

Peroxisomes

Discovered by **De Duve** and his colleagues, Peroxisomes are simple membrane bound vesicles with a diameter of 0.1 to 1.0 micrometers, which contain a dense, crystalline core of oxidative enzymes.

- Found in both animal and plant cells.
- Unlike lysosomes, peroxisomes are not derived from E.R. and therefore are not a part of the endomembrane system.
- Peroxisomes are found ubiquitously in eukaryotic cells and are especially prominent in Mammalian Liver and Kidney cells, in algae and photosynthetic cells of plants species that store fats in their seeds.
- The role of peroxisomes is not as well understood in animals as they are in plant cells.
- Peroxisomes are a membrane bound cellular organelle that contains mostly enzymes. And perform many important functions, including lipid metabolism and chemical detoxification.

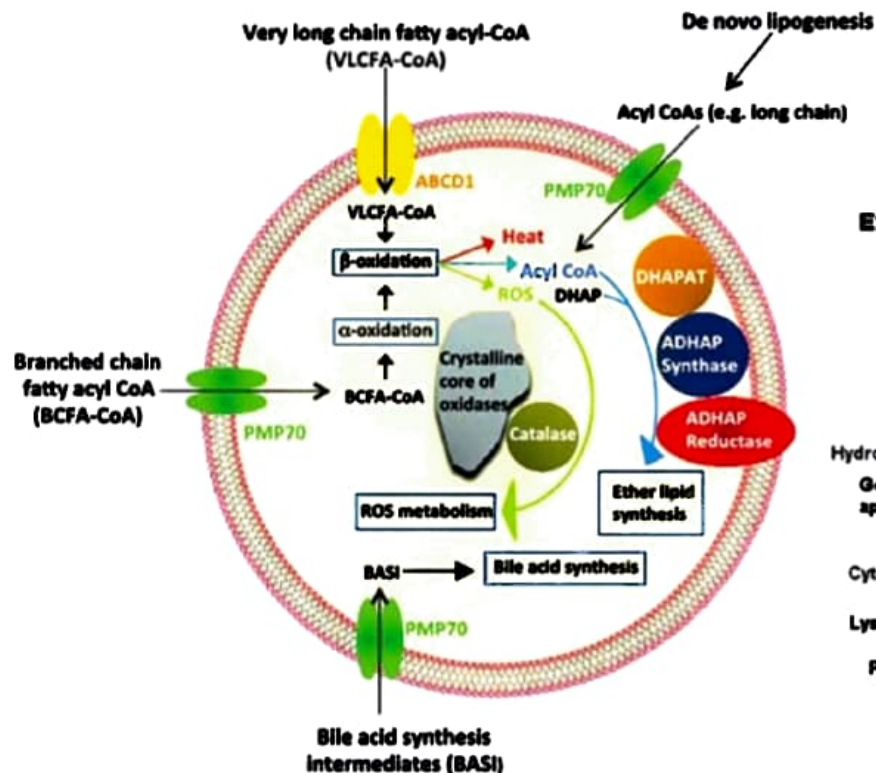
Peroxisomes Definition

- Peroxisomes are small, membrane-enclosed cellular organelles containing oxidative enzymes that are involved in a variety of metabolic reactions, including several aspects of energy metabolism.
- They are considered as an important type of micro-body found in both plants and animal cells.
- They were identified as organelles by **Belgian cytologist Christian de Duve** in **1967** after already been described.
- First peroxisomes to be discovered were isolated from leaf homogenate of spinach.
- They are most abundantly found in detoxifying organs such as the liver and kidney cells. However, they can be induced to proliferate in response to metabolic needs.
- Peroxisomes are multifunctional organelles containing more than 5 enzymes involved in diverse activities.
- These organelles were so named because they are the site of synthesis and degradation of hydrogen peroxide, a highly reactive and toxic oxidizing agent.

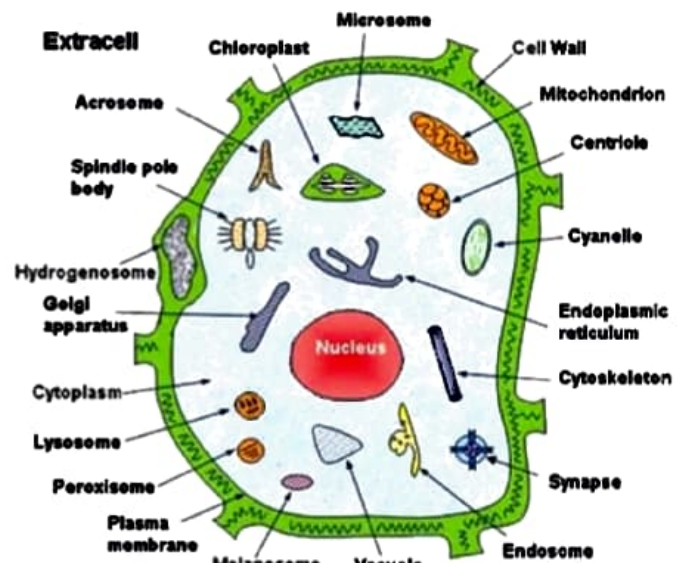
Structure of Peroxisomes

- They are membrane-bound spherical bodies of 0.2 to 1.5 μm in diameter found in all eukaryotic organisms including both plants and animal cells.
- They are found floating freely in the cytoplasm in close association of ER, mitochondria or chloroplast within the cell.
- They are among the simplest of eukaryotic organelles.

- They exist either in the form of a network of interconnected tubules called *peroxisome reticulum* or as individual *micro-peroxisomes*.
- They are variable in size and shape according to the cell and usually circular in cross-section.
- They range from 0.2 -1.5 μm in diameter.
- A lipid bilayer membrane surrounds which regulate what enters and exits the peroxisomes.
- It consists of a single limiting membrane of lipid and protein molecules enclosing the granular dense matrix.
- The matrix consists of fibrils or a crystalloid structure containing enzymes.



Peroxisomes

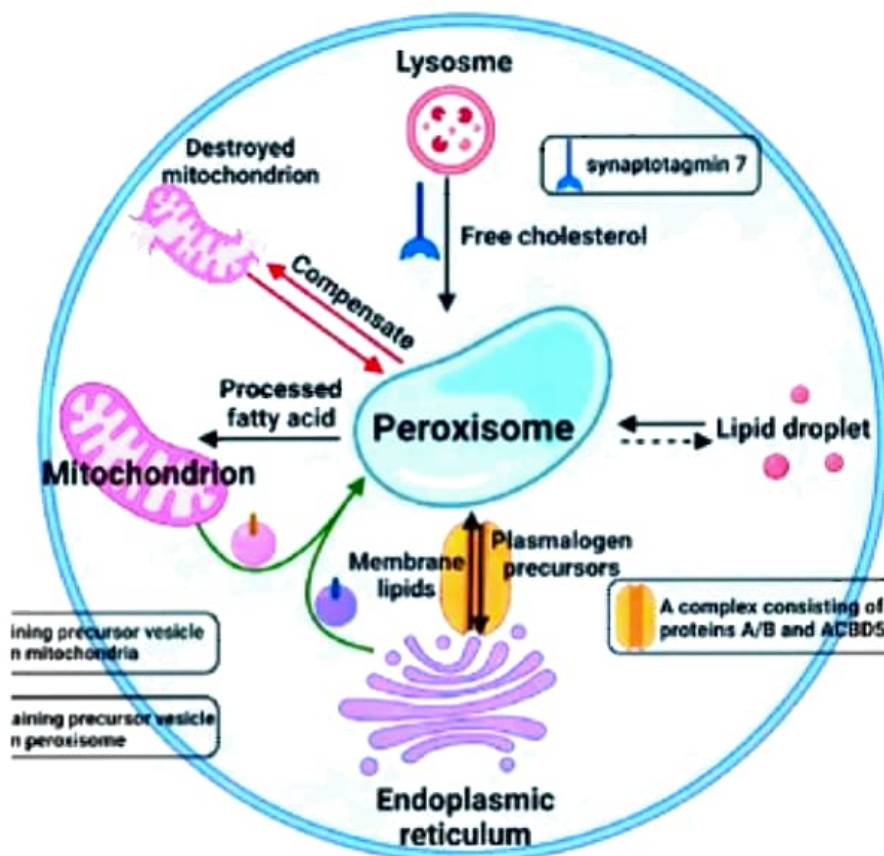


Peroxisomal Enzymes

- Approximately 60 known enzymes are present in the matrix of peroxisomes.
- They are responsible to carry out oxidation reactions leading to the production of hydrogen peroxide.
- The main groups of enzymes include:
 1. Urate oxidase
 2. D-amino acid oxidase
 3. Catalase
 4. Glycolate oxidase
 5. Luciferase

Regardless, where they occur, peroxisomes are characterized by the presence of catalase, an enzyme that plays a vital role in the breakdown of hydrogen peroxide.

- Hydrogen peroxide is a potentially toxic compound that is formed in a variety of oxidative reactions catalyzed by oxidases (which are located in peroxisomes along with catalase). Thus, the generation and degradation of hydrogen peroxide occurs in the same organelle thereby protecting the other parts of the cell from exposure to this toxic compound.



Functions of Peroxisomes

1. Hydrogen Peroxide Metabolism:

- Enzymes present in the peroxisomes both lead to the production and elimination of H_2O_2 which is a reactive oxygen species.
- The most obvious role of peroxisomes is detoxification of hydrogen peroxide. The oxidases present in peroxidases vary in the specific reactions they catalase but all of them share the property of transferring electrons from their specific substrates to oxygen and form hydrogen peroxide.
- The hydrogen peroxide formed is broken down by the enzyme catalase in two ways:
 - Catalytic mode
 - Peroxidative mode

Catalytic mode: One molecule of H_2O_2 is oxidized to O_2 and the second one is reduced to water. The overall reaction becomes:

