

2021

AP[®]

CollegeBoard

AP[®] Environmental Science

Sample Student Responses and Scoring Commentary Set 1

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Free Response Question 3

- Scoring Guideline**
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Question 3: Analyze an Environmental Problem and Propose a Solution**Doing Calculations****10 points**

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- (a) **Describe** a characteristic of a specialist species that would make the specialist species more likely to be negatively affected by habitat fragmentation than a generalist species. **1 point**

Accept one of the following:

- Specialists have narrow ecological niches compared to broad niches of generalist species, which are reduced even further by habitat fragmentation.
- Specialists with specialized adaptations are unable to adapt quickly, making them more vulnerable to habitat fragmentation than generalists that adapt quickly.
- Specialists tend to have small populations with less genetic variation than generalist species with larger populations and more genetic variation, making specialists more vulnerable to habitat fragmentation.

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- (b) **Identify** the symbiotic relationship between the wood thrush and the cowbird. **1 point**

Accept one of the following:

- Parasitism
- Brood Parasitism
- The cowbird uses the wood thrush (as the surrogate parent) to raise their hatchling, which negatively affects the wood thrush and benefits the cowbird.

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- (c) **Describe** one ecological advantage of leaving areas of undeveloped forest in the development plan as compared to clear-cutting the property. **1 point**

Accept one of the following:

- Since the habitat isn't being clear-cut, it does preserve some biodiversity by allowing some of the species to survive in the fragmented areas of the forest.
 - Habitat fragmentation can benefit some generalist species or species which thrive in edge habitat, leading to population increases for those species.
 - If planned with buffer zones around targeted conservation areas, edge disturbances for specialist species can be reduced.
 - The remaining forest/trees will reduce soil erosion.
 - The remaining forest will help with climate/cooling resulting from transpiration/shade from trees.
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- (d)** **Propose** a solution that will minimize the effect of development on the resident population of wood thrush while still meeting the municipality’s need for a housing development. **1 point**

Accept one of the following:

- Leave areas for wildlife corridors/crossings to prevent isolating populations.
- Include conservation easements in the plan that will preserve species and also provide tax breaks for the residents.
- Create buffer zones near the development to separate it from wildlife habitat.
- Create a mitigation plan that preserves land elsewhere of similar quality.
- Cluster housing or vertical development to limit the development footprint.
- Incorporate common green spaces that promote wood thrush populations.

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- (e)** A male wood thrush needs a minimum of 800 m² of territory for reproduction. The municipal development committee has set a biodiversity preservation target of 275 male wood thrush territories. **Calculate** the area that must be set aside to support the goal of 275 male thrush territories. **Show** your work. **1 point**

One point for the correct setup to calculate the area:

- $275 \text{ territories} \times \frac{800 \text{ m}^2}{1 \text{ territory}}$

One point for the correct calculation of the area: **1 point**

- 220,000 m²

Total for part (e) 2 points

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- (f)** A real estate developer wants to build houses on the property. The plan will support 1,000 lots with a lot size of 1,100 m². The developer has proposed setting aside land equal to 10% of the size of each lot it sells. **Calculate** the maximum number of male wood thrush territories that could be created under this proposal. **Show** your work. **1 point**

One point for the correct setup to calculate the number of male wood thrush territories:

- $1,000 \text{ lots} \times \frac{1,100 \text{ m}^2}{1 \text{ lot}} \times 0.10 \div 800 \text{ m}^2 \text{ per territory}$

One point for the correct calculation of the number of male wood thrush territories, accept one of the following: **1 point**

- 137.5 male wood thrush territories
- 137 male wood thrush territories
- 138 male wood thrush territories

Total for part (f) 2 points

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- (g)** Calculate the percentage of each of the 1,000 lots that would need to be set aside in order to support the goal of 275 male wood thrush territories. **Show** your work. **1 point**

One point for the correct setup to calculate the percentage of each lot to be set aside:

- $\frac{220,000 \text{ m}^2}{1,100,000 \text{ m}^2} \times 100$
- $275 \text{ territories} \times \frac{110,000 \text{ m}^2}{137.5 \text{ territories}} \div 1,100,000 \text{ m}^2 \times 100$
- $\frac{275 \text{ territories} \times 10\%}{137.5 \text{ territories}} \times 100$

One point for the correct calculation of the percentage of each lot to be set aside: **1 point**

- 20% of each lot

Total for part (g) 2 points

Total for question 3 10 points

Question 1

Question 2

Question 3



Begin your response to each question at the top of a new page. Do not skip lines.

3a.) Specialist species have narrower range of tolerance and can only survive in certain conditions, so ~~the~~ they are not as able to adapt as generalists, which have wider range of tolerance and can respond/adapt better to environmental disruptions like habitat fragmentation.

3b.) Parasitic relationship between wood thrush & cowbird.

3c.) Undeveloped forests sequester carbon and are carbon sinks, and can also help regulate climate. Clearcutting ~~it~~ releases carbon dioxide into the atmosphere, contributing to global warming. Undeveloped forests prevent global warming due to the high albedo/reflectivity of trees & storage of carbon.

3d.) Grow up instead of out, so make multi-story housing development that reduces the use and development of land, and reduces habitat destruction.

$$3e.) \frac{800 \text{ m}^2}{1 \text{ wood thrush}} \times 275 \text{ wood thrush} = 220000 \text{ m}^2 \text{ of territory}$$

Question 1 Question 2 Question 3



Begin your response to each question at the top of a new page. Do not skip lines.

$$3f.) \quad 1000 \text{ lots} \times \frac{1100 \text{ m}^2}{1 \text{ lot}} = 1,100,000 \text{ m}^2 \times .1 = 110,000 \text{ m}^2$$
$$\frac{110,000 \text{ m}^2}{800 \text{ m}^2} = 137.5 \text{ territories, so } \boxed{137 \text{ territories}}$$

rounded to whole #

3g.) $\approx 220,000 \text{ m}^2$ of territory needed.

$$\frac{220,000 \text{ m}^2}{1,100,000 \text{ m}^2} \times 100 = \boxed{20\%}$$

Question 1 Question 2 Question 3



Begin your response to each question at the top of a new page. Do not skip lines.



- (a) They are specialized to only be able to live in certain habitats.
- (b) Parasitism
- (c) There would be less soil erosion compared to clear-cutting, destroying less habitats of wildlife and plants.
- (d) A solution would be to create a green belt around developed housing areas, so that wood thrush populations could reside there.
- (e) $800 \text{ m}^2 \times 275 = 220,000 \text{ m}^2$
- (f) $1000 \times 1100 \text{ m}^2 \times 0.1 \div 800 \text{ m}^2 = 137.5$
Maximum of 137 male wood thrush territories.
- (g) $800 \text{ m}^2 \times 275 \times 100 \div 1000 \div 1100 \text{ m}^2 = 20$
20% would need to be set aside.

Question 1

Question 2

Question 3



Begin your response to each question at the top of a new page. Do not skip lines.

3. a) A specialist species is less likely to adapt to environmental changes therefore habitat fragmentation causes possible oil contamination which would easily kill off a specialist species. A generalist is able to adapt in different ~~environmen~~ environments.

b) This is a parasitic relationship because it only benefits the cowbirds as their eggs are hatched and raise. Contrarily the wood thrush ~~thrust~~ thrush population will ~~decrease~~ decrease because their eggs are ~~to~~ broken. It only benefits the cowbird.

c) Leaving areas of underdeveloped forests give a change for the emergence and preservation of biodiversity.

d) If you keep some parts of the forest or plant more trees the wood thrush population and the humans will have housing.

e) $800\text{ m}^2 \times 275 \text{ male wood thrush} = 220,000\text{ m}^2$

Question 1

Question 2

Question 3



Begin your response to each question at the top of a new page. Do not skip lines.

$$f) 1,100 \text{ m}^2 \times 1,000 \text{ (trees)} = 1,100,000 \text{ m}^2$$

~~$1,100 \text{ m}^2 \times 1,000 \text{ m}^2 = 1,100,000 \text{ m}^2$~~

$$g) 1,100,000 \text{ m}^2 \times 2.75 \text{ wood thrush} = 30.25\%$$

Question 3

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

Overview

The intent of this question was for students to demonstrate their ability to describe specialist species, identify parasitism, and describe and propose a solution to habitat fragmentation. Students were expected to correctly calculate three values associated with bird territories in a forest undergoing development for housing.

In part (a) students were asked to describe a characteristic of specialist species that would make them more vulnerable to habitat fragmentation than a generalist species [Practice 1-Concept Explanation, Topic 2.1-Introduction to Biodiversity]. In part (b) students were provided a paragraph in the prompt about the relationship between wood thrush and cowbirds that lay eggs in wood thrush nests. Students were asked to identify the symbiotic relationship between the two birds [Practice 1-Concept Explanation, Topic 1.1-Introduction to Ecosystems]. In parts (c) and (d) students were asked to identify an ecological advantage of leaving undeveloped forest rather than clearcutting and to propose a solution for minimizing the impact on the wood thrush while still meeting the needs for housing development [Practice 1-Concept Explanation and Practice 7-Environmental Solutions, Topic 5.2-Clearcutting and Topic 9.10-Human Impacts on Biodiversity]. In parts (e), (f), and (g) of the question, students were asked to calculate the minimum area required for a targeted number of wood thrush territories, how many territories would be created based on a developer's proposal of set aside land, and what percentage of each proposed lot would need to be set aside to meet the targeted number of territories. The calculation portions of the question evaluated understanding and application of Science Practice 6-Mathematical Routines.

Sample: 3A

Score: 9

One point was earned in part (a) for describing “narrower range of tolerance ... so they are not as able to adapt as generalists ... environmental disruptions.” One point was earned in part (b) for identifying “Parasitic.” No point was earned in part (c). One point was earned in part (d) for proposing “Grow up instead of out ... reduces habitat destruction.” Two points were earned in part (e). One point was earned for the correct setup, and one point was earned for correctly calculating “220000 m².” Two points were earned in part (f). One point was earned for the correct setup, and one point was earned for correctly calculating “137 territories.” Two points were earned in part (g). One point was earned for the correct setup, and one point was earned for correctly calculating “20%.”

Sample: 3B

Score: 6

No point was earned in part (a). One point was earned in part (b) for identifying “parasitism.” One point was earned in part (c) for describing that “There would be less soil erosion compared to clear-cutting.” One point was earned in part (d) for proposing the solution to “create a green belt around developed housing areas.” One point was earned in part (e) for correctly calculating “220,000 m².” No point was earned for setup. One point was earned in part (f) for correctly calculating “137 male wood thrush territories.” No point was earned for setup. One point was earned in part (g) for correctly calculating “20%.” No point was earned for setup.

Question 3 (continued)

Sample: 3C

Score: 3

No point was earned in part (a). One point was earned in part (b) for identifying “parasitic.” One point was earned in part (c) for describing “Leaving areas of underdeveloped forest ... preservation of biodiversity.” No point was earned in part (d). One point was earned in part (e) for correctly calculating “220,000 m².” No point was earned for setup. No points were earned in part (f). No points were earned in part (g).