



Student Performance Q&A: 2012 AP[®] Environmental Science Free-Response Questions

The following comments on the 2012 free-response questions for AP[®] Environmental Science were written by the Chief Reader, Art 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 question was based on a mock newspaper article. The article described hydraulic fracturing (fracking) as a means of obtaining natural gas from the Marcellus Shale. Students were asked to identify and describe two water-related environmental problems associated with fracking and were later asked to describe two non-water-related environmental drawbacks associated with using the fracking process to extract natural gas from shale. Students were also asked to identify one economic benefit to society of using this process to obtain natural gas. Additionally, they were asked to discuss two environmental benefits of using natural gas instead of coal and to describe two negative impacts associated with nuclear power.

How well did students perform on this question?

The mean score was 2.99 out of a possible 10 points.

What were common student errors or omissions?

In part (a) many students did not identify the problem or described impacts that were not water related. Students mistakenly thought that the ponds were preexisting and not newly formed waste ponds and described impacts on the biotic inhabitants of a pond.

In part (b) some students did not fully describe the benefits of natural gas as compared with coal. For example, students said that natural gas emits fewer air pollutants than coal without identifying the specific pollutant. Students also confused natural gas with petroleum or thought natural gas is not a fossil fuel. Additionally, students said that combusting natural gas produces no CO₂ emissions.

In part (c) students frequently described an environmental drawback related to water as opposed to a non-water-related drawback. Students demonstrated that they did not know what occurs in the fracking process.

In part (d) there were no notable common errors. Most students described a decrease in the cost of natural gas due to the increased domestic supply or an increase in jobs as the economic benefit to society.

In part (e) many students noted that nuclear waste or accidents are environmental problems but did indicate a specific environmental impact of the problem.

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 consider the following suggestions:

- Remind students to read the question carefully and not merely restate the question or information directly from the document. Students should directly link their descriptions to their identifications.
- Remind students to provide specific information in their answers. Generalities like “air pollution” or “pollution” do not demonstrate the level of understanding expected of a student who has completed a college-level course in environmental science. At this level students should be able to specify types of pollutants (SO_x, NO_x, particulates, etc.)
- Spend time in the course comparing and contrasting different types of fossil fuels. Also, update your courses to reflect current environmental issues and events. Though textbooks may not cover hydraulic fracturing, the document provided the essential information needed to answer this question.
- Give students practice answering document-based questions and extracting information from the document.

Question 2

What was the intent of this question?

This question presented data regarding the carbon footprint of a school. Students were asked to describe how a specific alternative energy source could be used in place of fuel oil to reduce the carbon footprint and to discuss one benefit and one drawback of using the alternative energy source in place of fuel oil. Students were also asked to identify two ecological benefits of intact forest ecosystems, other than reduced CO₂ emissions. In addition, they were required to perform mathematical calculations and dimensional analyses relating to carbon storage in a forest.

How well did students perform on this question?

The mean score was 3.80 out of a possible 10 points.

What were common student errors or omissions?

In part (a) the majority of students identified the alternative energy source but did not attempt to describe the energy source. Many students identified benefits and drawbacks that are not environmental (e.g., renewable, costly), and many identified a drawback that is a reason not to use the alternative energy source to begin with (e.g., harnessing wind energy would be effective only in windy areas) rather than an environmental drawback of actually using the alternative energy source.

In part (b) the main error was identifying human-related benefits rather than ecological benefits (e.g., providing wood for building materials/paper, providing medicines, aesthetics).

Common errors in part (c) included incorrectly working with scientific notation and converting exponents, not showing all units in the setup, not showing work, and not converting forest biomass to carbon mass in part (i). Also, some students made mathematical errors that could have been avoided if proper dimensional analysis had been performed (e.g., many students divided by 0.27 when they should have multiplied by 0.27).

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?

The following suggestions may be helpful:

- Encourage students to read questions carefully and discern the difference between identifying and describing.
- Help students understand the processes by which the alternative energy sources are converted to usable forms of energy.
- Help students discern the differences between the terms “ecological,” “environmental,” and “economic” and answer accordingly when prompted in a question.
- Teach students how to perform dimensional analyses and work with scientific notation/exponents.
- Encourage students to consider whether their answers are reasonable (e.g., the school could not reasonably conserve billions of hectares of forest).

Question 3

What was the intent of this question?

The intent of this question was to have students demonstrate their ability to design a controlled experiment and to demonstrate their knowledge of integrated pest management (IPM) and agricultural practices that increase crop yields.

How well did students perform on this question?

The mean score was 4.59 out of a possible 10 points.

What were common student errors or omissions?

In part (a)(i) most students did not write a hypothesis in which they predicted a specific change in a measure of minnow health that would result from an increase or decrease in exposure to product X. In part (ii) students often described a method in which only two experimental groups would be used, one with and one without product X. In part (iii) students were often unable to correctly identify the dependent variable in the experiment.

In part (b) most students correctly described results that would lead them to reject their hypothesis.

In part (c)(i) most students did not list two pest control approaches as part of a description of IPM; instead, they simply listed two approaches and did not describe IPM. Some students stated that natural pesticides could be used as one pest-control approach; however, they did not describe the characteristics of such a pesticide that would be used in IPM, such as being a narrow-spectrum pesticide or being less persistent in

the environment. In part (c)(ii) some students were too vague in their identification of an environmental benefit.

In part (d) some students described agricultural practices that involve pest control, which could not earn a point based on the wording of the prompt.

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?

Some suggestions for teachers include the following:

- Give students instruction in experimental design. Ideally, they would be given opportunities throughout the year to design and conduct experiments. Although it may not be feasible to conduct numerous experimental design labs during the school year, experiments can be designed, and the methodology scored, without actually being carried out.
- Offer students practice writing hypotheses in which they must predict a specific change in a dependent variable that results from a specific change in an independent variable.
- Remind students to practice using correct terminology in their experimental design (e.g., control, dependent and independent variable). Make sure students understand the difference between a controlled variable and a control group.
- Remind students to respond appropriately to each prompt. When asked to describe something, they should write the most complete description they are capable of writing. If they simply identify something or write an incomplete description, they will not earn a point for a description.
- Remind students that when writing about an environmental benefit, the best answers will be associated with the natural world, and social and economic benefits should not be used.

Question 4

What was the intent of this question?

The intent of this question was to ascertain students' knowledge of wetland ecology, including characteristics of wetlands, wetland food webs, energy conversions in these food webs, economic benefits provided by wetlands, how human activities have degraded wetlands, and how wetlands perform functions that mimic primary and secondary treatment of wastewater.

How well did students perform on this question?

The mean score was 3.85 out of a possible 10 points.

What were common student errors or omissions?

Many students had difficulty describing the characteristics scientists use to define a wetland. Students often gave answers that were the definition of a biome, stating that the amount of rainfall, temperature, and location were determining factors, without being specific. Many stated that wetlands are biologically diverse with nutrient-rich soils, but these are not characteristics scientists use to define wetlands, and they are also not exclusive to wetlands.

Some students did not draw arrows on the food web diagram as directed or had the arrows pointing in the wrong direction, indicating an incorrect flow of energy. Many students also struggled with the section that asked about energy transfers in wetland food webs. Some common mistakes were that eagles are territorial

or need to have a lot of habitat, that food is spread out and difficult to find, or that eagles are in competition with each other and with other species for food, thus requiring a large area.

Students often were able to describe an ecosystem service but did not link it to its economic benefit. Some examples of language that earned points included “revenue,” “profits,” “cost,” “jobs,” “value,” “investment,” and “financial loss.” Students frequently confused primary and secondary wastewater treatment or were unable to identify these processes. Many gave examples of tertiary treatment (plants absorbing excess nutrients such as phosphates and nitrates) when asked to describe secondary treatment.

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 remind students of the following points:

- Follow the directions as written in the exam. Give only the number of examples requested, and clearly distinguish which point is being made. The instructions stated that students should complete the diagram below, but many students drew the diagram twice, which was acceptable but unnecessary.
- Using specific examples better demonstrates knowledge and comprehension of the subject matter.
- Be specific with the language in responses. Words such as “pollution,” “biodiversity,” and “habitat” are insufficient and need further qualification. Clear language using vocabulary that does not simply repeat the question is required to earn credit.