Name: Answer Key

AP Biology

Activity 53.2 What models can you use to calculate how quickly a population can grow?

1. In the simplest population growth model ($dN/dt = rN$).

a. What do each of the terms stand for?

Term	Stands for
dN	Change in population size.
dt	Change in time.
r	Per capita growth rate.
N	Population size.

b. What type of population growth does this equation describe?

Exponential growth.

c. What assumptions are made to develop this equation?

We're assuming that the environment can support and sustain such rapid growth.

2. Population growth may also be represented by the model, $dN/dt = r_{max}N[(K - N)/K]$.

a. What is K?

The carrying capacity.

b. If $N = K$, then what is dN/dt?

When $N = K$ the rate of growth $\left(\frac{dN}{dt}\right)$ is zero.

c. Describe in words how dN/dt changes from when N is very small to when N is large relative to K.

When N is small the rate of growth is small because there are few organisms reproducing. When N is near K the growth rate is also small because resources are being used up. The growth rate is highest when $N = \frac{1}{2}K$.

d. What assumptions are made to develop this equation?

We're assuming we know what the carrying capacity is and what limits contribute to defining it.

3. You and your friends have monitored two populations of wild lupine for one entire reproductive cycle (June year 1 to June year 2). By carefully mapping, tagging, and censusing the plants throughout this period, you obtain the data listed in the chart.

Parameter	Population A	Population B
Initial number of plants	500	300
Number of new seedlings established	100	30
Number of the initial plants that died	20	100

a. Calculate the following parameters for each population.

Parameter	Population A	Population B
B (births during time interval)	100	30
D (deaths during time interval)	20	100
b (per capita birth rate)	$100/500 = .20$	$30/300 = .10$
m (per capita death rate)	$20/500 = -.04$	$100/300 = .33$
r (per capita rate of increase)	$.20 - .04 = .16$	$.10 - .33 = -.23$

b. Given the initial population size and assuming that the population is experiencing exponential growth at growth rate r, what will the number of plants be in each population in 5 years? (Use the initial population size as time 0, and compute to time 5.) $N(t) = N_0 e^{rt}$

Population A: 1113

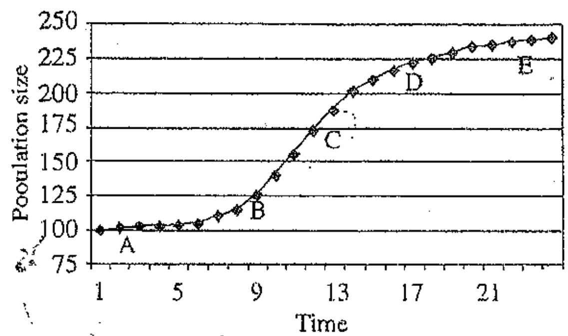
Population B: 95

9. Suppose you have a "farm" on which you grow harvest, and sell edible freshwater fish. The growth of the fish population is logistic. You want to manage your harvest to maintain maximum yields (that is, the maximum rate of production) from your farm over a number of years.

As a fisheries manager, you are responsible for deciding how many walleye can be harvested without destabilizing the population.

a. Below is a data table showing the walleye population in a typical pond on your fish farm over 24 week.

Time (weeks)	1	2	3	4	5	6	7	8	9	10	11	12
Population Size	100	101	102	103	104	106	110	115	125	140	155	172
Time (weeks)	13	14	15	16	17	18	19	20	21	22	23	24
Population Size	188	201	209	217	221	225	229	233	235	237	238	239



b. How large should you let the population get before you harvest? Identify the point on your graph *and explain why.*

When considering logistic growth, the maximum population growth rate occurs when $N = \frac{1}{2}K$. K appears to be around 250, so I would maintain 125 fish in the pond to obtain maximum population growth. (A little above Point B).

c. Assume the carrying capacity for your pond is 250 individuals. Check your answer in part b by using the data in the chart and computing the change in the population size (dN/dt) when the population is at several different levels relative to its carrying capacity. Use $K = 250$ and $r_{max} = 0.20$.

Population size (N)	$(K - N)/K$	dN/dt (fish / week)
25 (low)	.9	4.5
50 (moderately low)	.8	8
125 (half K)	.5	12.5
200 (moderately high)	.2	8
250 (high)	0	0