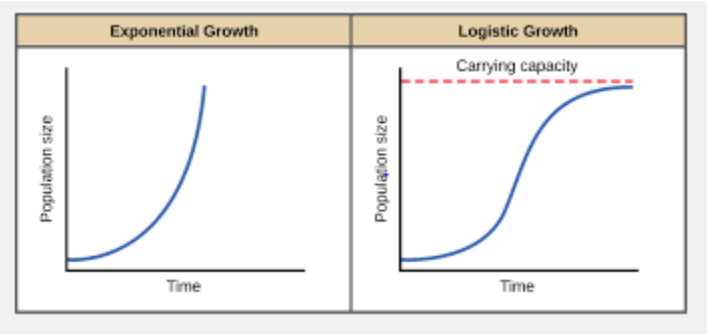
Name: _____ **Period:** _____

How Does Competition Affect Population Growth?

Background Information

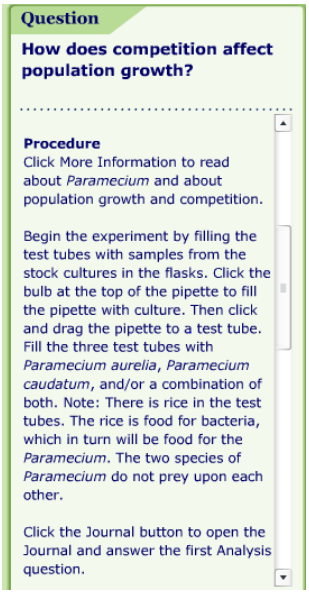
The genus *Paramecium spp.* consists of unicellular species of protists that live in freshwater environments. Under ideal conditions - enough food, water, and space - populations of these species grow rapidly and follow a pattern known as **exponential growth**. Exponential growth is explosive population growth in which the total number of potentially reproducing organisms increases with each generation. However, populations of organisms will not increase in size forever. Eventually, limitations on food, water, and other resources will cause the population to stop increasing.

When a population arrives at the point where its size remains stable, it has reached the carrying capacity of the environment. The **carrying capacity** is the greatest number of individuals a given environment can sustain. Competition for resources among members of a population (intraspecific competition) places limits on population size. If a population grows this way, they grow logistically **(logistic growth).**



Competition for resources among members of two or more different species (interspecific competition) also affects population size. In a classic series of experiments in the 1930s, a Russian ecologist, G.F. Gause, formulated his principle of **competitive exclusion**. This principle states that if two species are competing for the same resource, the species with a more rapid growth rate will outcompete the other. In other words, no two species can occupy the same niche (niche is defined as the feeding job of an organism).

In competing populations of organisms, genetic variations that reduce competition are favored through natural selection. Suppose two species (A and B) compete for the same food source. Individuals of species A can also use another food source, which reduces the competition over the food source needed by species B. The individuals of species A that can use another food source survive because they do not have to compete with individuals of species B for that food. In nature, organisms frequently invade unoccupied habitats simply to avoid intense competition. Once the organism is in a new habitat, any variations that allow it to use the available resources will tend to be perpetuated through the population. In this way, the genetic makeup of the population may slowly change, and the species will become adapted to a new niche.



Go to: http://www.mhhe.com/biosci/genbio/virtual_labs/BL_04/BL_04.html . Work through the virtual lab, following the steps carefully listed on the left side of the web page. Input data from the virtual lab in the data table below. Ignore the journal entry questions.

Make a Prediction:

1. What kind of growth pattern do you think both species of *Paramecium spp.* follow?

2. What is your hypothesis for the test tube where the two species of *Paramecium spp.* are grown together in experiment that we are about to simulate?

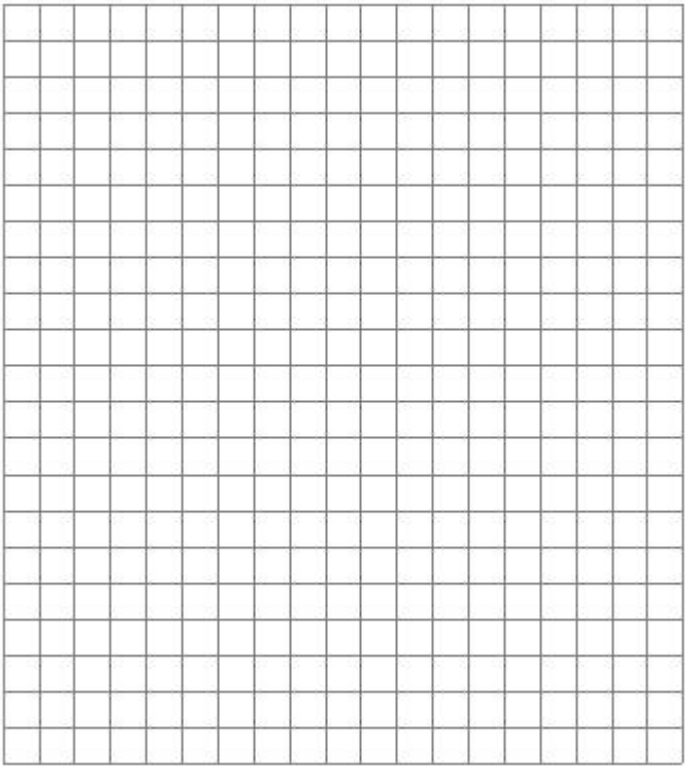
Objectives:

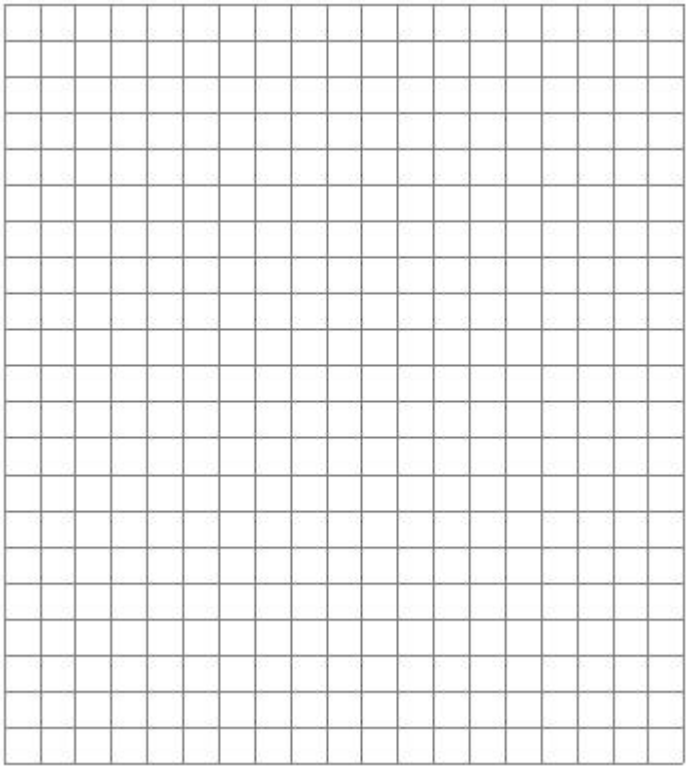
- Demonstrate how competition for natural resources in the environment can affect population growth.
- Explain how availability of resources, such as food in an environment, can limit the growth of a population.

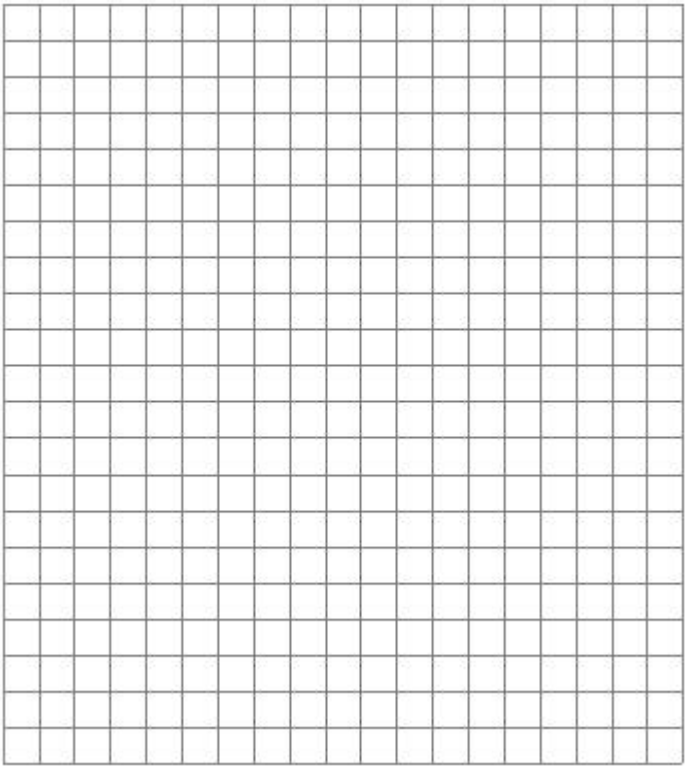
Observations/Data: Multiply the count by two so that you get the estimate for cell/mL correct.

Data Table				
	P. caudatum grown alone, cells/mL	*P. aurelia* grown alone, cells/mL	*P. caudatum* grown in mixed culture, cells/ mL	*P Aurelia* grown in mixed culture, cells/mL
Day O				
Day 2				
Day 4				
Day 6				
Day 8				
Day 10				
Day 12				
Day 14				
Day 16				

Graphing The Results:







How to Calculate An Average:

$$\frac{\text{Add up all numbers}}{\text{How many numbers}} \qquad \frac{72 + 81 + 60}{3} = 71$$

Mean (Average) Calculations

Analysis: Answer the questions below using complete sentences.

1) What are the objectives for this experiment?

2) On what day did the *Paramecium caudatum* population reach the carrying capacity of the environment [when they are grown alone]? How can you tell (what is the evidence)?

3) On what day did the *Paramecium aurelia* population reach the carrying capacity of the environment [when they are grown alone]? How do you know (what is the evidence)?

4) Explain the differences in the population growth patterns of the two *Paramecium* species. What does this tell you about how *Paramecium aurelia* uses available resources?

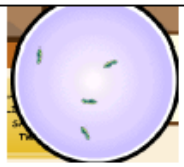
5) Describe what happened when the Paramecium populations were mixed in the same test tube. Do the results support the principle of competitive exclusion? (You may need to briefly explain what competitive exclusion is)

6) Explain how this experiment demonstrates that no two species can occupy the same niche.

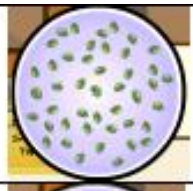
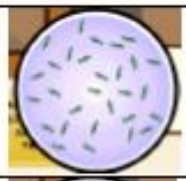
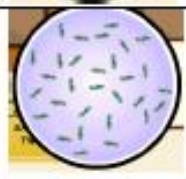
7) Propose a mechanism/process in which two species who have the same niche can live in the same area at the same time.

8) How does competition for natural resources in the environment affect population growth?

9) Explain how availability of resources, such as food, are limiting for populations. What else could be limiting?

Day	*P. caudatum (grown alone)*	*P. aurelia (Grown Alone)*	*P. caudatum & P. aurelia (Mixed culture)*
Day 0			
Day 2			
Day 4			

Microscope Observations (If Virtual Lab Not Working or No Internet Connection Available in Class)

Day 6		
Day 8		
Day 10		
Day 12		
Day 14		
Day 16