

2000 AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

3. Species such as the dusky seaside sparrow, the passenger pigeon, and the woolly mammoth are extinct. Populations of other species have declined to the point where they are designated as threatened or endangered.
- (a) Identify one threatened or endangered species and explain why its population has declined.
 - (b) Describe three characteristics of organisms that would make them particularly vulnerable to extinction.
 - (c) Present three arguments in favor of the maintenance of biodiversity.
 - (d) Name and describe one United States federal law or one international treaty that is intended to prevent the extinction of species.

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(c) 3 POINTS MAXIMUM

1 point earned for EACH method DESCRIBED (two methods are requested)

Methods are associated to the point in the process where the reduction may occur. Simply listed, these methods, which are NOT considered descriptions, include:

Input, where 1) using low-sulfur coal; 2) “washing” the coal; 3) coal gasification; and 4) using alternative combustible fuels are identified in textbooks.

Example of description: “Coal can be chemically treated to reduce its sulfur content.”

Combustion, where 1) fluidized-gas combustion and 2) burning low-sulfur coal are identified in textbooks.

Example of description: “Plant can add limestone to the coal when it is burned.”

Output, where 1) using scrubbers and 2) treatment with NH_3 are identified in textbooks.

Example of description: “Plant can install scrubbers in its smokestacks.”

Other, where 1) conservation education is common and 2) source reduction, which includes reducing the electricity generated by the plant and/or increasing the efficiency of the plant, are identified in textbooks

Example of description: “Plant can develop conservation education programs to reduce electricity demand.”

1 point earned for elaboration on either, but not both, methods. Elaborations must include a detailed description of how the described method is related to the sulfur emissions.

Elaboration point examples:

Discussion of fluidized-bed combustion: crushed limestone is introduced into the crushed coal, which is then burned. The calcium in the limestone reacts with the sulfur in the coal to produce calcium sulfite (CaSO_3), calcium sulfate (CaSO_4), or gypsum (CaSO_4).

Discussion of wet vs dry scrubbing: Injected crushed limestone or lime slurry into emission (wet scrubbing); Injected sodium carbonate or bicarbonate into emission (dry scrubbing)

Discussion of source reduction: the plant reduced the amount of electricity it generates by reducing its capacity, thereby burning less coal, or by increasing the efficiency of the plant to increase the amount of electricity generated, which reduces the absolute amount of its emissions.

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(d) 3 POINTS MAXIMUM

1 point for DISCUSSION of the problem (must include either how or why the emissions are a problem)

Two commonly recognized problems: 1) increasing acidification of ecosystems (how or why), and 2) increased oxides of sulfur aerosols leading to regional cooling, smog, or respiratory distress (how or why).

1 point possibly earned for elaboration

Elaboration point examples:

- Formation of H_2SO_4 from SO_2 ($\text{SO}_2 \Rightarrow \text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$)
- Wet vs. dry deposition
 - SO_2 and SO_3 wind transport and reaction with water in ecosystems is dry
 - H_2SO_4 in precipitation is wet
- increased amounts of sulfur oxide aerosols absorb incoming UV-radiation, thereby cooling the lower atmosphere
- increased amounts of sulfur oxide aerosols irritate mucous linings in respiratory system (aerosols NOT disease-causing agents)

1 point earned for description of negative effect

Possible Negative Effects:

- Increased solubility of toxic metals as a result of the increased acidity in the ecosystem
- Increased leaching of soil nutrients
- Reduced buffering capacity of soil
- Fisheries kills as a result of changes in pH of aquatic ecosystems (In addition to deaths of adults, survival of eggs, young, fry, fingerlings are reduced.)
- Fisheries kills as a result of increase of toxic chemicals in aquatic ecosystems due to changes in pH
- Tree deaths as a result of changes in pH of soil ecosystems
- Tree deaths as a result of increase of toxic chemicals in soil ecosystems due to changes in pH
- Change in species composition due differences in range of tolerance for pH.
- Increase in disease-susceptibility of plants
- Disruption (simplification) of food webs as a result of the decline or loss of pH-sensitive organisms at various trophic levels
- Increased solubility of methyl mercury
- Interferes with calcium deposition and/or uptake as a result of the increased acidity in the ecosystem
- Changes in vegetation, including crops, due to changes in regional climate
- Changes in fauna distribution due to changes in regional climate
- Changes in fauna distribution due to changes in vegetation
- Changes in precipitation patterns due to changes in regional climate

1 point possible for elaboration (must demonstrate a more detailed understanding of the negative effect)

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(c) *(continued)*

OR

Newspapers:

- Paper is the number one source of municipal solid waste/ used in greater amounts than aluminum
- As aluminum cans are replaced by refillable glass bottles or PET plastic bottles, there will be fewer aluminum cans to recycle
- Recent legislation mandates a greater amount of recycled paper (30% -40%) be included in finished products
- Positive effects of trees on the environment are greater than aluminum ore (bauxite)**

(d) Two Difficulties -- 1 point for each difficulty (2 POINT MAXIMUM)

- Obtaining adequate funding to support the program (increased taxes)
- Difficult to enforce or monitor public compliance/participation
- Opposition from virgin material industries
- Short term reduction in jobs (from virgin resource industries)
- Public resistance to recycling plants located in their community (NIMBY)
- Organization of the infrastructure to collect, process and transport recyclables
- Supply and demand for recycled materials
- Fluctuation in market price of recycled material
- Opposition from groups that promote reduction in resource use as opposed to recycling or from groups that are opposed to recycling
- Legal implications of ownership of the recyclable materials (township vs. individual)
- Organization of publicity and education to encourage public support for the program

* Environmental effects of mining include acid mine drainage, contamination from tailings, increase in particulates (dust) as well as disruption of the land surface and dam construction to provide electricity for the extraction and processing of ore.

** Positive environmental effects of trees (forests) include oxygen production, preservation of habitats and biodiversity, and their role as carbon sinks. No point earned if previously stated as an elaboration point in (a), i.

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Question 3 Scoring Guide

(a) 2 POINTS MAXIMUM

1 point earned for identification of a specific species. General names are not accepted (e.g., whale, owl), unless all members of the group are endangered (e.g., elephant).

Examples of Species Accepted

Giant panda, elephant, whooping crane, manatee, rhinoceros, California condor, bald eagle, western lily, woolly spider monkey, Florida panther, blue whale, Galapagos tortoise

1 point earned for explanation linked to species above

Examples of Explanations Accepted

- habitat alteration for a specific reason, such as:
 - human encroachment (urban sprawl)
 - fragmentation (building highways)
 - conversion (building a marina)
 - simplification (agriculture)
- OR
- identification of the specific habitat altered (e.g., “The bamboo forest needed by the giant panda has been destroyed.”)
- hunting or poaching for a specific reason (e.g., food, sport, commercial, cultural beliefs)
- inability to compete with non-native or invasive species (must be specific, e.g., “Arrowroot is outcompeted by the non-native purple loosestrife.”)
- pollution (must be specific, e.g., “Lead poisoning of bottom-feeding waterfowl.”)
- pest control (must be specific, e.g., “DDT causes thin egg shells in bald eagles.”)

(b) 3 POINTS MAXIMUM

Each characteristic must be clearly described, explained, **or** a specific example must be provided (only first three are graded)

Acceptable characteristics (need description)

- specialized feeding behavior/food source
- requires large territory
- preys on livestock/people
- competition with humans (for space/food)
- no natural defense (against introduced species)
- fixed migratory patterns
- specialized reproductive behavior, breeding
- low reproductive rate
- limited geographic range, habitat
- specific behavior patterns
- exploited for economic value (specific)
- *k*-strategist
- feed at high trophic level, biomagnification
- large size
- slow speed
- limited range of tolerance
- small population linked to lack of genetic diversity

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(c) 3 POINTS MAXIMUM

1 point earned for each argument (only first three are graded)

- ecosystem function and/or stability based on a specific reason such as
 - organism's role in food web (e.g., keystone species, predator-prey relationships)
 - organism's role as a pollinator
 - organism's role in nutrient cycles (e.g., decomposer, nitrogen-fixer)
- future medical resources
- future food resources
- economic potential (ecotourism, future products with market value)
- genetic bank (species diversity to allow continued evolution)
- recreation (hiking, camping, hunting, fishing, etc.)
- scientific value for research/natural lab
- scenic/aesthetic value
- symbolic/religious value
- intrinsic value/ethical reasons (organism have inherent right to live, ecological wealth)
- provides resources for indigenous human population
- minimizes spread of infectious diseases

(d) 2 POINTS MAXIMUM

1 point earned for naming the law or treaty

1 point earned for describing the law

Federal Laws (1 point)

Endangered Species Act
(ESA)

Components (1 point; need ONE of the following)

- identify species that are endangered/threatened or
- protect endangered species from one of the following:
import/export, taking, harassing, harming, hunting, shooting,
wounding, trapping, killing, capturing, collecting, possessing,
selling, delivering, transporting, shipping, receiving or
- penalize violators or
- design protection plans or
- reintroduce species or
- protect habitat

Lacey Act - prohibits transport of protected species between states

The following are also acceptable with a correct description:

Wild Bird Conservation Act	Eagle Protection Act
Migratory Bird Treaty Act	African Elephant Conservation Act
Whaling Conservation and Protection Study/Act	Fur Seal Act
Marine Mammal Protection Act	Whaling Convention Act
Migratory Bird Conservation Act	Fish and Wildlife Conservation Act
Fish and Wildlife Coordination Act	Fish and Game Sanctuary Act
Marine Protection, Research and Sanctuary Act	Fish and Wildlife Act
Wildlife Restoration Act of 1937 (Pittman-Robertson Act)	
National Wildlife Refuge System Administration Act	

International Treaties:

- CITES (Convention on International Trade in Endangered Species) – regulates international trade of protected species and their products
- Convention on Biological Diversity – treaty signatories are expected to adopt biodiversity plans, establish protected ecosystems, promote sustainable use of biological resources, restore degraded habitats, protect threatened species
- International Whaling Commission Ban on Whaling – imposed moratorium on whaling