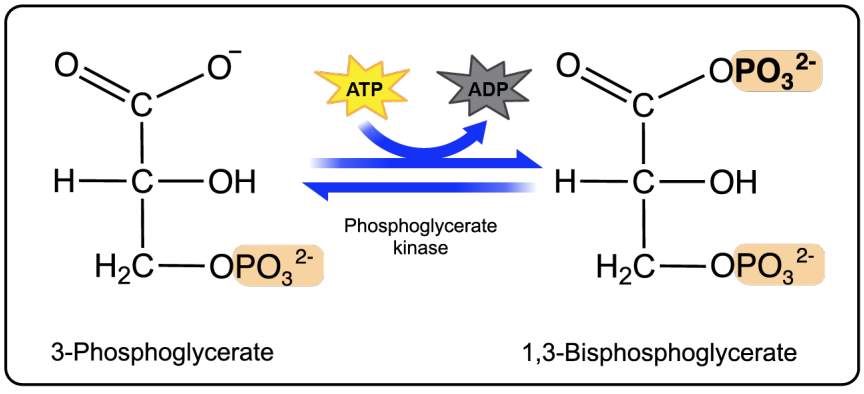
4 **Isomerization x 2:** 2PG undergoes isomerization to yield 3PG.

□ Catalyzed by enzyme phosphoglycerate _____.



5 **Phosphate Transfer x 2:** 3PG produces 1,3-bisphosphoglycerate by gaining a P_i group.

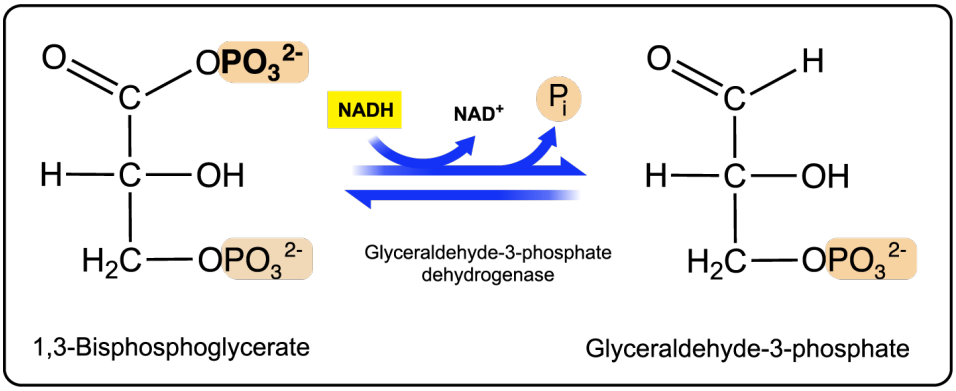
□ Catalyzed by phosphoglycerate _____. □ ATP is converted to ADP.



CONCEPT: GLUCONEOGENESIS

6 **Reduction x 2:** 1,3-bisphosphoglycerate undergoes reduction to produce G3P.

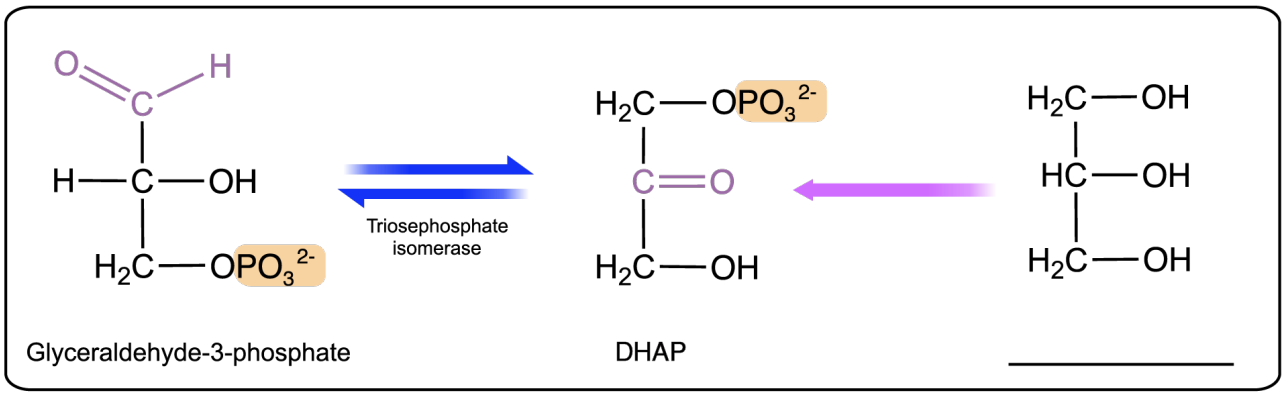
□ Catalyzed by enzyme G3P _____. □ NADH is oxidized to NAD^+.



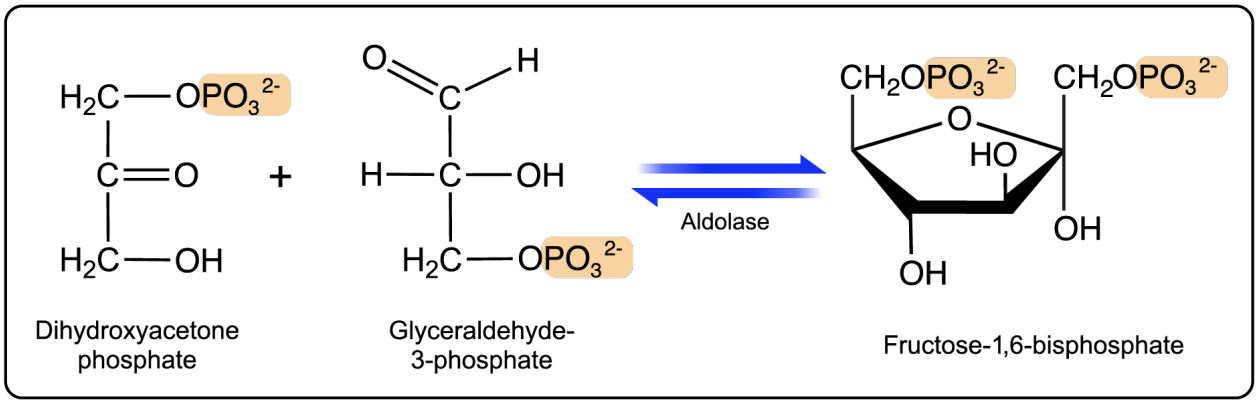
7 **Isomerization:** One G3P molecules is isomerized to dihydroxyacetone phosphate (DHAP).

□ Catalyzed by enzyme triosephosphate _____.

□ **Note:** Glycerol enters gluconeogenesis as _____.



8 **Linkage:** Enzyme _____ combines 2 triose phosphates into fructose-1,6-bisphosphate.



CONCEPT: GLUCONEOGENESIS

EXAMPLE: Which enzymes so far are involved in glycolysis but not gluconeogenesis?

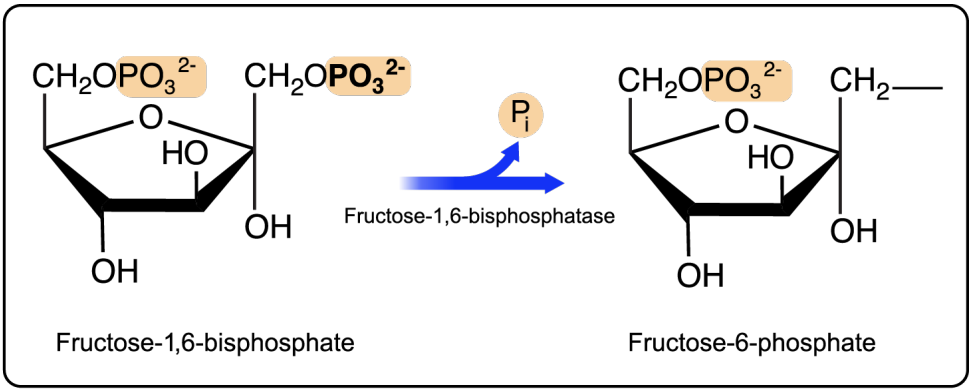
a) pyruvate carboxylase

b) phosphoglycerate kinase

c) pyruvate kinase

d) glyceraldehyde-3-phosphate dehydrogenase

9 **Dephosphorylation:** Enzyme fructose-1,6-bisphosphat_____ removes a P_i group to form fructose-6-phosphate.



EXAMPLE: Why is it not possible to dephosphorylate fructose-1,6-bisphosphate with phosphofructokinase enzyme?

a) Phosphofructokinase does not function properly in the cytoplasm of the cell.

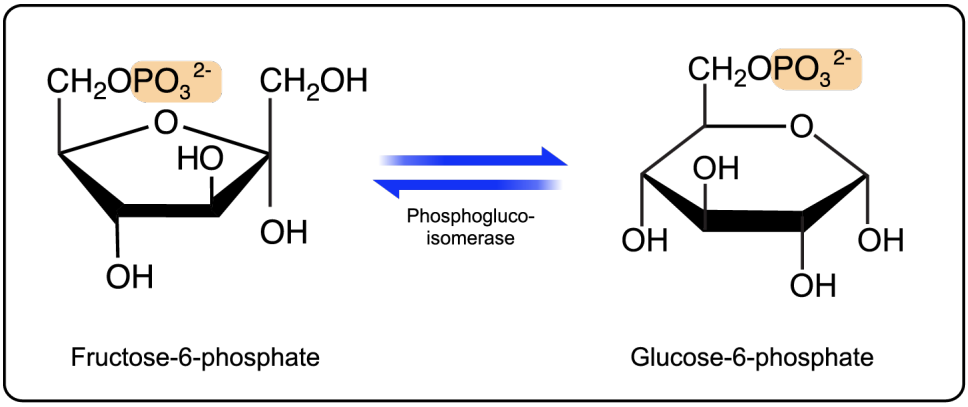
b) Phosphofructokinase catalyzes transfer of a Pi group from one molecule to another, not removal of a Pi group.

c) Phosphofructokinase lacks enough energy to catalyze dephosphorylation.

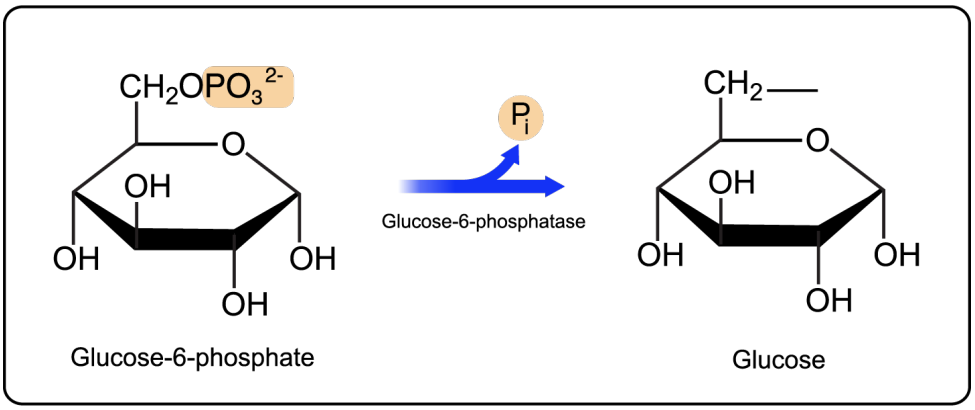
d) It is possible.

CONCEPT: GLUCONEOGENESIS

10 **Isomerization:** Enzyme phosphogluco_____ isomerizes fructose-6-phosphate into glucose-6-phosphate.



11 **Dephosphorylation:** Enzyme glucose-6-phosphatase removes a P_i group forming _____.



EXAMPLE: Step 9 and 11 of Gluconeogenesis:

a) Uses ADP to dephosphorylate and produces ATP.

b) Produces ADP as a result of dephosphorylation.

c) Requires GTP to dephosphorylate.

d) Does not require energy to dephosphorylate.

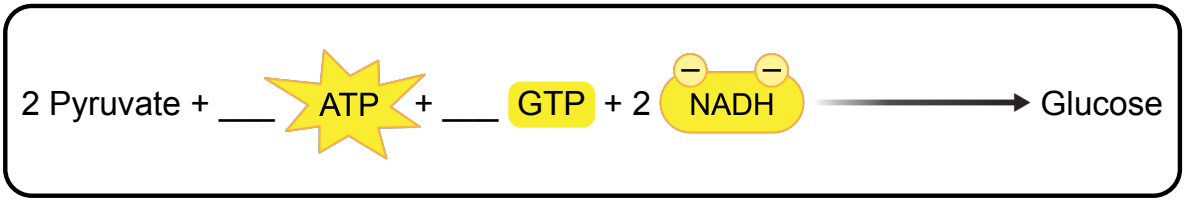
CONCEPT: GLUCONEOGENESIS

Remembering Gluconeogenesis

Remembering Gluconeogenesis			
MEMORY TOOL 1 **(Reactions)**	In the ___st ___ minutes of accident	call ___	___
MEMORY TOOL 2 **(Metabolites)**	__irates __nly __op	__ruit __rom	__orgeous __ardens
MEMORY TOOL 3 **(Enzymes)**	__irates __onsume _____-___	__ructose __iz__izz	__lucose __izz

Summary

- Gluconeogenesis reduces pyruvate to glucose via following reaction:



MEMORY TOOL 4:

Reaction 1: **ATP**
__ll __he __irates

Reaction 2: **GTP**
__ot __o __arty

Reaction 5: **ATP**
____ 5 __m

EXAMPLE: Reactions 1 & 2 consume _____ & _____ and are catalyzed by _____ & _____.

a) ATP & GTP, Pyruvate oxaloacetase & Oxaloacetate carboxykinase.

b) ATP & GTP, Pyruvate carboxylase & Phosphoenolpyruvate carboxykinase.

c) GTP & ATP, Pyruvate carboxykinase & Phosphoenolpyruvate carboxylase.

d) GTP & ATP, Phosphoenolpyruvate carboxykinase & Phosphoglycerate kinase.

CONCEPT: GLUCONEOGENESIS

PRACTICE: The following metabolites are present both in glycolysis and gluconeogenesis, except:

a) oxaloacetate

b) fructose-1,6-bisphosphate

c) glyceraldehyde-3-phosphate

d) dihydroxyacetone phosphate

PRACTICE: Which molecule is added to pyruvate and then removed in the next reaction?

a) H^+

b) H_2O

c) PO_3^{2-}

d) CO_2

PRACTICE: Enzyme responsible for decarboxylation and phosphate transfer in the same gluconeogenic reaction is:

a) Tyrosine kinase

b) Oxaloacetate carboxykinase

c) Pyruvate kinase

d) Phosphoenolpyruvate carboxykinase

e) Phosphofructokinase

PRACTICE: Fructose-1,6-bisphosphate is dephosphorylated by _____ to fructose-6-phosphate.

a) Glucose-6-phophatase

b) Fructose-1,6-bisphosphatase

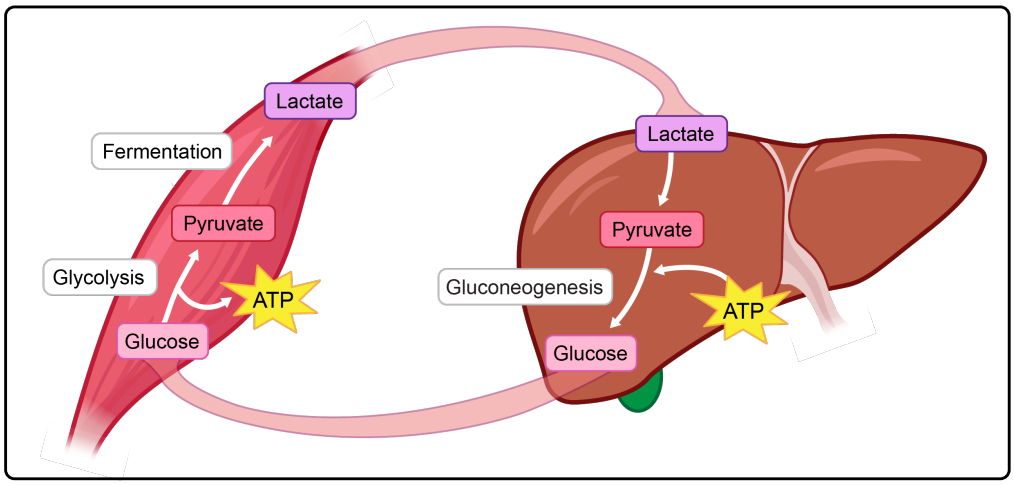
c) Phosphofructokinase

d) Fructose-6-phosphotase

CONCEPT: GLUCONEOGENESIS

Cori Cycle

- Cyclic metabolic pathway that transports _____ from muscle cells to liver cells and converts it to _____.
- **Recall:** Lactate is produced by muscle cells during ____aerobic conditions.
  - □ It is then transported by bloodstream to liver cells and converted to glucose through _____neogenesis.



EXAMPLE: The primary purpose for Cori cycle is to:

a) Produce lactate through fermentation process.

b) To provide a metabolite for gluconeogenesis.

c) Generate glucose for muscle cells to use as energy source.

d) Provide liver with much needed energy.

PRACTICE: Which of the following statement(s) correctly describes the Cori cycle?

a) Lactate is converted back to pyruvate in the muscles.

b) Conversion of lactate to glucose in the liver generates ATP.

c) Glucose from muscle cells is transported to liver through bloodstream.

d) Lactate from the muscle cells is regenerated into glucose in the liver.

e) Both a & b.

f) a, c & d