Exam 1 – Microbial Populations

Name: _____ **Date:** _____

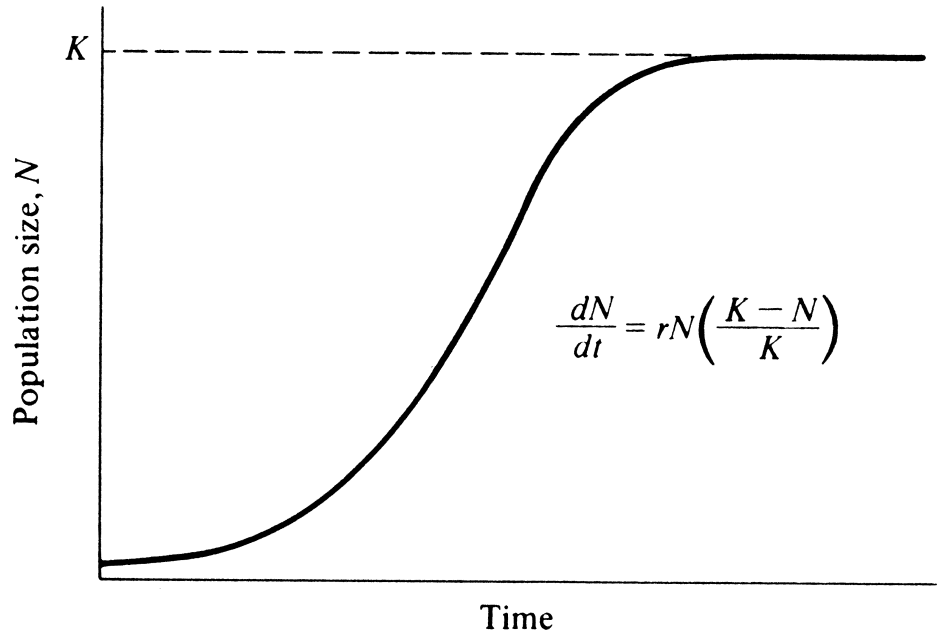
Directions: Please read each of the following questions carefully. For multiple choice questions, please pick the most appropriate answer. For short answer questions, please provide an answer in the space provided. For essay questions, please a 1-2 paragraph (minimum) answer in the space provided. If you need additional space you can continue on the back of the exam or attach extra sheets (available in the front of the class). You will have 50 minutes to complete this exam. If you have questions, quietly approach the front of the classroom.

1. (5 pts) DNA replication is said to occur in a semi-conservative fashion. What does this refer to?
    a. The bacterial cells are limited by nutrients and thus do not replicate until absolutely needed
    b. 50% of each new molecule of DNA is comprised the original
    c. The cell does not produce an excess of nucleotides for DNA replication
    d. The error rate of DNA replication is kept low, but some errors are allowed to pass in order for the molecule to rapidly be replicated and keep up with cell division
    e. All of the above

2. (5 pts) Osmotic stress on a microbial cell is likely to cause the following:
    a. Increased cellular metabolite concentration
    b. Increased ion transportation
    c. Decreased cellular metabolism
    d. Accumulation of solutes
    e. All of the above

3. (5 pts) After years of study, we now know that Archea are more closely related to Eukaryotes than Bacteria. Which of the following Archeal traits most resembles Eukaryotes and not Bacteria?
    a. Circular DNA Structure
    b. The presence of peptidoglycan
    c. Lack of introns
    d. Similar DNA replication and repair systems
    e. All of the above
    f. None of the above

4. (5 pts) The growth curve below depicts which growth model:



   a. Exponential Growth
   b. Logistic Growth
   c. Logarithmic Growth
   d. Michaelis-Menten Growth
   e. None of the above

5. (Short Answer, 8 pts) The 'A' indicated on the above growth curve depicts the which features of population growth? Also given by the equation $'x' = \frac{1}{2}K$

6. (Short Answer, 8 pts) _____ evolution refers to the process by which large phenotypic changes are achieved over a relatively small number of generations through small gene mutations (usually in regulatory genes). This concept has been particularly important for understanding evolutionary Arms Races between bacteria and phage.

7. (6 pts) If a bacterial isolate contained a mutation that limited the production of primase (the enzyme that produces the priming section of RNA during DNA replication) which of the following processes would function the least efficiently? (Chose the best answer)
    a. Initiation of DNA replication
    b. Termination of DNA replication
    c. Leading strand synthesis
    d. Lagging strand synthesis
    e. All of the above

8. (8 pts) By now you know that not all microbes are bacteria and some even belong to the domain Eukaryea. Some Eukaryotic microbes are fascinating because they are mixotorophic (can both fix carbon by photosynthesis and consumer resources to obtain carbon) . Name one such microbe:

9. (25 pts) Please discuss the difference between batch culture versus chemostats methods. What are the strengths and limitations of each? Elaborate. Provide examples of experiments for each (describe experiment, why batch/chemostat was used, any issues).

10. (25 pts) What is the Central Dogma of Biology? Please draw a flow diagram the demonstrates this idea. In addition, describe the major elements: molecules (including characteristics), cellular processes, and major enzymes involved.

Exam 1 – Microbial Populations: Key and Rubric

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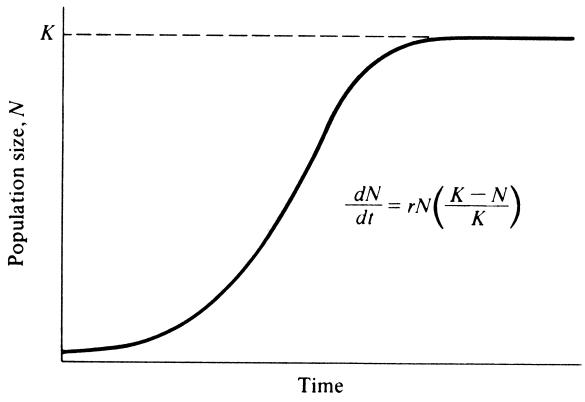

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Maximum growth rate

6. (Short Answer, 8 pts) _____ evolution refers to the process by which large phenotypic changes are achieved over a relatively small number of generations through small gene mutations (usually in regulatory genes). This concept has been particularly important for understanding evolutionary Arms Races between bacteria and phage.

Rapid Evolution

7. (6 pts) If a bacterial isolate contained a mutation that limited the production of primase (the enzyme that produces the priming section of RNA during DNA replication) which of the following processes would function the least efficiently? (Chose the best answer)
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Euglena, Dinoflagellates, Chrysophyta

9. (25 pts) Please discuss the difference between batch culture versus chemostats methods. What are the strengths and limitations of each? Elaborate. Provide examples of experiments for each (describe experiment, why batch/chemostat was used, any issues).

Component	Excellent (5 pts)	Good (3-4 pts)	Poor (0-2 pts)
Comparison	Batch Culture = Tubes, Flasks, No inputs or outputs Chemostats = Continuous growth using inputs and outputs regulated by pumps	Minor Inaccuracies	Major Inaccuracies
Strengths/Limitations	Able to provide strengths/limitations for each Fully articulated arguments and elaborate both strengths and weaknesses	Strengths/Limitations listed but descriptions/elaborations weak and inaccurate	Unable to provide a full list of strengths and limitations.
Batch Example	Provided Relevant Example and fully articulates the purpose of the study and why batch culturing was used	Relevant example, Able to discuss experiment Unable to but not describes well	Inappropriate Example, Unable to articulate the purpose of the study
Chemostat Example	Provided Relevant Example and fully articulates the purpose of the study and why chemostat culturing was used	Relevant example, Able to discuss experiment Unable to but not describes well	Inappropriate Example, Unable to articulate the purpose of the study
Length	2-3 Paragraphs	<1 full paragraph	List Only

10. (25 pts) What is the Central Dogma of Biology? Please draw a flow diagram the demonstrates this idea. In addition, describe the major elements: molecules (including characteristics), cellular processes, and major enzymes involved.

Component	Excellent (5 pts)	Good (3-4 pts)	Poor (0-2 pts)
Central Dogma (DNA→RNA→Protein)	Correct		Incorrect
Flow Diagram	Includes: Core Theme Descriptions	Accurate Descriptions Missing	Major Inaccuracies, Components Missing
Molecules Identified	DNA, RNA, Protein 2-3 characteristics for each	Some Characteristics But <2 each or Inaccuracies	Missing 1 or more molecules No Characteristics
Cellular Processes	Transcription and Translation Both Described in Detail	Details Missing Inaccuracies	No Processes Wrong Order Major Inaccuracies
Enzymes	2+ Enzymes Identified Includes RNA Polymerase and Ribosomes	Only 1 Enzyme Identified Doesn't include either RNA Polymerase	None