



AP[®] Environmental Science 2004 Sample Student Responses

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ADDITIONAL PAGE FOR ANSWERING QUESTION 1

a) According to the article, running machines or factories that utilize bituminous coal or anthracite can release mercury into the environment. The mercury enters aquatic systems that are often far away primarily through the hydrologic, or water cycle. For example, the mercury released as a gas enters the atmosphere and solidifies. This provides particles around which rain droplets may form. Rain clouds often travel great distances before producing precipitation. Thus, the rain clouds may produce this acid deposition over oceans in far-away regions. The mercury enters the oceans and is absorbed by phytoplankton, which are then consumed by zooplankton, which are then consumed by fish. Thus, biomagnification of the mercury occurs until it poses a threat to humans. In addition, the mercury may be released as acid deposition (again, in far-away lands) and create an off which, instead of infiltrating and percolating down to the groundwater, runs into the sea, thereby entering the aquatic system.

b) An obvious way to reduce mercury released into the environment, if the source is fossil fuel burning, is to reduce fossil fuel burning! This may be accomplished by (a) initiating stricter coal burning standards (using only factories can only use anthracite or low-sulfur content bituminous) or (b) providing government incentives for companies to switch from coal to natural gas, which emits fewer pollutants. A second way is to provide government subsidies for renewable, sustainable energy sources such as wind or solar power to run the factories and machines. These methods produce no mercury emissions.

c) There are greater health risks associated with eating larger fish because of (a) biomagnification and (b) bioaccumulation of

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mercury in nekton such as fish. Biomagnification is defined as the process by which an (often toxic) chemical is converted from a low concentration in a trophic level to a high concentration in subsequently higher trophic levels. For instance, the mercury is found in low concentrations in the phytoplankton that absorb it and the zooplankton that consume the phytoplankton (probably in ppb). But small fish consume many zooplankton, which magnifies the mercury concentration. Thus, the mercury bioaccumulates, or is stored in the small fish and not released back into the water. Then, when larger predatory fish consume many smaller fish, the Hg's concentration is biomagnified and bioaccumulates in each fish's body. When enough of these bio-processes occur, what was once a harmless concentration becomes a deadly one for humans. What was once mercury in ppb becomes Hg in ppthousand (or perhaps dangerous levels of ppm) in the large fish consumed by humans.

d) Lead is a toxic substance that has a negative impact on human health. As it was once used extensively in old paints, it is often found on the walls of older buildings. It can in fact cause these buildings to become "sick buildings," defined as areas in which 20% or more of people complain of respiratory or other physical ailments such as ① asthma, ② dizziness, or ③ headaches. A particularly pernicious effect occurs with children, who often eat the lead paint because it tastes sweet. Although only very high exposures cause death, nasty sublethal effects include ① brain retardation, or ② mental sluggishness, or ~~③ social inept~~.

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- a.) One human activity that releases mercury into the atmosphere is the burning of fossil fuels, particularly coal. Mercury is found in the particulates released in the smoke produced by the generation of electricity. Once mercury is in the atmosphere, it becomes a part of the hydrological cycle or the water cycle. It is able to end up in ~~at~~ aquatic ecosystems far away because the clouds travel a great distance, and when it rains, mercury particulates are released from clouds and end up in the water.
- b.) ~~Two~~ ^{One} way the amount of mercury released could be reduced is by installing scrubbers on the inside of the smokestacks in the plant, which would catch the mercury particles before they were ever released into the atmosphere. Another way mercury output could be reduced is by switching ~~dependence~~ from depending on coal to ~~re~~ depending on a cleaner, more efficient energy source, so that does not create as much pollution, such as natural gas or solar energy.
- c.) There is more risk of becoming sick by eating large predatory fish instead of smaller fish because mercury becomes bioaccumulated. This means as the trophic level increases, the concentration of mercury increases, making it more dangerous to eat organisms higher up in the food chain because the concentration of mercury would be so great.

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d.) Lead is a toxic metal that has had a negative impact on human health. Up until the 1970s, lead was found in paint and up until the 1980s, it was found in gasoline. Lead ^{primarily} would enter the body either by ~~be~~ being breathed in with the car exhaust fumes, or by being eaten, either by a small child eating chipping paint, or by someone eating off of plates that had not been sealed properly. Also, lead was found in pipes for many years, and this sometimes contaminated the drinking water. Although lead can cause serious affects, such as death or severe brain damage, it can also just cause a shortened attention span or cause someone to feel ill.

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- (a) One human activity that releases mercury into the environment is the burning of fossil fuels. When fossil fuels are burned, they release various gasses into the atmosphere. The gasses collect and can be blown by the wind far away from the source of pollution. When it rains, snows, hails, etc., the toxins in the air fall to the earth and are absorbed into the ground and into the water. Mercury is one of the toxins released into the atmosphere and when it rains over the oceans, lakes and ponds, the aquatic life absorbs the mercury.
- (b) One way the amount of mercury ^{released into the environment} could be reduced ~~from~~ is to clean the coal ~~used~~ before burning it. Another way to reduce the amount of mercury ~~from~~ being released into the environment is for power plants that use coal to ~~fi~~ produce electricity to find alternative methods to burning coal. If they invested in wind turbines, for instance, they could rely more on the wind turbines to produce electricity than the coal.
- (c) The larger fish have higher concentrations of mercury in them. The larger fish feed on smaller fish and plants that

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have absorbed mercury, which will increase the level of mercury in the bigger fish. The smaller nonpredatory fish eat less and don't consume other fish, therefore they have lower levels of mercury.

(d) Lead is another toxic metal introduced into the environment from dumping ^{toxic} wastes into rivers and streams. The lead is absorbed into the water, ground, and water table which can poison the drinking water. Humans can get lead poisoning from drinking water with high levels of lead.

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