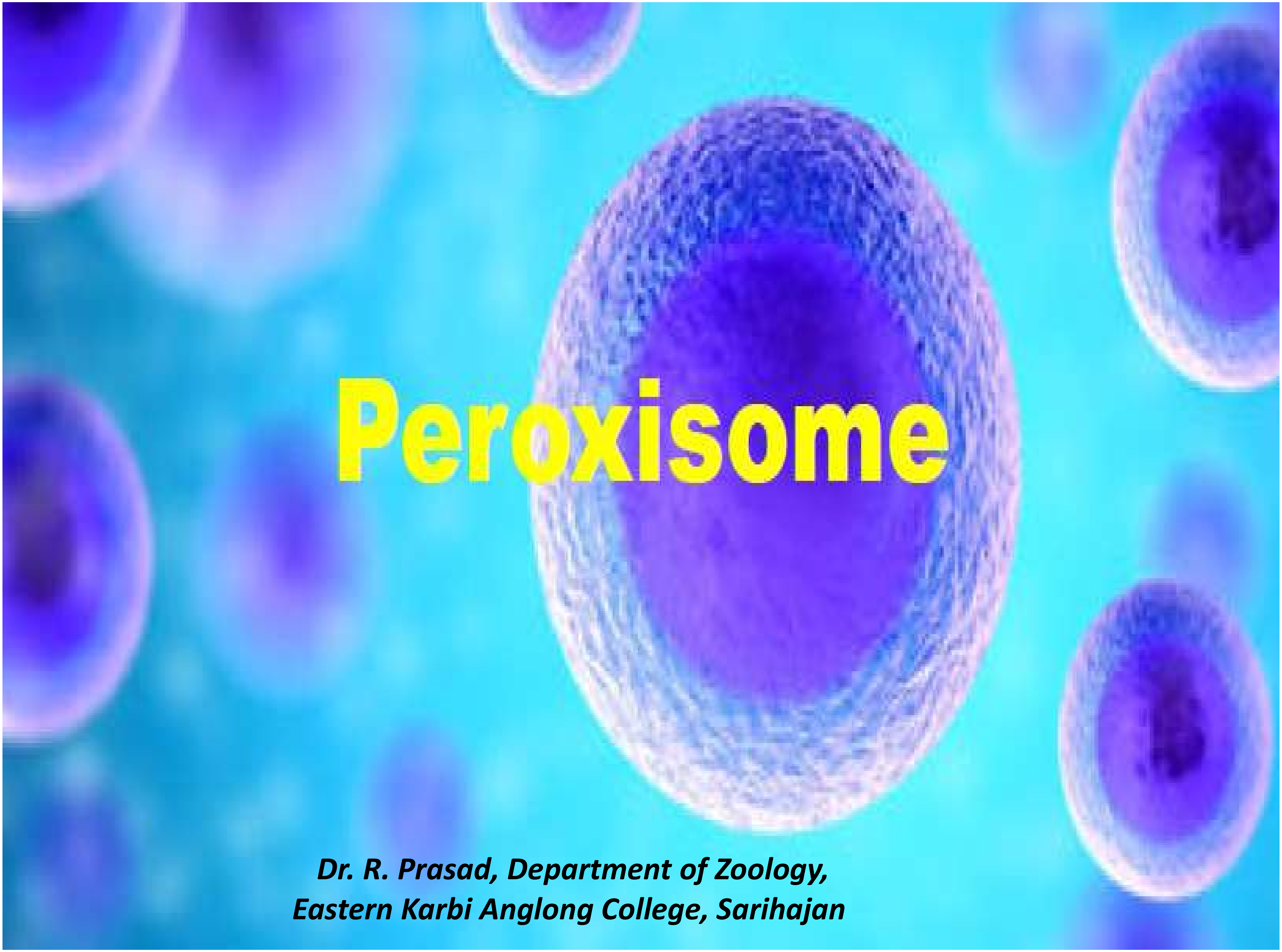

Peroxisome

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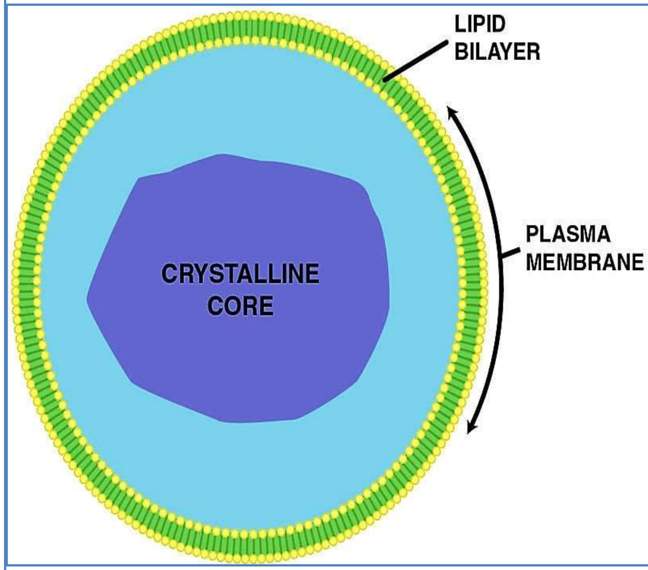
What is peroxisome?

- Peroxisomes are small, **membrane-enclosed organelles that contain enzymes** involved in a variety of metabolic reactions, including several aspects of energy metabolism.
- Peroxisomes were discovered by **Christian de Duve in 1967.**
- Although peroxisomes are **morphologically similar to lysosomes, they are assembled, like mitochondria and chloroplasts.**
- Although peroxisomes do **not contain their own genomes**, they are similar to mitochondria and chloroplasts in that **they replicate by division.**
- It is found **in the cytoplasm** of virtually **all eukaryotic cells.**
- Peroxisomes contain a battery of **oxidative enzymes** that are involved in breakdown of small molecules. Important **peroxisomal enzymes include D-amino acid oxidase and catalase,** the enzyme responsible for the **degradation of dangerous peroxides**. Peroxisomes are also involved in **drug detoxification** and the **biosynthesis of essential ether-phospholipids known as plasmalogens.**

Structure of Peroxisome

- Peroxisomes are enclosed in a **single membrane** and are **0.5 micrometer in diameter**.
- It contains fine **granular substances** that may condense to form an **opaque urate oxidase crystalline core** or **nucleoid.**
- The peroxisome **without nucleoid** is called **microperoxisome**.
- Peroxisomes contain **more than 50 enzymes and self-replicate by enlarging and then dividing**.
- They **contain H_2O_2 producing enzymes like oxidases and catalases** as well as **oxidative enzymes like peroxidase, Catalase, glycolic acid oxidase** and some other enzymes.
- Often compared to lysosomes, peroxisomes differ in that they **hold anti-oxidative enzymes**. Main enzymes are **uric acid oxidase, D amino acid oxidase, NADH glyoxylate reductase, catalases etc.**
- Peroxisomes contain **no DNA or ribosomes** and have **no means of producing proteins.** Instead, all of these proteins are imported across the membranes.

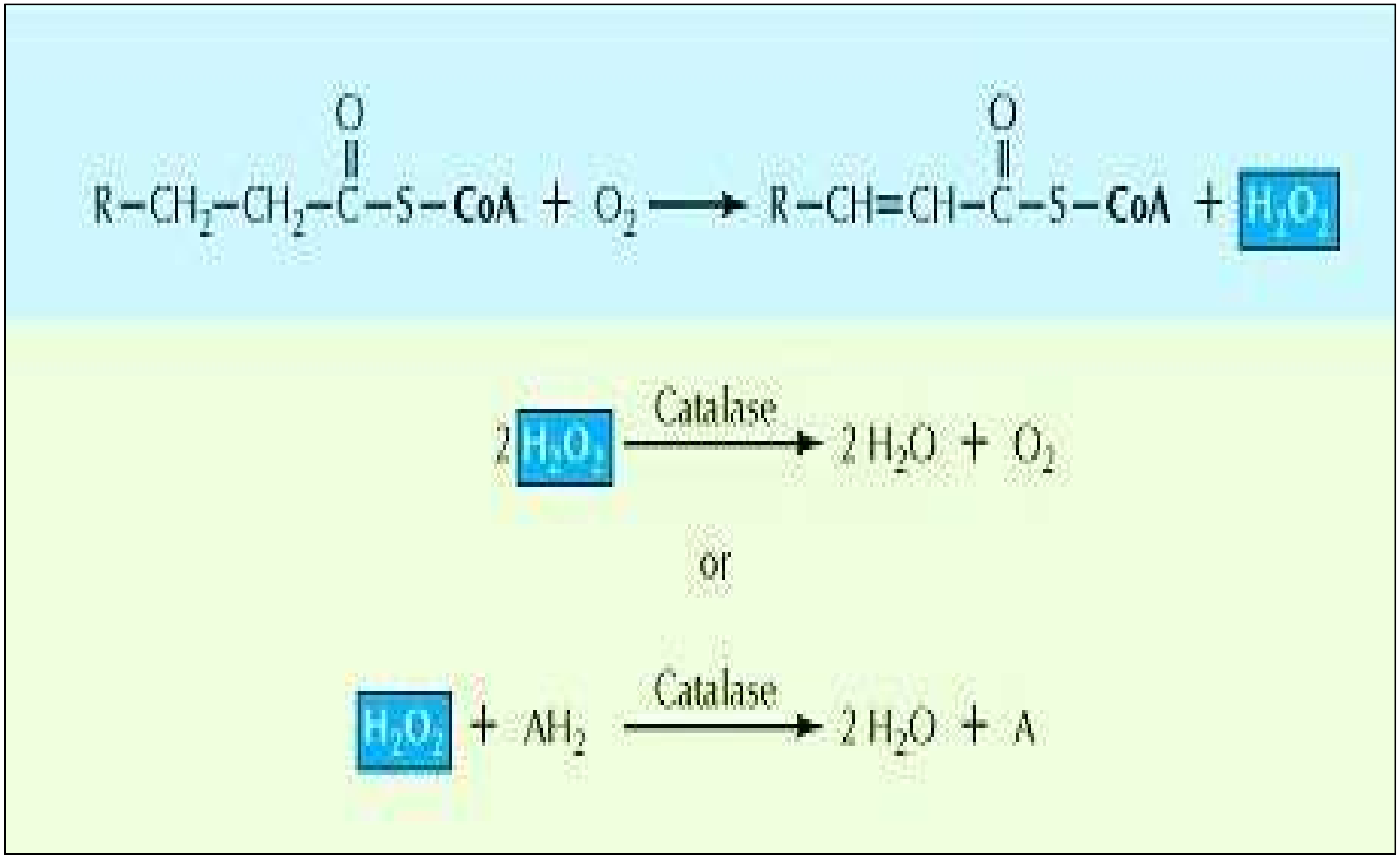


Functions of peroxisomes

- Peroxisomes are membrane-bound organelles in most eukaryotic cells, primarily involved in **lipid metabolism** and the conversion of reactive oxygen species such as **hydrogen peroxide into safer molecules like water and oxygen.** Peroxisomes are **vital to the healthy function of the liver.** These vesicles are found surrounding liver cells and contain enzymes responsible for many metabolic reactions including energy **metabolization and holding the digestive enzymes necessary for breaking down toxic matter in the cell.**
- Peroxisomes originally were defined as organelles that carry out **oxidation reactions leading to the production of hydrogen peroxide.** Because hydrogen peroxide is harmful to the cell, peroxisomes also contain the enzyme **catalase,** which **decomposes hydrogen peroxide either by converting it to water or by using it to oxidize another organic compound.** A variety of substrates are broken down by such oxidative reactions in peroxisomes, including uric acid, amino acids, and fatty acids.

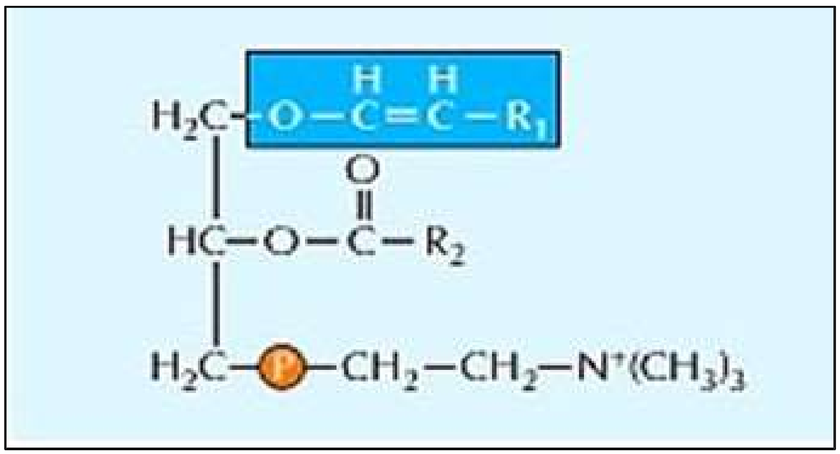
1. Oxidation of fatty acids

It is a particularly important example, since it provides a major source of metabolic energy. In animal cells, fatty acids are oxidized in both peroxisomes and mitochondria, but in yeasts and plants fatty acid oxidation is restricted to peroxisomes.



2. Lipid biosynthesis

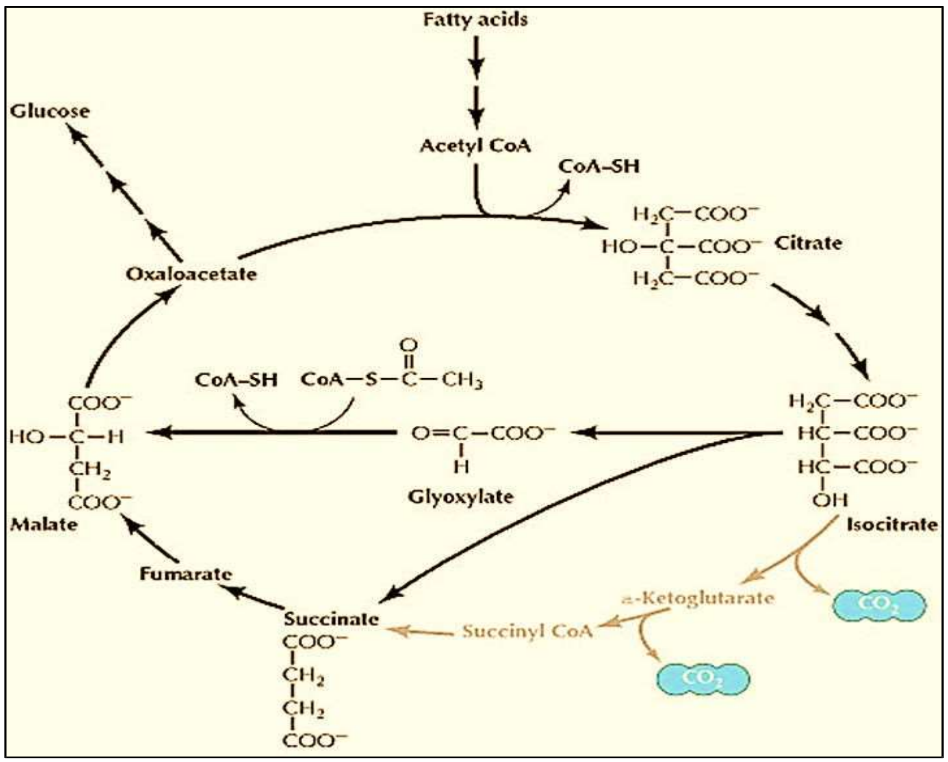
- **In addition to providing a compartment for oxidation reactions, peroxisomes are involved in lipid biosynthesis.**
- **In animal cells, cholesterol and dolichol are synthesized in peroxisomes as well as in the ER.**
- **In the liver, peroxisomes are also involved in the synthesis of bile acids, which are derived from cholesterol.**
- **In addition, peroxisomes contain enzymes required for the synthesis of plasmalogens—a family of phospholipids in which one of the hydrocarbon chains is joined to glycerol by an ether bond rather than an ester bond. Plasmalogens are important membrane components in some tissues, particularly heart and brain, although they are absent in others.**



3. Peroxisomes play two particularly important roles in plants

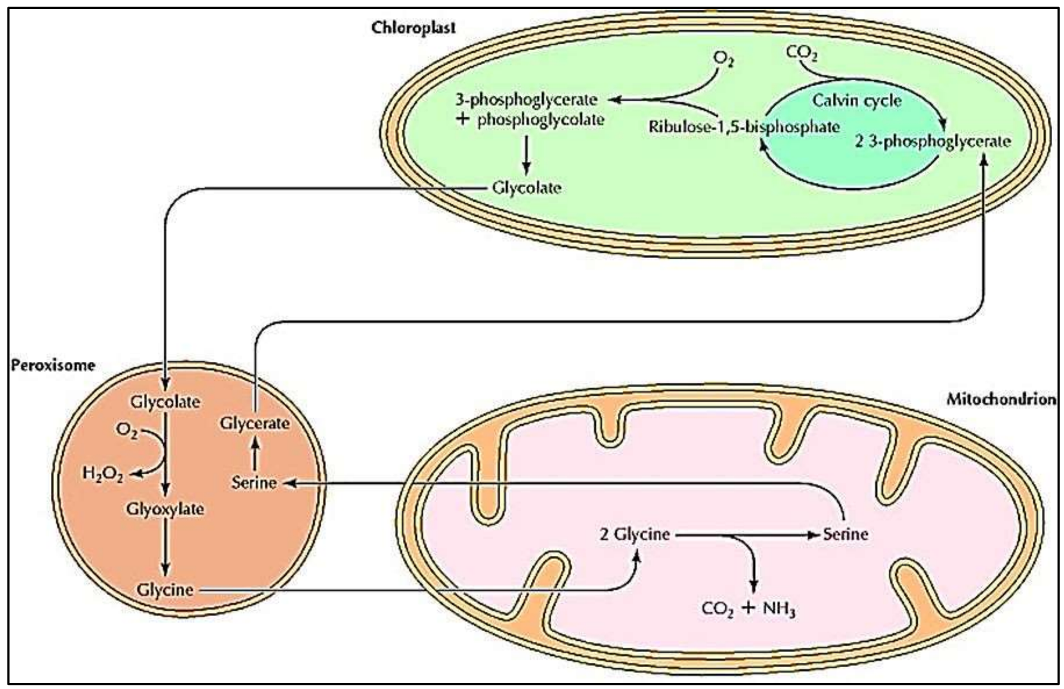
i. Glyoxylate cycle

Peroxisomes in seeds are responsible for the conversion of stored fatty acids to carbohydrates, which is critical to providing energy and raw materials for growth of the germinating plant. This occurs via a series of reactions termed the **glyoxylate cycle**, which is a variant of the citric acid cycle. The peroxisomes in which this takes place are sometimes called **glyoxysomes**.



ii. Photorespiration

- Peroxisomes in leaves are involved in **photorespiration,** which serves to metabolize a side product formed during photosynthesis. CO_2 is converted to carbohydrates during photosynthesis via a series of reactions called the Calvin cycle. The first step is the addition of CO_2 to the five-carbon sugar ribulose-1,5-bisphosphate, yielding two molecules of 3-phosphoglycerate (three carbons each).



Note: **Photorespiration does not appear to be beneficial for the plant, since it is essentially the reverse of photosynthesis—O_2 is consumed and CO_2 is released without any gain of ATP. However, the occasional utilization of O_2 in place of CO_2 appears to be an inherent property of rubisco, so photorespiration is a general accompaniment of photosynthesis. Peroxisomes thus play an important role by allowing most of the carbon in glycolate to be recovered and utilized.**