

2010 2011

Ecology Unit: Population Growth Activities (Objective #2)



Mrs. Engelbrecht
MCHS Biology
2010 2011

Ecology—Population Growth

Objective 2

2A. I can classify examples of factors that limit a population's growth as either density-independent or density-dependent.

2B. I can predict what will happen to a population's size if the following occur: emigration, immigration, changes in birth rates and death rates.

2C. I can interpret two different graphs of population growth: exponential population growth and logistic population growth.

Vocabulary Practice

density-independent factor

density-dependent factor

emigration

immigration

birth rate

death rate

exponential population growth

logistic population growth

carrying capacity

Vocabulary Cards

A. Get nine (9) index cards—one for each of the vocabulary words above. Split one side of each card to make it look like the diagram below. Write each word above in the **center box** of each card. Then, for each word, write what is in each box for each word. You may use markers or colored pencils to make your vocabulary cards aesthetically pleasing. Use your textbook, one of Mrs. E's textbooks, or a dictionary to help you.

Book definition	Your definition in your own words
WORD	
Picture of the word	(Word) is NOT _____ because _____.

B. Lay all of your vocabulary cards out on your desk. Decide which words go together (are connected). Put them into groups by moving those words near each other on your desk.

C. For each group you made, get a blank index card. For each group, write WHY those words go together (a category name) on a blank card, and place it above each group.

D. Share your groups with the people at your table. Have them show you're their categories, too! Make any changes you want at this time to what words go in each group and your categories.

E. On a separate sheet of paper and USING ALL OF THE WORDS, summarize how all of the words are connected. Use your categories to help you connect the groups of words, and then write connections between EACH word. Keep this summary; you'll need it after the reading activity that follows.

Reading For Understanding—Practice

A. Read the truly riveting passage below about population growth. If, while reading, you are asked to do something, then do it.

B. As you are reading, underline any definitions of vocabulary words you find. Change your vocabulary cards if you need to if you realize you got something wrong on your cards as you read.

C. Mark the following as you read:

DGT = I don't get this. I had to re-read this to try and understand it.

!! = I am surprised to find this out

?? = I have a question about this (write your question in the margin)

D. Discuss what you marked and any changes you made after your table is done reading the passage below. Have your table help you answer your questions and clarify what you don't get.

The Ups and Downs of Population Growth

A population is a group of organisms of the same species that live in a certain area. Ecologists regularly monitor the number of organisms in many populations, but why do they do this? Why do we care if the number of organisms in an area is growing or shrinking? Well, populations that are growing and shrinking can be indicators of potential problems occurring in the organisms' environment, and gives ecologists a "heads up" if something is going wrong. But it is not enough to simply know if the number of organisms in an area is going up or going down; ecologists need to know why the number of organisms is fluctuating. So, one of the main questions ecologists ask themselves is this: Why is a population's size is going up or going down?

There are many factors that can cause a population's size to change. But first, you must understand the basic reasons behind why a population grows or shrinks. Any population, whether it be humans, chipmunks, the mold growing on bread, or the bacteria living in your intestines, will grow if more organisms are being created, or born, than are dying. If a population has more organisms dying than are being born, then the population will shrink. The number of births in a population is called the **birth rate** (also referred to as natality). The number of organisms that are dying in a population is called the **death rate** (also referred to as mortality). Thus, if the birth rate is greater than the death rate, a population will grow. If the death rate is greater than the birth rate, then the population will decrease in size.

Stop and Think #1:

- a) The human population is currently growing at an exponential rate. What does this mean about our birth and death rates?
- b) The Mantled Howler Monkey (found in Mexico and South America) is currently considered an endangered species. What does this mean about its birth and death rates?

While populations would probably like to continue to grow in size, a population of organisms cannot grow forever—its growth will be limited, or stopped, at some point, and the death rate will be greater than the birth rate. A population's growth is limited by two general factors: **density-independent factors** and **density-dependent factors**. Why are these factors named in such a complicated way? Well, actually, these names aren't as complicated as they seem; in fact, they can even help you remember what each of the terms means.

To understand why scientists named these factors in the way they did, you must first understand the concept of **population density**. A population's density is NOT whether or not the population will float or sink (they would probably sink. . .resulting in a lot of tragic, needless organism deaths). Population density refers to how many organisms there are in one particular spot. If a population's density is very high, that means there are a lot of organisms crowded into a certain area. If a population's density is low, that means there are very few organisms in an area.

Now that you know about population density, we can talk about the difference between the two types of limiting factors. If a factor that stops a population's growth is influenced by the population's density, then it is called a density-dependent limiting factor. If the population's density does not influence whether or not the factor stops the population's growth, then it is called a density-independent limiting factor.

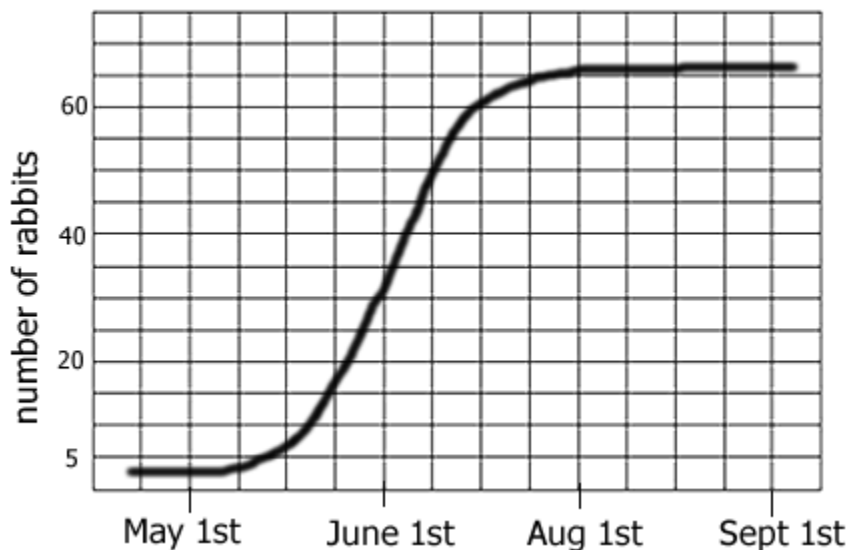
Stop and Think #2: Imagine a population of skunks. Yes, skunks. Imagine that the skunks are reproducing at a very high rate, and the skunk population is growing rapidly—especially in the field behind Mrs. E's house.

- a) List a possible density-independent factor that could stop the skunk population's growth.
- b) List a possible density-dependent factor that would limit the skunk population's growth.

Revise your answers as you read more about density-independent limiting factors and density-dependent limiting factors

Density-independent limiting factors that can stop a population from growing can be such things as natural disasters, temperature, sunlight, and the activities of humans in the environment. Natural disasters such as tornadoes, floods, and fires will stop a population from growing no matter how many organisms are living in a certain area. The same goes for the temperature of an area and the amount of sunlight an area receives—if the temperature increases due to global warming, or if the ash kicked up into the atmosphere from an asteroid smashing into the earth blocks out a lot of sunlight for a few decades, these will both cause a decrease in a population’s numbers, no matter how large or small the population was to begin with. Human activities that alter the environment will also decrease the amount of organisms in a population, no matter the size of the population.

Density-dependent limiting factors come into play when a population reaches a certain number of organisms. Thus the number of organisms in the population matters when talking about density-dependent limiting factors. For example, when a population reaches a certain size, there won’t be enough resources (food, shelter, water) for all of the organisms. This could cause the population to stop growing when it reaches the maximum number of organisms that can be supported, or “carried,” by the environment. This number is known as the population’s **carrying capacity**. Each population of organisms has a different carrying capacity, depending on the area in which it lives and the amount of resources available in that area. Below is a graph of a rabbit population that has reached its carrying capacity:



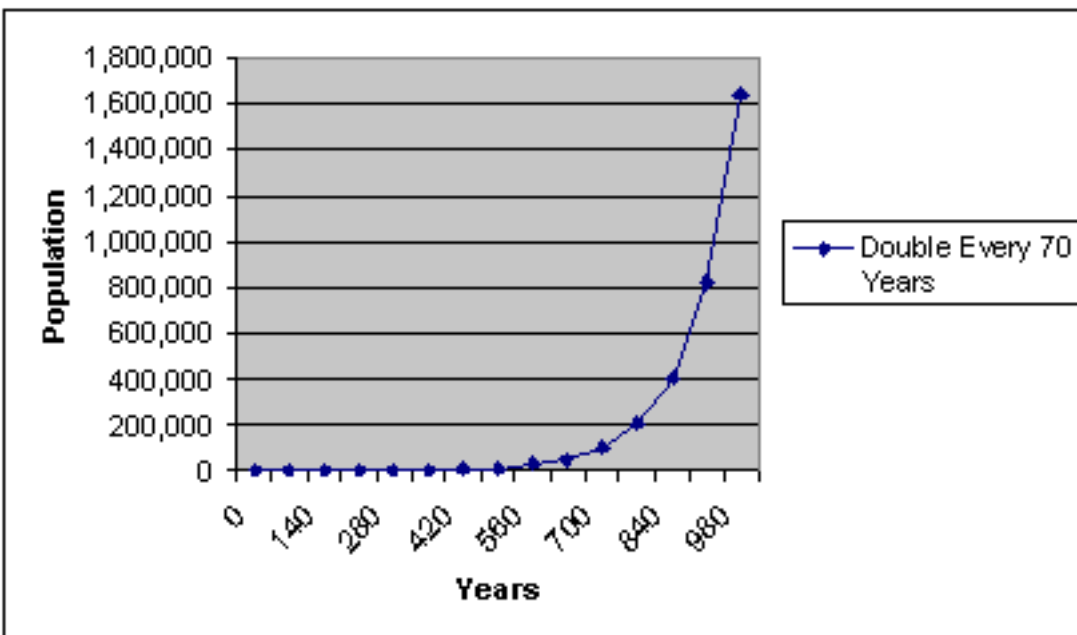
This type of population growth is called **logistic population growth**; it represents what actually occurs as a population’s numbers get too large for the environment to support it. While the number of rabbits in the population increased rapidly at first, its growth began to slow down towards the end of August. Once the population numbers leveled off, roughly equal numbers of rabbits were dying as being born.

Stop and Think #3: Study the graph on the previous page carefully.

- a) What is the rabbit population's carrying capacity? _____
- b) The population of rabbits between mid-May and mid-June is growing as fast as: (circle one)
- a turtle walking (super slow.) a student running late to class (fast!)
you walking to class (slow.) Mrs. E running away from a mountain lion (super fast!)
- c) What about the graph led you to circle the answer you chose in letter b?

Revise your answers (if necessary) as you read more about population growth.

Before a population reaches its carry capacity, it experiences a period of rapid growth. This period of growth is called **exponential population growth**, because, mathematically, the population is adding organisms at an exponential rate. During this time period, there are plenty of resources available for all organisms, so more organisms are being born than are dying. The graph for exponential population growth looks sort of like the graph for logistic population growth, only without the flat "leveling off" line at the end of it:



Stop and Think #4:

a) Fill in the differences chart below:

density-independent limiting factor	density-dependent limiting factor
logistic population growth	exponential population growth

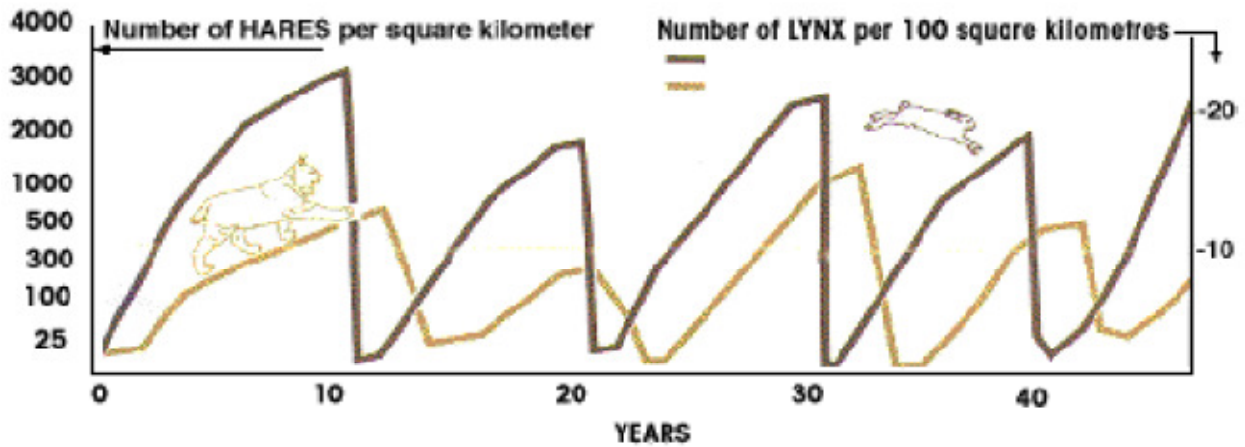
b) The human population is currently growing at an exponential rate. Since you have learned that populations cannot grow forever, what are some things (more than one!) that could happen when the human population reaches its carrying capacity?

Revise your answers as you read further, if necessary.

The amount of resources is not the only limiting factor that depends on a population's density. Diseases and parasites can limit a population's growth once the population reaches a certain number of organisms. The more organisms there are, the faster a disease can spread or a parasite can be transferred to another organism because there are more available hosts that are near each other. Competition for resources—either between the same species or two different species—will also decrease a population's size. Resources are limited in any habitat, and, when populations reach a certain size, there will not be enough to go around. When two organisms in the same habitat are trying to use the same resource, they are competing for that resource. Whichever organism has the better adaptations to obtain that resource will be able to reproduce more often, and their population will grow. The organism that is not successful at competing for the resource will not reproduce as often, and their population will decrease.

Predation is another density-dependent limiting factor seen in populations. When lots of prey is available, predators will eat the prey, have energy to reproduce, and their numbers will increase. The population of their prey will begin to decrease as more and more of them are eaten. However, the predator population will eventually reach carrying capacity—there will not be enough prey for all of the predators in the population, since the predators themselves are competing for their “prey” resource. As the number of prey decreases, so will the number of predators, because there isn't enough food to go around. As the number of predators decreases, that means the prey have time to reproduce and increase their population. Thus,

predator-prey populations go through cycles of population growth, which is shown in the graph below between lynx (predator) and snowshoe hares (prey):



Graph taken from the following website: http://www3.gov.ab.ca/srd/fw/watch/rabb_cycles.html 9/30/02
 Courtesy of Alberta Sustainable Resource Development
 © 2002 [Government of Alberta](http://www3.gov.ab.ca)

Stop and Think #5:

a) Pretend the graph on the previous page is the data you obtained after doing your own lab, and you are filling out the lab write-up form. You get to the part of the form where you have to fill out your results sentence. Using the data in the graph to guide you, fill out the results sentence below:

As the number of lynx increases, the number of snowshoe hares: _____.

b) Using what you know from the reading and from the graph, give a scientific explanation for the results sentence you completed above. (Remember: a "2" is simply repeating what's in the reading. A "3" would involve using what's in the reading and using the graph above as an example. A "4" would involve using what's in the reading, using the graph above to help you explain it, and giving a new example or an analogy.)

A scientific explanation for these results is:

One last density-dependent limiting factor that stops a population from growing is emigration. Emigration occurs when, as a population approaches carrying capacity, individual organisms from the population leave and go to a new area where they can find enough resources for survival and reproduction. This, obviously, will cause a decrease in the amount of organisms in a population. You may have heard of a word that has the exact opposite meaning and effect on population size—immigration.

Stop & Think #6:

- a) Knowing that immigration is the opposite of emigration, what does immigration mean?
- b) Will immigration cause populations to increase or decrease in size? _____
- c) Using Marengo as an example, give an example of immigration and emigration's effects on the population of humans in Marengo.

Making Connections—Understanding How Words & Concepts Fit Together

A. Choose ONE of the options below:

1. Make a concept map on poster paper that includes ALL of the words. Make sure it has a central idea, includes all the words, and has all connectors labeled.

A “2” will show me you just know what the words mean. A “3” will show me you know what the words mean, and understand the basic connections between all the words.

A “4” will show me what a “3” does, but will also add words, examples, or analogies to demonstrate an in-depth mastery of the concepts.

2. Get a blank jigsaw puzzle. Choose either a level “3” understanding puzzle, or a level “4” understanding puzzle.

→ Using all the words, write the words in the puzzle pieces. If you place two or more words next to each other, they must have a connection!

→ Write the connections between the words along the borders between two connected jigsaw puzzle pieces.

→ Draw a picture of each word in its puzzle piece.

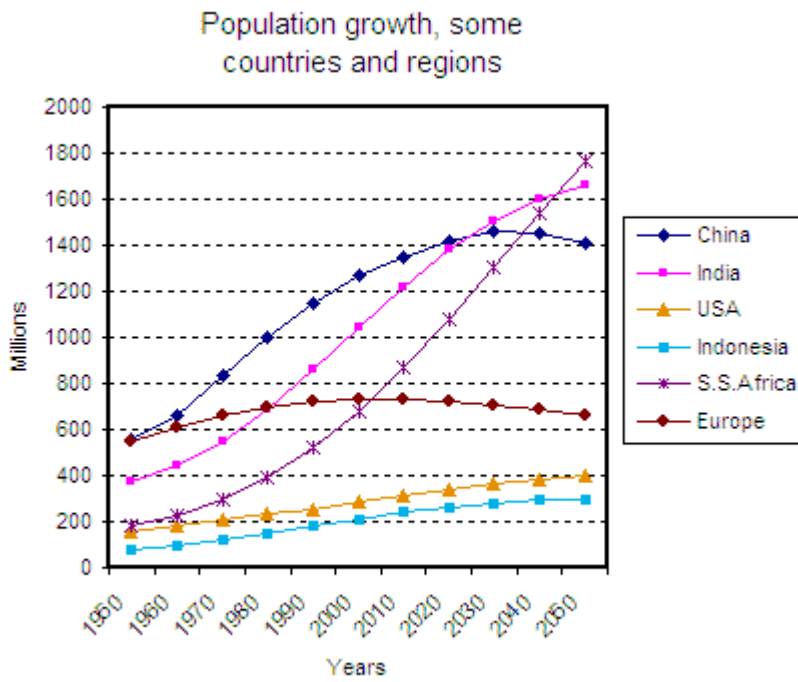
B. Get out your summary that you wrote from your vocabulary cards. Change or revise your summary in any way you see is necessary. Use your concept map or your jigsaw puzzle to help you. Share your summary with the people at your table when you are finished.

Working Towards Mastering the I Can Statements—Practice

1. Read each situation in the chart below. Then, state if it is a density-independent limiting factor or a density-dependent limiting factor. Then, state the specific limiting factor that is occurring. The first one is done for you as an example.

Situation	Density-independent, or density-dependent?	Limiting Factor:
Mrs. Engelbrecht has 32 students assigned to her Biology class, but she only has room for 28. Because the room is so crowded, the extra 4 students leave the room to go to Guidance and have their schedules changed.	density-dependent	emigration
Northern pike (it's a fish) feed on another fish, the yellow perch. An increase in the yellow perch population causes an increase in the northern pike population.		
The BP oil spill in the Gulf of Mexico has harmed many aquatic organisms that live in the Gulf region.		
A new strain of influenza (the flu) breaks out in New York City.		
A population of rabbits and a population of deer are both feeding off the same plants in the same habitat.		
Hurricane Katrina forced thousands of people to leave New Orleans.		
65 million years ago, a large asteroid collided with the Earth. As a result, large amounts of ash were ejected into Earth's atmosphere.		
Due to humans putting increasing amount of greenhouse gases into the atmosphere and cutting down trees that would normally take up some of those gases, the Earth slowly gets warmer and changes climates around the globe.		

2. Study the graph below:



a. Which country looks like it is experiencing exponential growth? _____

b. Which country looks like it has reached its carrying capacity? _____

Because it has reached its carrying capacity, describe the relationship between its birth rates and death rates in the space below:

c. Describe what is happening to Europe's population size in terms of birth rates and death rates.

d. Which country or countries could be experiencing:

• emigration: _____

Explain your answers here:

• immigration: _____

Explain your answers here:

3. Read the CAUSE on the left hand side of the table below. Then, predict the EFFECT of the cause in the right-hand column. For the last one, fill in the CAUSE portion of the table.

CAUSE	EFFECT
During the 1920s, many Eastern European people leave their countries to come to the United States.	
During the 1920's, many Eastern European people enter the United States.	
Many more babies were born in the post-World War II era than in the pre-World War II era.	
China imposed a "one child only" policy in 1979 which is still in effect today.	
Seals are hunted for their meat and fur in some regions, resulting in many deaths of seals.	

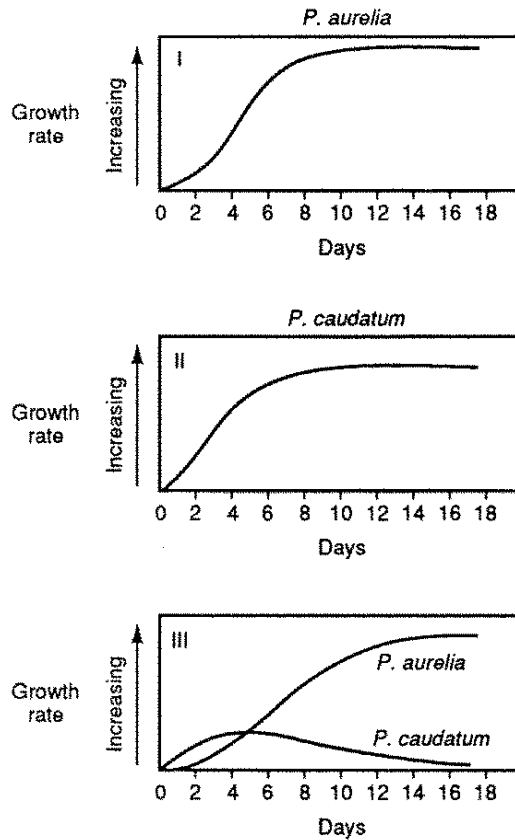
Have some extra time and want to see if you can do this at a "4"? You could do the following in the space below:

A. Do some research (use Mrs. E's books or a textbook) and look up other examples of immigration, emigration, and how birth and death rates affect population growth. Then, construct your OWN chart just like the one above.

B. Do the same thing as letter A, only this time create a chart where the EFFECTS are filled in, and someone else has to come up with the CAUSES.

**If you have time to do either of these, show them to your instructor.

4. Graph I shows the growth curve for a culture of *Paramecium aurelia*, a type of microscopic, unicellular protist. Graph II shows the growth curve for a culture of *Paramecium caudatum*, a larger species of the same protist. Graph III shows the growth curves of both species when they are grown together.



a. What type of population growth is shown in Graphs I and II, when each protist is in its own jar? _____

Explain how you know:

b. Study Graph III (the bottom graph) very carefully. It shows what happens when you put both populations of paramecia in the same jar.

Why did the population of *P. caudatum* decrease, but the population of *P. aurelia* increase?

Look at your answer above. Go back and add if what occurred was a density-independent limiting factor, or a density-dependent limiting factor. Then, explain why it is the factor you chose.

5. Go get your netbook. After logging in, open up Open Office Calc (which is like Microsoft Excel). Use the program to construct a graph of the data below:

Use the data below to graph the population of white-tailed deer

YEAR	POPULATION SIZE			
	WINTER	SPRING	SUMMER	FALL
1	100	114	95	102
2	98	111	89	75
3	80	88	87	90
4	93	101	104	98
5	105	114	107	105
6	110	120	112	105
7	109	103	98	94
8	96	100	92	86
9	75	90	93	96

a. What type of growth is shown by this white-tailed deer population? _____

Explain how you know:

b. What is the white-tailed deer's carrying capacity? (Give the range that it falls into):

Between _____ and _____.

c. Predict what could be causing the white-tailed deer population to reach its carrying capacity:

d. Adjust the data for the SPRING so that the graph of that data looks like a graph of exponential population growth. Show your graph to your instructor before moving on.

6. Fill out the differences chart below. Make sure your differences are specific enough to tell me that you truly understand, but don't write me a novel. Also, make sure your differences match!

birth rate	death rate
density-independent limiting factor	density-dependent limiting factor
A farmer spraying crops with pesticides	Necrotizing fasciitis (what you get if you come in contact with flesh-eating bacteria)
exponential population growth	logistic population growth

Level 4 Thinking Practice

Write analogies for the words below. Remember, analogies take two seemingly unrelated things and make a connection between them. Think outside the “science box” for these!

a. Density-independent limiting factors are like: _____ because _____.

b. Density-dependent limiting factors are like: _____ because _____.

c. Exponential population growth is like _____ because _____.

d. Logistic population growth is like _____ because _____.

Demonstrating Mastery of the I Can Statements

Score yourself on how well you have mastered the I can statements using the rubric below:

Population Growth	0 = No evidence	1 = Beginning	2 = Progressing	3 = Proficient	4 = Advanced
2A. I can classify examples of factors that limit a population's growth as either density-independent or density-dependent.					
2B. I can predict what will happen to a population's size if the following occur: emigration, immigration, changes in birth rates and death rates.					
2C. I can interpret two different graphs of population growth: exponential population growth and logistic population growth.					

- 1) Take the Exit Ticket provided by your instructor.
- 2) Check your answers when you are finished.
- 3) Mark whatever you did not get correct on your exit ticket.
- 4) Re-rate yourself on how well you have mastered the I can statements in the rubric above.
- 5) Staple this page to the back of your Exit Ticket and turn it in to your period's box.