



AP[®] Environmental Science 2004 Sample Student Responses

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4. Suppose that you have just started a summer internship working for a cooperative extension service, where you will collect soil samples, conduct laboratory and field tests, and make recommendations on soil conservation and agricultural practices.
- (a) Identify and describe one chemical soil test and one physical soil test that could be performed and explain how the results of these tests will allow the cooperative extension service to make specific recommendations for sustainable agriculture.
 - (b) Explain one advantage and one disadvantage to using inorganic commercial fertilizers.
 - (c) Describe TWO soil conservation practices that are designed to decrease soil erosion.
 - (d) Identify one biome that is characterized by soil that is rich in humus. Describe how humus originated in the soils of this biome and TWO ways that humus improves soil conditions for plant growth.

(a) One chemical soil test could test for nitrogen levels of the soil. Nitrogen is a crucial element in plant growth so adequate nitrogen must be present. If lacking in nitrogen, these tests will advise the cooperative extension service to plant legumes, such as beans or alfalfa, which contain nitrogen fixing bacteria in their root nodules. These rhizobium bacteria will increase nitrogen levels in soil and lead to sustainable agriculture. A physical soil test should be done to determine soil type. Soil types include combinations of sand, silt, clay, or a mixture of the three called loam. Soil composition is crucial knowledge in planning crop development, because different types have different permeabilities and porosities. Thus the type of soil will determine how well the ground holds water, and will allow the cooperative extension service to plant crops with soil preferences in accordance to the soil type found in the tests.

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(b) One advantage of using inorganic commercial fertilizers is that they are easy to transport and acquire in comparison with manure or compost. Inorganic commercial fertilizers can provide phosphorus, which is often a limiting factor in plant growth. However, in addition to being expensive and inadequate in providing all necessary nutrients to plants, inorganic commercial fertilizers can cause serious environmental harm when their nutrients enter runoff. Phosphates and nitrates from fertilizer enter runoff and flow into lakes, causing cultural eutrophication, which, in turn, suffocates fish and other organisms by causing a large algal bloom and death which reduces dissolved oxygen content.

(c) Planting windbreaks is an effective method to decrease soil erosion. Rows of trees are planted to block sweeping winds along flat plains. This prevents loose soil particles from being swept into the air. The roots of the trees also anchor soil in the ground, decreasing soil erosion.

Conventional till methods often leave loose soil exposed and subject to the forces of soil erosion such as wind and rain. The soil conservation practice

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of no-till-farming gets rid of this tilling procedure. Instead, seeds are injected into the ground by a machine, along with fertilizers and water. The slit is then covered. In this no-till method no ~~more~~ loose soil is created, and, thus, soil erosion is prevented.

(d) Soil rich in humus is often found in temperate deciduous forests. Deciduous trees drop their leaves for the winter, which leaves a thick layer of leaf litter on the ground. This, along with other decaying organic matter is decomposed, by bacteria in the soil, creating a rich brown material called humus. Humus improves soil conditions for plant growth because it is rich in nitrogen compounds, necessary for plant growth. The decomposition of decaying organic matter is what gives the humus a high nitrogen content. It is also rich in other nutrients such as carbon, and phosphorus. Its porosity and spongy nature allows spaces for air and water to percolate through. Its ability to hold water makes it optimal for plant growth conditions.

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a) One chemical soil test that could be performed is a pH test. The results of this test will identify the need to add sulfur if the soil is too ~~basic~~^{basic} or the need to add lime and fertilizer if the soil is too acidic. One physical soil test that could be performed is soil texture. This test would provide information on which crops would ~~be~~ thrive in the soil sample.

b) An advantage of inorganic commercial fertilizers is the increased productivity of the land by increasing ~~the~~ the levels of ^{some} vital plant nutrients. A disadvantage of inorganic commercial fertilizers is that the fertilizers ~~do not~~ ~~add a few of the~~ ~~nutrients~~ ~~needed~~ ~~for~~ ~~plant~~ ~~growth~~ not add humus to the soil, therefore reducing the soil's ability to retain water and increasing soil erosion.

c) No-till farming is where farmers ~~do not~~ not break up the soil but rather inject the seed, herbicides, and fertilizers into the soil, greatly reducing soil erosion. Also, in alley cropping,

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rows between crops are planted with grasses or legumes. This increases the ~~the~~ water-holding capacity of the soil and reduces the amount of soil that can be eroded by the wind.

d) Temperate grasslands are rich in humus. The vast quantities of decaying grass throughout the biome create humus. Humus is nutrient rich and therefore promotes plant growth. Also, humus retains water considerably well and ~~it~~ ~~also~~ supplies plants with ~~adequate~~ ample supplies of water.

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A A chemical test that may be performed on soil is a pH test. The acidity of the soil may prevent some plants from flourishing. ~~Some plants' tolerance levels~~ Some plants' tolerance levels ~~can~~ limit them to soil that is nearly neutral, if there are too many hydroxide ions, the plant would not survive. A physical test that could be performed includes discovering the type of soil (the particle size). It could be clay, sand, silt, or loam. Depending on the plant, and its root structure, how much water it needs, the type of soil is very important in determining a plant's survival.

B An advantage of using inorganic fertilizer is spurring the growth of a plant and providing it with all the nutrients it needs to thrive. A disadvantage is the runoff from the ground where the fertilizer was administered. Chemicals in fertilizers such as nitrates can be harmful to other organisms. If the chemicals end up in streams and lakes, it could kill fish and other creatures.

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C Planting grasses or other groundcovers prevents erosion of topsoil. Roots from these plants keep soil in place when it rains, and protects soil from blowing away in the wind. Another way to prevent erosion is to create an effective drainage system. When water rushes over an area with no drainage system, it can easily take inches of soil along with it. With a drainage system to slow water down, and give it a place to go, less soil would be lost.

D The Rainforest biome has soil rich in humus. ^{dead} Organisms on the forest floor are rapidly decomposed by bacteria and ~~decomposers~~ decomposers. The soil becomes rich in organic matter and oxygen - which means there is lots of humus. Humus improves conditions for plant growth because it is rich in nutrients that plants need to thrive. ~~It~~ Nitrogen, carbon, and other organic compounds are abundant in humus. Humus is also ~~the~~ ~~the~~ the right texture for optimum root growth. The soil is loose enough that roots can grow freely and access water. The soil is well drained and arable.

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