

**2022**



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# **AP<sup>®</sup> Environmental Science**

## **Free-Response Questions Set 2**

## ENVIRONMENTAL SCIENCE

## SECTION II

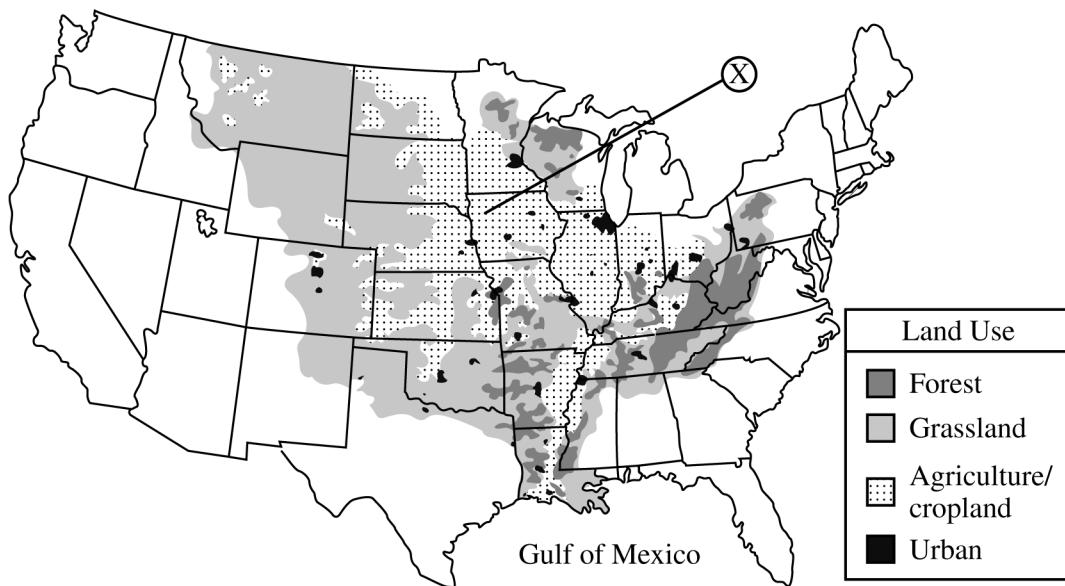
Time—1 hour and 10 minutes

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. The dead zone in the Gulf of Mexico occurs every summer when winter snow melts and spring rain flows into the Mississippi River. Recent studies have shown that both the total area covered by algae and the depth of the algal mass in the dead zone are increasing.

LAND USE WITHIN THE MISSISSIPPI RIVER WATERSHED



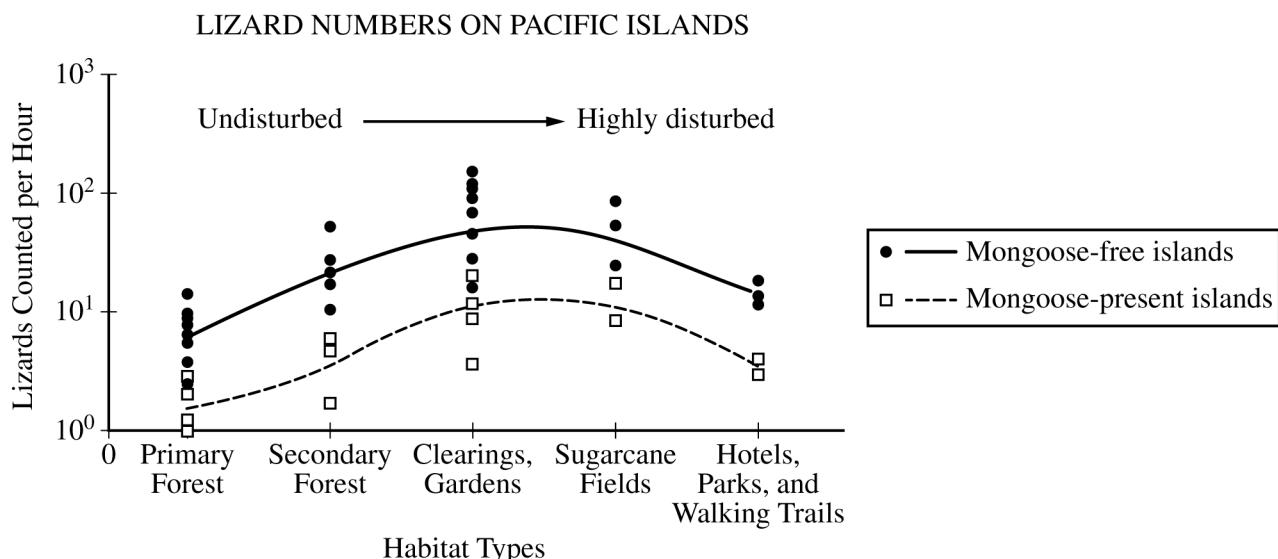
- (a) Various land use practices can have different effects on the waters that surround a dead zone.
- (i) **Identify** the land use that covers the least amount of area in the Mississippi River watershed, based on the diagram.
  - (ii) **Describe** one way that the land use practice at location X in the diagram could contribute to the dead zone in the Gulf of Mexico.
  - (iii) **Describe** one way that urban areas in the Mississippi River watershed could contribute to the dead zone in the Gulf of Mexico.

- (b) The dead zone in the Gulf of Mexico has both economic and environmental effects for coastal communities.
- (i) **Describe** how a dead zone affects marine organisms living in the Gulf of Mexico.
  - (ii) **Describe** one economic effect on communities along the Gulf of Mexico that can result from the presence of the dead zone.
  - (iii) **Describe** one factor that causes the area of the dead zone in the Gulf of Mexico to increase in the summer months.
- (c) Researchers want to examine the effect of riparian vegetation buffers on water quality in streams in agricultural areas. Researchers will measure the water nutrient concentrations over the course of one year. The study sites are located 100 meters downstream from areas either with or without riparian vegetation buffers.
- (i) **Identify** a testable hypothesis for the study.
  - (ii) **Describe** a control that the researchers could use in the study.
  - (iii) **Identify** one water quality test, other than measuring nitrates or phosphates, that the researchers could use to evaluate how riparian vegetation buffers affect water quality.
  - (iv) During the investigation, researchers discovered that some of the land next to one of the streams with a riparian vegetation buffer is going to be converted from cornfields into a large-scale concentrated animal feeding operation. **Explain** one way that this change in land use could alter the results of the study.

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**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.**

2. Biologists collected data on the abundance of lizards on several Pacific islands with and without mongoose populations. The surveys were conducted at different locations on the islands by counting the number of lizards observed per hour and included habitats with both undisturbed areas and anthropogenically disturbed areas.



- (a) The graph shows data collected by biologists on lizard numbers on several Pacific islands.
- (i) Based on the data in the graph, **identify** the habitat type with the greatest number of lizards.
  - (ii) Based on the data in the graph, **describe** the relationship between the lizard numbers observed on islands with and without mongoose populations.
- Globally, islands vary in size, location, and habitat.
- (b) Based on the theory of island biogeography, **describe** the characteristics of an island with the greatest species diversity.
- (c) Island ecosystems are often threatened by invasive species, such as the mongoose populations studied in the survey.
- (i) **Describe** one environmental problem caused by invasive animal species.
  - (ii) Invasive species are often pests. **Make a claim** that proposes one way to control pest species.
  - (iii) **Justify** the solution proposed in (c)(ii) by providing an additional benefit of the solution.
- (d) Islands provide humans with many ecosystem services. However, humans may alter ecosystems when they obtain these services. Large-scale commercial sugarcane farming on the Pacific islands has led to significant ecological damage.
- (i) **Identify** a provisioning ecosystem service provided by primary forests.
  - (ii) Based on the data in the graph, **explain** how replacing primary forests with sugarcane fields may have affected the number of lizards counted on the mongoose-free Pacific islands.
  - (iii) The long-term use of monocultures in commercial sugarcane farming is one cause of the ecological damage. **Describe** one problem associated with monocultures.

One solution to the ecological damage of monocultures is to use a form of crop rotation using legumes.

- (e) **Describe** an advantage of crop rotation using legumes on soil fertility.

3. North Carolina is one of the fastest-growing states by population in the United States, with most growth concentrated in major cities like Charlotte. Increased population leads to increased demands for resources such as power and water.

The majority of electrical energy in North Carolina is produced during the combustion of coal.

- (a) **Identify** one negative human health effect linked to the exposure to pollutants resulting from the combustion of coal.
- (b) Coal ash, the powdery, solid substance that remains after coal combustion, presents a variety of potential environmental issues. Disposal of toxic coal ash is a growing concern in the state. Coal ash can be mixed with water and disposed of in large, unlined pits or as dry ash in landfills.
  - (i) **Describe** an environmental problem associated with coal ash waste disposal.
  - (ii) A proposed solution is to dispose of North Carolina's coal ash in clay-lined pits. **Justify** this solution by providing one advantage of using clay soil.
- (c) The population of Charlotte, North Carolina, has grown over the last few decades. The table shows the increase in the population size of Charlotte from 2013 to 2019.

**Population of Charlotte, North Carolina, 2013–2019**

Year	Population
2013	757,278
2014	774,807
2015	792,137
2016	808,834
2017	826,060
2018	841,611
2019	857,425

- (i) **Calculate** the percent change in Charlotte's population from 2013 to 2019. **Show** your work.
- (ii) Based on Charlotte's 2019 growth rate of 1.88%, **calculate** the year when the population of Charlotte will double, assuming the growth rate stays the same. **Show** your work.
- (iii) The average Charlotte resident uses 90 gallons of water per day. **Calculate** the gallons of water used by the population of Charlotte in the year 2018. **Show** your work.
- (d) Drought periods are becoming more frequent in North Carolina, causing water resources to become more scarce. **Describe** one realistic action that citizens could take to reduce domestic outdoor water use.

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**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.**

**STOP**

**END OF EXAM**