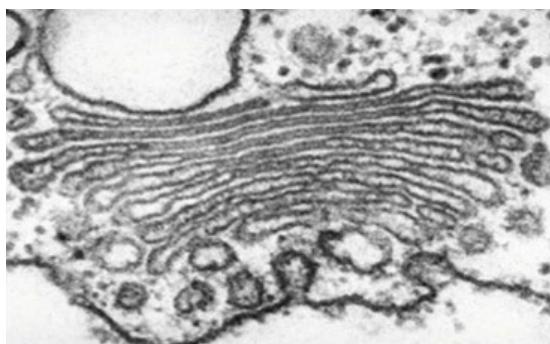


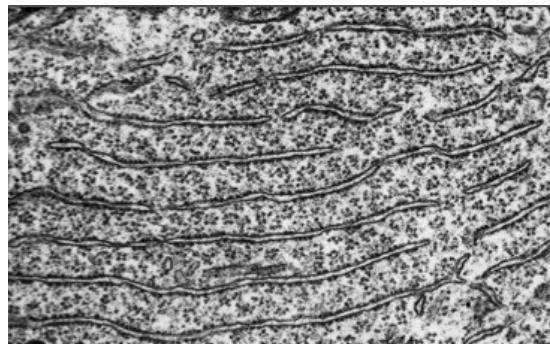


2023-24 ARCHIMEDEAN SATELLITE INVITATIONAL
MICROBE MISSION - TEST

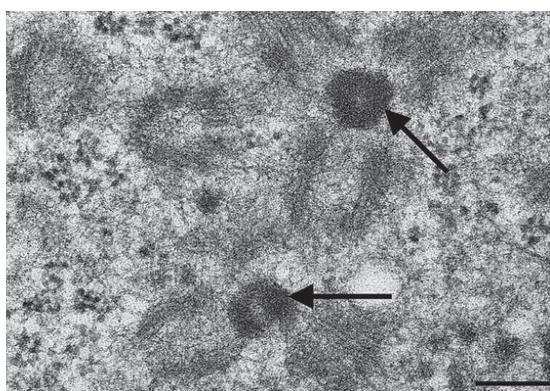
The following images will be used for questions 1-6:



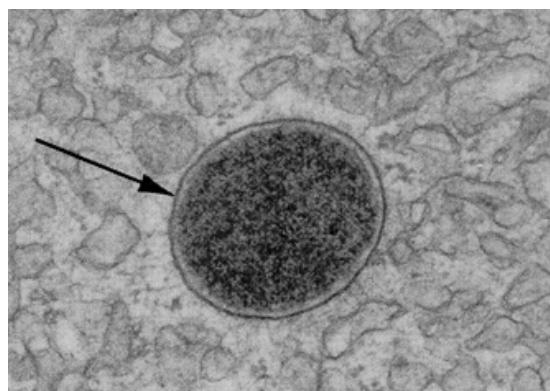
A



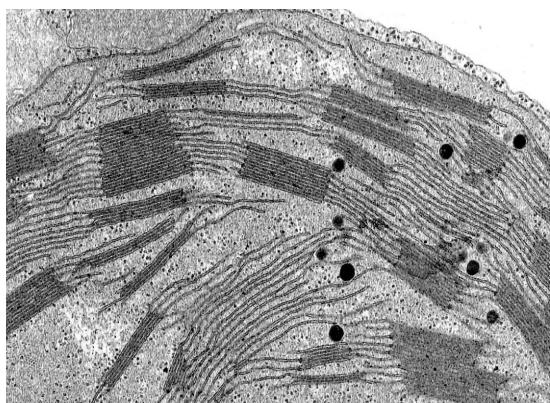
B



C



D



E

1. Which micrograph displays the organelle that is responsible for breaking down waste and bacteria?
 - A. A
 - B. B
 - C. C
 - D. D

- E. E
2. Which micrograph displays the organelle that is responsible for processing and preparing proteins for transport?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
3. Which micrograph displays the organelle that is responsible for production of ATP and O₂?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
4. Which micrograph displays the organelle that is responsible for organizing organelles?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
5. Which micrograph displays the organelle that is responsible for protein synthesis, folding, and modification?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
6. Which organelles are included in the endomembrane system? Select all that apply.
- modification?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E

F. All of the above

Read the following case report:

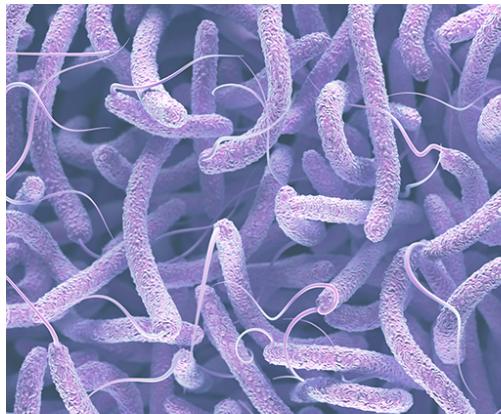
A 30-year-old pre-school teacher comes into the doctor's office. She reports that she has been having extreme fatigue and nausea. Additionally, she has been having frequent diarrhea, loose stools, and has experienced bloating and rapid weight loss. She remembers having previously eaten 12 containers of yogurt before her symptoms began (they were buy-one-get-one free, she couldn't resist), having met with a friend visiting from abroad, and having a few children with similar symptoms in her class.

Based on your knowledge and the information provided, answer the following questions:

7. What disorder does the patient have?
8. What microbe causes this disorder?
9. What may have caused the patient to contract this disorder?
10. Write and number the steps of performing a gram stain.
11. What will be the difference between the gram negative and gram positive bacteria after the procedure?

Questions 12-16 will provide images of different microbes. For each, name the microbe and the disease it causes.

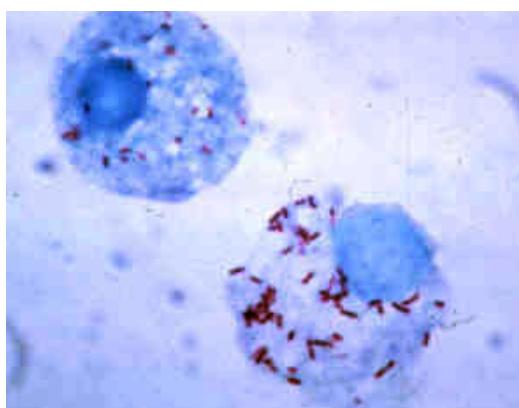
12.



13.



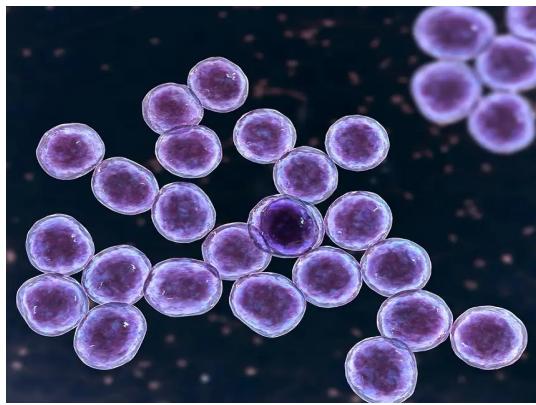
14.



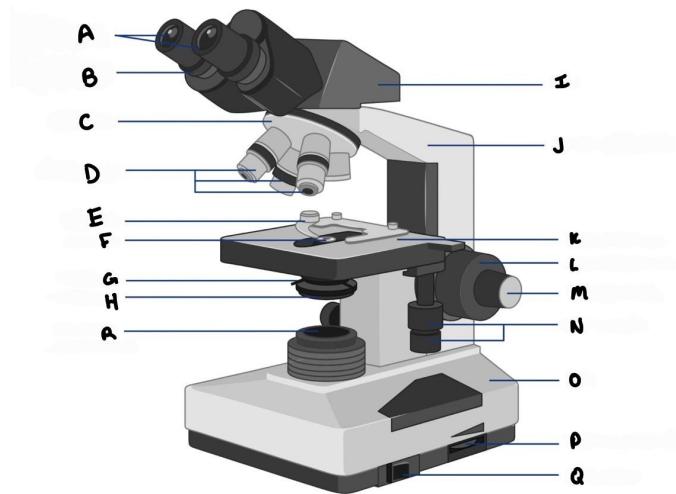
15.



16.



Use the following diagram for questions 17-24:



17. Label parts A, B, and C

18. Label parts D, E, and F

19. Label parts G, H, and I

20. Label parts J, K, and L

21. Label parts M, N, and O

22. Label parts P, Q, and R

23. Which type of microscope is most suitable for observing various microbes in pond water?

24. Which type of microscope is most suitable for examining the surface of a virus?

25. What is a downside to using a transmission electron microscope to observe organisms?

26. Explain the life cycle of *alternaria solani*, making sure to number each step.

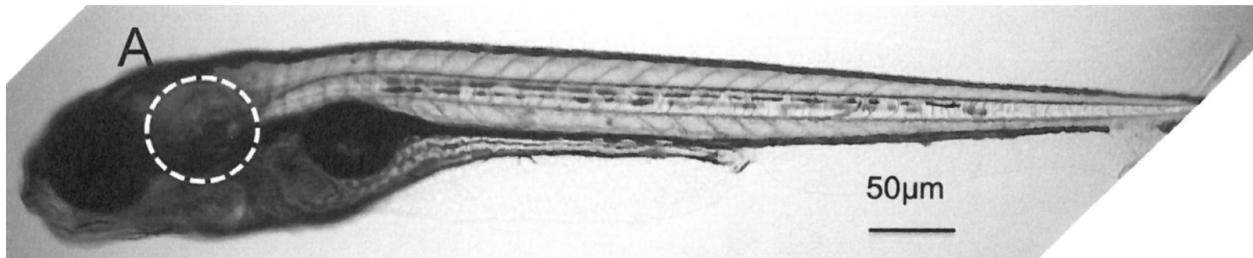
27. Define the following terms:

- a. Acidophile:
- b. Piezophile:
- c. Xerophile:
- d. Polyextremophile:
- e. Psychrophile:
- f. Microaerophile:

28. Compare adherent vs. suspension culturing.

29. What is one industrial application/use of Lactobacillus? Be sure to explain how it is used in its application.

Questions 30 and 31 use the image and the information provided below



Shown here in 'A' a zebrafish larva, a common model for bacterial infections. The area circled in white is the otic vesicle, or the zebrafish ear. Assume that the zebrafish ear is a perfect sphere with a volume of 1×10^5 cubic microns.

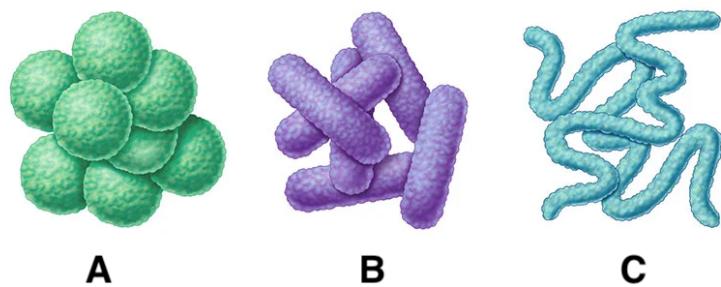
30. If a zebrafish researcher wanted to fill the zebrafish otic vesicle completely with *Streptococcus pneumoniae*, how many bacteria should be injected into the ear, assuming

that a single *S. pneumoniae* bacterium is 2 micron in diameter? Give your answer in scientific notation.

31. If you have a culture tube with *S. pneumoniae* at a concentration of 1×10^8 bacteria/mL, how many mL would you need to inject into the fish's ear? Give your answer in scientific notation. Given this number, should you dilute or concentrate your bacterial stock to make it easier to work with?

32. What are the 2 main glycoproteins on the influenza virion?

33. Name the three variations of bacteria pictured:



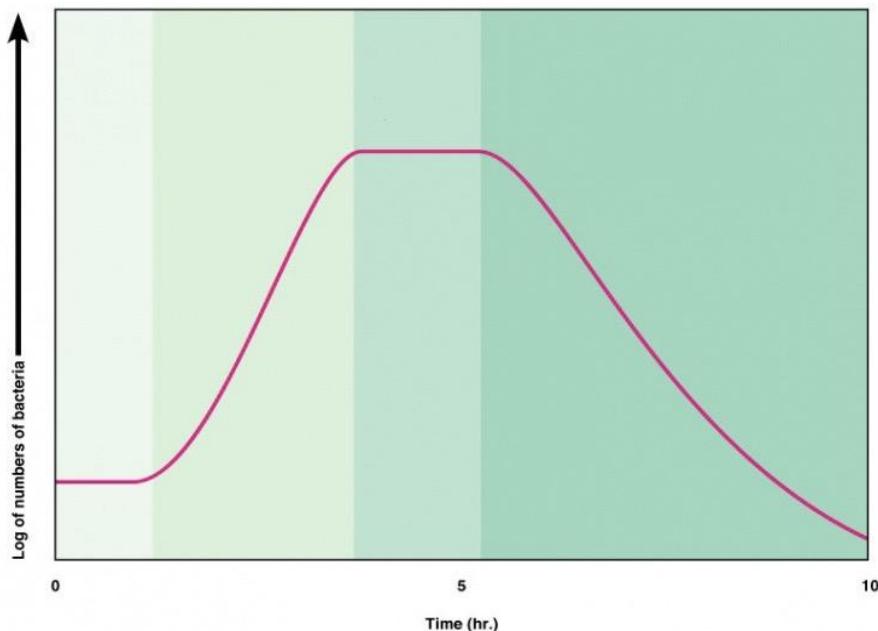
34. What are the diagnostic pathological features of Creutzfeld-Jakob disease?

35. Provide a step-by-step (numbering each step) description of how an individual may contract Bovine Spongiform Encephalopathy.

36. Which of the following places the listed tapeworms in the correct order of increasing length?

- A. Whipworm, Roundworm, Hookworm, Tapeworm
- B. Whipworm, Tapeworm, Hookworm, Roundworm
- C. Roundworm, Hookworm, Tapeworm, Whipworm
- D. Roundworm, Whipworm, Hookworm, Tapeworm

The diagram below corresponds to questions 37-41:



37. From left to right, list the proper terminologies for each colored section of the graph, separating each response with a comma.
38. What is happening in the first phase of the diagram and why does the graph appear the way it does?
39. What is happening in the second phase of the diagram and why does the graph appear the way it does?
40. What is happening in the third phase of the diagram and why does the graph appear the way it does?
41. What is happening in the last phase of the diagram and why does the graph appear the way it does?
42. List and describe the steps of lytic and lysogenic virus replication.

43. For which of the following organisms would antibiotics be effective ?
- A. Influenza B
 - B. Staphylococcus aureus
 - C. Varicella-zoster
 - D. Nematode
44. Which organism is the primary cause of food poisoning from canned foods?
- A. Varicella
 - B. Clostridium botulinum
 - C. Vibrio Cholerae
 - D. Alternaria Solani
45. What bacterial stage of development is believed to be responsible for bacteria being able to resist harsh environmental conditions?
46. Which of the following is not true about viruses?
- A. Antibiotics are ineffective against them
 - B. They can only contain RNA
 - C. Viruses release virions during cell lysis and budding
 - D. Are obligate intracellular parasites
47. What part of the influenza virus does the flu vaccine recognize?
- A. DNA
 - B. Capsid
 - C. Surface protein
 - D. Peptidoglycan
48. List three examples of microbial usage in food production.
49. Why can algal blooms be dangerous for aquatic environments?
50. Which microbial process is responsible for the conversion of sugar into alcohol and carbon dioxide?
- A. Fermentation
 - B. Photosynthesis
 - C. Respiration
 - D. Mitosis

51. What is the term for a protective structure formed by bacteria that allows them to survive harsh environmental conditions?
- A. Capsule
 - B. Nucleus
 - C. Chloroplast
 - D. Endoplasmic reticulum
52. Which of the following diseases is caused by a virus?
- A. Tuberculosis
 - B. Cholera
 - C. Influenza
 - D. Lyme disease
53. In microbiology, what is the significance of a plasmid?
- A. It is a component of the bacterial cell wall
 - B. It carries genes that may provide advantages, such as antibiotic resistance
 - C. It is involved in photosynthesis
 - D. It is a structure for locomotion in bacteria
54. Which of the following is an example of a Gram-negative bacterium?
- A. Staphylococcus aureus
 - B. Escherichia coli (E. coli)
 - C. Streptococcus pneumoniae
 - D. Bacillus subtilis
55. What is the process by which bacteria exchange genetic material through direct cell-to-cell contact?
- A. Conjugation
 - B. Transformation
 - C. Transduction
 - D. Replication
56. In microbial ecology, what is the term for a relationship between two organisms where one benefits, and the other is neither helped nor harmed?
- A. Mutualism
 - B. Commensalism
 - C. Parasitism
 - D. Amensalism

57. Which enzyme is responsible for the synthesis of complementary DNA (cDNA) from RNA templates in reverse transcription?

- A. DNA polymerase
- B. RNA polymerase
- C. Reverse transcriptase
- D. Ligase

58. Which of the following is an example of an obligate anaerobe?

- A. Escherichia coli
- B. Streptococcus pyogenes
- C. Clostridium botulinum
- D. Pseudomonas aeruginosa

59. What is the significance of quorum sensing in microbial communities?

- A. Regulation of gene expression based on population density
- B. Energy production through photosynthesis
- C. Antibiotic resistance
- D. Cellular respiration

60. Which microbial process is responsible for the fixation of atmospheric nitrogen into a usable form?

- A. Denitrification
- B. Nitrification
- C. Nitrogen Fixation
- D. Nitrogenation

61. What is the difference between vertical and horizontal gene transfer?

62. Which microbial process involves the exchange of genetic material through the uptake of free DNA from the environment by a bacterial cell?

- A. Transduction
- B. Transformation
- C. Conjugation
- D. Transposition

63. Which microbial structure is involved in the attachment of bacteria to surfaces and the formation of biofilms

- A. Flagellum
- B. Pilus

- C. Capsule
 - D. Ribosomes
64. What is the primary role of bacteriophages in the context of microbial ecosystems?
- A. Nitrogen fixation
 - B. Predation on bacteria
 - C. Decomposition of organic molecules
 - D. Plant symbiosis
65. What is the primary advantage of sexual reproduction over asexual reproduction in microbial populations?