Population Dynamics: Three Types of Population Growth

Click on the following site: http://ats.doit.wisc.edu/biology/ec/pd/pd.htm

You will investigate three different scenarios of population growth:
Investigation 1: Exponential Growth of Zebra Mussels
Investigation 2: Logistic Growth
Investigation 3: Logistic Growth of an Elephant Population

For each investigation, you will complete data charts and a few short questions. You will put this into your BILL when the activity is complete. I will be taking a lab grade on this activity so make sure you are doing your very best work!

Investigation 1: Zebra Mussels

In this investigation, you are a Department of Natural Resources aquatic biologist assigned to study the ecology of Lake Madonna, a small lake in south central Wisconsin.

Recently, a single adult zebra mussel was found in Lake Madonna. Citizens, government officials, and scientists are concerned about a large scale invasion of the lake by this pest. It's up to you to answer the question: What will the zebra mussel population look like in 5 years?

Here's what you'll do to answer this question:

1. Find out what the experts predict will happen about the zebra mussel population.
2. Collect data about the population for a period of 5 years.
3. Process the data and compare it with the models the experts propose.

In the space below, sketch the population graphs that illustrate the experts' predictions about the population.

Expert 1	**Expert 2**	**Expert 3**
Type of growth:	Type of growth:	Type of growth:

After you have sketched each graph, be sure to click "Next" after the last expert's prediction to move on to collect data. You will need to collect both qualitative and quantitative data.

Table Title: ____

Year	Number of Zebra Mussels/m^2	Qualitative Observations
1		
2		
3		
4		
5		

Using the graphing tool provided, answer the following questions:

1. What is the dependent variable? ____
2. What is the independent variable? ____

Plot your graph in the space below. Be sure it has an appropriate title, units and axis labels!

Title: ____

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1. Of the three experts, which expert's prediction most closely matches yours?
2. Which of the three equations for population growth is predicted by your model? Write the equation in the space below and identify the variables within it:

Investigation 2: Logistic Growth in a Fish Population

In this brief investigation you will step through a model of logistic growth in a population of fish.

Follow the simulation from Step 1 to Step 4.

1. Give the equation for population growth here: ____
2. On a graph, what does this equation represent? _______________________________________
3. What is density-dependent growth? What factors affect this type of growth?

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4. Give the equation for logistic growth here: ____
5. What similarities doe s this equation have with the general equation for population growth? What differences are there between the two equations?

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6. What is carrying capacity and how is it determined? What happens as a population reaches its carrying capacity?

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7. Explain what is meant by the "unused portion of K."

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8. Add fish to the lake. What is the relationship between N and [1-(N-K)]?

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9. Define the following and describe its relationship with N:
   a. r: ____
   b. r_{max}: ____
10. What is the equation for the realized intrinsic rate of increase? Write it in the space below:

11. Predict what happens to r as the population reaches K: ___________________________________

12. If K = 50, and r_{max} = 0.5, when will r be half of r_{max}? _____________________________________

Investigation 3: Elephant Population Growth in a Nature Reserve

Your task is to use the logistic model to follow the growth of an endangered elephant population in Kruger National Park, South Africa. Step through the introductory information before beginning the mathematical model of the population's growth.

What problems does overcrowding of elephant populations cause, and how did the park wardens solve these problems?

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Fill in the data chart below, for values of r_{max} = .15 and K = 7500. Remember you will use the formula for logistic growth, which you wrote down earlier.

Time	Year	N	1-(N/K)	dN/dt
1	1905	10		
2	1930			
	1935			
	1940			
3	1944			
	1946			
	1950			
4	1996			

Answer the questions below as you complete the data table.

1. What was the realized intrinsic rate of growth/increase in 1905? ______________________________
2. What do you notice about the relationship between the elephant population's growth rate and the "unused portion of K"? ____
3. At what point is the population closest to its r_{max}?____
4. What assumption about the environment can we make when the population is small?

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5. What do you notice about dN/dt when the population is at half its carrying capacity?

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6. What could have happened as the elephant density reached K?

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7. Now look at the graph of the data you collected and compare it to the data collected by the researchers. How do the two compare to one another?

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8. What are the limitations of using a simple logistic model to evaluate population growth?

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