MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The presence of membrane-enclosed organelles is a characteristic of 1) _____
A) prokaryotic cells. B) viruses.
C) all cells. D) eukaryotic cells.

2) Prokaryotes are made up of which two groups? 2) _____
A) *Archaea* and fungi B) *Bacteria* and fungi
C) protozoa and animals D) *Bacteria* and *Archaea*

3) Protein-coding sequences of DNA are known as 3) _____
A) genes. B) histones.
C) chromosomes. D) RNA segments.

4) The Gram stain differentiates bacterial cells into gram positive and gram negative based on differences in the 4) _____
A) cell's metabolic capabilities. B) cell wall structure.
C) presence of a plasmid. D) genomic content.

5) Disease-causing prokaryotes are found exclusively among the 5) _____
A) viruses. B) *Bacteria*. C) *Archaea*. D) fungi.

6) Organisms most likely to be found in extreme environments are 6) _____
A) fungi. B) *Bacteria*. C) viruses. D) *Archaea*.

7) Cyanobacteria are most closely related to the 7) _____
A) gram-negative *Bacteria*. B) *Eukarya*.
C) *Archaea*. D) gram-positive *Bacteria*.

8) Syphilis and Lyme disease are both caused by 8) _____
A) spirochetes.
B) endospores from the *Bacillus* group.
C) toxins from the *Streptomyces*.
D) mycoplasmas.

9) Which of the following organisms lives within the host cell as a means of avoiding destruction by the host's immune response? 9) _____
A) *Mycobacterium tuberculosis* B) *Chloroflexus sp.*
C) *Streptococcus sp.* D) *Deinococcus radiodurans*

10) At the present time, _____ phyla of the *Archaea* have been identified. 10) _____
A) 2 B) 3 C) 4 D) 5

11) Which statement is TRUE about the genus *Natronobacterium*? 11) _____
A) They are halophilic and alkaliphilic.
B) They are halophilic and acidophilic.
C) They are acidophilic but not halophilic.
D) They are alkaliphilic but not halophilic.

12) Which statement is TRUE? 12) _____
A) Both yeasts and molds are degenerate plants.

B) Yeasts are fungi, whereas molds are degenerate plants.
C) Yeasts are degenerate plants, whereas molds are fungi.
D) Both yeasts and molds are fungi.

13) In a lichen, the _____ is the phototrophic component, and the _____ provides the phototroph with an anchor and with protection from the elements. 13) _____
A) alga / cyanobacterium
B) alga or cyanobacterium / fungus
C) fungus / alga
D) fungus / cyanobacterium

14) The eukaryotic fruiting body is generally associated with the 14) _____
A) trypanosome.
B) *Paramecium*.
C) yeast.
D) slime mold.

15) Early branching *Eukarya* lack 15) _____
A) genetic material.
B) mitochondria.
C) ribosomes.
D) nuclei.

16) In relation to eukaryotic cells, prokaryotic cells are generally 16) _____
A) smaller.
B) about the same size.
C) larger.
D) There is no general rule about comparative cell size.

17) Paired chromosomes are found in 17) _____
A) viruses.
B) eukaryotes.
C) *Archaea*.
D) bacteria.

18) Mechanisms for controlling gene expression are found 18) _____
A) in all cells, prokaryotic and eukaryotic.
B) only in eukaryotes.
C) in some but not all prokaryotes and in some but not all eukaryotes.
D) only in prokaryotes.

19) Ribosomal RNA-based studies reveal that 19) _____
A) all eukaryotic organisms are related but that all prokaryotic organisms are not necessarily related.
B) all prokaryotic organisms are related but that all eukaryotic organisms are not necessarily related.
C) all organisms are thought to have diverged from a common ancestral organism (LUCA) or community of organisms.
D) the *Archaea* are most closely related to the viruses.

20) Which statement is TRUE? 20) _____
A) All natural and most synthetic compounds can be broken down by one or more microorganisms.
B) Most natural and most synthetic compounds can be broken down by one or more microorganisms.
C) All synthetic and most natural compounds can be broken down by

one or more microorganisms.

D) All natural and all synthetic compounds can be broken down by one or more microorganisms.

21) According to our present understanding, mitochondria and chloroplasts are _____ in origin. 21) _____

A) archaeal B) bacterial
C) eukaryotic D) viral

22) The model organism for microbial physiology, biochemistry, and molecular biology is 22) _____

A) *Azotobacter sp*. B) *Candida albicans*.
C) *Escherichia coli*. D) *Pseudomonas aeruginosa*.

23) Which of the following groups of organisms is NOT gram positive? 23) _____

A) *Clostridium* B) *Streptococcus*
C) *Pseudomonas* D) *Lactobacillus*

24) RNA-based phylogenies have influenced which subdiscipline(s) of microbiology? 24) _____

A) microbial ecology B) clinical diagnostics
C) microbial classification D) all of the above

25) What type of energy-yielding metabolism is found ONLY in prokaryotes? 25) _____

A) chemoorganotrophy B) autotrophy
C) phototrophy D) chemolithotrophy

26) In which of the following habitats might an extremophile be isolated? 26) _____

A) human skin B) freshwater pond
C) garden soil at neutral pH D) boiling hot springs

27) Which organism has unusual cell walls, can reassemble its chromosome after it has been damaged, and has an innate resistance to high levels of radiation? 27) _____

A) *Pseudomonas* B) *Chlamydia*
C) *Lactobacillus* D) *Deinococcus*

28) How was it determined that mitochondria and chloroplasts of eukaryotes are actually ancestors of specific lineages of *Bacteria*? 28) _____

A) molecular sequencing B) visual inspection
C) clinical diagnosis D) evolutionary studies

29) The ultimate limit of what we are able to see with a microscope is dictated by 29) _____

A) visual acuity. B) magnification.
C) light intensity. D) resolution.

30) The most common type of microscopy for laboratory courses in biology and microbiology is done with the 30) _____

A) electron microscope. B) phase-contrast microscope.
C) dark-field microscope. D) bright-field microscope.

31) When the oil-immersion lens is used, 31) _____
A) objects are held in place on the microscope slide.
B) light rays are scattered so unnecessary background material is not seen.
C) light rays are collected to increase clarity.
D) magnification of objects is increased by about tenfold.

32) A tiny stylus positioned so close to a specimen that weak repulsive forces are established is used in 32) _____
A) confocal scanning laser microscopy.
B) atomic force microscopy.
C) dark-field microscopy.
D) none of the above.

33) The cytoplasmic membrane is the 33) _____
A) primary support structure of the cell.
B) structure that identifies a cell as eukaryotic or prokaryotic.
C) permeability barrier of the cell.
D) source of nutrient production.

34) If the magnification of an ocular lens of a particular microscope is 10× and the magnification of the objective on the same microscope is 47×, the total magnification achieved is 34) _____
A) 4,700×. B) 4.7×. C) 470×. D) 57×.

35) Fluorescent microscopy is commonly used in 35) _____
A) cancer therapy.
B) clinical diagnostic microbiology.
C) the detection of chemical contaminants in a solution.
D) radiation biology.

36) *Bacteria* stain as gram positive or gram negative because of differences in the cell 36) _____
A) cytoplasm. B) wall.
C) chromosome. D) nucleus.

37) What type of microscopy has found widespread use in microbial ecology because of its ability to resolve the different layered components of a biofilm? 37) _____
A) confocal scanning laser microscopy (CSLM)
B) scanning electron microscopy
C) dark-field microscopy
D) differential interference contrast (DIC) microscopy

38) Why is the presence of a cell wall significant from a clinical standpoint? 38) _____
A) Animal cells do not have cell walls, so antibiotics that target cell walls can destroy invading microorganisms.
B) Only gram-negative *Bacteria* have cell walls.
C) All types of cells have a cell wall, and it makes identification of the causative agent of disease difficult.
D) The cell wall protects microorganisms from destruction by the

immune system.

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

39) Microorganisms today are probably a degeneration of the earliest life forms. 39) _____

40) Ribosomes function primarily in energy production. 40) _____

41) Prokaryotic chromosomes are generally linear. 41) _____

42) Meiosis is the process by which haploid gametes are formed. 42) _____

43) Ribosomal RNAs can be used to study phylogenetic relationships between organisms. 43) _____

44) Endosymbiosis is an explanation for the origin of mitochondria and chloroplasts in eukaryotic cells. 44) _____

45) Phototrophs use light as an energy source. 45) _____

46) Viruses necessarily cause disease in the organisms they infect. 46) _____

47) Species of *Archaea* are more closely related to *Eukarya* than to *Bacteria*. 47) _____

48) The waste products of chemoorganotrophs are often used for energy by chemolithotrophs. 48) _____

49) The evolutionary significance of extreme thermophiles may be that they are modern descendants of very ancient cell lines dating back to a time when the planet was very warm. 49) _____

50) Organisms of the genus *Halobacterium* can grow within salt crystals. 50) _____

51) The *Picrophilus* are the most alkaliphilic prokaryotes known. 51) _____

52) All known *Archaea* are extremophiles of one sort or another. 52) _____

53) The cyanobacteria were the first oxygenic phototrophs to evolve on Earth. 53) _____

54) The genus *Chlamydia* harbors respiratory and sexually transmitted pathogens of humans. 54) _____

55) A differential stain is called "differential" because it does not stain all kinds of cells the same color. 55) _____

56) In bright-field microscopy, contrast differences arise because different cells and cellular components absorb and scatter light in varying degrees. 56) _____

57) In phase-contrast microscopy, the differences in refractive indices between organisms and their environments are utilized for better vie g of win living

specimen 57)
s.

___
___

58) Light microscopy is an effective way of viewing objects in three dimensions. 58) _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

59) The distinct feature of the Planctomyces group is a(n) _____. 59) _____

60) To say that an organism is an "obligate intracellular parasite" means _____. 60) _____

61) One major difference between chromosomes and plasmids is that plasmids generally contain _____ rather than _____ genes. 61) _____

62) A eukaryotic, chlorophyll-containing organism that can live in environments containing only a few minerals, water, carbon dioxide, and light is a(n) _____. 62) _____

63) Two major roles of fungi are _____ and _____. 63) _____

64) The entire span of heritable nucleotides, both protein-encoding and non-encoding regions, in an organism is collectively called the _____. 64) _____

65) The evolutionary relationships between organisms are studied in the science of _____. 65) _____

66) The three options by which an organism may obtain energy are: _____, _____, and _____. 66) _____

67) The difference between chemoorganotrophy and chemolithotrophy is _____. 67) _____

68) A cell that uses carbon dioxide as its carbon source is a(n)_____. 68) _____

69) The largest division (or phylum) of *Bacteria* is the _____. 69) _____

70) The unique feature of the mycoplasmas is the _____. 70) _____

71) The function of the chloroplast is to _____. 71) _____

72) Lichens are called mutualistic organisms because _____. 72) _____

73) The commonality linking the *Aquifex* and *Thermotoga* species is _____. 73) _____

74) _____ are a specialized cell type found in certain filamentous cyanobacteria that carry out a globally important process knoas _____.
wn

74) _____

75) The _____ provides structural strength to plant cells and most microorganisms. 75) _____

76) Cyanobacteria and their phylogenetic relatives undergo a process known as _____ in which molecular oxygen is liberated. 76) _____

77) The two eukaryotic organelles involved in energy generation are _____ and _____. 77) _____

78) The measure of the light-gathering ability of the objective lens is known as the _____. 78) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

79) What might you learn by taking a properly stained sample of water and placing it under a light microscope?

80) Explain the similarities and differences between viruses and true cells.

81) Why are the *Archaea* so difficult to study in the laboratory?

82) Why are most of the "early branching" *Eukarya* pathogenic or parasitic?

83) Explain the role of the methanogens in ecological studies.

84) Compare and contrast algae and cyanobacteria.

85) In what way are the *Thermoplasma* like the *Mycoplasma*?

86) Explain the concept of domain in relation to the tree of life.

87) Sketch a phylogenetic tree showing the domains and major branches.

88) Elaborate on how chemolithotrophy and phototrophy have influenced microbial competition and, thus, microbial habitats.

89) Explain why primary producers, especially those that undergo oxygenic photosynthesis, are essential for life on Earth.

90) Compare and contrast the mechanisms of differential interference contrast (DIC) microscopy and confocal scanning laser microscopy (CSLM).

91) Compare and contrast both the purposes and the functions of the transmission electron microscope and the scanning electron microscope.

1) D
2) D
3) A
4) B
5) B
6) D
7) D
8) A
9) A
10) A
11) A
12) D
13) B
14) D
15) B
16) A
17) B
18) A
19) C
20) A
21) B
22) C
23) C
24) D
25) D
26) D
27) D
28) A
29) D
30) D
31) C
32) B
33) C
34) C
35) B
36) B
37) A
38) A
39) FALSE
40) FALSE
41) FALSE
42) TRUE
43) TRUE
44) TRUE
45) TRUE
46) FALSE
47) TRUE
48) TRUE
49) TRUE
50) TRUE
51) FALSE

52) FALSE
53) TRUE
54) TRUE
55) TRUE
56) TRUE
57) TRUE
58) FALSE
59) distinct stalk allowing for attachment to a solid substratum
60) the organism must live inside of another organism to survive
61) genes conferring special properties / housekeeping (essential)
62) alga
63) any two of the following in any order: food / medicine / decay / recycling of nutrients / biodegradation in nature / recycling of organic matter
64) genome
65) phylogeny
66) organic chemicals / inorganic chemicals / light (any order)
67) Answers will vary, but chemoorganotrophs use organic compounds as an energy source and chemolithotrophs use inorganic compounds as an energy source.
68) autotroph
69) *Proteobacteria*
70) lack of a cell wall
71) carry out photosynthesis in eukaryotic cells
72) they are composed of two organisms that live together for mutual benefit
73) both groups grow at near-boiling-point temperatures
74) Heterocysts / nitrogen fixation
75) cell wall
76) oxygenic photosynthesis
77) mitochondria / chloroplasts (either order)
78) numerical aperture
79) Possible answers include cell abundance, cell associations either with other cells or abiotic particles, cell morphology, diversity estimation, multi-cellular or unicellular presence, and sterility of sample.
80) Answers will vary, but one similar feature is that both have a nucleic-acid based genome. A difference that should be emphasized is how viruses depend on a host for metabolism.
81) Answers will vary, but a theme should be the challenge of growing them in the lab due to their distinguishing characteristic of being extremophiles. Examples could include various harsh conditions such as boiling temperatures sustained in a liquid medium.
82) Answers should generally include a statement about the organisms being unable to live a free and independent existence.
83) Answers will vary, but methanogens should be highlighted as those microorganisms involved in the final stages of biomass decomposition, where the methane can be assimilated to begin remaking large carbon-containing molecules (in the carbon cycle).
84) Answers will vary. Possible answers include: Algae are eukaryotes and cyanobacteria are prokaryotes. Both are photosynthetic.
85) Answers will vary but should include a statement that they both lack a cell wall.
86) Answers will vary but should include a description of unifying characteristics of a domain and how some characteristics are shared and therefore create a network (tree) of domains.
87) Answers will vary, but the sketch should resemble "the phylogenetic tree of life" (Figure 2.17) in the textbook.
88) Answers will vary. One possible discussion could focus on how these different ways of obtaining energy allow microorganisms to thrive in the same habitat and minimize competition for resources by having different physiologies.

89) Answers will vary, but a theme should be how oxygen must be cycled back into a usable form for aerobes by organisms that evolve oxygen during photosynthesis as long as aerobic organisms continually use up gaseous oxygen.
90) Answers will vary, but one unifying characteristic is both yield three-dimensional images. Differing features could include computational requirements, staining procedures, and the principles of how an image is observed.
91)

Answers will vary, but a major similarity that should be emphasized is the employment of electrons (rather than a light source) to greatly increase the limit of magnification and resolution. Contrastive examples could include sample preparation requirements and the different cell structures observable in each.