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## Lysosomes

Study Guide — Cell Organelles

Pre-Med practice questions about lysosomal structure and function

7 items — Study Guide with Answers

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**1 Which statement best describes the internal environment and function of a lysosome?**

- A It has a neutral pH and contains enzymes that function optimally at pH 7.
- B **It has an acidic lumen containing hydrolytic enzymes that degrade macromolecules.**
- C It has an alkaline lumen used for ATP synthesis.
- D It stores  $\text{Ca}^{2+}$  for rapid release during signaling.
- E It specializes in beta-oxidation of very-long-chain fatty acids.

► **Explanation:** Lysosomes maintain an acidic environment (pH ~5) where acid hydrolases degrade proteins, nucleic acids, lipids, and carbohydrates.



**2 Proton pumps in the lysosomal membrane are directly responsible for:**

- A Importing lysosomal enzymes from the cytosol.
- B **Maintaining the acidic pH required for lysosomal enzyme activity.**
- C Transporting digested amino acids into the cytosol.
- D Generating ATP within the lysosome.
- E Driving exocytosis of lysosomal contents.

► **Explanation:** V-type  $\text{H}^+$ -ATPases pump protons into the lysosomal lumen, lowering the pH to activate acid hydrolases.



**3 A macrophage engulfs a bacterium by phagocytosis. For the bacterium to be digested, the phagocytic vesicle must:**

- A Fuse with the Golgi apparatus to receive acid hydrolases.





- B Fuse with a lysosome to form a phagolysosome. ✓**
- C Migrate to the nucleus for degradation.
- D Be exported from the cell by exocytosis.
- E Remain isolated in the cytosol until the bacterium dies.

► **Explanation:** Fusion of the phagosome with a lysosome delivers acid hydrolases and an acidic environment, forming a phagolysosome that digests the bacterium.

**4 In a genetic disorder, acid hydrolases fail to reach lysosomes and are instead secreted outside the cell. Which step is most likely defective?**



- A Synthesis of hydrolases on free ribosomes in the cytosol.
- B Addition of mannose-6-phosphate to hydrolases in the Golgi apparatus. ✓**
- C Fusion of lysosomes with the plasma membrane.
- D Assembly of ribosomes in the nucleolus.
- E Oxidative phosphorylation in mitochondria.

► **Explanation:** Without mannose-6-phosphate tagging in the Golgi, lysosomal hydrolases are misrouted and secreted instead of delivered to lysosomes.

**5 Which process is most directly associated with lysosomal function in non-plant eukaryotic cells?**



- A Maintenance of turgor pressure.
- B Photosynthesis.
- C Autophagy of damaged organelles. ✓**
- D Beta-oxidation of very-long-chain fatty acids.





- E Storage of genetic information.

► **Explanation:** Lysosomes participate in autophagy, fusing with autophagosomes that contain damaged organelles and digesting their contents.

**6** A drug prevents acidification of endosomes and lysosomes but does not affect vesicle formation or fusion. In receptor-mediated endocytosis of LDL (low-density lipoprotein), which step is most directly impaired?



- A Binding of LDL to its receptor at the plasma membrane.
- B Internalization of receptor-LDL complexes into clathrin-coated vesicles.
- C Dissociation of LDL from its receptor and subsequent degradation of LDL in lysosomes. ✓**
- D Recycling of empty LDL receptors back to the plasma membrane.
- E Synthesis of LDL receptors in the rough endoplasmic reticulum.

► **Explanation:** Low pH in endosomes and lysosomes is required for LDL to dissociate from its receptor and for lysosomal hydrolases to digest LDL; blocking acidification prevents ligand release and degradation.

**7** In a lysosomal storage disease caused by deficiency of a single lysosomal hydrolase, affected cells typically show which morphological feature?



- A Complete absence of lysosomes.
- B Accumulation of undigested substrate within enlarged lysosomes. ✓**
- C Massive proliferation of peroxisomes containing excess catalase.
- D Condensed chromatin and nuclear fragmentation typical of mitosis.
- E Absence of mitochondria, with ATP produced only by glycolysis.





► **Explanation:** Lysosomal storage diseases usually involve accumulation of specific undigested substrates inside lysosomes, causing them to become enlarged and packed with storage material.

