**Virtual Lab: Population Growth** Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
 Date \_\_\_\_\_\_\_ Period \_\_\_\_

**Background:**

**How does competition affect population growth?**

The genus *Paramecium* 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.

**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 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://glencoe.mheducation.com/sites/dl/free/0078759864/383928/BL_04.html> to access the virtual lab.

**Thinking About This:**

1. What kind of growth pattern do both species of Paramecium follow? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
   \*\*We expect a somewhat slow start and then a very rapid increase in number.

**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 0 |  |  |  |  |
| Day 2 |  |  |  |  |
| Day 4 |  |  |  |  |
| Day 6 |  |  |  |  |
| Day 8 |  |  |  |  |
| Day 10 |  |  |  |  |
| Day 12 |  |  |  |  |
| Day 14 |  |  |  |  |
| Day 16 |  |  |  |  |
| Analysis | | | | |
| 1. Summarize the objectives for this experiment. | | | | |
| 2. Make a hypothesis about how you think the two species of Paramecium will grow alone and how they will grow when they are grown together. | | | | |
| 3. Explain how you tested your hypothesis. | | | | |
| 4. On what day did the *Paramecium caudatum* population reach the carrying capacity of the environment when it was grown alone?  How do you know? | | | | |
| 5. On what day did the *Paramecium aurelia* population reach the carrying capacity of the environment when it was grown alone?  How do you know? | | | | |
| 6. Explain the differences in the population growth patterns of the two Paramecium species when they are grown alone.  What does this tell you about how *Paramecium aurelia* uses available resources? | | | | |
| 7. Describe what happened when the Paramecium populations were mixed in the same test tube.  Do the results support the principle of competitive exclusion? | | | | |
| 8. Explain how this experiment demonstrates that no two species can occupy the same niche. | | | | |

**Graphing the Results**: Create 3 separate line graphs; one for each experiment. You should have a graph for *P. caudatum* grown alone, one for *P. aurelia* grown alone, and one graph for the two populations grown in a mixed culture. Your graph for the mixed culture should have TWO lines (one for each species).

**Reflection**: In this lab you examined how competition works on a microscopic scale. Would you expect to observe different patterns in your data if the scale of the system were enlarged (i.e. a pond instead of test tubes)? Would you expect to observe different results if the scale of the organisms were enlarged (i.e. macroscopic organisms instead of microscopic organisms)?