ONLINE LAB: POPULATION BIOLOGY

How does competition affect population growth?

The genus *Paramecium* consists of unicellular species of protists that live in freshwater environments. Under ideal conditions-sufficient 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.

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 **principal 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 out-compete the other*. In other words, no two species can occupy the same niche.

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.

Objectives:

- Demonstrate how competition for natural resources in the environment can affect population growth.
- Explain how availability of resources, such as food, can be limiting for populations.

Procedure:

Part 1: Begin the experiment by filling the test tubes with sample from the stock cultures in the flasks.

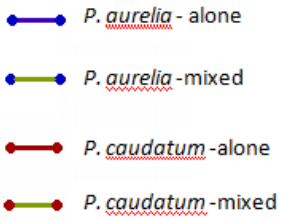
1. Click the bulb at the top of the pipette to fill the pipette with culture.
2. Then click and drag the pipette to a test tube.
3. Fill the 3 test tubes with *Paramecium aurelia*, *Paramecium caudatum*, and a combination of both

Note: There is rice on the bottom of each test tube. The rice is food for bacteria, which in turn will be food for the *Paramecium*. The 2 species of *Paramecium* do not prey upon each other.

Part 2: 1.Click the microscope on the back shelf.

2. Click the clean microscope slides box.
3. Click the Take Sample test tubes.
4. Click and drag one wet mount to the stage of the microscope.
5. Count the number of cells of each type of *Paramecium* and record on your data table.
   Click on the **Grid On** button for help with counting.
6. Then click and drag the next microscope slide and count the number of *Paramecium*. Then do the same for the 3rd slide.
7. When finished with the 3 slides, then click on the blue **Clear Slides** button.
8. Then click on the day calendar to change the date by 2 days.
9. Then repeat steps 1 through 7.
10. Repeat all these steps until you have finished day 16.

Part 3: Graph your data. Use 3 colored pencils. Color the *P. aurelia* blue dots and *P. caudatum* red dots
Use the same color when connecting the points when the paramecia are alone.
Use the 3rd color green to connect the points when they are mixed.



Part 4: Answer the questions.

Name _____ Hour _____
Biology I Date _____

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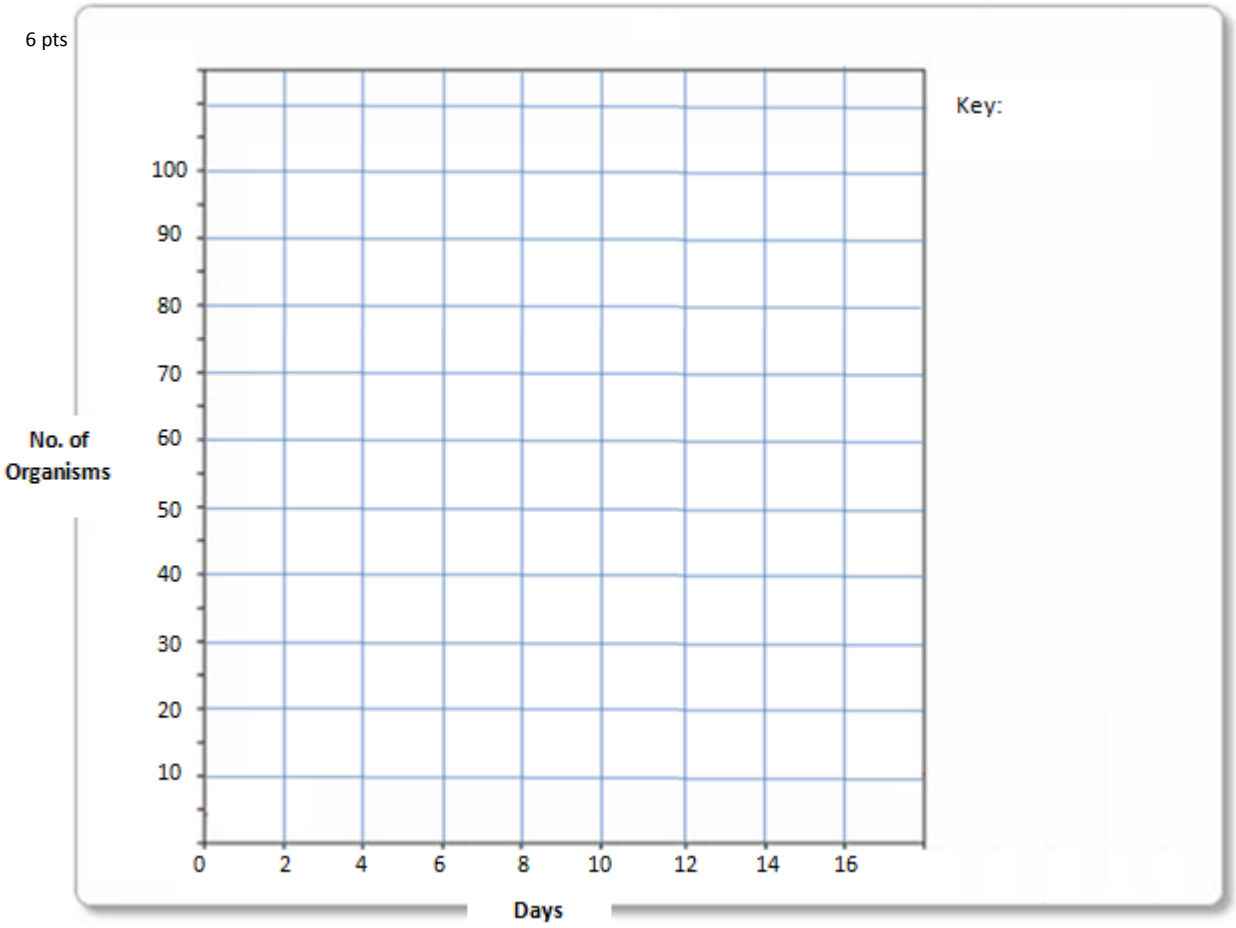
Data Table:

4 pts

	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 0				
Day 2				
Day 4				
Day 6				
Day 8				
Day 10				
Day 12				
Day 14				
Day 16				

Graph

6 pts



Questions:

1. On what day did the *Paramecium aurelia* population reach the carrying capacity of the environment? How do you know? (1 pt)

2. On what day did the *Paramecium caudatum* population reach the carrying capacity of the environment when it was grown alone? How do you know? (1 pt)

3. Which of the paramecia were more successful alone? (½ pt) _____

4. Which of the paramecia were more successful when mixed? (½ pt) _____

5. What happened to the *Paramecium aurelia* population when mixed with the *Paramecium caudatum* population? (½ pt)

6. What happened to the *Paramecium caudatum* population when mixed with the *Paramecium aurelia* population? (½ pt)

7. What is the *principle of competitive exclusion* state? (1 pt)

8. Do the results support the principle of competitive exclusion? (½ pt) _____

9. What did both paramecia eat? (½ pt) _____

10. Explain how this experiment demonstrates that no two species can occupy the same niche. (1 pt)