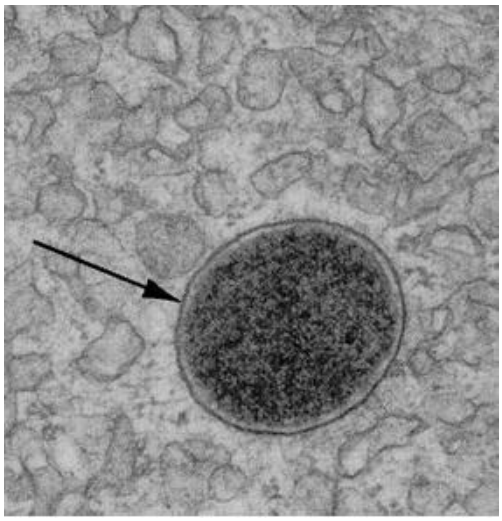
❖ Cytoplasmic Organelles (part2)

❖ Lysosomes

- Lysosomes are membrane bounded organelles that contain about 40 different **digestive enzymes called hydrolytic enzymes** such as protease, lipase, nuclease, glycosidase ……..ect.
- Produced by the Golgi apparatus, Lysosomal hydrol**ases** are synthesized and segregated in the RER and then transferred to the Golgi apparatus, where the hydrolytic enzymes are further modified and packaged in vacuoles that form lysosomes.
- Present in all cells and particularly abundant in cells with phagocytic activity (eg, macrophages, neutrophils) because it digest any foreign substance by hydrolytic enzyme.
- **L.M.** identify by special histochemical methods for their enzymes.
- **E.M.** they appear as homogenous membrane bound vesicles, trilaminar unit membrane, variable in size, number, shape and homogeneity



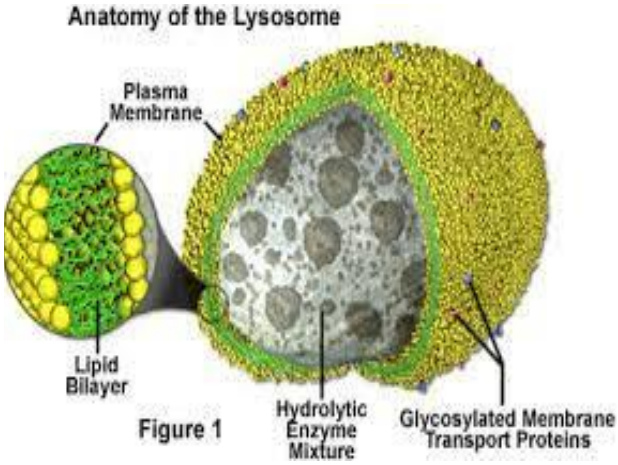


Figure 1

The functions of lysosome

1. Digestion of exogenous macromolecules like pathogens(bacteria, virus,…ect) by phagocytosis and LDL by receptor mediated endocytosis
2. Maintain cell health by remove all old endogenous macromolecules, excess or worn-out cell parts by autophagy.
3. Have important role in post mortum autolysis.

✓ **Exogenous macromolecules** taken from outside the cell by **endocytosis** digested when the membrane of the **phagosome** or **pinocytotic vesicle** fuses with a lysosome. The composite, active organelle is now termed a **secondary** or

heterolysosome. Heterolysosomes are generally somewhat larger and have a more heterogeneous appearance in the TEM because of the wide variety of materials they may be digesting. During this digestion of macromolecules, released nutrients diffuse into the cytosol through the lysosomal membrane. Indigestible material is retained within a small vacuolar remnant called a residual body. In some long-lived cells (eg, neurons, heart muscle), residual bodies can accumulate over time as granules of lipofuscin.

- ✓ Besides degrading exogenous macromolecules, lysosomes also function in the removal of excess or nonfunctional organelles and other cytoplasmic structures (**endogenous macromolecules**) in a process called **autophagy**. A membrane from SER forms around the organelle or cytoplasmic portion to be removed, producing an **autophagosome**. These then fuse with lysosomes that digest the enclosed cytoplasm. Autophagy is enhanced in secretory cells that have accumulated excess secretory granules and in times of nutrient stress, such as starvation. Digested products from autophagosomes are reused in the cytoplasm.

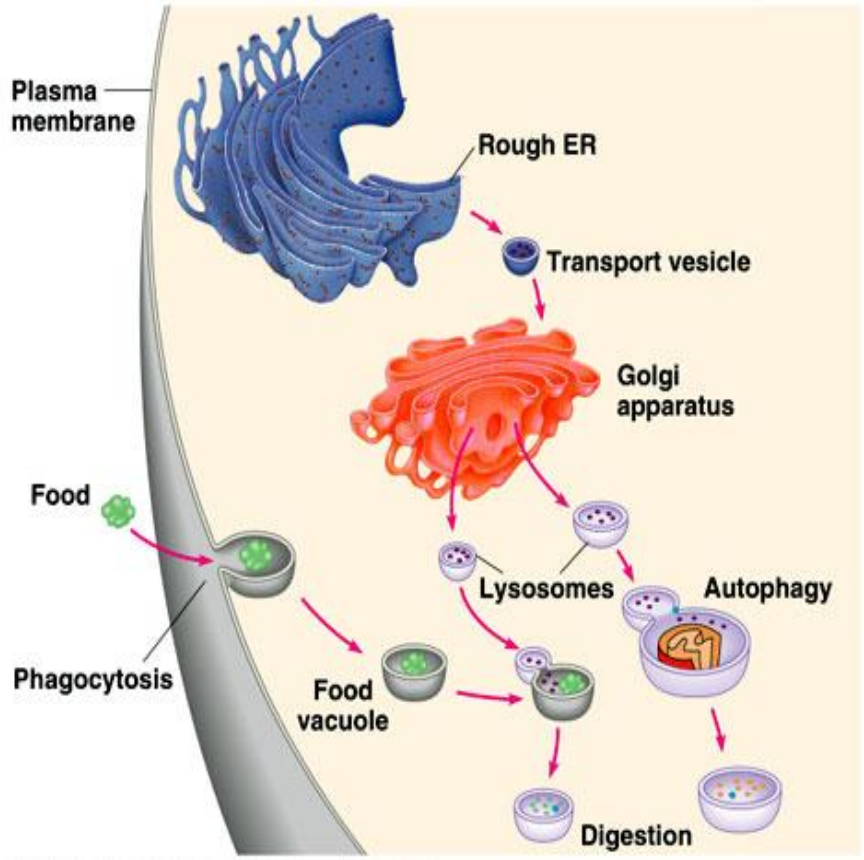
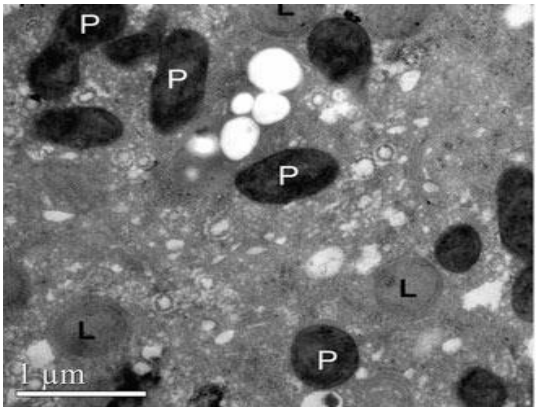


Figure show the endogenous and exogenous digestion by lysosome

✓ *Diseases categorized as **lysosomal storage disorders** stem from defects in one or more of the digestive enzymes present in lysosomes . In cells that must digest the substrate of the missing or defective enzyme following autophagocytosis, the lysosomes cannot function properly. Such cells accumulate large secondary lysosomes or residual bodies filled with the indigestible macromolecule. The accumulation of these vacuoles may eventually interfere with normal cell or tissue function, producing symptoms of the disease. Like **Tay-Sachs disease** is a rare disorder passed from parents to child. It's caused by the absence of an enzyme that helps break down fatty substances. These fatty substances, called gangliosides, build up to toxic levels in the child's brain and affect the function of the nerve cells. As the disease progresses, the child loses muscle control. Eventually, this leads to blindness, paralysis and death.*

❖ Peroxisome

- Small membrane bounded organelle. Present in all cell type.
- Named for their enzymes producing and degrading hydrogen peroxide (H_2O_2), which is potentially damaging to the cell.
- Similar to lysosome but less dense and contain no hydrolytic enzyme but contain several types of **oxidases ; catalases enzymes** and other metabolic enzymes. The peroxisome enzymes are synthesized on free cytosolic polyribosomes
  - **Oxidases** is enzyme that oxidized various organic substance to form hydrogen peroxide highly toxic product
  - **Catalase** enzyme which eliminate excess hydrogen peroxide by breaking it down into water and oxygen molecule. These enzymes also have important role in fatty acid oxidation to produce acetylcholine that is very important in make lipids and cholesterol like plasmalogen (white matter of brain) and steroid hormones. Another function is alcohol metabolism and inactivates various potentially toxic molecules, including some prescription drugs.
- So that the peroxisome protect the cell from the cytotoxic product because the degradation of hydrogen peroxide occur in the same organelle.
- Very abundant in the cell of liver and kidney.



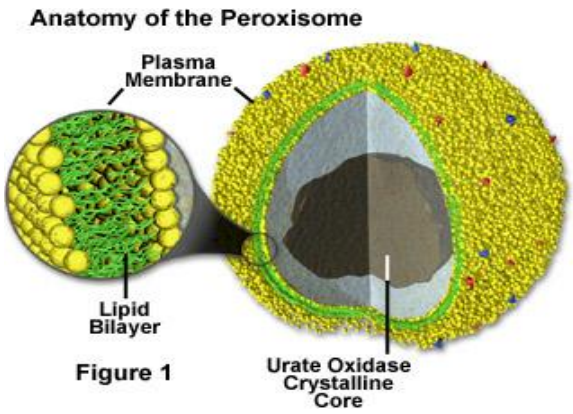


Figure 1

The structure of peroxisome under TEM

✓ Peroxisomes form in two ways:

1. Budding of precursor vesicles from the ER
2. Growth and division of preexisting peroxisomes.

Deficiencies of peroxisomal enzymes cause what is called peroxisomal disoreders (exp: Zellweger syndrome) that affects the structure and functions of several organ systems, producing symptoms of the disease.