

1. Respond to parts A, B, C, D, E, F, G, H, and I, and all subparts.

- A. Based on the data in the graph, **identify** the number of Common Tern breeding pairs in 1995.
- B. Based on the data in the graph, **describe** the trend in the number of Common Tern breeding pairs from 1995 to 2008.
- C. A group of students hypothesized that sea level rise will lead to an increase in Common Tern populations. **Describe** one way that the data in the graph refute this hypothesis.
- D. **Explain** how climate change can lead to sea level rise.
- E. Wading birds are a group of large-bodied birds that inhabit coastal wetlands all over the world. Researchers monitored the number of wading bird species at four coastal locations experiencing rising sea levels over a 5-year period. The data are shown in the following table.

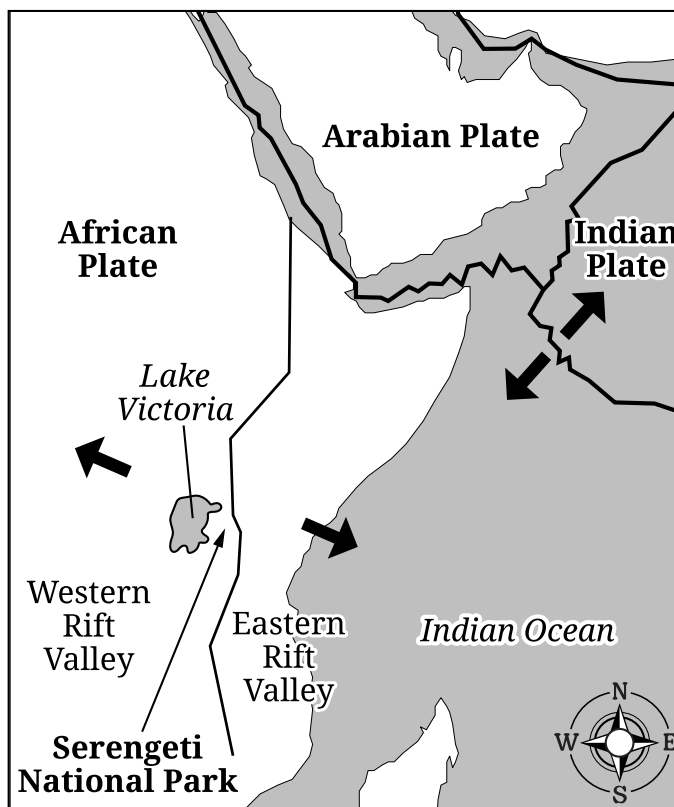
Sea Level Rise and Number of Wading Bird Species at Four Coastal Locations

Year	Increase in Sea Level (m)	Location A	Location B	Location C	Location D
1	0.05	1	5	3	4
2	0.08	2	4	3	6
3	0.10	6	7	5	5
4	0.12	5	7	7	7
5	0.15	7	8	9	8

- i. **Identify** a hypothesis that researchers are likely investigating in the wading bird study.
- ii. **Identify** the dependent variable in this study.
- F. One year after the completion of the study of wading bird species described in Part E, locations A and B experienced an increase in the concentration of PCBs, known to be a persistent organic pollutant, running off into the water.
If the researchers repeated their study, **explain** how this environmental change could affect the results of the study.
- G. **Describe** a regulating ecosystem service that can be provided by wetlands.
- H. Since 1990, there has been an increase in urbanization around the coastal wetlands that wading bird communities inhabit. Most of these bird species eat fish and locate prey visually while walking through shallow water. An increase in sediment was discovered in a wetland located near an urban area.
Explain how increased sediment might lead to a change in the size of the wading bird populations.
- I. **Describe** an environmental problem, other than an increase in sediment, that can occur in wetlands that is associated with increased urbanization and development.

Serengeti National Park is located in Tanzania, Africa. The park is located in a valley along a tectonic plate boundary called the East African Rift. Figure 1 shows the East African Rift and other plate boundaries near the east coast of Africa.

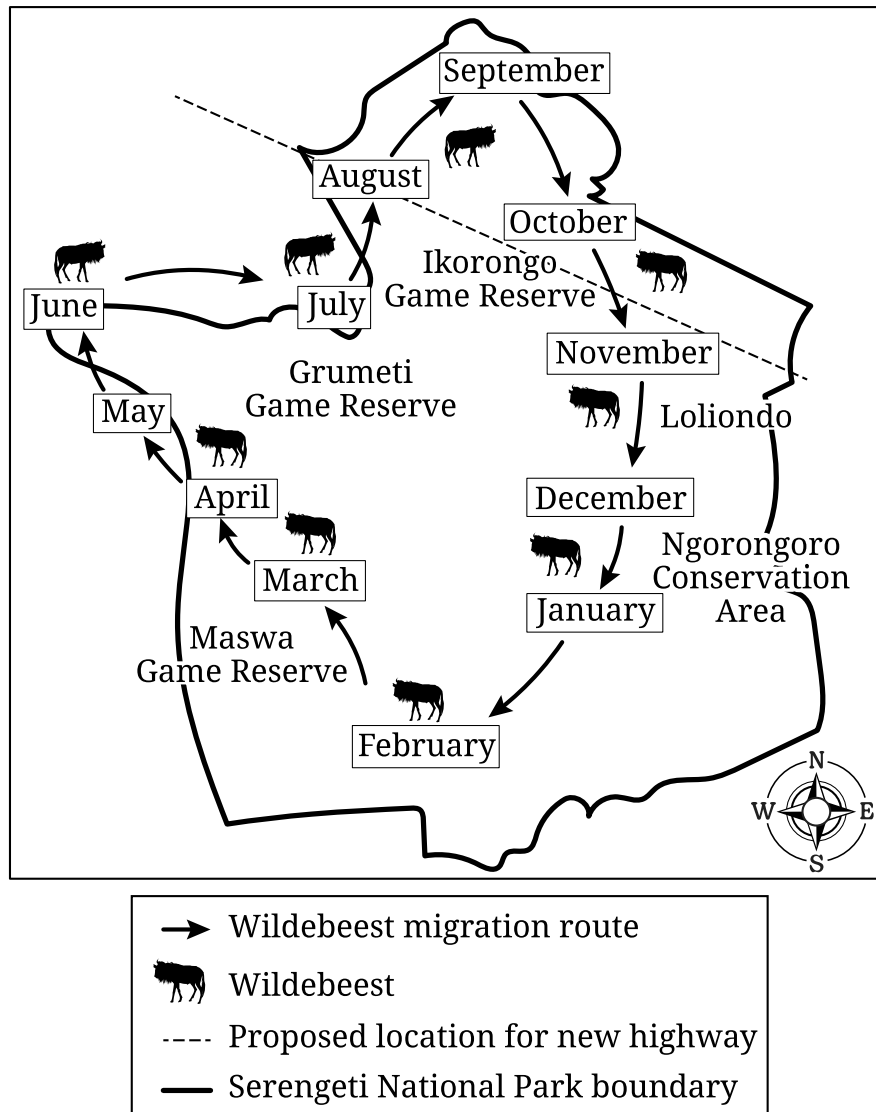
Figure 1. Tectonic Plate Movement near East Coast of Africa



- ~ Plate boundaries
- East African Rift
- ➔ Direction of plate movement

Serengeti National Park contains a variety of tropical habitats but is dominated by wideopen lands that include a variety of grass species with scattered trees and shrubs. Most grass growth occurs after the March through May rainy season. Many of the park’s herbivores, such as wildebeest and zebra, migrate through the park in an annual cycle following the growth of new grass (Figure 2).

Figure 2. Annual Migration of Wildebeest in Serengeti National Park



ENVIRONMENTAL SCIENCE

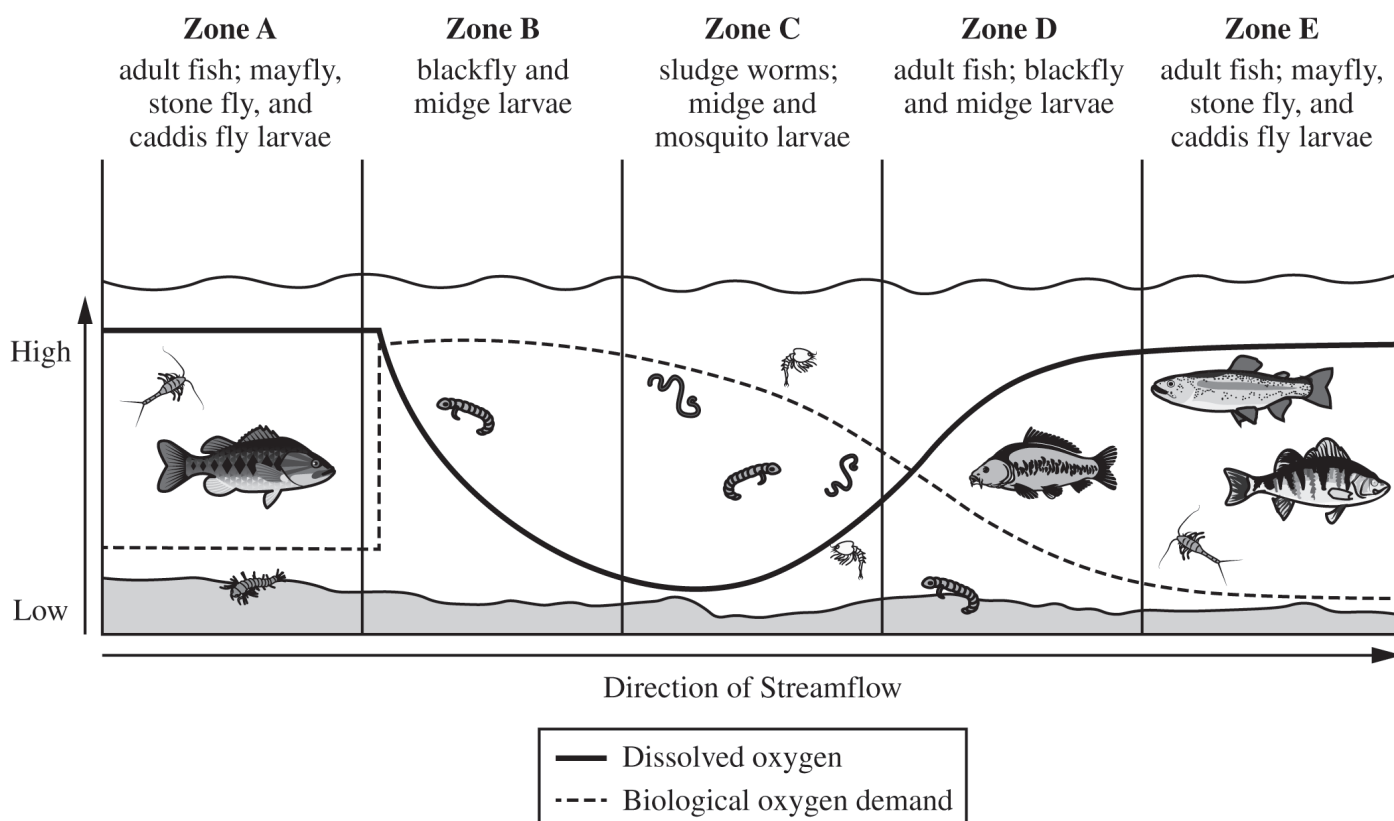
SECTION II

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.**

1. Researchers are studying the stream ecosystem shown in the following diagram. They have identified five different zones based on the dissolved oxygen levels and biological oxygen demand as the water flows downstream. Biological oxygen demand is the amount of oxygen needed by bacteria and other microorganisms to break down organic material in water. Some of the most common fish and macroinvertebrate species found in each zone are listed in the diagram.

Dissolved Oxygen and Biological Oxygen Demand in a Stream Ecosystem

- (a) Based on the information in the diagram, **identify** the zone with the lowest level of dissolved oxygen..
- (b) Based on the information in the diagram, **describe** the relationship between biological oxygen demand and dissolved oxygen.
- (c) Based on the information in the diagram, **identify** the zone where there is most likely point-source water pollution discharged into the stream.

The research team is interested in investigating the relationship between dissolved oxygen levels and macroinvertebrate species richness in the stream. Researchers counted the number of macroinvertebrate species in zones A, B, and C during the summer months. The researchers selected zone A to serve as the control in the investigation.

- (d) **Identify** the dependent variable in the researchers' investigation.
- (e) **Identify** a testable hypothesis for the researchers' investigation.
- (f) **Describe** the reason the researchers selected zone A to serve as the control in the investigation.

The researchers decided to repeat their data collection during the winter months.

- (g) **Explain** how the modification to collect data in the winter months could alter the results of the investigation.

Stream ecosystems are affected by point-source organic pollution in a variety of ways.

- (h) **Describe** the effect that the introduction of raw sewage into the stream could have on the population of bacteria in the stream.
- (i) **Identify** an abiotic factor other than dissolved oxygen and organic pollution that could also influence the population size of bacteria in the stream.
- (j) **Explain** how persistent organic pollutants can affect higher trophic levels in an aquatic food web.

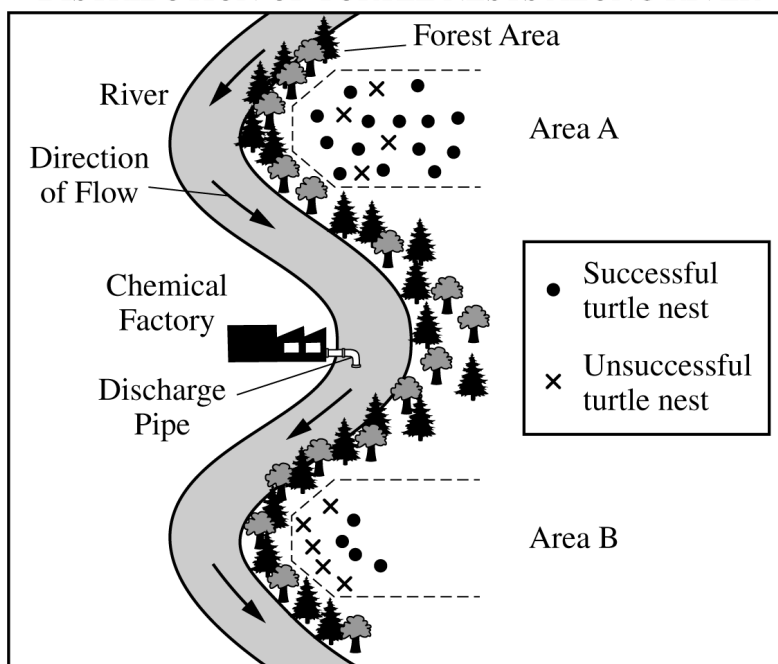
Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

ENVIRONMENTAL SCIENCE**SECTION II****Time—1 hour and 10 minutes****3 Questions**

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1. 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.

DISTRIBUTION OF TURTLE NESTS ALONG RIVER



- (a) The map shows locations of both successful and unsuccessful turtle nests.
- (i) **Identify** the area with the greatest nest success rate, based on the information in the diagram.
 - (ii) **Identify** the dependent variable in the study.
 - (iii) Based on the information provided, **identify** a likely scientific question for the study.
 - (iv) **Describe** why researchers measured mercury levels in locations upstream from the factory.
 - (v) There are plans to remove trees and other vegetation along the river bank. **Explain** how this modification could affect the location and number of successful turtle nests in Area B.
- (b) Mercury can affect organisms and ecosystems in many ways.
- (i) **Describe** how a persistent pollutant, such as mercury, can negatively affect an organism.
 - (ii) **Describe** how a persistent pollutant, such as mercury, can negatively affect an ecosystem.
 - (iii) Researchers measured methylmercury in a location downstream from the factory. **Explain** how methylmercury could be present in the stream.
 - (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. **Explain** how the pattern shown in the diagram supports or refutes this claim.
- (c) The turtle study was conducted in an agricultural area. **Describe** how a specific agricultural practice changes the soil in an area.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.