2021

AP CollegeBoard

AP® Environmental Science

Sample Student Responses and Scoring Commentary Set 2

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Free Response Question 2

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Question 2: Analyze an Environmental Problem and Propose a Solution

10 points

(a) (i) **Identify** the latitudinal range with the greatest amphibian species richness. **1 point**

Accept one of the following:

- Between the Tropic of Cancer and the Tropic of Capricorn
- The range between 30 degrees N and 30 degrees S latitude
- The range between 10 degrees N and 15 degrees S latitude

(ii) **Identify** what biome this range most likely represents. **1 point**

- Tropical Rainforest

(iii) **Describe** one reason amphibian species richness would tend to be highest in this region. **1 point**

Accept one of the following:

- More rainfall/warm temperatures year-round are the preferred conditions for amphibians.
- Greater biodiversity/higher NPP provides more habitat/food sources/niches.

Total for part (a) **3 points**

(b) There are many environmental threats facing amphibians today, such as deforestation. **Describe** one possible anthropogenic reason for deforestation. **1 point**

- Human demand for agriculture/housing/firewood/forest products (medicine/food/lumber).

(c) (i) **Explain** how the species richness of an ecosystem influences its response to environmental stressors. **1 point**

- An ecosystem with greater species richness/diversity is more resilient/resistant to environment stressors because some species will survive helping to restore/stabilize the ecosystem.

(ii) **Explain** why amphibian biodiversity is declining globally, other than from deforestation. **1 point**

Accept one of the following:

- Increasing water pollution including:
    - Pollution from pharmaceuticals that cause reproductive harm/decrease reproductive success.
    - Pesticide pollution that is absorbed via the skin and is toxic to amphibians leading to death.
    - Endocrine disruptors (such as atrazine) can alter reproductive development leading to decreased number of successful offspring.
- Pesticide use reduces food sources for amphibians (insects), leading to decreasing population size.
- Microclimatic changes from overall global climate change (e.g., warmer, drier conditions in previously cool, moist areas, loss of wetlands) decreases available habitat leading to a decline in population size.
- Illegal amphibian trafficking removes species from an area leading to a decline in population sizes.
- Introduction of invasive species that compete for niche space leading to a decline in population sizes.
- Habitat fragmentation from human activity would limit range/reduce the ability to access resources, decreasing survival.
- Fungal infections (such as Chytrid) cause their skin to dry out, and they cannot breathe.

Total for part (c) **2 points**

(d) (i) **Identify** one specific piece of legislation that has been designed to protect species threatened by extinction. **1 point**

Accept one of the following:

- Endangered Species Act (ESA)
- Convention on the International Trade of Endangered Species (CITES)
- Lacey Act

(ii) **Explain** how the requirements of the legislation identified in part (d)(i) specifically protect species threatened by extinction. **1 point**

Accept one of the following**:**

Legislation identified in (d)(i)	Explanation of requirements that specifically protect species threatened by extinction
• Endangered Species Act (ESA)	• Lists endangered/threatened plant and animal species and prevents them from being killed or harmed. • Designates/protects critical habitat to promote survival and recovery of listed species. • Creates plans to restore populations to healthy sizes. • Identifies species that are threatened before they become endangered to provide protections.
• Convention on the International Trade of Endangered Species (CITES)	• A global agreement that protects endangered/threatened plants and animals (including goods such as ivory, shark fins, or rhinoceros' horns) by banning/regulating the trade of these species.
• Lacey Act	• Prohibits the trade of wildlife, fish, and plants that have been illegally taken, possessed, transported, or sold.

Total for part (d) **2 points**

(e) (i) **Propose** a viable solution that will result in the protection of the endemic frog species while still allowing for maximum profit of the property development. **1 point**

Accept one of the following:

- Move/transplant the frog populations to an adjacent undeveloped area prior to development.
- A portion of the wetland can be designated as a park/preserve.
- Wildlife corridors (land/bridges) can be built/created on a portion of the wetlands.
- Restrict development within a minimum setback away from the wetland.
- Project developers can group buildings together/can build up, not out.

(ii) **Justify** the solution proposed in (e)(i) by describing a potential advantage of the plan, other than frog protection. **1 point**

Accept one of the following:

Solution proposed in (e)(i)	Justification of how solutions offer potential advantages, other than frog protection
• Move/transplant frogs	• Developers will only have a one-time disruption during the removal but will not have to deal with continued disruptions (such as increasing human population, increasing use of fertilizer/pesticides). • Developer will have the maximum amount of land available.
• Designate as a park/preserve	• By protecting areas, animal species will have more food and space availability increasing survival rates. • Potential educational/environmental draw of living near a park/preserve may allow the developer to charge higher rents for the apartments. • There is aesthetic value of the wetland and its species for the people that live there. • The preserved wetland area will help prevent flooding.
• Use of wildlife corridors	• By establishing corridors, the other species will also not be as greatly affected by multiple habitat fragments. • The animal species can continue to move back and forth for food, shelter, and reproduction by way of the habitat corridors.
• Setback	• By establishing setbacks, a buffer zone will be created between the development and the wetland area, filtering runoff into the wetland. • A buffer zone will add privacy for residents between the two developments.
• Project development	• By developing the apartments in groups/clusters and leaving preserved wetlands, the species will not be as affected by multiple habitat fragments.

Total for part (e) 2 points

Total for question 2 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.

(ai) The greatest amphibian species richness is located between 30° north and 30° south of the equator.

(aii) This range most likely represents the tropical rainforest biome.

(aiii) Amphibian species richness would tend to be highest in this region because tropical rainforests have very high levels of biodiversity, including biodiversity of amphibians.

(b) One possible anthropogenic reason for deforestation is the need for more agricultural land as the world's human population grows.

(ci) The higher species richness an ecosystem has, the easier it is for that ecosystem to respond to environmental stressors. If one species' population declines due to environmental stressors, these species rich ecosystems have more other species to support each others' survival than ecosystems with fewer species.

(cii) Amphibian biodiversity is declining globally due to human pollution of amphibian habitats. Amphibians are especially vulnerable to water pollution, and certain pesticides can kill or sterilize amphibians if they are found in the water where amphibians are living.

(di) CITES has been designed to protect species threatened by extinction.

(dii) CITES protect endangered species by prohibiting their trade and the trade of products made using endangered species.

(ei) The town could sell the pasture sections of the land and leave the wetland undeveloped, as the wetland would be hard to develop and is home to the frogs.

(eii) By leaving the wetland undeveloped, the town would retain more

Question 1 ○ Question 2 ● Question 3 ○

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

protection against flooding. Instead of water getting into homes and causing extra expenses to the town and its residents, the water would be absorbed by the permeable wetland soil and its plants.

Question 1 Question 2 Question 3

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

a) i) latitude 0° has the greatest amphibian species richness.

ii) Tropical rainforests.

iii) Amphibian species richness is most likely highest in tropical rainforests because this biome reaches all of their needs, such as a moist climate with a suitable habitat.

b) The high demand for lumber products is most likely a large ~~sour~~ cause for deforestation.

c) i) High species richness means that there is a high biodiversity in an area. And ~~birds~~ areas with biodiversity respond to ~~environmental~~ environmental stressors well, due to the abundance of multiple species.

ii) Because another habitat for amphibians is fresh water. And fresh water may ~~be polluted~~ now have a ~~this~~ low pH level, causing it to be too acidic for amphibians to survive in.

d) The Endagered Species Act.

ii) The Endangered Species Act states that the poaching of endangered animals is illegal, thus reducing the poaching of endangered species.

e) i) To not use chemicals such as herbicides on the pastures for the crops. Instead nitrogen-fixing crops could be planted from time-to-time instead.

ii) The nitrogen-fixing crops will benefit the soil ~~the~~ by making it nutrient-rich. This will also cause the next crops that are planted in the soil to also be nutrient rich.

Question 1 Question 2 Question 3

○ ● ○

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

60° latitude & 0° longitude has the greatest amphibian species richness with over 101 species according to the map.

ii an equal display of all seasons since many species are able to live in this biome

iii Since the weather varies more amphibians are able to adapt considering it's not to far north or south.

b) Population increase leads to more buildings being needed which means more land. This leads to deforestation.

c) i The species richness allows them to be less triggered or affected by environmental stressors.

~~ii The hunting of some amphibians is leading to their extinction directly impacting biodiversity.~~

ii Global climate change is a direct cause for the decline of biodiversity globally since this affecting the weather everywhere.

d) i The hunting of elephants for their tusks was made illegal.

ii since it is illegal to hunt them the elephants will be able to reproduce; this protects them from further going extinct.

e) i They could develop properties all around

Question 1 Question 2 Question 3

○ ● ○

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

the wetland; this will allow them to be able to develop a lot of properties while still protecting the home of the frogs.
ii This solution will allow wetland to still remain untouched which could lead to more than just the frogs there. This would help increase biodiversity.

Question 2

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 evaluate a diagram of the global distribution of amphibian species, discuss threats to biodiversity, and identify and explain ways to protect endangered species.

In part (a) students were asked to identify and describe regions with high amphibian biodiversity [Practice 2-Visual Representations, Topic 1.2 Terrestrial Biomes, Topic 2.1 Introduction to Biodiversity] based on information on a map of the global distribution of amphibian species. In part (b), students were asked to describe an anthropogenic reason for deforestation [Practice 7-Propose and justify solutions, Topic 5.1 The Tragedy of the Commons] In part (c) students were asked to identify and describe threats to amphibian biodiversity and biodiversity in general [Practice 1-Concept Explanation, Topic 2.1 Introduction to Biodiversity, Topic 9.10 Human Impacts on Biodiversity]. In part (d) students were asked to identify and explain one environmental law relevant to the protection of endangered species that is used to solve environmental problems [Practice 7-Environmental Solutions, Topic 9.9 Endangered Species]. Finally, in part (e), students were asked to propose and justify a viable solution for a case study involving real estate development in a wetland that is home to a native frog species [Practice 7-Environmental Solutions].

Sample: 2A
Score: 9

One point was earned in part (a)(i) for identifying "30° north and 30° south of the equator." One point was earned in part (a)(ii) for identifying "tropical rain forest." No point was earned in part (a)(iii). One point was earned in part (b) for describing "the need for more agricultural land as the world's human population grows." One point was earned in part (c)(i) for explaining "these species rich ecosystems have more other species to support each others' survival than ecosystems with fewer species." One point was earned in part (c)(ii) for explaining that "certain pesticides can kill or sterilize amphibians." One point was earned in part (d)(i) for identifying "CITES." One point was earned in part (d)(ii) for explaining that "CITES protects endangered species by prohibiting their trade." One point was earned in part (e)(i) for proposing that "could sell the pasture sections of the land and leave the wetland undeveloped." One point was earned in part (e)(ii) for justifying that "By leaving the wetland undeveloped, the town would retain more protection against flooding."

Sample: 2B
Score: 5

No point was earned in part (a)(i). One point was earned in (a)(ii) for identifying "tropical rainforests." One point was earned in part (a)(iii) for describing a "moist climate with a suitable habitat." One point was earned in part (b) for describing "The high demand for lumber products." No point was earned in part (c)(i). No point was earned in part (c)(ii). One point was earned in part (d)(i) for identifying "Endangered Species Act." One point was earned in part (d)(ii) for explaining that "the poaching of endangered animals is illegal." No point was earned in part (e)(i). No point was earned in part (e)(ii).

Question 2 (continued)

Sample: 2C
Score: 2

No point was earned in part (a)(i). No point was earned in part (a)(ii). No point was earned in part (a)(iii). One point was earned in part (b) for describing, "Population increase leads to more buildings being needed which means more land. This leads to deforestation." No point was earned in part (c)(i). No point was earned in part (c)(ii). No point was earned in part (d)(i). No point was earned in part (d)(ii). One point was earned in part (e)(i) for proposing that "develop properties all around ... this will allow them to be able to develop a lot of properties while still protecting the home of the frogs." No point was earned in part (e)(ii).