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AP[®]

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AP[®] Biology

Sample Student Responses and Scoring Commentary

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Question 5: Analyze Model or Visual Representation of a Biological Concept or Process

4 points

The following models represent all the interacting species in two different communities with some of the same species and feeding relationships. These models assume that both communities have the same initial biomass. The models can be used to understand the effects of human activities on the communities.

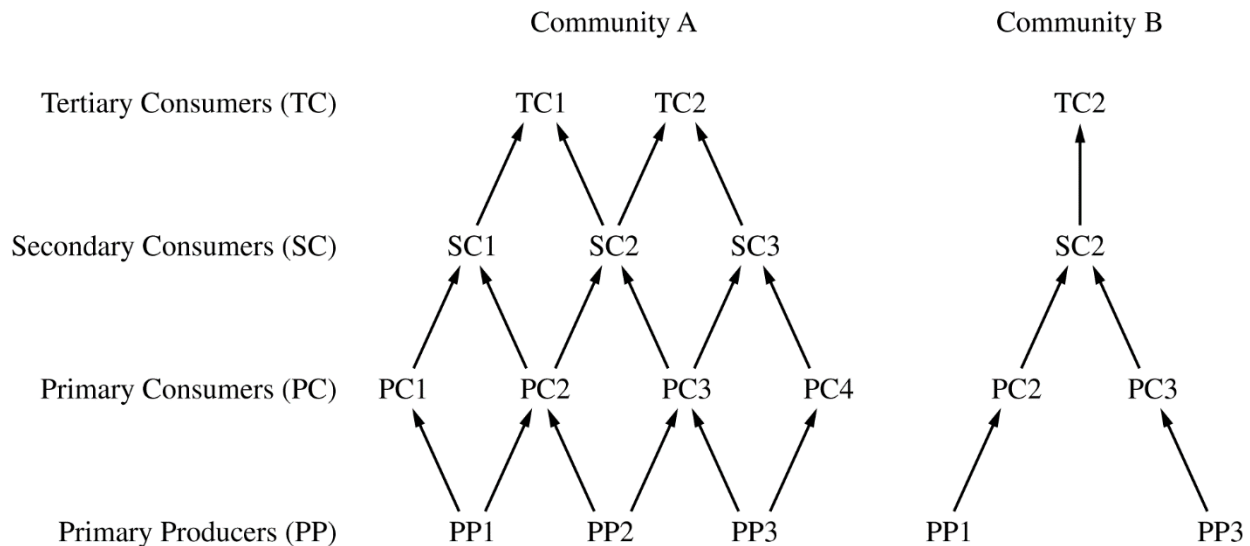


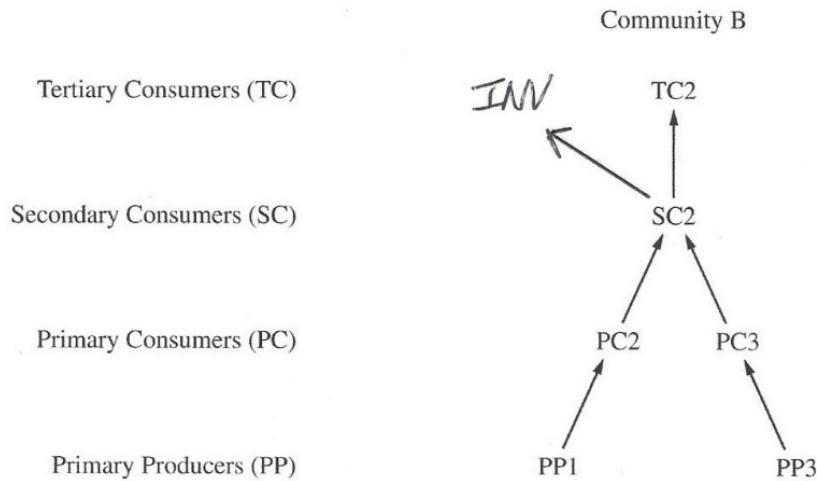
Figure 1. Models of two different communities with some of the same species

- (a) **Describe** a characteristic of a community that makes a species invasive in that community but not invasive in a different community. **1 point**
- Accept one of the following:
- There are no/reduced numbers of natural predators of the species in the community where it is invasive.
 - There are no/reduced numbers of competitors of the species in the community where it is invasive.
 - There are no/reduced numbers of diseases to which the species is susceptible in the community where it is invasive.
-
- (b) **Explain** why removing species PP1 will have a greater effect on community B than on community A. **1 point**
- Accept one of the following:
- In community B, there will be decreases in PC2, SC2, and TC2 / PC2, SC2, and PC3. In community A, PC2 has alternative food sources.
 - With fewer/less diverse primary producers (and primary consumers), there are fewer paths for energy to move through the community.
 - With fewer species/fewer feeding interactions/less diversity, community B will be less resilient to future environmental change.

- (c) An invasive species (INV) that eats individuals of species SC2 is introduced into community B. Using the template in the space provided for your response, for community B, indicate the feeding relationship for this invasive species by correctly placing **INV** to represent the invasive species and **an arrow** to represent the feeding relationship within community B.

1 point

- INV should be added in a position that is horizontally aligned with TC2. An arrow should point from SC2 to INV.



- (d) **Explain** how human activities that add toxins to the soil could change a community with many species at each trophic level, such as community A, into a community with few species at each trophic level, such as community B.

1 point

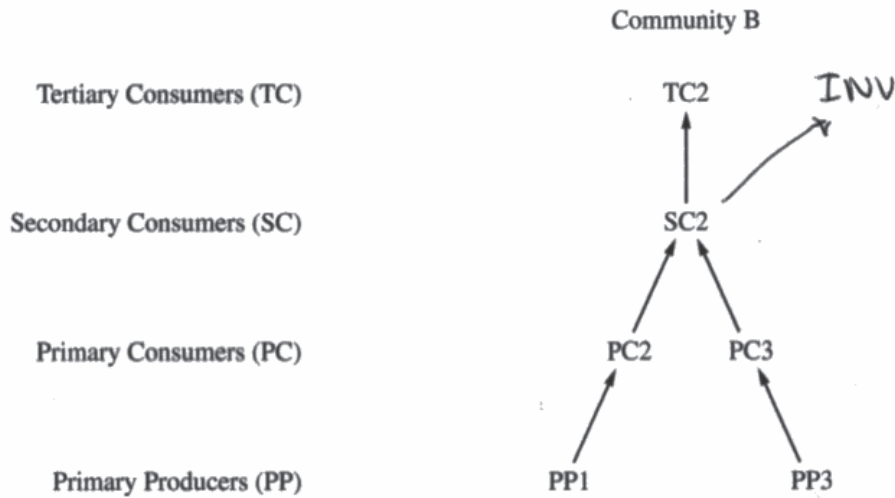
Accept one of the following:

- The activities could eliminate primary producers, which reduces species diversity at higher trophic levels.
- The activities could cause biomagnification of the toxins, reducing species diversity at higher trophic levels.

Total for question 5 4 points

BEGIN Question 5

Begin your response to **QUESTION 5** on this page. Do not skip lines.



- a. A community not having a natural predator or worse competition allows a species to become invasive as they are able to grow & thrive in their new environment. However, if the community has a natural predator or there's other species more suited to the environment than the "invasive" species, then it can't be invasive because it isn't taking over the ecosystem with its growth & expansion.
- b. Removing PP1 ~~work~~ from Community B would mean that PC2 would have no food, essentially killing it off. This would lead to SC2 only having half of its food available, making its population drop & consequently TC2's as well. ~~How~~ However, such drastic changes wouldn't occur in Community A because only PC1 solely depends on PP1. PC2 could still eat PP2 & SC1 could then only eat PC2. With multiple source of food, the

Additional page for answering Question 5

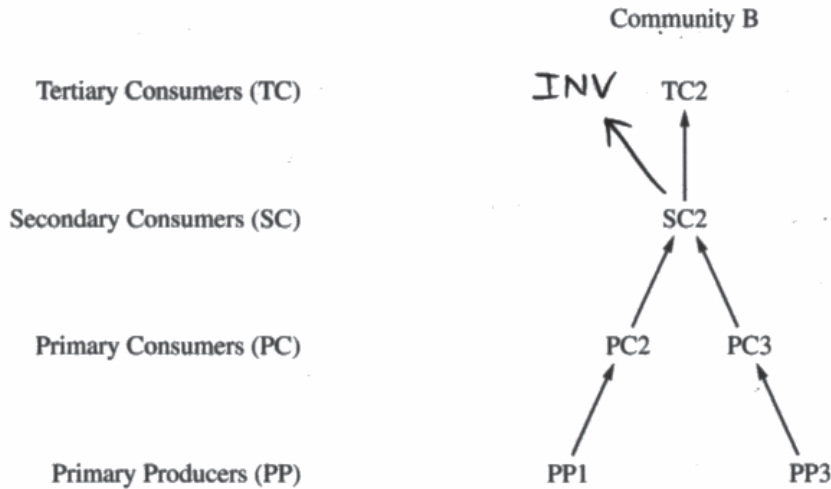
Continue your response to **QUESTION 5** on this page. Do not skip lines.

loss of PP1 would have a much smaller impact on Community A.
d. Human activities that add toxins to the soil would kill many plants, which are primary producers. Less primary producers would lead to less food for primary consumers, making their population numbers drop. There would then be less ~~for~~ primary consumers for secondary consumers to eat, leading their population numbers to drop. With less resources, ~~the~~ many species of each trophic level would compete more. This would likely lead to many species being outcompeted to the point where they go extinct or migrate away from the community. Thus, each trophic level would have less species.

Use a pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

BEGIN Question 5

Begin your response to **QUESTION 5** on this page. Do not skip lines.



A) One characteristic of a community could be the niches and resources it occupies and utilizes. If an invasive species begins to compete for those same resources, it will be invasive in that community, and if it has a greater fitness as compared to the existing species, it will be invasive. In a different community where the new species utilizes different niches and resources, or has less fitness than the existing species, it will not be invasive.

B) Removing PP1 will have a greater effect on Community B because PP1 is only one of 2 primary producers in Community B, and is the only one that supplies PC2. In Community A, there are three primary producers, thus removal of one would

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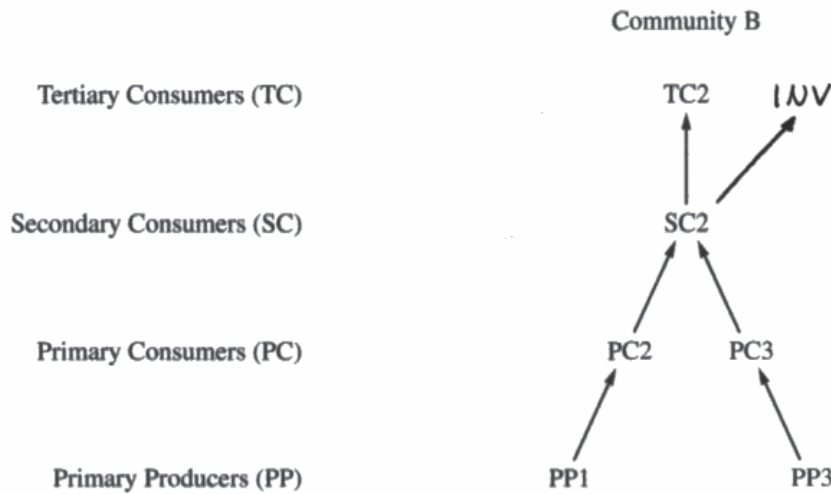
have less impact.

D) Human activities that add toxins could result in the ~~loss~~ extinction of a type of primary producer, thus resulting in the collapse of the section of the food chain containing consumers that rely on the producer for food. Additionally, biomagnification of the toxin ~~is~~ when the animals move up the food chain could also result in increased extinction. This would decrease the species at each trophic level.

Use a pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

BEGIN Question 5

Begin your response to **QUESTION 5** on this page. Do not skip lines.



If one community were to have an abundance of a food source for a specific species, that species would grow to the point where the community cannot support it, and possibly lead to the extinction of that food source. However, if a community only has a small amount of a food source that a species needs, that species will not grow to the point of being invasive.

Removing the PP1 species from community A will result in one of the four PCs losing a food source. If the PP1 species was removed from Community B, one of two, or half of the primary consumers would no longer have a food source. Therefore there would be a greater effect on community B.

If humans introduce toxins into the soil, it could cause many of the plant life (PP) to die. This could lead to

Additional page for answering Question 5

Continue your response to **QUESTION 5** on this page. Do not skip lines.

fewer primary producers in the community, which would leave less food for the primary consumers (PC), leading to a decrease in the food available to secondary consumers (SC), and so on.

Question 5

Note: Student samples are quoted verbatim and may contain spelling and grammatical errors.

Overview

Question 5 presented models of the food webs of two communities that differ in species diversity.

Responses to part (a) were expected to describe that invasive species can exploit niches that are free from competitors or predators (Learning Objective SYI-2.A).

Responses to part (b) were expected to explain that removing a primary producer from community B that contains only two primary producers would decrease the energy available to all trophic levels, while removing a primary producer from community A that contains three primary producers would have less effect, because there are more paths for energy to move through community A (Learning Objective SYI-3.F).

Part (c) described an invasive species introduced to community B, the community with lower species diversity. Responses were expected to represent the relationships among the invasive species and other species in the community (Science Practice 2D).

Responses to part (d) were expected to explain that human activities could eliminate primary producers, resulting in reduced species diversity at higher trophic levels of the community (Learning Objective SYI-2.B).

Sample: 5A

Score: 4

The response earned 1 point in part (a) for describing a lack of predators of a species as a characteristic of a community that makes the species invasive. The response earned 1 point in part (b) for explaining that removing PP1 from community B would cause a decrease in PC2, which would result in decreases in SC2 and TC2, while PC2 in community A has an alternative food source if PP1 were removed. The response earned 1 point in part (c) for correctly representing INV. The response earned 1 point in part (d) for explaining that toxins could eliminate primary producers, reducing species diversity at higher trophic levels.

Sample: 5B

Score: 2

The response did not earn a point in part (a) because the response identifies “niches and resources” as a characteristic instead of the lack of or reduction in the numbers of predators or competitors or diseases of the species. The response did not earn a point in part (b) because the response does not indicate that the numbers of PC2, SC2, and TC2 in community B would all decrease as a result of removing PP1, while in community A, PC2 has alternative food sources. The response earned 1 point in part (c) for correctly representing INV. The response earned 1 point in part (d) for explaining that biomagnification of the toxins could result in reduction of species diversity at higher trophic levels.

Sample: 5C

Score: 1

The response did not earn a point in part (a) because the response incorrectly identifies “abundance of a food source.” The response did not earn a point in part (b) because the response does not explain that the numbers of SC2 and TC2 would decrease as a result of removal of PP1. The response earned 1 point in part (c) for correctly representing INV. The response did not earn a point in part (d) because the response does not explain that elimination of primary producers would result in a decrease of species diversity at higher trophic levels.