# Assignment Summary

For this assignment, you will construct and analyze the population graph of a species using principles and mathematical models of population ecology.

Background Information

Population ecology is a subdiscipline of ecology that involves studying the dynamics of species populations and how these populations interact with the environment. Population ecologists study how ecological factors influence the density, dispersion, and size of species populations. Ecologists group ecological factors as either abiotic or biotic. The term abiotic describes the nonliving chemical and physical components of an ecosystem, such as water and temperature. The term biotic describes living components of an ecosystem, such as plants and animals. How these factors interact with a species determines how much its population can change over time.

When studying the possibilities of why a population size has changed, ecologists pinpoint which ecological factors that interact with the species are possibly limiting the population size. Many factors can limit a population, and they can be further categorized as either density independent or density dependent. Density-independent limiting factors limit a population regardless of its growth or size. They are most often random events such as storms or droughts that affect the population by chance. Density-dependent limiting factors limit the population growth or size based on the number of individuals that exist in the area. These factors are typically those that determine the constant, daily survival of the species population, such as food, water, shelter, and competition. These factors also determine the carrying capacity of a species in a particular ecosystem. Carrying capacity can best be described as the maximum number of individuals in a species that the ecosystem can support. When the population of a species overshoots its carrying capacity, the density-dependent limiting factors will eventually drive the population size back down.

When a population has reached its carrying capacity, its growth can best be mathematically modeled through a logistic growth curve. This is different from, and more sustainable than, exponential growth in an ecosystem. With exponential growth, a population per capita growth stays at a constant rate regardless of the population size. This results in a population that grows faster as it gets larger. Logistic growth, on the other hand, involves a population per capita growth that gets smaller as the population becomes larger. This is because density-dependent limiting factors, such as food, limit the population from growing exponentially, resulting in an S-shaped curve. Ecologists explore these two models through the general equation for population growth.



Materials

* Writing and drawing supplies (colored pencils, paper, etc.)
* Access to the internet, lesson, Student Guide, and other reference materials

# Assignment Instructions

For this project, you are expected to submit the following:

1. A completed version of this guide, featuring your labeled diagrams and written analysis

**Step 1: Prepare for the project.**

1. Read through the guide before you begin so you know the expectations for this project.
2. If anything is unclear to you, be sure to ask your teacher.

**Step 2: Complete Activity 1.**

1. Using Table 1, graph the population numbers for populations A and B.
2. Label all necessary components of the graph.

**Step 3: Complete Activity 2.**

1. Using Table 1, calculate the growth rate for both mice populations between two data points.
2. Show your work and your final answer in the table.

**Step 4: Complete Activity 3.**

1. Using the data from Activity 1 and your work from Activity 2, identify one biotic factor and one abiotic factor that could be causing the different growth rates between the two populations.
2. Explain how the biotic and abiotic factors affect the two populations in different ways.

**Step 5: Complete the questions in the Written Analysis section.**

**Step 6: Evaluate your project using this checklist.**

If you can check each box below, you are ready to submit your project.

* Did you graph Table 1 in the graphing space in Activity 1?
* Did you label necessary components in the graph?
* Did you calculate the population growth rate for both mice populations in Activity 2?
* Did you show your work and are your answers clearly written in the table in Activity 2?
* Did you identify one abiotic factor and explain how that affects both mice populations in Activity 3?
* Did you identify one biotic factor and explain how it affects both the mice populations in Activity 3?
* Did you answer the **Written Analysis** questions?

**Step 7: Revise and submit your project.**

1. If you were unable to check off all of the requirements in the checklist, go back and make sure that your project is complete. Be sure to save your project before submitting it.
2. Turn in your completed student guide to your teacher. Make sure that your name is on it.
3. Congratulations! You have completed your project.

Activity 1: Graphing Population Data

Researchers collected data on the effects of environmental factors on population growth of two different mice populations. Both populations belong to the same species; however, these populations can be found in different habitats. The habitat of population A is a desert area with rocks and small shrubs across the landscape. The habitat of population B is a sandy beach with little vegetation or aboveground rock formations. This particular species of mice reproduces a new generation every two months. Table 1 shows the population data collected for every generation produced for 10 generations.

Table 1: Number of Individuals in Mice Populations A and B for 10 Generations

|  |  |  |
| --- | --- | --- |
| **Generation** | **Mice Population A** | **Mice Population B** |
| 1 | 251 | 248 |
| 2 | 349 | 276 |
| 3 | 556 | 323 |
| 4 | 956 | 401 |
| 5 | 1,432 | 502 |
| 6 | 2,100 | 631 |
| 7 | 3,200 | 980 |
| 8 | 4,500 | 1,300 |
| 9 | 6,834 | 1,875 |
| 10 | 9,701 | 2,560 |

Graph the data from Table 1 in the space below.



Activity 2: Calculating Population Growth

Select a time frame between two generations. Calculate the growth rate between the two generations for populations A and B.

|  |  |
| --- | --- |
| **Mice Population A** | **Mice Population B** |
| Show your work here: | Show your work here: |
| Final growth rate: | Final growth rate: |

Activity 3: Population Data Analysis

Using Table 1 from Activity 1 and your work from Activity 2, compare the population numbers and growth rates between mice populations A and B.

In the table below, identify a difference in one abiotic factor and one biotic factor that might cause the differences seen in the growth rates between these two populations. Beside each factor, explain how that factor is affecting both populations in different ways.

|  |  |
| --- | --- |
| **Factor** | **Explanation** |
|  |  |
|  |  |

Written Analysis

Answer the questions below.

1. Review the graph you produced in Activity 1. Using the graph, which population is growing more rapidly? Explain how you know.
2. Suppose population A reaches carrying capacity in its ecosystem. Predict what effect that would have on its population numbers and population growth rate using Table 1 and your calculated growth rate.
3. Suppose there is predator-prey relationship between an owl population and population A. After population A reaches carrying capacity, predict the consequential effect that would have on the owl population. In your answer, include what was reasonably occurring to the owl population before and what would happen after (assume that no other factor is limiting the owl population, and the main food source is mice).