



Student Performance Q&A: 2001 AP[®] Biology Free-Response Questions

The following comments are provided by the Chief Faculty Consultant regarding the 2001 free-response questions for AP Biology. *They are intended to assist AP workshop consultants as they develop training sessions to help teachers better prepare their students for the AP Exams.* They give an overview of each question and its performance, 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 included. Consultants are encouraged to use their expertise to create strategies for teachers to improve student performance in specific areas.

Question 1

What was intended by the question?

Question 1 was a structure/function physiology question that gave students the choice of writing on three of six structures. Structure connection to Function is one of the major themes of AP Biology. There was a maximum of 4 points for each component (structure). Students were required to describe the structure, then explain how the structure is linked to its function, and finally explain how the structure connects to the organ system to which it is associated. There was opportunity for students to elaborate on the structure and function parts of their responses.

How well did the students perform? What were the common errors or omissions?

Students still have difficulty with the breadth of physiological concepts. Also, they have trouble making the connection between structure and function. Students often connected the particular structure to an organ, but neglected to connect it to the organ system to which it belonged. Finally, by not reading the question carefully, students sometimes wrote on fewer or more than the three parts that they were directed to answer.

What can teachers do to improve performance?

Teaching students how to think conceptually is critical. Students should be encouraged to see the overall patterns of organ systems as they learn the detailed structures.

Question 2

What was intended by the question?

Question 2 dealt with evolution, the most fundamental concept of all of biology, including AP Biology. This was a two-part question asking students to first explain Darwin's Theory of evolution by natural selection, and then explain three out of five biological processes that are related to evolution by natural selection. There was a maximum of 6 points in each part, and students could not receive a score of 10 without gaining points from each of the three sections in part (b) of the question. Part (a) was focused exclusively on Darwinian evolution, while standards in part (b) allowed students to respond with a broader neo-Darwinian perspective.

How well did the students perform? What were the common errors or omissions?

Although students are still confused about the differences between Darwinian processes and Lamarckism, they did seem to know some of the most basic concepts of evolution. They would often use colloquial phrases (e.g., “survival of the fittest”), but not demonstrate much depth of evolutionary knowledge. This lack of depth probably indicates how teachers teach (or possibly not teach) this extremely important topic and misportrayals of evolutionary mechanisms in news and film media. There were a number of clear cut misconceptions: “species evolve to better survive,” use of “survive well” for reproductive success, “organisms evolve to better themselves,” and “they must have certain characteristics to contend with harsh environments.”

What can teachers do to improve performance?

Teachers should be on the alert for the subtle and not so subtle allusions to Lamarckian thought patterns. Students should be discouraged from falling into careless patterns of speech, such as referring to the “need” for species to change or the “desire” to change, or to shifts in the environment “causing” specific mutations.

Question 3

What was intended by the question?

Question 3 asked students to plot dissolved oxygen results obtained from a eutrophic lake over time, and then to draw an additional line on the graph based on a prediction. After plotting came two parts worth of explaining. Students first had to explain the biological processes that might have produced the observed data, then relate those processes to their predicted results. The final part of the question dealt with a description and explanation of how high-level nutrient addition would affect observations. Four points were available for the graphing, 5 points for explaining the biological processes, and 3 points possible for the third part dealing with nutrient loading effects. Elaboration points were available for the two narrative portions of the question.

How well did the students perform?

The question had a higher mean than the other three questions primarily because students were well prepared to draw the graph. Students were aware that dissolved oxygen and photosynthesis were related, but most students failed to understand the role of respiration in accounting for the data obtained. Although AP Biology Lab 12 is titled “Dissolved Oxygen and Aquatic Primary Productivity,” students rarely made the connection to primary productivity. Without the generous graphing points, the mean would have been quite low for this question.

What were the common errors or omissions?

Common misconceptions included the following:

- Nitrate and phosphate are “food” and relieved the plant from the necessity of doing photosynthesis, or the nutrients are energy or an energy source.
- The light phase occurs during the day, and the dark phase occurs only at night.
- Plants don’t respire, only animals use the oxygen the plants produce.
- Plants carry on photosynthesis during the day, *then* they carry on respiration at night.
- Cloudy days are automatically windy.
- Nitrates and phosphates come apart and release free oxygen when dissolved in water.
- Oxygen can evaporate out of a water molecule.
- Percent saturation = O₂ concentration.

What can teachers do to improve performance?

Teachers should remember to focus on meeting the published objectives in each lab. Performing this lab immediately following the respiration and photosynthesis units would be helpful, as would strictly evaluating student graphing skills on class assignments.

Question 4

What was intended by the question?

Question Four was a three-part question dealing with protein structure(s), protein synthesis, and protein function in membrane structure and transport. Each part had a 4-point maximum with parts (a) and (c) having internal maxima. All parts had elaboration points. Part (a) required less conceptual understanding than parts (b) and (c).

How well did the students perform? What were the common errors or omissions?

Though students wrote about parts/aspects of protein synthesis, they were weak in their understanding of the roles of DNA and RNA in protein synthesis. Also, they had much difficulty in presenting the functional role of proteins in membrane transport.

What can teachers do to improve performance?

A significant number of students connected the process of DNA replication with protein synthesis. Teachers can emphasize the separate roles of these processes. It may be that NOT covering these topics sequentially in courses will assist students in separating these processes.