Population Limits Lab

Name _____

Date _____

Period _____

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Every population can grow fast when nothing holds it back. But no population grows forever. In this lab you will find what holds four real populations back. A **limiting factor** is anything that keeps a population from growing bigger.

☐ I can use a pond model's numbers to tell exponential (J-curve) growth from logistic (S-curve) growth.

☐ I can use the St. Matthew Island reindeer numbers to explain overshoot and a population crash.

Part 1. Duckweed pond (Tab 1)

SEP 4, 5 · CCC Scale, Proportion, and Quantity

Set each row below, then press **Skip to the end**. The **Your runs** box keeps the numbers.

1. Fill in the table.

Settings	Plants on day 10	Plants on day 30	Curve: J (keeps shooting up) or S (levels off)?
Limits OFF · 200 m² · normal			
Limits on · 200 m² · normal			
Limits on · 400 m² · normal			
Limits on · 200 m² · fertilizer runoff			

2. With limits on at 200 m², the plants level off near _____. This number is the pond's _____. Population density on day 30: _____ plants ÷ 200 m² = _____ plants per m².

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then answer 3 and 4.

3. A bigger pond and fertilizer runoff both raised the carrying capacity. Name the two **limiting factors** this shows.

4. Turn on **Early frost** . It kills 6 of every 10 plants, crowded or not. Is frost **density-dependent** or **density-independent** ? How do you know?

Part 2. Reindeer island (Tab 2, St. Matthew Island)

SEP 2, 4 · CCC Stability and Change

Press **Run** and watch the island, the reindeer line and the lichen line. The black dots are the real counts.

5. Compare the model to the real counts.

Year	1957	1963	1966
Real count	1,350	about 6,000	42
Model			

6. Highest count: _____ reindeer ÷ 128 square miles = _____ per square mile. The carrying capacity line is about _____. The herd grew to about _____ times the carrying capacity.

7. Lichen left in 1963: _____%. Uncheck **The hard winter** . Reindeer in 1966: _____. Hard winter back on, check **Wolves on the island** . Highest count: _____ Curve, J or S: _____ Lichen left in 1990: _____%.

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then answer 8 and 9.

8. Use the words **carrying capacity** and **overshoot** . Why could the herd grow so far past what the island could feed? Use your lichen number.

9. (a) Was the real limit the winter or the food? Use your no-winter number and **density-dependent** or **density-independent** . (b) Why did the lichen last with wolves?

☐ I can use survival numbers to find a range of tolerance and say why too much or too little limits.

☐ I can match survivorship curves to r- and K-selected species and say which is most at risk.

Part 3. Trout tanks (Tab 3)

SEP 3 · CCC Cause and Effect

Every tank starts with 20 brook trout. Only the pH is different. Run all 30 days.

10. Write how many trout are alive in each tank on day 30.

pH	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Alive													

11. Check **Show the zones on the graph** . Optimum range: pH _____ to _____. Zones of stress: pH _____ to _____ and pH _____ to _____. No trout survive at pH _____ and _____.

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then answer 12 and 13.

12. Why is this experiment good evidence that pH **caused** the trout to die?

13. Acid rain has pushed some Adirondack lakes down to about pH 4.8. Use the **range of tolerance** and your tank numbers to predict what happens to brook trout in those lakes.

Part 4. Life strategies (Tab 4)

SEP 4, 6 · CCC Patterns

Run **Survivorship**, then **Recovery**. Use the **Life facts** box too.

14. Fill in the three number columns now. Leave the last two columns for after the Learn It box.

Species	Alive at 10%	Alive at 50%	Years to recover to 90%	Curve type: late, constant or early loss	r or K?
Black bears					
American robins					
Yellow perch					

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then fill in the last two columns of Q14 and answer 15.

15. A disease kills most of the animals in all three populations in one year. Which species is most likely to go extinct? Use **r-selected** or **K-selected** , your recovery numbers and one fact from the Life facts box.

Wrap it up

SEP 6, 7 · CCC Stability and Change

16. Claim: No population can grow forever. Give **evidence** from two different tabs. Then give your **reasoning** : what do the limits have in common?

NYSSLS: building toward HS-LS2-1, HS-LS2-2 and HS-LS2-6 (DCI LS2.A Interdependent Relationships in Ecosystems; LS2.C Ecosystem Dynamics). Environmental Science, Chapter 5, Lesson 5.3: What Limits the Growth of Populations? Tags: SEP = Science and Engineering Practice, CCC = Crosscutting Concept.