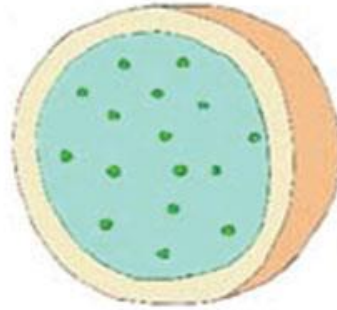
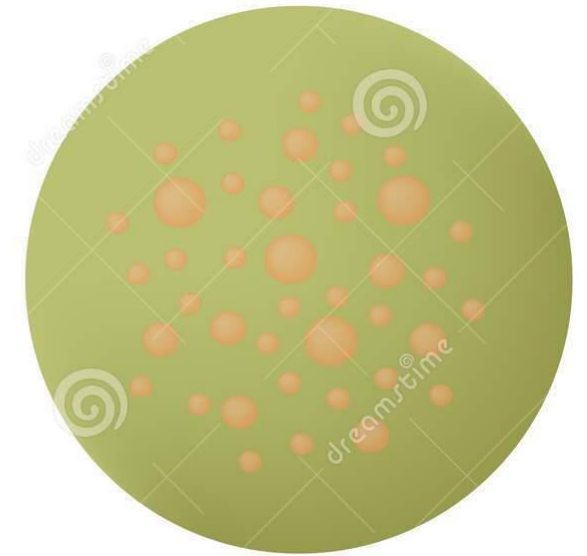
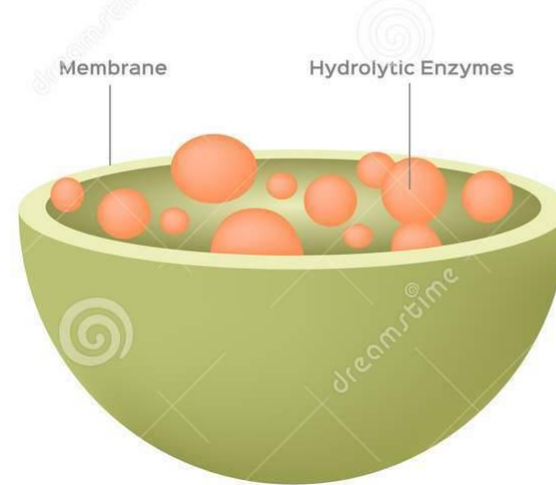


Lysosomes



Lysosomes

LYSOSOME



Dr. Rupesh B. Yadav

Asst. Prof.

TCSC, Mumbai.

Lysosomes

Discovery

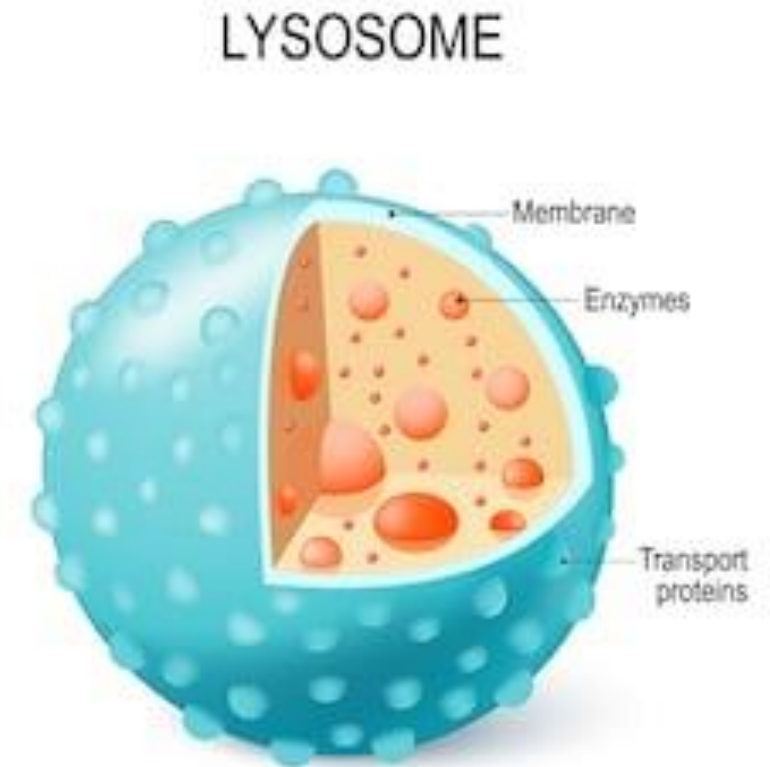
- **Christian Duve** discover the lysosome first time in the liver cell and due to which he was awarded **Nobel Prize** in Physiology or Medicine in **1974**



Lysosomes

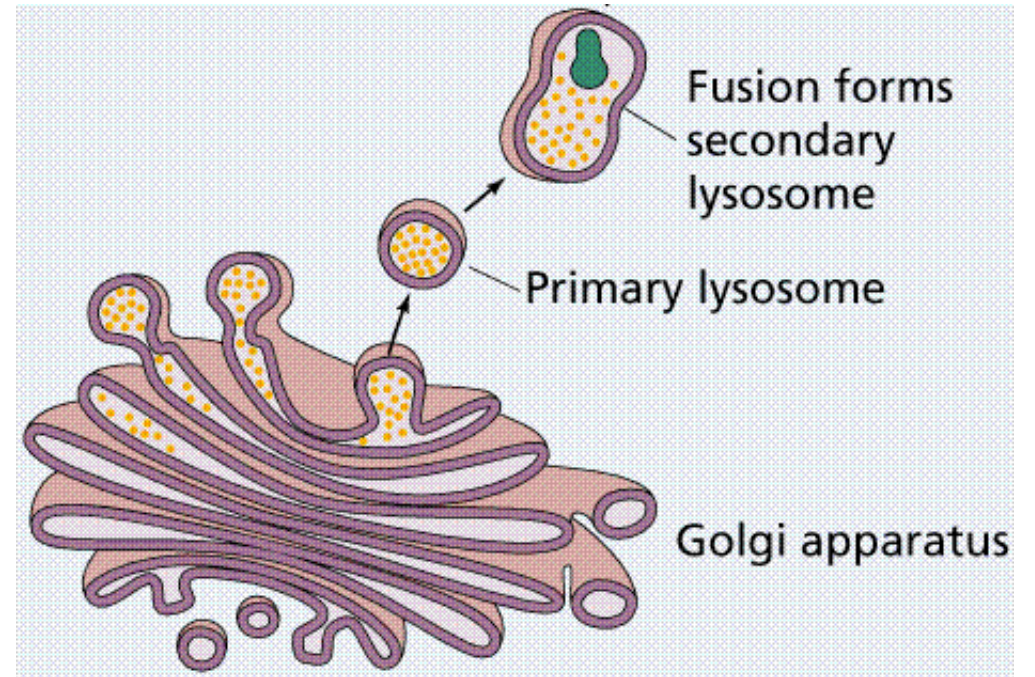
Introduction

- Lysosomes are **membrane-bound**, dense granular structures **containing hydrolytic enzymes** responsible mainly for **intracellular and extracellular digestion**.
- The word “lysosome” is made up of two words “**lysis**” meaning **breakdown** and “**soma**” meaning **body**.
- It is an **important** cell organelle responsible for the **inter and extracellular breakdown** of substances.



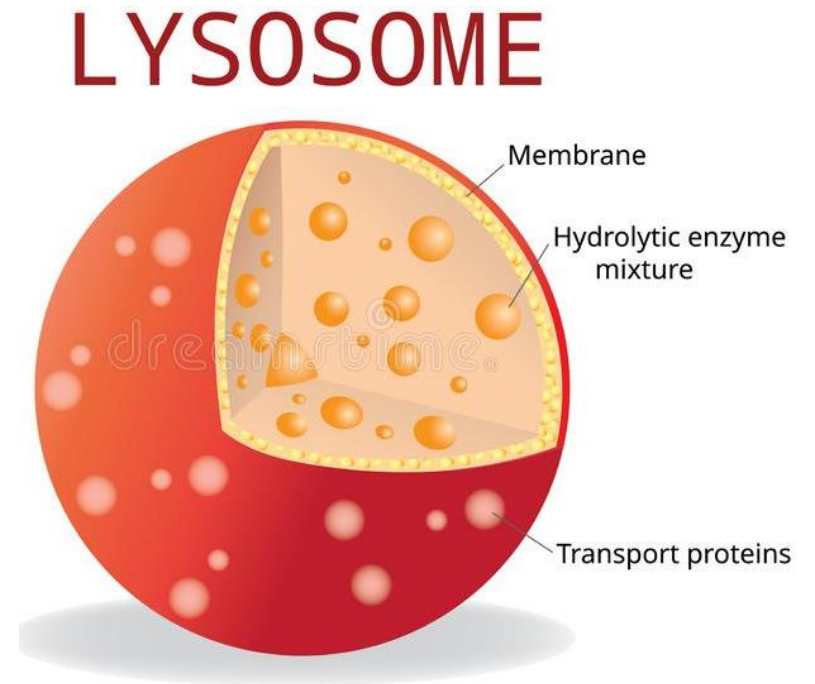
Origin & Occurrence

- Lysosomes originate by budding off from the membrane of the trans-Golgi network, a region of the Golgi complex responsible for sorting newly synthesized proteins, which may be designated for use in lysosomes, endosomes, or the plasma membrane.



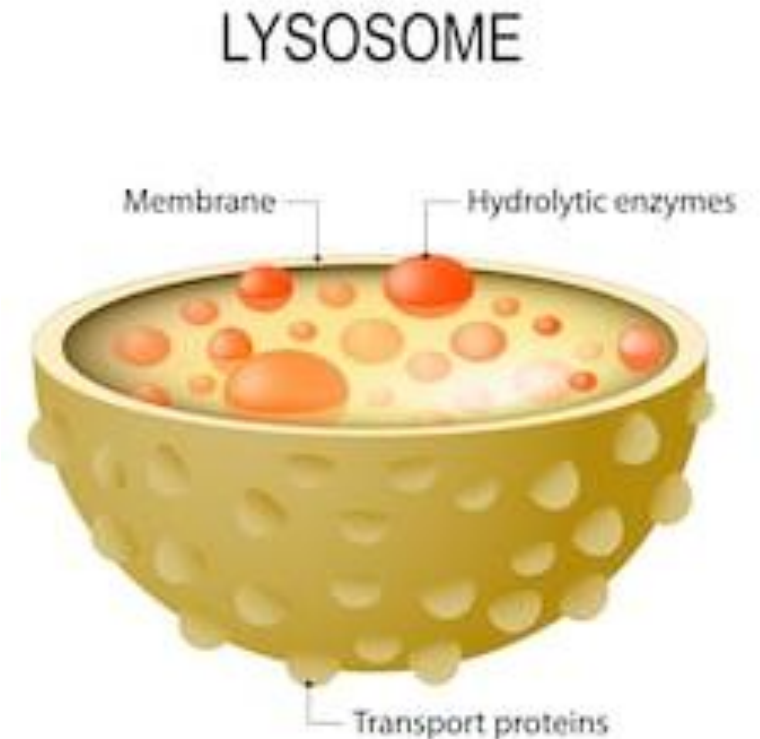
Origin & Occurrence

- They are **more commonly found in animal cells** while only in some lower plant groups (slime molds and saprophytic fungi).
- Lysosomes **occur freely in the cytoplasm**. In animals, found in almost all cells **except in the mature mammalian RBCs**.
- **A human cell contains around 300 Lysosome.**



Origin & Occurrence

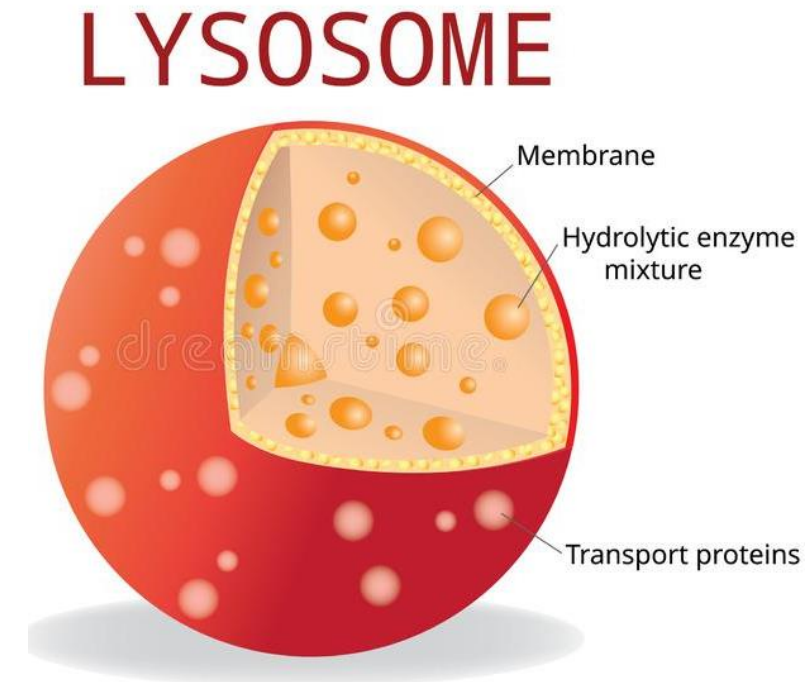
- They are found in **most abundant numbers in cells related to enzymatic reactions such as liver cells, pancreatic cells, kidney cells, spleen cells, leucocytes, macrophages, etc.**, the **Maximum no. of lysosomes :** **WBCs, Osteoclast, Phagocytes**
- Lysosome **not only digest large molecules** but also responsible for **breaking down and getting rid of waste products** of the cell.
- Lysosomes **contain over 60 different enzymes** that allow them to carry out these processes.



shutterstock.com • 754284892

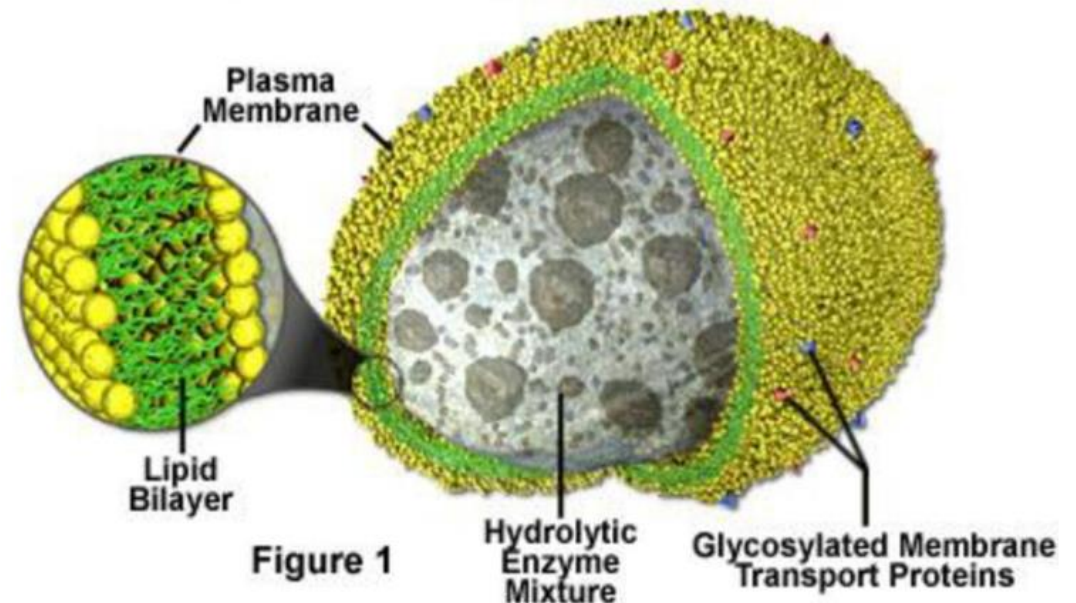
Structure

- Lysosomes are without any characteristic shape or structure i.e. they are pleomorphic
- They are mostly globular or granular in appearance.
- It is 0.2 - 0.8 μm in size and is surrounded by a single lipoprotein membrane unique in composition.
- In mammalian kidney- 0.5 μm
- MW- 200 D
- Gomori stain – Lysosome stain



Structure

- The membrane contains highly glycosylated lysosomal associated membrane proteins (LAMP) and Lysosomal integral membrane proteins (LIMP).
- LAMPs and LIMPs form a coat on the inner surface of the membrane
- They protect the membrane from attack by the numerous hydrolytic enzymes retained inside.
- The lysosomal membrane has a hydrogen proton pump which is responsible for maintaining pH conditions of the enzyme
- Inside the membrane, the organelle contains enzymes in the crystalline form.



Polymorphism in Lysosome

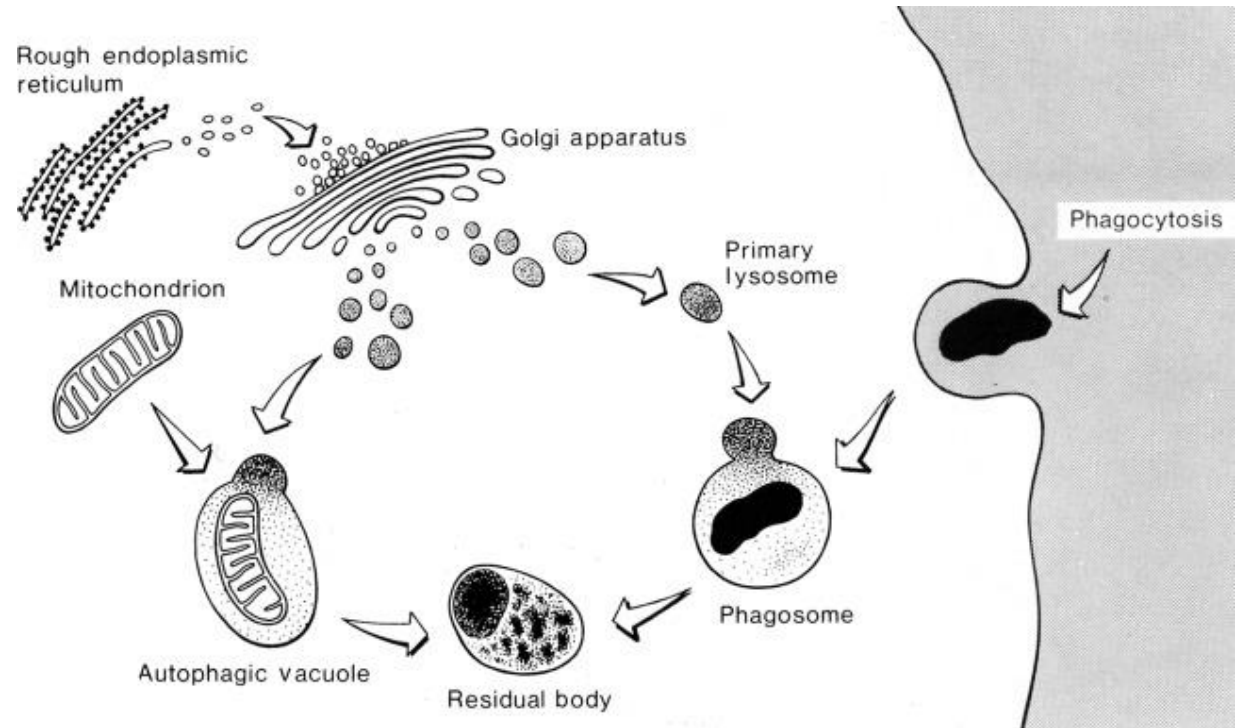
- Lysosomes are **polymorphic** as they are present in more than one form inside the cell.
- Lysosomes are **derived from vesicles released from the Golgi apparatus** and are rich in hydrolytic enzymes.
- They are formed by the fusion of these vesicles with the **vesicles released from the plasma membrane**.
- The **polymorphism in lysosome** is due to association with different materials and functions it performs. There are **four types of lysosomes present in the cell, viz.**
 1. Primary lysosomes
 2. Secondary lysosomes
 3. Tertiary lysosomes or Residual bodies
 4. Autophagic Vacuole/ Auto-lysosomes

Types of Lysosomes

1. Primary lysosomes: These lysosomes are surrounded by a single phospholipid layer and contain inactive acid hydrolases or enzymes

2. Secondary lysosomes:

- ✓ Most of the time, **primary granules will fuse with food containing phagosomes, which results in the formation of secondary lysosomes.**
- ✓ They are **also referred to as endosomes**
- ✓ The fusion also causes the previously inactive enzymes to be activated and **capable of digesting biomolecules** such as nucleic acids and lipids among others.
- ✓ The digested food passes out into the cytoplasm. Finally, the **secondary lysosome is left with undigested food.**



Types of Lysosomes

3. Residual bodies or Tertiary lysosomes :

- ✓ They are those lysosomes in which **only undigestible food materials have been left.**
- ✓ The residual bodies or lysosomes **pass outwardly and fuse with the plasma membrane to throw out the debris into external environment by exocytosis.**
- ✓ Sometimes, residual bodies remain inside the cells due to **failure of exocytosis** and absence of some hydrolytic enzymes. This **leads to pathological diseases** (storage diseases) like hepatitis, **Ageing is also due to them.**

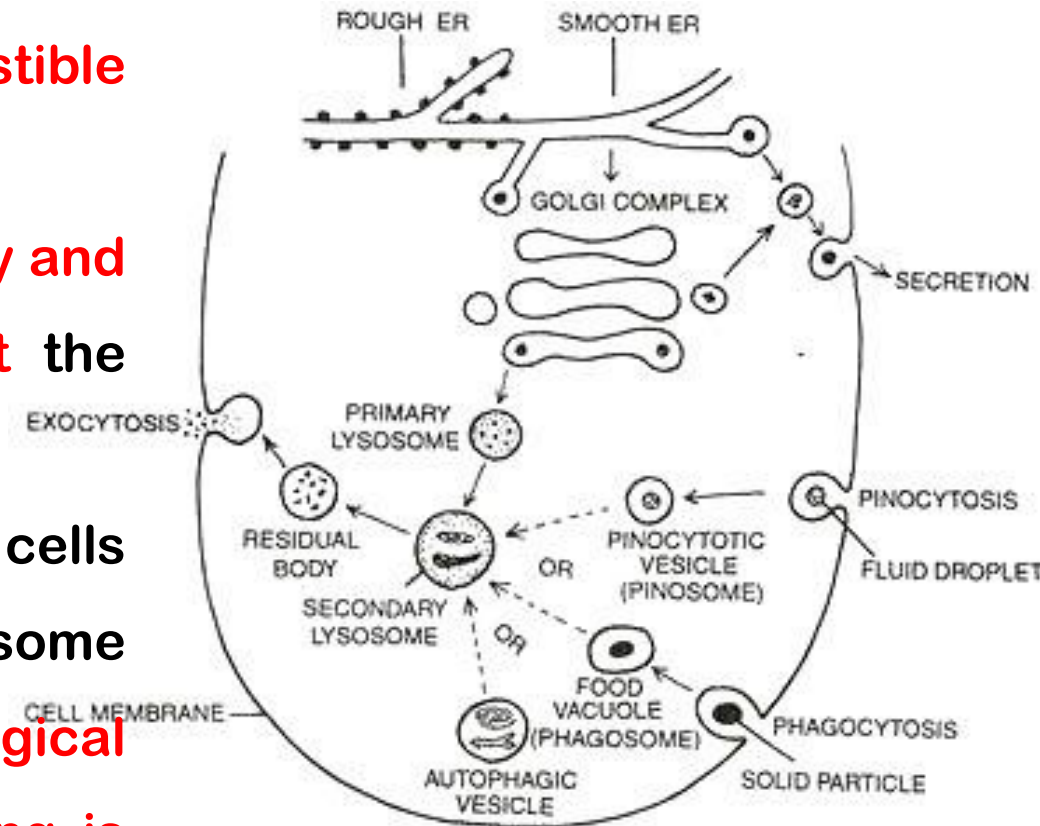


Fig. 8.33. Types of lysosomes and their functions.

Enzymes synthesized by Lysosomes

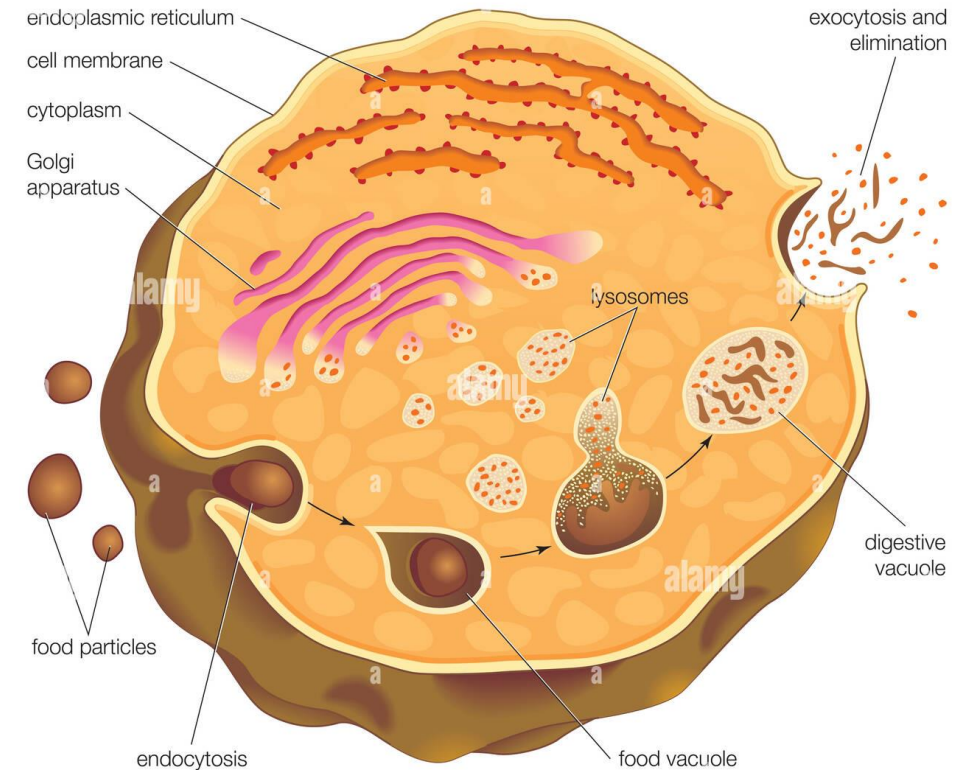
- They contain about 60 enzymes that are grouped in to six main categories:
- **1. Nucleases** - Nucleases are important enzymes that hydrolyze nucleic acids.
- **2. Proteases** - Proteases includes enzymes like collagenase and peptidases that acts on proteins converting them to amino acids
- **3. Glycosidases** - Act on the breakdown of glycosidic bonds
- **4. Phosphatases** - Act on the breakdown of phosphate bonds
- **5. Lipases** - Lipases include esterase's and phospholipases that act on lipids to produce acids and alcohol
- **6. Sulphatases** - Sulphatases are enzymes that act on organic compounds to release sulphates

Functions

Lysosomes serve two major functions

1. Intracellular Digestion:

- ✓ To digest food, the lysosome membrane fuses with the membrane of food vacuole and sprays the enzymes inside.
- ✓ The digested food then diffuses through the vacuole membrane and enters the cell to be used for energy and growth.



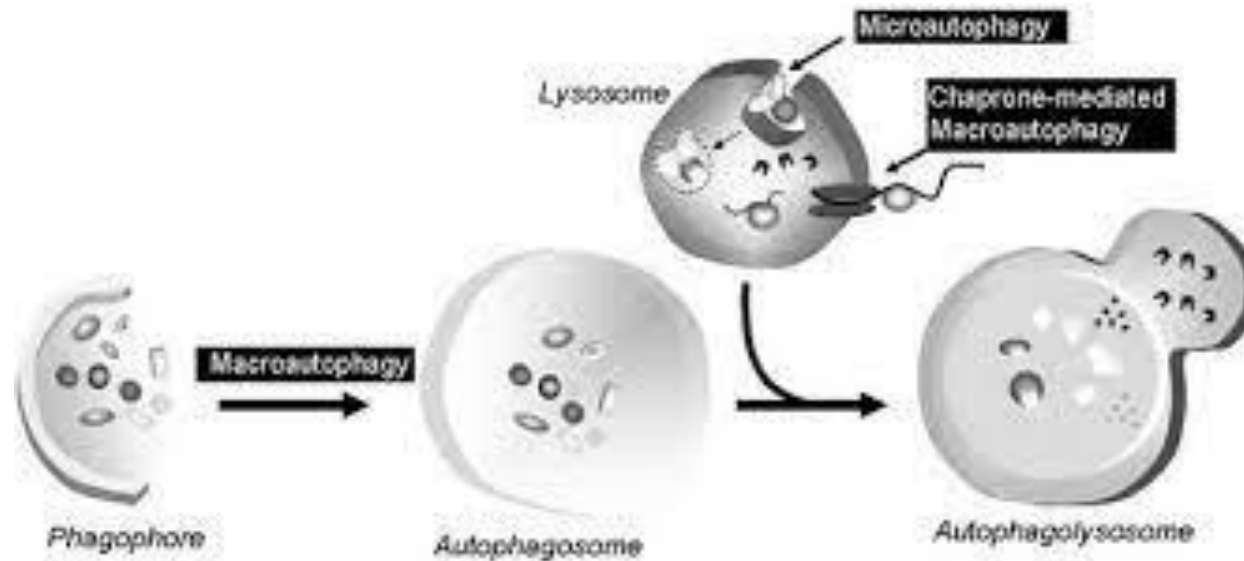
alamy

Image ID: B84ABH
www.alamy.com

Functions

2. Autolytic Action:

- ✓ Cell organelles that need to be get ridden are covered by vesicles or vacuoles by the process of autophagy to form autophagosome.
- ✓ The autophagosome is then destroyed by the action of lysosomal enzymes.

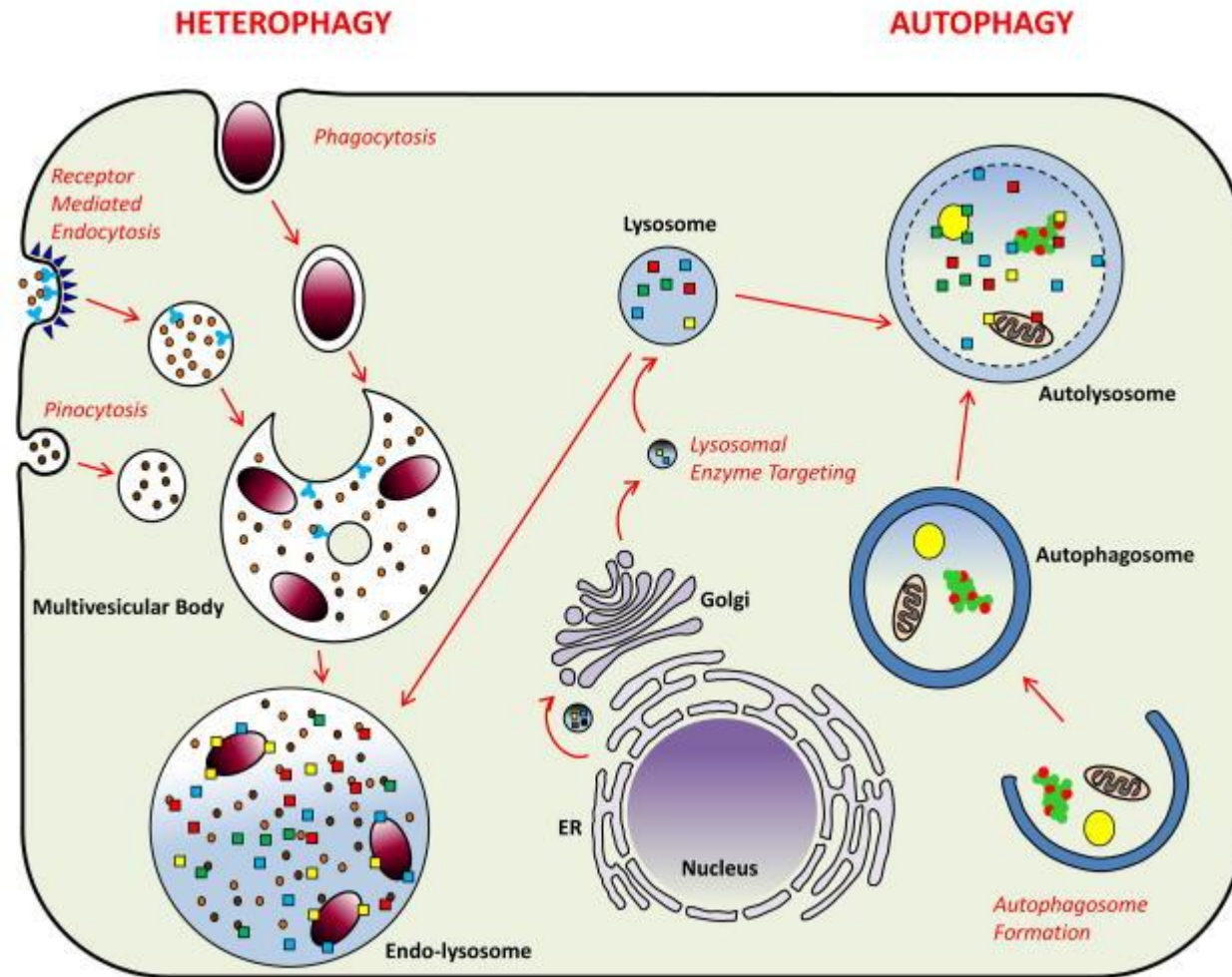


Functions

Lysosomes play crucial roles include:

1. Heterophagy

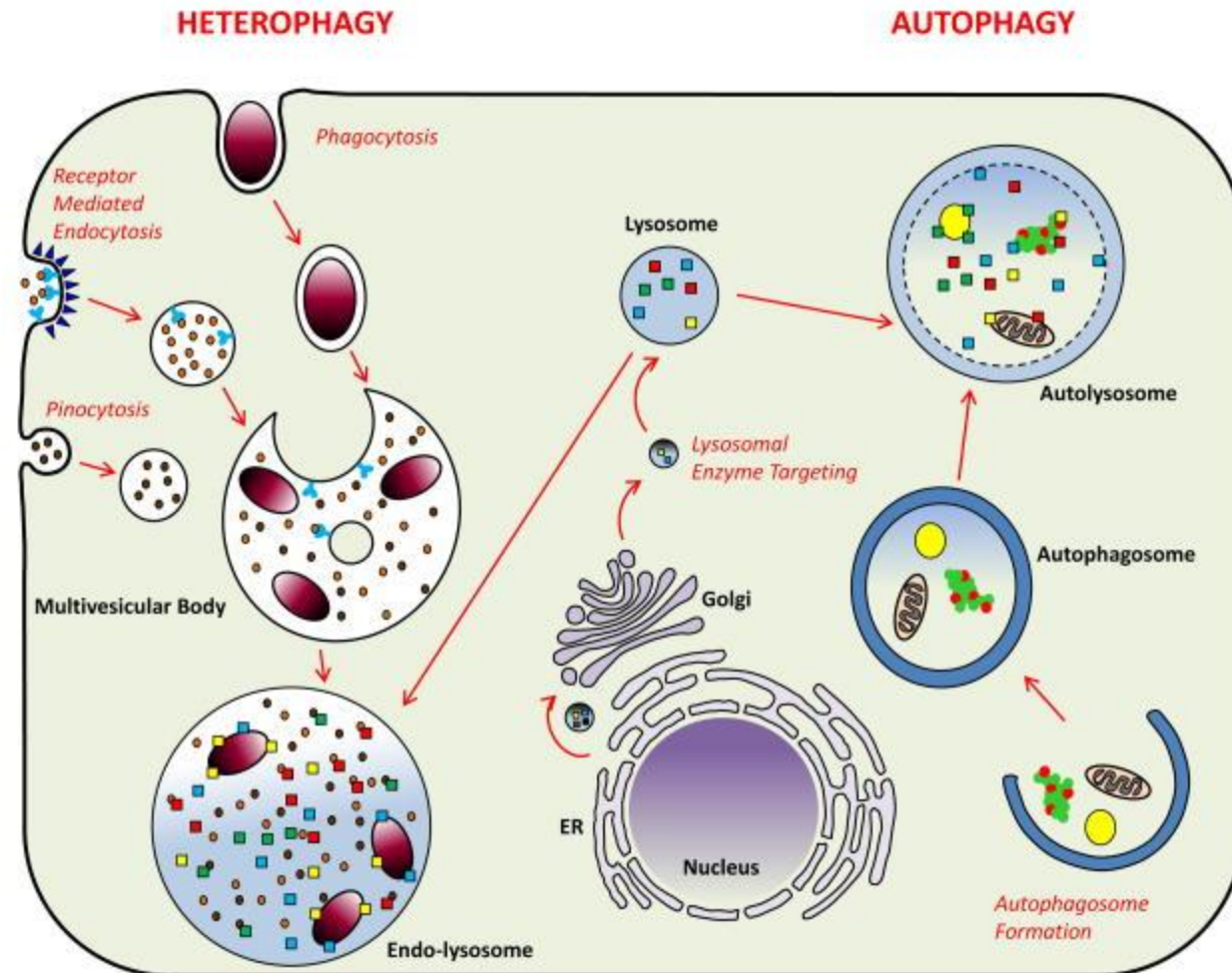
The taking into the cell of exogenous material by phagocytosis or pinocytosis and the digestion of the ingested material after fusion of the newly formed vacuole with a lysosome.



Functions

2. Autophagy

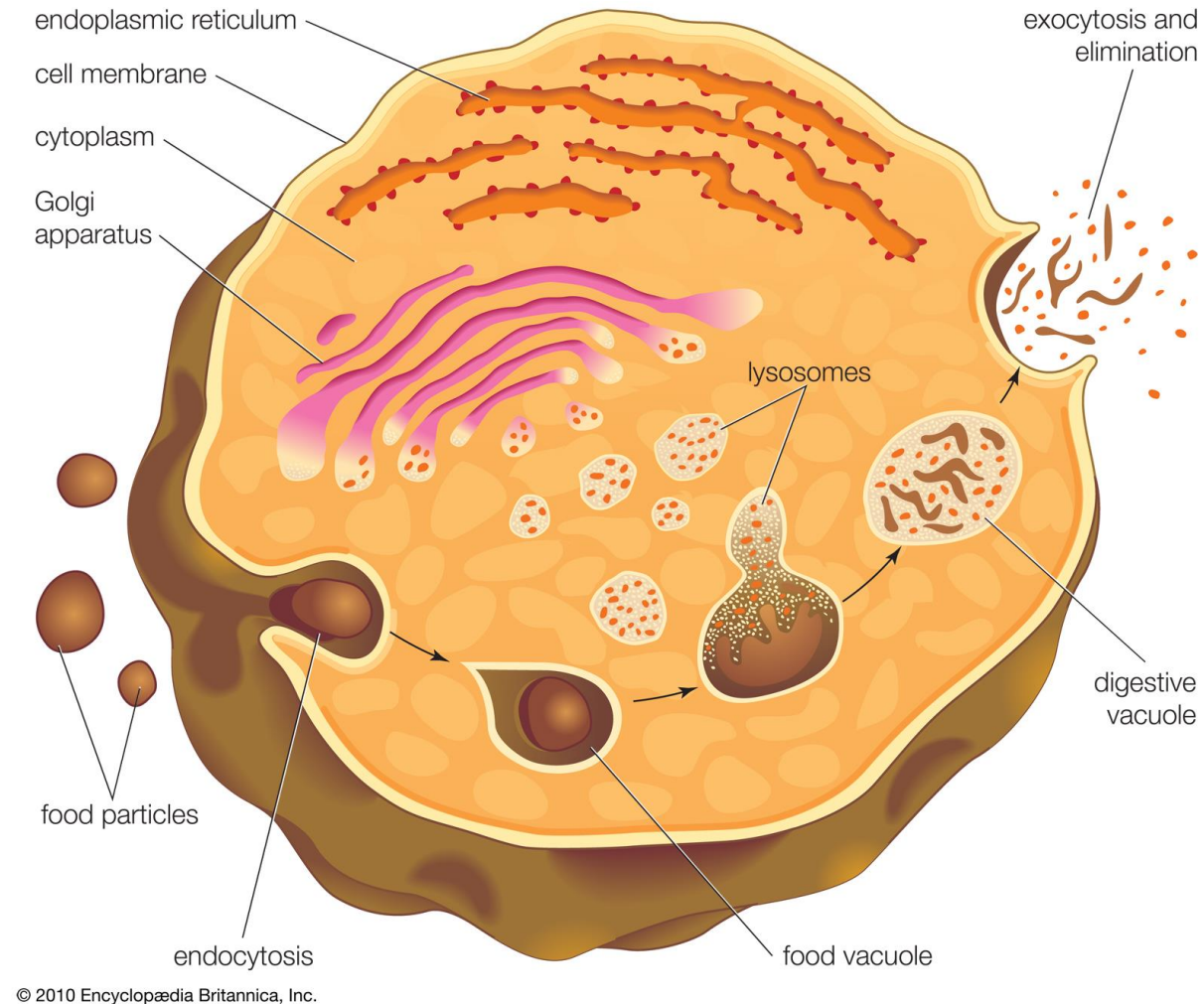
A normal physiological process that deals with the destruction of cells in the body. It is essential for maintaining homeostasis, for normal functioning by protein degradation, turnover of destroyed cell organelles for new cell formation



Functions

3. Extracellular Digestion

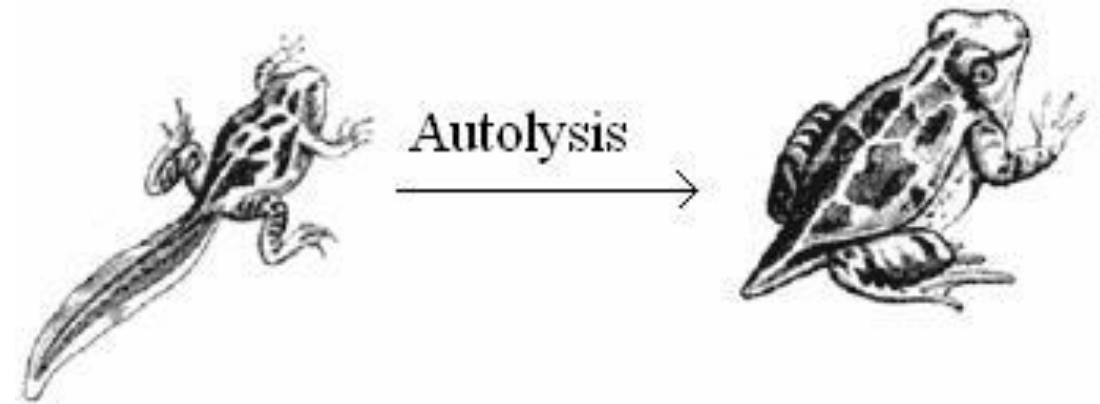
Primary lysosomes secrete hydrolases outside by exocytosis resulting in degradation of extracellular materials. Eg. Saprophytic fungi



Functions

4. Autolysis/ Role in the development process

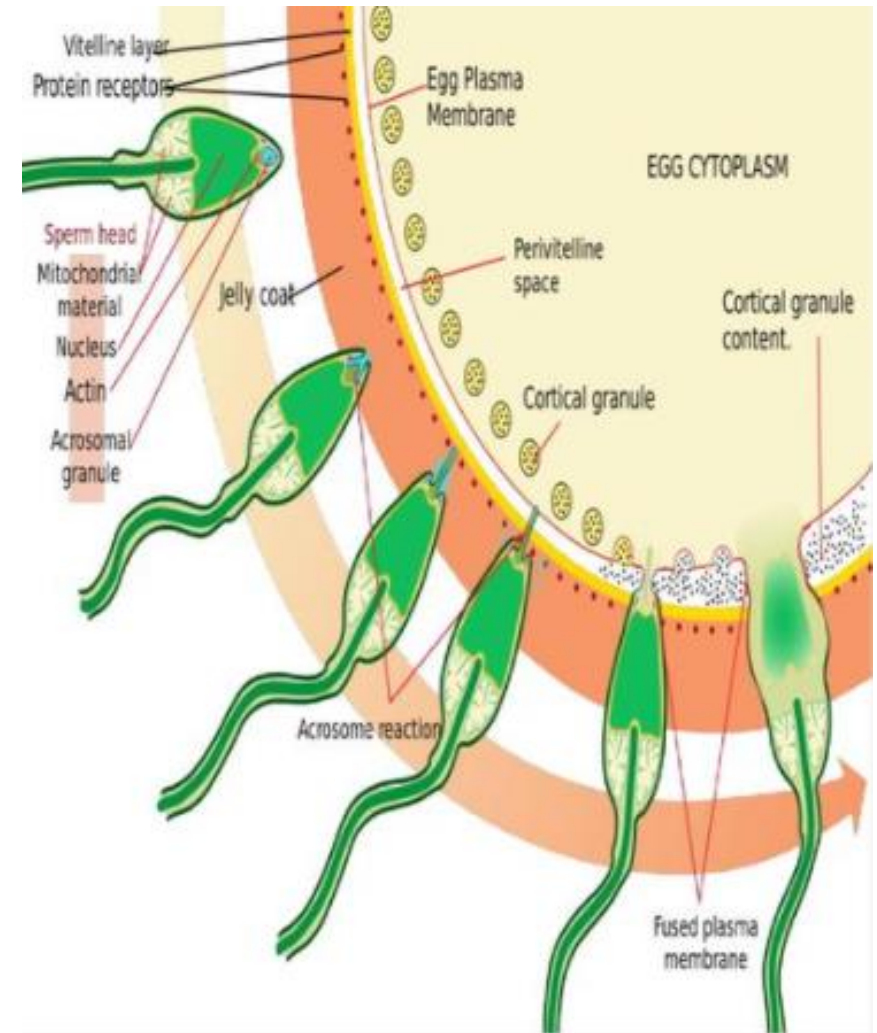
Many development processes involve the shedding or remodeling of the tissue with the removal of whole cells & extracellular material. For e. g. The degeneration of tadpole tail is produced by the action of cathepsins contained in the lysosomes



Functions

5. Fertilization

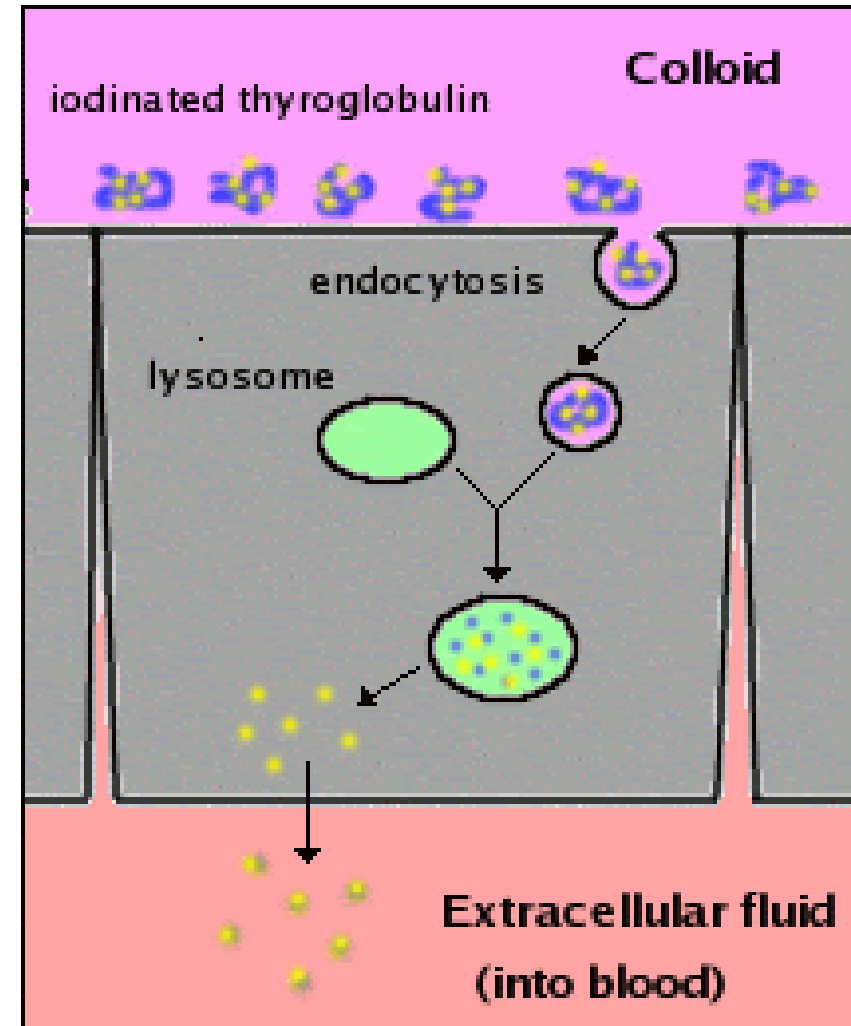
The acrosome of the sperm head is a giant lysosome that ruptures and releases enzymes on the surface of the egg. This provides the way for sperm entry into the egg by digesting the egg membrane.



Functions

6. Hormone Secretion

The lysosomal proteases activate the secretion of Thyroid hormones in the follicles



Functions

7. Human diseases & Syndromes

In certain pathological condition such as RA, Silicosis, Asbestosis, there is release of lysosomal enzymes from a macrophage and acute inflammation of the tissue that may lead to an increase in collagen synthesis.



Functions

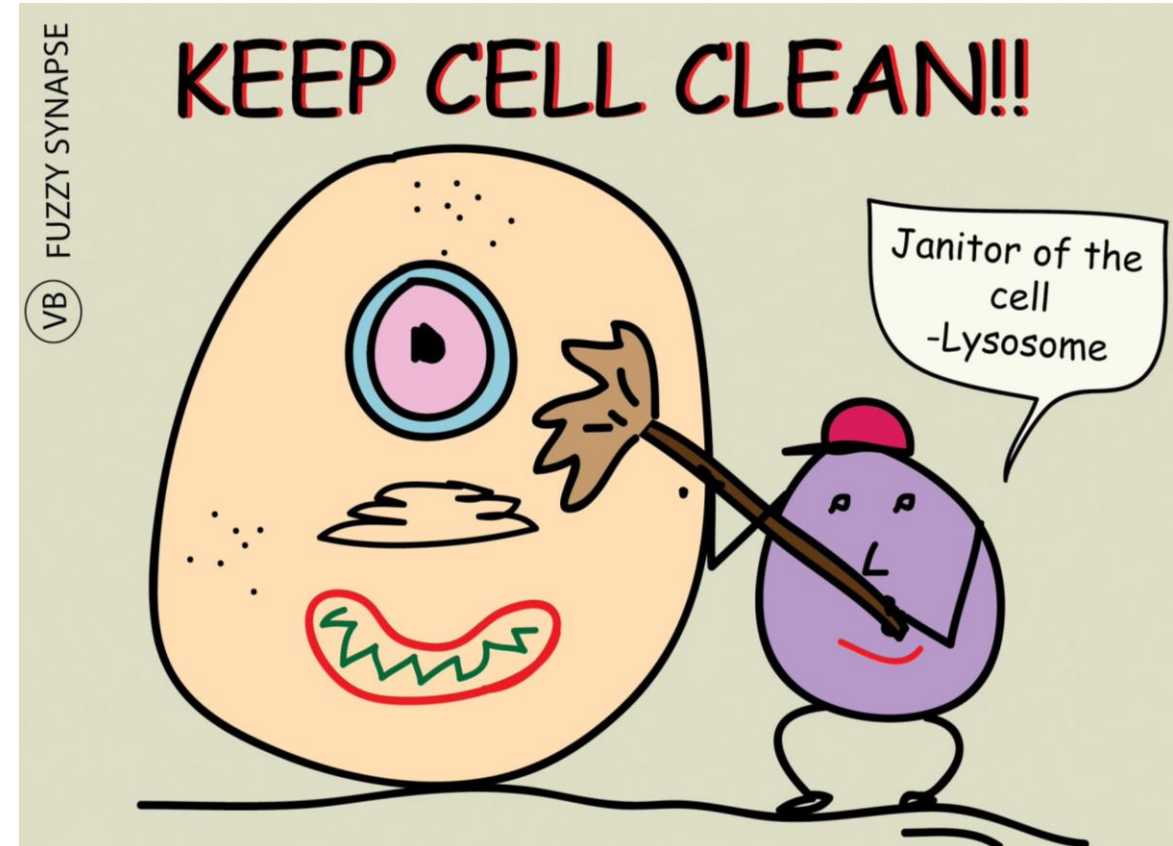
8. Lysosomes in plant cells & their role in seed germination

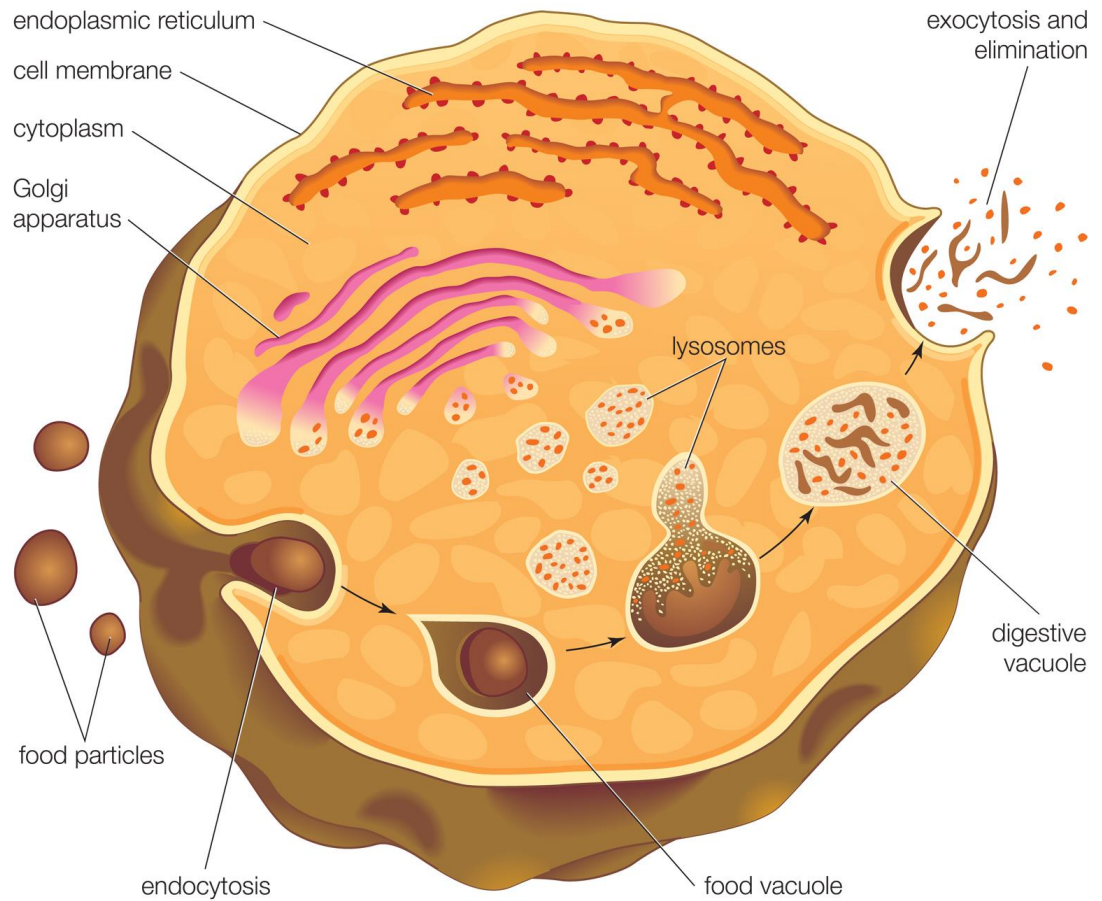
Lysosomes are found in plant cells. In seedling, they are involved in the hydrolysis & in removal of protein & starch during germination.

Functions

9. As Janitors of the Cell

Lysosomes remove 'junk' that may accumulate in the cell helping to prevent diseases.





*Thank
You*

© 2010 Encyclopædia Britannica, Inc.