GROWTH AND DISEASE

LEVEL:

Grades 9-12. This lesson builds conceptual understanding, scientific investigation and practical reasoning while developing and using reading, writing, and mathematics.

PURPOSE:

To investigate the nature and consequences of growth of disease to help students to protect themselves and others from diseases.

CONTENT:

This unit covers Science Standards Unifying Concepts, Science As Inquiry, Life Science, and Science in Personal and Social Perspectives.

SCIENCE CONCEPTS:

This unit covers Science Concepts Systems, order and organization , Evidence, models, and explanations, Change, constancy, and measurement, Form and function, Abilities necessary to do scientific inquiry, Understandings about scientific inquiry, Interdependence of organisms, Biological evolution , Behavior of organisms, Personal and community health, Population growth, Environmental quality, Natural and human-induced hazards, Science and technology in local, national, and global challenges.

OVERVIEW:

This lesson focuses on growth and control of diseases using four learning activities regarding the spread of viruses, antibiotic action, parasitic organisms, and probability of contracting diseases. The learning activities will take from 4 to 12 class periods. Each activity has a performance task that assesses the applied skills in individual or group ways. All tasks and assessments may be scored by rubrics for diagnostics and reporting. (See Graphic Organizers-Teachers in Teacher Resource Center.)

INTRODUCTION:

Preview the lessons on Growth and Disease by introducing the skills and concepts to be learned and how these skills will be used in the lesson activities. Concepts/terms we will encounter as we learn about growth and disease are virus, bacteria, antibiotic, parasitic, vector, and composite.

BASIC SKILLS APPLIED IN THIS LESSON

MATHEMATICS SKILLS	ACT 1	ACT 2	ACT 3	ACT 4
probability				X
exponential functions	X	X		
use modeling to achieve mathematical meaning	X	X	X	
use graphing to achieve mathematical meaning	X	X		
use numbers to achieve mathematical meaning	X			X
use tables and graphs as tools to interpret expressions, equations, and inequalities		X		
use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty				X
use simulations to estimate probabilities				X

LANGUAGE ARTS SKILLS	ACT 1	ACT 2	ACT 3	ACT 4
summarizes	X		X	
identifies steps in a procedure			X	
describes content			X	
applies technical information			X	
makes inferences or predicts future events		X		
identifies faulty logic			X	
distinguishes between fact and opinion	X		X	
compares sources	X			
letter	X			
instructions	X			
technical report	X			
poster		X		
diagram			X	
article for Internet home page			X	
television script				X

LEARNING ACTIVITY 1

THE VIRUS GAME

HOW FAST DO VIRUSES SPREAD?

OBJECTIVES:

Students will apply the Mathematics skills of making and testing conjectures, modeling real-world phenomena , representing and analyzing relationships using tables and graphs , analyzing the effects of parameter changes on the graphs of functions , understanding operations on, and the general properties and behavior of, classes of functions; and the English skills of data tables, graphing, writing instructions, and technical reporting to examine the nature of exponential growth of a virus.

PERFORMANCE TASK:

One student will be given an imaginary virus which is transmitted by handshaking. The class will shake hands a number of times, and record and graph the number of students who caught the virus each time period. They will compare their graphs and analyze their results. Students will make predictions about the growth of the virus with different conditions, design and perform an experiment to test their predictions, and write a technical report.

CLASS STRUCTURE:

The whole class will play the game, then work in small groups or individually to graph the data. The whole class will compare results. Small groups will design and carry out the experiments. Each students will write a set of experimental instructions and a technical report.

PROCEDURES:

Make enough small squares of paper for each student. Write “You have the virus” on one of the pieces and fold all the pieces in half.

Explain that the class is going to play a game to simulate a virus epidemic. Explain to the class that you are going to distribute pieces of paper and that one person will receive a paper that has “Virus” written on it. The identity of the person with the virus will remain secret.

When the teacher calls out the number of a time period, starting with time period one, the students will shake hands. A student who has the virus will give a quick squeeze when he/she shakes hands, passing the virus to the person who receives it. Each person who catches the virus needs to remember the time period when he/she first caught it. After catching the virus, the person must always pass the virus when he/she shakes hands with another person. Try to shake hands with a different person each time period.

After about 8 time periods, stop and count the number of students who caught the virus in each time period, recording the results in a table on the blackboard or overhead.

Have each student graph the data, with "Time Period" on the horizontal axis and "Number of Students Who Caught It" on the vertical axis.

Ask the following questions during class discussion:

Compare the graphs, and ask why they are different. What is the effect of scale on the shape of the graph? What kind of behavior does the shape of the graph demonstrate? (These graphs will usually start out exponential then begin to level off when all the students have caught the virus and are shaking hands with each other.

Use the CCR to look up data on the growth of the AIDS virus on the Internet and graph it. Write a letter to a friend describing your predictions for the epidemic.

Form small groups and predict the effect on virus growth if some persons were immune to the virus. Sketch a graph of your hypothesis and design an experiment to test your predictions.

Write a set of instruction on how to perform the experiment. Present your idea to the class. The class will choose a design and perform the experiment. Each student will write a short technical report of results, including data tables and graphs.

REFLECTION / EVALUATION:

(Use the following questions during whole class or small group discussion).

Did you learn more by designing your own experiment than by performing one already designed by someone else?

LEARNING ACTIVITY 2

ANTIBIOTIC ACTION

HOW DO ANTIBIOTICS CURE DISEASE?

OBJECTIVES:

Students will apply the Mathematics skills of modeling real-world phenomena , representing and analyzing relationships using tables and graphs, constructing and drawing inferences from charts, tables, and graphs that summarize data from real-world situations; and the English skills of data tables, graphs, research and making posters to to examine the nature of antibiotic action.

PERFORMANCE TASK:

The students will construct data tables and graphs that demonstrate bacterial growth and antibiotic action. They will research the rate of discovery of new antibiotics and compare it to the rate at which diseases are becoming resistant. They will use the information they have found to make a poster.

CLASS STRUCTURE:

Students will work in small groups to construct the data tables and graphs, to do Internet research, and to make posters. The whole class will compare results.

PROCEDURES:

INTRODUCTION / MOTIVATOR

Tell the students they will investigate the way the antibiotics fight infections and how organisms can become resistant to antibiotics.

Tell the students the following:

At a temperature of 21 °C the *e. coli* bacteria multiplies every 20 minutes by dividing in half. If one bacteria is dropped into a glass of milk how many bacteria will there be after 24 hours? Draw a graph of the bacterial growth vs. time. Write a formula to find the number of bacteria at any time.

An antibiotic is added to the refrigerated milk after the number of bacteria has reached one million. It begins to kill the bacteria at the rate of 50% of the bacteria every 15 minutes. How many

bacteria will be left 2 hours after the antibiotic is administered? Draw a graph.

The antibiotic loses its ability to kill the bacteria at an exponential rate after it is put into the milk. What effect will this have on the bacterial growth? Create a math model that will show possible growth patterns of the bacteria, based on the various decay rates for the antibiotic. What if no more antibiotic is added to the milk? Will the bacteria all die? Will some survive to become resistant to the antibiotic?

Many antibiotic wonder drugs in the medical arsenal against disease are becoming ineffective because disease organisms have become resistant to the antibiotics.

Use CCR to research the rate at which new antibiotics are being discovered vs. the rate at which diseases are becoming resistant. Draw a graph of your findings.

Use the results of your research to make a poster to inform patients at a medical clinic about the growth and spread of resistant organisms and what they can do to protect themselves and others from them. Use your graphs and be sure to answer the following questions with your poster:

Based on your research about the rate at which organisms are becoming resistant to antibiotics, what is your prediction for the future of medical practices. What can people do to prevent organisms from becoming resistant to antibiotics? What would you tell patients about taking antibiotics?

REFLECTION / EVALUATION:

(Use the following questions during whole class or small group discussion).

How did this activity affect your ideas about antibiotics?

LEARNING ACTIVITY 3

COMPOSITE RELATIONSHIPS

HOW DO PARASITIC ORGANISMS SPREAD?

OBJECTIVES:

Students will apply the English skills of reading, diagrams, articles, oral reports, and research to investigate the spread of parasitic organisms.

PERFORMANCE TASK:

The students will read and discuss articles about the spread and control of parasitic organisms. They will draw diagrams of the life cycles of the organisms and the human causes and effects of parasitic diseases. They will write an article for an Internet home page describing their findings.

CLASS STRUCTURE:

Students will each read the assigned articles, discuss them, and draw diagrams in small groups. Each students will create an article for an Internet home page. Groups will report to the whole class on their results.

PROCEDURES:

INTRODUCTION / MOTIVATOR

Tell students to do the following:

Form small groups and choose a chapter to read in the book by Robert Desowitz "New Guinea Tapeworms and Jewish Grandmothers." Draw a diagram that shows the life cycle of a parasitic organism and how it depends on its hosts.

Display your diagram and explain it to the class.

Many factors affect the spread of parasitic diseases. Find examples of how seemingly unrelated human activities often cause the spread of disease. Draw a diagram showing how can solutions to one problem cause another.

The spread of vector-born diseases is a major problem for developing countries, and is becoming a threat to the United States. Investigate Internet sites such as the Center for Disease control, and the World Health Organization to find out what problems are

occurring and their proposed solutions. Write an article for an Internet home page reporting your findings.

In your article answer the following questions:

How can parasitic diseases best be controlled? What factors might increase the number of parasitic diseases in the United States?

REFLECTION / EVALUATION:

(Use the following questions during whole class or small group discussion).

Did drawing the diagrams help you to understand parasitic diseases better? How could you use this information to stay healthy?

LEARNING ACTIVITY 4

WHAT'S THE PROBABILITY

WHAT ARE THE CHANCES OF YOU CONTRACTING A SERIOUS DISEASE?

OBJECTIVES:

Students will apply the Mathematics of using probability to represent and solve problems involving uncertainty and the English skills of research and reporting to investigate the probability of contracting a serious disease.

PERFORMANCE TASK:

The students will conduct research, perform calculations, and write a report about the results.

CLASS STRUCTURE:

For this session the structure is flexible. Each student should conduct the research, however, if the are in groups they can help each other and/or compete with each other. Each student should write a TV report.

PROCEDURES:

INTRODUCTION

Choose the ten diseases you believe to be the greatest threat to mankind. Use CCR to find the frequency of contraction for each and use this to calculate you probability of contracting this disease as a 'typical' person. Then recalculate the probabilities based upon your doing what you can to minimize your risk. For example, after calculating the probability of contracting polio as a member of the general population then recalculate the probability assuming you have been fully vaccinated.

Now write a TV report for a magazine style show (60 Minutes). Explain the risks of contracting the 'dread diseases' and what you can do to prevent it.

REFLECTION/EVALUATION:

Use the following questions during whole class or small group discussions.

Has this exercise made you more or less afraid of catching a disease? Why? Has this research changed your idea of what diseases are the worst? How and why?