

Checkpoint: People, Populations and Protecting Ecosystems

Learning target: I can recall and apply the chapter's key ideas about population patterns, per capita resource use, human pressures on ecosystems and the evaluation of competing solutions.

Retrieval and mastery check

About 35 min

Individual

MS-LS2-5 · assesses

MS-ETS1-2 · practice

MS-ETS1-1 · practice

MS-ESS3-4 · supports

independent practice

writing

Standards connections

MS-LS2-5 (assesses, evaluating competing design solutions (q6, q9, q12)): Items 6, 9 and 12 ask students to connect solutions to the biodiversity or ecosystem services they protect and to evaluate competing solutions with scientific, economic and social criteria, producing individual evidence toward the PE.

MS-ETS1-2 (practice): Item 9 is a short weighted decision matrix in which students compute totals and judge whether a small difference settles a choice.

MS-ETS1-1 (practice): Item 7 checks that students can tell a criterion from a constraint in a new design problem.

MS-ESS3-4 (supports): Items 1, 4 and 5 use real population facts and the population times per capita idea. In California MS-ESS3-4 is a Grade 8 performance expectation; it is background here and is not assessed.

Purpose: assess · **Time:** about 35 minutes · **Format:** individual

Answers with reasoning

Part A: Retrieval practice

1. In 2025, the United Nations estimated that the world's population was about:

Answer: C. 8.2 billion.

Why: The UN Population Fund's 2025 estimate is 8,232 million. 10.3 billion is the UN's projected peak in the mid-2080s, and 7 billion was reached in 2011.

Also acceptable: None.

2. In the fur-trade records of snowshoe hares and Canada lynx, lynx peaks usually come:

Answer: B. A year or two after hare peaks.

Why: Lynx numbers respond to their food supply with a delay, because it takes time for more kittens to be born and survive and for lynx to starve when hares crash.

Also acceptable: None.

3. Explain why the lag between hare and lynx peaks does not, by itself, prove that lynx cause hare crashes. Name the other factor that field experiments showed also matters.

Answer: A lag shows that the two numbers change in a related pattern, but a pattern alone cannot show cause; other factors could produce it, and pelt counts also reflect trapping effort. Experiments in the Yukon showed that food supply also matters: adding food raised hare numbers, and removing predators plus adding food raised them the most.

Why: Correlation and timing support but do not prove causation; the Krebs et al. experiment showed food and predation together drive the cycle.

Also acceptable: Accept 'food and predators work together' with a reference to the experiment.

- States that a pattern or lag is not proof of cause
- Names food supply (winter food) as the other factor

4. A city of 250,000 people uses 40,000,000 liters of water a day. (a) What is its per capita water use? (b) If the city grows to 300,000 people and per capita use stays the same, how much water will it use each day?

Answer: (a) $40,000,000 \text{ L} \div 250,000 \text{ people} = 160 \text{ liters per person per day}$. (b) $300,000 \text{ people} \times 160 \text{ L} = 48,000,000 \text{ liters per day}$.

Why: Total use = population $\times$ per capita use; a 20 percent bigger population uses 20 percent more water if per capita use stays the same.

Also acceptable: Accept 48 million L/day.

5. True or false: The world population's growth rate, measured as a percentage per year, is higher today than it was in the 1960s. Explain.

Answer: False. The growth rate peaked in the 1960s at a little over 2 percent per year and has fallen since to under 1 percent, even though the total population is still rising.

Why: A rising total and a falling rate are compatible: each billion since 1974 has taken about 11 to 13 years.

Also acceptable: Accept 'False: growth has slowed even though the population is still increasing.'

- Marks false
- Distinguishes the rate from the total

6. For each solution, name the human pressure it addresses and one part of biodiversity or one ecosystem service it protects.

Answer: Electric barriers: invasive species; protect native fish of the Great Lakes (and the fisheries people rely on). Shade-grown coffee: habitat degradation; protects forest birds such as wintering warblers, bees that pollinate, and soil. Larger-mesh nets: over-exploitation; protect snail-eating fish and the disease control and food they provide. Removing nitrogen at sewage plants: pollution; protects oxygen-rich water and the lobsters, fish and oysters (seafood) that depend on it.

Why: Each solution targets one pressure and protects specific species or services.

Also acceptable: Shade coffee: accept 'biodiversity' alone only if a species is named elsewhere in the row.

- Correct pressure for at least three of four
- A correct species or service for each

7. A town is designing a new shrimp net. 'Each net must cost less than \$400' is a _____. 'Fewer than 2 sea turtles caught per 100 trawls' is a _____.

Answer: constraint; criterion.

Why: A cost limit restricts possible designs (constraint); a turtle-catch target describes what success means (criterion).

Also acceptable: None.

8. Which is the strongest evidence that a nitrogen-reduction plan is helping Long Island Sound?

Answer: B. Bottom-water oxygen measured over many summers is higher, and the low-oxygen area is smaller than before the plan.

Why: Repeated measurements of the quantity the model says matters, compared with before the plan, are the strongest evidence. Looks, opinions and cost do not measure ecosystem health.

Also acceptable: None.

9. A town scores two designs from 1 to 5. Weights: protects wildlife × 3, low cost × 2, residents accept it × 1. Design X scores 4, 2 and 5. Design Y scores 3, 5 and 3. Calculate both weighted totals. Which design wins, and why might such a small difference not settle the decision?

Answer: X: $4 \times 3 + 2 \times 2 + 5 \times 1 = 12 + 4 + 5 = 21$. Y: $3 \times 3 + 5 \times 2 + 3 \times 1 = 9 + 10 + 3 = 22$. Design Y wins by 1 point. The difference is so small that a slightly different weight or score could flip it (for example, weighting wildlife 4 instead of 3 makes it a 25-25 tie), so the town should look at uncertainty, constraints and the evidence behind each score.

Why: A decision matrix organizes judgment; close totals mean the choice depends on the weights.

Also acceptable: Accept any valid reason a close score is not decisive (scores are estimates; a constraint might rule one out).

- Both totals correct with work
- Identifies Y as the winner
- Explains why a small difference may not decide

10. Draw the cause-and-effect chain by which Nipah virus reached farmworkers in Malaysia (start with fruit bats). Then draw a thick line across the arrow where keeping pigs away from bat feeding trees breaks the chain.

Answer: Fruit bats carry the virus → bats feed in fruit trees on or near pig farms and drop or bite fruit → pigs eat contaminated fruit → pigs become infected → farmworkers handling pigs become infected. The thick line crosses the arrow between bats' dropped fruit and pigs eating it (keeping pigs away from the trees).

Why: The solution breaks the chain at the bat-to-pig step without harming the bats.

Also acceptable: Accept a second break between pigs and workers labeled 'protective gear' as an addition.

- At least four linked steps in the correct order, starting with bats
- The break marked between the fruit trees or dropped fruit and the pigs

11. Name one thing science **can** do and one thing science **cannot** do when a community chooses how to protect an ecosystem.

Answer: Science can measure a problem, predict the likely results of each solution and test whether a solution works. Science cannot decide what a community values most, such as jobs versus wildlife; people make that choice.

Why: This is the chapter's closing idea: science informs society's decisions but does not make them.

Also acceptable: Accept 'science cannot tell you what you should do' as the cannot statement.

- One valid thing science can do
- One valid thing science cannot do

Part B: Synthesis

12. Hare and lynx numbers rise and fall, but the human population has kept rising. Use this contrast and the idea of per capita use to explain why people need engineered solutions to protect ecosystems. Then evaluate **one** solution from this chapter using a scientific, an economic and a social criterion, and name its main tradeoff.

Answer: Example: Hare numbers crash when their food runs short and predators catch up, so a boom limits itself. People have avoided those limits with farming, trade and medicine, so the population has risen to about 8.2 billion, and per capita use of energy, water and materials has also grown. Total demand is roughly population times per capita use, so pressure on forests, rivers and oceans keeps rising unless people design ways to meet their needs with less harm. Shade-grown coffee is one such design. Scientifically it keeps many more bird species, holds soil and supports pollinators. Economically it harvests fewer beans, though a premium price can make up some of the difference. Socially it lets farm families keep their livelihoods, but only if buyers will pay more. Its main tradeoff is less coffee per hectare in exchange for healthier forest habitat.

Why: The synthesis connects the chapter phenomenon to the need for solutions and applies the three-criteria evaluation of MS-LS2-5.

Also acceptable: Any chapter solution (nets, TEDs, electric barriers, nitrogen limits, keeping pigs from bat trees, marsh restoration) is acceptable if evaluated on all three kinds of criteria.

- Explains why hares cycle and people have not
- Uses per capita and links total demand to population and use per person
- Evaluates one solution with scientific, economic and social criteria
- Names a tradeoff

Teacher notes

Items 1-11 are retrieval practice across the chapter and can be used as a quiz (1 point each for 1, 2, 5, 7 and 8; 2 points each for 3, 4, 6, 9, 10 and 11). Item 12 is the synthesis and can be scored with the W6 rubric's claim, evidence and reasoning rows. Population facts follow the UN: 8 billion in November 2022, the UNFPA 2025 estimate of 8,232 million, a growth rate that peaked in the 1960s and is now below 1 percent per year, and a projected peak of about 10.3 billion in the mid-2080s. The hare experiment cited in q3 is Krebs et al., Science, 1995.

Scaffold offered to students: A plan for the synthesis

Before writing q12, jot three notes: (1) why hares cycle and people have not; (2) what happens to total demand when population and per capita use both rise; (3) one solution with a plus or minus for scientific, economic and social criteria. Turn each note into one or two sentences.

Extension: Write a test item

Write one multiple-choice item that tests whether a classmate can tell biodiversity from an ecosystem service. Include four options with one correct answer and three believable wrong answers, and write a one-sentence explanation of why each wrong answer is wrong.