1. Overall, students demonstrated a strong understanding of ecological consequences of human expansion. Common errors included statements indicating that organisms in a specific area would either go extinct or undergo speciation. Students attempted to connect the removal of plants from the area with effects on the atmosphere, but incorrectly claimed that carbon dioxide is a pollutant or that loss of trees resulted in loss of oxygen in the atmosphere for animals in the local area. Many students provided only superficial support as justification of the ecological consequence. Students also described the impact of human expansion on the wrong type of community, often skipping the discussion of the impact on plants and discussing only the impact on animals.

2. Overall, students demonstrated a poor understanding of genetically modified (GM) crops. Many students made the assumption that if any plant was genetically modified, it was bad and should be viewed as a threat to the ecosystem. Students often confused herbicides with pesticides and stated that GM plants may have developed resistance to a pesticide rather than an herbicide. Errors included the assumption that the GM crops were sprayed with insecticide rather than produce the insecticidal proteins as a result of the genetic modification or that generic chemicals were applied to the crops rather than specific treatments. Students also asserted that the modification of a small number of genes in a plant would cause a disruption of many other genes in the plant. Some students indicated that all, not just some, of the plant’s genes had been genetically modified. Finally, students misidentified one of the goals of the genetic modification, i.e., to kill insect pests, as one of the potential risks of their use. Students also incorrectly answered the question by providing non-biological risks (e.g., economic or policy). Students struggled to correctly assess the variation in the number of spots over time and frequently responded that genetic variation of the population was increasing because the slope of the line is positive. Students made the assumption that the allele for spots was dominant because the mean number of spots increased, or that the male guppies have spots and the females do not. Students were unable to speak clearly about the mechanism of natural selection as it relates to evolution, including that organisms choose to evolve (i.e., Lamarckian evolution), or that individuals evolve rather than populations.

3. In general, responses often discussed carbon cycling in vague terms (e.g., photosynthesis absorbs carbon) without specifying specific molecules involved (CO2, glucose, organic molecules). Also, carbon was often incorrectly used interchangeably with CO2. In part (a) many students confused the carbon cycle with oxygen cycling and indicated that the purpose of photosynthesis is to make O2 for animals to breathe. Students included unnecessary details about the biochemical pathways involved in photosynthesis and cellular respiration. They also described photosynthesis as the conversion or breakdown of CO2 into O2 or cellular respiration as the conversion of O2 into CO2. Many students described an indirect proportion between CO2 and O2 in the atmosphere because of the misconception that the air can hold only a finite number of molecules. In part (b) it was often difficult to distinguish the predictions from the explanations in the responses, and many students did not correctly state a prediction. Many indicated that changes to the
carbon cycle (absence of decomposers, deforestation, etc.) result in, and require, either increasing production of carbon or the slowing or stopping of the entire cycle. Students did not have a clear understanding of the process of decomposition. Many students confused decomposition with nitrogen fixation, and some focused on nitrogen rather than carbon in discussing the effects of decomposition. Students also indicated that decomposers return carbon dioxide to the soil, and plants then acquire carbon from the soil. Students also described how a lack of decomposition causes rotting of dead organisms. They also indicated that volcanic dust contains large amounts of carbon, and that the dust clogs the pores of the plants so they cannot absorb CO2. Finally, many students did not grasp the degree of anticipated increase in ocean temperatures and stated that warming of oceans will result in protein denaturation. In part (c) students had difficulty understanding the process of acidification. Students also claimed that cows produce large amounts of CO2 (as opposed to methane). Students generally described fossil fuel emissions with no mention of combustion.

4. In part (c) students had difficulty understanding the process of acidification. Students described CO2 itself as acidic and explained how increased acidity causes an increase in pH. Students claimed that acid rain causes ocean acidification, which in turn denatures enzymes and causes mutations. Many students described how an increased atmospheric CO2 leads to destruction of the ozone layer. Students could not specifically describe how atmospheric CO2 levels fluctuate, writing that the use of aerosol sprays, unspecified “pollution,” people exercising, and breathing all increase atmospheric CO2 levels. Students also claimed that cows produce large amounts of CO2 (as opposed to methane). Students generally described fossil fuel emissions with no mention of combustion. In part (c) students had difficulty understanding the process of acidification.

1. In part (d) the levels of the energy pyramid were often mislabeled, including the lack of a producer at the bottom of the pyramid. Some responses actually reversed the trophic levels, putting the producer at the top. When choosing examples of the trophic levels in a marine ecosystem, some essays wrongly focused on a terrestrial ecosystem example. A common inaccuracy was in accounting for the dissipation of energy along the pyramid. Most essays simply said it was “lost,” although many unsuccessfully cited the 10 percent rule without explaining what happened to the 90 percent of the energy that does not move directly into the succeeding trophic level.
In part (a) students had difficulty with the definitions of GPP and NPP. They were often unsure of exactly what is being "produced" when we talk of productivity. Few students were able to discuss the idea that productivity is actually a measure of the "conversion" of energy from light to chemical in the form of organic molecules. Some students stated that primary productivity is the total "oxygen" that is produced in an ecosystem. In addition, many students wandered from the central idea of primary productivity and included the role of consumers in their answer. A common answer was that net productivity is what remains after "subtracting what the consumers use up" in an ecosystem.

Finally, part (d) contained the most commonly earned points, although many students neglected to tie their predictions of changes in net productivity to depth as the question asked. Some students lost focus on the central idea of this question (light and productivity) and attempted to answer it based on changes in temperature. Although latitude was allowed in this part of the question for plausible predictions that used temperature, most students again wrote from the perspective of the consumers, stating that "consumer metabolism increased," while ignoring the fact that producer metabolism (photosynthesis) will increase as well.

Predators/Prey Population Dynamics: Many students earned 3 points for correctly stating that predators limit the size of prey populations and for discussing how an increase or decrease in predator population leads to a decrease or increase, respectively, of the prey population. Some students wrongly reversed the relationship and discussed how the amount of prey regulates the predator population size. Many students described the prey as primary consumers and the predators as secondary consumers. Many students included diagrams of food webs and food chains, but only infrequently did a student provide a correct diagram showing the lag/fluctuation between predator and prey population cycles. Students often described the predator as improving the gene pool of the prey and thus acting as a driving force in natural selection; however, that information was not sought in this question, so it earned no points.
Fire/Ecological Succession: Many students earned a point for noting that fire adds nutrients to the soil or that heat allows certain types of seeds to germinate. Indicating that some plants and animals replace other plants and animals as the community matures or ages demonstrates a superficial understanding of succession and was not an adequate description for receiving any points. Fire as the regulator was often described as “destroying everything.” Very few students earned points for discussion of the disruption of succession (by dramatic increases or decreases in fires) and the resulting impact on the community.

Also in part (b), some essays described strategies to naturalize the experimental tank, making it more like the fish’s natural habitat. In such cases the testing apparatus was not distinguished from aquariums that one might have at home or in the classroom. Some essays showed signs of confusion about the temporal aspects of the experiments, with predictions that the fish would evolve or adapt to the conditions in 30 minutes. In part (c) the implications of an ectothermic lifestyle were occasionally a point of confusion, because some essays suggested that colder temperatures necessitate increased cell respiration in order to generate enough heat to keep the fish “warm.” Descriptions of the effect of increased temperature on enzyme activity occasionally erred by suggesting that the fish would die in Section E (27°C) because the heat would cause their enzymes to denature.

Part (e) required the student to propose a model that described how environmental cues affect the behavior of the flies in the choice chamber. A model would be a highly simplified explanation of the relationship between environmental cues (stimulus) and behavior (response). Many different examples, including written explanations, labeled drawings, and graphs, were acceptable.