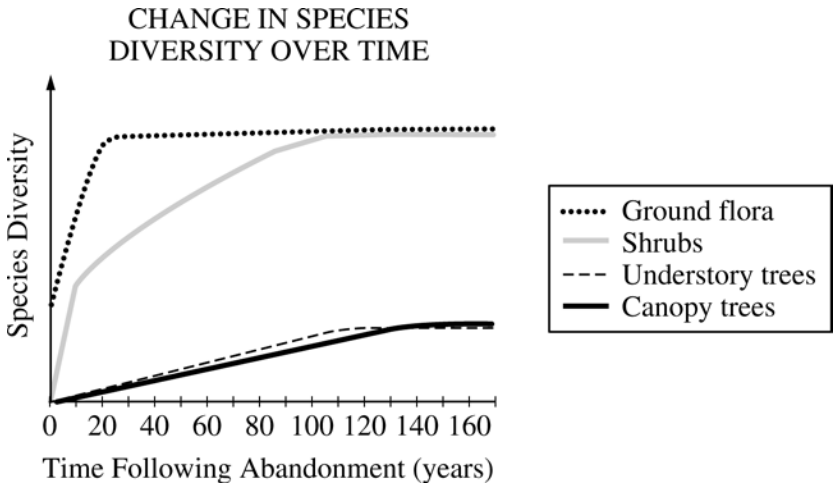
AP® BIOLOGY
2011 SCORING GUIDELINES (Form B)

Question 2

Ecological succession describes the pattern of changes in communities over time. The graph below shows changes in plant diversity following the abandonment of an agricultural field in a temperate biome.



(a) **Discuss** the differences in plant diversity shown in the graph and **explain** how the changes affect the animal species composition between years 0 and 120.
(*4 points maximum*)

Discussion of differences in diversity shown in the graph (2 points maximum)

- Differences in the amount of diversity
  - More diversity in ground flora and shrubs
  - Less diversity in understory and canopy
- Differences in the rate of change in diversity
  - Rapid change in ground flora and shrubs
  - Slow change in understory and canopy
- Differences in the rate to community stabilization
  - Faster for ground flora
  - Slower for understory and canopy

Explanation of effect on animal species composition (2 points maximum)

- Pioneer community consists of small herbivores, insects, and other small, ground-dwelling animals.
- Climax community consists of insects, birds, and mammals and is multilayered.

(b) **Identify** TWO biotic and TWO abiotic factors and **discuss** how each could influence the pattern of ecological succession.
(*4 points maximum*)

Examples of biotic factors (1 point for each identification and 1 point for each appropriate discussion of its influence on succession; 2 points maximum)

- Competition
- Predation
- Herbivory

Question 2 (continued)

- Disease
- Parasitism
- Seed dispersal
- Nitrogen fixation
- Reproductive strategy
- Human impact

Examples of abiotic factors (1 point for each identification and 1 point for each appropriate discussion of its influence on succession; 2 points maximum)

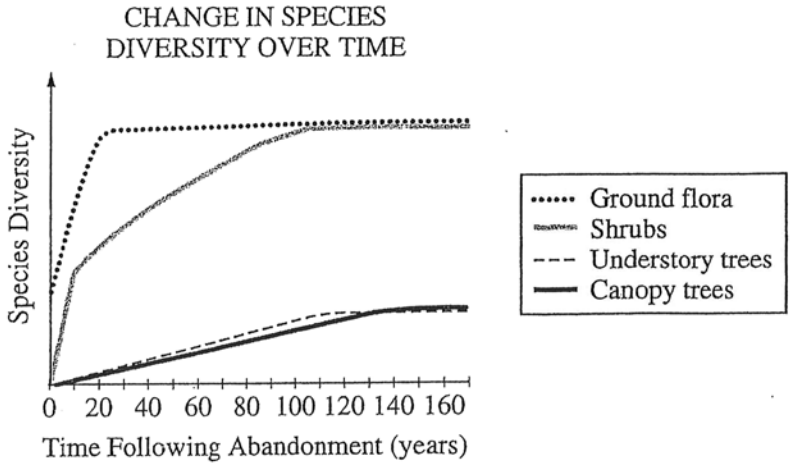
- Climate
- Rainfall
- Light
- Wind
- Temperature
- Soil composition
- Fire
- Drought
- Altitude
- Geographic location

(c) **Design** a controlled experiment to determine how the diversity of plant species in a newly abandoned field would be affected by large herbivores.
(*4 points maximum*)

Experiment design (1 point each)

- Identify the independent variable and how it is manipulated.
- Identify the dependent variable and how it is measured (e.g., "count number of species"; not "observe diversity").
- Discuss variables to be held constant (at least three; one can be "divide the field in half").
- Identify the control (e.g., no herbivores).
- Verification and replication (e.g., large plot or many plots).
- Hypothesis or testable prediction related to species diversity.

2. Ecological succession describes the pattern of changes in communities over time. The graph below shows changes in plant diversity following the abandonment of an agricultural field in a temperate biome.



2A1

(a) **Discuss** the differences in plant diversity shown in the graph and **explain** how the changes affect the animal species composition between years 0 and 120.

(b) **Identify** TWO biotic and TWO abiotic factors and **discuss** how each could influence the pattern of ecological succession.

(c) **Design** a controlled experiment to determine how the diversity of plant species in a newly abandoned field would be affected by large herbivores.

a.

All of the ground flora and shrubs have much more species diversity than the understory trees or canopy trees. The pioneer species moved in first and started to grow here. This explains the rapid increase in the species diversity in the first few years. There will be many species here that rely on flora and shrubs and that will stay consistant. The flora and shrubs have reached

2A2

their carrying capacity. The trees will slowly continue to become more diverse, so species will continue to increase in number and diversity. ...

b. One biotic factor that could influence the pattern of ecological succession is the logistic growth of a species that feeds off of the vegetation growing here. If the species thrives and becomes overpopulated, the number of ~~PS~~ vegetation will decrease. Another biotic factor that could affect the pattern of ecological succession is the introduction of new species that compete in the same niche for resources, or interspecific competition. In the end, only one species will prevail.

An abiotic factor that could effect the pattern of ~~ecolo~~ ecological succession is the temperature. If temperature ~~increases too~~ fluctuates too much species may not be adapt to live. Another abiotic factor is rainfall. Too much rain could drown species, and draught can

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ADDITIONAL PAGE FOR ANSWERING QUESTION 2

kill plant species. Natural disaster is another abiotic factor including volcanoes, hurricanes, storms, tornadoes, wildfires, and so on.

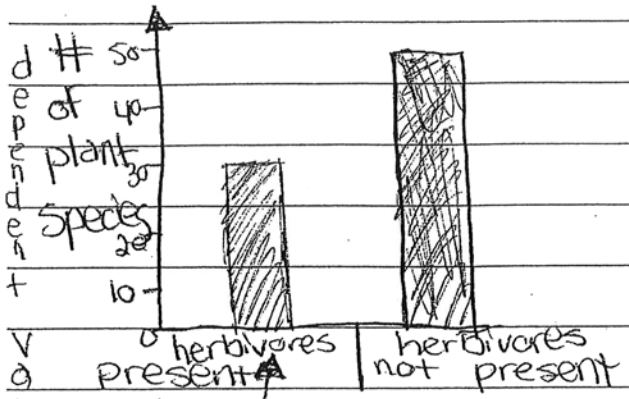
C. First, I would make a hypothesis. I hypothesise that releasing large herbivores would decrease the species diversity in plants. The independent variable would be the presence of large herbivores. The dependent variable would be number of different species of plants after a period of time.

As a control, I would allow a newly abandoned field grow with plants for several years, making sure to keep any large herbivores out. All of the variables would have to remain constant, such as temperature, amount of rainfall, and soil composition, and amount of sunlight. Next, I would have a separate field, but place large herbivores on the plot of land. I would observe the separate numbers of plant species in a table over

2A-4

a certain number of years. After recording data, I would want to make a graph.

The Effect of Large Herbivores on Species Diversity



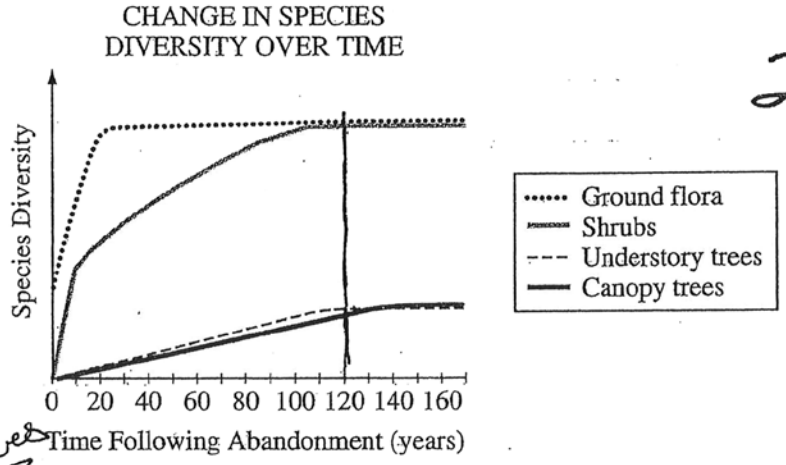
independent variable on X-axis

y-axis

From the experiment I would draw my conclusion, retest it, and publish it.

2. Ecological succession describes the pattern of changes in communities over time. The graph below shows changes in plant diversity following the abandonment of an agricultural field in a temperate biome.

2B1



2. Competition among the for resources 2

(a) **Discuss** the differences in plant diversity shown in the graph and **explain** how the changes affect the animal species composition between years 0 and 120.

1, Bacteria (soil) (Nitrogen fixing bacteria)

(b) **Identify** TWO biotic and TWO abiotic factors and **discuss** how each could influence the pattern of ecological succession.

L Water temperature / sunlight

(c) **Design** a controlled experiment to determine how the diversity of plant species in a newly abandoned field would be affected by large herbivores.

A, It seems that the trees in the ecosystem have undergone less diversification that the other shrubs and ground flora. This is ~~prob~~ probably because of their rates of reproduction and population size. There are fewer ~~the~~ trees and therefore ~~there~~ a smaller genetic pool and less allelic variation. This, coupled with a more paced rate of reproduction and longer life span, has resulted in less diversity. On the other hand, shrubs and flowers and grasses have greater population sizes and can often interbreed, resulting in a large genetic pool and a large amount of allelic variation, which over a rather short period of time, has resulted in alot of ~~other~~ diversification.

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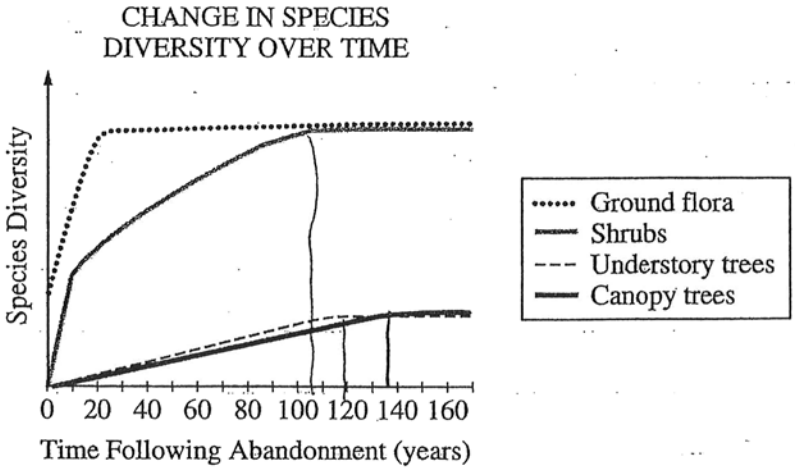
2B2

B. Two biotic factors that could affect succession is (1) competition and (2) the availability of nitrogen-fixing bacteria. ~~Certain trees~~ With respect to competition, some plants are naturally better adapted to their environments, which results in their dominance in the area. Furthermore, some species may rely more on the availability of nitrogen in the soil than other species, ~~the~~ and therefore the amount and type of bacteria present is important. Two abiotic factors would include (1) water and (2) sunlight. Water is important to all plants, and the ability of a plant to conserve water may make it better adapted to survive. Further, plants that live under the canopy must be adapted to reduced sunlight to live successfully.

C. To create such an experiment, one needs two seperate areas, both with the same type of flora, except one will contain herbivores, and the other will be allowed to grow on its own. Just let the two areas sit for some time (several years), and compare the type of diversification that has occurred afterward. (one must also insure that ~~both~~ regions have equal access to pollinators, sunlight, water, etc.).

2. Ecological succession describes the pattern of changes in communities over time. The graph below shows changes in plant diversity following the abandonment of an agricultural field in a temperate biome.



2C1

(a) **Discuss** the differences in plant diversity shown in the graph and **explain** how the changes affect the animal species composition between years 0 and 120.

(b) **Identify** TWO biotic and TWO abiotic factors and **discuss** how each could influence the pattern of ecological succession.

(c) **Design** a controlled experiment to determine how the diversity of plant species in a newly abandoned field would be affected by large herbivores.

As for as differences, the ground flora and the shrubs are very close to the ground whereas the understory trees and canopy trees are tall. The species of ground flora diversified at an incline for about twenty years after the abandonment and then leveled off. The shrubs diversified at a steep rate for about 10 years and then the the rate was not as sharp anymore. Finally, after about 60 years, the diversification leveled off as well.

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The Understory and canopy trees, the tall plants, diversities are above the same steady. Slow rate. The understory shrubs leveled off first after about 20 years. The canopy trees did the same after 140 years.

Two factors that could influence the pattern of ecological succession could be occurrences in nature and expansion of civilization. Natural occurrences could wipe out whole species and make lands barren and unfertile. As civilization expands, species needed for ecological succession dwindles and is altogether eradicated. Meanwhile inventions of man also hurt the earth and endangers ecological processes.

Experiment:

Simply introduce species of large herbivores to a newly abandoned field before hand, observe and record the amount of species and the rate of diversification of species. Then after 50 years to centry, observe and record here many species and the rate of the diversification of the species

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in the abandoned field after the institution of the species of herbivores.

$2C_3$

AP® BIOLOGY
2011 SCORING COMMENTARY (Form B)

Question 2

Sample: 2A
Score: 10

In part (a) the response earned 1 point for stating that "the ground flora and shrubs have much more species diversity than the understory trees or canopy trees." Another point was earned for stating, "The flora and shrubs have reached their carrying capacity." The response does not address animal species composition.

The response earned the maximum of 4 points in part (b). One point was earned for identifying a biotic factor that could influence succession: "If the species [earlier described as feeding on vegetation] thrives and becomes overpopulated, the number of vegetation will decrease." The response earned 1 point for identifying "the introduction of new species" as a biotic factor and stating that it could cause competition "in the same niche." The third point was earned for identifying temperature as abiotic and explaining that some of the species may not be adapted to live with extreme temperature fluctuations. The fourth point was earned for identifying rainfall as abiotic and explaining that "[t]oo much rain could drown species." Additional examples did not earn points because the maximum of 4 points had already been reached.

The response earned the maximum of 4 points in part (c). One point was earned for stating a testable hypothesis, "I hypothesise [*sic*] that releasing large herbivores would decrease the species diversity in plants." Another point was earned for stating, "The dependent variable would be number of different species of plants after a period of time." The third point was earned for identifying three variables to hold constant: temperature, rainfall, and soil composition. The fourth point was earned for identifying the independent variable by stating that "I would have a separate field but place large herbivores on the plot of land." An additional point could have been earned for stating, "I would draw my conclusion, retest it, and publish it," but the response had already earned the maximum number of points in this part.

Sample: 2B
Score: 7

In part (a) the response earned 1 point for stating that the trees "have undergone less diversification" than the shrubs and ground flora. The response does not address animal species composition.

The response earned the maximum of 4 points in part (b). Two points were earned for identifying two biotic factors (competition and nitrogen-fixing bacteria) and explaining how they are related: "some species may rely more on the availability of nitrogen in the soil than other species, and therefore the amount and type of bacteria present is important." The response earned 1 point for identifying water as an abiotic factor and explaining that "the ability … to conserve water" makes some plants "better adapted," and 1 more point was earned for identifying sunlight as another abiotic factor and stating that "plants that live under the canopy must be adapted to reduced sunlight to live successfully."

In part (c) the response earned 1 point for identifying the independent variable ("two seperate [*sic*] areas, both with the same type of flora, except one will contain herbivores"). One point was earned for holding three variables constant: "equal access to polinators [*sic*], sunlight, water, etc."

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Question 2 (continued)

Sample: 2C
Score: 4

In part (a) 1 point was earned for stating that the "ground flora diversified at an incline for about twenty years." One point was earned for stating that after 20 years the ground flora "leveled off." The response does not address animal species composition.

No points were earned in part (b) because no biotic or abiotic factors are identified.

In part (c) 1 point was earned for identifying the independent variable: "introduce … large herbivores to a newly abandoned field." The description of the dependent variable earned 1 more point: "[o]bserve and record how many species [exist] … after the institution [*sic*] of the species of herbivores."