



---

# **AP<sup>®</sup> Environmental Science 2015 Scoring Guidelines**

---

© 2015 The College Board. College Board, Advanced Placement Program, AP, AP Central, and the acorn logo are registered trademarks of the College Board.

Visit the College Board on the Web: [www.collegeboard.org](http://www.collegeboard.org).

AP Central is the official online home for the AP Program: [apcentral.collegeboard.org](http://apcentral.collegeboard.org).

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE**  
**2015 SCORING GUIDELINES**

**Question 1**

- (a) **Describe** how TWO human activities, other than those that result in anthropogenic climate change, have resulted in a decrease in the amount of freshwater flowing into the Everglades ecosystem.

*(2 points: 1 point for each description of an appropriate human activity. Students have to describe, not merely identify, the human activity. Only the first two descriptions can earn a point)*

- The water is diverted for irrigation of crops
- The water is withdrawn for domestic uses such as watering lawns, washing cars, drinking water, flushing toilets, etc.
- The water is withdrawn for industrial processes such as the production of goods, cleaning the facility or an additional appropriate use
- The water is diverted for flood control
- Road construction/development interrupts the flow of surface water
- Wetlands are filled in for agriculture, or housing developments and/or road construction

- (b) In addition to water quantity problems, the Everglades is faced with a variety of water quality issues. For example, phosphorus concentrations in the Everglades have increased since the 1960s.

- (i) **Describe** how one specific human activity contributes to increased phosphorus levels in the Everglades.

*(1 point for a description of a human activity that has led to increased phosphorus levels in the Everglades)*

- Runoff from fertilizer or pesticides\* used in agriculture, residential lawn care or golf courses
- Seepage from septic systems located near canals
- Discharges from wastewater treatment plants that lack tertiary or advanced wastewater treatment
- Combined sewer overflows (CSOs) when rain volume exceeds wastewater treatment plant capacity
- Runoff of animal waste from feedlots
- Use of phosphate-containing detergents

*\*Pesticides are acceptable only if they are identified as an organophosphate.*

- (ii) **Explain** one way in which an increase in phosphorus levels can adversely affect the Everglades ecosystem.

*(1 point for an explanation of how increased phosphorus levels adversely affect the Everglades ecosystem)*

- Phosphorus can speed eutrophication and stimulate harmful algal blooms
- Phosphorus may give a selective advantage to invasive species, which displace native plants (native species are adapted to low levels of phosphorus)
- A specific example of a native species being displaced by a non native species (or a non endemic species, such as cattails, replacing the endemic sawgrass)

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE 2015 SCORING GUIDELINES

## Question 1 (continued)

**(iii) Describe** one step that could be taken to reduce phosphorus inputs from the activity you identified in part (i).

*(1 point for a description of a step to reduce phosphorus inputs, **must be linked to (i)**)*

- Buffer zones/retention ponds/waste lagoons around agricultural areas
- Swales/rain barrels/cisterns/rain garden/green roofs in residential areas
- Artificial wetlands created to capture runoff from agricultural areas (Storm water treatment areas (STA) are planted with cattails)
- Permeable pavements/permeable pavers to treat runoff
- Fertilizer used more efficiently/precision agriculture/more efficient irrigation techniques
- Restrictions on phosphate-containing detergents or pesticides
- Restrictions on the use of phosphate-containing fertilizers
- Wastewater treatment plants upgraded to remove phosphates from wastewater (tertiary or advanced treatment)
- Public education campaign about efficient use of fertilizers or alternatives to fertilizers  
(Note: better use of fertilizers is not the same as efficient use of fertilizers)

**(c)** Climate change could have a variety of impacts on water quantity, water quality, and habitat. For EACH of these three factors, **identify and describe** one specific example of an impact on the Everglades likely to result from climate change.

*(3 points: 1 point each for an identification with a correct description of an impact on water quantity, water quality, and habitat; the impacts can be positive or negative)*

Acceptable responses may include the following:

<b>Water Quantity</b>	
<b><u>Negative</u></b>	<b><u>Positive</u></b>
Higher temperatures lead to increased evaporation, lowering water levels	Storm water runoff and flooding will help maintain water levels
Periods of heavy rainfall will increase storm water runoff and flooding	
Sea level rise will flood areas of the Everglades	

<b>Water Quality</b>	
<b><u>Negative</u></b>	<b><u>Positive</u></b>
Elevated air temperatures can raise water temperatures	Periodic flooding can dilute concentrations of harmful pollutants
Elevated temperatures cause dissolved oxygen levels to decrease	Periodic flooding will dilute salinity levels in areas affected by sea level rise
Increased evaporation will increase concentration of pollutants in surface water	
Pollutants are carried by storm water runoff into the Everglades, threaten aquatic life	
Sea level rise will lead to increased salinity and/or salt water intrusion into coastal wells	
Warmer water temperatures will lead to increases in algal blooms/rate of eutrophication	

**AP® ENVIRONMENTAL SCIENCE  
2015 SCORING GUIDELINES**

**Question 1 (continued)**

<b>Habitat</b>	
<b><u>Negative</u></b>	<b><u>Positive</u></b>
Due to changes in water quantity (rainfall): <ul style="list-style-type: none"> <li>• Reduced runoff/drought dries out aquatic habitat</li> <li>• Flooding/storm water runoff floods previous semi-aquatic habitat</li> </ul>	Increased runoff/flooding helps maintain aquatic habitats
Due to sea level rise (salt water intrusion): <ul style="list-style-type: none"> <li>• Increased salinity levels in estuaries can lead to a decline in populations for species not adapted to higher salinity levels</li> <li>• Nests of wading birds and other coastal dwelling animals may be destroyed</li> <li>• Salt tolerant communities (such as red mangroves) can move inland, displacing existing communities</li> </ul>	New habitat is created for organisms that are salt tolerant
Elevated temperatures favor invasive species	
Elevated temperatures push some species past their upper temperature tolerance limit (terrestrial or aquatic)	

**(d)** The article states that Governor Moss believes that the “preservation and enhancement of the Everglades, key goals of the restoration program, are absolutely essential for the continued environmental and economic health of the state.”

**(i) Describe** one way that restoring water quantity and water quality in the Everglades is expected to improve the structure and function of the ecosystem.

*(1 point for a correct description of how the restoration of water quantity and water quality will improve the structure and function of the Everglades ecosystem)*

- Re-establish biodiversity
  - By providing/re-establishing habitats (For example, wading birds will be able to re-establish their populations)
  - Re-establishment of native species/vegetation so that food webs/food chains become more stable (For example, apple snails will be able to lay their eggs and the food source for the Everglades Kite will be assured)
- Prevent degradation of adjacent coastal areas
- Less eutrophication leading to fewer algal blooms

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 1 (continued)

**(ii) Describe** one way that restoring the Everglades is expected to provide economic benefits to Florida.

*(1 point for a description of an ECONOMIC benefit)*

Acceptable responses may include the following:

- Increase tourism/recreation, (for example, increase the number of visitors to the Everglades National Park)
- Create jobs to work in the tourism/recreation/restoration industries
- Maintain clean water, so less money has to be spent on water treatment
- Attract businesses that provide tours of the area that will increase tax revenue

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE  
2015 SCORING GUIDELINES**

**Question 2**

Approximately 30 million mobile devices were sold in 1998 in the United States. The number sold increased to 180 million devices in 2007.

**(a) Calculate** the percent increase of mobile device sales from 1998 to 2007.

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

$$\frac{(180 \text{ million} - 30 \text{ million})}{30 \text{ million}} \times 100\% = 500\%$$

**OR**

$$\frac{(180 - 30)}{30} \times 100\% = 500\%$$

(Note: Students must show the calculation in order to receive credit for the correct answer. Math setup must be shown for second point.)

**(b)** Each mobile device sold in 2007 contained an average of 0.03 gram of gold. **Calculate** the number of grams of gold that were used in the production of the mobile devices sold in 2007.

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

$$1.8 \times 10^8 \text{ devices} \times \frac{3 \times 10^{-2} \text{ grams}}{\text{device}} = 5.4 \times 10^6 \text{ grams or } 5,400,000 \text{ grams}$$

**OR**

$$180,000,000 \text{ devices} \times \frac{0.03 \text{ grams}}{\text{device}} = 5,400,000 \text{ grams or } 5.4 \times 10^6 \text{ grams}$$

(Note: Students must show the calculation to receive credit for the correct answer. Math setup must be shown for second point. Mass units and correct numbers must be shown for second point.)

**(c)** Assume that the average mass of each mobile device was 0.1 kilogram. The United States Environmental Protection Agency estimates that about 10 percent of the mobile devices sold in 2007 were recycled. **Calculate** the mass (in kilograms) of the mobile devices sold in 2007 that were not recycled.

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

$$1.8 \times 10^8 \text{ devices} \times \frac{0.1 \text{ kg}}{\text{device}} \times 0.9 = 1.62 \times 10^7 \text{ kg or } 16,200,000 \text{ kg}$$

**OR**

$$180,000,000 \text{ devices} \times \frac{0.1 \text{ kg}}{\text{device}} \times 0.9 = 16,200,000 \text{ kg or } 1.62 \times 10^7 \text{ kg}$$

**OR**

$$\left(1.8 \times 10^8 \text{ devices} \times \frac{0.1 \text{ kg}}{\text{device}}\right) - \left(1.8 \times 10^8 \text{ devices} \times \frac{0.1 \text{ kg}}{\text{device}} \times 0.1\right) = 1.62 \times 10^7 \text{ kg or } 16,200,000 \text{ kg}$$

**OR**

$$\begin{aligned} &\left(180,000,000 \text{ devices} \times \frac{0.1 \text{ kg}}{\text{device}}\right) - \left(180,000,000 \text{ devices} \times \frac{0.1 \text{ kg}}{\text{device}} \times 0.1\right) \\ &= 16,200,000 \text{ kg or } 1.62 \times 10^7 \text{ kg} \end{aligned}$$

(Note: Students must show the calculation to receive credit for the correct answer. Math setup must be shown for second point. Mass units and correct numbers must be shown for second point.)

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 2 (continued)

- (d) Discarded mobile devices become part of the electronic waste stream (e-waste). Mercury is often present in e-waste. **Identify** one negative human health effect, other than death, associated with exposure to mercury.

*(1 point earned for identification of a specific health effect associated with mercury. Identification of the specific form of Hg responsible for the health effect is not required)*

- Birth defects
- Nervous system damage
- Brain damage
- Learning disabilities
- Mental retardation
- Paralysis
- Attention deficit disorder
- Reproductive system damage
- Low sperm counts
- Kidney damage
- Hearing loss
- Minimata disease
- Mad Hatter's disease
- Seizures
- Visual impairment
- Skin disorders
- Headaches
- Mental illness

- (e) Improper disposal of e-waste has harmed human health and caused environmental damage in developing countries.

- (i) **State** TWO reasons why large quantities of e-waste from the United States are shipped to developing countries rather than being recycled in the United States.

*(2 points: 1 point for each of two reasons why e-waste is shipped to developing countries.*

*Acceptable responses include a variety of potential answers, but the key is to include a reason why the U.S. sends the material, not why the receiving country would want it)*

#### **Economic**

- Lower labor costs in developing countries
- Disposal is cheaper in developing countries
- Shipment/recycling/disposal in developing countries is cheaper than transporting and landfill tipping fees within the U.S.
- Corruption of officials allows evasion of more expensive recycling and disposal options

(Note: "Cheaper" earns only one point unless two distinct reasons are given.)

#### **Public Relations**

- Recycling or disposal inside of the U.S. may be a public relations problem (NIMBY)
- When e-waste is shipped outside of the U.S., companies often avoid internal scrutiny

#### **Regulatory/Liability**

- Laws and enforcement may be lax
- Environmental impacts of disposal in the U.S. (pollution) may be more visible long-term
- U.S. workers are more likely to be able to sue successfully over health problems
- "Watchdog" organizations common in U.S. may be less common in developing countries

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 2 (continued)

(ii) Retailers or manufacturers could take specific steps to dramatically reduce the amount of e-waste. **Describe** a realistic change in current practices that would accomplish this.  
(1 point for a realistic change)

- Encourage recycling/reuse (trade-in incentives, rebates, repurchase/buy-back, mail-in)
- Reduce planned obsolescence as a design objective
- Production of modular units that can be reused/refurbished or parts (i.e. power supplies) that can be reused
- Make devices smaller and/or more durable
- Shift toward service flow economy
- Establish cradle-to-grave and/or cradle-to-cradle tracking of manufactured products



# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

- (a) Using the data in the graph above, **determine** the maximum volume of oil estimated to have been spilled during the Deepwater Horizon (BP) incident.

*(1 point for identifying a specific number  $\geq 185$  million gallons and  $\leq 199$  million gallons. Include units)*

- (b) **Describe** TWO environmental problems that can result from oil spills in coastal areas.

*(2 points: 1 point for each of two reasonable description of an environmental problem)*

- Birds may lose their buoyancy or ability to fly if their feathers are coated with oil
- Degradation of nursery grounds, feeding grounds, and habitat may lead to a loss of biodiversity
- Food webs may be disrupted when populations of specific organisms in the web are reduced or suffer negative health impacts
- Oil spill may decrease the amount of sunlight reaching photosynthetic organisms in water
- Organisms may be killed by smothering, or by ingesting, inhaling, or absorbing oil

- (c) **Identify** one economic impact that results from oil spills in coastal areas.

*(1 point for an economic impact which may be positive or negative impact)*

Negative Economic Impacts	Positive Economic Impacts
Cost of cleanup efforts	Financial aid brought into local economies through grants, disaster relief, and settlements
Decline in tourism/loss of revenue from tourism or commercial fishing	Increase in jobs and revenue during cleanup and monitoring of spill
Monetary value of lost crude oil	

- (d) Chemical dispersants have been used in cleanup efforts following major oil spills.

- (i) **Discuss** both one advantage and one disadvantage of the use of chemical dispersants for oil spill cleanup.

*(2 points: 1 point for an advantage and 1 point for a disadvantage)*

Advantages of Chemical Dispersants	Disadvantages of Chemical Dispersants
Breaks down oil into smaller droplets, diluting the concentration of oil to reduce its toxicity	Dispersants increase underwater damage as the dispersed oil settles
Easy to apply quickly and easily, or is less costly than shoreline cleanup	May be toxic to organisms/humans
Minimizes spreading of surface oil	May increase the area affected by the oil spill
Protects birds from surface oil	Oil is dispersed but not removed

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE  
2015 SCORING GUIDELINES**

**Question 3 (continued)**

**(ii) Identify** either one biological or one physical method (other than chemical dispersal) used for oil spill cleanup in coastal waters or on beaches and **describe** how the method is used.  
(1 point for description of an acceptable method)

Biological Method	Physical Methods
Introduction of microbes that degrade the oil	Burning oil on the surface of water
	Dredging and vacuuming to remove oil
	Physical washing of rocks/organisms
	Use of absorbent material to remove oil or to keep the spill from spreading
	Using booms to contain oil on the surface and skimmers to separate the oil from the water

**(e)** Catastrophic spills make up less than 20 percent of the oil that pollutes marine waters. **Identify** one other source of oil contamination and **explain** how the oil from this source enters marine waters.

(2 points: 1 point for identification of a source, and 1 point for an explanation of how oil from that source enters the water)

Source	Explanation
Leaks from oil infrastructure	Leaks can occur during the exploration, production, and transport of oil
Oil from boats	Oil can leak from boat engines and during the emptying of bilge tanks
Natural seeps	Crude oil leaks to the surface naturally from the ocean floor
Oil from automobiles	Oil dripped from cars can be washed into water with storm runoff
Oil intentionally dumped	Oil is then carried to water with runoff or directly dumped into the water

**(f)** Petroleum has many uses as a raw material for consumer goods. Identify one substitute for petroleum in a specific consumer product (other than fuel).

(1 point for identification of a reasonable substitute for petroleum in a product)

- Paper bags
- Corn-based plastic water bottles
- Bamboo or wood storage containers
- Natural fibers (cotton, hemp, bamboo, etc.) in garments, upholstery, etc.

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 4

The term “urban sprawl” describes the expansion of cities into rural areas. This phenomenon has occurred around the world and has had economic, health, and environmental consequences.

**(a) Describe** TWO causes of urban sprawl.

*(2 points: 1 point for each reasonable cause; only the first two causes can earn a point)*

#### Transportation

- Increased use of/reliance on automobiles
- Improved/expanded roads
- Low gas prices promote driving
- Telecommuting has made it possible to work remotely

#### Economic

- Increasing wealth/affluence providing choice
- Higher taxes in inner city
- High land/property costs in city vs. less expensive land prices outside the city (cannot earn both)
- Tax deductions for home mortgages interest
- Jobs move out and employees follow
- Home buying subsidies/reduced interest rates e.g., GI Bill
- Lack of/poor city-regional planning: (urban centers plan in isolation; lack of cohesive plan for growth)
- Lower cost of living in suburbs

#### Quality of Life

- Desire for property/yard/lower density
- Better quality suburban schools
- Urban blight/declining infrastructure in inner cities
- High crime rates in inner cities
- Seek natural environments, aesthetics, cleaner air, less noise pollution, etc.

**(b) Discuss** TWO human health effects associated with urban sprawl.

*(2 points: 1 point for each human health effect, which can be positive or negative)*

- Asthma, bronchitis, emphysema, airway inflammation, irritation of mucus membranes, respiratory irritation, lung irritation, aggravated heart disease from increased air pollution
- Obesity, impaired immune response, diabetes, hypertension, high blood pressure from less exercise due to auto travel time and/or a commuter diet
- Depression, anxiety, suppressed immune response from social isolation due to spread out housing
- Personal injuries associated with automobile crashes due to increased driving
- Hearing loss, high blood pressure, impaired immune response from noise pollution
- Survival rate/recovery rate hindered due to delays in emergency medical services response and fire department response times due to spread out housing
- Reduction in disease spread in lower density areas

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 4 (continued)

- (c) The graph below shows the relationship between population density and petroleum use in selected cities. **Describe** the relationship between population density and petroleum use shown in the graph.

*(1 point for a description)*

- Petroleum use is inversely proportional to population density ;
- Petroleum use increases as population density decreases;
- Petroleum use and population density are inversely related
- There is a negative (exponential) relationship between petroleum use and population density

- (d) Smart growth focuses on ways to encourage sustainable urban development. **Describe** TWO steps a municipality could take to encourage smart growth in order to limit urban sprawl.

*(2 points: 1 point for each step; only the first two steps can earn a point)*

#### Transportation

- Subsidize mass transit to encourage less automobile use
- Build bike paths to encourage less automobile use
- Establish moratoria on highway and new road construction
- Develop master plans which direct new residents/jobs to busy hubs

#### Zoning/Design

- Modify zoning ordinances to encourage multi-use/mixed land uses, create minimum development densities; promote compact communities; a range of housing opportunities; vertical development
- Establish development barriers surrounding cities and towns (Urban Growth Boundaries)
- Preserve and protect farms/agricultural lands by designating these areas as agricultural land reserves or conservation easements
- Create a range of housing opportunities & choices (Urban Village Strategy): dense, multi-family- and single-family housing near shops, cafes, & public transit
- Foster communities that provide a sense of place: promote appreciation of unique environments, community involvement, and social context of cities
- Promote gentrification
- Promote reclamation of brownfields

#### Tax Incentives

- Create tax incentives/reduced taxes for living in city

#### Increased Amenities

- Enhance the quality of living/increase amenities in cities (e.g., schools, parks, pools, recreation to encourage people to remain in cities); efforts to reduce pollution/improve air quality

#### Other

- Carry out public education campaign

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE**  
**2015 SCORING GUIDELINES**

**Question 4 (continued)**

**(e)** Highway systems and urban sprawl often threaten wildlife populations. **Describe** TWO methods to reduce harmful effects on wildlife populations from highways and urban sprawl.

*(2 points: 1 point for each correct method; only the first two methods can earn a point)*

- Create wildlife corridors/tunnels between green areas
- Create wildlife crossing zones/tunnels/overpasses, etc.
- Plan highways around existing migratory routes and prime habitats
- Avoid fragmentation of habitat by housing developments
- Set aside land for/increase size of refuges; increase green space and buffer zones along highways
- Construct highway fencing, especially along migratory routes
- Promote planting of native plants to provide habitat
- Enforce anti-littering laws along highways; reduce highway speed limits; “wildlife caution signs”
- Encourage carpooling (fewer cars, fewer wildlife collisions)

**(f)** Urban sprawl often results in the loss of productive agricultural land near cities. **Describe** one practical way to increase food production within urban areas.

*(1 point for a practical way to increase urban food production, such as one of the following)*

- Gardens/victory gardens; roof-top gardens; vertical farming, hydroponics, greenhouses
- Edible gardens in public/open spaces
- Green roofs can include edible plants (“green roof” by itself should not earn a point)
- Zoning to allow the raising of bees, chickens, microlivestock
- Provide incentives for: use of greenway/area gardens, vacant lots for community agriculture; land under power lines, in floodplains;
- Brownfield reclamation and conversion to gardens