



AP[®] Environmental Science 2003 Sample Student Responses

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ADDITIONAL PAGE FOR ANSWERING QUESTION 1

- (a) Leaf litter has several important roles in a deciduous forest ecosystem. It prevents soil erosion, and in turn, it helps the soil retain valuable nutrients such as nitrates and phosphates. The leaf litter itself is being decomposed by detritivores (bacteria) which creates ~~rich~~ nutrient-rich black soil full of humus. Leaf litter prevents other ~~to~~ shrubbery from competing with the trees. By locking in moisture, leaf litter is also home to several types of animals and insects, notably: worms, snakes, small rodents, and sometimes amphibians.
- (b) One abiotic change would definitely be a lack of moisture in the soil if the exotic worms consumed all the leaf litter. Other abiotic changes include ^{increased} susceptibility to erosion and a lack of nutrient-rich humus which makes the soil so perfect for deciduous trees. In the winter, it is possible that the soil could freeze (very bad for plants) without a protective insulating layer of leaf litter.
- (c) Without the nutrient rich layer of humus that comes with leaf litter, the stage is set for other plant species, such as the Japanese still grass, to move in. Other exotic plants could follow, ones that don't need moisture and nutrient-rich soil to survive. ~~Once~~ Once any exotic species can get settled, it puts the native species in jeopardy of being out-competed.
- (d) A controlled experiment to determine the effects of the invasive new worm would involve setting up several plots of deciduous forest land for investigation. Each plot should have finite boundaries so it may be easiest for the ~~the~~ experimenter

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to set up artificial ecosystems in the lab. Next, there should be three key groups, one without any worms, one with only the native worms, and one with both the native and exotic worm species. The same conditions should be applied to each individual plot, in essence, same precipitation, # of trees, and — most importantly — the same amount of initial leaf litter. At the end of the experiment's time-span, the mass of the leaf litter should be taken and compared to the original mass. ~~Hypothesis~~ It is expected for the plot with the exotic worms to have the least amount of remaining leaf litter. The hypothesis reads: If ^{an} exotic worm species is introduced into a deciduous forest ecosystem, ^{then} the amount of leaf litter remaining at the end of a season will be significantly less than the amount remaining from a plot with only the native worm species. ~~The~~ Multiple trials of this experiment should be conducted to ensure accurate results.

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a. "The leaf litter is critical to the survival of local species of forest plants" because it keeps the entire food chain and food web in alignment. In a deciduous forest ecosystem, the leaf litter serves as primary food for bacteria and other decomposers, and those feeders help keep the food chain stable. They are at the bottom of the food chain. In addition, as the article explains, the leaf litter also serves another purpose: it helps cover the soil so that other plants - invader species - cannot come into the ecosystem and displace the main plants. It also helps keep the soil from being displaced during erosion, and therefore maintains the soil for the plants to use. Finally, when the plant matter decomposes, it combines nutrients with the soil, which therefore help the plants thrive.

b. There are three abiotic changes that would occur if the exotic worms consumed all the leaf litter in one year. One, there would be nutrient deficiencies in the soil because the plant matter would not decay and deposit nutrients in the soil. Two, the depth of the soil would probably suffer, because the matter serves as a barrier between the soil and eroding agents, such as rain and wind. Three, this, in turn, may lead to an increase in water pollution as the sediments (and all those nutrients so valuable to trees) would get swept away and pollute the water.

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c. The consumption of the leaf litter could set the stage for exotic species to take over the ecosystem. This is partially because there would be a change in the nutrient composition of the soil. ~~Although~~ the changes may be negative for the deciduous trees, but the decline in native populations would leave an opening for the new invader species. Also, the change in the nutrient makeup of the soil may lead to more favorable conditions for other species, such as the Japanese stilt grass.

d. The testable hypothesis could be: If Asian worms are introduced into a deciduous forest, then there will be changes in the nutrient (ie nitrogen, phosphorus, and sulfur) makeup of the soil. The control ~~group~~ group would be a section of the forest somehow quarantined from the worms. However, this forest would be exposed to the same amount of sunlight and temperatures and precipitation to provide a control. The scientists could then measure the nitrogen, phosphorus, and sulfur levels in the two parts of the forest and see if the Asian worms really do have an effect on the forest ecosystem.

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a) Dr. Tate is correct in saying "the leaf litter is critical to the survival of local species of forest plants." The buildup of leaf litter in a forest allows for a rich in nutrient soil. The leaf litter slowly decomposes and leaches into the soil. The high nutrient soil supports many species of forest plants, especially those in thick, deciduous forests. This litter also provides a habitat for insects and microorganisms which may contribute to the growth of local plants as well. The nutrients from the decomposed litter can support many plants.

b) If the worms consumed all of the leaf litter in a single year the soil would lose its nutrients eventually. There would be no replenishing of nutrients from the litter because it was depleted, therefore the soil will ~~become~~^{have} less nutrients. Due to the lower content of nutrients, plant life will suffer. The plants will grow less or possibly be weaker and more susceptible to disease. Finally, the leaf litter's disappearance is also a habitat disappearance. Many small bugs and microorganisms flourish in the leaf litter. With the

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absence of the litter, there will be a decline in small insects & microorganisms.

c.) Once the nutrient poor soil could no longer support it's needy plants, the plants would slowly weaken or die. Furthermore, an ~~non~~native species could take over.

If the worms ate the litter, and the plants there couldn't sustain life, a Japanese silt grass or other exotic species could take over.

It would further take more nutrients from the soil and kill off more plants, and it would spread rapidly. The exotic plants would eventually consume all the other plants space and greedily take all the nutrients from the already nutrient poor soil.

d.) If designing a controlled experiment, I would have a test plot of land without the worms, and a test plot with the worms. Each plot would be in a deciduous forest rich with leaf litter, with the same weather and climate. The plot A, one without worms, would be the control. It will be used for comparing, and will give me information on how much destruction the worms cause, if any. My hypothesis would be "If there is a

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deciduous forest rich in leaf litter and Asian worms are introduced, then the worms will consume the leaf litter and cause the forest's ecosystem to weaken."

I will collect data on how ~~often~~^{quickly} it took for the worms to consume the leaf litter, how fast they reproduce and how that affects the consumption of leaf litter, and how the worms consumption of the litter allows for nonnative species to prevail.

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