STUDY MATERIAL

VIVEKANANDA COLLEGE THAKURPUKUR

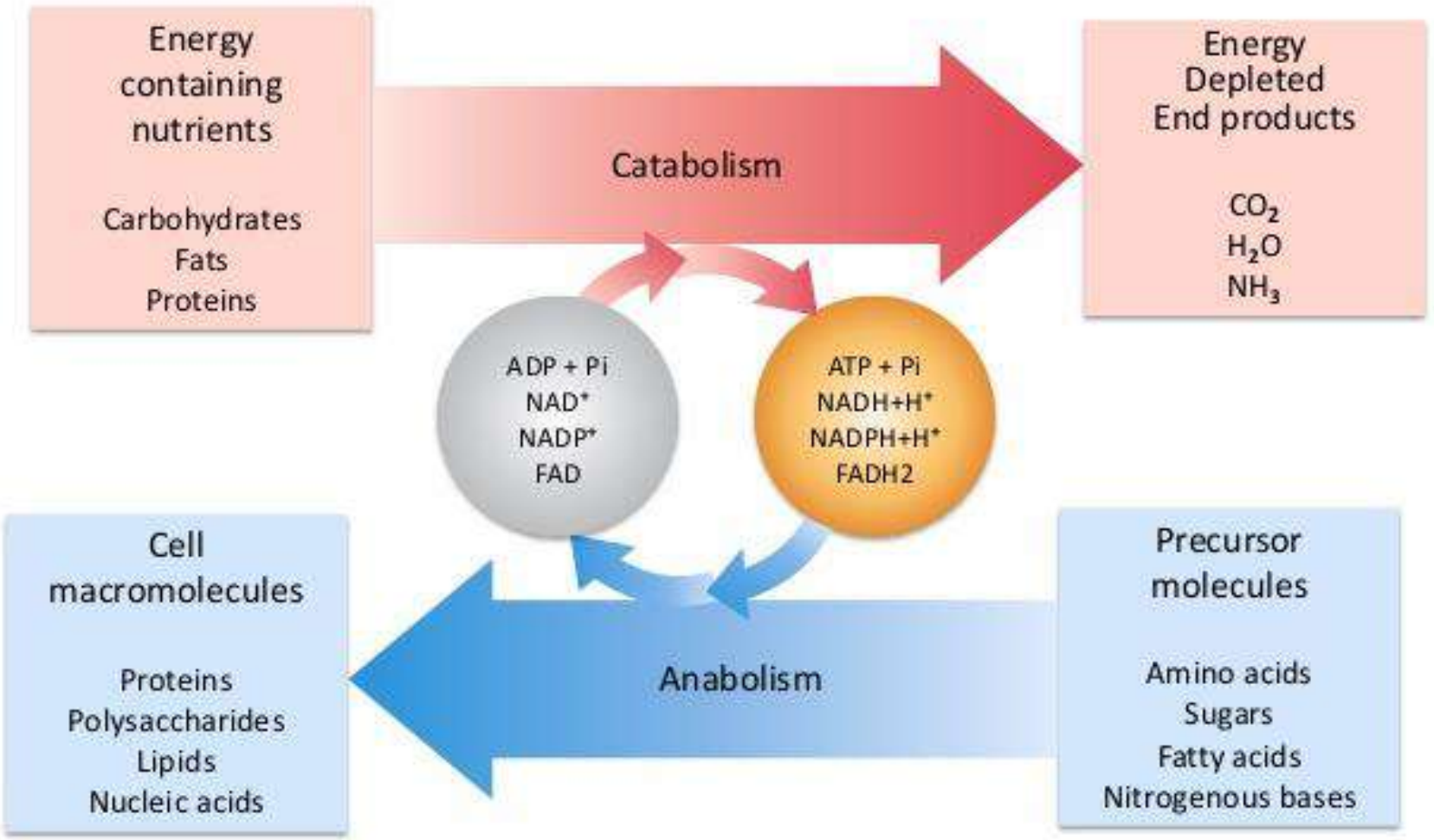
NAAC ACCREDITED GRADE—'A'

Subject: Metabolism

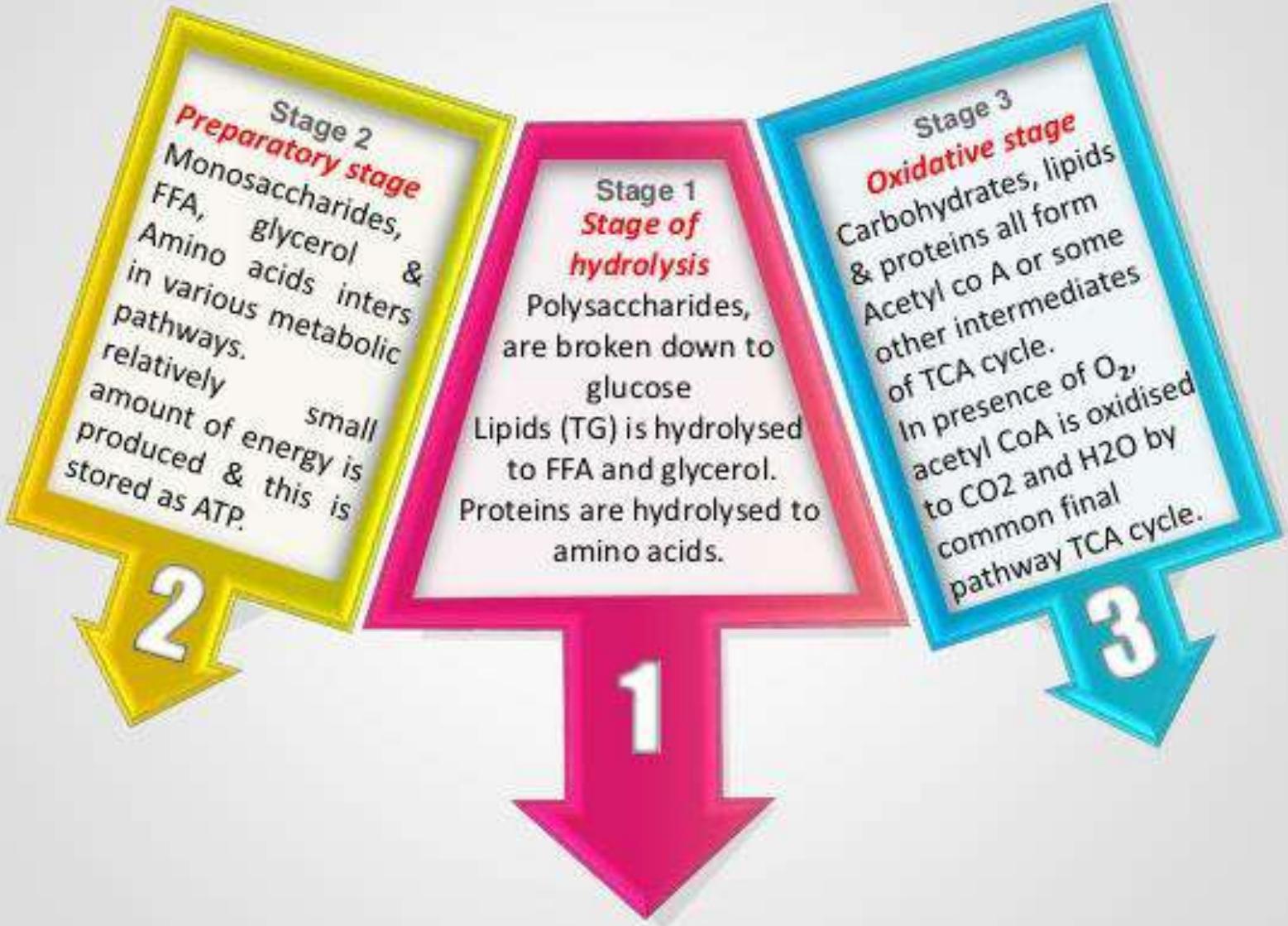
Topic: **Integration of Metabolic Pathways**

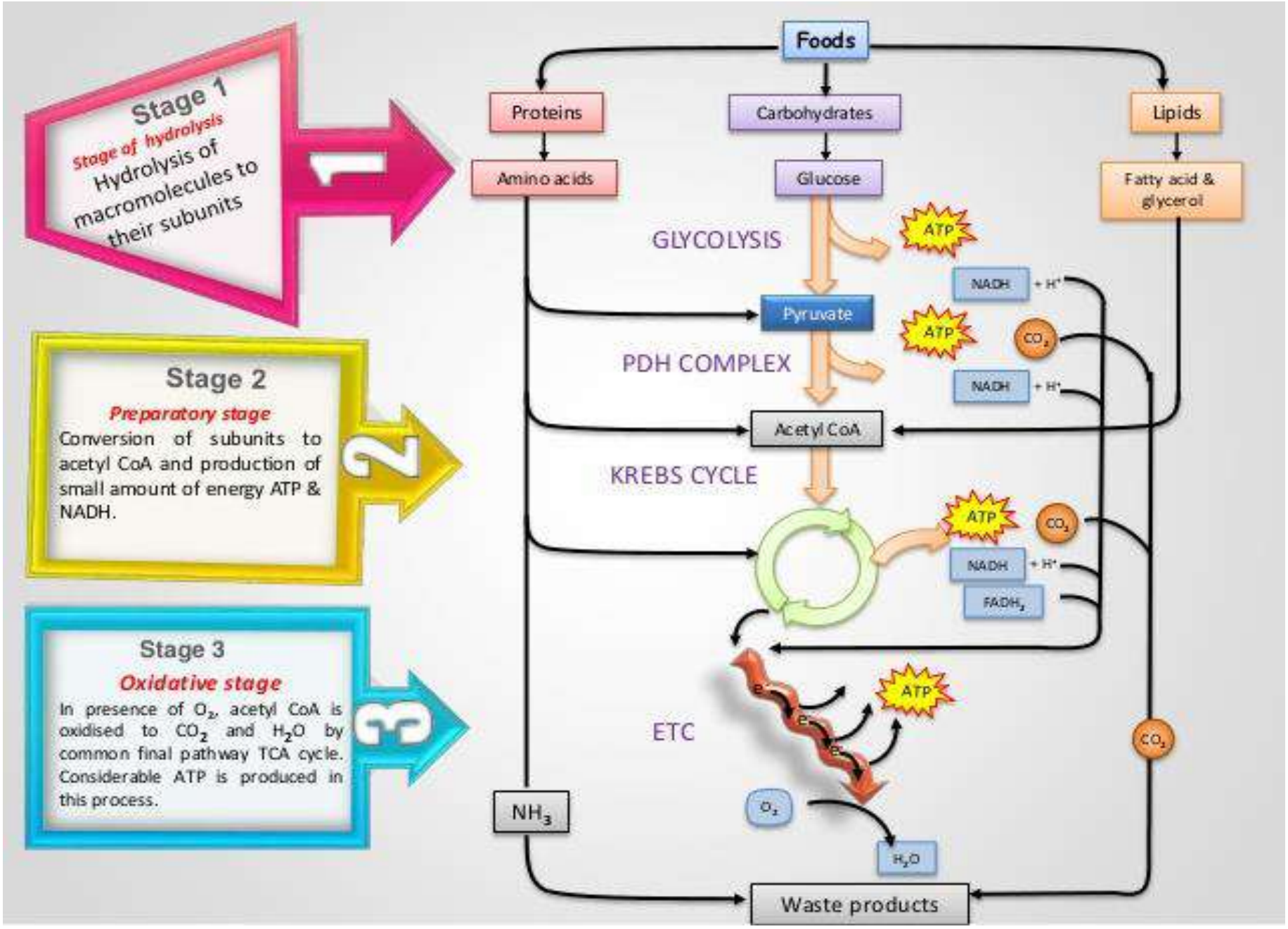
Name of the Teacher: **Dr. Dibyendu Raj**

Metabolism


Energy containing nutrients
Carbohydrates
Fats
Proteins
Catabolism
Energy Depleted End products
CO_2
H_2O
NH_3
ADP + Pi
NAD+
NADP+
FAD
ATP + Pi
NADH+H+
NADPH+H+
FADH2
Cell macromolecules
Proteins
Polysaccharides
Lipids
Nucleic acids
Anabolism
Precursor molecules
Amino acids
Sugars
Fatty acids
Nitrogenous bases

Three Stages of Metabolism




Stage 1
Stage of hydrolysis
Hydrolysis of macromolecules to their subunits
1
Stage 2
Preparatory stage
Conversion of subunits to acetyl CoA and production of small amount of energy ATP & NADH.
2
Stage 3
Oxidative stage
In presence of O_2, acetyl CoA is oxidised to CO_2 and H_2O by common final pathway TCA cycle. Considerable ATP is produced in this process.
3
Foods
Proteins
Carbohydrates
Lipids
Amino acids
Glucose
Fatty acid & glycerol
GLYCOLYSIS
ATP
NADH + H+
Pyruvate
ATP
CO2
PDH COMPLEX
NADH + H+
Acetyl CoA
KREBS CYCLE
ATP
CO2
NADH + H+
FADH2
ETC
ATP
e-
e-
e-
CO2
NH3
O2
H2O
Waste products

Major Metabolic Pathways:

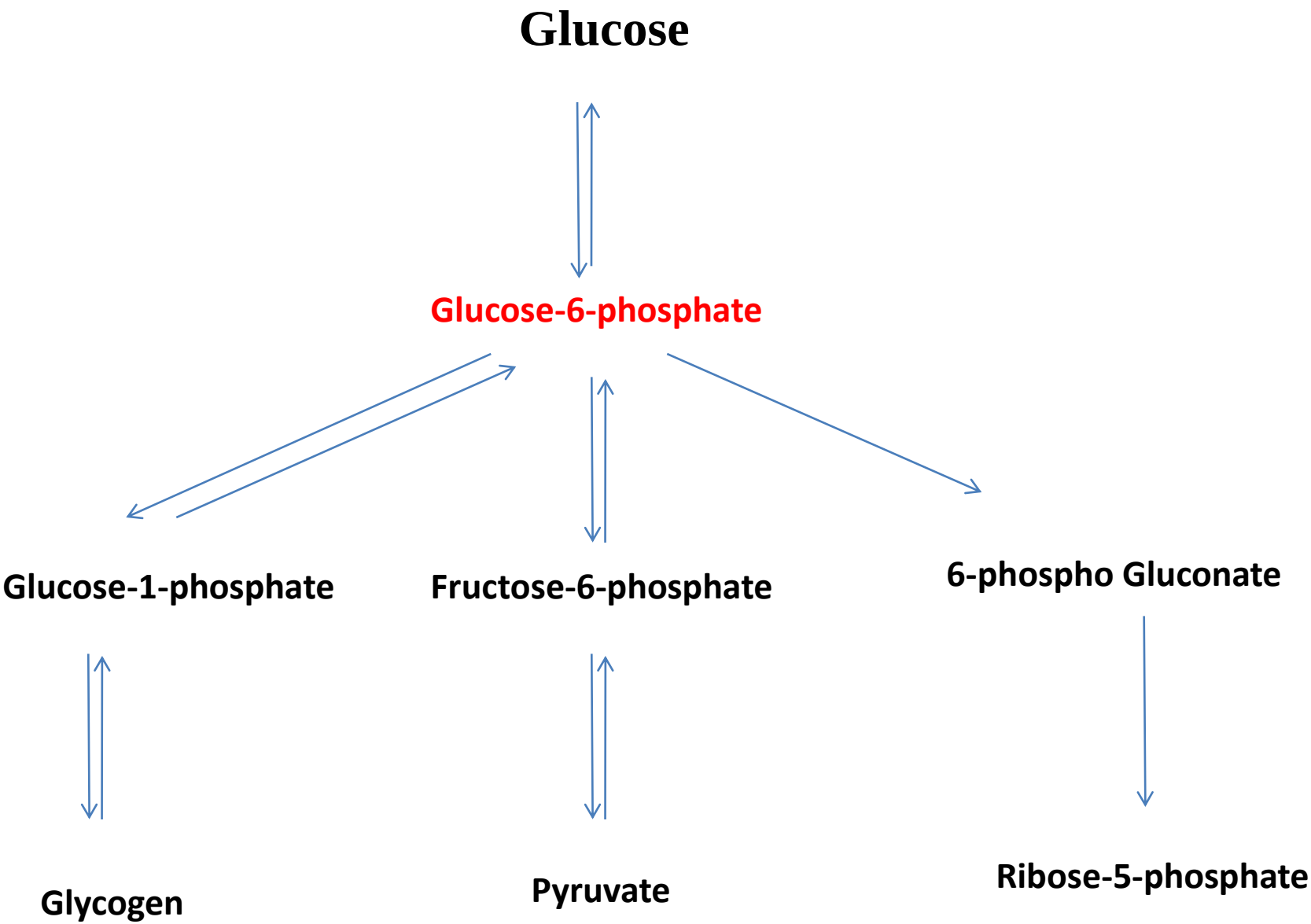
- 1. Glycolysis
- 2. Gluconeogenesis
- 3. Glycogen Metabolism
- 4. Fatty Acid Metabolism
- 5. Citric Acid Cycle
- 6. Oxidative Phosphorylation
- 7. Amino Acid Metabolism
- Only the liver can carry out all of the reaction ……the major pathways

The key junction points:

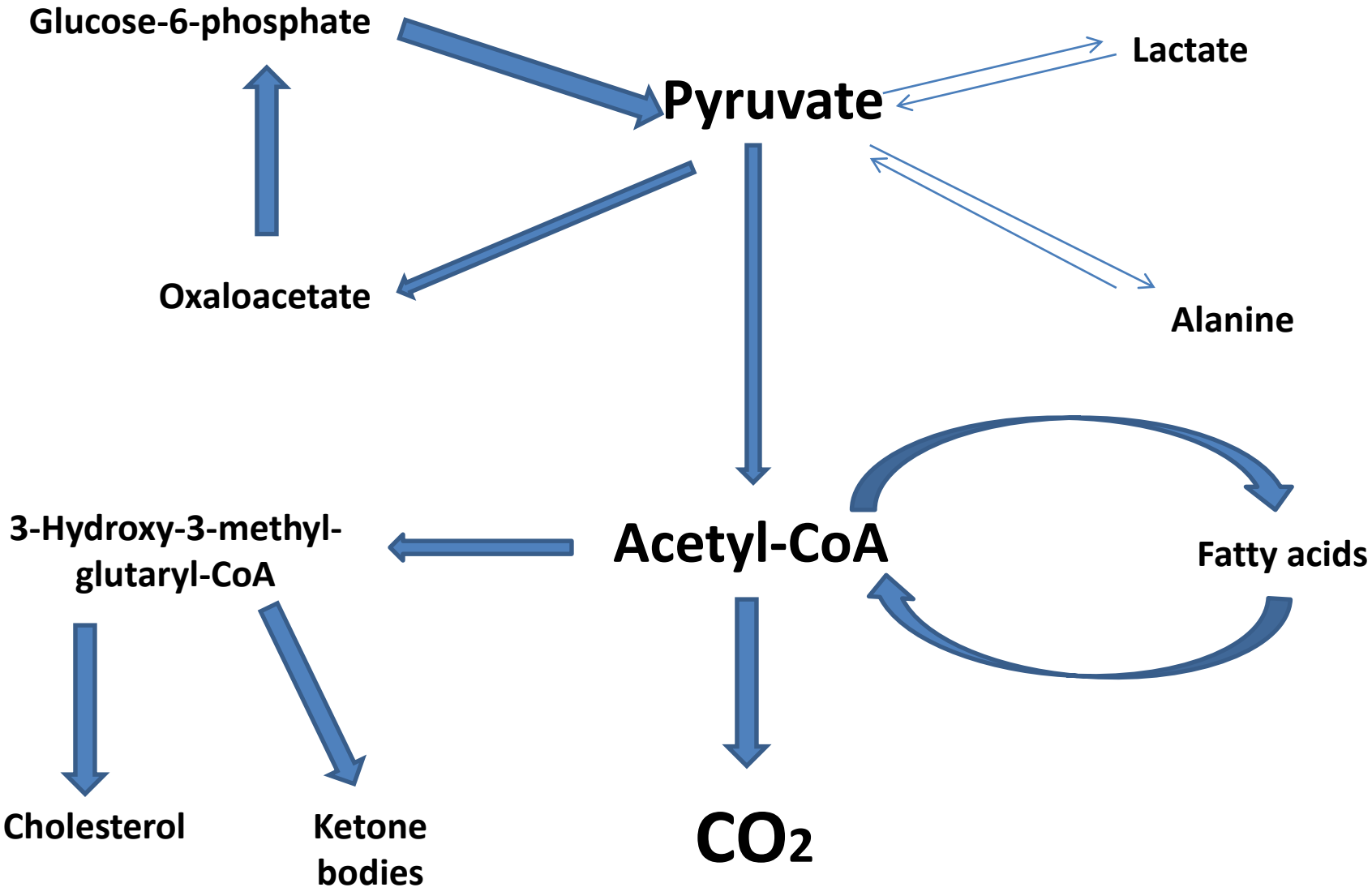
 The key junction points are:-

- Glucose- 6-phosphate,
- Pyruvate and
- Acetyl CoA.

Key Junctions



Key Junctions



Metabolic Fate of Glucose:

- Glucose: The intracellular form of glucose is glucose-6-phosphate.
- Only liver cells have the enzyme glucose-6-phosphatase that dephosphorylates G-6-P and releases glucose into the blood for use by other tissues
- G-6-P can be oxidized for energy in the form of ATP and NADH
- G-6-P can be converted to acetyl CoA and then fat.
- Excess G-6-P is stored away as glycogen.
- G-6-P can be shunted into the pentose phosphate pathway to generate NADPH and ribose-5-phosphate

Metabolic Fate of Fatty Acids:

- Fatty acids are oxidized to acetyl CoA for energy production in the form of NADH.
- Fatty acids can be converted to ketone bodies. Ketone bodies can be used as fuel in extrahepatic tissues.
- Fatty acids are used for the biosynthesis of bioactive molecules such as arachidonic acid and eicosanoids.
- Cholesterol, steroids and steroid hormones are all derived from fatty acids.
- Excess fatty acids are stored away as triglycerides in adipose tissue.

Metabolic Fate of Amino Acids:

- Amino acids are used for the synthesis of enzymes, transporters and other physiologically significant proteins.
- Amino acid Nitrogen is required for synthesis of the cell's genetic information (synthesis of nitrogenous bases).
- Several biologically active molecules such as neurotransmitters.
- Amino acids are precursors of several hormones (peptide hormones like insulin and glucagon and Amine hormones such as catecholamines).
- Aminoacids can be catabolized to acetyl CoA, pyruvate or intermediates of the TCA cycle for complete oxidation.

The key points of Metabolic Pathways:

- Acetyl CoA is a common intermediate of all metabolic pathways. It interconnects glucose, fatty acid and amino acid metabolism.
- Oxidation of dietary fuel leads to the capture of energy in the form of ATP and NADH / $FADH_2$.
- NADH / $FADH_2$ transfer their electrons to O_2 via the electron transport chain. The energy released is used to synthesize ATP.
- Biosynthetic and degradative pathways are distinct and co-ordinately regulated.

The overall Metabolic Pathways