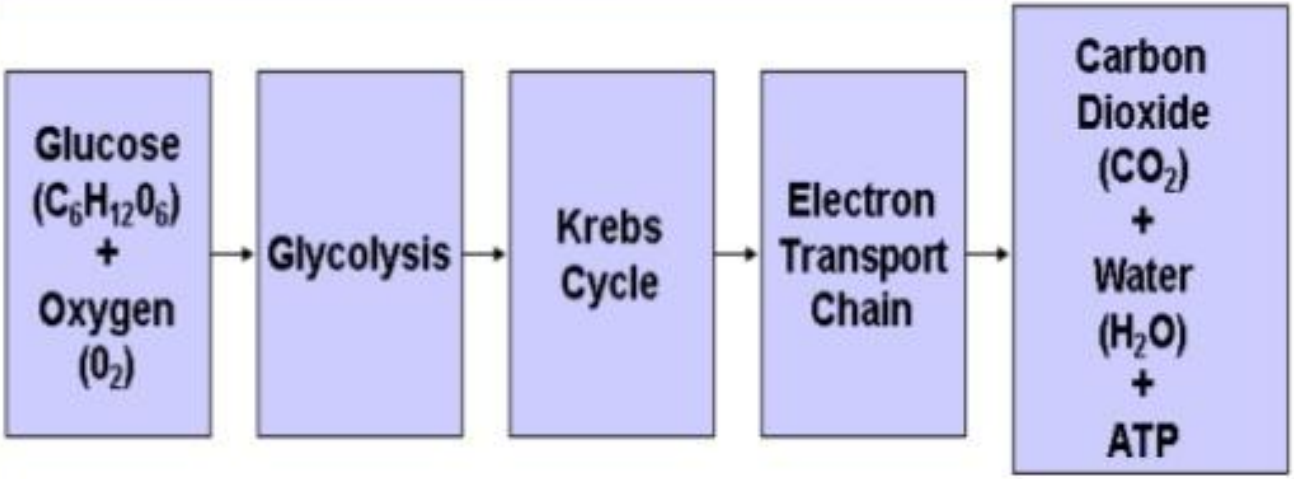
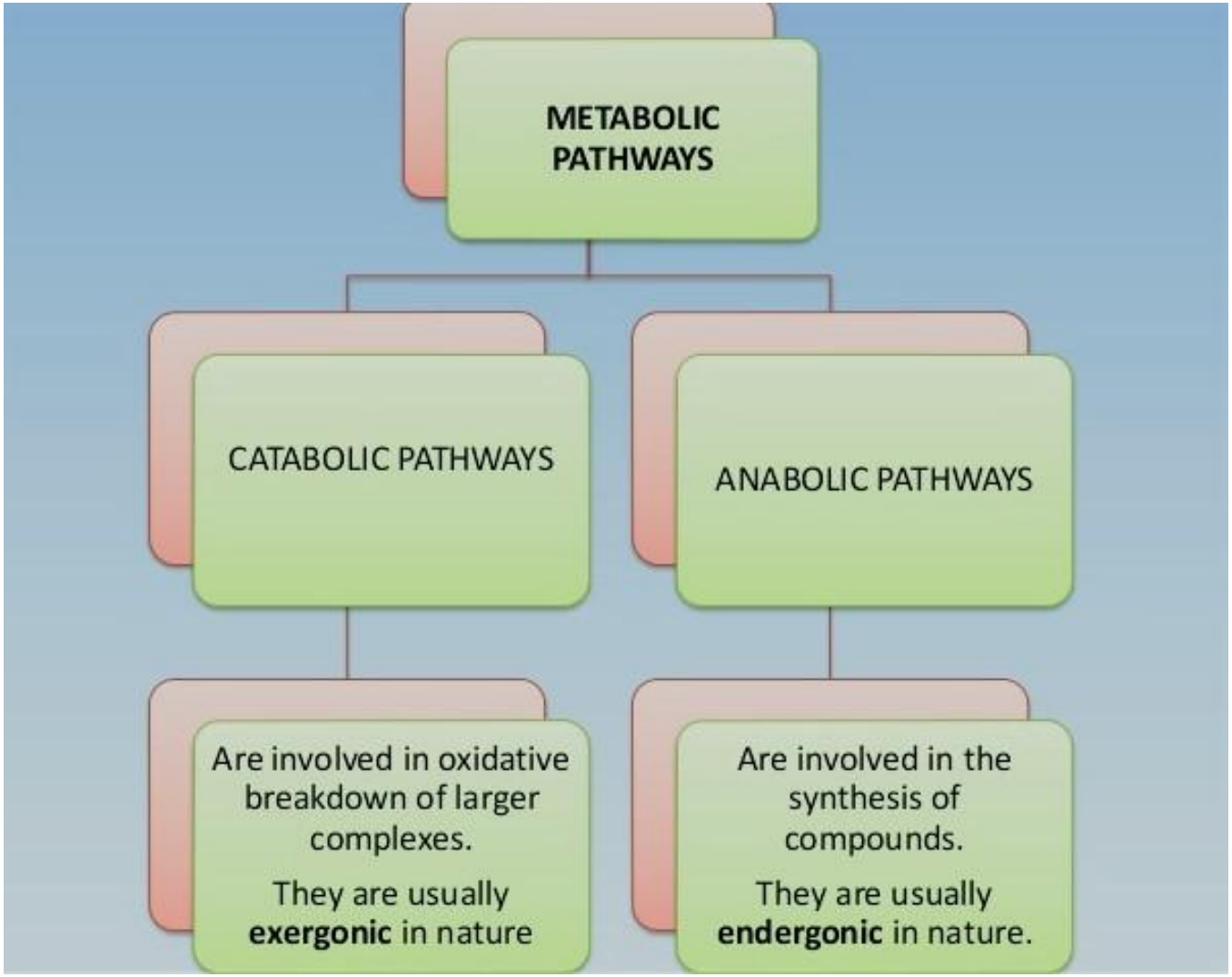
GLYCOLYSIS: UNIVERSAL PATHWAY FOR CELLULAR ENERGY PRODUCTION

Aerobic Respiration



Cellular Respiration



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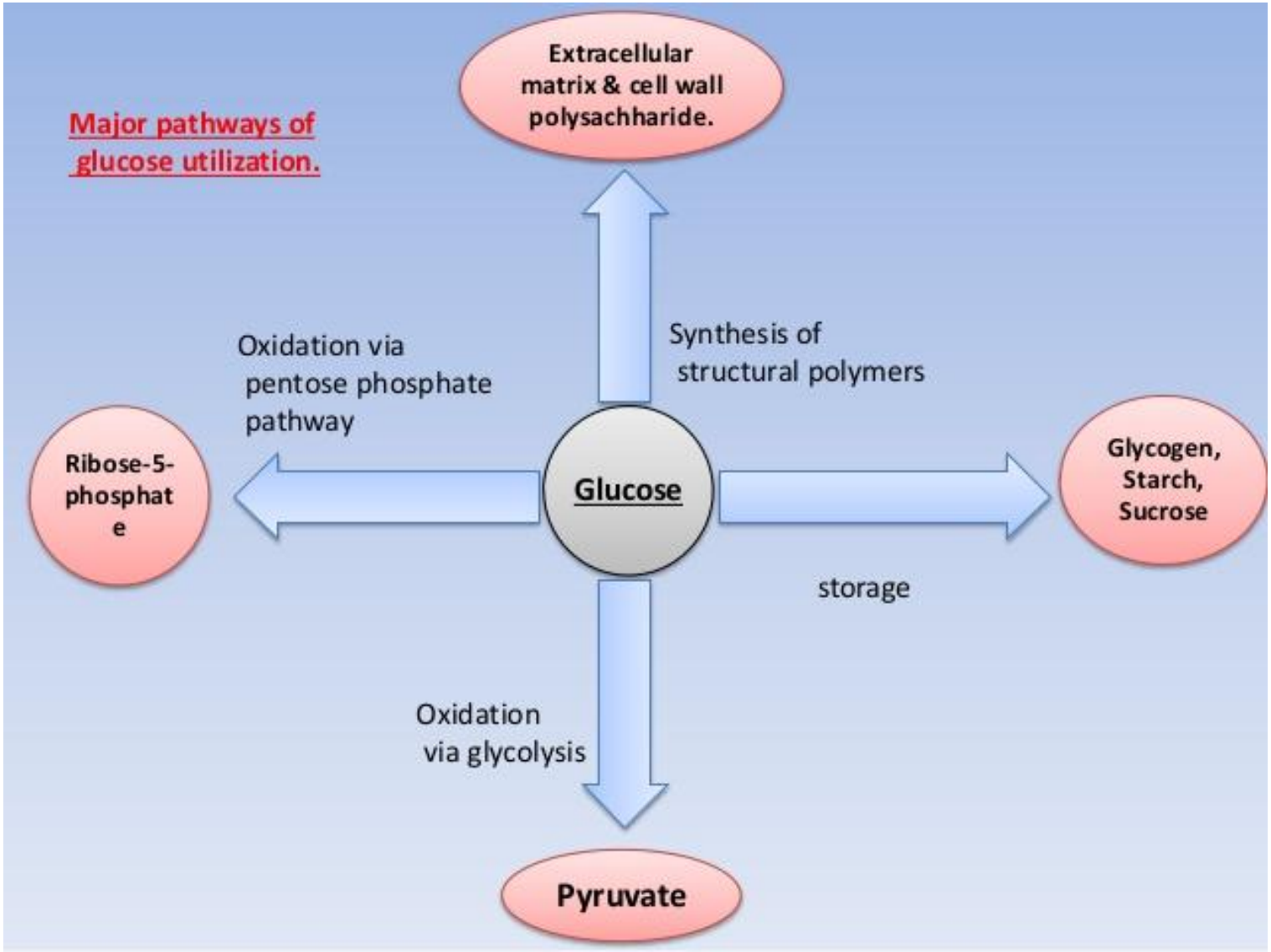
CHARACTERISTICS OF METABOLISM

1. Metabolic pathways are mostly irreversible
2. Every metabolic pathway has a committed first step which is the rate limiting step
3. All metabolic pathways are regulated by some feedback mechanisms
4. In case of eukaryotes metabolic ractions occur in specific cellular locations.



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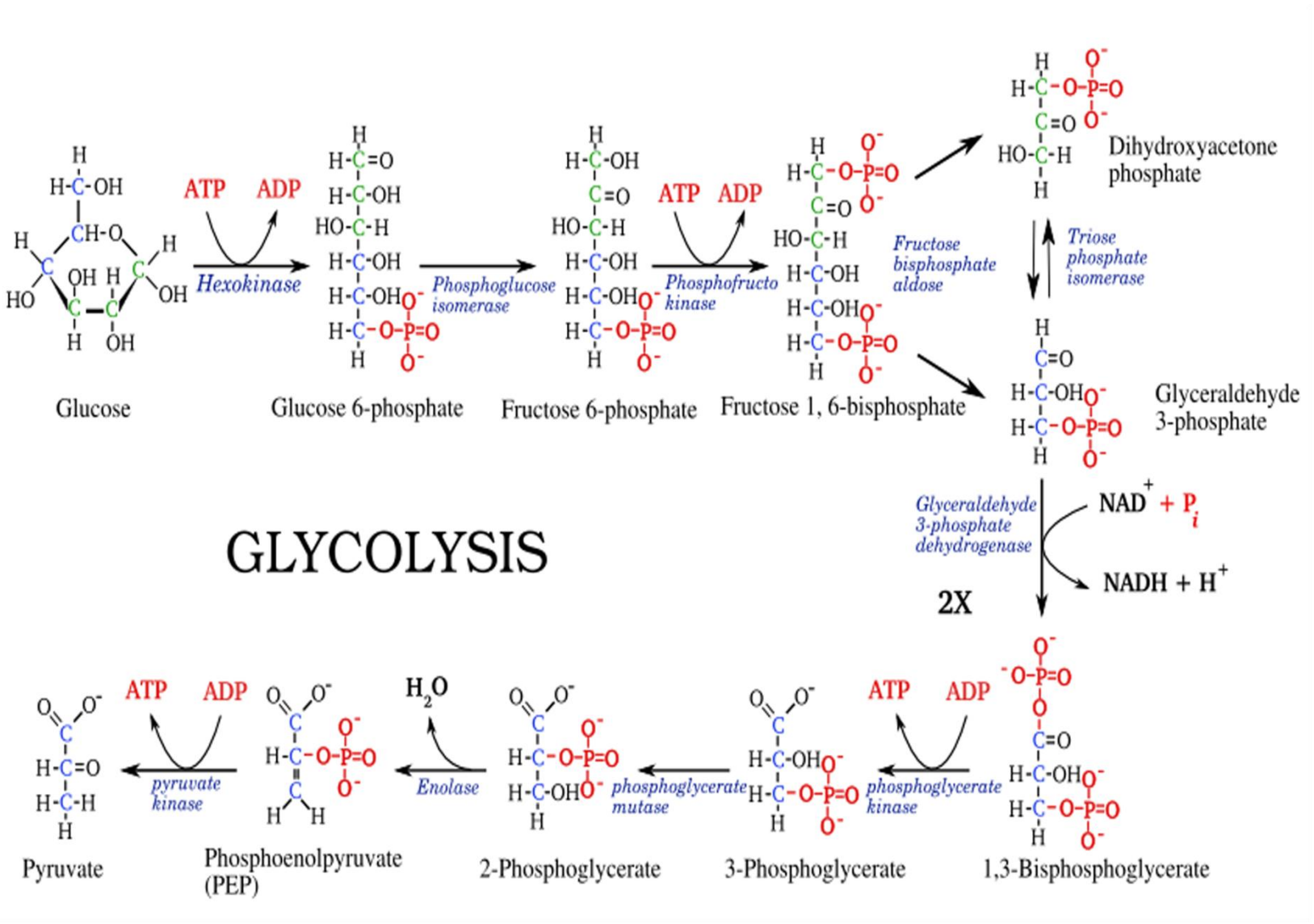
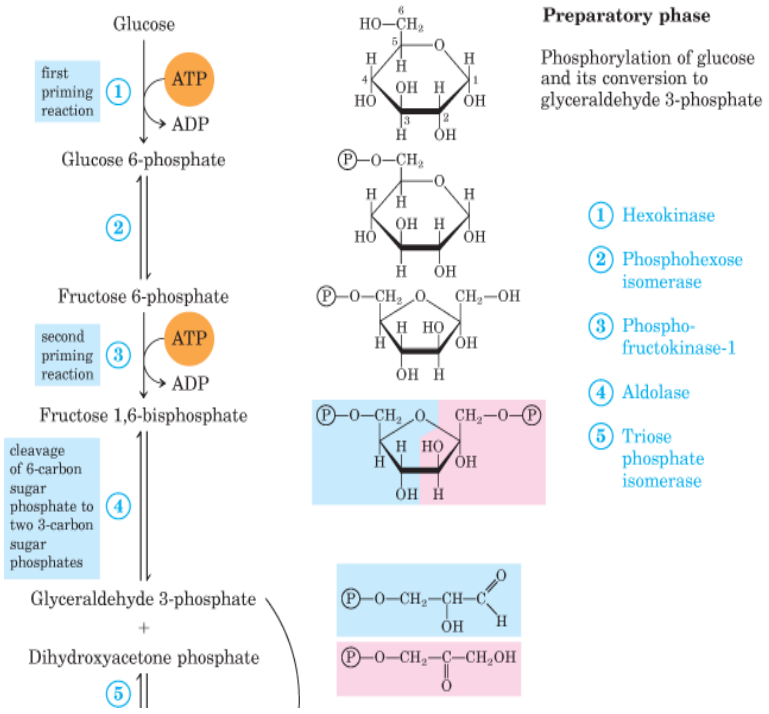


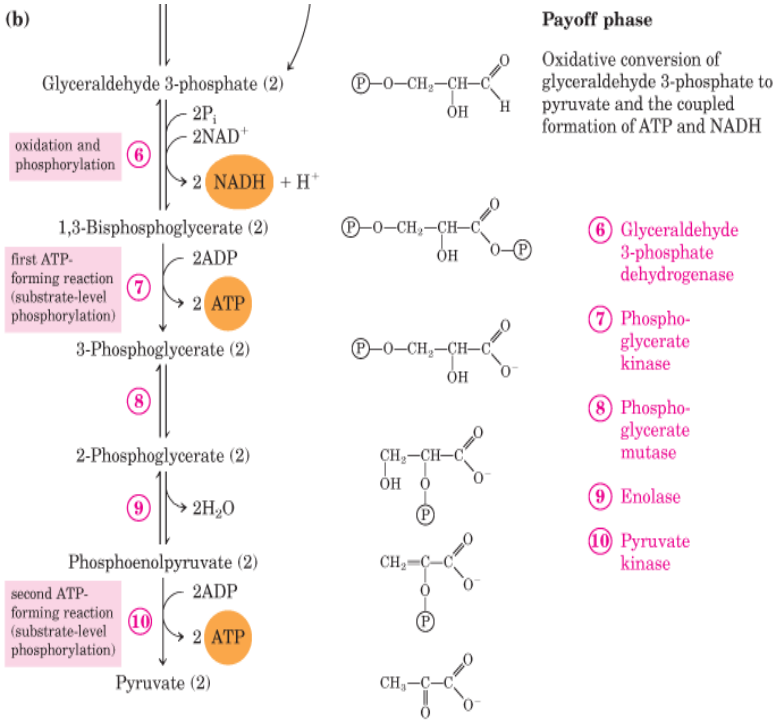
Adopted from: https://www.onlinebiologynotes.com/glycolysis-steps-diagram-and-enzymes-involved

Phases of Glycolysis

Preparatory Phase



Pay off Phase



Adopted from: https://laboratoryinfo.com/glycolysis-steps-diagram-energy-yield-and-significance/

Preparatory Phase:

- **Step 1:** Formation of Glucose-6-Phosphate from glucose molecule by the enzyme *Hexokinase*. Hexokinase use Mg2+ as a cofactor and transfer one phosphate molecule from ATP to C6 of glucose.

- **Step 2:** In this step the enzyme *Phosphogluco Isomerase* isomerises glucose-6-P to fructose-6-phosphate.No ATP molecule is used in this step, hence it is a reversible step.

- **Step 3:** In the third step another PO4- molecule is added at the C1 position of fructose-6-phosphate to form fructose 1,6 bis-phosphate. The enzyme involved in this process is *Phosphofructo Kinase* which utilize another ATP molecule and transfer it's one PO4- group to fructose-6-phosphate with the help of Mg2+. It is the second irreversible step of preparatory phase.

- **Step 4:** It is the final step of preparatory phase where the enzyme *Aldolase* broke down fructose 1,6 bis-phosphate to one molecule of glyceraldehyde-3-phosphate(GA3P) and one molecule of di-hydroxy acetone phosphate(DAHP). Later 1 molecule DAHP is converted to another molecule of GA3P by the enzyme *Triosephosphate Isomerase*.

Pay Off Phase:

❖ **Step1:** In the first step of pay off phase 2 GA3P molecules are converted in to 2 molecules of 1,3 bis phosphoglycerate by the enzyme *Glyceraldehyde 3 phosphate Dehydrogenase* which adds 2 inorganic phosphate molecules to 2 GA3P molecules and transfer the 'H' atom of aldehyde group to it's co-factor NAD+ to form 2 NADPH.

❖ **Step2:** In this step enzyme *Phosphoglycerate Kinase* transfer the PO4- molecule of C1 position of 1,3 bis-phosphoglycerate to an ADP molecule to form 3 phosphoglycerate and an ATP molecule.

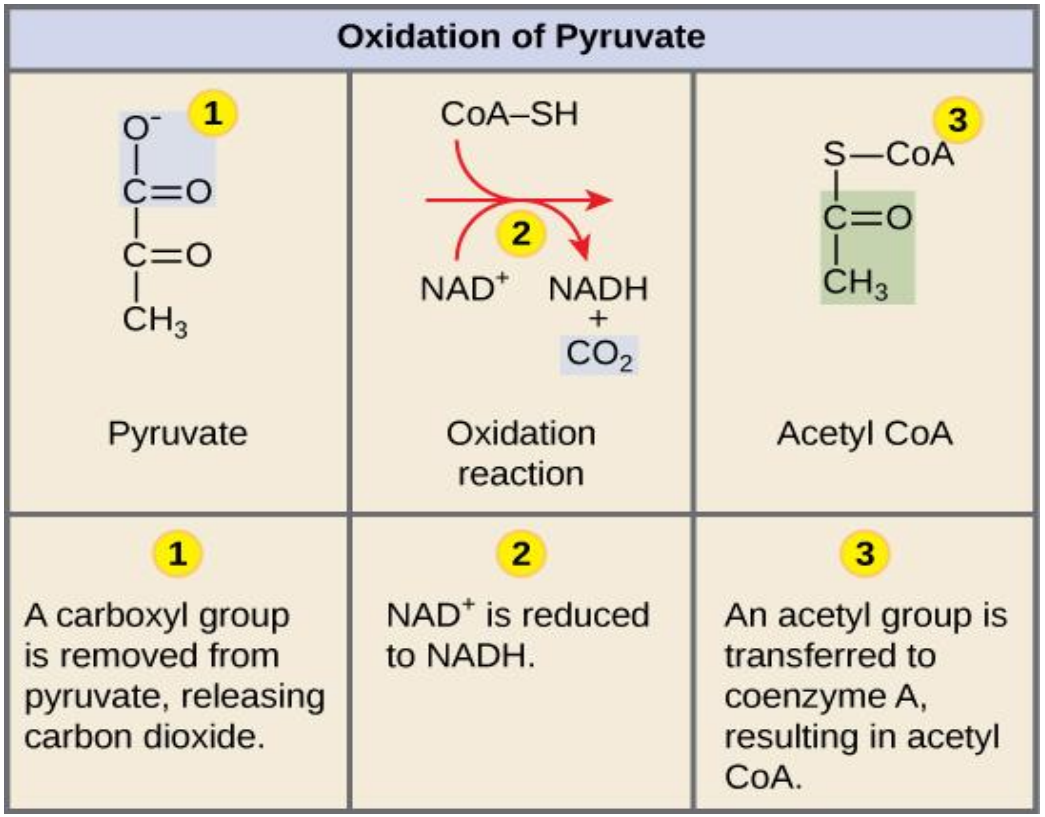
❖ **Step3:** Third step is conducted by the enzyme *Phosphoglycerate Mutase* which transfer the PO4- molecule from C3 to C2 position to form 2-phosphoglycerate.

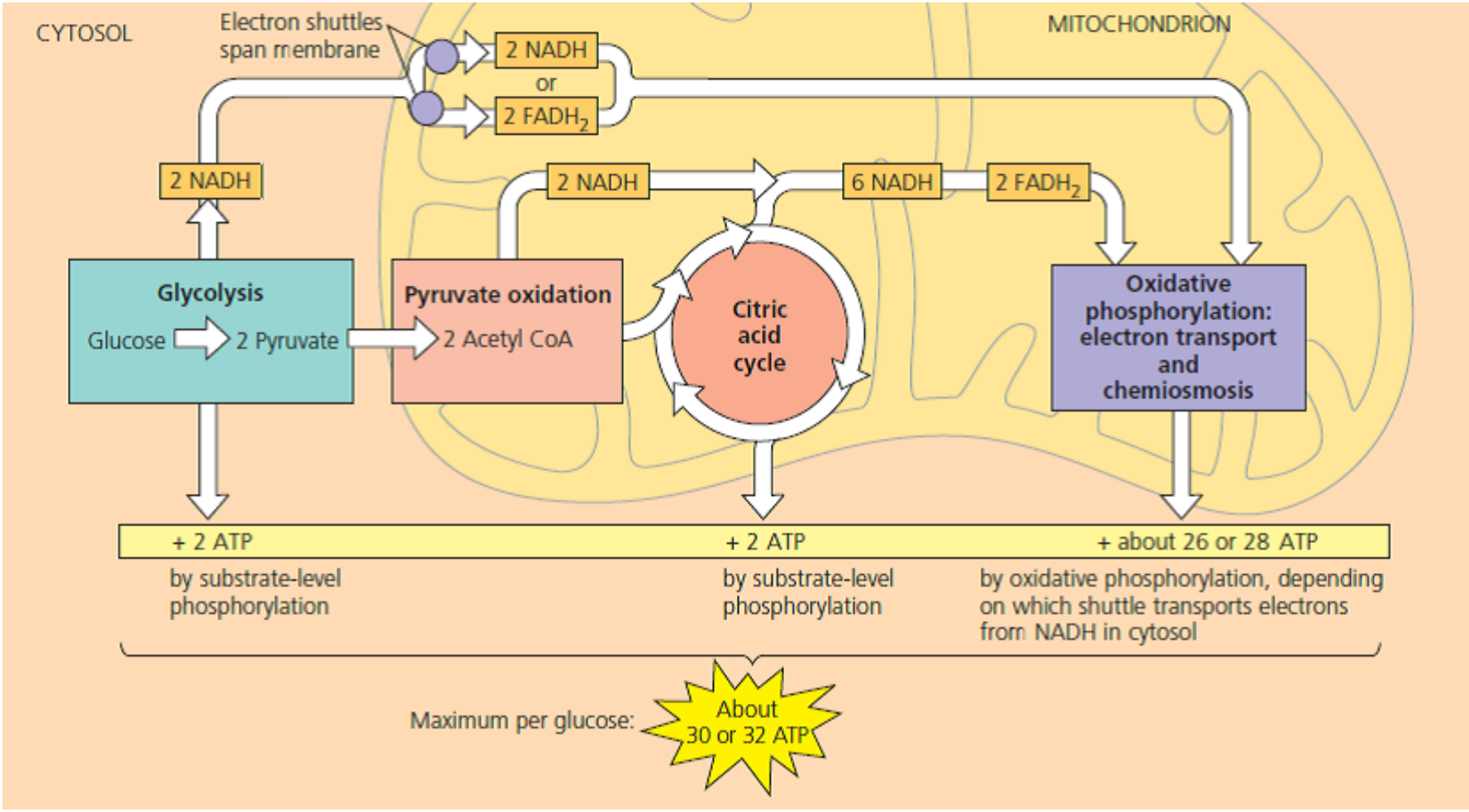
❖ **Step4:** In this step two molecules of 2-phosphoglycrate is converted to 2 molecules of phosphoenol pyruvate (PEP) by the enzyme *Enolase*.

❖ **Step5:** In the final step 2 PEP molecules are converted to 2 pyruvate molecules by the elimination of 2 PO4- molecules which are transferred to 2 ADP molecules to form 2 ATP. The enzyme works in this reaction is *Pyruvate Kinase*. Pyruvate is the final product of glycolysis.

Fate of Pyruvate:

❖ Pyruvate produced from glycolysis undergoes oxidation phase to form acetyl CoA. The enzyme involved in this process is *Pyruvate Dehydrogenase Complex (PDH complex).* Thus 2 acetyl CoA produced after glycolysis of one molecule of glucose. Acetyl CoA enters in mitochondria and initiates TCA cycle to produce more energy in the cell.





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SIGNIFICANCE OF GLYCOLYSIS :

❖ Glycolysis is the universal source energy production for cells

❖ It is the only source of energy in case erythrocytes.

❖ In strenuous exercise, when muscle tissue lacks enough oxygen, anaerobic glycolysis forms the major source of energy for muscles.

❖The glycolytic pathway may be considered as the preliminary step before complete oxidation.

❖ The glycolytic pathway provides carbon skeletons for synthesis of non-essential amino acids as well as glycerol part of fat.

❖ Most of the reactions of the glycolytic pathway are reversible, which are also used for gluconeogenesis.

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