MBIO 2815 – Introduction to Microbiology
Midterm 2 (125 points) -- Green
April 10, 2002

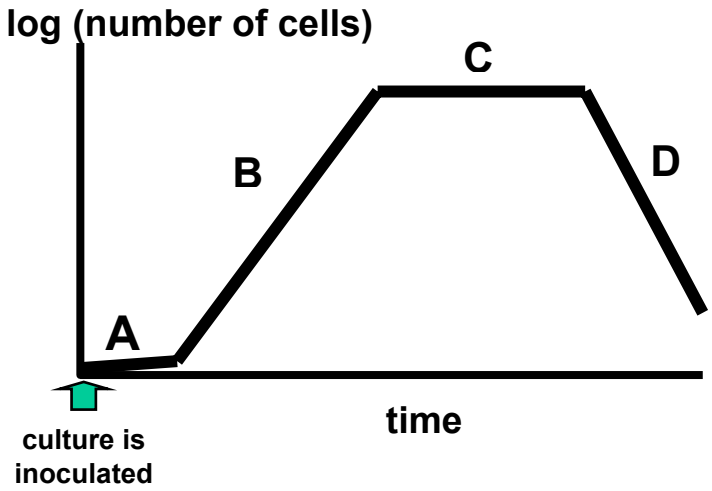
Part I: Multiple choice, true-false, and matching (75 points = 3 points each)

True-false (mark A for true, B for false):

1. Exponential growth, which occurs when a population doubles at regular intervals, can continue only as long as all essential resources are available.
2. Chemiosmosis generates ATP both in respiration and in the light reactions of photosynthesis.
3. All viruses have genetic material, a capsid, and an envelope.
4. Certain viral infections can lead to cancer.

Multiple choice / matching

5. In the curve shown to the right, which letter represents the growth phase during which the number of new cells is the same as the number of deaths?
   a. A
   b. B
   c. C
   d. D
   e. both B and D



6. In the curve shown to the right, which letter represents the growth phase during which cells are most vulnerable to antibiotics?
   a. A b. B c. C d. D e. E

7. A psychrophilic, obligately anaerobic alkalophile would most like to live in which of the following conditions?
   a. temperature 20-50 C, O_2 present, pH 10-12
   b. temperature > 65 C, O_2 absent, pH 10-12
   c. temperature < 20 C, O_2 absent, pH 10-12
   d. temperature < 20 C, O_2 present, pH 1-3
   e. temperature 20-50 C, O_2 present, pH 1-3

8. Which of the following statements about photosynthesis is FALSE?
   a. NADPH is the electron carrier that reduces CO_2 during the dark reactions (Calvin cycle).
   b. H_2O is the electron source in the light reactions of oxygenic photosynthesis.
   c. ATP produced during the light reactions is used in the dark reactions.
   d. In photosynthesis, CO_2 is used in both the dark and the light reactions.
   e. O_2 gas is a byproduct of oxygenic photosynthesis.

9. Which of the following statements about DNA is FALSE?
   a. Enzymes are required for DNA replication.
   b. The two strands of a DNA molecule run in opposite directions (“antiparallel”).
   c. In DNA, the number of cytosine bases is always exactly the same as the number of adenine bases.
   d. When DNA replicates, the two resulting double-stranded DNA molecules each contain one strand from the original DNA molecule.
   e. The two strands of a DNA molecule are held together by hydrogen bonds between the nitrogenous bases.

10. Suppose you are a geneticist working with fruit flies, and you use chemicals to cause mutations in the flies' DNA. Suppose you find that a particular mutation has no effect on the amino acid sequence of the resulting polypeptide. You conclude that the mutation probably involved:
    a. deletion of one nucleotide
    b. insertion of one nucleotide
    c. substitution of one nucleotide
    d. deletion of three nucleotides
    e. deletion of the entire gene

11. What type of RNA carries an anticodon?
    a. rRNA b. tRNA c. mRNA d. all of these e. none of these

12. Which of the following is physically the largest?
    a. operon b. gene c. codon d. nucleotide e. A-T base pair

13. During replication, DNA is synthesized by:
    a. DNA polymerase
    b. RNA polymerase
    c. ribosomes
    d. mitochondria
    e. b and c

14. The CO_2 produced during respiration is produced mainly during:
    a. glycolysis
    b. the Kreb cycle
    c. the electron transport chain
    d. the light reactions
    e. the dark reactions

15. Which of the following is a characteristic of fermentation?
    a. Produces organic acids, gases, and/or alcohol.
    b. Does not require oxygen.
    c. Reduces pyruvic acid.
    d. Follows glycolysis and produces NAD.
    e. All of the above.

16. Which of the following statements is FALSE?
    a. Transduction, conjugation and transformation all increase the genetic diversity of bacteria.
    b. Only certain cells can take up naked DNA from the environment.
    c. Transduction is the transfer of DNA between bacterial cells by a virus.
    d. Both transduction and transformation require direct contact between the donor and recipient cells.
    e. The genetic information needed for a cell to participate in conjugation resides in the DNA of the cell's F plasmid.

17. Diseases such as Creutzfeld-Jacob disease, kuru, mad cow disease, and scrapie are caused by:
    a. viruses b. bacteria c. prions d. viroids e. fungi

18. Of the diseases covered by student groups during this portion of the semester (warts, toxic shock syndrome, trichinosis, ringworm, anthrax, and malaria), how many are caused by animals?
    a. none b. one c. two d. three e. four

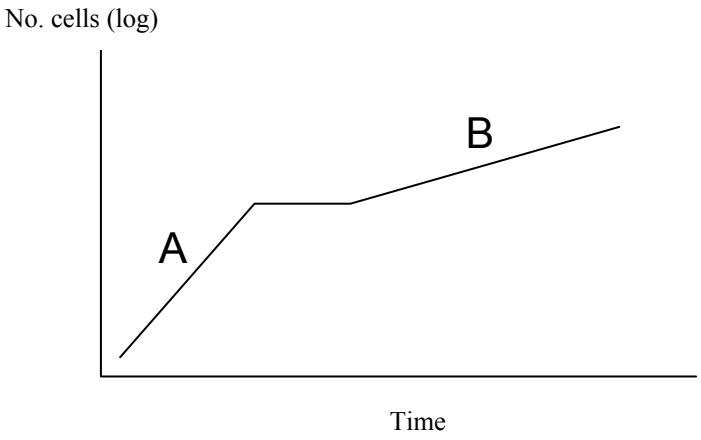
19. Of the diseases covered by student groups during this portion of the semester (warts, toxic shock syndrome, trichinosis, ringworm, anthrax, and malaria), how many are caused by bacteria?
    a. none b. one c. two d. three e. four

20. Which of the following correctly pairs a nucleotide with its complement?
    a. A – T
    b. C – G
    c. A – U
    d. C – T
    e. all of the above except d are correct.

21. Which of the following statements about the *lac* operon is true?
    a. When a cell contains high levels of lactose, the lactose will bind with the repressor.
    b. The *lac* operon is found in both prokaryotic and eukaryotic cells.
    c. When glucose is present, the lactose-metabolizing genes in the *lac* operon are transcribed.
    d. The promoter in the *lac* operon is made of protein.

22. Suppose you engineer a virus with the protein coat of a cold virus and the genetic material of the smallpox virus, with the evil intention of spreading smallpox through a population as easily as colds spread. If this virus were allowed to infect a human cell, the resulting viruses produced in the host cell would have:
    a. the protein of the cold virus and the genetic material of the smallpox virus.
    b. the protein of the smallpox virus and the genetic material of the cold virus.
    c. a mixture of the genetic material and proteins of both viruses.
    d. the protein and genetic material of the cold virus.
    e. the protein and genetic material of the smallpox virus.

23. The curve at right shows the growth of a population of *E. coli* in a medium that initially contains both lactose and glucose. Which of the following statements is true?
    a. Growth is faster in part A of the curve than in part B of the curve.
    b. In part A of the curve, *E. coli* is eating both lactose and glucose.
    c. In part B of the curve, *E. coli* is eating lactose only.
    d. All of the above are true.
    e. Only two of the above are true.



24. Which of the following statements is FALSE?
    a. Most viruses can only infect a specific cell type within a particular host.
    b. Viruses may contain DNA or RNA, and either molecule may be single-stranded or double-stranded.
    c. Viruses are classified partly based on their shape (e.g. helical or polyhedral).
    d. The five stages common to ALL viral replication cycles are adsorption to the host cell, penetration of the host cell, synthesis of viral proteins and nucleic acids, viral assembly, and viral release.
    e. The RNA in retroviruses such as HIV acts directly as mRNA inside the host cell.

25. Which group of animals is NOT usually of concern to microbiologists?
    a. ticks b. tapeworms c. fish d. fleas e. mosquitoes

26. What color is your test form? (0 points)
    a. green b. yellow

MC _____ / 75
SA _____ / 50
Total = _____ / 125

Name:_____ ID#:_____

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Score (this page) _____ / 19 points

Part II: Short answer (50 points)

1. Are ice cubes safe sources of water in areas with poor water supplies? Why or why not? (3 points)

2. a. Name any *chemical* method of preserving food, and explain the mechanism by which it works (2 points).

   b. Name any *non-chemical* method of preserving food, and explain the mechanism by which it works (2 points).

3. a. What is the difference between a disinfectant and an antiseptic? (2 points)

   b. Name any mechanism by which disinfectants and antiseptics kill microbes (1 point).

4. Fill in the blanks: In respiration, __A__ is the process by which glucose is split into two molecules of pyruvate. During this process, ATP is produced, as are two molecules of the electron carrier called __B__. In the electron transport chain, these electrons are passed to other carriers, but ultimately end up reducing __C__, which is the terminal electron acceptor in aerobic respiration (3 points total).

   A = _____ B = _____ C = _____

5. a. What is a plasmid? (2 points)

   b. What is a restriction enzyme? (2 points)

   c. Explain how biologists use plasmids and restriction enzymes to engineer DNA for placement into a bacterial cell (2 points).

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Score (this page) _____ / 16 points

6. Given the following sequence of DNA: **G A T T A T A A C A T G A G C**

   In protein synthesis, what is the name of the process by which mRNA is synthesized using DNA as a template? (2 points)

   _____

   What is the sequence of mRNA that would be synthesized from the above DNA template? (2 points)

   Using the genetic code on the back of this sheet, predict the sequence of amino acids that would result from the above DNA sequence (2 points).

   What is the name of the structure in the cell where polypeptide (protein) assembly takes place? (1 pt)

   _____

   Mutate the above DNA sequence with a *single-base substitution mutation* that would NOT affect the sequence or number of amino acids. What is the new, mutated, DNA sequence? (2 points)

   Suppose you changed the original DNA sequence such that the G in the fourth-to-last position was changed to a C. How many amino acids would be in the resulting protein? Explain your answer (2 points).

   Describe one way in which protein synthesis is different in prokaryotes vs. eukaryotes (2 points).

7. Describe how the replication cycle of a lytic bacteriophage is different from that of a lysogenic bacteriophage (3 points).

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Score (this page) _____ / 15 points

8. The virus that causes chickenpox is an example of a dsDNA virus that invades skin cells. At or in which host cell organelle:

   … is the viral DNA replicated? _____(1 point)

   … are the viral proteins synthesized? _____(1 point)

   … are the new viruses assembled? _____(1 point)

9. a. What characteristics do all protista have in common? (2 points)

   b. Name any protist that causes disease in humans, and name the disease it causes. (2 points)

   c. What characteristics do all fungi have in common? (2 points)

10. For any three of the diseases covered by student groups during this section of the course, (warts, toxic shock syndrome, trichinosis, ringworm, anthrax, and malaria), name the causal agent of the disease and explain how the disease is transmitted to new hosts (6 points total).

Disease	Causal agent	Transmission

11. ***EXTRA CREDIT! !*** Explain how a prophage is similar to and different from a provirus (2 points).