LESSON MAKER PRO

Creek Population Forecasts

Use a model to test how human actions change ecosystems.

HIGH SCHOOL · HS-ENV1-2

HS-ENV1-2 "Use a computational representation to illustrate that humans are part of Earth's ecosystems and how human activities can, deliberately or inadvertently, alter ecosystems."

NAME _____ DATE _____

MODEL ONE SEASON AT A TIME

Use N_next = (1 + r)N - H + S, where N is the current population, r is its growth rate, H is the number people remove, and S is the number people add. To model another season, use the previous season's result as the new N. A human activity can also change r by changing habitat, so compare scenarios to estimate its effect.

WORKED EXAMPLE

A pond starts with 48 fish. For one season, r = 1/4, H = 13, and S = 0. What population does the model predict?

1. Calculate growth: (1 + 1/4) × 48 = 60.
2. Account for human actions: 60 - 13 + 0 = 47.

Answer: 47 fish

PRACTICE 6 problems

1 A stream starts with 80 fish. For one season, r = 1/10, H = 5, and S = 0. Find the predicted population.

ANSWER _____

2 A pond starts with 60 fish. For one season, r = 1/5, H = 0, and S = 9. Find the predicted population.

ANSWER _____

3 A lake starts with 100 fish. In each of two seasons, r = 1/5, H = 14, and S = 0. Find the predicted population after each season.

ANSWER _____

4 A pond starts with 90 fish. After one season with r = 1/3 and S = 0, the model predicts 108 fish. How many fish did people remove?

ANSWER _____

5 Use the model inputs in the table. After one season, how many fewer fish does the road salt runoff scenario predict? Does runoff increase or decrease the modeled population?

STREAM SCENARIOS FOR ONE SEASON

Scenario	Starting fish N	Growth rate r	Removed H	Added S
Clean water	64	1/8	4	0
Road salt runoff	64	0	4	0

ANSWER _____

6 A pond starts with 75 fish. People remove 6 fish and add none. The model predicts 84 fish after one season. Find r as a percent.

ANSWER _____

APPLY IT Show your work

1 Students help restore a creek where 64 minnows live. The table shows two possible growth rates. No minnows are removed or added. After two seasons, how many more minnows does the model predict with restoration than without it?

CREEK HABITAT SCENARIOS

Scenario	Growth rate r each season
With restoration	1/2
Without restoration	1/8

ANSWER _____

2 A teen fishing league tracks a lake with 120 fish and r = 1/10 each season. During season 1, anglers catch 12 fish and no fish are added. During season 2, a conservation group adds 5 fish. What is the greatest number anglers can catch in season 2 if the modeled population must finish at 115 fish or more?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A creek starts with 100 fish, and no fish are added. The table shows two model scenarios. Find each scenario's population after season 2 and the difference between them. Then explain why the difference does not prove that runoff caused every real-world population change.

TWO-SEASON CREEK SCENARIOS

Scenario	Season	Growth rate r	Removed H
Runoff, then cleanup	1	0	10
Runoff, then cleanup	2	1/5	8
No runoff	1	1/5	10
No runoff	2	1/5	8

WORK SPACE AND ANSWER

Creek Population Forecasts

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A stream starts with 80 fish. For one season, r = 1/10, H = 5, and S = 0. Find the predicted population.	**83 fish**
2	A pond starts with 60 fish. For one season, r = 1/5, H = 0, and S = 9. Find the predicted population.	**81 fish**
3	A lake starts with 100 fish. In each of two seasons, r = 1/5, H = 14, and S = 0. Find the predicted population after each season.	**After season 1: 106 fish. After season 2: 113.2 fish.**
4	A pond starts with 90 fish. After one season with r = 1/3 and S = 0, the model predicts 108 fish. How many fish did people remove?	**12 fish**
5	Use the model inputs in the table. After one season, how many fewer fish does the road salt runoff scenario predict? Does runoff increase or decrease the modeled population?	**8 fewer fish. Runoff decreases the modeled population.**
6	A pond starts with 75 fish. People remove 6 fish and add none. The model predicts 84 fish after one season. Find r as a percent.	**20%**

PART 2 · APPLY IT

1. **63 more minnows** With restoration, the model predicts 64 → 96 → 144 minnows. Without restoration, it predicts 64 → 72 → 81, so the difference is 144 - 81 = 63.
2. **22 fish** Season 1 ends with (11/10) × 120 - 12 = 120 fish. In season 2, 132 - H + 5 ≥ 115, so H ≤ 22.

CHALLENGE

Runoff, then cleanup: 100 fish after season 2. No runoff: 124 fish after season 2. The difference is 24 fish. This is a model prediction, not proof of cause, because other factors that affect survival may not be included.

Accept equivalent calculations and percent forms, including r = 0.20 in problem 6. Fractional fish in problem 3 are a model output, not a literal head count.