The Pop Ecology Files

activity 8

Introduction:

Line graphs are well suited for showing populations over time. By comparing graphs of different populations, students can gain an understanding of both the nature of that growth and ecology of the species being studied.

Procedure:

1. Distribute copies of the Student Worksheet and graph paper to each student and give them time to complete Part 1 individually.
2. Orient students to Part 2 and 3 by explaining that:

   "A population graph shows what happens to the population of a certain species over time. The *x*-axis shows passage of time; the farther you go to the right, the more time elapses. The *y*-axis shows population size; as you go up the axis, the population increases. The scales for both population and time are determined by the data.
3. Give students time to plot the data in Parts 2 and 3, following the directions on their worksheet. Students can complete Part 2 individually, or in groups. If it is completed as group work, ask students to post their completed graphs so others can see and discuss them.
4. Once the Student Worksheet has been corrected, review the discussion questions with the class.

Discussion Questions:

Part 1:

1. Can you think of other situations where growth occurs arithmetically? (*cost of postage stamps over time, basketball scores over course of game, a person's age over time, etc.*)
2. How about other situations where growth occurs exponentially? (*number of internet sites, baseball player's salaries over time, acceleration due to gravity, etc.*)

Part 2:

3. Which of the populations show seasonal fluctuations? (*The rabbit, fox, and warbler.*)
4. What do you think is causing their populations to shrink? (*Lack of resources; like food, air and water to survive; and shelter to keep safe.*)
5. If your Aunt found that by July 2, 1999, the fox population dropped to 36 individuals, would that be a cause for concern? Why? (*No, because each July its population has been between 35 and 39, but it rebounds.*)
6. How do you think the populations of the rabbits and the foxes are related? (*The fox population grows when rabbits are abundant, and shrinks when they are scarce.*)

Part 3:

7. Because of its appearance, the human growth curve is called a J-Curve, because of its shape. Are any of the other graphs similar? (*The closest fit is the 1st population of bacteria, up to the point where its population crashes.*)
8. Would we want the human curve to look like the 1st bacteria population? Why? (*No, because the bacterial population plummets once their resources are exhausted.*)
9. Are humans susceptible to the kind of resource shortages that affect the populations of the other species? (*Yes, we also depend on food, water, air, and shelter to survive.*)
10. What might the ideal graph for humans look like over the next 200 years? (*The curve would level off, like the 2nd population of bacteria.*)

Concept:

Students are introduced to the concepts of arithmetic and exponential growth. They use this knowledge to identify a group of mystery species, and compare the growth curves of these species to that of humans.

Objectives:

Students will be able to:

- Interpret graphs that depict populations charted over time.
- Plot human population growth over time.
- Compare characteristics of human population growth to that of other species'.

Skills:

Drawing and interpreting line graphs, deductive reasoning, developing inferences based on data, problem solving

Method:

Students complete a worksheet in which they graph and interpret growth curves for money, six mystery species, and humans.

Materials:

Student Worksheets
Graph paper
Optional: Calculator

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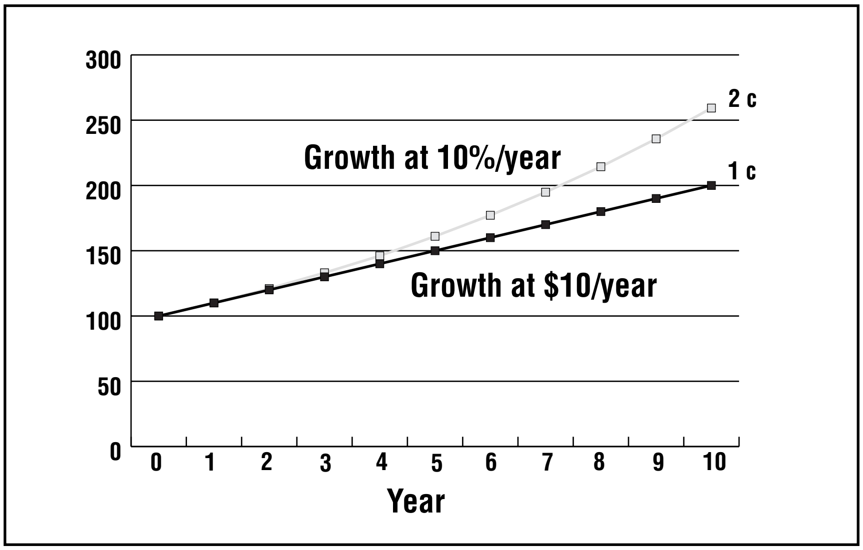
Student Worksheet Answers:

Part 1:

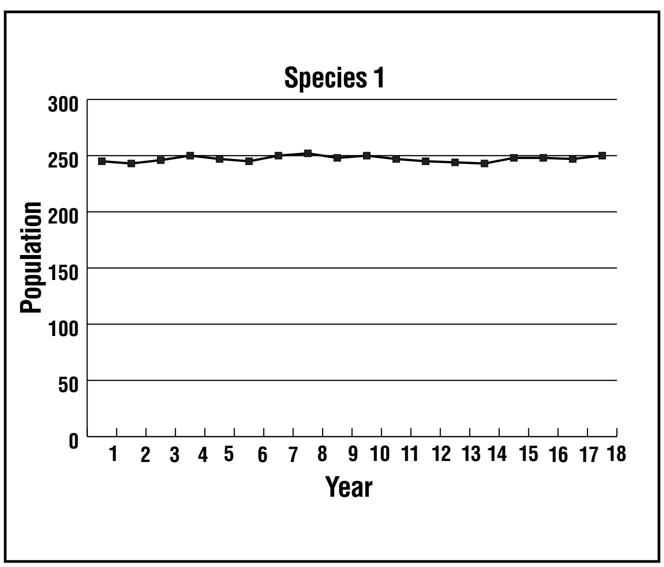
	Start	1	2	3	4	5	6	7	8	9	10
1. a-b	$100	$110	$120	$130	$140	$150	$160	$170	$180	$190	$200
2. a-b	$100	$110	$121	$133.1	$146.41	$161.05	$177.16	$194.87	$214.36	$235.79	$259.37
3	1000	1100	1210	1331	1464	1610	1772	1950			

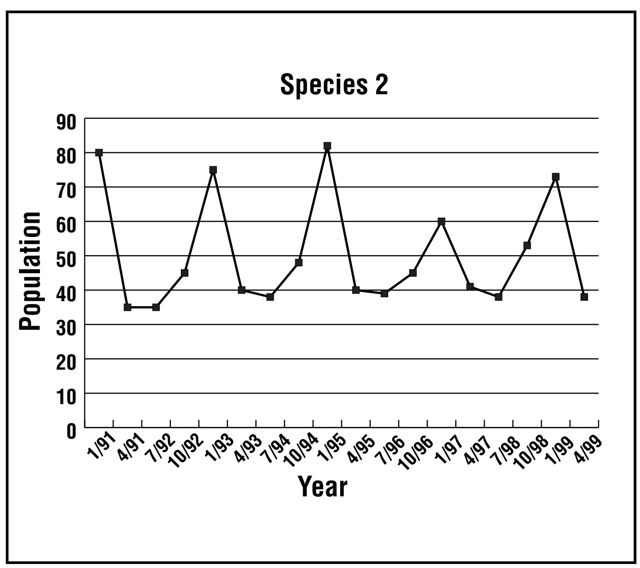


Part 2:

a. Species 1: Bristlecone Pine (*In a slow growing, long-lived species, you would expect little change over time.*)

b. Species 2: Red Fox (*The population fluctuates annually, following the boom and bust of rabbit numbers.*)





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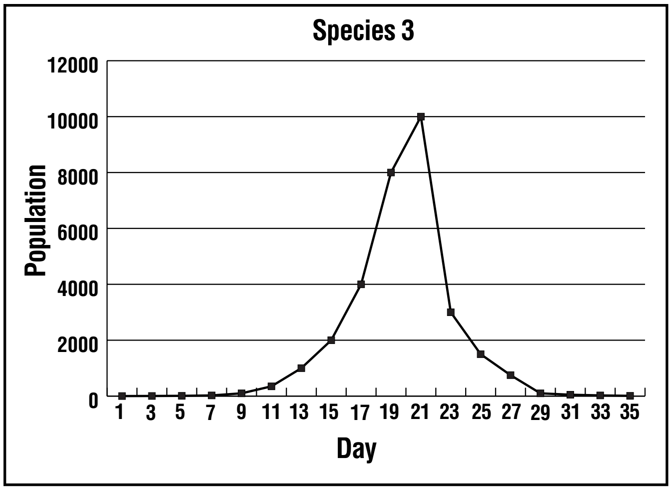
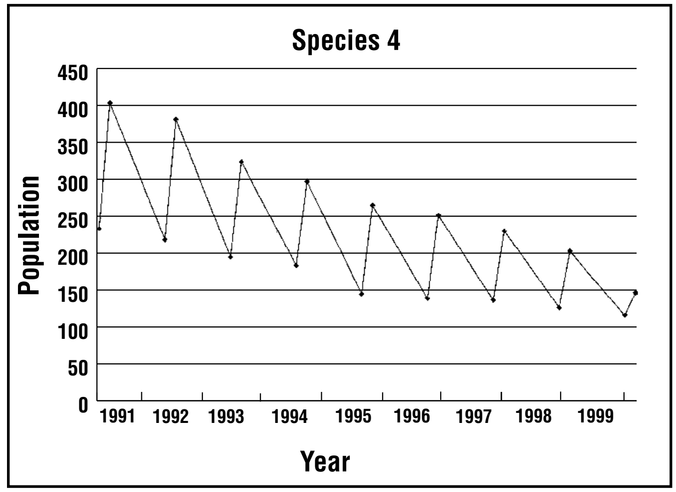
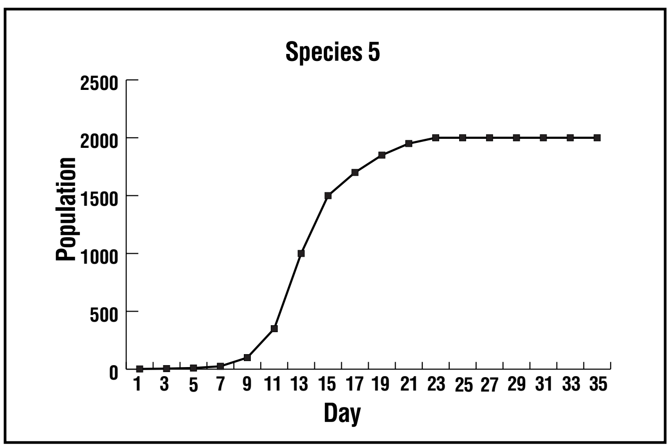
c. Species 3: Bacteria X (1st population) (*You would expect the bacterial colony to grow fast, and also to die fast as their resources dwindled.*)



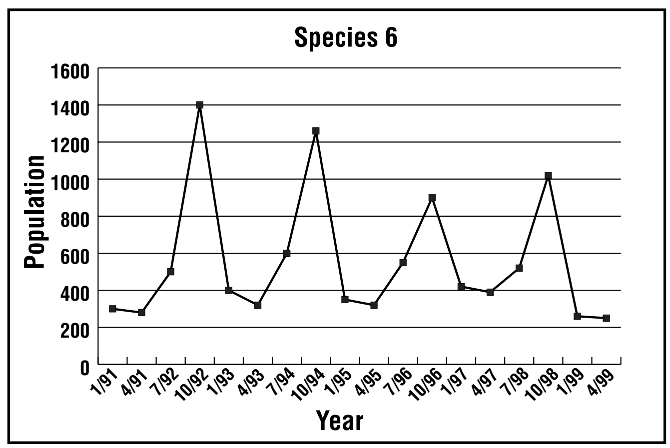
d. Species 4: Cerulean Warbler (*The population is declining over time.*)



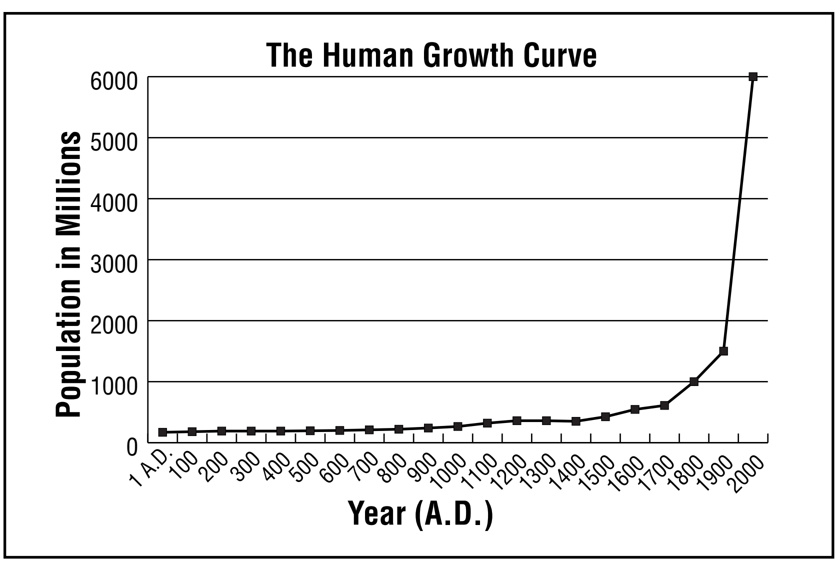
e. Species 5: Bacteria X (2nd population) (*The population stabilizes because although bacteria are being supplied with new nutrients, they are growing in a finite area.*)



f. Species 6: Eastern Cottontail (*The population shows large annual spike, and rabbits are capable of multiplying rapidly when conditions allow.*)



Part 3:



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The Pop Ecology Files—Student Worksheet

Part 1: Measuring Growth

1. If you had $100 and added $10 to it the first year and each successive year, how much money would you have...
a. After 5 years?
b. After 10 years?

Start	1	2	3	4	5	6	7	8	9	10
$100	$110									

c. Create a line graph to show your money's growth over 10 years.
This is arithmetic growth - growth that results from a constant rate of change over time.

2. If instead you had $100 and it grew by 10% each year, your money would be growing on an ever-increasing base. How much money would you have...
a. after 5 years?
b. After 10 years?

Start	1	2	3	4	5	6	7	8	9	10
$100	$110									

c. Using the graph above, add a second line to show how this money would grow over 10 years.
This is exponential growth, growth that results from a constant percent rate of change over time. Populations tend to grow the same way. Because the base population is always increasing, population grows exponentially, as long as there are sufficient resources. Without sufficient resources, a population would exceed its carrying capacity and decline.

3. Jefferson Middle School has 1000 students. A new housing development is being built nearby, and it is predicted that that the school population will increase 10% each year for seven years. How many students will there be in the school in seven years?

Start	1	2	3	4	5	6	7
1000							

Part 2: The Naturalist's dilemma

Your aunt left a stack of her papers with you while she was traveling in the wilderness. These papers include important population data that she has gathered on the species she's studied over the years. She's due back in town today, so you want to give her papers back to her, but they've gotten all mixed up. You have the data, and you know the list of species, but you can't tell what data goes with what species. By graphing the population data for each species, you'll be able to sort it all out.

Species list:

Species	Background	Where studied
Bacteria X (1st population)	A common bacteria found in soil.	Studied in a laboratory test tube over the course of several weeks.
Cerulean Warbler	This tiny migratory forest bird may be added to the endangered species list.	Central Maryland, over several years.
Bristlecone Pine	This slow-growing tree species can live several thousand years.	Eastern California, over several years.
Eastern Cottontail	The common fast-breeding rabbit from the eastern United States.	Central Ohio, over several years.
Red Fox	One of several predators on the cottontail rabbit.	Central Ohio, over several years.
Bacteria X (2nd population)	A common bacteria found in soil.	Studied in a laboratory test tube over several weeks. New nutrients provided regularly.

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Pop Ecology Files—Student Worksheet

Population data:

Species 1		Species 2		Species 3		Species 4		Species 5		Species 6	
Date	Pop	Date	Pop	Date	Pop	Date	Pop	Date	Pop	Date	Pop
Year 1	245	1/1/91	80	Day 1	2	5/91	236	Day 1	2	1/1/91	300
Year 2	243	4/2/91	35	Day 3	5	7/91	402	Day 3	5	4/2/91	280
Year 3	246	7/3/92	35	Day 5	10	5/92	221	Day 5	10	7/3/92	500
Year 4	250	10/1/92	45	Day 7	25	7/92	380	Day 7	25	10/1/92	1400
Year 5	247	1/2/93	75	Day 9	100	5/93	198	Day 9	100	1/2/93	400
Year 6	245	4/2/93	40	Day 11	350	7/93	324	Day 11	350	4/2/93	320
Year 7	250	7/1/94	38	Day 13	1000	5/94	187	Day 13	1000	7/1/94	600
Year 8	252	10/2/94	48	Day 15	2000	7/94	298	Day 15	1500	10/2/94	1260
Year 9	248	1/2/95	82	Day 17	4000	5/95	150	Day 17	1700	1/2/95	350
Year 10	250	4/2/95	40	Day 19	8000	7/95	267	Day 19	1850	4/2/95	320
Year 11	247	7/1/96	39	Day 21	10000	5/96	144	Day 21	1950	7/1/96	550
Year 12	245	10/1/96	45	Day 23	3000	7/96	254	Day 23	2000	10/1/96	900
Year 13	244	1/2/97	60	Day 25	1500	5/97	142	Day 25	2000	1/2/97	420
Year 14	243	4/2/97	41	Day 27	750	7/97	233	Day 27	2000	4/2/97	390
Year 15	248	7/2/98	38	Day 29	100	5/98	132	Day 29	2000	7/2/98	520
Year 16	248	10/1/98	53	Day 31	50	7/98	206	Day 31	2000	10/1/98	1020
Year 17	247	1/3/99	73	Day 33	25	5/99	122	Day 33	2000	1/3/99	260
Year 18	250	4/1/99	38	Day 35	10	7/99	152	Day 35	2000	4/1/99	250

4. Create line graphs for the six mystery species above. Consider how to scale the axes before you begin. Then, use the background descriptions to match the graphs with the species.

a. Species 1 =
Why?

b. Species 2 =
Why?

c. Species 3 =
Why?

d. Species 4 =
Why?

e. Species 5 =
Why?

f. Species 6 =
Why?

Part 3: the Human Growth Curve:

5. Now, plot the growth curve for humans, using data from the last 2000 years.

Year	1A.D.	200	400	600	800	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	1930	1960	1975	1987	1999
Pop. (In Millions)	170	190	190	200	220	265	320	360	360	350	425	545	610	1000	1500	2000	3000	4000	5000	6000

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