Student Performance Q&A:

2010 AP® Environmental Science Free-Response Questions

> The following comments on the 2010 free-response questions for AP® Environmental Science were written by the Chief Reader, Arthur N. Samel of Bowling Green State University in Ohio. They give an overview of each free-response question and of how students performed on the question, including typical student errors. General comments regarding the skills and content that students frequently have the most problems with are included. Some suggestions for improving student performance in these areas are also provided. Teachers are encouraged to attend a College Board workshop to learn strategies for improving student performance in specific areas.

Question 1

What was the intent of this question?

This was a document-based question based on a mock newspaper article. The article reported the effects of industrial pollution on a town in India. Students were asked to describe a source, pathway into humans, human health effect and public measures for the control of PCBs, mercury or lead. In addition, students were asked to explain why children are more susceptible to toxic pollutants, to perform a calculation and to identify a type of technology that can reduce the amount of NO_x, SO_x or particulates from the waste stream of coal-burning power plants. Finally, students were asked to explain why a company would choose to build a manufacturing facility in China or India rather than in the United States or Europe.

How well did students perform on this question?

Students performed well. The mean score was 6.05 out of a possible 10 points.

What were common student errors or omissions?

In part (a)(i) there were no notable common errors. In part (a)(ii) students often identified the ingestion of food or water as a source of their selected pollutant without indicating how the contamination occurred — for example, a student would write that "lead is ingested when drinking water" (earning no point) rather than "lead is ingested when drinking water that is contaminated by lead in pipes" (earning 1 point). In part (a)(iii) many students described a ban that was excluded in the prompt, or they did not describe steps a city or nation could take to reduce the effects of toxic pollutants but instead discussed steps that *individuals* could take.

In part (b) there were no notable common errors.

In part (c) most students earned both points for the correct setup and correct answer.

In part (d) most students named an appropriate technology for the removal of their selected pollutant.

In part (e) many students incorrectly stated that India and China have "no regulations" or "fewer regulations" rather than stating that regulations are less stringent or less rigorously enforced.

Based on your experience of student responses at the AP Reading, what message would you like to send to teachers that might help them to improve the performance of their students on the exam?

- Remind students to read the exam questions carefully. When they are asked to describe a step or action that a city, nation or government can take to effect change, they will not earn points for steps or actions that an *individual* can take. When answering this question, students should have also described a policy, regulation or law that could be implemented and enforced to effect the required change.

- Continue to practice mathematics with students. This should include arithmetic such as multiplication and division. College-level work in science requires the ability to perform arithmetic operations.

- Encourage students to avoid exaggeration in responses.

Question 2

What was the intent of this question?

The intent of this question was to assess whether the student could interpret and apply information supplied in a data table to determine the optimal conditions for wood consumption by termites and to determine quantitatively the amount of methane produced by termites. Students were required to apply the concepts of limiting factors or range of tolerance or both to the termite population. The question also required students to demonstrate an understanding of the impact of tropical rain forest destruction on anthropogenic climate change.

How well did students perform on this question?

The mean score was 3.57 out of a possible 10 points.

What were common student errors or omissions?

Part (a) consisted of four parts, but many students skipped the calculation portion, parts (a)(ii) and (a)(iii). Those that did attempt this portion often failed to earn full credit because they did not include units in their work or they miscalculated the answer. In part (a)(iv) many students restated the question instead of explaining the impacts of temperature and humidity on the termite population.

Part (b) consisted of two parts. Many students did not earn credit in part (b)(i) because they did not discuss the most likely reason for the increase in size of the termite population (increase in food supply) but instead explained the impact of a reduction in the number of predators or a decrease in food supply.

Most students earned at least 1 point in part (c). Students who did not earn credit frequently discussed habitat destruction and a decline in biodiversity instead of anthropogenic climate change.

Based on your experience of student responses at the AP Reading, what message would you like to send to teachers that might help them to improve the performance of their students on the exam?

- Remind students to read the question carefully and not merely restate the question as their answer.

- Work with students on answering the question that has been asked. For example, if asked about deforestation and its impact on anthropogenic climate change, students should not discuss the impacts of deforestation on biodiversity.

- Work with students on analyzing data, dimensional analysis and scientific notation.

- Remind students to show all their work, including units, where calculations are required.

- Remind students to use the data they are given to answer the question.

- Remind students to fully describe, discuss or explain their answers. Buzzwords without explanations do not earn credit.

Question 3

What was the intent of this question?

This question afforded students an opportunity to demonstrate knowledge about a well-known invasive species, the zebra mussel. In addition to asking for basic information about the introduction of the zebra mussel and its effects on the ecosystem, the question asked students to consider more broadly the question of what makes a species invasive, and how humans have changed ecological dynamics through introductions and biological control measures. Notably, the question asked students to provide specific examples, thereby demonstrating the diversity in content across AP classrooms as teachers utilize local or regional examples in many cases.

How well did students perform on this question?

The mean score was 4.16 out of a possible 10 points.

What were common student errors or omissions?

Students were able to understand the basic premise of the question and generally address all its parts. However, a significant number had difficulty clearly stating ecological effects: "cause problems," "making an imbalance in community," or similar vague responses do not sufficiently explain ecological principles. Another important consideration was that the question specifically referred to "invasive species" rather than "pests" or "weedy species," implying that the examples discussed must be exotic, not native. Many responses mentioned problematic or troublesome native species; those are not valid examples to illustrate the dynamics of invasive species. Lastly, many responses were clearly using hypothetical examples; the question called for "specific examples," so general or hypothetical examples were not appropriate.

Based on your experience of student responses at the AP Reading, what message would you like to send to teachers that might help them to improve the performance of their students on the exam?

- Teachers should be commended, as it is obvious they spend considerable time on this topic and engage their students on an important environmental issue. Nearly all exam takers

attempted to answer the question, and most answered at least portions correctly. However, many students restated the question in their answer, such as when discussing climate conditions in part (a), which did not demonstrate knowledge nor score points.

- As always, students must read the question carefully to ensure that they not only "identify" but then also "explain," as required.

- Although the exam is designed to test knowledge of environmental principles rather than mere vocabulary, nevertheless it should be impressed on students that effective use of terminology is important, both to clarify thinking and to express ideas effectively. This is particularly true when discussing ecology; it is important to recognize that terms are used in specific ways by scientists, and precision in communication is important.

Question 4

What was the intent of this question?

The intent of this question was to have students demonstrate their knowledge of the phenomena that cause sea level rise, what the impacts of sea level rise are on estuarine ecosystems, what negative economic impacts may result from sea level rise, and how governments could discourage movement of populations into coastal areas.

How well did students perform on this question?

The mean score was 4 out of a possible 10 points.

What were common student errors or omissions?

In part (a), where students had to calculate the expected increase in sea level, a large number of students did not convert their millimeter answer into meters, and some neglected to show any work.

In part (b) many students gave descriptions of the factors causing climate change, such as increased greenhouse gas emissions, instead of addressing directly the causes of sea level rise. Another common error was to describe changes in the water cycle (increased evaporation and precipitation due to increased atmospheric temperatures) as the cause. When students were able to identify melting ice, they often were unclear about the difference between continental ice and sea ice and their respective impacts on sea level, and they frequently described melting of polar ice caps as a cause of sea level rise. If students did not state that the ice was a glacier, an ice sheet or land-based ice, they did not receive points for their response. Few students were able to identify thermal expansion as a phenomenon.

In part (c) students were often not able to describe the specific effect of sea level rise on estuaries and components of an estuary ecosystem. Some responses described human, not environmental, impacts.

In part (d)(i) students were often unable to describe how flooding can cause negative economic impacts. Students often stated that flooding causes destruction of property without tying it to monetary values. In part (d)(ii) students who were not specific or did not describe viable strategies that governments can use to discourage movement to the coast did not receive credit. For example, "educate" or "tell" the public about the dangers of living at the coast is not a clear strategy. Responses that stated strategies not available to governments, such as setting property values or raising the cost of living, were not given credit.

4

Based on your experience of student responses at the AP Reading, what message would you like to send to teachers that might help them to improve the performance of their students on the exam?

- Remind students that to receive full credit for any questions that require calculations, they must show how they arrived at an answer. Also, students should make sure that the answer given is in the correct units.

- The response should demonstrate that the student understands the details of a specific situation. Students need to be explicit in their examples and avoid using vague language, such as "habitat loss," "animals dying," "toxins" and "pollution," without concrete examples. In this question, exemplary answers contained clear descriptions, such as the distinction between continental and sea ice, and the specific impacts of sea level rise on estuarine ecosystems. High-scoring answers also linked negative impacts of sea level rise to economics and described viable strategies that governments can employ to discourage people from moving to the coast.