

# Chapter 4

# Bioenergetics

### Science titbits

The rate of photosynthesis is directly proportional to the  $\text{CO}_2$  consumed or  $\text{O}_2$  released therefore, it can be measured by measuring the amount of  $\text{CO}_2$  consumed or by measuring the amount of  $\text{O}_2$  released during the process in specific time.

### Teacher's Point

Teachers would guide the students to draw the molecular structure of chlorophyll showing the porphyrin head and phytol tail.

### Teacher's Point

Teacher would guide the students to develop the graphical interpretation of the wavelengths of light along with the percentage absorption by of chlorophyll a and b.

### Science Titbits

A complex oxidation-reduction involves NAD or NADP. NAD and NADP act as intermediate in cellular reactions involving electron transfer. Many of the electrons removed from reduced carbon compounds in various enzyme-catalyzed reactions are transferred to NAD to produce NADH. When a molecule of NAD or NADP gains electrons and becomes closely associated with each reduced molecule. Technically, it is more accurate to represent the reduced form as  $\text{NADH}^+ + \text{H}^+$  and  $\text{NADPH} + \text{H}^+$ . For convenience, these reduced forms i.e.

$\text{NADH}^+ + \text{H}^+$  and  $\text{NADPH} + \text{H}^+$  can be represented as  $\text{NADH}_2$  and  $\text{NADPH}_2$  respectively.

### **Science Titbits:**

Ubiquinone is not a protein, but a small molecule soluble in lipids and insoluble in water. Cytochromes literally means "Cell colour". The reduced cytochromes are pink in colour. They are protein plus pigment molecules containing iron. They can gain or lose an electron.

**Q1. Explain cellular respiration of fats and proteins.**

**Ans:**

#### **Cellular Respiration of Fats and proteins:**

When a fat is used as an energy source, it breaks down to glycerol and three fatty acids. As figure indicates, glycerol is converted to PGAL, a metabolite in glycolysis. The fatty acids are converted to acetyl-CoA molecules.

The hydrolysis of proteins results in amino acids whose R-group size determines whether the carbon chain is oxidized in glycolysis or the Krebs cycle. The carbon chain is produced in the liver when an amino acid undergoes deamination i.e. the removal of the amino group. The amino group becomes ammonia ( $\text{NH}_3$ ) which enters the urea cycle and becomes a part of urea.

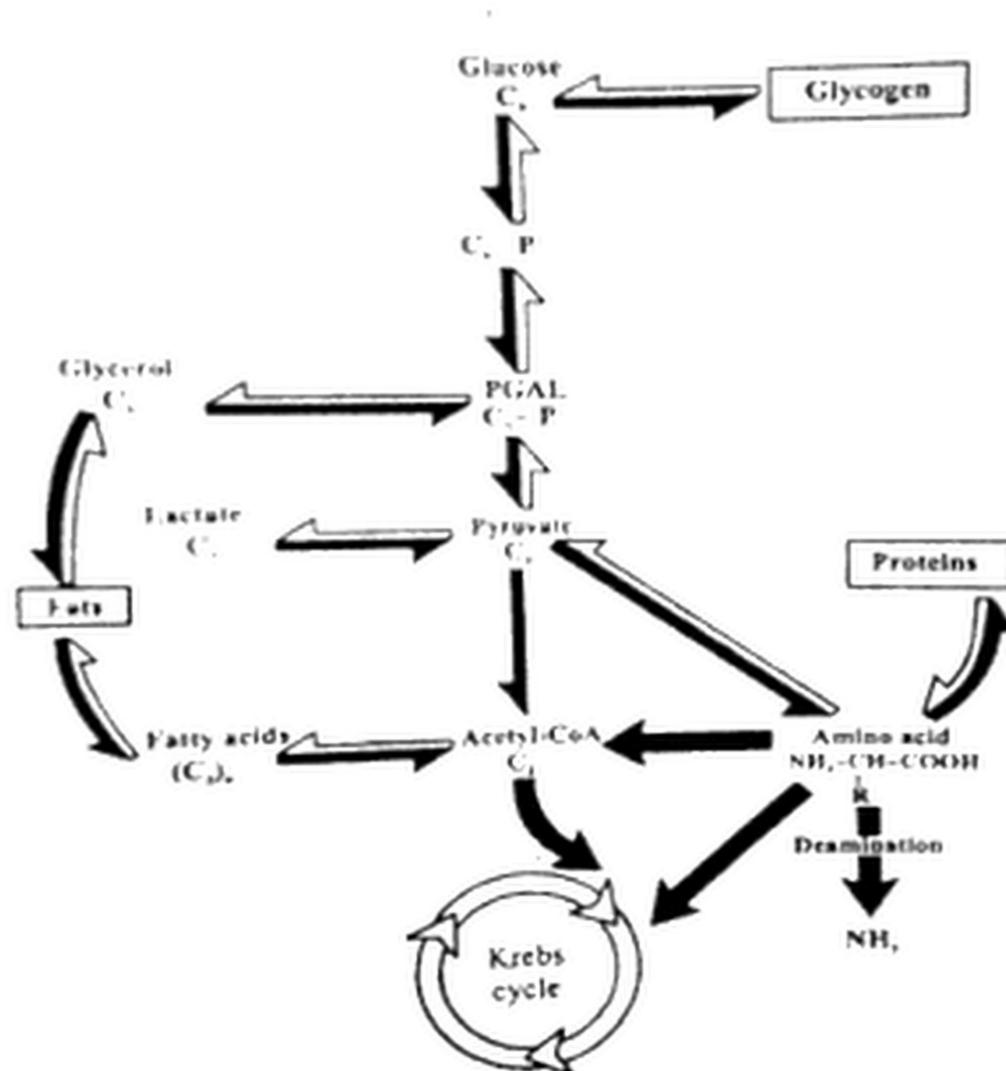


Fig The metabolic pool concept. When they are used as energy sources carbohydrates, fats and proteins enter degradative pathways at specific points. Degradation produces metabolites that can be used for synthesis of other compounds.

### Teacher's point

Teachers would guide the students to:

- Draw flowcharts showing the events of glycolysis and Krebs cycle.
- Illustrate the net energy output during glycolysis, oxidation of pyruvate and Krebs cycle.

### Science, Technology and society connections

- Analyze the impact of photorespiration on the agriculture yield in the tropic climates.

Photorespiration decreases net photosynthesis because a portion of  $\text{CO}_2$  fixed in photosynthesis escapes from the leaf after it is fixed. Under certain conditions, up to 5% of the photosynthetic potential is lost in photorespiratory metabolism. Thus, photorespiration reduces dry matter production and agriculture yield in tropical climate.

### **Teacher's Point**

Teachers would guide the student to justify why photorespiration is interference in the successful performance of the Calvin cycle.

### **Activity**

Extraction of the leaf pigments and their separation by paper chromatography.

