

Topic: Population Growth Rates Lab

Summary: Students participate in an activity that models a population of rabbits. Students learn how density-dependent factors affect a population size.

Goals & Objectives: Students will be able to explain how exponential and logistic growth rates affect population size. Students will be able to predict how density-dependent factors like competition for resources and predators control population growth.

NGSS Standards:

HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

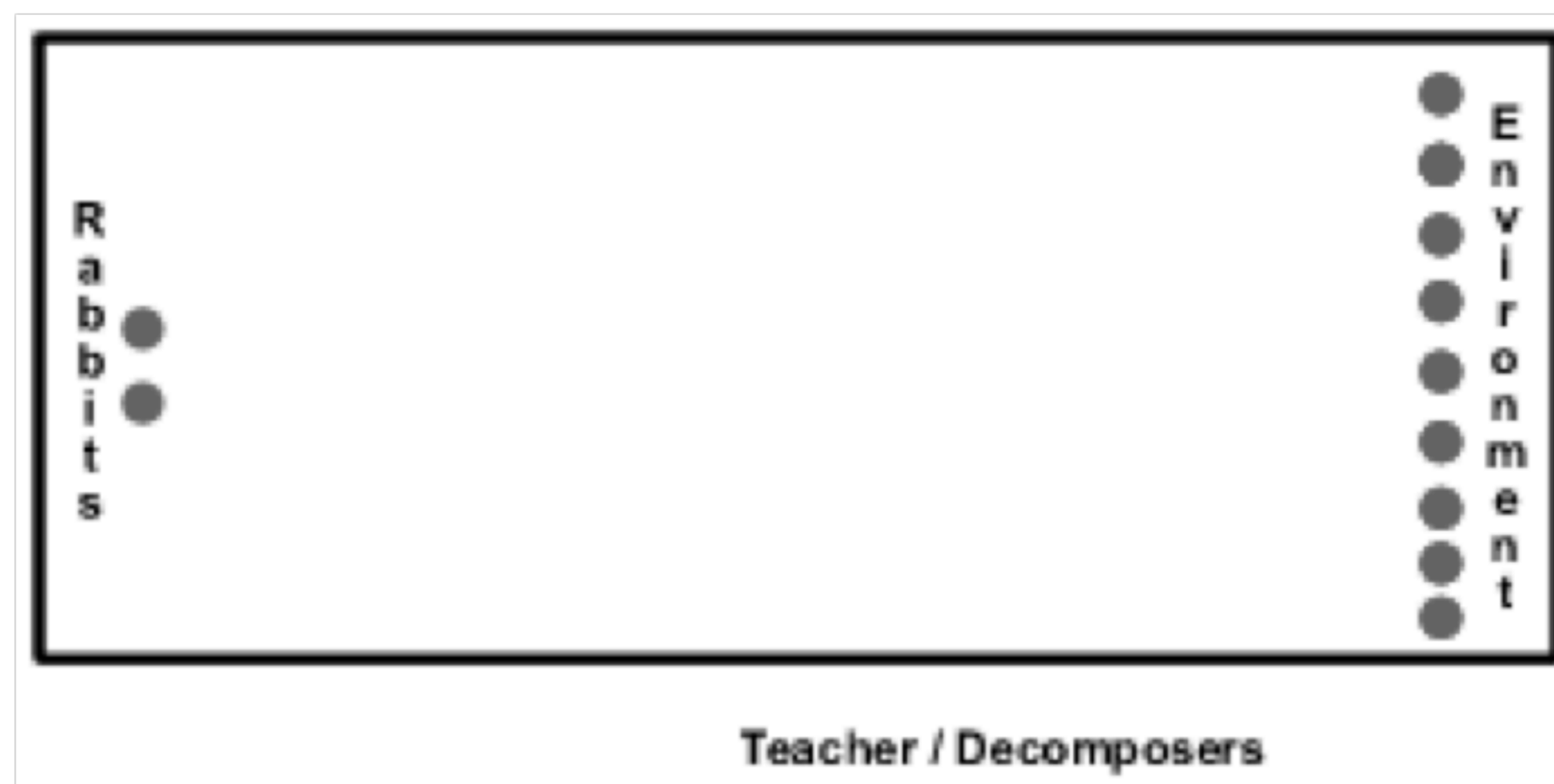
Time Length: 90 minutes

Materials:

- Grass field or blacktop with a distance of at least 20 meters
- Good weather for students to run
- Clipboard and lesson plan for recording data

Procedures:

1) The class is going to mimic how a population of rabbits grows based upon the resources in the environment and predators. On a grass field outside, *two* students will stand on one side and face students about 30 meters away. The side with two students will represent rabbits and the other side will represent resources in the environment. The teacher will stand on the side and will be the decomposing area.



- 2) The teacher will tell the predator to face away from the environment and the environment to face away from the rabbits. The teacher will then tell the environment group to choose the resource they want to be and the rabbit group which resource they are searching for. Students choose their resource kinesthetically by making a triangle over their head (shelter), hand over their mouth (water) and hand over their stomach (food).
- 3) Once a student has chosen a resource, they cannot change it. The teacher will then tell the environment group to turn around and face the rabbits. The environment group needs to maintain showing their resource. The teacher will then tell the rabbits to turn around and run towards the environment, and in particular the resource, they chose. Rabbits must run straight and once they reach the environment, they tag the resource they chose and stop. Rabbits may not run around in the environment area searching for their resource.
- 4) If a rabbit tags a resource, the rabbit survives and reproduces one offspring. The tagged environmental person will become a rabbit in the next generation. If a rabbit does not tag the resource they were searching for, they die and go to the decomposer section. Decomposers go to the environment after one generation. If a resource is not tagged, they stay where they are at for the next generation.
5. Students repeat this procedure for 10 generations. Count the number of rabbits/environment before you tell the students to “go.” Record the numbers in the data table.
6. On the 9th generation, introduce a fox. Have one student from the decomposers become a predator of the rabbits. The fox stands where the teacher stands and goes on the same “go” as the rabbits. The fox then tries to tag as many rabbits as possible before they reach the environment. If the fox tags one rabbits, the fox lives. Each additional rabbit becomes a fox in the next generation (round). Record the number of foxes in the data per generation.

Accommodations: Students who are not able to participate can record the data and not participate in running or being a resource. Students with an IEP can take the handout home if they need extra time, not graph the data, or not calculate the exponential and logistic growths for the populations.

Editable DOCX File and Answer Key:

Available at www.ngsslifescience.com

Population Growth Rates Lab

Driving Question: How do density-dependent limiting factors affect the population size of rabbits.

Hypothesis: If a population is affected by density-dependent factors, then its rate of growth will represent a _____ growth curve.

Materials: Grass field, graph paper, nice weather for students to run.

Procedure Summary:

Rabbits: Face away from the environment group and choose an environmental resource. Run and tag the corresponding resource on the environment side. If you tag the resource, you live and go back to the rabbit section for the next generation. If you do not tag a resource, you die and decompose (stand next to the teacher).

Environmental Resource: Face away from the environment group and choose which resource you want to be (shelter, food or water). If a rabbit tags you, you will become a rabbit in the next generation. If no rabbits tag you, you stay as a resource for the next generation.

Decomposers: Stand next to the teacher for the next generation. Go to the environment side after one turn (generation).

Foxes: Stand next to the teacher. Run and tag as many rabbits as possible when the teacher says “go.” If you tag one rabbit, you survive. If you tag more than one rabbit, they become a fox in the next generation.

Data Table:

Generation	Rabbit Population	Environment Amount	Fox Population
1	2		0
2			0
3			0
4			0
5			0
6			0
7			0
8			0
9			0
10			1
11			
12			
13			
14			
15			
16			

Graphing:

Create a three-line graph with population size on the y-axis against number of generations on the x-axis. Use a key and graph rabbit, environment and fox populations. Predict the carrying capacity of the rabbits by drawing a dotted line to represent the carrying capacity.

Limiting Factor Questions 1-3. Determine if the scenario involves a density dependent limiting factor or a density independent limiting factor.

1) In this lab, competition and predation were a _____ limiting factor of population size.

2) Drought is a _____ limiting factor that can affect the abundance of both food and water resources.

3) If a parasite introduced a new rabbit disease, what kind of limiting factor would this be? _____

Carrying Capacity Question 4-5. Give examples of density dependent and independent factors and how they influence the rabbit carrying capacity for each scenario.

4) Explain how the fox in this activity affected the carrying capacity of the rabbits once it was introduced. _____

5) Predict and explain what would happen if you started with the same two rabbits on an island that had 100 times the environmental resources. _____

Population growth rate = $\Delta N / \Delta T$ (change in population size divide by change in time). Use the data table for questions 6-8. *Show all your work.*

6) What was the rabbit population growth rate from generation 1 to generation 5?

7) What was the rabbit population growth rate from generation 6 to generation 10?