Theme-Integrated Lesson Plans

Title: **Bacterial Growth Curves**

Grade: 9-12

Subject: Algebra I

Length of Lesson: 45 min

Standards: 3**.03** Create linear models for sets of data to solve problems

Abstract: Students will calculate and graph the exponential growth of bacteria in culture. They will be asked to identify the lag, exponential, and stationary phase on the curve as the create the curve.

Essential Question(s): How does bacterial growth fit an exponential growth curve?

Instructional Strategies:

Activation of Prior Knowledge/Purpose: Have students respond to the following prompt: Explain how the entire school knows the secret you only told your best friend 2 hours ago.

Engaging the content: Students will complete the Bacterial Growth Curve activity

Summarizing/Assessment: Write a paragraph explaining what would happen to a deer population if there were no controls on the reproduction of the animals

Student Assessment: Summary writing rubric

Resources/Materials needed: Calculators

Websites:

http://www.otherwise.com/population/exponent.html (exponential growth in fish)

http://www.microbiologybytes.com/LabWork/bact/bact1.htm (virtual bacteria lab)

Notes from Author: Lynessa Clark and Terry Howerton

Bacterial Growth Curves

Background

Under optimum conditions, E.coli cells double every 20 minutes. Optimum conditions include the "right" temperature, food, pH, amount of oxygen, and amount of light. Since E. coli cells are so tiny, the growing colony is not visible without a microscope until there are several billion cells present. A colony will continue to grow exponentially until its food, space, or other nutrients begin to run low. At this point, the colony is said to be in an environment at carrying capacity.

Purpose: Determine how fast a colony grows under optimum conditions.

Procedure

1. Assume that a plate has been streaked with E.coli. The goal is to produce an isolated colony started by depositing a single, isolated cell.
2. Assume the plate is incubated at optimum conditions for 8 hours.
3. Create a chart that shows the number of cells that would be present in the colony after doubling every 20 minutes.
4. Communities of organisms (like bacteria colonies) will grow as long as their resources are not limited. A community will start to grow slowly since there are only a few organisms to reproduce. This time period is called the "lag phase'. Create a graph similar to the one shown on the following page to chart the growth of the E. coli colony. Label the lag phase on your graph.
5. Once substantial numbers of organisms are present in a community/colony, doubling causes large changes in community size. On a graph, this is shown by a fast rise in the number of organisms correlating to exponential growth. Label the exponential phase on your graph.
6. All communities of organisms eventually slow their reproductive rate as the individuals start to be crowded. The line on the growth curve starts to level out. This is called the "stationary phase," and the culture is said to be at carrying capacity. Label the stationary phase on the graph a place an asterisk (*) by the point at which carrying capacity is reached.

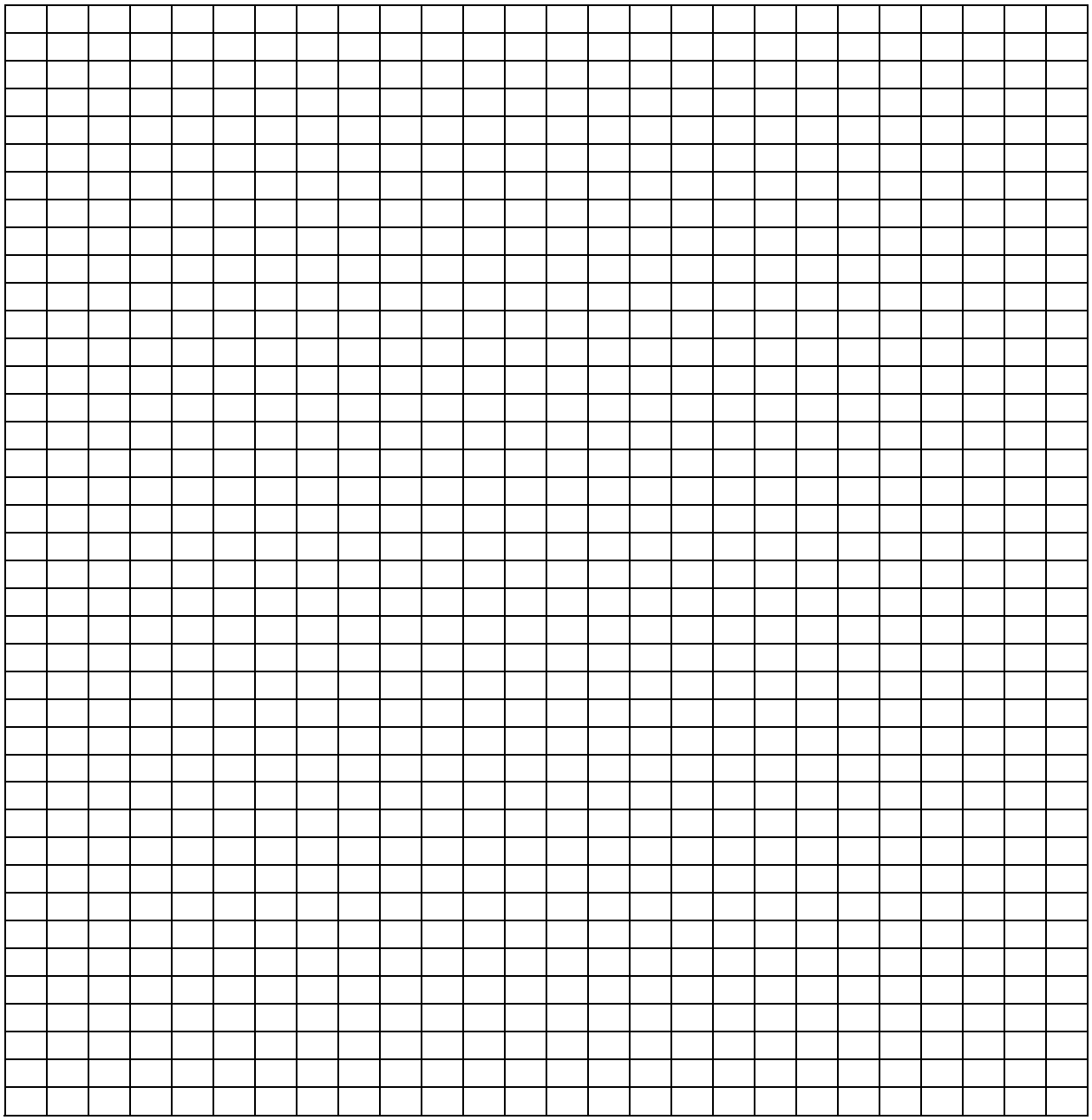
7. Explain how a colony on a Petri plate could reach its carrying capacity. Suggest why; biotechnologists would want to keep colonies of cells in the exponential phase. Suggest methods of how biotechnologists might keep cells in exponential growth.

Adapted from Biotechnology: Science for the New Millenium by Ellyn Daugherty

The Number of E.coli in a Colony over Time

Time (min)	No. of Cells	Time (min)	No. of cells
0		260	
20		280	
40		300	
60		320	
80		340	
100		360	
120		380	
140		400	
160		420	
180		440	
200		460	
220		480	8,400,306
240			

The Growth of an E.coli Colony over Time



Name: **Date:** **Assignment**:

Summary Writing Rubric	**4 Superior**	**3 Good**	**2 Fair**	**1 Poor**
Quality of Information	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
Accuracy	All supportive facts and statistics are reported accurately.	Almost all supportive facts and statistics are reported accurately.	Most supportive facts and statistics are reported accurately.	Few supportive facts and statistics are reported accurately.
Understanding of Concepts	Summary illustrates an accurate and thorough understanding of the concepts underlying the activity	Summary illustrates an accurate understanding of most of the concepts underlying the activity	Summary illustrates an accurate understanding of some of the concepts underlying the activity	Summary illustrates inaccurate understanding of the concepts underlying the activity.

Assignment Grade: _____