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AP[®]

CollegeBoard

AP[®] Environmental Science

Sample Student Responses and Scoring Commentary Set 1

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Question 2: Analyze an Environmental Problem and Propose a Solution**10 points**

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- (a)** Pesticide use has advantages, disadvantages, and unintended consequences on human health. **Describe** one benefit to human health that can result from the use of pesticides. **1 point**

Accept one of the following:

- Control disease vectors, such as mosquitos, ticks, rats, mice that can spread diseases to humans/between humans.
- Reduce exposure to stinging insects that carry disease.
- Increased food production leads to decreased famine/increased availability of food, improving human health.

Total for part (a) 1 point

-
- (b)** **Identify** one way chemical pesticides can enter the human body. **1 point**

Accept the following:

- Inhalation/Breathing (in aerosols and powders)
- Drinking water contaminated by runoff (from farms, yards, golf courses, etc.)
- Consumption of food (pesticide residue on or in food eaten by consumers)
- Dermal absorption/through skin during application of pesticide

Total for part (b) 1 point

-
- (c) (i)** **Identify** the year when the pesticide was most effective at reducing the size of the pest population. **1 point**

- 1975

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- (ii)** **Describe** the change in the number of crop insect pests in the cotton fields over time. **1 point**

Accept one of the following:

- From 1960 to 2015 the number of pests captures increased from 700 to 1100.
 - The number of pests was high before the pesticide was used, then it dropped dramatically after the first application and then increased again over time.
 - The number of pests went from 2 captured in 1975 to 1100 captures in 2015.
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- (iii) **Explain** how the change in the cotton-crop pesticide effectiveness between the initial application in 1975 and the latest application in 2015 illustrates genetic resistance in pests, based on the data in the table. **1 point**

Accept one of the following:

- Over time the number of pests that are killed decreases (more pests are found in traps), and more pesticide has to be applied (increased grams per hectare) because the pests that are resistant to the pesticide survive and reproduce, passing along resistance to the pesticide.
- The data in the table illustrates the pesticide treadmill, where each year more pesticide has to be applied, and fewer pests die because following the application only pests with resistance to the pesticide survive and reproduce.
- Pesticide effectiveness following the initial application in 1975 decreased over time. Regardless of whether application quantities were constant (1975-1985) or increased (1990-2015), the number of pests captured steadily increased because an increasing number of surviving pests had genetic resistance to the pesticide.

Total for part (c) 3 points

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- (d) **Describe** TWO effects of pesticide use, other than death, on nontarget wildlife. **2 points**

Accept two of the following:

- The pesticide may contaminate soil/water having a negative impact on organisms.
- The pesticide may bioaccumulate in the body of the organisms.
- The pesticide may biomagnify in the food web/chain of the organisms.
- There may be an increase in the population of non-target organisms unaffected by the pesticide that will have new areas of habitat available to them.
- There could be a decrease in predator species, so prey species will grow rapidly.
- Endocrine disruption leading to reproductive/development abnormalities.
- Chemicals disrupt signaling/communication in bees.
- Lead to thinning of eggshells/developmental abnormalities in organisms.
- Eliminates food supply; disrupts food chain for other species.

Total for part (d) 2 points

-
- (e) (i) Crop rotation is often used to reduce pesticide use. **Describe** the process of crop rotation. **1 point**

Accept one of the following:

- The process of growing different crops in succession on the same piece of land.
 - The process of growing different crops in the same area during different seasons.
 - The process of harvesting one crop followed by the planting of a different crop in the same area.
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-
- (ii) Propose** one reasonable method, other than crop rotation, to reduce the use of pesticides in agricultural practices while still maintaining a high crop yield. **1 point**

Accept one of the following:

- Use integrated pest management to control the insect crop pest.
- Use a method of pest control that employs a variety of biological, physical, and chemical methods to control the insect crop pest.
- Reduce stubble/crop residues in fallow fields that can harbor the insect crop pest.
- Apply the pesticide when the insect crop pest is most susceptible.
- Use intercropping rather than a monoculture to reduce the amount of habitat for the pests.
- Use pest-resistant genetically modified organisms.

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- (iii) Justify** how the method proposed in (e)(ii) would provide a benefit to humans. **1 point**

Accept one of the following:

- Reduction in pesticide residue in food/reduction of pesticide ingested by humans.
- Economic benefits to humans including:
 - Less money spent on pesticides
 - Increased profit for farmers from crops
 - Less equipment required/less labor required to spray fields with pesticides
- Reduction in the number of workers exposed to pesticides/Improved health in agricultural workers from reduced pesticide exposure.

Total for part (e) 3 points

Total for question 2 10 points



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

a)

- Benefit: Pesticides increase crop yield by killing off pests that would feed on the crops. This allows for the same amount of land to produce more food. This increases food production and decreases ~~starvation~~ starvation.

b) Pesticides will often get carried off farms and into groundwater or rivers by rain. ~~By~~ Groundwater and rivers are the most common source of drinking water and if not treated properly, pesticides will enter the human body through drinking water.

c)

i) 1975

ii) While initial pesticides used in 1975 dropped crop insect populations ~~more~~ more than 100 fold, after 1975, crop pest populations grew exponentially through 2015 even with increasing pesticide usage.

iii) As we kill off pests, the ones that will survive will be only those with resistance to the pesticides. Those pests will reproduce and their offspring will be ~~existing~~ resistant to the pesticides. This is exemplified in the table because from 1975 onward, with 1975 ^{pesticide use} killing most of the crop pests, the crop pest population grew exponentially, a natural growth rate. This shows that the pests grew resistant even after just the initial pesticide use because their growth rate was unaffected by the pesticides.

Question 1 Question 2 Question 3



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

d) Effect 1: Genetic mutation leading to ~~species~~ species irregularity. The most common example is DDT. The use of this chemical/pesticide caused birds, specifically bald eagles to create extremely fragile shells leading to a lower offspring survival rate.

Effect 2: Loss of food. Wildlife which feed on pests such as certain types of birds or spiders will lose their main food source causing them to be forced to leave the region or undergo massive evolutionary change to prevent the ~~death~~ termination of the species.

e)

i) Crop rotation is the process of planting different crops after the crop you had planted is harvested in the same plot of land. An example would be planting tomatoes on the plot of land your squash was planted on, then returning to squash and repeating possibly with other crops.

ii) Introducing predators to crop pests into your farmland.

iii) By introducing predators instead of using pesticides you remove the risk of pesticides entering human drinking water and poisoning or causing problems in humans after contaminated water consumption.

Question 1 Question 2 Question 3



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

(a) pesticides kill harmful pests that carry extremely harmful diseases. Mosquitos carry deadly diseases such as malaria, and pesticides will kill those mosquitos so humans do not suffer the affects.

(b) Chemical pesticides can be found in drinking water. Since they can be found in the runoff ~~is~~ from agriculture fields, this runoff, can seep into the ground water systems, making its way into the body. These pesticides can also enter our bodies through the crops we consume. If these produce isn't thouroghly cleansed before preparing, the pesticides make their way into our diet.

~~###~~

Question 1 Question 2 Question 3



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

(c)(i) 1975 was the year most effective.

(c)(ii) The number of crop insect pests in the cotton fields increased over time.

(c)(iii) The effectiveness between the initial application in 1975 and the last application decreased. This is shown because in 1975 only 500 grams of pesticides were applied per Hecter. ~~However in~~ And only 2 crop insects were captured. However in 2015 1000 grams of pesticides were added per hecter, which is double the amount initially, and 1,100 insects were captured. This is because those insects that resisted the pesticides primarily survived and reproduced, then passing that resistance generation after generation. This genetic resistance caused the pesticides to become less effective.



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

d(i) Pesticides can enter the surface runoff, and flow into nearby rivers and streams. Adding excess nutrients and pollutants into the waterways, then causing water Eutrophication. The use of pesticides can also be extremely expensive, and using these on crops can be harmful to human health because we are consuming chemicals.

e(i) crop rotation is using the same plot of land, but instead of only planting one crop all year round, several different crops take turns using this plot of land. Each crop has a specific growing season, and by rotating the crops, pest populations do not inhabit the plot for a long time.

(e)(ii) Terrace farming is perfect for maintaining a high crop yield, and reducing the use of pesticides in agriculture.

e(iii) Terrace farming is a very spacial efficient way of farming. Developing countries with high population, and little space can grow a lot of food and feed many people, without taking a lot of land which is environmentally bad.

Question 1 Question 2 Question 3



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

2a: Pesticides can increase the size of particular foods giving you more nutrients.

2b: Consuming the pesticides through food.

2ci: 2015

2cii: There were more crop insect pests over time.

2ciii: The pesticide became more effective overtime because the pests were resistant to it at first.

2d: Pesticide use can negatively affect humans who consume it through food. It can also negatively affect the organisms in the environment by killing off predators food.

2ei: Crop rotation is switching off crops during the different seasons. When ~~changing~~ changing the crops other crops can add necessary nutrients to the soil ~~to~~ to help other crops grow better.

2eii: Drip irrigation can be used to give crops the perfect amount of water without causing erosion.

2eiii: The drip irrigation method gives crops the perfect amount of water without wasting water. This benefits humans because it will be cheaper on their part.

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 describe the impacts of pesticide use, evaluate data on cotton-crop pesticide effectiveness in the southern United States, and justify a proposed alternative to crop rotation to reduce the use of pesticides in agricultural practices.

In parts (a) and (b) students were asked to describe one human health benefit of pesticide use and identify one way chemical pesticides can enter the human body [Practice 1-Concept Explanation, Topic 5.6-Pest Control Methods]. In part (c) the stimulus provided a data table on the number of crop insects captured and grams of pesticide applied per hectare by cotton farmers from 1960 to 2015. Students were asked to use the data to identify the year pesticide was most effective, describe the change in pest number over time, and explain cotton-crop pesticide effectiveness between 1975 and 2015 [Practice 5-Data Analysis, Topic 5.6-Pest Control Methods]. In part (d) students were asked to describe two effects of pesticide use on nontarget wildlife [Practice 1-Concept Explanation]. Finally, in part (e), students were asked to describe crop rotation, propose an alternative to crop rotation to reduce the use of pesticides, and justify how their proposed method would benefit humans [Practice 7-Environmental Solutions, Topic 5.15-Sustainable Agriculture].

Sample: 2A

Score: 9

One point was earned in part (a) for describing that pesticide use “allows for the same amount of land to produce more food. This increases food production and decreases starvation.” One point was earned in part (b) for identifying that pesticides can “enter the human body through drinking water.” One point was earned in part (c)(i) for identifying “1975.” One point was earned in part (c)(ii) for describing that “initial pesticides used in 1975 dropped crop insect populations more than 100 fold, after 1975, crop pest populations grew exponentially through 2015 even with increasing pesticide usage.” One point was earned in part (c)(iii) for explaining that increased pesticide use led to increased pest resistance because “the ones that will survive will be only those with resistance to the pesticides. Those pests will reproduce and their offspring will be resistant to the pesticides.” One point was earned in part (d) for describing an effect on “wildlife which feed on pests such as certain types of birds or spiders will lose their main food source.” One point was earned in part (e)(i) for describing crop rotation as “planting different crops after the crop you had planted is harvested in the same plot of land.” One point was earned in part (e)(ii) for proposing “Introducing predators to crop pests into your farmland” as a reasonable method to reduce the use of pesticides. One point was earned in part (e)(iii) for justifying that predators would “remove the risk of pesticides entering human drinking water.”

Sample: 2B

Score: 5

One point was earned in part (a) for describing that “pesticides kill harmful pets that carry extremely harmful diseases” to humans. One point was earned in part (b) for identifying that “chemical pesticides can be found in drinking water.” One point was earned in part (c)(i) for identifying “1975.” No point was earned in part (c)(ii). One point was earned in part (c)(iii) for explaining that increased pesticide use resulted in increased insect captures and that “insects that resisted the pesticides primarily survived and reproduced.” No point was earned in part (d). One point was earned in part (e)(i) for describing crop rotation as “using the same plot of land, but instead of only planting one crop all year round, several different crops take turns using this plot of land.” No point was earned in part (e)(ii). No point was earned in part (e)(iii).

Question 2 (continued)

Sample: 2C

Score: 2

No point was earned in part (a). One point was earned in part (b) for identifying pesticides can enter the human body by “consuming the pesticides through food.” No point was earned in part (c)(i). No point was earned in part (c)(ii). No point was earned in part (c)(iii). One point was earned in part (d) for describing that pesticide use would disrupt the food chain by “negatively affect the organisms in the environment by killing off predators food.” No point was earned in part (e)(i). No point was earned in part (e)(ii). No point was earned for part (e)(iii).