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OUTLINE OF COURSE

- Introduction to metabolism
- Breakdown of Biological molecules and their uses as fuel
- Biological oxidation: Electron transport chain
- Oxidative phosphorylation

HIGH-ENERGY PHOSPHATES PLAY A CENTRAL ROLE IN ENERGY CAPTURE AND TRANSFER

Standard free energy of hydrolysis of some organophosphates of biochemical importance.[1,2]

Compound	$\Delta G^{0'}$ kJ/mol	$\Delta G^{0'}$ kcal/mol
Phosphoenolpyruvate	–61.9	–14.8
Carbamoyl phosphate	–51.4	–12.3
1,3-Bisphosphoglycerate (to 3-phosphoglycerate)	–49.3	–11.8
Creatine phosphate	–43.1	–10.3
ATP → ADP + P_i	–30.5	–7.3
ADP → AMP + P_i	–27.6	–6.6
Pyrophosphate	–27.6	–6.6
Glucose 1-phosphate	–20.9	–5.0
Fructose 6-phosphate	–15.9	–3.8
AMP	–14.2	–3.4
Glucose 6-phosphate	–13.8	–3.3
Glycerol 3-phosphate	–9.2	–2.2

[1] P_i, inorganic orthophosphate.
[2] Values for ATP and most others taken from Krebs and Kornberg (1957). They differ between investigators depending on the precise conditions under which the measurements are made.

Metabolism

Metabolism is the sum total of chemical transformations taking place in a cell or organism which occurs through a series of enzyme-catalyzed reactions.

These series of enzyme-catalyzed reaction constitutes METABOLIC PATHWAYS.

Each of the consecutive steps in a metabolic pathway brings about a specific, small chemical change.

This change is usually the removal, transfer or addition of a particular atom or functional group.

The precursor is converted into a product through a series of metabolic intermediates called METABOLITES.

TWO PHASES OF METABOLISM

CATABOLISM

- Is the degradative phase of metabolism in which organic nutrient molecules (carbohydrates, fats and proteins) are converted into smaller, simpler end products (e.g lactic acid, CO_2 , NH_3).

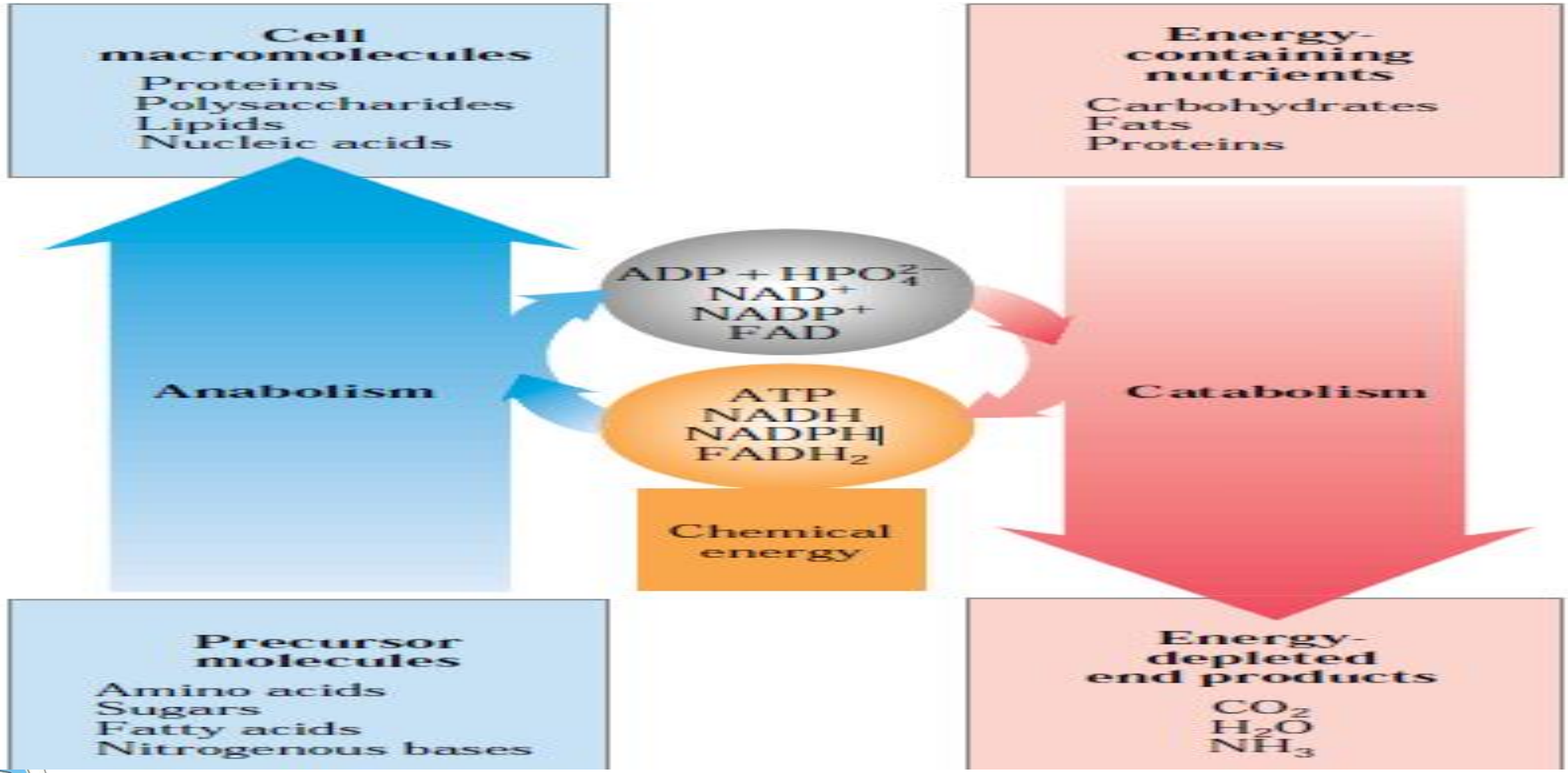
- Catabolic pathways release energy, some of which is conserved in the formation of ATP and reduced electron carriers (NADH, NADPH & $FADH_2$).

ANABOLISM

- Is the biosynthetic phase in which small, simple precursors are built up into larger and more complex molecules, including lipids, polysaccharides, proteins and nucleic acids.

- Anabolic reactions require an input of energy, generally in the form of ATP or NADH/NADPH and $FADH_2$

ANABOLISM AND CATABOLISM



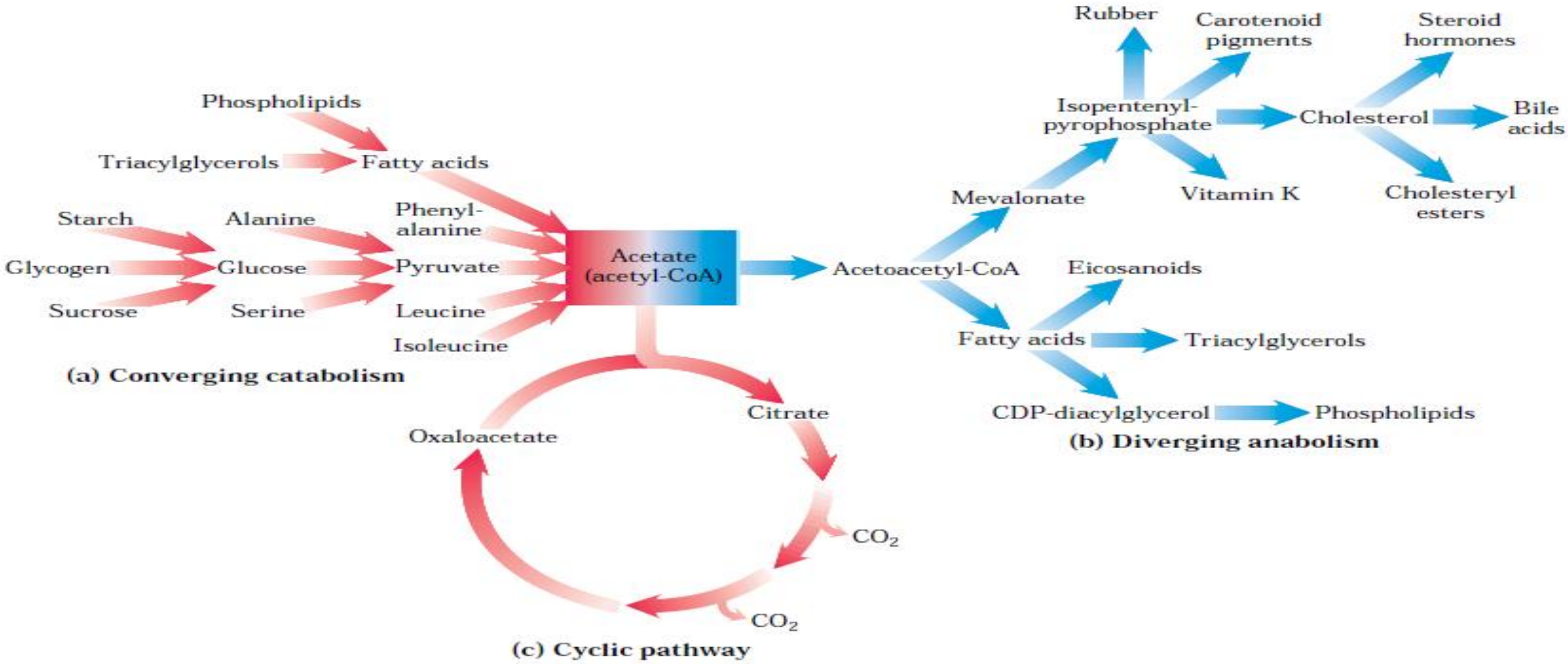
STRATEGY OF METABOLISM

1. TO PRODUCE ATP.

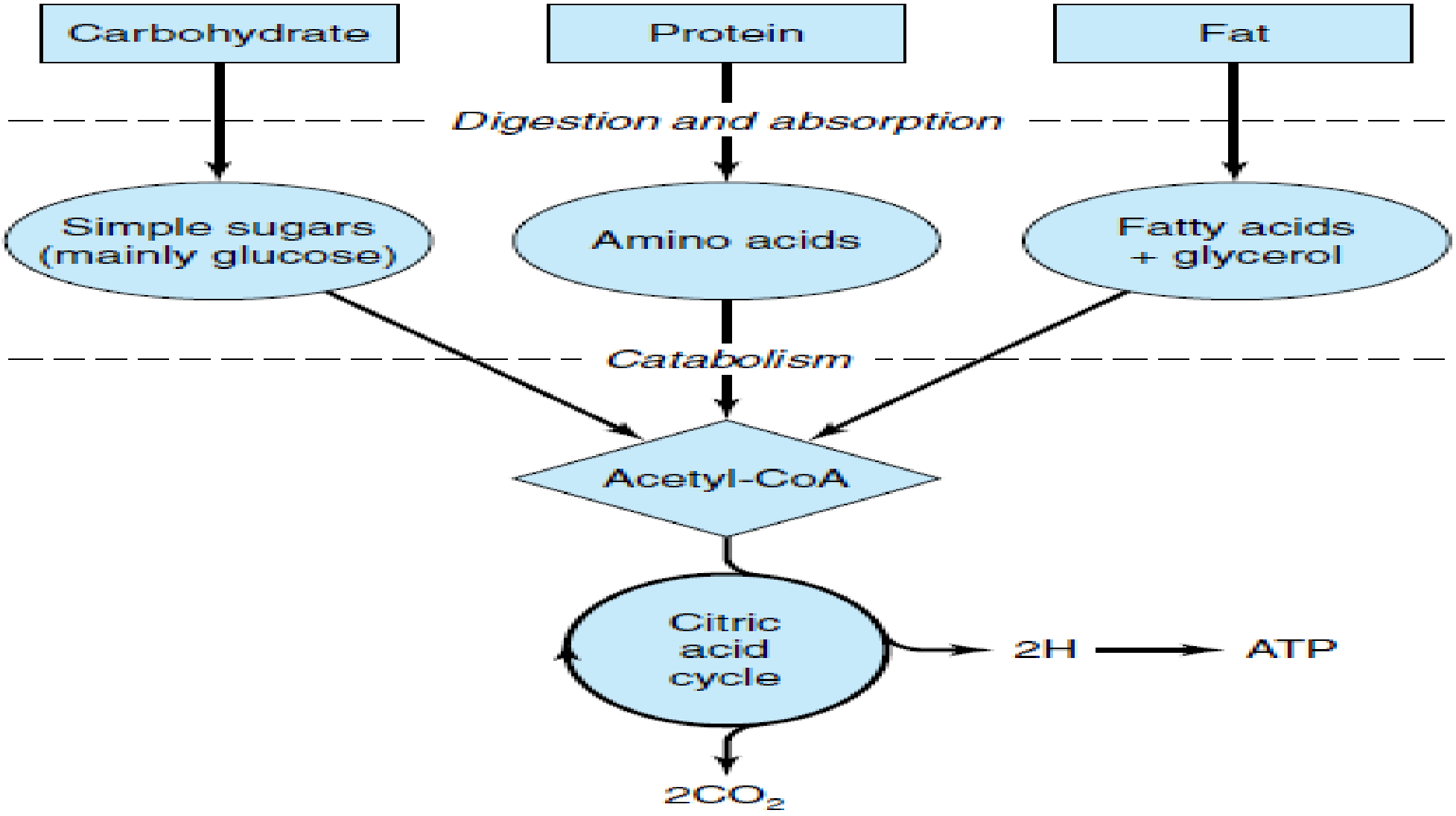
2. TO GENERATE NADPH (REDUCING EQUIVALENTS).

3. SYNTHESIZE AND DEGRADE BIOMOLECULES REQUIRED IN SPECIALIZED CELLULAR FUNCTIONS.

4. TO ALTERNATE DEGRADATIVE AND BIOSYNTHETIC PATHWAY.


Phospholipids
Triacylglycerols
Fatty acids
Starch
Alanine
Phenyl-alanine
Glycogen
Glucose
Pyruvate
Sucrose
Serine
Leucine
Isoleucine
Acetate (acetyl-CoA)
(a) Converging catabolism
Rubber
Carotenoid pigments
Steroid hormones
Isopentenyl-pyrophosphate
Cholesterol
Bile acids
Mevalonate
Vitamin K
Cholesteryl esters
Acetoacetyl-CoA
Eicosanoids
Fatty acids
Triacylglycerols
CDP-diacylglycerol
Phospholipids
(b) Diverging anabolism
Citrate
Oxaloacetate
CO_2
CO_2
(c) Cyclic pathway

Overview of metabolism



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METABOLISM OF CARBOHYDRATES

1. Glycolysis
2. Fates of pyruvate
3. Gluconeogenesis
4. Citric acid Cycle
5. Glycogen synthesis
6. Pentose Phosphate pathway
7. Glyoxylate pathway

Metabolism of Lipids

1. Lipolysis and Lipogenesis
2. Fatty acid Biosynthesis
3. Fatty acid oxidation
4. Ketogenesis

Metabolism of Amino acids and proteins

1. Transamination
2. Oxidative Deamination
3. Urea cycle
4. Biosynthesis of the nutritionally non-essential amino acids (Alanine, Aspartate, Asparagine, Glutamate, Glutamine, Glycine, Cysteine, Proline, Serine, Tyrosine)

METABOLISM OF NUCLEIC ACIDS

1. BIOSYNTHESIS OF PURINE NUCLEOTIDES
2. BIOSYNTHESIS OF PYRIMIDINE NUCLEOTIDES
3. BREAKDOWN OF PURINE AND PYRIMIDINE NUCLEOTIDES

THANK YOU