

2015 AP[®] ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

ENVIRONMENTAL SCIENCE

SECTION II

Time—90 minutes

4 Questions

Directions: Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in this book. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

1. Read the article below and answer the questions that follow.

The Floridian Daily

May 21, 2013

The small community located on the edge of the magnificent wetlands of Florida's Everglades was the site of a press conference today where Governor Gayle Moss announced that the restoration of the Everglades is successfully underway. She noted that the Everglades ecosystem has suffered threats to its water quality, water quantity, and habitats in recent decades. Moss noted that intensive urban and agricultural development in adjacent areas has diverted substantial amounts of

freshwater resources and impaired water quality. Governor Moss then emphasized 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. She closed the press conference by saying, "The Everglades is a gem not only for Florida but for the entire world. Each of us has the responsibility to do our part to preserve this magnificent resource."

- (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.
- (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.
 - (ii) **Explain** one way in which an increase in phosphorus levels can adversely affect the Everglades ecosystem.
 - (iii) **Describe** one step that could be taken to reduce phosphorus inputs from the activity you identified in part (i).
- (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.
- (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.
 - (ii) **Describe** one way that restoring the Everglades is expected to provide economic benefits to Florida.

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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)

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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:

Water Quantity	
<u>Negative</u>	<u>Positive</u>
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	

Water Quality	
<u>Negative</u>	<u>Positive</u>
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	

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Question 1 (continued)

Habitat	
<u>Negative</u>	<u>Positive</u>
Due to changes in water quantity (rainfall): <ul style="list-style-type: none"> • Reduced runoff/drought dries out aquatic habitat • Flooding/storm water runoff floods previous semi-aquatic habitat 	Increased runoff/flooding helps maintain aquatic habitats
Due to sea level rise (salt water intrusion): <ul style="list-style-type: none"> • Increased salinity levels in estuaries can lead to a decline in populations for species not adapted to higher salinity levels • Nests of wading birds and other coastal dwelling animals may be destroyed • Salt tolerant communities (such as red mangroves) can move inland, displacing existing communities 	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

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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