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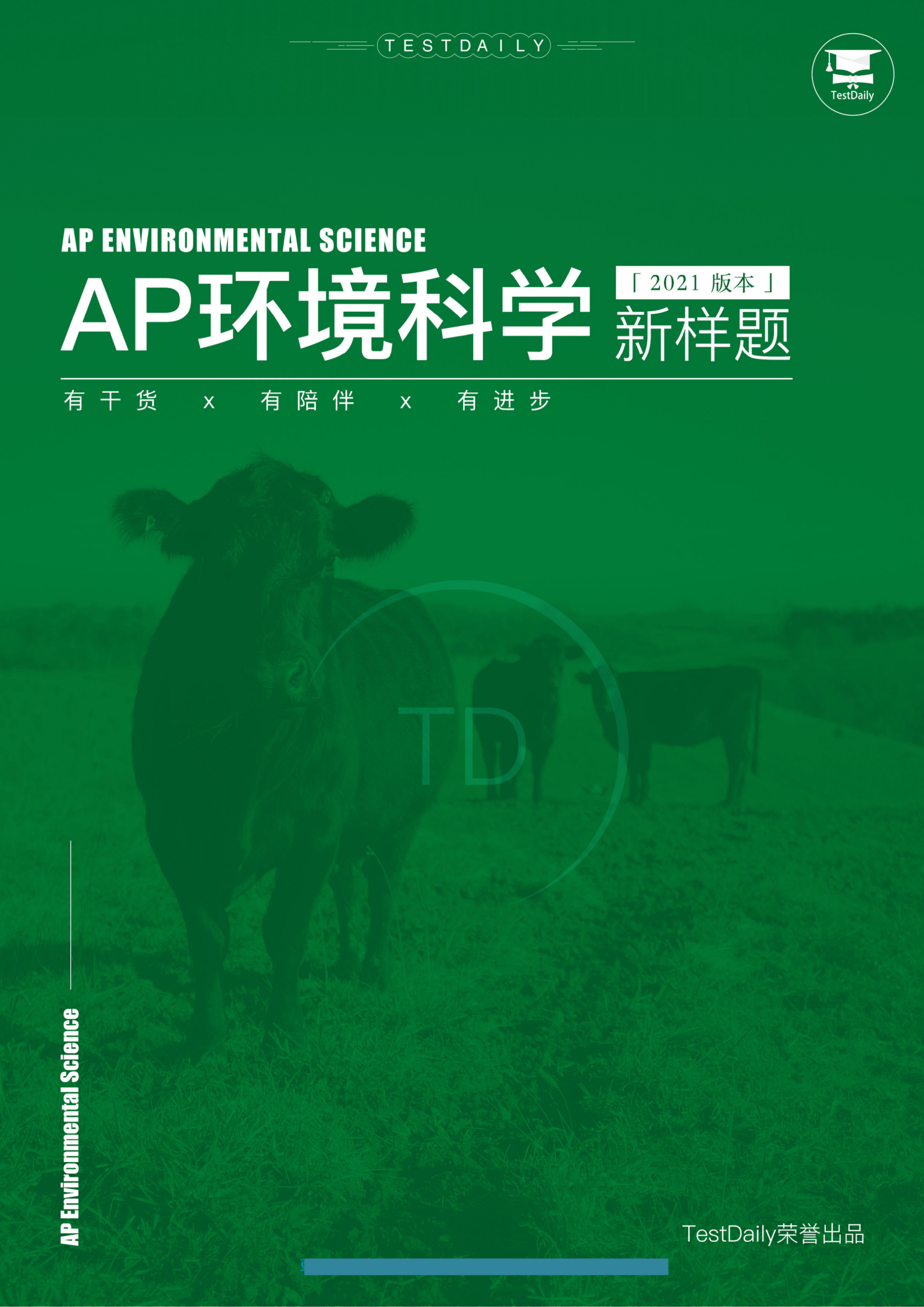
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AP ENVIRONMENTAL SCIENCE

AP环境科学 新样题

「2021 版本」

有干货 x 有陪伴 x 有进步



AP Environmental Science

TestDaily荣誉出品

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Section I: Multiple-Choice Question

1. For which of the following reasons do small isolated islands have a greater rate of species extinction than larger, less isolated islands?

A. Small isolated islands are more likely to receive more migrating species.

B. Small isolated islands provide opportunities for a greater diversity of species.

C. Because of their size, small isolated islands accumulate more species by chance.

D. Small isolated islands have a lower availability of resources.

2. The consumption of mosquitoes by bats and the control of flooding provided by tropical forests in mountainous areas of Central America are examples of

A. adaptive radiation

B. ecosystem services

C. evolution by natural selection

D. ecological equilibrium

3. In North America, native pollinators often increase the quantity and quality of crops of native plants that are insect pollinated more effectively than European honeybees do. The most likely reason for the phenomenon is that native pollinators

A. are unaffected by commercial pesticides

B. are uniformly smaller than European honeybees

C. have no known native predators

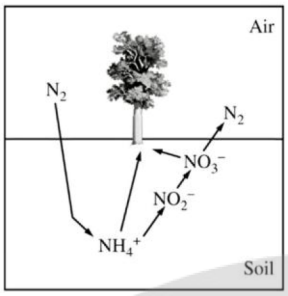
D. have coevolved with native plant species

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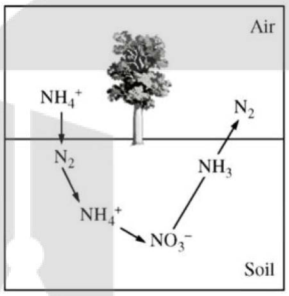
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4. Which of the following diagrams correctly illustrates the nitrogen cycle?

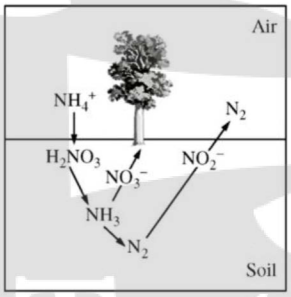
A.



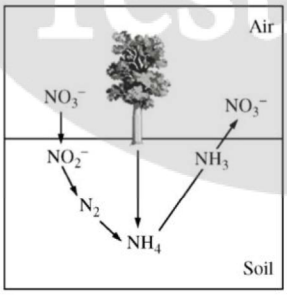
B.



C.



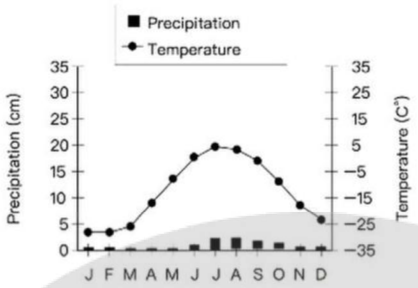
D.



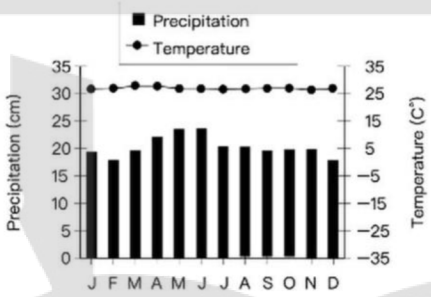
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5. Which of the following climatograms represents the environment characterized by the highest diversity of tree species?

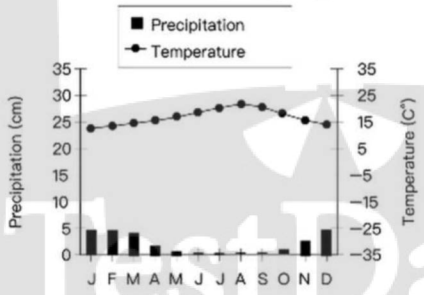
A.



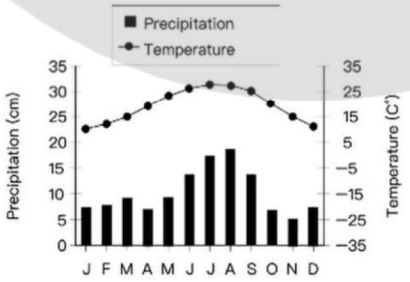
B.



C.

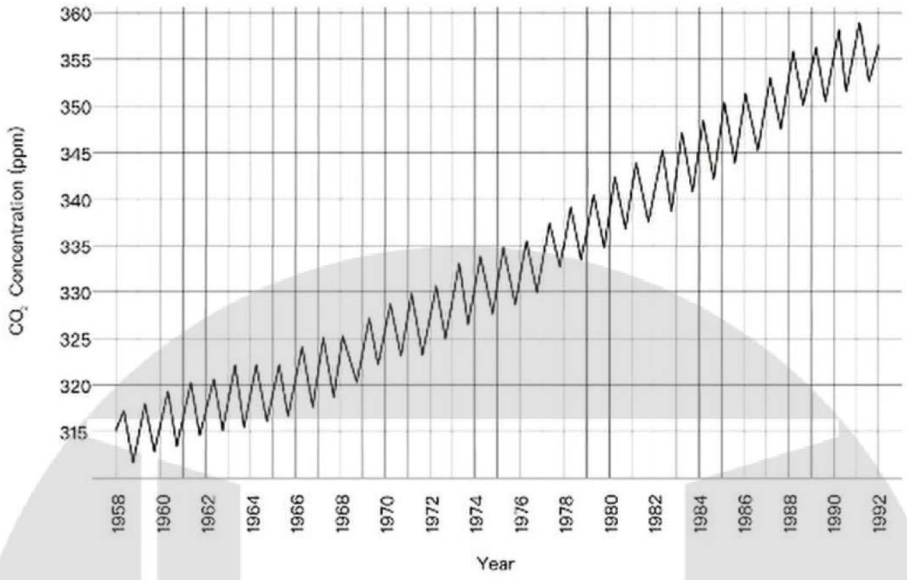


D.



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6. The graph shows the monthly average CO_2 concentration, in parts per million, as measured at Mauna Loa Observatory in Hawaii.



According to the graph, the increase in CO_2 concentration, in parts per million, between 1970 and 1990 is closest to

A. 5 ppm

B. 30 ppm

C. 50 ppm

D. 340 ppm

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Questions 7 through 8 refer to the following table.

Country	Population (millions)	Approximate Total Land Area (million km^2)	Total Annual Electricity Usage (10^{10}kWh)
Australia	19. 7	8. 2	22
Bangladesh	144	0. 14	1. 6
China	1, 295	9. 6	150
Ethiopia	70	1. 12	0. 20
India	1, 000	3. 29	60
United States	300	9. 63	400

7. The country with a population about three times that of the United States is

A. Australia

B. Bangladesh

C. China

D. India

8. The country with the highest population density is

A. Australia

B. Bangladesh

C. China

D. India

9. A country currently has a population of 100 million and an annual growth rate of 3. 5 percent. If the growth rate remains constant, what will be the population of this country in 40 years?

A. 150 million

B. 200 million

C. 300 million

D. 400 million

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10. Of the following, which has the greatest permeability?

A. Clay

B. Loam

C. Sand

D. Silt

11. A homeowner wants to test the soil in their yard to determine if they can grow a type of plant that requires fast draining acidic soil. Which of the following soil tests should the homeowner perform?

A. Nitrogen concentration and phosphorus concentration

B. Nitrogen concentration and pH

C. Permeability and pH

D. Permeability and phosphorus concentration

12. During an El Niño-Southern Oscillation event, which of the following best describes conditions in the eastern part of the tropical Pacific Ocean (e. g. , near Peru and Ecuador)?

A.

Sea Surface Temperature	Rainfall
Low	Low

B.

Sea Surface Temperature	Rainfall
Low	High

C.

Sea Surface Temperature	Rainfall
High	Low

D.

Sea Surface Temperature	Rainfall
High	High

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Questions 13 through 14 refer to the following data table.

Year	Anchovy Catch (10^6 metric tons)	Sea Surface Temperature (℃)
1995	8. 6	18. 9
1996	8. 9	15. 5
1997	7. 7	15. 6
1998	1. 7	26. 2
1999	8. 7	15. 4
2000	11. 2	15. 5
2001	7. 2	16. 9

13. The high sea surface temperature in 1998 was most likely due to

A. global warming

B. El Niño

C. Eutrophication

D. Salinization

14. The low anchovy catch in 1998 was most likely the result of

A. an increase in the number of hurricanes

B. an increase in the population of anchovy predators

C. reduced ocean upwelling along the coast

D. reduced surface runoff due to drought

15. The primary cause of Earth's seasons is the

A. constant tilt of Earth's rotational axis with respect to the plane of its orbit around the Sun

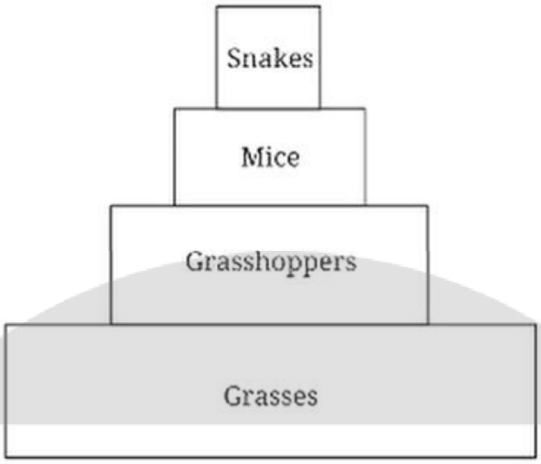
B. changing distance of Earth from the Sun at different times of the year

C. periodic wobbling of Earth on its axis of rotation

D. changing relative positions of Earth, its Moon, and the Sun

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Questions 16 through 18 refer to the following diagram of a biomass pyramid in a grassland ecosystem.



16. Based on the diagram, which group of organisms would be considered herbivores?

A. Snakes

B. Mice

C. Grasshoppers

D. Grasses

17. Based on the diagram, which group of organisms would be considered producers?

A. Snakes

B. Mice

C. Grasshoppers

D. Grasses

18. Based on the diagram, which group of organisms would have the smallest quantity of energy available to sustain them?

A. Snakes

B. Mice

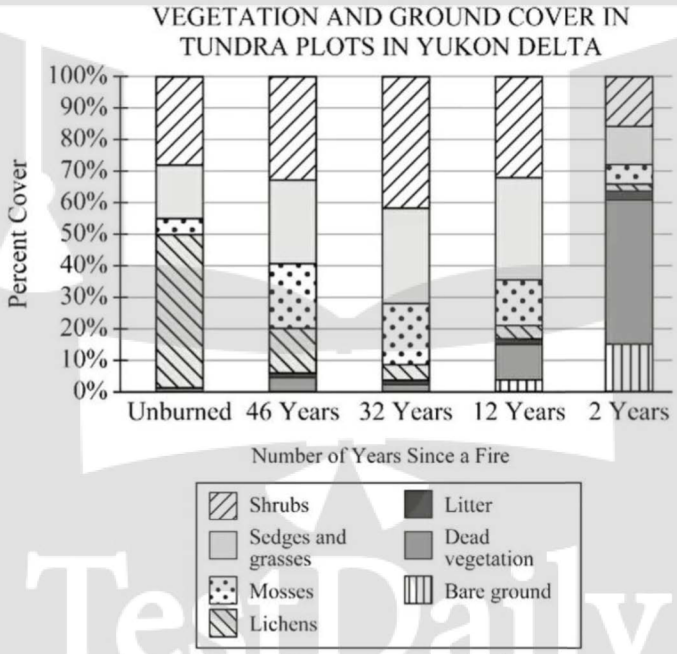
C. Grasshoppers

D. Grasses

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Section II: Free-Response Question

1. The Yukon Delta in Alaska is one of the warmest areas in the Arctic tundra. Common species of flora include lichens, bryophytes and mosses. Other flora such as grasses, sedges, and shrubs are also present. Sedges are grass-like plant species. Tundra fires are common in the Yukon Delta of Alaska.
Scientists collected data on vegetation ground cover in plots along 50-meter transect lines. The percentage of the ground covered by different types of vegetation (or in cases with no vegetation, the bare ground surface) was calculated in an unburned plot as well as several plots that had experienced fire.



a. Based on the information in the graph, identify the percent of cover that was shrubs in the unburned plot.

b. Based on the information in the graph, identify the dominant groundcover in the plot where a fire occurred 2 years before the data were collected.

c. Based on the information in the graph, describe the percent coverage of dead vegetation in the unburned plot compared to the plot burned most recently.

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d. A researcher hypothesizes that in the Alaskan tundra study area, sedges and grasses will dominate the landscape in later succession stages. Make a claim based on evidence in the graph to support or refute this hypothesis.

e. Lichen populations have been eliminated from some areas since the Industrial Revolution. Lichen are sensitive to sulfur dioxide because they can quickly and efficiently absorb sulfur from the atmosphere. Describe how lichen could be used as an environmental indicator species to monitor emission levels from a power plant that is using a nonrenewable energy source.

Much of the arctic soil is frozen year-round. Scientists measured soil thaw depth in areas burned in the Arctic at S-meter intervals. Additionally, the thickness of surface organic layer was measured at each site. The data collected is in the table below.

Treatment group	Average thaw depth (cm)	Average surface organic thickness (cm)
Unburned plots	41	32
46 years since last fire	42. 5	31. 5
32 years since last fire	47	35. 5
12 years since last fire	52	37

f. Identify the control group for the investigation.

g. Identify the hypothesis of the investigation.

h. Describe the relationship between average thaw depth and average surface organic thickness.

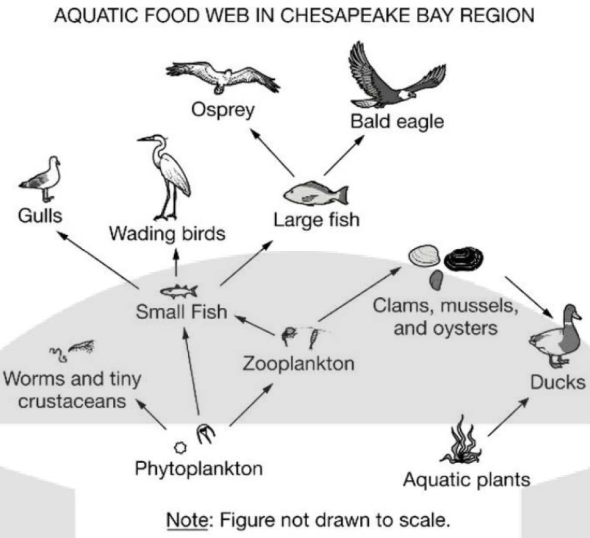
Now a scientist wants to investigate how burning of land affects nutrient levels in soil. The scientist sets up 10 plots, each with an area of 1 m^2. Five plots are burned, and five plots are not burned. Over the next year, a variety of soil tests are performed in the plots every month.

i. Explain why the scientist would test for pH levels in the soil in the study plots.

j. Soil texture also affects soil nutrient levels. Make a claim about the relative soil nutrient levels in sandy soils compared to clay soils.

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2. The food web illustrates the feeding relationships between organisms in the Chesapeake Bay, a coastal estuary in the eastern United States.



a. Based on the information in the diagram, identify a primary producer.

b. Based on the information in the diagram, identify an organism that is an omnivore.

c. Based on the information in the diagram, identify a population of organisms that likely has the highest amount of energy available in the food web.

d. Based on the information in the diagram, explain why an increase in the bald eagle population could lead to a decrease in the osprey population.

e. Based on the information in the diagram, explain why a decrease in the wading bird population would likely lead to an increase in the biomass in the large fish population.

f. Based on the information in the diagram, identify a primary consumer that is also a generalist species.

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g. The city of Baltimore is one of many cities located on the Chesapeake Bay, and the presence of urban areas affects the biogeochemical cycles of the Chesapeake Bay region in different ways than do more rural areas. Describe one environmental problem caused by a change to a biogeochemical cycle in the Chesapeake Bay that is related to urban areas like the city of Baltimore.

h. Make a claim that proposes a workable solution to the problem you identified in part g.

i. For the solution you proposed in part h describe one additional benefit that could result from the implementation of your solution.
The land use around the Chesapeake Bay is primarily agricultural, with large areas of land that were originally forested now used for the poultry industry. Many of these poultry farms are large-scale feeding operations.

j. Describe one unintended consequence of concentrated poultry feeding operations on the biodiversity in the Chesapeake Bay.

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3. The Fremont School District uses oil to heat school buildings. Go Green! is a new project the district will implement. The superintendent has declared that the district will dedicate itself to reducing its carbon footprint. In addition to taking serious energy-conservation measures, the district is planning to help offset its carbon dioxide emissions by raising money to help conserve a portion of a large tract of forest land adjacent to the high school campus.

a. Describe how fossil fuels form.

b. Explain how the use of fossil fuels affects the timing of the typical movement of carbon between storage reservoirs in the carbon cycle.

c. Identify TWO ecological benefits provided by intact forest ecosystems (other than reducing CO_2 levels in the atmosphere).
Use the assumptions below to answer the questions that follow. For each calculation, show all work.

·The biomass of the forest increases at an annual rate of 2.7×10^5 kg/ha.

·The forest biomass is 50 percent carbon by mass.

·Each year the district uses 3.0×10^5 gallons of fuel oil for heating and hot water.

·10 kg of CO_2 is produced when 1 gallon of fuel oil is burned.

·1.0 kg of CO_2 contains 0.27 kg of carbon.

·The cost of putting 1.0 ha of the forest into conservancy is $12,000.

d. Calculate the mass of carbon, in kg , that is accumulated and stored in 1.0 ha of forest in one year.

e. Calculate the mass of carbon, in kg , that is emitted by the school as a result of its fuel-oil consumption in one year.

f. Calculate the amount of money the school district must raise to conserve enough hectares of forest in order to offset the carbon released in one year by the school burning its fuel oil.

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2021 Digital Exam Practice

AP Environmental Science

Scoring Materials for Digital Exam Practice

Please note: the digital exam practice resource was developed for students to complete technology checks, experience the digital platform,and practice answering exam questions, including each type of multiple-choice and free-response question they will encounter on exam day.
This digital exam practice is not a full-length exam, and it does not represent the complete scope of content and skills that students will see on the actual AP exam. This digital exam practice includes only content that would typically be taught in the first half of the school year, following the unit sequence in the AP Environmental Science Course and Exam Description. For more information on the 2021 Exam format, please visit: apcentral.collegeboard.org/pdf/ap-2021-exam-formats.pdf

AP Exams are scored differently than traditional high school or college exams. When an AP Exam is administered, psychometric analysis determines the score ranges corresponding with each AP Exam score (5, 4, 3, 2, and 1) based on a composite score scale that combines and weights the different exam parts. Earning 40-50% of the available points can result in a score of 3 or better on many AP Exams. However, because the number of points corresponding with each AP Exam score can vary on different exams, students and teachers should not use the results of the digital exam practice to predict performance on the 2021 AP Exam.

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Multiple-Choice Answer Key

Multiple-Choice Question	Answer
1	D
2	B
3	D
4	A
5	B
6	B
7	D
8	B
9	D
10	C
11	C
12	D
13	B
14	C
15	A
16	C
17	D
18	A

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Question 1: Design an Investigation — 10 points

(a) Based on the information in the graph, **identify** the percent of cover that was shrubs in the unburned plot. **1 point**

Accept one of the following:

- 27%
- 28%
- 29%

(b) Based on the information in the graph, **identify** the dominant groundcover in the plot where a fire occurred 2 years before the data were collected . **1 point**

Accept one of the following:

- dead vegetation

(c) Based on the information in the diagram, compare the percent coverage of dead vegetation in the unburned plot to the plot burned most recently. **1 point**

Accept one of the following:

- There is a higher percentage of dead vegetation ground cover in the plot that was burned most recently (two years before the data were collected).
- There is a lower percentage of dead vegetation ground cover in the unburned plot compared to the plot that was burned most recently.
- The percent cover of dead vegetation in the unburned plot is close to 0% compared to the most recently burned plot at 42% – 45%. Carbon cycling in the savanna will occur at a higher rate than in the tundra because there are warmer temperatures.

(d) A researcher hypothesizes that in the Alaska tundra area in the study, sedges and grasses will dominate the landscape in later succession stages. **Make a claim** based on evidence in the graph to support or refute this hypothesis . **1 point**

Accept one of the following:

- The hypothesis is refuted because lichens (50% ground cover) dominate the unburned plot, not sedges and grasses (17% ground cover).
- The hypothesis is refuted because sedges and grasses do not dominate in the unburned plot or later succession stage such as 46 years.

(e) **Describe** how lichen could be used as an environmental indicator species to monitor emission levels from coal-burning power plants . **1 point**

Accept one of the following:

- Coal-burning power plants can release sulfur dioxide into the air. If lichen populations decline in an area, it could indicate that excessive sulfur dioxide was being emitted from coal-burning power plants.

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(f)	**Identify** the control for the investigation. Accept one of the following: • unburned plots	**1 point**
(g)	**Identify** the hypothesis of the investigation. Accept one of the following: • The average thaw depth will decrease overall as the number of years since the last fire increases or the average thaw depth will increase overall as the number of years since the last fire decreases. • The average surface organic thickness will increase overall as the number of years since the last fire increases or the average surface organic thickness will decrease overall as the number of years since the last fire decreases.	**1 point**
(h)	**Describe** the relationship between average thaw depth and average surface organic thickness . Accept one of the following: • As the average thaw depth increased overall, the average surface organic thickness decreased overall. • As the average thaw depth decreased overall, the average surface organic thickness increased overall. • The average thaw depth and the average surface organic thickness are inversely proportional.	**1 point**
(i)	**Explain** why the scientist would test for pH levels in the soil. Accept one of the following: • Most soil nutrients are more soluble in slightly acidic soils. pH is a measure of acidity and would therefore indicate if it would be for soil nutrients to be taken up by plants or a soil amendment would need to be added to make the soil more acidic. • Plants are adapted to growing at specific levels of acidity in soil. pH is a measure of acidity and a wildfire may alter the soil's pH to the point that it exceeds a plant's range of tolerance and some plants would be unable to grow. • Typically, after a wildfire the pH of soil increases. A high pH may indicate a more recent fire.	**1 point**

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(j)	Soil texture also affects soil nutrient levels. **Make a claim** about the relative soil nutrient levels in sandy soils compared to clay soils. Accept one of the following: • Soils with high percentages of clay tend to hold more water and nutrients than sandy soils so sandy soils would have lower nutrient levels than clay soils. • Soils with high percentages of clay have negatively charged sites on clay particles (high cation exchange capacity) that help them hold positively charged nutrient ions. As a result, clay soils have higher nutrient levels than sandy soils. • Soils with high percentages of clay have a higher surface area than sandy soils. As a result, clay soils have higher nutrient levels than sandy soils.	**1 point**
	Total for question 1	**10 points**

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Question 2: Analyze an Env. Problem and Propose a Solution — 10 points

(a)	Based on the information in the diagram, **identify** a primary producer. Accept one of the following: • Phytoplankton • Aquatic plants	**1 point**
(b)	Based on the information in the diagram, **identify** an organism that is an omnivore. Accept one of the following: • Small fish • Ducks	**1 point**
(c)	Based on the information in the diagram, identify a population of organisms that likely has the highest amount of energy available in the food web. Accept one of the following: • Phytoplankton • Aquatic plants	**1 point**
(d)	Based on the information in the diagram, **explain** why an increase in the bald eagle population could lead to a decrease in the osprey population. Accept one of the following: • Bald eagles and ospreys compete for large fish; if there are more bald eagles, there could be less food available for the ospreys or more competition for prey. • Bald eagles and ospreys specialize in the same prey, so if there are more bald eagles, there could be less food available for the ospreys or more competition for prey.	**1 point**
(e)	Based on the information in the diagram, **explain** why a decrease in the wading bird population would likely lead to an increase in the biomass in the large fish population. Accept one of the following: • The wading birds and the large fish compete for small fish; if there are fewer wading birds, then there would likely be more food available for the large fish or less competition for the prey. • Wading birds and large fish specialize in the same prey, so if there are fewer wading birds, there would be more food available for the large fish or less competition for the prey.	**1 point**

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(f)	Based on the information in the diagram, **identify** a primary consumer that is also a generalist species. Accept one of the following: • Small fish • Ducks	**1 point**
(g)	**Describe** one environmental problem caused by a change to a biogeochemical cycle in the Chesapeake Bay that is related to urban areas like the city of Baltimore. Accept one of the following: • Runoff from impervious surfaces affects the water cycle by reducing the volume of groundwater resulting in land subsidence. • Runoff from impervious surfaces affects the water cycle by increasing the volume of surface water resulting in floods that damage riparian areas. • Runoff from impervious surfaces affects the nitrogen cycle by increasing the concentration of nitrogen in surface water resulting in harmful algal blooms. • Runoff from impervious surfaces affects the phosphorus cycle by increasing the concentration of nitrogen in surface water resulting in harmful algal blooms. • Fossil fuel use affects the carbon cycle by reducing the amount of carbon in fossil fuel reservoirs, which can result in land subsidence. • Fossil fuel use affects the carbon cycle by increasing the amount of carbon dioxide in the atmosphere resulting in global warming. • Fossil fuel use affects the nitrogen cycle by increasing the amount of NOx in the atmosphere resulting in acid rain. • Fossil fuels use affects the sulfur cycle by increasing the amount of SOx in the atmosphere resulting in acid rain.	**1 point**
(h)	**Make a claim** that proposes a workable solution to the problem you identified in (g). Accept one of the following: • replacing traditional pavement with permeable pavement • planting trees in median strips/sidewalk boxes, rain gardens on rooftops • incorporating urban gardens • replace fossil fuel use with alternative energy sources • reduce fossil fuel use though energy conservation	**1 point**

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(i) For the solution you proposed in part (h) **describe** one additional benefit that could result from the implementation of your solution . **1 point**

Accept one of the following:

Proposed Solution from part (h)	Additional Benefit
• permeable pavement	• decreased flooding during storms
• planting trees	• reduce urban heat island effect
• urban gardens	• reduced urban heat island effect • provide locally grown produce that reduces need for transport of food from more distant areas
• reduce fossil fuel use	• decreased spending on healthcare for air pollution-related illness
• replace fossil fuels	• increased jobs in the alternate energy sector • decreased spending on healthcare for air pollution-related illness

(j) **Describe** one unintended consequence of concentrated poultry feeding operations on the biodiversity in the Chesapeake Bay . **1 point**

Accept one of the following:

- (Organic) wastes could run off into the bay.
- Nutrients from feces or excess foods could run off into the bay.
- Antibiotics that are often used in such operations could be toxic to some aquatic organisms (e.g., algae).
- Hormones that are often used in such operations could affect growth and reproduction of some aquatic organisms (e.g., frogs, fish).

Total for question 2 **10 points**

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Question 3: Analyze an Environmental Problem and Propose a Solution (with Calculations) — 10 points

(a) **Describe** how fossil fuels form. — **1 point**

Accept one of the following:

- Fossil fuels form when buried organic material is subjected to heat and pressure for millions of years.
- Fossil fuels form when decomposed plants and animals are buried and subjected to heat and pressure for millions of years.

(b) **Explain** how the use of fossil fuels affects the timing of the typical movement of carbon between storage reservoirs in the carbon cycle. — **1 point**

Accept the following:

- When fossil fuels are extracted from long-term storage reservoirs and burned, the carbon is transferred to the atmosphere much faster than under natural conditions.

(c) **Identify** TWO ecological benefits provided by intact forest ecosystems (other than reducing CO_2 levels in the atmosphere). — **2 points**

Accept two of the following:

- Provide homes/shelter (students may say "habitat") for organisms
- Provide food for organisms
- Maintain biodiversity
- Moderate/regulate (local) climate
- Produce oxygen
- Purify water
- Purify air
- Reduce soil erosion
- Absorb/store/regulate water
- Moderate stream temperature
- Moderate stream flow
- Aid in nutrient cycling
- Aid in soil formation

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(d)	**Calculate** the mass of carbon, in kg, that is accumulated and stored in 1.0 ha of forest in one year. One point for the correct setup: • 1 ha forest x 2.7 x 10^5 kg forest/ha forest x 0.5 kg C/kg forest One point for the correct calculation: • 1.35 x 10^5 kg • 135,000 kilograms	**2 points**
(e)	**Calculate** the mass of carbon, in kg, that is emitted by the school as a result of its fuel-oil consumption in one year. One point for the correct setup: • 3.0 x 10^5 gal x 10 kg CO2/gal x 0.27 kg C/kg CO2 One point for the correct calculation: • 8.1 x 10^5 kg • 810,000 kilograms	**2 points**
(f)	**Calculate** the amount of money the school district must raise to conserve enough hectares of forest in order to offset the carbon released in one year by the school burning its fuel oil. One point for the correct setup: • 8.1 x 10^5 kg C x 1 ha forest/1.35 x 10^5 kg C x $12,000/ha • 8.1 x 10^5 kg C x 1 ha forest/1.35 x 10^5 kg C = 6 ha x 12,000 dollars/ha One point for the correct calculation: • $72,000 • 7.2 x 10^4 dollars	**2 points**
	Total for question 3	**10 points**

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Section I: Multiple-Choice Question

1. 本题选 D

本题考察 Unit 2 岛屿生态系统

A 选项为与世隔绝的小岛更有可能接纳更多的迁徙物种。B 选项小岛为物种多样性提供了机会。C 选项由于它们的大小，孤立的小岛偶然积累了更多的物种。D 选项为小的孤立岛屿可获得的资源较少。在岛屿生态系统理论中，岛屿面积会决定生物多样性，这主要是由系统稳定性决定的，面积越小，物种通常越少，各种资源都匮乏，更容易灭绝。

2. 本题选 B

本题考察 Unit 2 生态系统服务

蝙蝠捕食蚊子与热带雨林控制洪水，分别隶属于生态服务的支持功能和管理功能，因此选生态服务，A 选项为适应辐射，C 选项为进化，D 选项为生态平衡，都和本题干无关。

3. 本题选 D

本题考察 Unit 9 本地物种

本地物种比起外来物种更好的适应了环境变化并且与其他本地物种达到了和谐状态，所以当地传粉者比起外来传粉者会与当地物种共同发展，选择 D。而其他选项 A，本地物种同样也受杀虫剂的影响，B 选项，大小并不影响传粉效果，C 选项没有当地捕食者，本地物种也有捕食者。

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4. 本题选 A

本题考察 Unit 1 N 循环

空气中的 N 组分是氮气，N 循环从空气中的氮气开始，经过硝化作用，反硝化作用等最后变回氮气，重新进入大气中，因此选择 A。

5. 本题选 B

本题考察 Unit 1 陆地生态系统-热带雨林

热带雨林是物种多样性最多的生态系统，它的气候特点是温度高并且降雨多，根据题目的气候图，选择降水最多，温度最高的即可。

6. 本题选 B

本题考察 Unit 9 全球变化的 CO2 增多

本题为计算问题，直接读取数据，1990 年浓度为 355 左右，1970 年为 325 左右，因此二者差值为 30ppm 左右。

7. 本题选 D

本题考察 Unit 3 人口数量

直接根据图标获得数据，其中美国的人口为 300，印度的人口为 1000，比例关系大约为 3 倍，印度是最接近 3 倍的选项。

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8. 本题选 B

本题考察 Unit 3 人口密度

人口密度为人口数量除以国土面积，这道题目利用表格数据进行具体计算，其中 Bangladesh 的密度计算为 144/0.14 约为 1000，是表格中人口密度最高的国家。

9. 本题选 D

本题考察 Unit 3 人口倍增时间

人口增长速度为 3.5%，则人口倍增时间为 70/3.5=20 年，因此经过 40 年，人口倍增两次，则 100 变为 400。

10. 本题选 C

本题考察 Unit 4 土壤质地

土壤粒子分为三种，sand，silt 以及 clay，其中 sand 粒径最大，渗透性最好，silt 次之，clay 的渗透性最差，而 loam 是三种粒子的混合物。因此 sand 渗透性最好。

11. 本题选 C

本题考察 Unit 4 土壤的性质

根据题干，户主需要一种土壤要求酸性并且排水快，应该分析土壤的哪种性质，酸性对应的性质为 PH，排水速度对应的是渗透性（Permeability），因此选择 C。A 选项为营养物质 NP 的含量，B 选项为 N 的含量与 PH，D 选项为渗透性和 P 含量，均不对应。

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12. 本题选 D

本题考查 Unit 4 厄尔尼诺现象

厄尔尼诺现象发生时，东太平洋的上升流受到阻碍，取而代之的是温度较高的表面海水，同时温度较高随之而来的是高蒸发量，致使更多的降水产生。因此选择 D 选项。

13. 本题选 B

本题考查 Unit 4 厄尔尼诺现象

本题需要的适当的思考，厄尔尼诺现象会影响气候，而 A 选项全球变暖是长期的过程，bi 哪个不是某年高低的变化，C 选项水体营养化和温度的直接关联非常弱，D 选项盐渍化也同样没有什么关系，因此选 B。

14. 本题选 C

本体考察 Unit 4 厄尔尼诺现象

厄尔尼诺现象会导致鱼类的减少，渔业的崩溃，主要是因为该现象会阻碍海底的上升流，影响海底营养的上浮，因此选择 C 选项。

15. 本题选 A

本题考查 Unit 4 四季

季节产生的原因是地球围绕太阳公转，并且在旋转时候黄赤交角的存在，使得地球出现南北回归线，导致了四季的产生。因此选择 A 选项。

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16. 本题选 C

本题考查 Unit 1 食物链

根据营养金字塔，Grass 是生产者，食用生产者的生物称为 herbivore，在 Grass 上方的为 Grasshoppers，选择 C 选项。

17. 本题选 D

本题考察 Unit 1 营养级

生产者的定义为各种可以实现自养的植物，位于食物链的开始部分，因此本题选择 Grass。

18. 本题选 A

本题考察 Unit 1 营养级

营养级越高，生物数量越少，同时能够获取的能量也少，在这个图表中，获得营养最少的应该营养级最高的生物即 snakes，选择 A。

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Section II: Free-Response Question

1. 本题 a-d 问考察生态演替的过程，并需要结合着图表进行数据分析，进行一些简单计算。

a. 根据图中的信息，确定未燃烧地块中灌木覆盖的百分比，直接读取灌木的范围大概是 72%-100%之间，因此总共占据大约 28%，本题 27%与 29%也同样是正确答案。

b. 根据图中的信息，确定数据收集前 2 年发生火灾的土地上主要的生物，根据图表，占据最多的是 Dead vegetation。

c. 根据图中的信息，描述未燃烧的土地与最近被燃烧的土地中死亡植被覆盖率的百分比，未燃烧的百分比为 1%左右，燃烧后的大约为 60%-15%=45%，本题可以利用数据解释也可以直接解释

第一种解释为：The percent cover of dead vegetation in the unburned plot is close to 0% compared to the most recently burned plot at 42% – 45%. Carbon cycling in the savanna will occur at a higher rate than in the tundra because there are warmer temperatures.

第二种解释为：There is a higher percentage of dead vegetation ground cover in the plot that was burned most recently (two years before the data were collected).

两种解释方法均可。

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d. 一位研究人员假设，在阿拉斯加冻土带研究区域，莎草和禾草将在演替后期主导景观。根据图表中的证据提出一个主张来支持或反驳这个假设。本题应当是反对意见，根据图表，有两个数据可以使用，一个是未被燃烧的土地，占比最高的是 lichens，另一个是燃烧 46 年后，占比最高的是 Shrubs，从两个角度其中一个进行反驳即可，示例如下：

The hypothesis is refuted because lichens (50% ground cover) dominate the unburned plot, not sedges and grasses (17% ground cover).

The hypothesis is refuted because lichens (50% ground cover) dominate the unburned plot, not sedges and grasses (17% ground cover).

e 问考察 Unit 8 指示物种

e. 自从工业革命以来，一些地区的地衣已经灭绝了。地衣对二氧化硫很敏感，因为它们能迅速有效地吸收大气中的硫。描述地衣如何作为一种环境指示物种来监测使用不可再生能源的发电厂的排放水平。因为地衣比较敏感，如果一个发电厂释放过多的二氧化硫，周边的地衣数量会下降，起到检测作用，示例如下：

Coal-burning power plants can release sulfur dioxide into the air. If lichen populations decline in an area, it could indicate that excessive sulfur dioxide was being emitted from coal-burning power plants.

f-h 问考察 Unit 9 实验的内容

f. 确定调查的对照组，对照组为没有烧过的土地，即 unburned plots

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g. 确认调查的假设，假设可以分为两个方面，一个是平均解冻深度，一个为平均表面有机物厚度，回答如下：

The average thaw depth will decrease overall as the number of years since the last fire increases or the average thaw depth will increase overall as the number of years since the last fire decreases.

The average surface organic thickness will increase overall as the number of years since the last fire increases or the average surface organic thickness will decrease overall as the number of years since the last fire decreases.

h. 描述平均解冻深度与平均表层有机厚度的关系，根据图表所示，解冻深度和有机层的厚度成反比，因此可以解释为：

As the average thaw depth increased overall, the average surface organic thickness decreased overall.

As the average thaw depth decreased overall, the average surface organic thickness increased overall.

The average thaw depth and the average surface organic thickness are inversely proportional.

i-j 问考察的为 Unit 4 土壤的性质

i. 解释科学家为什么要测试研究地块土壤的 pH 值。因为酸度越高，越有利于养分的溶解，分析酸度可以评测养分的含量，而同时野火会影响酸度，可以体现土壤是否被酸度影响过。示例如下：

Most soil nutrients are more soluble in slightly acidic soils. pH is a measure of acidity and would therefore indicate if it would be for soil nutrients to be taken up by plants or a soil amendment would need to be added to make the soil more acidic.

Plants are adapted to growing at specific levels of acidity in soil. pH is a measure of acidity and a wildfire may alter the soil's pH to the point that it exceeds a plant's range of tolerance and

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some plants would be unable to grow.

j. 土壤质地也影响土壤养分水平。粘土含量高的土壤往往比砂土含有更多的水分和营养物质，粘土含量高的土壤在粘土颗粒上有带负电荷的位置(高阳离子交换容量)，这有助于它们保持带正电的营养离子。因此，粘土比沙土具有更高的营养水平。解释如下：

Soils with high percentages of clay tend to hold more water and nutrients than sandy soils so sandy soils would have lower nutrient levels than clay soils.

Soils with high percentages of clay have negatively charged sites on clay particles (high cation exchange capacity) that help them hold positively charged nutrient ions. As a result, clay soils have higher nutrient levels than sandy soils.

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2. a-f 考察 Unit 1 的食物链，食物网和营养级别的内容

a. 根据图中的信息，确定主要生产者。生产者有两个，Phytoplankton 和 Aquatic plants 均可。

b. 根据图中的信息，确定一种生物是杂食动物。杂食动物指的是又可以食肉也可以食草的动物，因此 Small fish 和 Ducks 均可。

c. 根据图中的信息，确定在食物网中可能拥有最高能量的生物种群。根据能量流动原则，营养级越低其营养越多，越往上流动营养越少，因此 Phytoplankton 和 Aquatic plants 均可。

d. 根据图中的信息，解释为什么秃鹰数量的增加会导致鱼鹰数量的减少。因为两种生物互为竞争者，同样捕食 Large fish，可以解释为：

Bald eagles and ospreys compete for large fish; if there are more bald eagles, there could be less food available for the ospreys or more competition for prey.

Bald eagles and ospreys specialize in the same prey, so if there are more bald eagles, there could be less food available for the ospreys or more competition for prey.

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e. 根据图中的信息，解释为什么 wading bird 种群的减少可能会导致大型鱼类种群生物量的增加。因为二者互为竞争关系，同样捕食 small fish，解释为：

The wading birds and the large fish compete for small fish; if there are fewer wading birds, then there would likely be more food available for the large fish or less competition for the prey.

Wading birds and large fish specialize in the same prey, so if there are fewer wading birds, there would be more food available for the large fish or less competition for the prey.

f. 根据图表中的信息，确定一个初级消费者也是一个兼性物种。初级消费者指的是食草类动物，而兼性物种意味着生存环境比较多样化，在图表中的含义为可以吃多种食物，因此 Small fish 和 Ducks 均可。

g-i 问考察 Unit1 物质循环，Unit 5 城市扩张以及 Unit 7 大气污染

g. 描述一个由切萨皮克湾城市地区的对生物地球化学循环的影响。城市对于物质循环的影响主要包括水循环的影响，表现为不透水路面的问题，C、N、S 循环的影响，主要表现为城市化石燃料燃烧会增加三者的排放，因此本题回答如下：

Runoff from impervious surfaces affects the water cycle by reducing the volume of groundwater resulting in land subsidence.

Fossil fuel use affects the carbon cycle by reducing the amount of carbon in fossil fuel reservoirs, which can result in land subsidence.

Fossil fuel use affects the carbon cycle by increasing the amount of carbon dioxide in the atmosphere resulting in global warming.

Fossil fuel use affects the nitrogen cycle by increasing the amount of NOx in the atmosphere resulting in acid rain.

Fossil fuels use affects the sulfur cycle by increasing the amount of SOx in the atmosphere resulting in acid rain.

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h. 对你在第 g 部分中发现的问题提出可行的解决方案。对于水循环的影响，可以通过更换渗水路面来实现，而化石燃料问题可以通过寻找替代品的方式实现，回答方式如下：

replacing traditional pavement with permeable pavement.

replace fossil fuel use with alternative energy sources.

reduce fossil fuel use though energy conservation.

i. 对于您在 h 部分提出的解决方案，请描述您的解决方案的实施可能带来的一个额外好处.渗透路面的好处也可以减少地表径流，减少洪水。寻找化石燃料替代品可以减少空气污染，保护人类健康。回答如下：

decreased flooding during storms

decreased spending on healthcare for air pollution-related illness.

j 问考察 Unit 5 集中养殖的问题

j. 描述集中饲养家禽对切萨皮克湾生物多样性造成的意外后果。集中养殖对于环境的危害包括动物粪便的累计，疾病的传播以及可能造成水体污染等，回答方式如下：

(Organic) wastes could run off into the bay.

Nutrients from feces or excess foods could run off into the bay.

Antibiotics that are often used in such operations could be toxic to some aquatic organisms (e.g., algae).

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3. a-c 问考察 Unit 6 化石燃料，Unit 1 C 循环以及 Unit 2 生态服务

a. 描述化石燃料是如何形成的。化石燃料由植物埋葬在地底下经过百万年形成的，这个过程伴随着高压和比较高的温度，回答如下:

Fossil fuels form when buried organic material is subjected to heat and pressure for millions of years.

Fossil fuels form when decomposed plants and animals are buried and subjected to heat and pressure for millions of years.

b. 解释化石燃料的使用如何影响碳循环中储存库之间典型的碳流动的时间。化石燃料的使用会影响 C 平衡，以为化石燃料是很早以前储存的 C，解释为:

When fossil fuels are extracted from long-term storage reservoirs and burned, the carbon is transferred to the atmosphere much faster than under natural conditions.

c. 森林生态系统提供的两项生态效益(减少大气中的二氧化碳水平除外)。森林可以为生物提供栖息地，还可以为动物提供食物，并且可以产生氧气，保持水土流失，净化空气等，因此可以从以下方面回答:

Provide homes/shelter (students may say “habitat”) for organisms

Provide food for organisms

Moderate/regulate (local) climate

Produce oxygen

Purify air

Reduce soil erosion

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d-f 问考察计算

d. 计算碳的质量，以 kg 为单位，在 1 公顷的森林一年储存多少 C

一公顷每年增加 270000kg，其中百分之五十是 C，因此计算方法为 270000*0.5=135000kg

e. 计算学校因一年的燃油消耗而排放的碳的质量(以公斤为单位)。

每年燃烧 300000gallon 的燃料，每 gallon 释放 10kg 二氧化碳，每 kg 二氧化碳里有 0.27kgC，计算方式为 300000*10*0.27=810000kg

f. 计算出该学区必须筹集多少资金来保护足够公顷的森林，以抵消学校燃烧燃油在一年内所释放的碳。

保护一公顷森林花费$12000，计算方式为 810000/135000*12000=$72000.

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