AP Environmental Science
Scoring Guidelines

AP® ENVIRONMENTAL SCIENCE
2017 SCORING GUIDELINES

Question 1

Read the following article from the *Fremont Daily Times* and answer the questions that follow.

(a) **Describe** TWO effects that ingesting microbeads has on aquatic organisms.

(2 points: 1 point for each correct description of an effect of microbeads on aquatic organisms.)

- Microbeads fill or block the digestive tract
- Organisms accumulate toxic chemicals (PCBs, dioxins) from microbeads, leading to long-term health effects

(b) Dr. Ewoldsen states that nitrates pose different threats to aquatic ecosystems than microbeads do. **Describe** how nitrate levels can negatively affect water quality in some aquatic ecosystems.

(2 points: 1 point for a correct description of the ecosystem response to increased nitrate levels and 1 point for a correct description of the effect of increased algal growth on water quality. The effect on water quality must be linked to response to increased nitrate levels to earn point.)

Response to increased nitrate levels	Effect on water quality
- Cause excessive algal growth or algal blooms - Cause cultural eutrophication - Speed eutrophication process	- Algae die and microbes deplete the water of available oxygen (DO) during decomposition of algae (hypoxic/anoxic conditions) - Algal blooms increase turbidity - Algal blooms lead to reduced light penetration - Algal blooms cause taste/odor problems

(c) While wastewater treatment plants are ineffective at removing microbeads, they are very effective at removing large pieces of plastic waste and other pollutants.

(i) **Identify** one way large pieces of plastic are removed from wastewater during primary treatment.

(1 point for a correct identification of one way plastics are removed during primary treatment.)

Physical mechanism for removing plastics from the liquid component of wastewater, such as

- Screens/Sieves
- Settling
- Nets
- Skimmers
- Filters
- Manual removal

(ii) Prior to discharge, wastewater is often disinfected. **Identify** one technique commonly used to disinfect wastewater.

(1 point for a correct identification of one technique used to disinfect wastewater.)

- Chlorination
- Treatment with ultraviolet (UV) light
- Ozonation
- Membrane filtration (reverse osmosis and ultrafiltration)

Question 1 (continued)

(iii) Sludge or biosolids produced during the wastewater treatment process can be spread on agricultural fields. **Identify** one advantage and one disadvantage of this practice.

(2 points: 1 point for a correct identification of an advantage of spreading sludge and 1 point for a correct identification of a disadvantage of spreading sludge.)

Advantage	Disadvantage
- Used as fertilizer - Increases crop yields/crop revenue - Improves soil quality - Reduces need for disposal of sludge/biosolids in landfills or by incineration - Generates revenue from sale of sludge/biosolids - May be less expensive than commercial fertilizer - May be least expensive disposal option	- Foul odors - Surface water and groundwater contamination by nutrients, heavy metals, pharmaceuticals, hormones, pathogens - Soil contamination by heavy metals, pharmaceuticals, hormones, pathogens - Crop contamination by heavy metals, pharmaceuticals, pathogens - Lack of public acceptance

(d) Coastal ecosystems are threatened by other human activities in addition to wastewater disposal. Mangrove swamps are one such threatened ecosystem.

   (i) **Provide** one reason why mangrove trees are being removed by humans.

   (1 point for a correct reason for why mangrove trees are being removed by humans.)

   - Establishing aquaculture facilities (fish and shrimp farming)
   - Expanding agriculture
   - Developing coastal areas (e.g., marinas, condos, resorts, infrastructure)
   - Harvesting mangroves for wood products, including paper pulp
   - Burning mangroves for energy/charcoal production
   - Removing mangroves for aesthetic reasons (to improve views)
   - Removing trees to increase access to coastal waters

   (ii) **Identify** one ecosystem service provided by intact mangrove ecosystems.

   (1 point for a correct identification of an ecosystem service provided by intact mangroves.)

   - Shoreline stabilization/protection (e.g., storm surge, tsunami, wave action)
   - Commercial fisheries
   - Nursery grounds for aquatic organisms
   - Biodiversity preservation
   - Flood control
   - Groundwater recharge
   - Sediment/nutrient retention
   - Nutrient cycling
   - Absorption of carbon dioxide and release of oxygen
   - Purification of water, air
   - Ecotourism/tourism/recreational opportunities
   - Protection from saltwater intrusion

Question 2

Populations of large terrestrial animals, such as African elephants and snow leopards, are in decline around the world. Many of these large animals are now on the verge of extinction.

(a) Using the data provided in the table above, **plot** the elephant population data as points on the grid below, placing the independent variable on the *x*-axis. Clearly **label** the axes.

(2 points: 1 point for correctly labeled and scaled axes and 1 point for correct plotting of data with no more than one error.)
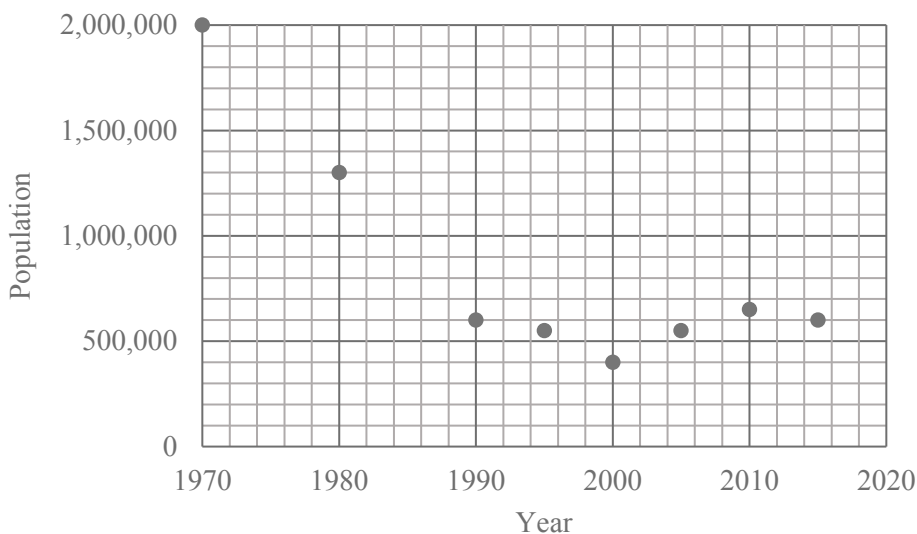
(b) **Calculate** the percent loss of elephants in Africa from 1970 to 2000. **Show all work**.

(2 points: 1 point for the correct setup and 1 point for the correct answer.)

2,000,000 - 400,000 = 1,600,000   1,600,000/2,000,000 × 100 = 80%

$2 \times 10^6 - 4 \times 10^5 = 1.6 \times 10^6$ $(1.6 \times 10^6 / 2 \times 10^6) \times 100 = 80\%$

(c) The International Union for Conservation of Nature (IUCN) estimates that the elephant population will decline by 20 percent between 2015 and 2022. Use this estimate to **calculate** how many elephants will be left in Africa in 2022. **Show all work**.

(2 points: 1 point for the correct setup and 1 point for the correct answer.)

0.80 × 600,000 = 480,000 elephants $0.80 \times (6 \times 10^5)$= 480,000 elephants

OR

(0.20 × 600,000 = 120,000), then 600,000 − 120,000 = 480,000 elephants

$(0.20 \times (6 \times 10^5) = 1.2 \times 10^5)$, then $6 \times 10^5 - 1.2 \times 10^5 = 4.8 \times 10^5$ elephants

(d) Most large terrestrial mammals are K-strategists. **Identify** one characteristic of a K-strategist and **explain** how the characteristic you identified can make these mammals prone to extinction.

(*2 points: 1 point for a correct identification of a characteristic of a K-strategist and 1 point for an explanation of how this characteristic makes mammals prone to extinction.*)

Characteristic of a K-strategist	Explanation
Few offspring (per event/year/lifetime) OR Low reproductive rate	• Difficult recovery from population decline • Unable to adapt to changing environments or human-induced ecosystem changes • Fewer opportunities for reproduction to pass on genes
High parental care and protection of offspring	• Loss of parent = loss of offspring • Offspring vulnerable to predation
Long gestation period	• Fewer opportunities for reproduction
Late age for first reproduction/long maturation period	• Difficult recovery from population decline • Unable to adapt to changing environments or human-induced ecosystem changes • Fewer opportunities for reproduction to pass on genes

(e) **Identify** and **discuss** TWO conservation strategies that could be implemented to prevent the extinction of large terrestrial mammals, such as the African elephant or snow leopard.

(*2 points: 1 point for each correct discussion of a conservation strategy that was identified.*)

- More laws limiting hunting → less poaching, greater animal survival
- Better enforcement of animal or habitat protection laws → less poaching, greater animal survival
- Laws restricting or prohibiting trade of these species or their parts → no market, less poaching
- Establishment/expansion of preserves/parks → safe habitat in which to live and reproduce, reduce poaching
- Education about ecological value of animals → increased public support
- Development of ecotourism industry → creation of market for tourism, less poaching
- Tusk dyeing (elephants), horn removal (rhinos) → devalue animal parts, less poaching
- Captive breeding programs aimed at reintroduction → increased population or genetic diversity
- Armed protection (guards) for animals → less poaching
- Movement of threatened species to new location → greater survival, increased genetic diversity

Question 3

Haiti shares a border with the Dominican Republic on the Caribbean island of Hispaniola.

(a) The border between the two countries can be seen using satellite images because of the severe deforestation in Haiti.

  (i) **Provide** one reason why deforestation commonly occurs in a less developed country such as Haiti.

    (1 point for a correct reason why deforestation commonly occurs in a less developed country.)

- Converting forests into agricultural land, ranchland
- Using trees/charcoal for fuel or source of income
- Protecting forests through regulations is less common than in developed countries
- Harvesting timber for use as building materials
- Using forested land for commercial purposes by corporations/industrialized countries
- Clearing forested land to accommodate growing rural populations (e.g., roads, homes, schools)

  (ii) **Describe** one realistic strategy to reduce deforestation in a less developed country.

    (1 point for a correct description of a realistic strategy to reduce deforestation in a less developed country.)

- Enact/enforce laws or regulations that restrict cutting of trees
- Encourage sustainable agriculture/forestry programs
- Introduce more efficient cooking methods that reduce use of wood as a fuel source
- Establish programs to promote alternate building materials that reduce the demand for wood
- Develop economic programs to increase individual incomes/decrease reliance on forest conversion
- Reduce population growth resulting in less demand for wood for fuel and income
- Promote ecotourism to protect natural areas and to discourage tree harvesting

(b) Deforestation can affect water quality. **Identify** one change that can occur in the water quality of streams within a watershed that has been deforested. **Explain** how deforestation can lead to this change.

(*2 points: 1 point for identifying a correct change in water quality and 1 point for correctly explaining the linkage to deforestation. The explanation point cannot be earned without correctly identifying a change in water quality.*)

Change in Water Quality	Linkage to Deforestation
Increase in water temperature	Loss of shade; increased solar radiation reaching the stream
Increase in sediment/turbidity	Loss of root structure, leaf litter, canopy leads to increased soil erosion and runoff
Increase in nutrient concentration	Loss of vegetation results in less nutrient uptake and subsequent runoff into stream
Decrease in pH	Loss of root structure allows naturally-occurring acids to run off into streams
Decrease in dissolved oxygen	Loss of shade leads to warmer water, which holds less dissolved oxygen

(c) **Identify** TWO environmental benefits, other than those related to water quality, of maintaining forest ecosystems.

(*2 points: 1 point for each correct environmental benefit identified. Only the first two benefits can earn a point.*)

- Maintains habitat/biodiversity
- Releases oxygen
- Stores carbon
- Slows climate change/global warming
- Absorbs/reduces/filters air pollutants

- Regulates local temperatures/maintains microclimates and regional climates
- Reduces erosion, thus preserving soil quality/quantity
- Maintains nutrient cycles

The table below contains demographic data for Haiti in 1995 and 2015.

DEMOGRAPHIC DATA FOR HAITI

Measure	1995	2015
Fertility rate (number of children per woman)	5.2	2.7
Life expectancy (years)	55	64
Infant mortality (deaths per 1,000)	85	48

(d) **Identify** and **discuss** one factor in a less developed country that could contribute significantly to a change in life expectancy, similar to what occurred in Haiti from 1995 to 2015.

> *(2 points: 1 point for correctly identifying a factor that increases life expectancy and 1 point for discussing how that factor contributes significantly to this increase. The discussion point may be earned without the identification point.)*

Factor	Contribution to Increasing Life Expectancy
Increased access to health care	• Fewer deaths from treatable diseases • Prevention of early death by giving vaccines
Improved food quality or quantity	• Better health and general wellness resulting in less malnutrition or fewer early deaths • Decrease in food-borne diseases
Increased access to clean water (e.g., sanitation, sewage treatment, drinking water)	• Fewer water-borne and communicable diseases
Fewer pregnancies	• Fewer children resulting in fewer maternal deaths
Increased health-related education	• Better sanitation, less disease transmission

(e) **Identify** and **discuss** one economic or cultural factor in a less developed country that could contribute significantly to a change in the fertility rate, similar to what occurred in Haiti from 1995 to 2015.

(2 points: 1 point for correctly identifying one economic or cultural factor that decreases fertility rate and 1 point for discussing how that factor contributes significantly to this decrease. The contribution point may not be earned without earning the factor point.)

Factor	Contribution to significantly decreasing fertility rate
Increased education of women	• Fewer children • Later age at first reproduction • Aware of choices for family planning
More economic opportunities for women	• Fewer children • Later age at first reproduction • Less dependence on males
Later marriage age for women	• Fewer children • Later age at first reproduction
Cultural acceptance of family planning strategies/increased access to family planning	• Fewer children • Confidence that children will survive to adulthood
Increased women's rights/gender equality/empowerment of women	• Access to family planning • Choices in reproduction • Financially less dependent on males
Increased industrialization/economic development	• Children no longer an asset, but a financial liability
More social programs to support elderly citizens	• Children no longer needed to support aging parents

Question 4

Dams are built by humans for various purposes including hydroelectric power generation and control of downstream flooding.

(a) **Explain** how electricity is generated at a hydroelectric dam.

(3 points: 1 point for a description of each step in the process of generating electricity at a hydroelectric dam.)

Step	Description of Step
Water moves	• Water falls/drops • Water is directed to a turbine • Potential energy → kinetic energy
Turbine rotates	• Water turns/rotates a turbine • Kinetic energy → mechanical energy
Electricity produced	• Turbines turn/drive a generator • Rotation converted to electricity • Mechanical energy → electricity

(b) **Identify** TWO economic benefits, other than hydroelectric power generation and control of downstream flooding, associated with dams.

(*2 points: 1 point for each correct identification of an economic benefit. Only the first two identifications can earn a point.*)

- Recreation/tourism
- Job creation
- Provision of water for domestic, industrial, or agricultural use
- Commercial fisheries
- Commercial shipping

(c) **Describe** one ecological benefit of seasonal flooding of the floodplain of a free-flowing river.

(*1 point for a correct description of an ecological benefit of seasonal flooding of the floodplain.*)

- Flooding can deposit nutrients/increase soil fertility
- Sediment can create banks
- Sediment can build/replenish soil
- Overflow can deposit seeds
- Flooding can recharge the aquifer
- Overflow can create/maintain habitat for fish and birds (e.g., riparian zones, wetlands)
- Flooding can decrease soil/water salinization

(d) Some dams have been removed from rivers.

   (i) **Explain** how removal of a dam can benefit fish populations.

   (*1 point for correct explanation of how dam removal benefits fish populations.*)

   - Restoration of wetland/riparian habitats supports fish populations
   - Removal of barrier allows fish migration/increases access to habitats/mates
   - Removal of dam turbines/spillway decreases fish mortality
   - Restoration of pre-dam conditions (e.g. water temperature, habitat, dissolved oxygen, turbidity) benefits native species

   (ii) **Describe** one negative environmental consequence of removing a dam from a river (other than effects on fish populations).

   (*1 point for correct description of a negative environmental consequence of dam removal.*)

   - Loss of lake habitat/species or downstream habitat/species following restoration of pre-dam conditions
   - Increased deposition of sediment downstream
   - Erosion of stream banks by high flow following rapid dam removal
   - Increased turbidity from release of silt/sediment
   - Movement of pollutants accumulated behind the dam downstream
   - Change of water temperatures downstream
   - Spread of invasive species

(e) Dams are also built by beavers, a keystone species in some North American ecosystems.

   (i) **Define** keystone species.

   (*1 point for a correct definition of a keystone species.*)

   - Has a large effect on its environment relative to its abundance
   - Increases ecosystem stability OR reduces ecosystem stability when absent

   (ii) **Describe** how dams built by beavers can make beavers a keystone species in some ecosystems.

   (*1 point for a description of how beaver dams transform their environment linked to impact on other species.*)

   - Creation of habitats/alteration of existing habitat
   - Fewer floods maintains habitat stability
   - Removal of water-borne pollutants increases survival of aquatic life
   - Entrapment of sediments behind dam creates habitat/reduces turbidity
   - Reduction of erosion of stream banks