

1. (1 point) How do objects under a microscope appear?
 - A. Inverted only
 - B. Reversed only
 - C. Both inverted and reversed**
 - D. Neither inverted or reversed

2. (1 point) If an amoeba is moving towards the top left of the field, in reality, towards which direction is the amoeba moving?
 - A. Top left
 - B. Top right
 - C. Bottom left
 - D. Bottom right**

3. (1 point) If a microscope has an ocular of 20X and an objective of 45X, what is the total magnification?
 - A. 250
 - B. 650
 - C. 800
 - D. 900**

4. (1 point) Which of the following is responsible for a class of diseases known as Transmissible Spongiform Encephalopathies?
 - A. Archaea
 - B. Prions**
 - C. Bacteria
 - D. Virus

5. (1 point) What kind of virus is HIV?
 - A. Lytic
 - B. Lyptic
 - C. Lysone
 - D. Lysogenic**

6. (1 point) In the exponential growth phase, the microbe population _____ each generation.
 - A. Doubles**
 - B. Triples
 - C. Quadruples
 - D. Stays constant

7. (1 point) Spherical bacteria are described as being
 - A. Coccus**
 - B. Bacillus
 - C. Spirillum
 - D. None of the above.

8. (1 point) A common Spirillum bacteria is
- A. Neisseria
 - B. Anthrax bacterium
 - C. Helicobacter pylori**
 - D. Bacillus thuringiensis
9. (1 point) Centrioles are found in which type of cells?
- A. Eukaryotes**
 - B. Prokaryotes
 - C. Archaea
 - D. All of the above
10. (1 point) Prions are thought to have originated from what kind of proteins?
- A. COP
 - B. ZIP**
 - C. CCP
 - D. AJX
11. (1 point) Helix, an intern, working with the great Dr. Capsid is tasked with identifying which patient is infected with which virus. Helix takes samples for testing and finds out that the patients have been infected with polio, smallpox, influenza, and rabies. However, he doesn't know which sample returned which result. Now , Helix must test the samples himself! Use the table below to help him.

Name	Size (mcm)
Polio	0.03
Smallpox	0.3
Influenza	0.10
Rabies	0.15

- Helix uses a special gizmo, much like a microscope. He analyzes the sample for patient A using a field with a diameter of 0.1 mm. This special microscope tells him that the sample has around 333 cells lined up through the middle of the field. Which of the following viruses is Helix analyzing?
- A. Polio
 - B. Smallpox**
 - C. Influenza
 - D. Rabies
12. (1 point) What is a transposon?
- A. DNA that can move itself to a different place in the cell's genome.**
 - B. Circular fragments of DNA that are typically found in the cytoplasm in prokaryotes.
 - C. DNA fragments that are exchanged due to decoupling during replication.
 - D. DNA that is inserted by viruses.

13. (1 point) Gram-positive bacteria are best known for producing what as a survival mechanism?
- A. Glycosaccharide chains
 - B. Ribosomes
 - C. Endospores**
 - D. Lysosomes
14. (1 point) Spores are produced in specialized structures called
- A. Sporial synthase
 - B. Spore cysts
 - C. Sporanglo
 - D. Spore sacs**
15. (1 point) The staining in gram negative bacteria is easily washed away because
- A. It has a very thin peptidoglycan layer**
 - B. It has a very thick peptidoglycan layer
 - C. It has one layer of plasma membrane
 - D. It has two layer of plasma membrane
16. (1 point) If a bacteria is gram positive, it has
- A. Two plasma membrane layers
 - B. One plasma membrane layer**
 - C. Two peptidoglycan layers
 - D. One peptidoglycan layers
17. (1 point) In a gram negative bacteria, the layer under the capsule is
- A. Plasma membrane
 - B. Peptidoglycan
 - C. Outer plasma membrane
 - D. Lipopolysaccharide layer**
18. (1 point) The Domain of Eukaryotes is made up of
- A. Protista**
 - B. Bacteria
 - C. Archaea
 - D. Two of the above
19. (1 point) Halophiles like to live in _____ environments.
- A. Bright
 - B. Salty**
 - C. Swampy
 - D. Hot

20. (1 point) The ideal pH for bacteria to thrive is in
- A. 6.0
 - B. 7.0**
 - C. 7.4
 - D. 8.0
21. (1 point) Bacteria are more likely to grow in _____vegetables, due to their _____pH.
- A. Uncooked, basic
 - B. Uncooked, neutral
 - C. Cooked, basic
 - D. Cooked, neutral**
22. (1 point) Bacteria are used to make all of the following except
- A. Tempeh
 - B. Kimchi
 - C. Wine
 - D. Popcorn**
23. (1 point) What kind of disease is malaria?
- A. Viral
 - B. Bacterial
 - C. Fungal
 - D. Protozoan**
24. (1 point) Where do hookworms live?
- A. Liver
 - B. Small intestine**
 - C. Large intestine
 - D. Appendix
25. (1 point) Mononucleosis is caused by which of the following?
- A. Epstein-Barr virus**
 - B. Zoster virus
 - C. Rubella
 - D. None of the above
26. (1 point) Ergotism can come from
- A. Mushrooms
 - B. Peas
 - C. Rye**
 - D. Cheese

27. (1 point) Scrapie affects the central nervous system of
- A. Pigs
 - B. Sheep**
 - C. Horses
 - D. Chickens
28. (1 point) SHIM stands for
- A. Standing Helix Ion Microscope
 - B. Standing Helium Ion Microscope
 - C. Scanning Helix Ion Microscope
 - D. Scanning Helium Ion Microscope**
29. (1 point) SAM is a type of microscope that uses what to create an image?
- A. Light
 - B. Electrons
 - C. Sound**
 - D. X-ray
30. (1 point) What is the third phase in a microbial growth curve?
- A. Lag phase
 - B. Stationary phase**
 - C. Exponential growth phase
 - D. Decline phase
31. (1 point) What is the name of the retroviral enzyme responsible for converting RNA to DNA?
- A. DNA Polymerase III
 - B. DNA Polymerase I
 - C. Reverse Transcriptase**
 - D. Primase
 - E. DNA Gyrase
32. (1 point) Red tides are caused by what group of protists?
- A. Diatoms
 - B. Forams
 - C. Dinoflagellates**
 - D. Euglenids
33. (1 point) Bacteria are (select all that apply):
- A. Prokaryotic**
 - B. Eukaryotic
 - C. Unicellular**
 - D. Multicellular

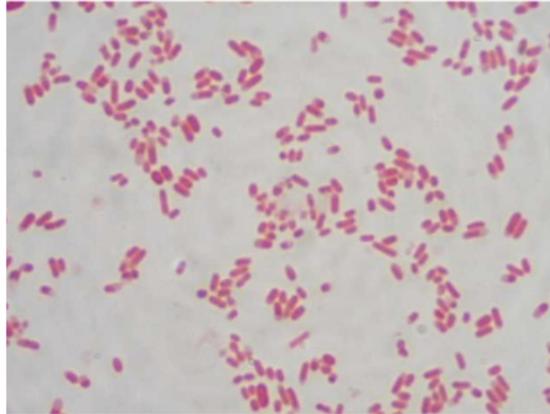
34. (1 point) Archaea DNA polymerases are most closely related to:
- A. Gram-negative bacteria
 - B. Gram-positive bacteria
 - C. Viruses
 - D. Protists**
35. (1 point) A symbiotic relationship between a plant and fungus is known as a:
- A. Lichen
 - B. Mycorrhiza**
 - C. Myco-heterotrophy
 - D. Coral
36. (1 point) Protozoa is a _____ group.
- A. Monophyletic
 - B. Paraphyletic
 - C. Polyphyletic**
 - D. None of the above
37. (1 point) Termites contain a microbe within their guts that assists in the digestion of wood. What type of microbe is contained within termites?
- A. Virus
 - B. Bacteria
 - C. Archaea
 - D. Fungus
 - E. Protozoan**
38. (1 point) A mycosis is a disease caused by a(n):
- A. Virus
 - B. Bacterium
 - C. Archaeon
 - D. Fungus**
 - E. Protozoan
39. (1 point) Alphaproteobacteria appear entirely pink during a gram stain. This means that they are:
- A. Gram-negative**
 - B. Gram-neutral
 - C. Gram-positive
 - D. Gram-variable

40. (1 point) An mystery yeast strain you found contains a mutated HSP104. Because of this, it is more likely to have
- A. Viroids
 - B. Prions**
 - C. Viruses
 - D. Bacteria
 - E. Protozoans
41. (1 point) Dutch Elm Disease is caused by what group of microbe?
- A. Viruses
 - B. Bacteria
 - C. Archaea
 - D. Fungi**
 - E. Protozoans
42. (1 point) Chloroplasts are most closely related to which modern group of unicellular microorganism?
- A. Cyanobacteria**
 - B. Chlorobiota
 - C. Chlorophyta
 - D. Rhodophyta
43. (1 point) Which of the following is not one of the four types of shellfish poisoning?
- A. Paralytic
 - B. Amnesic
 - C. Occipital**
 - D. Diarrheal
44. (1 point) After plating a colony of bacteria on a dish, you add DNA from a resistant bacterial strain to the dish. After treating with an antibody, certain cells from the colony remain. Which bacterial process took place?
- A. Conjugation
 - B. Transduction
 - C. Transformation**
 - D. Transduction
45. (1 point) Nitrobacter is:
- A. Photoautotrophic
 - B. Chemoautotrophic**
 - C. Photoheterotrophic
 - D. Chemoheterotrophic

46. (1 point) A new cell was found to have centrioles within the cytosol. Which of the following groups could it be a part of?

- A. Viruses
- B. Bacteria
- C. Archaea
- D. Algae**

47. (1 point) Which of the following best describes this bacteria's shape.



- A. Bacillus, Gram-positive
- B. Bacillus, Gram-negative**
- C. Coccus, Gram-positive
- D. Coccus, Gram-negative

48. (1 point) Psychrophiles are bacteria that grow best in what conditions?

- A. Moist
- B. Dry
- C. Warm
- D. Cold**

49. (1 point) Which of the following is not involved in the life cycle of Trichinosis?

- A. Humans
- B. Rodents
- C. Ducks**
- D. Pigs

50. (1 point) You located a cell from a human disease that contains a cell wall composed of chitin. What group of microbes does this cell belong to?

- A. Viruses
- B. Bacteria
- C. Archaea
- D. Fungi**
- E. Protozoans

-
51. (1 point) You managed to isolate a segment of mRNA from a cell and found the consensus sequence for a Shine-Dalgarno sequence. Which of the following groups could this mRNA not be from?
- A. Viruses
 - B. Bacteria
 - C. Archaea
 - D. Algae**
52. (1 point) A tetrad is a cluster of bacteria that is composed of
- A. 2 bacillus
 - B. 4 bacillus
 - C. 2 cocci
 - D. 4 cocci**
53. (1 point) Which of the following is the main vector for lyme disease?
- A. Ticks**
 - B. Mosquitoes
 - C. Rats
 - D. Squirrels
54. (1 point) Clostridium causes which important bacterial disease?
- A. Botulism**
 - B. Cholera
 - C. Rocky Mountain Spotted Fever
 - D. Tuberculosis
55. (1 point) The process of the breaking down of a cyst wall is known as:
- A. Cyst degradation
 - B. Acystation
 - C. Encystment
 - D. Excystation**

56. (2 points) What is the shape of the following bacteria?

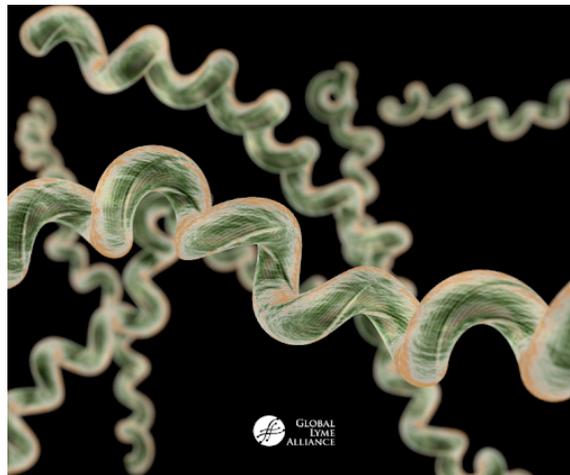


vibrio

57. (2 points) Name a bacteria that has this shape.

Solution: Any acceptable answer

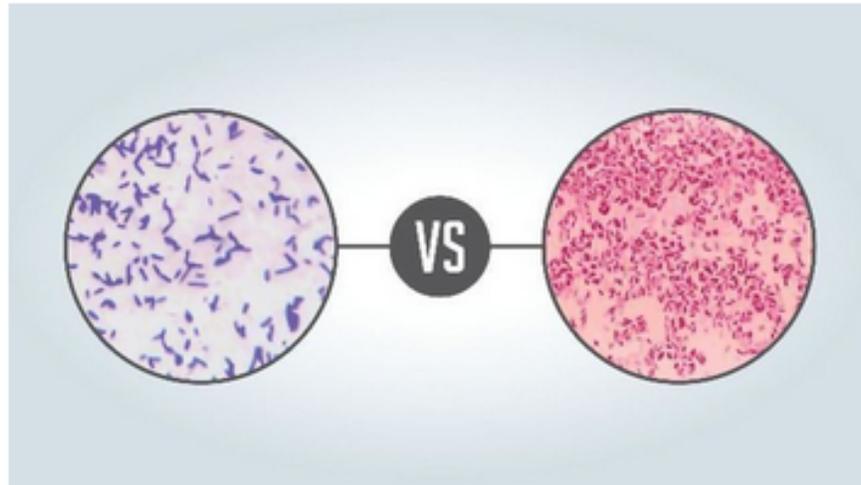
58. (2 points) What is the shape of the following bacteria?



Spirochaetes

59. (2 points) Name a bacteria that has this shape.

Solution: Any acceptable answer



Refer to the image on the above for 5-6.

60. (2 points) What does the right side show?

Gram-negative bacteria

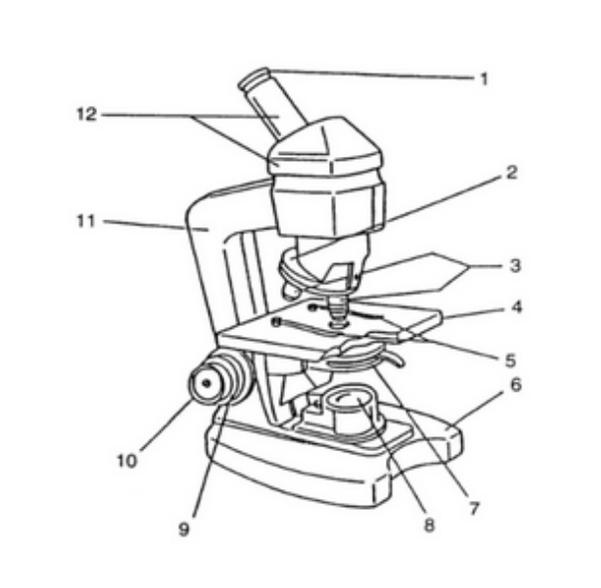
61. (2 points) What does the left side show?

Gram-positive bacteria

62. (2 points) What is used to receive the result on the left. (Hint: its used to stain it!)

Crystal violet

Name each part of the microscope:



63. (0 points) What is represented by the number 1?

Ocular

64. (0 points) What is represented by the number 2?

Nosepiece

65. (0 points) What is represented by the number 3?

Objectives

66. (0 points) What is represented by the number 4?

Stage

67. (0 points) What is represented by the number 5?

Stage clips

68. (0 points) What is represented by the number 6?

Base

69. (0 points) What is represented by the number 7?

Diaphragm

70. (0 points) What is represented by the number 8?

Illuminator

71. (0 points) What is represented by the number 9?

Course adjustment

72. (0 points) What is represented by the number 10?

Fine adjustment

73. (0 points) What is represented by the number 11?

Arm

74. (0 points) What is represented by the number 12?

Body tube

75. (1 point) Gram staining can be performed on protists, fungi and archaea.

A. True **B. False**

76. (1 point) Mitochondria can reproduce independently.

A. True B. False

77. (1 point) Protists are prokaryotic.

A. True **B. False**

78. (1 point) Prions attack tissue from the cardiovascular system.

A. True **B. False**

79. (1 point) Electron microscopes can magnify objects up to 2 million times their original size.

A. True B. False

80. (3 points) Describe the Endosymbiotic Theory.

Solution: +1 Both Chloroplast and Mitochondria are mentioned

+1 Eukaryotic cells mentioned

+1 Discusses some sort of engulfing that happened, eventually leading to a symbiotic relationship and modern-day organelles.

****Notes: No points should be awarded if Chloroplast, Mitochondria, and Eukaryotic Cells are not mentioned.**

81. (4 points) Describe two pieces of evidence that supports the Endosymbiotic Theory. (Make sure to include how it supports the theory!)

Solution: +1 for evidence (max up to 2)

+1 for reasoning (max up to 2)

****Note: Evidence must match reasoning**

Evidence: Reasoning

Double-membrane: Supports the fact that the organelle was taken in, creating two layers

Size: Similar in size to prokaryotes, which proves that mitochondria and chloroplasts were once prokaryotes

DNA replication: Have their own DNA, which is replicated independently - further proves that these organelles were originally prokaryotic

82. (3 points) You are trying to approximate the width of Cell A. Five Cell A's fit across the diameter of the field. Given that the diameter of the field is 3 mm, what is the width of a single Cell A in μm ? Show work for credit.

Solution: +3 Correct Answer of 600 μm (units necessary for points to be awarded)

83. (6 points) List 3 beneficial and 3 dangers of microbes.

Solution: +1 for every benefit (up to 3 points)

+1 for every disease (up to 3 points)

Benefits:

Help digest food, absorb nutrients, and out-compete harmful bacteria in the intestines, produce vitamins and proteins that human genes cannot produce, prevent the growth of harmful skin bacteria, helps fight infections and diseases throughout the human body, helps produce medicine, help clean up oil spills (bioremediation), helps produce antibiotics/insulin/etc, industry etc.

Dangers:

Hookworm, Pinworm, AIDS, Chicken Pox & Shingles, Common Cold, Dengue Fever, Ebola Hemorrhagic Fever, Hepatitis, Influenza, Measles, Mumps, Mononucleosis, Polio, Rabies, West Nile Fever etc.

84. (4 points) Describe the steps to performing a gram staining.

Solution: +1 Heat-fix the bacteria
+1 Stain with crystal violet, the primary stain
+1 Apply iodine as a mordant, or trapping agent
+1 Apply safranin (sometimes basic fuchsin) as a counterstain

85. (4 points) List the 4 stages of biofilm development in order.

Solution: +1 Reversible/Initial attachment (1)
+1 Irreversible attachment (2)
+1 Maturation (I or II does not matter as long as "Maturation" is stated) (3)
+1 Dispersion (4) **Note: No points should be awarded if the answer is not in the order above

86. (6 points) List three ways used to preserve food and why it works.

Solution: +1 for method (max up to 3)
+1 for reasoning (max up to 3)
****Note: method must match reasoning to receive point**
Method: Reasoning
Heat (Pasteurization, Sterilization): High temperatures kill bacteria by denaturing enzymes etc.
Chilling/Freezing: Stops/Slows down microbial metabolism and activity Dehydration: Microorganisms need water to grow
Fermentation: Created compounds that slow microbial growth
Salting/Sugaring: Dehydration or osmosis - limits microbial growth in this way Chemical additive: Kills microorganisms
Irradiation: Kills microorganisms

Virus X is a novel positive sense virus known to cause disease. You were able to sequence a part of its genome and found the 5' to 3' sequence "AAUGCGACG". Assume that the reading frame starts with the first nucleotide.

		SECOND BASE															
FIRST BASE	UUU } Phenyl-alanine F	UCU } Serine S	UAU } Tyrosine Y	UGU } Cysteine C	THIRD BASE	UUC } Leucine L	UCC } Serine S	UAC } Tyrosine Y	UGC } Cysteine C								
	UUA } Leucine L	UCA } Serine S	UAA } Stop codon	UGA } Stop codon		UUG } Tryptophan W	UUA } Leucine L	UCC } Serine S	UAC } Tyrosine Y	UGC } Cysteine C							
	CUU } Leucine L	CCU } Proline P	CAU } Histidine H	CGU } Arginine R		CUC } Leucine L	CCC } Proline P	CAC } Histidine H	CGC } Arginine R	CUA } Leucine L	CCA } Proline P	CAA } Glutamate Q	CAG } Glutamate Q	CUG } Leucine L	CCG } Proline P	CAG } Glutamate Q	CUG } Leucine L
	AUU } Isoleucine I	ACU } Threonine T	AAU } Asparagine N	AGU } Serine S		AUC } Isoleucine I	ACC } Threonine T	AAC } Asparagine N	AGC } Serine S	AUA } Methionine start codon M	ACA } Threonine T	AAA } Lysine K	AGA } Arginine R	AUG } Methionine start codon M	ACG } Threonine T	AAG } Lysine K	AGG } Arginine R
GUU } Valine V	GCU } Alanine A	GAU } Aspartic acid D	GGU } Glycine G	GUC } Valine V	GCC } Alanine A	GAC } Aspartic acid D	GGC } Glycine G	GUA } Valine V	GCA } Alanine A	GAA } Glutamic acid E	GGA } Glycine G	GUG } Valine V	GCG } Alanine A	GAG } Glutamic acid E	GGG } Glycine G		

87. (1 point) Define positive sense in the context of a virus.

Solution: +1 The genome can be directly translated

88. (1 point) Because virus X is a positive sense virus, it contains:

- A. ssRNA
- B. dsRNA
- C. ssDNA
- D. dsDNA

89. (2 points) If the purified genome of virus X was inserted into a target cell, would this still cause disease? Why?

Solution: +1 Yes
+1 the genome can be directly translated

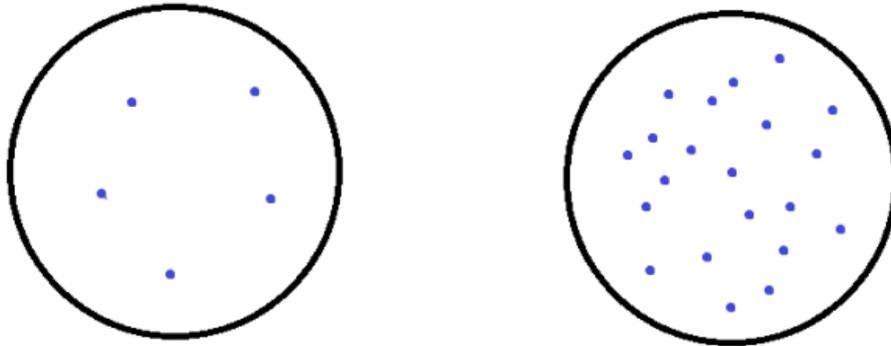
90. (2 points) What is the amino acid sequence encoded by the given sequence? Answer using the one letter amino acid abbreviations not separated by spaces (example: AAA)

NAT

91. (1 point) A new discovery found that virus X is actually a negative sense virus. What would be the amino acid sequence encoded by the sequence if the sequence is unchanged? Answer using the one letter amino acid abbreviations not separated by spaces (example: AAA)

RRR

The Ames test is a procedure to identify mutagens using bacteria. The general procedure involves the use of *Salmonella* bacteria that cannot grow without histidine, and placing them on a plate lacking histidine. Sometimes, rat liver extract is also added to the plates. In the control, few colonies will arise only due to spontaneous reversions, but if a mutagen is added, large amounts of colonies will appear on the plate due to mutations caused by the compound. Using the information above and the following image, answer the next 5 questions.



Results from an Ames test. Each blue dot represents a bacterial colony. Left is control, right is treatment with a mystery substance Y.

92. (1 point) Bacterial strains such as this which require a nutrient due to an inability to synthesize it are known as:

Auxotroph

93. (2 points) What is the purpose of adding the rat liver extract?

**Solution: +1 contains enzymes that are similar to humans
+1 metabolizes substances to see if metabolites are mutagens**

94. (2 points) From the results of the experiment, what can be determined about substance Y? Why can this conclusion be drawn?

**Solution: +1 Y is a mutagen
+1 There are a large number of colonies on the dish**

95. (2 points) After running the test, it was found that the bacteria used in the right dish were normal and not mutants. What does this change about the results of the test, and why?

**Solution: +1 Unsure whether Y is a mutagen
+1 because they would grow if Y was a mutagen or not**

96. (3 points) The Ames test can also be used to test for carcinogens. Why can it do this? What are two advantages of using the Ames test instead of testing on animals?

**Solution: +1 Mutagens are often carcinogens
+2 any two advantages (cheaper, less confounding variables, quicker, more ethical)**

97. (2 points) An unknown bacteria takes 10 minutes to divide. If you plate one bacterium in an enriched medium with a limitless supply of nutrients, how many hours will it take for the population on the plate to reach one million (round to the nearest tenth and do not include units).

3.3

98. (1 point) A lichen is composed of a symbiotic relationship between

Solution: Fungus and Cyanobacteria/Algae

99. (2 points) What is a virulent phage? What is one example of one?

Solution: +1 A virus that infects bacteria and uses only the lytic cycle +1 Any valid virulent phage (T4, etc.)

100. (6 points) Explain how an resistant Hfr cell can transfer its resistance to an F^- cell. Include what Hfr and F^- mean and the process of transfer.

**Solution: +1 Hfr has an integrated F plasmid and F^- lacks an F plasmid (needs both)
+1 Sex pillus is created and Hfr chromosome is nicked
+1 F plasmid and more is transferred to the other cell through the pilus
+1 Pillus is destroyed and foreign DNA is disintegrated
+1 DNA can be integrated to F^-
+1 The extra replicated parts can hold the resistance gene**

101. (2 points) What is the primary role of Nitrobacter in the nitrogen cycle? If removed, what would accumulate?

Solution: +1 oxidize nitrite into nitrate +1 nitrite

102. (2 points) An unknown population of algae grows by 5% each day. What is the doubling time of this population to the nearest day? Do not include units in your answer.

14

Use the information below for the next two questions. A mystery cell from a human disease has a mutant sigma factor.

103. (1 point) What group of microbes does this cell most likely belong to?

- A. Viruses
- B. Bacteria**
- C. Archaea
- D. Fungi
- E. Protozoans

104. (3 points) What are the equivalents of the sigma factor in each of the domains?

**Solution: +1 Archaeal transcription factor B (Archaea)
+1 Sigma factor (Bacteria)
+1 TFIIB (Eukaryota)**

105. (3 points) What is the function of a TATA box? What domains of life have one, and what is the equivalent in groups that do not have it?

**Solution: +1 Helps form the preinitiation complex
+1 Archaea and Eukaryotic
+1 Pribnow box in Bacteria**

Use the information below for the next 4 questions. After starting with a solution with 10^6 bacteria per mL within solution, you run a 10-fold serial dilution with 4 steps. You start with 1 mL of solution, and require only 1 mL of final solution.

106. (1 point) What is the concentration of bacteria within the final solution?

- A. 1 bacterium/mL
- B. 10 bacteria/mL
- C. 100 bacteria/mL**
- D. 1000 bacteria/mL
- E. 10000 bacteria/mL

107. (1 point) If we attempted to dilute the bacteria to the concentration in one step, how much more diluent would it take to dilute the solution to the final bacteria concentration (in mL)? Do not include units in your answer.

9963

108. (1 point) If we had used a 2 fold serial dilution, how many steps would it take to achieve a concentration lower than the concentration achieved with the 4 step test used in the example?

- A. 8
- B. 10
- C. 12
- D. 14**
- E. 16

109. (2 points) What is an obligate aerobic organism?

**Solution: +1 Needs
+1 Oxygen to survive**

110. (2 points) What are two prevention methods for norovirus infection?

Solution: hand washing, safe foods, intensive cleaning, etc.