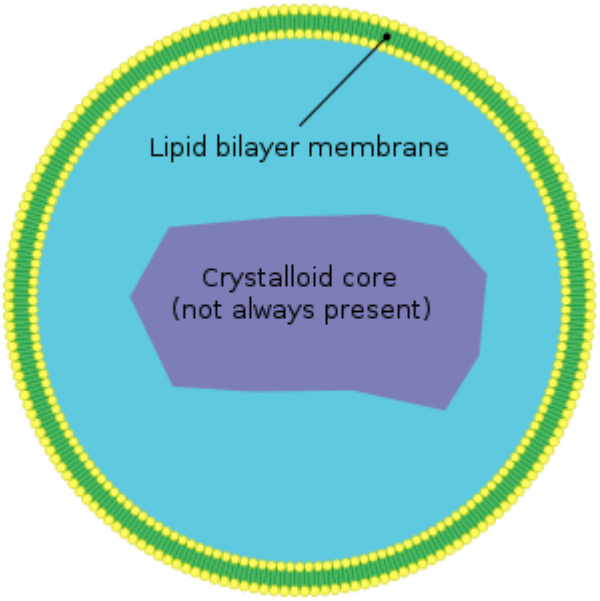
PEROXISOMES

STRUCTURE



- Peroxisomes are fundamentally similar to that of mitochondria and chloroplasts, rather than to that of the endoplasmic reticulum, Golgi apparatus, and lysosomes. However, they lack DNA unlike mitochondria and chloroplasts.
- Peroxisomes are not derived from the endoplasmic reticulum and therefore are not a part of endomembrane system.
- They replicate by fission. This organelle is surrounded by a lipid bilayer membrane which encloses the crystalloid core. The bilayer is a plasma membrane which regulates what enters and exits the peroxisomes.
- There are at least 32 known peroxisomal proteins, called peroxins, which carry out peroxisomal function inside the organelle.
- Proteins destined for peroxisomes are translated on free cytosolic ribosomes and then transported into peroxisomes as completed polypeptide chains.

FUNCTIONS OF PEROXISOMES

- Peroxisomes are enclosed in a single membrane and are 0.5 micrometer in diameter. In some mammalian tissues, peroxisomes form an extensive network. Often compared to lysosomes, peroxisomes differ in that they hold antioxidative enzymes.
- 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. Proteins are selectively imported into peroxidases.
- Peroxisome contains oxidative enzymes, such as catalase, D-amino acid oxidase and uric acid oxidase. They use molecular oxygen to remove hydrogen atoms from a specific organic substrate (R) in an oxidative reaction. It produces hydrogen peroxide (H_2O_2 is a toxic byproduct of cellular metabolism).

$$RH_2 + O_2 ==>> R + H_2O_2$$

- Catalases uses this H_2O_2 in the peroxisome to oxidize other substrates like phenols, formic acid, formaldehyde, and alcohol:

$$H_2O_2 + R'H_2 ==>> R' + 2H_2O$$

- Peroxisomes contain no DNA or ribosomes and have no means of producing proteins. Instead, all of these proteins are imported across the membranes.
- Peroxisomes contain at least 50 different enzymes, which are involved in a variety of biochemical pathways in different types of cells.
- 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. The oxidation of fatty acids 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.
- 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.
- 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 via glyoxylate cycle, which is a variant of the citric acid cycle. The peroxisomes in which this takes place are sometimes called glyoxysomes.
- Peroxisomes in leaves are involved in photorespiration, which serves to metabolize a side product formed during photosynthesis.