

ENVIRONMENTAL SCIENCE

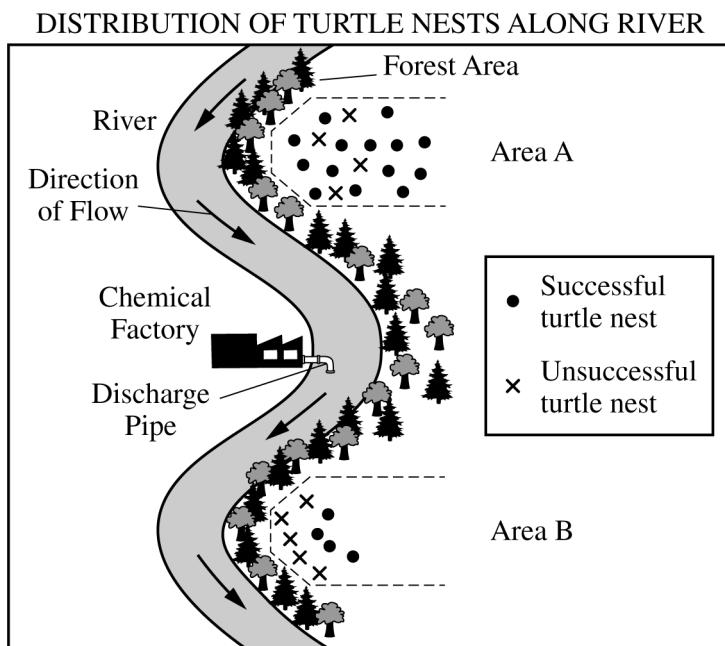
SECTION II

Time—1 hour and 10 minutes

3 Questions

Directions: Answer all three questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers in the Free Response booklet. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples. You may plan your answers in this orange booklet, but no credit will be given for anything written in this booklet. **You will only earn credit for what you write in the separate Free Response booklet.**

- Common snapping turtles, *Chelydra serpentina*, are primarily aquatic, but they lay their eggs on land. Researchers are interested in understanding the impact of pollution on turtle nesting sites. The researchers examined nesting sites at two agricultural areas along the floodplain of a river upstream and downstream from a chemical factory that is a known source of aqueous mercury pollution. Turtle eggs, soil, and vegetation samples taken from areas around turtle nests downstream from the chemical factory showed high levels of mercury in a previous study. Mercury was not detected in samples taken upstream from the chemical factory.



Question 1: Design an Investigation**10 points**

- (a) (i) Identify the area with the greatest nest success rate, based on the information in the diagram. **1 point**
- Accept one of the following:
- Area A
 - Site/area upstream from the factory
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- (ii) Identify the dependent variable in the study. **1 point**
- Accept one of the following:
- Turtle nesting success
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- (iii) Based on the information provided, identify a likely scientific question for the study. **1 point**
- Accept one of the following:
- Does mercury content in the turtle's habitat affect common snapping turtle nest success?
 - Does mercury content in the turtle's habitat affect the location/site of common snapping turtle nests?
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- (iv) Describe why researchers measured mercury levels in locations upstream from the factory. **1 point**
- Accept one of the following:
- The upstream locations acted as a control group in the study.
 - The site was used to compare with the high mercury turtle nests downstream.
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- (v) There are plans to remove trees and other vegetation along the riverbank. Explain how this modification could affect the location and number of successful turtle nests in Area B. **1 point**
- Accept one of the following:
- With more open area closer to the river, turtles don't have to travel as far to build nests, leading to exposure to higher levels of mercury near the river, decreasing the number of successful nests.
 - With less vegetation to remove the mercury/heavy metals/endocrine disruptors/pesticides, there will be increased concentrations in the soil, decreasing the number of successful nests.
 - Soil erosion along the stream would increase, which would make it more difficult for turtles to build nests there and decrease the number of successful nests.
 - With less vegetation and reduced shade, the soil temperature will increase/moisture will decrease, decreasing the number of successful nests.

Total for part (a) 5 points

(b) (i) Describe how a persistent pollutant, such as mercury, can negatively affect an organism. **1 point**

Accept one of the following:

- The mercury/persistent pollutant could bioaccumulate in the tissues of organisms because the pollutants do not easily break down and can accumulate over time.
- Mercury is a neurotoxin, which can disrupt an animal's nervous system/neuron functioning.
- The mercury/persistent pollutant disrupts regular functioning of an animal's brain/kidneys/liver/immune system/reproductive system and can lead to death.

(ii) Describe how a persistent pollutant, such as mercury, can negatively affect an ecosystem. **1 point**

Accept one of the following:

- A toxin can biomagnify in the food chain impacting top predators that will have a very high concentration of the pollutant.
- The death of top predators in a food chain leads to a trophic cascade.
- Reproductive success of individual organisms can decrease from exposure to the pollutant, altering the ecosystem's food webs/trophic levels and decreasing its stability/resulting in a decline in biodiversity.

(iii) Researchers measured methylmercury in a location downstream from the factory. **1 point**

Explain how methylmercury could be present in the stream.

- Mercury is likely released into the stream by the factory as a waste product. Bacteria/microorganisms in the water/sediments then convert the mercury into methylmercury.

(iv) Researchers claimed that the soil nearest to the river has higher levels of mercury than the field has, and those elevated levels have affected the nesting success for turtles. **1 point**

Explain how the pattern shown in the diagram supports or refutes this claim.

Accept one of the following:

- The nests near the river in Area B where there is mercury are not successful, but the nests further away are successful. This supports the claim that the high concentration in the soil negatively affects the nesting success.
- There are fewer total nests/successful nests in Area B closer to the river than in Area A indicating that the mercury in the soil has negatively affected the nesting success. This supports the claim.

Total for part (b) 4 points

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- (c) The turtle study was conducted in an agricultural area. **Describe** how a specific agricultural practice changes the soil in an area. 1 point

Accept one of the following:

- Tilling/plowing softens/loosens soils and/or removes organic matter or leads to erosion.
- Monocropping removes nutrients and/or moisture from soil.
- Use of synthetic fertilizers disrupts the soil chemistry in areas used for agriculture.
- Irrigation can lead to waterlogging, erosion, and/or salinization of soils.
- Slash and burn removes vegetation and upper organic layers of the soil/adds nutrients to the soil.
- Use of industrialized machinery (harvesters, plows, planters) compacts soil.
- Use of polycultures/cover cropping with nitrogen-fixing plants can add nutrients to soil.
- Use of manure/organic fertilizer can increase moisture content of the soils.

Total for part (c) 1 point

Total for question 1 10 points