

THE GROWTH OF MICROORGANISMS

Objective/Rationale

Recognizing the conditions necessary for microbial growth is vital to disease prevention and treatment. The student will graph the four stages of the growth curve and identify the four stages.

TEKS 121.14 4D

Algebra II 4F1, 4F2, 4F3, 4F4

TAKS ELA 1, 4

Mathematics 3, 4, 5, 8, 9, 10
Science 1, 2

National Science Education Standards A9-12; C9-12

National Health Care Skills Standards .01, .04, .05, .06, .07, .08

National Curriculum Standards for School Mathematics S1; S3; S10; S11

Key Points

- I. Definition of key terms
 - A. Generation time
 - B. Logarithmic growth
 - C. Thermophiles
 - D. Psychrophiles
 - E. Microaerophilic
 - F. Aerobe
 - G. Anaerobe
- II. Bacterial growth
 - A. The lag phase – when the bacteria are getting ready to divide
 - B. The logarithmic or exponential phase – growth of bacteria
 - C. The stationary phase – when bacterial growth begins to slow
 - D. The death phase – cell death due to the depletion of nutrients, crowding from growth, and drop in pH.
- III. Factors influencing bacterial growth
 - A. Temperature - microorganisms grow over a broad range of temperatures but the optimal growth temperature for most medically important bacteria is 20 – 45C.
 - B. Moisture - water is necessary for the metabolic activities of microorganisms
 - C. Salt requirements - some microorganisms are high-salt tolerant.
 - D. Oxygen Requirements – aerobic and anaerobic
 - E. Neutral pH is optimal
 - F. Nutritional requirements
- IV. Determining Bacterial Growth
 - A. Measuring cell mass .
(Bacterial growth measurements are important in urine cultures and are useful in food and environmental micro.)

1. Cell weight
 2. Turbidity – as bacteria grow in a culture broth, the broth becomes cloudy. Turbidity can be measured with a spectrophotometer and a growth curve can be identified by charting data on graph paper.
- B. Measurement of cell number.
1. Direct cell counts
 2. Viable cell counts

Activities

- I. Completion of the **Bacteria Growth Curve Laboratory Investigation.**

Materials/Resources

Spectrophotometer (Ask AP Biology or Chemistry instructor)
Nonpathogenic Escherichia coli cultures (other cultures may be used)
Broth tubes
Incubator at 37C
Graph Paper
Inoculating loops
Bunsen Burner
Gloves
Goggles
Laboratory coats or aprons
Biohazard container
Surface disinfectant
Paper towels

Microbiology for Health Careers, e. Fong, et al., Delmar publishers, 5th edition; chapter 12

Assessment

Laboratory Investigation Rubric

Accommodations

For reinforcement, the student will draw a diagram showing the typical growth curve of a bacterial population. Explain the processes that occur in each phase and factors that play a role

For enrichment, the student will research and report on why antibiotics must be taken for ten days and the consequences of noncompliance.

Reflections

BACTERIA GROWTH STUDIES

NAME:

DATE:

PURPOSE:

In this laboratory investigation, the student will graph the growth curve and identify the four stages.

BACKGROUND INFORMATION:

MATERIALS:

TSB of Nonpathogenic Escherichia coli

Inoculating loop

Spectrophotometer

Black markers

Test tube rack

2 tubes of TSB

gloves

goggles

lab coat or apron

37C Incubator

Bunson burner

Surface disinfectant

Paper towels

PROCEDURE:

1. Students should work in groups of two.
2. Wash hands and put on gloves.
3. Assemble equipment and materials and prepare work area.
4. Set the spectrophotometer at 450nm and let it warm up 30 minutes before performing the readings. The meter on the spectrophotometer should read "0% Transmittance".
5. Obtain 2 tubes of TSB. Label one C (uninoculated) for control and one S (inoculated) for sample.
6. Place tube C into the sample holder of the spectrophotometer. Turn the light control knob until the meter needle is on "100% Transmittance". Remove the control tube. The spectrophotometer is now standardized.
7. Flame and cool the loop.
8. Mix the culture of E. coli and inoculate tube S with 5 loopfuls of the broth.

9. Flame and cool the loop.
10. Start the turbidity readings by placing the S tube into the sample well and read the OD (absorbance). Record the results in the data section.
11. Take OD reading over the time period specified in the data section and return the TSB tube to the 37 C incubator between each reading.
12. Turn off the spectrophotometer upon completion of the readings.
13. Plot the readings on the graph paper as absorbance vs. time.
14. Clean work area with disinfectant.
15. Remove gloves and wash hands with disinfectant.

DATA:

Record the absorbance value for each sample reading starting at 0 time.

TIME (MIN)	ABSORBANCE
0:00	
5:00	
10:00	
15:00	
20:00	
25:00	
30:00	
35:00	
40:00	

CONCLUSIONS:

1. Plot the absorbance values vs. time on graph paper. Label the x and y axis. Each of the readings will represent the growth of the E. coli in the culture.
2. Label each part of the growth curve: Lag phase, Exponential growth phase, and the Stationery phase.
3. Why is the Death phase not represented on graph?
4. What is the correlation between the turbidity of the broth and the growth of the bacteria?
5. Why do you use an uninoculated tube to standardize the spectrophotometer?