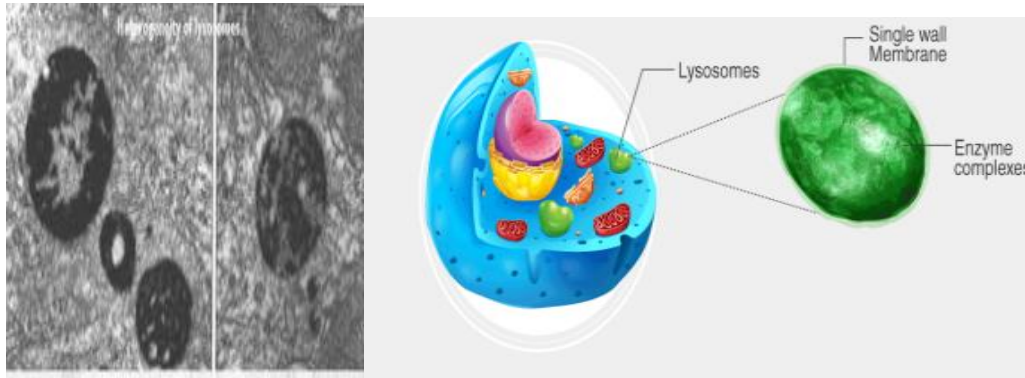




SUBJECT	ZOOLOGY
PaperNo. And Title	V Cell Biology
Module No. and Title	Ultrastructure of Animal cell-Lysosomes
Module tag	DAYA-ZOO-CB-1

Lysosomes-Structure and Function



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Learning Outcomes

The course provides a detailed insight into basic concepts of cellular structure and function.

Understand the structure and function of Lysosomes

Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.

Table of contents

S.No.	
1	Introduction
2	Structure of Lysosomes
3	Types of Lysosomes
4	Functions of Lysosomes

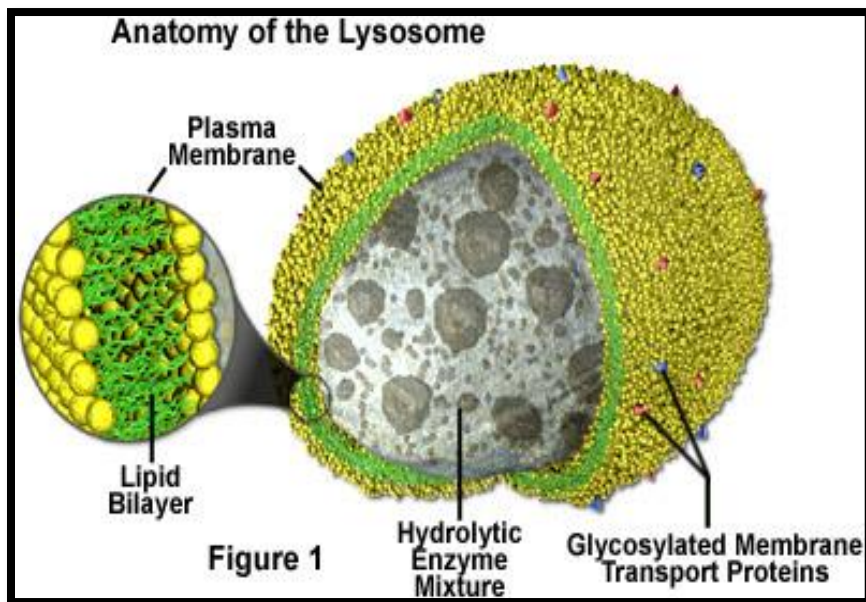
Lysosomes-The suicidal bags of cell

Introduction:

- In 1955, Christian de Duve isolated the particles containing high content of acid phosphatase and other hydrolytic enzymes.
- Due to their enzymatic properties they were named as lysosomes (Lysis= dissolution; soma= body).
- The lysosomes are membrane-bound, dense, granular structures containing hydrolytic enzymes responsible for intracellular and extracellular digestion.
- There are about 50 hydrolases present in lysosomes.
- The lysosomal hydrolases are enclosed by a membrane and are not readily available for the substrate.

Therefore, it also protects the rest of the cells from destructive effects of the hydrolases or enzymes

- Lysosomes are present in both animal and plant cells. Absent in bacterial cell and mature erythrocytes of mammals.
- They are found in abundant number in cells related to enzymatic reactions, such as liver cell, pancreatic cells, kidney cell, spleen cells, leucocytes, macrophages etc.
- The shape of lysosomes varies from cell to cell and time to time, i.e. they are polymorphic.
- Generally they are globular or vacuolar structures.
- Their diameter ranges from 0.2 to 0.8 microns.
- Due to presence of vacuole in the stroma region, they appear as tiny bags which are filled with digestive enzymes.
- If these enzymes are released, they digest and dissociate the cell. Hence they are called as “suicidal bags”.



- The lysosome show two distinct parts. The outer limiting membrane and inner stroma with vacuole.
- The limiting membrane is bounded by single lipoprotein (unit membrane).
- The lysosomal enzymes (acid hydrolases) are active at acidic pH (about 5).

➤ **Forms of Lysosomes:**

- There are four different forms of lysosomes.

1. Primary lysosomes: These are pure and original lysosomes having single unit membrane and containing enzymes in inactive form.

- The Golgi complex buds off the primary lysosomes.
- The lysosomal enzymes are synthesized in ribosomes attached to the ER and translocated in Golgi complex. From Golgi complex, the enzymes are translocated to lysosomes.

2. Secondary lysosomes:

- These are also called as phagosomes. They contain engulfed material and enzymes.
- When the pinocytic and phagocytic vacuoles fuse with primary lysosomes then it is called as secondary lysosomes.
- The enzymes then gradually digest the engulfed material.

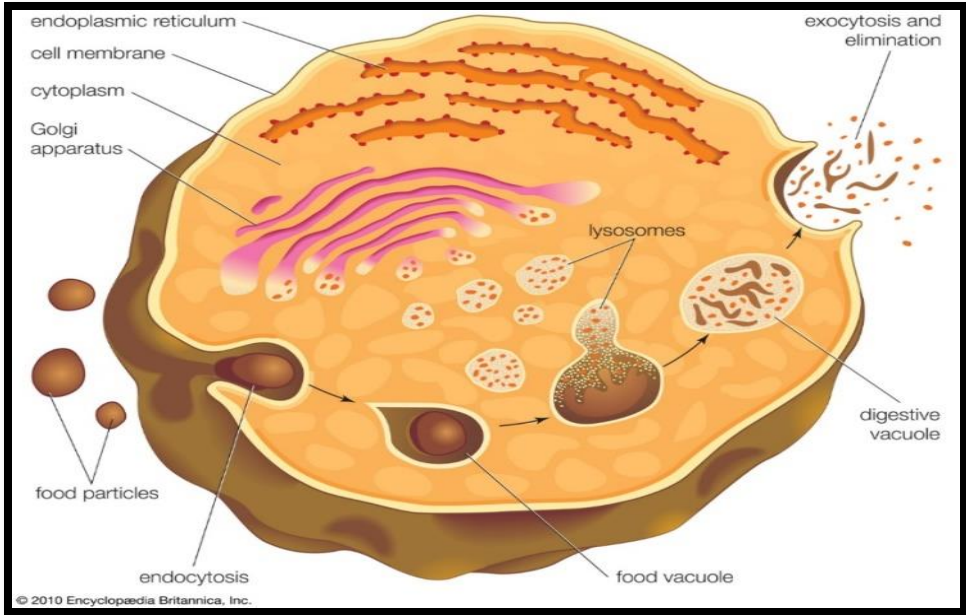
3. Residual or post lysosomes:

- The lysosome containing the undigested material is called residual bodies. Accumulation of such residual bodies in the cell leads to many pathological disorders or infections.
- The autophagic vacuole are formed when the cell feeds on its intracellular organelles like mitochondria, ER by the process of autophagy.
- The primary lysosomes concentrate around the organelle and digest them.
- The autophagic vacuoles are formed during some physiological or pathological conditions.

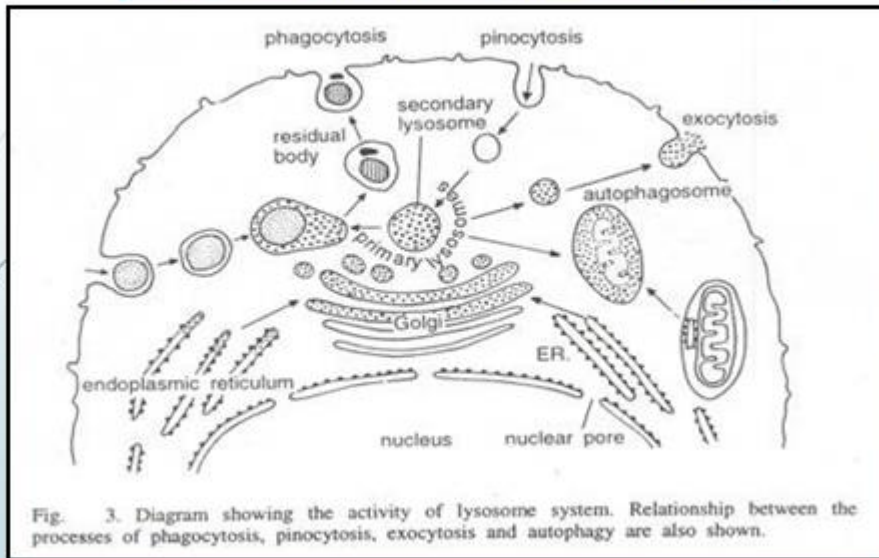
Ex. During starvation of organism, many autophagic vacuole are developed in the liver cells.

4. Autophagic vacuoles:

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Phagocytosis, Pinocytosis, Exocytosis and Autophagy



Functions of Lysosomes.

1. Extracellular digestion: Lysosomal enzymes released outside the cell and they take part in hydrolysis of extracellular material. During fertilization, the sperms discharge their enzymes to digest the limiting membrane of ovum for penetration. The white blood cell i.e. neutrophil or phagocytes ingest the bacteria by phagocytosis. Therefore they protect from harmful microorganisms.

2. Intracellular digestion: Digestion of substances within the cell is called intracellular digestion. Ex. Autophagy or Heterophagy.

a) **Autophagy:** It is a intracellular digestion of endogenous material by the enzymes.

b) **Heterophagy:** Intake of exogenous material by endocytosis into cell and breakdown by lysosomal enzymes.

- **Autolysis:** In some pathological condition, the lysosome membrane ruptures and enzymes are released in the cytoplasm. These enzymes digest the various organelles of cells, which is known as autolysis or cellular autophagy.

4. Role in secretion of hormones: Lysosome play role in formation of secretory products in secretory cells. Ex. Lysosome mediated thyroid hormone secretion.

5. Chromosome breaks: The Deoxyribonuclease (DNase) enzyme of lysosome causes chromosomal breaks and their rearrangements.

6. Fertilization: During fertilization, the acrosomal enzymes of sperm help in penetration of sperm through egg envelope.
7. Role in metamorphosis: During process of metamorphosis in insects and amphibians, the larval tissue is destroyed. Ex. Resorption of tadpole tail.
8. Role in cell metabolism: Lysosomes are more active and well developed in liver and pancreas of birds. It indicates that the lysosomes have some possible relationship in cell metabolism.
9. Removal of dead cells: Lysosome help in removal of dead cells in tissues.

Links:

<https://docs.google.com/presentation/d/1fiziLDWjdPy35leReDcWdagMlt8drqx/edit#slide=id.p1>

https://docs.google.com/document/d/1QnXlcm1m4PFcSEWeDN7qyA_F3lpJy3FeVjCvIKUirg/edit?usp=sharing

Vedio

<https://youtu.be/VC1zbUEEw9k>

<https://drive.google.com/file/d/14Gwzy4g8jkQyRyfdpiCKsp6l8w5YwIOP/view?usp=sharing>

<https://drive.google.com/file/d/14aSVmb4jQELeA2b0mnECLwINN6XCL8cY/view?usp=sharing>

Explore more

1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA
4. Becker, W.M.; Kleinsmith, L.J.; Hardin, J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.

ASSESSMENT

Module / Topic: Cytoskeleton			
Year: SYBSc-Sem-III			
ILO	Teaching Activity	Assessment Type	Assessment Mode & Tool
1.Students will be able to draw neat labelled diagrams of different types of cells		Strategies Used Explanation & drawing the diagram. Showing models and discussing. Ask students to prepare animation PPT's	Assessment type: Draw a chart of the different parts of Cell Give a diagrammatic sketch with arrows and ask them to label the different parts. Sketch & label Eukaryotic cell ----- -----.
			Google class room code:un5po2c
2. Students will be able to differentiate between prokaryotic and eukaryotic cell		Strategies Used Quiz, MCQ https://docs.google.com/document/d/1o_8fa3y7FH2f10XdWp0T1esK4-zRnInj26_PPbuQ5Dk/edit	Assessment type: Grading till they are able to get minimum score of 60%
			https://forms.gle/dJ2EJBG5adFUysPd7
3.To explain the mechanism & functions of each part of the cell.		Strategies Used Explanation- Concept map	Give a concept map with blanks in different columns to be filled by the students, Quiz, https://forms.gle/dJ2EJBG5adFU
			MCQ's Class test https://forms.gle/dJ2EJBG5adFUysPd7

		YsPd7 MCQ, Short answers	MOODLE LMS has these activities which can be designed