

**Topic:** Carrying Capacity Lab

**Summary:** Students will experience how competition for resources will be a limiting factor on an organism's growth rate.

**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.

**Time Length:** 60 minutes

**Prerequisite Knowledge:** population growth, carrying capacity, limiting factors, growth rate calculations

$$\frac{\Delta n}{\Delta t} = \frac{\text{change in population size}}{\text{change in time}}$$

**Materials:**

- Plastic spoon, 1 per student
- Paper or plastic cup, 1 per student
- 100 beans
- 2 cookie sheets
- Teacher clipboard, timer

**Lab Setup:**

Being outside is best for kids to run around. Distribute one plastic spoon and a cup per student. Each student writes their name on the cup. Place 50 beans on a flat cookie sheet. Repeat for a second cookie sheet. Place the two cookie sheets in the center, but not next to each other.

Take a clipboard, pencil and these procedures to record bird population data for the students.

**Procedures:**

1. Have all the students circle around the two cookie sheets with an equal distance of about 15 to 20 feet away. The goal is that the students create a circumference around the food. All students put their cup on the ground representing the circumference.
2. Start with one student. One student runs into the center and using their spoon, picks up as many beans as they can with their spoon. That student then runs back to their cup with the beans in their spoon. This repeats until the 15 seconds is up.

Rules:

- The student may not use their other hand.
- If he/she drops the beans, they have to go back and get more beans.

3. Have the student(s) count the number of beans in their cup.

4. The student(s) survive if they can eat 6 or more beans. The student(s) have one baby per six beans in their cup. For example:

- 6-11 beans in cup = one new student next generation
- 12-17 beans in cup = two new students next generation
- 18+ beans in cup = three new students next generation
- 0-5 beans = your bird dies and no longer participates in the next generation

5. Students return their beans to the same cookie sheet to bring its total back to 50 beans each.

6. Repeat from procedure 1 but this time two students go. Record the number of students participating at the beginning of each generation below.

Generation	Bird Population
1	1
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

7. Have students use Excel, Google sheets, etc or paper and pencil to create a line graph of the data. Show the class the graph.

**Accommodations:** Students who are not able to participate can record the data and not participate in being a bird. Students may take the handout home if they need extra time and/or not graph the data.

**Editable DOCX File and Answer Key:**

Available at [www.ngsslifescience.com](http://www.ngsslifescience.com)

## Carrying Capacity Lab

### Goal:

Pretend you are a bird and your beak is a spoon. Your goal is to eat as many beans (worms) as you can within 15 seconds.

### Procedures:

1. Have all the students circle around the two cookie sheets with an equal distance of about 15 to 20 feet away. The goal is that the students create a circumference around the food. All students put their cup on the ground representing the circumference.

2. Start with one student. One student runs into the center and using their spoon, picks up as many beans as they can with their spoon. That student then runs back to their cup with the beans in their spoon. This repeats until the 15 seconds is up.

### Rules:

- The student may not use their other hand.
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- 0-5 beans = your bird dies and no longer participates in the next generation

5. Students return their beans to the same cookie sheet to bring its total back to 50 beans each.

6. Repeat from procedure 1 but this time the surviving student(s) and new students go; determined in step 4.

**Data:** Copy the data from the teacher into the data table below.

Generation	Bird Population
1	1
2	
3	
4	
5	
6	
7	
8	
9	

10	
11	
12	

Using a spreadsheet, recreate the data table and graph the data. Paste your digital graph below or staple the paper graph to the back of this activity. Draw a dotted line representing the carrying capacity from generation 8-12.

**Analysis:**

*Population growth rate =  $\Delta N / \Delta T$  (change in population size divide by change in time).*

- Using the data table, calculate below the growth rate from generation 1 to generation 5.

**Show your work**

- What kind of growth curve was between generation 1 and generation 5? \_\_\_\_\_
- What is it called when a population stops growing and then maintains that population size?  
\_\_\_\_\_
- What factors affected the bird's carrying capacity from generation 8-12? \_\_\_\_\_  
\_\_\_\_\_
- Is this limiting factor density dependent or independent? \_\_\_\_\_
- Pretend the activity was repeated with 1000 beans in the cookie sheets, how would the food resource being the limiting factor affect the bird's carrying capacity from generation 8-12?  
\_\_\_\_\_
- Pretend the activity was repeated again but you have to change a different limiting factor (not number of beans), what limiting factor would you change, would the limiting factor be density dependent or independent, and how would it affect the bird's carrying capacity from generation 8-12? \_\_\_\_\_  
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