

## Pentose phosphate pathway

### Significance of Pentose Phosphate Pathway

- To generate reducing equivalents, in the form of NADPH, which is needed for fatty acid synthesis and cell survival under stress conditions .
- To provide the cell with ribose-5-phosphate (R5P) for the synthesis of the nucleotides and nucleic acids.
- No ATP is generated in this pathway. So glucose can be metabolized through this pathway even when energy requirement is low.

### Location of the pathway

- The enzymes are located in the cytosol.

The tissues such as liver, adipose tissue, adrenal gland, erythrocytes, testes & lactating mammary gland, are highly active in the oxidative phase of HMP shunt.

Rapidly dividing cells have a high activity of the non-oxidative phase.

\*It is called the pentose phosphate shunt because the pathway allows for carbon atoms from glucose 6-phosphate to take a shunt before they proceed down the glycolytic pathway.

The PPP comprises two irreversible oxidative reactions followed by a series of reversible interconversions.

The PPP is thus divided into two biochemical branches: An oxidative and a non-oxidative branch.

The oxidative branch converts glucose 6-phosphate (G6P) into ribulose-5-phosphate (Ru5P), CO<sub>2</sub> and NADPH. NADPH is vital to maintain the reduction-oxidation (redox) balance under stress conditions and allows cells to proliferate rapidly.

The non-oxidative branch yields the glycolytic intermediates fructose 6-phosphate (F6P), glyceraldehyde 3-phosphate (G3P) and sedoheptulose sugars, resulting in the production of sugar phosphate precursors for amino acid synthesis and ribose-5-phosphate (R5P), which is essential for nucleic acid synthesis.

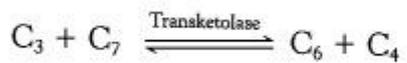
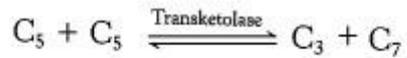
### Oxidative Phase of the Pentose Phosphate Pathway

Glucose 6-phosphate is oxidized to 6-phosphoglucono- $\delta$ -lactone to generate one molecule of NADPH.

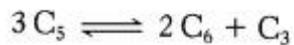
The lactone is hydrolyzed to 6-phosphogluconate, which is oxidatively decarboxylated to ribulose 5-phosphate with the generation of a second molecule of NADPH.

### Non-oxidative phase of PP pathway

Transketolase and transaldolase enzymes create a reversible link between the pentose phosphate pathway and glycolysis by catalyzing these three successive reactions.



The net result of these reactions is the formation of two hexoses and one triose from three pentoses:



Ribulose 5-phosphate $\rightleftharpoons$ ribose 5-phosphate	Phosphopentose isomerase
Ribulose 5-phosphate $\rightleftharpoons$ xylulose 5-phosphate	Phosphopentose epimerase
Xylulose 5-phosphate + ribose 5-phosphate $\rightleftharpoons$ sedoheptulose 7-phosphate + glyceraldehyde 3-phosphate	Transketolase
Sedoheptulose 7-phosphate + glyceraldehyde 3-phosphate $\rightleftharpoons$ fructose 6-phosphate + erythrose 4-phosphate	Transaldolase
Xylulose 5-phosphate + erythrose 4-phosphate $\rightleftharpoons$ fructose 6-phosphate + glyceraldehyde 3-phosphate	Transketolase

Pathway to be studied from any Biochemistry textbook.

\*This pathway and Glutathione Peroxidase protect R.B.C against hemolysis.

In R.B.C Pp pathway produce NADPH which is required for the reduction of oxidised glutathione by glutathione reductase. Reduced glutathione provides 2H to  $H_2O_2$  to form  $H_2O$  getting itself oxidised again. This latter reaction is brought about by glutathione peroxidase. Thereby preventing oxidative damage by  $H_2O_2$ .