

Checking Riley's Notes: Cycles, Counts and Who Decides

Learning target: I can find and explain errors in claims about predator-prey records, human population data, per capita calculations and how solutions are chosen, and rewrite each claim so it is accurate.

Error analysis

About 40 min

Pairs

MS-LS2-5 · practice

MS-ESS3-4 · supports

MS-ETS1-2 · supports

writing

discussion

independent practice

Standards connections

MS-LS2-5 (practice): Notes 7 and 8 and q7 ask students to judge how competing solutions should be evaluated and who makes the final choice, correcting the idea that science alone or cost alone decides. This builds the evaluation reasoning assessed in W6 and W9.

MS-ESS3-4 (supports): Students correct outdated population numbers and a per capita error using real UN data. In California this is a Grade 8 performance expectation; it is background here and no argument about Earth's systems is assessed.

MS-ETS1-2 (supports): Note 7 describes the test-compare-revise process correctly; students must recognize it as accurate, which supports later systematic evaluation of designs.

Purpose: practice · **Time:** about 40 minutes · **Format:** pairs

Answers with reasoning

Riley's notes

Riley's study notes (copied exactly)

Note	What Riley wrote
1	The fur records PROVE that lynx cause the hare crashes, because the lynx peak always comes after the hare peak.
2	Pelt counts tell us exactly how many hares and lynx were alive each year.
3	There are about 7 billion people on Earth, and the population is growing faster every single year.
4	The human population will crash soon, just like the hares, because all populations cycle.
5	Per capita water use in Riverside (50,000 people, 7,500,000 liters a day) = $7,500,000 \times 50,000 = 375,000,000,000$ liters per person.
6	In Long Island Sound, the algae used up the oxygen by doing photosynthesis.
7	A town should test its solution, compare the results with its goals, and change the design if it falls short.
8	Scientists should choose which solution a town uses, because science tells you the right answer.

Fact box: evidence Riley could have checked — Hare experiment (Yukon, Krebs and others, 1995): compared with an unchanged forest block, fencing out mammal predators gave about 2 times as many hares, adding food about 3 times, and doing both about 11 times. **Fur records:** count animals trapped and traded; the number depends on trappers, effort and fur prices as well as on the animals. **World population (United Nations):** 7 billion in 2011, 8 billion in 2022, about 8.2 billion in 2025; each billion since 1974 has taken 11 to 13 years; the next is projected around 2037; the population is projected to peak at about 10.3 billion in the mid-2080s, mainly because families are having fewer children. **Photosynthesis:** releases oxygen. **Decomposition:** bacteria use oxygen as they break down dead matter.

Part A: Diagnose

1. For each note, write 'correct' or 'error'. If it is an error, name what went wrong in a few words (for example: 'treats a pattern as proof', 'out-of-date number', 'wrong operation').

Answer: Note 1: error (treats a pattern and a lag as proof; experiments show food matters too). Note 2: error (pelts count animals trapped, not all animals alive). Note 3: error (out-of-date number; the percentage growth rate has been falling since the 1960s). Note 4: error (overgeneralizes; human growth is slowing because of lower birth rates and is projected to level off). Note 5: error (multiplied instead of dividing). Note 6: error (photosynthesis releases oxygen; bacteria decomposing dead algae use it up). Note 7: correct. Note 8: error (science informs the decision but people decide, weighing economic and social criteria as well as scientific ones).

Why: Seven notes contain errors and one (note 7) correctly describes the test-compare-revise process.

Also acceptable: Note 1 may be described as 'correlation is not causation' or 'ignores food'. Note 4 may be described as 'assumes people are limited like hares'.

- Note 7 marked correct
- At least six of the seven errors identified
- A specific mistake named for each error

Part B: Rewrite

2. Rewrite note 1 so it is accurate. Use the hare experiment numbers from the fact box.

Answer: Example: In the fur records, lynx peaks usually come a year or two after hare peaks, which fits the idea that lynx respond to their food. But the pattern alone cannot prove what causes the crashes. In an experiment, fencing out predators gave about 2 times as many hares, adding food about 3 times, and both together about 11 times, so predators and food both matter and work together.

Why: The rewrite should keep the real pattern, drop the word 'prove', and use the experiment to show that both causes matter.

Also acceptable: Accept 'predation is a major cause, but food also matters' if supported by the numbers.

- Removes the claim of proof
- Uses at least two of the experiment numbers
- Concludes that predators and food both matter

3. Rewrite note 2 so it is accurate, and give one reason a pelt count could rise even if the number of animals did not.

Answer: Example: Pelt counts show how many animals were trapped and traded, which rises and falls with the real populations but is not an exact count. A count could rise without more animals if more trappers worked that year, fur prices were high so trappers tried harder, or hungry lynx moved more and were easier to catch.

Why: A pelt record is an index, not a census.

Also acceptable: Accept 'records from more trading posts were added that year'.

- States that pelts measure animals trapped, not all animals alive
- Gives one valid reason a count could rise without more animals

4. Rewrite note 3 with accurate, dated numbers. Then explain how the population can still be rising while it is not 'growing faster every single year'.

Answer: Example: The world population reached 8 billion in 2022 and was about 8.2 billion in 2025 (UN estimates). It is still rising, but each billion since 1974 has taken about 11 to 13 years, and the next is projected to take about 15. The total keeps growing because more people are added each year than die, but the percentage growth rate has been falling, so growth is not speeding up.

Why: The total and the rate are different quantities. Adding a roughly steady number of people to a larger population means a falling percentage rate.

Also acceptable: Accept 'more than 8 billion' with a date of 2022 or later.

- Uses 8.2 billion (2025) or 8 billion (2022) with a date
- Distinguishes a rising total from a falling growth rate
- Uses the years-per-billion evidence

5. Rewrite note 4. Explain what the United Nations projects and why, and why a human population does not have to follow a hare-style boom and crash.

Answer: Example: The UN projects that the population will keep rising until it peaks at about 10.3 billion in the mid-2080s and then level off or decline slightly, mainly because families in many countries are having fewer children. Hares crash when food runs out and predators catch up; people grow and trade food and have no major predator, so a crash is not expected, although projections can change.

Why: Human population change is driven mostly by birth and death rates that people influence; it is not locked to a predator-prey cycle.

Also acceptable: Accept answers that mention projections are uncertain and could be higher or lower.

- States the projected peak and its approximate timing
- Gives falling birth rates as the main reason
- Explains why people do not follow the hare cycle

6. Redo note 5 correctly. Show the operation and give the answer with units. Then explain in one sentence how you can tell Riley's answer is impossible.

Answer: $7,500,000 \text{ L} \div 50,000 \text{ people} = 150 \text{ liters per person per day}$. Riley's answer is impossible because 375 billion liters is far more than the whole town uses; a per-person amount must be smaller than the town's total.

Why: Per capita means dividing a total by the number of people.

Also acceptable: Accept '150 L/person/day'.

7. Rewrite note 6 so it describes what really uses up the oxygen in the Sound's bottom water.

Answer: Example: Algae release oxygen when they photosynthesize. Extra nitrogen made the algae grow fast; when they died and sank, bacteria decomposing them used up the oxygen in the bottom water, so lobsters, fish and oysters could not get enough.

Why: This corrects the same error the textbook makes on p. 398.

Also acceptable: Accept mention of respiration at night as a smaller oxygen drain.

- Photosynthesis releases oxygen
- Bacterial decomposition of dead algae uses up oxygen
- Places the problem in bottom water or links it to nitrogen

8. Rewrite note 8. Explain what science **can** do when a town compares solutions and what science **cannot** do. Then name the three kinds of criteria a town should weigh.

Answer: Example: Science can measure the problem, predict what each solution is likely to do, and test whether a solution is working. Science cannot decide which outcome a community values most, such as jobs versus wildlife or cost versus fairness. People make that choice. A town should weigh scientific criteria (effects on biodiversity and ecosystem services), economic criteria (costs and income) and social criteria (fairness, health, acceptance and traditions).

Why: The lesson's final section stresses that science informs decisions but does not tell people what to do.

Also acceptable: Accept 'voters and leaders decide' as the people who choose.

- Names at least two things science can do
- States that values and choices belong to people
- Names scientific, economic and social criteria

Part C: Which mistake matters most?

9. Suppose a town council used Riley's notes to choose between two solutions for protecting a local wetland. Which **one** wrong note could lead to the worst decision? Explain what the council might do wrong and how the corrected note would help.

Answer: Example: Note 8 could lead to the worst decision, because the council might hand the choice to one expert and ignore the costs to families or what residents will accept, so the solution fails even if the science is right. The corrected note reminds them to use science to predict and test each option and then weigh economic and social criteria too. Another strong answer: note 1 or 6, because blaming the wrong cause leads to a solution that targets the wrong step.

Why: Any choice is acceptable if the student explains a realistic bad decision and how the correction prevents it.

Also acceptable: Accept note 5 (wrong per capita numbers lead to wrong estimates of demand) with a clear explanation.

- Chooses one note
- Describes a specific bad decision it could cause
- Explains how the corrected note leads to a better process

Teacher notes

Every wrong note reflects a real misconception or a textbook issue: note 1 (correlation and lag treated as proof; the Krebs et al. 1995 results show food and predation interact), note 2 (pelts as a census), note 3 (the textbook's dated 'well over 7 billion' and 'increasing rate'), note 4 (all populations must cycle), note 5 (per capita as multiplication), note 6 (the textbook's photosynthesis error on p. 398) and note 8 (science decides). Note 7 is correct on purpose; students who mark everything wrong are guessing. Population facts follow the UN (8 billion on 15 November 2022; WPP 2024 projections) and the UNFPA 2025 estimate of 8,232 million.

Scaffold offered to students: Three checks for every note

For each note ask: (1) Does it match the fact box? (2) Does it claim more than the evidence shows (words like 'prove', 'exactly', 'always', 'every')? (3) If it has a calculation, is the answer a sensible size for one person? A note can be wrong in more than one way; name the biggest problem first.

Extension: Write a trap of your own

Write one new note about this chapter that sounds convincing but contains a subtle error, such as calling every non-native species invasive or saying a 'biodegradable' bag disappears in the ocean. Trade with a partner, diagnose each other's notes, and write a correction that includes the evidence that disproves the trap.