



AP[®] Environmental Science 2005 Sample Student Responses

The College Board: Connecting Students to College Success

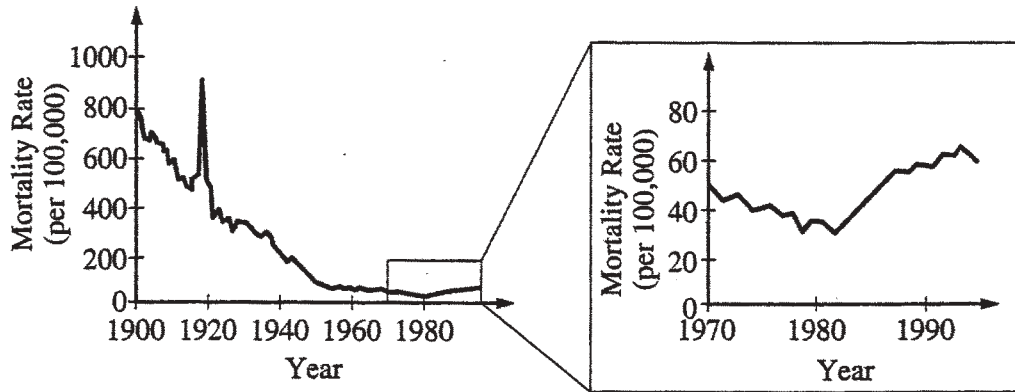
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INFECTIOUS DISEASE MORTALITY IN THE UNITED STATES, 1900-1996



(d) The graphs above show the mortality from infectious diseases in the United States since 1900. Identify an infectious disease that made an important contribution to the trend of increasing mortality rates that began in about 1980 and explain one major cause of the increased rate of mortality from that disease.

a) One new disease mentioned in the article is West Nile Fever. It is spread by mosquitos who suck the blood of an infected animal ~~especid~~ and then suck a humans blood. When they suck the humans blood it is transferred ~~into their blood stream~~ and then if they go to another human it will be transferred again. An effective method for controlling its spread is to control the mosquito population. This can be done by spraying ~~pesticides~~ insecticides but the mosquitos could become resistant. People can also make sure they do not leave standing water in places like old tires because that is the perfect breeding ground for mosquitos.

One old disease is cholera. This is spread by people drinking water that is contaminated with sewage, ^{waste and} bacteria. An effective way to control it is to sanitize the water. People can do this by not pouring sewage into water they drink or cleaning sewage before it is introduced

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back into the environment.

b) One environmental factor that led to the emergence of West Nile Fever was the rise in temperature due to global warming. This increased the incidence because it increased the temperatures in more places so mosquitos could survive in more places. ~~because~~ They live in warmer climates so if it is warmer in new areas they spread out and spread the disease at the same time.

c) Dr. Amodie is right that we need to address problems on a global scale. Disease can be spread easily around the globe because people are constantly traveling around the world. If they get the disease in Africa and then jump a plane to China, they will take it with them and spread it there. Now when somebody gets tuberculosis everybody who came in contact with that person in the past so many days has to go get tested. Sometimes this ranges just a small area and sometimes it is across continents.

d) One infectious disease is AIDS that has made a huge contribution to mortality rates. One major cause is mothers who have it passing it on to their offspring when they are born.

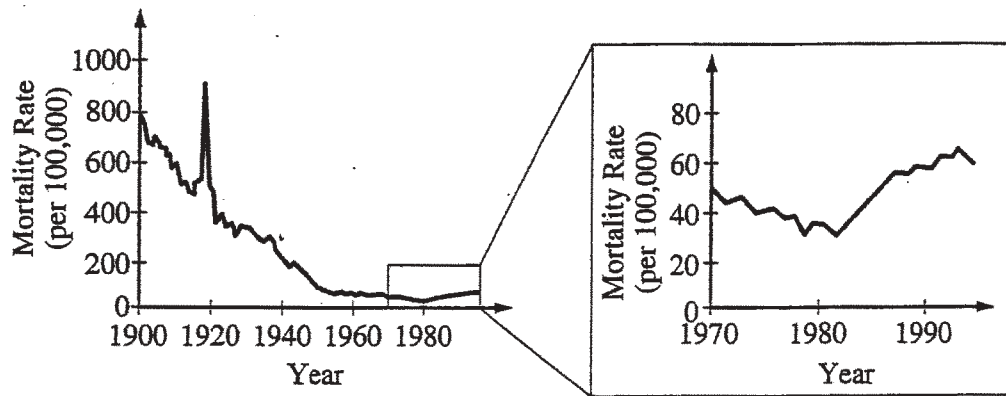
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often mothers do not know they have it until after they have a child. They then pass it on to their child. This is a huge deal in Africa where many children get the disease at birth and then are left parentless when their mom dies from it.

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INFECTIOUS DISEASE MORTALITY IN THE UNITED STATES, 1900-1996



(d) The graphs above show the mortality from infectious diseases in the United States since 1900. Identify an infectious disease that made an important contribution to the trend of increasing mortality rates that began in about 1980 and explain one major cause of the increased rate of mortality from that disease.

a) West Nile Fever, a relatively new disease, is transmitted through mosquito bites of carriers with the disease. It would be convenient to wipe out the global population of mosquitoes, who have spread many diseases for years. Mosquitoes are so abundant in population that simply wiping out their population would never work. The best prevention would be for humans to wear layers of clothing with long sleeves and pants and also to use a repellent while outside. This would be a great remedy for mosquitoes because they are drawn to body heat and aim for blood vessels which lets diseases enter the blood stream. Cholera, a relatively old disease, is caused by poor sanitation and poor disposal of human waste. It would be effective for the countries in which this disease is spreading to give more funds to the upkeep of healthy sanitation.

b) West Nile Fever, which is contracted from mosquitoes, had an emergence because of the environmental factor of global warming. Mosquitoes thrive in hot, moist environments so with the world becoming warmer each year it is easier for disease carrying mosquitoes to live. Mosquitoes can also multiply

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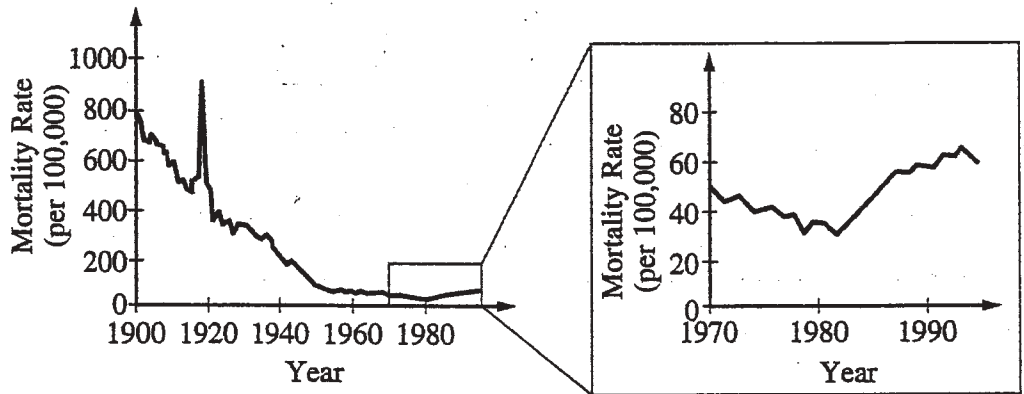
or reproduce better near damp ~~or~~ hot areas so the effects of global warming are increasing areas where this environment occurs.

C) Infections do not only affect the area in which they are most prevalent but can, and often do, spread around the world. Therefore if Americans want their health protected we must help other nations control their problems dealing with health as well, especially since most of the nations with these problems don't have the doctors, knowledge or facilities to deal with the problem or to even contain it.

D) An infectious disease that made an important contribution to the trend of increasing mortality rates that began in the 1980's is the AIDS virus. The AIDS/HIV virus is a disease that is contracted through blood transfusions, sharing needles or sexually transmitted. It has had an increased rate on mortality because it is incurable, although a lot of research has been conducted there is still no cure and those who have it usually spread it to someone else before they are aware that they have the disease. AIDS/HIV claims not only many lives in the USA but kills 6,000 people in Africa everyday. This is an epidemic that must be stopped.

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INFECTIOUS DISEASE MORTALITY IN THE UNITED STATES, 1900-1996



(d) The graphs above show the mortality from infectious diseases in the United States since 1900. Identify an infectious disease that made an important contribution to the trend of increasing mortality rates that began in about 1980 and explain one major cause of the increased rate of mortality from that disease.

(a) With diseases on the rise across across the globe it is apparent that these issues could become the leading cause of death. The West Nile fever, also known as the West Nile River Virus is a tropical disease spread by mosquitos. The disease was once known to be tropical because it occurred in ~~areas~~ ^{hot} hot, moist areas near the Equator. However because of global warming, this disease is continuing to spread North and South of the equator. Effective methods to control this disease would be the decrease in use of fossil fuels, increase use of mass transportation, and use of more effective fuels to decrease CO₂ emissions that cause global warming. Cholera is a result from humans not getting access to clean water. Humans obtain this disease from drinking water containing ~~but~~ human and animal wastes, also known as fecal coliforms. An effective method to control this disease would be to globally

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~~at~~
distribute chlorine or ozone water purifiers to disinfect the water and make it drinkable to the public.

(b) The West Nile Fever disease's reason for emergence is directly correlated to global warming. Global warming is the main reason for many tropical diseases, such as Malaria and West Nile, to increase in the globe. The reason is that the warmer climates and weather near the equator is expanding to higher latitudes. This warm environment allows Mosquitos carrying the virus to have more hospitable land to live, reproduce, and spread to greater areas and people.

(c) The rationale behind Dr. Amodie's statement is simple. The world and environment is connected to every living thing on it. Just because Americans have mostly controlled these infectious diseases does not mean the rest of the world's diseases may not affect them later on in the future.

(d) HIV and AIDS made an important contribution to the trend of increasing mortality. The major cause of the increased rate is because of overpopulation and developing countries inability to provide proper birth control for its population of people.

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2. Between 1950 and 2000, global meat production increased from 52 billion kilograms to 240 billion kilograms. During this period, the global human population increased from 2.6 billion to 6.0 billion.

- Calculate the per capita meat production in 1950 and in 2000.
- Use the values from part (a) to calculate the change in global per capita meat production during this 50-year period as a percentage of the 1950 value.
- Discuss why it is more efficient to produce grain for human consumption than to produce meat for human consumption. In your answer, consider both land use and energy use.
- Describe TWO environmental consequences of the increase in the production of meat for human consumption.
- Identify and explain one potential advantage and one potential disadvantage for human health of a diet that contains very little meat.

a) 1950

$$\frac{52 \text{ billion kg meat}}{2.6 \text{ billion people}}$$

$$52 \div 2.6 = 20$$

20 kg/person

20 kg meat per capita

2000

$$\frac{240 \text{ billion kg meat}}{6 \text{ billion people}}$$

$$240 \div 6 = 40$$

40 kg/person

40 kg meat per capita

b)

$$\frac{2000 - 1950}{1950} = \frac{40 - 20}{20} = \frac{20}{20} = 100\%$$

From an obvious glance, 40 kg is twice as much as 20 kg, so therefore it was a 100% increase, or 200% of the 1950 value.

100% increase from 1950 to 2000, 200% of the original 1950 value

- Producing grain for human consumption is much more efficient than growing grain to feed livestock intended for human use. Generally speaking, about twice the land use is needed for an unspecified figure. Land is required for growing the grain, then more land is needed for the pasture for the livestock to live in. It is a waste of land; More importantly, because the grain goes from the plant, to the livestock, then to the human, about 10 times more grain is required to produce the same amount of food as would grain directly to

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humans. This ~~is~~ is because an extra level is added to the trophic levels. Only about 10% transfers from the lower level to the next, as the other 90% is generally lost as heat energy. Knowing this, it takes about 10 pounds of grain to make one pound for a human or 100 pounds for 10 pounds of livestock, which then goes to one pound of human. It is more efficient to directly eat the grain, and with the abolishment of livestock, that extra range land could be used for crops, and therefore increasing grain and food supply for humans.

d) If more meat is produced for humans, more negative effects will occur. As livestock numbers increase, so will the amount of grazing. If the land is overgrazed, it leads towards desertification and loss of fertile land. Also, with increased livestock comes the demand for more grain to feed them, and that grain requires water to grow. More water will be in demand, leaving humans with less water for themselves to drink, empty reservoirs, and lower levels of water in streams. Increased livestock will also help to degrade the water condition because lower water levels result in increased pollution levels and agricultural wastes and runoff will greatly degrade stream health. Increased livestock numbers is a terrible idea.

e) Meat is important to our diet as humans, but alternatives are available. An increase in meat would definitely allow for our daily needs for proteins and other vitamins and minerals only found in meats, improving human health and ensuring our diet is well balanced. However, meat can tend to have a lot of pure fat that is unhealthy in large servings. A ~~reduction~~ reduction would help to prevent consuming this unhealthy fat and prevent the effects that result from obesity and other related health conditions, such as increased blood pressure, etc. An increase or decrease both have their advantages and disadvantages and they need to be carefully considered.

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2. Between 1950 and 2000, global meat production increased from 52 billion kilograms to 240 billion kilograms. During this period, the global human population increased from 2.6 billion to 6.0 billion.

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- Describe TWO environmental consequences of the increase in the production of meat for human consumption.
- Identify and explain one potential advantage and one potential disadvantage for human health of a diet that contains very little meat.

$$(A) \text{ 1950 - } \frac{52,000,000,000 \text{ kilograms of meat}}{2,600,000,000 \text{ people}} = 20 \text{ kg per capita}$$

$$\text{2000 - } \frac{240,000,000,000 \text{ kg of meat}}{6,000,000,000 \text{ people}} = 40 \text{ kg per capita}$$

$$(B) \text{ Change = } 40 \text{ kg} - 20 \text{ kg} = 20 \text{ kg} \quad \frac{20}{20} = 1.00 = \boxed{100\%} \text{ The global per capita meat production increased by 100\% over 50 years.}$$

(C) Grain is a much more efficient way to feed the world. To produce meat, by raising cattle, as an example, takes a large amount of land. Cattle need room to graze to mark, and to move around to stay healthy, as do any form of animals required for meat production. Grain does not require so much space. It does not, obviously need room to move around.

Grain is more energy-efficient. As a plant, it feeds itself. Animals used in meat production ~~also~~ need to be fed some form of grain in order to increase biomass. Plants, on the other hand, use ~~the~~ photosynthesis in order to turn solar energy into useable energy and biomass for the plant. As energy moves up through the food chain, more and more is wasted or transformed into ~~high-entropy~~ high-entropy heat energy under the 2nd Law of Thermodynamics.

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(D) Increased meat production means an increased number of domesticated grazing animals. These animals, when their numbers are increased, overshoot the carrying capacity of an area. As a result, they consume ~~over~~ the vegetation more quickly than it can replenish itself. This results in a loss of plant life and nutrients ~~in~~ in the area, speeding up the process of desertification. Increased meat production also leads to the destruction of more forested areas. This is an increasing trend in the South American Amazon rainforest. These rainforests hold a very large part of the earth's biodiversity. When they are removed, species that exist only in these areas become extinct. Therefore, meat production results in lost biodiversity.

(E) A diet of little meat could reduce ~~the~~ a person's caloric intake, therefore helping the person maintain a healthy weight. However, it could also cause the person to consume less protein, which aids the development of muscles.

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- Identify and explain one potential advantage and one potential disadvantage for human health of a diet that contains very little meat.

2. a) in 1950 the per capita meat production was 20 kg/head.

in 2000 the per capita meat production was 40 kg/head.

b) the percent change is 100%

c) It is more efficient to produce grain because ~~grain~~ ^{more} grain can be planted than cattle raised on any sized tract of land. ~~Also~~ ^{It} creates more calories when grain is raised. Grain is also more affordable than meat. It also takes more energy to raise cattle because they must be fed, whereas grain gets nutrients from soil.

d) ~~Two~~ ^{One} consequences ~~is~~ ^{is} desertification from cattle and other meat animals constantly stripping the land of natural vegetation and trampling it until it is dry sand. Another is an increase in methane gas that contributes to global warming because cattle emit methane gas because of anaerobic decomposition in their stomachs.

e) one potential advantage is that there is no risk of contracting diseases that live in meat like Mad Cow

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ZC₂

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disease. A potential disadvantage is that ~~the~~ someone who eats very little meat may not get a sufficient amount of ~~the~~ nutrients like iron, nitrogen, ~~protein~~ and potassium.

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3. Most of the coal mined in the United States today comes from surface (strip) mines. In surface mining, the vegetation, soil, and rock covering the coal (referred to as overburden) are removed and set aside. After the coal has been hauled away, good conservation practices require that the overburden be replaced and the surface be restored to its original condition. Land restoration may be difficult in some regions, due to factors such as the local climate, the thickness of the coal seam, the extent of the overburden, and the sulfur content of the coal.
- Describe the steps that should be taken to restore the land after the overburden has been replaced.
 - Explain why the restoration of the land would likely be more difficult in an arid climate (less than ten inches of precipitation per year).
 - Describe one environmental impact that the sulfur content of the remaining coal and the tailings would have on the reclamation process and suggest a possible remedy.
 - Other than mining and reclamation, describe TWO environmental impacts of using coal for energy.
 - Explain why per capita coal consumption in the United States is likely to increase.

A) after the overburden has been replaced, the many soil layers need to be restored. ~~At~~ Nutrient rich top soil is very important for growing new plants. After the soil is in place trees and new vegetation need to be planted. Plants are the key stone to a healthy successful environment. Once the trees begin to grow they should begin to attract animals and insects back to the environment. Slowly the environment should return to normal. The most important part of all of these steps is that any pollution be removed.

B) An arid climate would make restoration much more difficult. Without water new vegetation will have trouble getting a foothold in the area. Without vegetation all of the top soil will run off and the area will become a desert. Animals also need water to

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Survive

C) An environmental impact of the sulfur is acid deposition. The remaining sulfur could combine with other minerals and lower the pH of the surrounding water and soil. The lower pH will inhibit plant and animal growth and destroy the ecosystem. One solution is to try and remove the sulfur, eliminating the problem. Another solution is to mix the sulfur with a base like calcium carbonate. The base would neutralize the acids and keep the pH stable.

D) Burning coal for energy has many environmental impacts. The first is air pollution. Coal fire plants emit many greenhouse gases like CO_2 , SO_2 , and NO_x . These gases rise into the atmosphere and trap heat, slowly warming the planet. The air pollution also causes many respiratory diseases and lung cancer across America. The second reason is the secondary effects of the air pollution. If it is mixed with sunlight the pollutants cause photochemical smog, which can hang over areas and is very bad for people. The sulfur dioxide is one of the primary causes of acid rain. Acid rain can kill plants and animals and has a devastating effect on the environment. It can lower the pH of lakes and rivers too. Acid rain also breaks down rocks.

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that can leach out heavy metals that are very poisonous.

e) The per capita coal consumption in the US is likely to increase because the energy consumption of Americans is increasing. New technologies and labor saving devices use more energy. Americans are also very wasteful and take energy for granted. Americans have the money to pay to use more energy and coal is ~~very~~ ~~cheap~~ produces very cheap energy. The increase in efficiency of household products are being eclipsed by the sheer volume of the devices plugged in. 3 energy efficient devices use more ~~energy~~ electricity than 1 inefficient device.

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3. Most of the coal mined in the United States today comes from surface (strip) mines. In surface mining, the vegetation, soil, and rock covering the coal (referred to as overburden) are removed and set aside. After the coal has been hauled away, good conservation practices require that the overburden be replaced and the surface be restored to its original condition. Land restoration may be difficult in some regions, due to factors such as the local climate, the thickness of the coal seam, the extent of the overburden, and the sulfur content of the coal.
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 - Explain why per capita coal consumption in the United States is likely to increase.

A) After the overburden has been replaced, the topsoil must be restored. Soil may need to be imported from other areas in order to provide a base for new vegetation to grow. If the soil has been contaminated with sulfur or other chemicals from the coal mine steps should be taken to remove the contaminants. Finally, smaller, pioneer species may be necessary to hold the soil in place and prevent erosion until larger plant species can become established.

B.) Arid climates are harsh and fewer species of plants can survive there. Specialized species of plants which have adapted to the low water conditions are the only plants which can be grown in the area. Since water is necessary for plant growth, the large demand on the limited water supply will make the new growth of many plants difficult.

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C.) Sulfur is a component of sulfuric acid and atmospheric sulfur ~~acid~~ results in acid rain. When water seeps through sulfur contaminated tailings it could pick up the sulfur and become acid. This acidic water could then seep into the soil and make plant growth difficult. In order to remedy this problem the area could be treated with limestone to neutralize the acidic water.

D.) Burning coal produces greenhouse gasses such as carbon dioxide. These greenhouse gasses contribute to global warming. Burning coal also releases sulfur into the atmosphere. This sulfur may combine with water vapor and fall to the earth as acid rain. ~~Over time~~ Over time, acid rain can be devastating to plant species and can kill or damage a wide variety of plants.

E.) Coal is very cheap to mine and use as a source of energy. Coal is also very abundant in the United States, whereas the US imports over half of the oil it consumes. As the population increases, the demand for energy will also increase. Rather than importing more oil, the US will obtain a greater percentage of its energy from coal as a cheap method to meet growing energy demands.

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3. Most of the coal mined in the United States today comes from surface (strip) mines. In surface mining, the vegetation, soil, and rock covering the coal (referred to as overburden) are removed and set aside. After the coal has been hauled away, good conservation practices require that the overburden be replaced and the surface be restored to its original condition. Land restoration may be difficult in some regions, due to factors such as the local climate, the thickness of the coal seam, the extent of the overburden, and the sulfur content of the coal.

- (a) Describe the steps that should be taken to restore the land after the overburden has been replaced.
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- (c) Describe one environmental impact that the sulfur content of the remaining coal and the tailings would have on the reclamation process and suggest a possible remedy.
- (d) Other than mining and reclamation, describe TWO environmental impacts of using coal for energy.

(e) Explain why per capita coal consumption in the United States is likely to increase. *such as developers*

a). After overburden has been replaced, humans ^{such as developers} should leave the area alone. Since the area has been completely destroyed and habitats removed, lichens and mosses should be introduced as primary successors. That way, the area will naturally develop into a new habitat over many years.

b). Because successor species often require water to survive, an arid climate would make the area inhospitable to lichens and mosses. Rain would allow these species to break up rock and create soil for future habitats.

c). Remaining sulfur from coal could have environmental impacts. ~~Firstly~~ Rain can wash this sulfur into aquifers or surface water sources, contaminating the water. A possible remedy would be to mine ~~the~~ more thoroughly while

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still possible, to remove the sulfur

d). Combustion of coal for energy is oftentimes incomplete, releasing carbon in the form of CO_2 into the atmosphere, there, the CO_2 is a greenhouse gas, which contributes to global warming. Burning coal also releases the sulfur ~~compounds~~ content that is found in some coal sources. This sulfur reacts in the atmosphere to form SO_2 and H_2SO_4 , which contribute to acid deposition.

e). As Americans buy more appliances and consume more energy, ^{per capita} energy production must increase. Combined with the unwillingness to expand green sources of energy such as nuclear power, coal power plants are likely to grow, and with them coal consumption.

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4. The Alaskan National Wildlife Refuge (ANWR) on Alaska's North Slope is frequently in the news because petroleum geologists estimate that there are billions of barrels of economically recoverable oil beneath the surface of its frozen tundra. According to a 1998 United States Geological Survey (USGS) estimate, ANWR could contain up to 10 billion barrels of technically recoverable oil. Oil company officials advocate opening the refuge to oil exploration and the subsequent development of its petroleum resources. Environmentalists argue that oil exploration and development will damage this fragile ecosystem and urge Congress to protect ANWR by designating it as a wilderness area.
- (a) The United States consumes approximately 20 million barrels of oil per day. According to the USGS estimate, for how many days would the technically recoverable oil resource in ANWR supply the total United States demand for oil?
- (b) Describe TWO characteristics of arctic tundra that make it fragile and explain how these two characteristics make the tundra particularly susceptible to damage from human impacts.
- (c) Identify TWO activities that would be associated with the development of ANWR petroleum resources and describe a substantial environmental impact of each in ANWR.
- (d) Identify and describe TWO major end uses of the 20 million barrels of oil that the United States consumes each day and for each use describe a conservation measure that would substantially reduce United States consumption.

$$A) \quad \frac{10,000,000,000 \text{ barrels}}{20,000,000 \text{ barrels}} = 500 \text{ days}$$

B) Tundra is a fragile ecosystem because it is based on a relatively low amount of plant material. The cold dry ~~was~~ climate limits the amount of vegetation that can grow. If this vegetation ~~is~~ is destroyed it could cause a collapse of the higher trophic levels. Another reason this ecosystem is unstable is because a major part of its food chain, caribou relies on this limited resource and in order to achieve sustainable use of it they migrate throughout the year. This allows areas of grazed vegetation to re grow. If this migration was disturbed caribou would have to overgraze

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the land resulting in a food shortage and a large drop in their population. This would also cause a drop in the already low wolf population.

c) Two activities that would be associated with the development of ANWR petroleum resources would be an increase in ~~the~~ the building of roads and buildings and possibly the construction of another oil pipeline. The construction of roads and buildings would be built over important sources of food for many animals. Both the construction of roads and pipelines could inhibit the caribou's ability to migrate for food. The presence of humans in the construction of these will also lead to pollution and disruption of natural cycles.

d) Two uses for this oil are transportation and the heating of homes. The use of hybrid or hydrogen powered vehicles would greatly reduce the U.S.'s consumption of oil products. Hybrid cars still use gasoline but rely on an electrical motor for much of its energy. These cars have much better fuel mileage and would reduce gasoline intake. Hydrogen cars will eliminate the use of gasoline for transportation. Fuel cells will generate electricity to power the car. ~~More~~ More efficient forms of heating home can also

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reduce our dependence on oil. We can do this by implementing either or both passive and active solar heating. Passive solar heating is used by strategically placing windows where they would let sunlight in and act as a greenhouse. Active solar heating uses solar panels to convert the sun's energy into electricity, which in turn heats the house. Better insulation can also reduce oil consumption by minimizing heat that escapes from the house.

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4. The Alaskan National Wildlife Refuge (ANWR) on Alaska's North Slope is frequently in the news because petroleum geologists estimate that there are billions of barrels of economically recoverable oil beneath the surface of its frozen tundra. According to a 1998 United States Geological Survey (USGS) estimate, ANWR could contain up to 10 billion barrels of technically recoverable oil. Oil company officials advocate opening the refuge to oil exploration and the subsequent development of its petroleum resources. Environmentalists argue that oil exploration and development will damage this fragile ecosystem and urge Congress to protect ANWR by designating it as a wilderness area.
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$$4. a) \quad \frac{10,000,000,000 \text{ barrels}}{20,000,000 \text{ barrels/day}} = \underline{500 \text{ days}}$$

The oil in ANWR would supply the US with oil for 500 days.

b.) The layer of permafrost in the arctic tundra makes the vegetation in the area very delicate. It has to grow in very specific conditions and any changes in temperature or disturbances could severely damage the plants there.

Biodiversity in the tundra is very limited because of the extreme conditions. Disturbing the habitat of any animals, ~~the~~ vegetation or bacteria ~~can~~ would easily overthrow the equilibrium & limited food supply for ~~animals~~ biodiversity in the tundra.

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c.) ~~It would be used~~

① ~~Drilling for oil supplies in ANWR~~
~~would~~

① Building Roads that would lead to areas where they planned to drill for oil in ANWR would cause habit fragmentation and potentially loss of biodiversity in the refuge. Fragmenting habitats of territorial species in the area may cause them to move elsewhere, where they may invade another animals territory.

② Creating pipelines that reach to the continental US or to a ~~coast~~ water body where the oil would be exported could cause deforestation and oil leak problems. ~~It~~ Building pipelines would require the destruction of many acres of habitat for many organisms.

d.) Gasoline for cars: oil would be used to produce gasoline for cars. Conserving oil by reducing the amount of gasoline by developing more fuel-efficient vehicles, hydrogen-powered vehicles, using public transportation would reduce the US consumption of oil.

Production of Plastics: petroleum would be used in the manufacturing of plastics. The consumption

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of US oil could be reduced if substitutes for plastics such as ~~metals~~ glass and cardboard (which are more easily reused or recycled) were used instead of plastics.

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4. The Alaskan National Wildlife Refuge (ANWR) on Alaska's North Slope is frequently in the news because petroleum geologists estimate that there are billions of barrels of economically recoverable oil beneath the surface of its frozen tundra. According to a 1998 United States Geological Survey (USGS) estimate, ANWR could contain up to 10 billion barrels of technically recoverable oil. Oil company officials advocate opening the refuge to oil exploration and the subsequent development of its petroleum resources. Environmentalists argue that oil exploration and development will damage this fragile ecosystem and urge Congress to protect ANWR by designating it as a wilderness area.
- (a) The United States consumes approximately 20 million barrels of oil per day. According to the USGS estimate, for how many days would the technically recoverable oil resource in ANWR supply the total United States demand for oil?
- (b) Describe TWO characteristics of arctic tundra that make it fragile and explain how these two characteristics make the tundra particularly susceptible to damage from human impacts.
- (c) Identify TWO activities that would be associated with the development of ANWR petroleum resources and describe a substantial environmental impact of each in ANWR.
- (d) Identify and describe TWO major end uses of the 20 million barrels of oil that the United States consumes each day and for each use describe a conservation measure that would substantially reduce United States consumption.

4. a.
$$\frac{10,000,000,000 \text{ barrels}}{20,000,000 \text{ barrels/day}} = 500 \text{ days}$$

b. Arctic tundra ecosystems consist of a relatively small number of organisms. Because of this, anything that affects certain critical organisms can easily affect the entire ecosystem. This makes the tundra vulnerable and fragile.

c. Roads would be built in the refuge, which would create habitat islands. Habitat islands are generally less diverse than the original ~~area~~ area was, and biodiversity is essential to healthy ecosystems. Drilling for the oil would likely damage the soil of the tundra, and would require portions of the tundra

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to be cleared. This would destroy the habitats of many organisms that could be essential to the survival of the ecosystem.

d. The oil could be used to produce gasoline to fuel automobiles. ~~Automobiles~~ Automobiles could be made more efficient to conserve gas and waste less energy.

The oil could be used to fuel power plants. Alternative types of energy, such as renewable solar and wind power, could be used to reduce the need for nonrenewable fossil fuels.