

There is a natural climate phenomenon that occurs in the equatorial Pacific Ocean because of periodic fluctuations in sea surface conditions and atmospheric circulation. This phenomenon happens every few years, resulting in shifts in temperature and precipitation in many parts of the world.

Figure 1 shows temperature and precipitation patterns associated with one phase of this phenomenon in the equatorial Pacific Ocean. Figure 2 shows the associated temperature and precipitation patterns that occur over North America.

Figure 1. Effects of Changes in Sea Surface Conditions in Equatorial Pacific Ocean

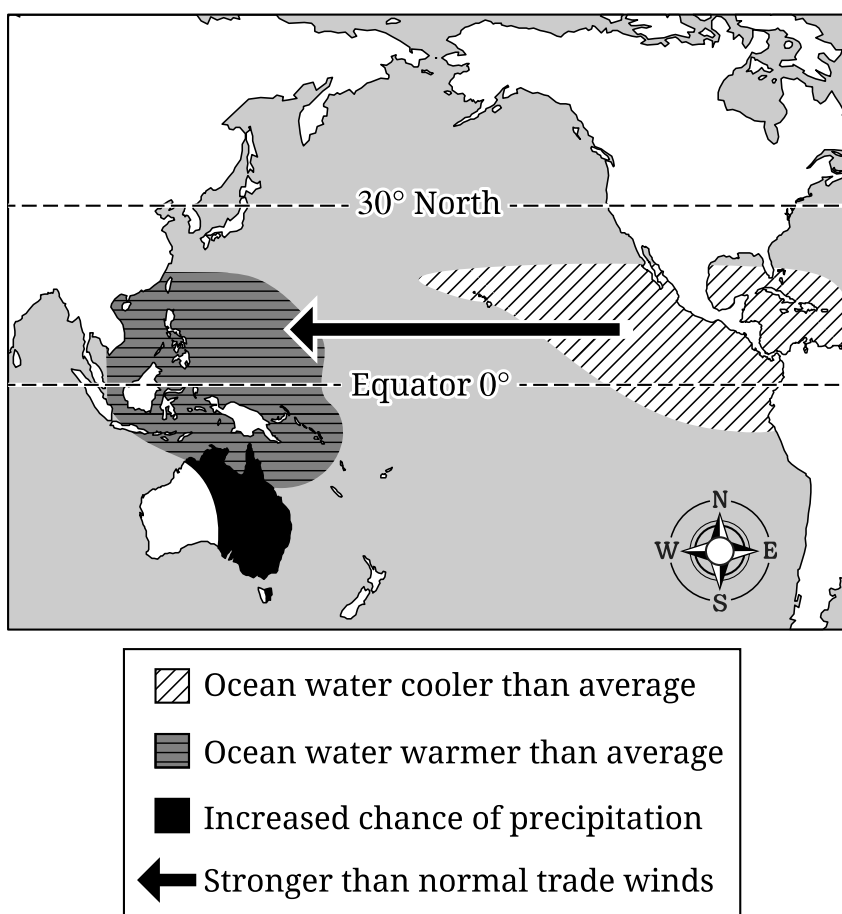
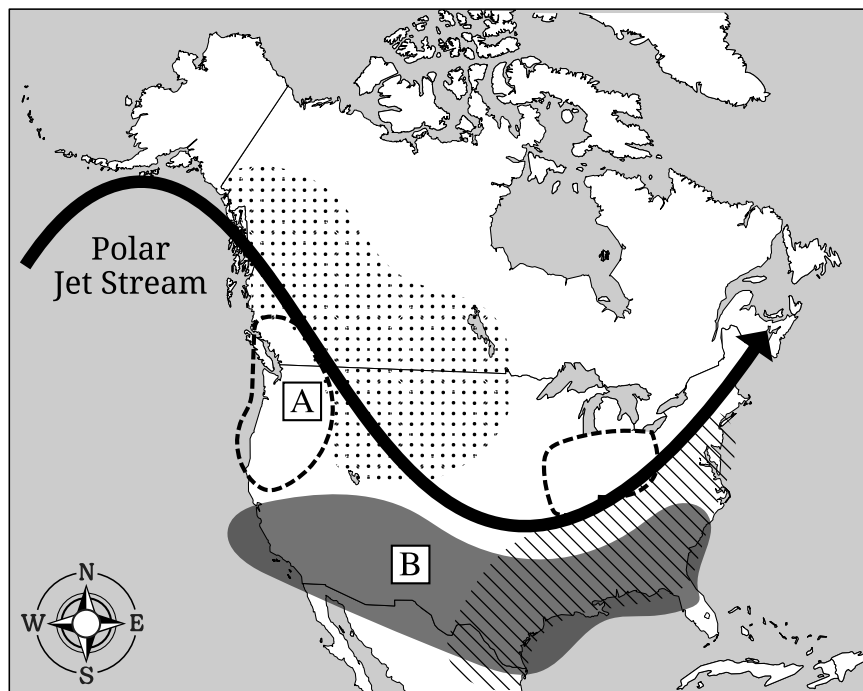


Figure 2. Polar Jet Stream and Climate Conditions in North America

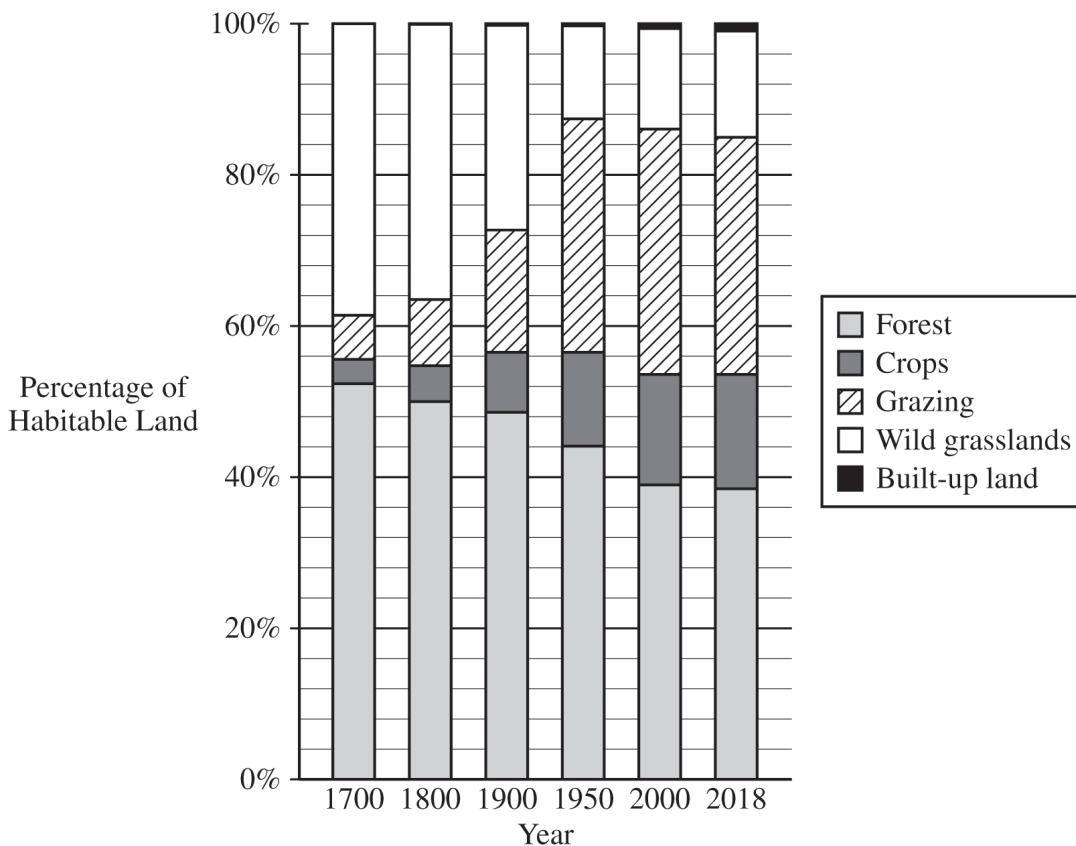
-  Increased chance of precipitation
-  Decreased chance of precipitation
-  Cooler than average
-  Warmer than average

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

- A. **Identify** the sea surface condition for the eastern equatorial area of the Pacific Ocean illustrated in Figure 1.
- B. Based on the information in Figure 1, **identify** the climate phenomenon associated with the sea surface conditions shown in the equatorial area of the Pacific Ocean.
- C. Based on the information in Figure 2, **describe** a difference in climate patterns between the regions A and B.
- D. Increases in regional precipitation can lead to increased flooding in certain locations. **Describe** one reason why there is an increased risk of flooding in urban areas during extended periods of precipitation.
- E. **Propose** a realistic solution a city could implement to decrease the risk of flooding in urban areas.
- F. **Justify** the solution proposed in part E by providing an additional advantage other than a reduction in the risk of flooding.
- G. Terrestrial biomes are primarily determined by temperature and precipitation patterns. **Describe** one difference between the climate of a temperate seasonal forest and that of a savanna.
- H. Droughts are one environmental problem that can affect the frequency and severity of forest fires. **Identify** the ecological process that occurs following a forest fire that leaves the soil intact.
- I. **Describe** one way burning forests contribute to atmospheric pollution.
- J. **Describe** one sustainable forestry practice that could be used to reduce the occurrence or severity of forest fires.

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.

4. Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.

(a) **Describe** how TWO climate factors affect the rate of soil formation.

(b) As soils form, distinct layers known as horizons develop over time. One of these is the A horizon.

(i) **Identify** one specific biotic component of the A horizon.

(ii) **Identify** one abiotic component of the A horizon.

Resources such as soil and water can be degraded by human activities.

(c) Nitrate levels exceeding the United States Environmental Protection Agency's primary drinking water standard have been found in the groundwater of areas with intensive agriculture.

(i) **Identify** one agricultural practice that can lead to elevated nitrate levels in groundwater.

(ii) **Describe** how the practice you identified in (c)(i) leads to elevated nitrate levels in groundwater.

(d) Acid deposition has affected soil quality in many parts of the northeastern United States.

(i) **Explain** one way acid deposition onto soil can affect plant health.

(ii) **Describe** one method for remediating soil affected by acid deposition.

(e) Climate change is causing far-reaching ecosystem changes, including soil degradation in many of the world's biomes. **Describe** TWO ways that climate change can degrade soil.

STOP

END OF EXAM