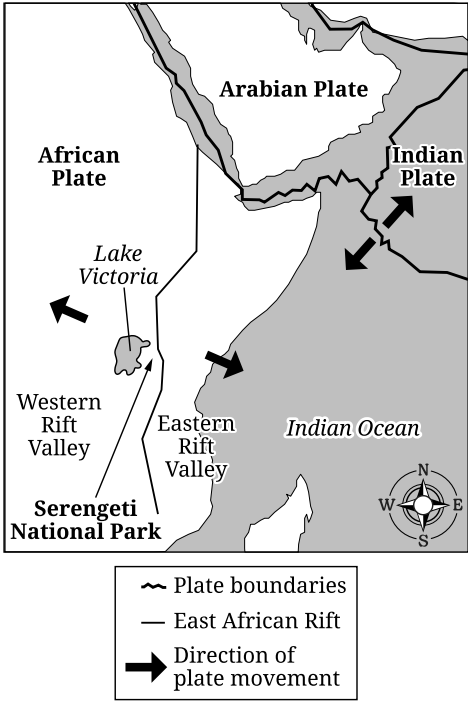


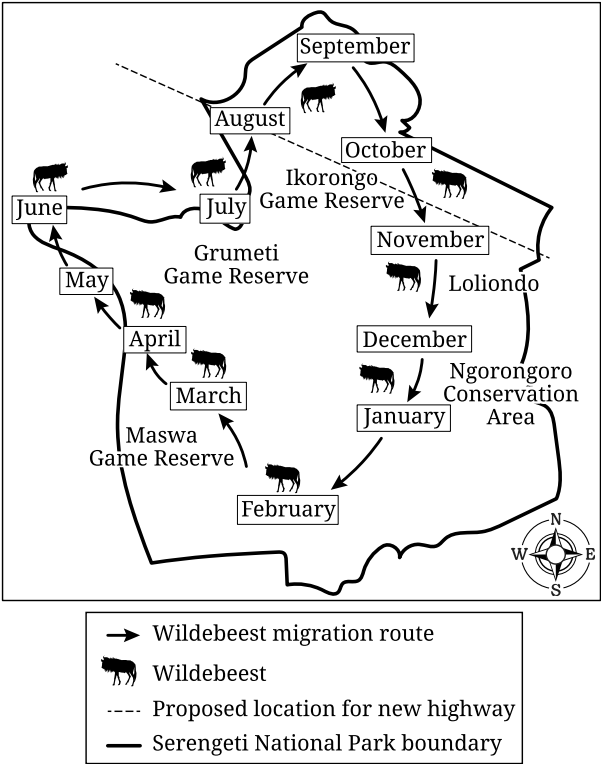
Serengeti National Park is located in Tanzania, Africa. The park is located in a valley along a tectonic plate boundary called the East African Rift. Figure 1 shows the East African Rift and other plate boundaries near the east coast of Africa.

Figure 1. Tectonic Plate Movement near East Coast of Africa



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



2. Respond to parts A, B, C, D, E, F, G, H, I, and J.

- A. Based on the information in Figure 1, **identify** the type of plate boundary that runs beneath Serengeti National Park.
- B. Based on the information provided, **identify** the dominant biome within the Serengeti.
- C. Wildebeest give birth to their young when new grasses are growing. Based on the information in Figure 2, **identify** the location in the Serengeti where wildebeest are most likely to give birth.
- D. The Serengeti has two primary types of grasses: long and short. The two grass types provide similar levels of nutrition for animals. Wildebeest primarily consume long grasses, while other herbivores such as gazelle consume the short grasses. These two similar species coexist in Serengeti National Park.

Explain why resource partitioning allows for the coexistence of the wildebeest and the gazelle in the Serengeti.

- E. The Tanzanian government plans to build a highway across the northern portion of the Serengeti, as shown in Figure 2.

Describe one way the planned highway shown in Figure 2 could negatively affect the wildebeest population in the Serengeti.

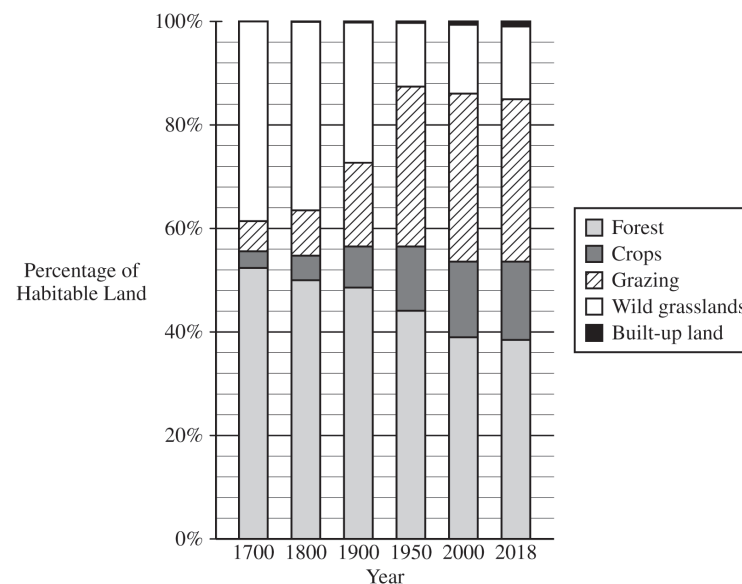
- F. **Propose** a solution to the negative effect created by the planned highway described in part E.
- G. Many organisms live in grasslands. One weed species, the spotted knapweed, was introduced at one location in North America in the 1890s and is currently found throughout the rangelands of the western United States. The spotted knapweed poses several environmental problems in North America. Farmers often use crop rotation to control populations of pests like the spotted knapweed. A more traditional method of controlling pests involves spraying pesticides.

Describe a characteristic of an invasive species, such as the spotted knapweed, that allows them to outcompete native species.

- H. **Justify** the use of crop rotation as an environmental solution by providing an additional advantage, other than controlling pest populations.
- I. **Describe** an environmental problem associated with controlling pest populations with large amounts of pesticide.
- J. **Propose** a solution to controlling pests, other than pesticides or crop rotation.

2. The following graph shows how global uses of habitable land have changed since 1700.

Land Use Changes on Earth, 1700–2018



- (a) Based on the data in the graph, **identify** the year with the highest percentage of forest.
- (b) Based on the data in the graph, **describe** the relationship between the land use changes in the wild grasslands and grazing from 1700 to 1950.
- (c) **Identify** an environmental problem associated with overgrazing by livestock.
- (d) A student hypothesized that the change in the percentage of forest from 1700 to 2018 has decreased atmospheric carbon dioxide concentrations. **Explain** whether the hypothesis is supported or refuted based on the data in the graph.
- Urban environments have accounted for an increasing percentage of land use within the last few decades.
- (e) **Describe** a water-related environmental problem associated with urbanization.
- (f) **Describe** a potential response to mitigate the environmental problem identified in part (e).

Farmers who own large sections of cropland notice that bobcats, a medium-sized predatory forest cat, were present many years ago but are now virtually absent in the area. Instead, smaller mammal species now inhabit the area. Over time, the farmers have cleared nearly all of the forest on their property and converted it to farmland.

(g) **Explain** why there are fewer bobcats present on the farmland now compared to several decades ago.

The small mammal species are considered pests by the farmers. The farmers partner with a conservation group to increase the number of bobcats in the area. As a solution, the conservation group will introduce bobcats onto the few isolated patches of the original forested habitat left in the area. They can introduce only a small number of bobcats in each patch.

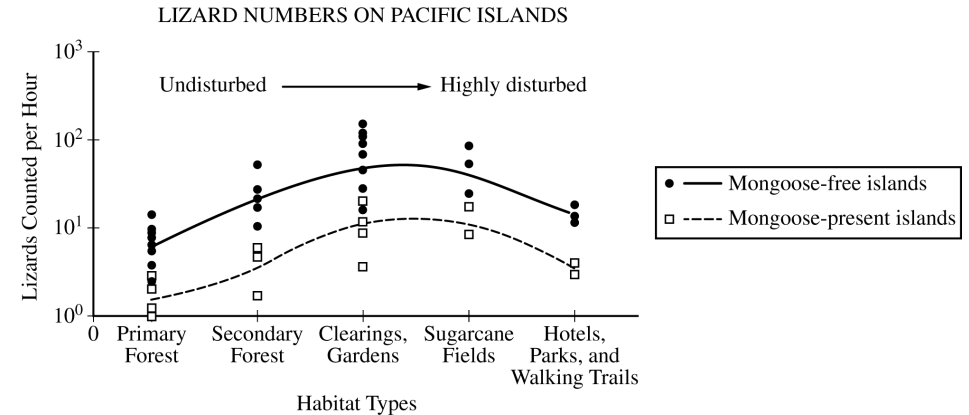
(h) **Describe** a disadvantage of introducing only a small population of bobcats.

(i) **Propose** a solution to improve the chances that the bobcat reintroductions will be successful in reestablishing wild populations.

(j) **Justify** the solution proposed in part (i) by describing an additional advantage, other than reestablishing the bobcat population near the farms.

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.

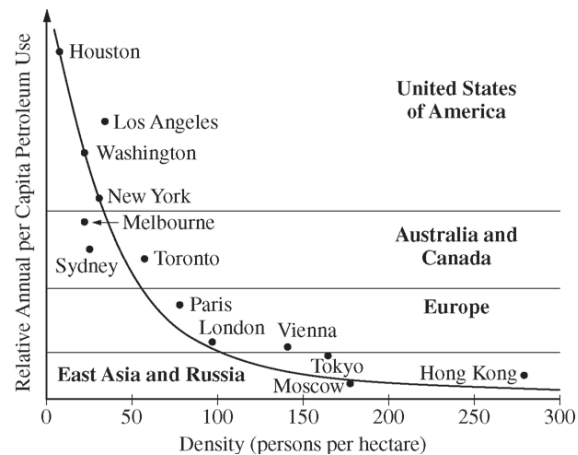
(ii) Based on the data in the graph, **explain** how replacing primary forests with sugarcane fields may have affected the number of lizards counted on the mongoose-free Pacific islands.

(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.

4. The term “urban sprawl” describes the expansion of cities into rural areas. This phenomenon has occurred around the world and has had economic, health, and environmental consequences.
- (a) **Describe** TWO causes of urban sprawl.
- (b) **Discuss** TWO human health effects associated with urban sprawl.
- (c) The graph below shows the relationship between population density and petroleum use in selected cities. **Describe** the relationship between population density and petroleum use shown in the graph.



- (d) Smart growth focuses on ways to encourage sustainable urban development. **Describe** TWO steps a municipality could take to encourage smart growth in order to limit urban sprawl.
- (e) Highway systems and urban sprawl often threaten wildlife populations. **Describe** TWO methods to reduce harmful effects on wildlife populations from highways and urban sprawl.
- (f) Urban sprawl often results in the loss of productive agricultural land near cities. **Describe** one practical way to increase food production within urban areas.

STOP

END OF EXAM