

**AP[®] ENVIRONMENTAL SCIENCE
2013 SCORING GUIDELINES**

Question 1

(a) Identify TWO human activities that alter the natural flow of sediments into Gulf Coast ecosystems. Explain how each of the activities alters the flow of sediments.

(4 points: 1 point for each activity; 1 point for each explanation [change in sediment load must be linked to its appropriate activity]; only the first two answers are accepted)

Activity	Explanation
Building dams*	<ul style="list-style-type: none"> • Blocks flow of sediment from upstream, decreases deposition downstream (coast starved of sediments) • Prevents flooding that deposits sediment in floodplain • Increases flow velocity, increases downstream erosion
Channelization/straightening/re-routing of river	<ul style="list-style-type: none"> • Prevents deposition in wetlands • Increases velocity, decreases deposition in floodplain/coast starved if sediments carried offshore
Building levees*	<ul style="list-style-type: none"> • Prevents deposition in wetlands • Increases velocity, sediments carried offshore
Loss of riparian/buffer zones and degraded stream banks*	<ul style="list-style-type: none"> • Increases erosion, increases sediment load to river • Decreases sediment trapping due to root loss, increases sediment load to river
Agriculture/irrigation practices	<ul style="list-style-type: none"> • Increases erosion, increases sediment load to river
Construction/urbanization	<ul style="list-style-type: none"> • Increases erosion, increases sediment load to river • Decreases infiltration leading to greater runoff, increases sediment load to river
Deforestation/logging*	<ul style="list-style-type: none"> • Increases erosion, increases sediment load to river • Decreases sediment trapping because of root loss, increases sediment load to river
Water use/extraction	<ul style="list-style-type: none"> • Over pumping/use of water reduces river flows, decreases sediment load to Gulf
Dredging/ditching*	<ul style="list-style-type: none"> • Removes sediment from the ecosystem • Increases erosion, increases sediment load to river
Draining of wetlands*	<ul style="list-style-type: none"> • Increases erosion due to increased overland flow, increases sediment load to river • Decreases sediment trapping because of vegetation loss, increases sediment load to river
Overgrazed rangelands*	<ul style="list-style-type: none"> • Increases erosion, increases sediment load to river
Mining (strip mining)*	<ul style="list-style-type: none"> • Increases erosion, increases sediment load to river

*opposite activities and explanations accepted as appropriate

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Question 1 (continued)

(b) Dr. James says that it is important to restore sediments. Describe TWO ways that the loss of natural sediment harms Gulf Coast wetland ecosystems.

(2 points: 1 point for each description [must be ecological, not economic]; only the first two descriptions provided can earn points)

- Conversion of wetlands to open water (flooding) due to lack of sediment renewal
- Loss of nutrients that are needed to maintain wetland plants (lower productivity)
- Loss of plant productivity leads to loss of biomass at higher trophic levels
- Loss of replenishment for floodplain soils, coastal beaches, barrier islands, marshes, estuaries
- Loss of specific coastal habitats (e.g., bird breeding areas, fish nurseries)
- Flooding of coastal wetlands due to loss of barrier islands and beaches

(c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Gulf of Mexico.

(i) Describe TWO environmental impacts on the marine ecosystem that are caused by fertilizer as it flows into the Gulf of Mexico.

(2 points: 1 for each impact description [must be ecological, not economic]; only the first two descriptions provided can earn points)

- Over-enrichment by excess nutrients (nitrates and phosphates)
- Increased growth of algae
- Decreased levels of light/decreased levels of photosynthesis
- Formation of dead zone (increased fish/shellfish death)
- Lower dissolved oxygen (hypoxic/anoxic conditions)
- Increased populations of bacteria
- Increased biochemical oxygen demand (BOD)/increased respiration of decomposers
- Outbreaks of red tides/harmful algal blooms (HABs)

(ii) What are TWO economic consequences that are caused by fertilizer when it flows into the Gulf of Mexico?

(2 points: 1 for each consequence [must be economic, not ecological]; only the first two consequences provided can earn points)

- Decreased income/revenue due to lower fish catches (e.g., shrimp, oysters, fin fish)
- Loss of jobs in the fishing industry
- Lower rates of tourism due to impacts (e.g., HAB, lower fish diversity, less aesthetically pleasing)
- Cost of cleanup of fish kills
- Increased seafood prices due to lower seafood supply
- Lower sales of seafood due to HABs
- Loss of property taxes if people move away
- Decreased property values

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Question 1 (continued)

(iii) Describe ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River.

(1 point for a description of a reduction strategy; only the first description provided can earn points)

- Protection, re-establishment of riparian/buffer zones (replanting) to trap fertilizer
- Limit farming near floodplains
- Limit development (e.g., lawns, golf courses) near floodplains
- Improve agricultural or residential practices (use techniques such as intercropping, cover crops, no till, timing of fertilizer application)
- Treatment of storm water to reduce nutrients before releasing into river
- Requirement of tertiary treatment for wastewater treatment plants and other point sources
- Education of public on techniques to reduce nutrient flow
- Limit septic systems near riparian zones
- Treatment of waste from livestock farms (CAFOs) to reduce nutrients
- Catchment basins/retention ponds to trap nutrients
- Green roofs to decrease runoff
- Permeable pavement to reduce flow of water into waterways

- (c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Mississippi River.
 - i. **Describe** TWO environmental impacts on the marine ecosystem that are caused by fertilizer when it flows into the Gulf of Mexico.
 - ii. What are TWO economic consequences that result from the flow of fertilizer into the Gulf of Mexico?
 - iii. **Describe** ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River.

less fish - less money
less farm

a) One human activity would be farming. ~~then~~ To irrigate the land they will take water from rivers and streams and divert it to their farms. This then causes lower water flow, so less sediment is carried and more is dropped off. A second activity would be damming waterways. When humans build dams, sediment cannot ~~to~~ travel past the dam, so it will not be brought downstream.

b) Without the constant restoration of sediment, the wetland will eventually disappear. The wetland needs the sediment to make up for the constant sinking. Without the wetland there would be increased flooding of the surrounding area. There would also be a loss of habitat for the many species that depend on the land such as migratory birds.

c) When Fertilizer flows into the Gulf, the water's level of oxygen decreases. This then causes fish to die off. With the pollution of Fertilizer, the turbidity of the water will increase, also causing a decrease in plant production from lack of light. Fertilizer effects the Gulf of Mexico ~~economically~~ economically because less fish means less money for

ADDITIONAL PAGE FOR ANSWERING QUESTION 1

fishermen as well as less food for the surrounding communities. It also affects our economy because of the ~~per~~ cost to fix the waterway and ~~mitigate~~ to mitigate the problem. One such way to fix this would be to plant trees and other plants along side the river to act as a barrier. The ~~these~~ plants can slow runoff, which would mean less fertilizer would enter the waterway.

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(c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Mississippi River.

- i. Describe TWO environmental impacts on the marine ecosystem that are caused by fertilizer when it flows into the Gulf of Mexico. eutrop
- ii. What are TWO economic consequences that result from the flow of fertilizer into the Gulf of Mexico? - loss of fertilizer costs \$
- iii. Describe ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River. fishing

a) Many human activities alter the natural flow of sediments. One such activity affecting the Gulf Coast is the construction of levees - walls along the river banks designed to prevent flooding. ^{but} it also ^{blocks} ~~inhibits~~ the flow of sediments from the land around the river into the River and down to the coast. Another sediment-reducing activity is the construction of dams. Dams significantly slow the flow of water in rivers and often create a buildup of sediment behind them, preventing them from reaching the coast.

b) The loss of sediment in Gulf Coast ecosystems could have seriously negative effects. ^{For one} Sediments carry nutrients that are vital for many organisms. They also help to establish habitats for many organisms.

ADDITIONAL PAGE FOR ANSWERING QUESTION 1

c) When fertilizer runs-off into the Gulf, one effect it can have is eutrophication, caused by the nitrates in the fertilizer. It can also decrease ^(dissolved oxygen) DO content in the water, due to increased Biological Oxygen Demand.

ii) When fertilizer flows into the Gulf, it pollutes the water. This is a problem because fishing is a major Gulf industry. If the water is polluted, the fish may not be safe to eat. Fertilizer runoff threatens this industry.

Furthermore, if fertilizer is flowing into the Gulf that means it is flowing off the fields of farmers. To replace that run-off fertilizer, they will have to buy more fertilizer, which may force them to increase the price of their products.

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ciii) TO Reduce the ~~fertilizer~~ fertilizer run-off into the River, the government could establish Rules that set a minimum distance ~~that~~ away from the River that fertilizer can be used. The further the fertilizer has to travel, the less likely it is to end up in the Gulf.

GO ON TO THE NEXT PAGE.

(c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Mississippi River.

- i. **Describe** TWO environmental impacts on the marine ecosystem that are caused by fertilizer when it flows into the Gulf of Mexico.
- ii. What are TWO economic consequences that result from the flow of fertilizer into the Gulf of Mexico?
- iii. **Describe** ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River.

a) one is damming. putting up dams slows the water flow into the gulf coast and stops the sediment. another is The use of the water for everyday domestic use. The large use of the water may slow the flow of the water and along with it the flow of the sediments.

b) One way is that the sediments might contain minerals needed to keep the ecosystem running, and another is The sediments ~~at~~ ~~from~~ might create home for the smaller ~~or~~ organisms.

c) i) Two impacts are that the fertilizer can kill of the fish and It can make the water very un healthy

ii) There would be less fish to catch and sell because they are being killed by the fertilizer and they would have to pay to have the water treated so that it can be restored.

iii) They can plant more trees around the rivers and the gulf because the large amount of trees and plants would lower the amount of runoff by a lot.

AP[®] ENVIRONMENTAL SCIENCE 2013 SCORING COMMENTARY

Question 1

Overview

The intent of this question was for students to demonstrate knowledge of how humans have impacted the coastal ecosystem of the Gulf of Mexico. Students were first asked to describe two specific activities that have altered the flow of sediment and then were asked to describe how fertilizer runoff has contributed to cultural eutrophication in the Gulf. Additionally, students were asked to demonstrate a basic knowledge of wetland ecosystems and the impact of cultural eutrophication on the economy of this region. The last task was to identify a strategy to reduce the flow of nutrients into the Gulf.

Sample: 1A

Score: 10

A point was earned in (a) for stating “take water from rivers and streams and divert to their farms” as an example of the activity of water use, and a point was earned for the explanation that “this then causes lower water flow, so less sediment is carried and more is dropped off.” A second activity point was earned in (a) for identifying dams, and an explanation point was earned for “sediment cannot travel past the dam” (sediment blocked). A point was earned in (b) for describing that “the wetland needs the sediment to make up for the constant sinking” and “without the wetland there would be increased flooding of the surrounding area.” A second point was earned in (b) for stating that a loss of habitat for migratory birds would occur. A point was earned for an environmental impact in (c)(i) for stating that the “water’s level of oxygen decreases,” and a second point was earned for stating “this then causes fish to die off.” An economic consequence point was earned in (c)(ii) for stating “less fish means less money for fishermen.” No point was earned for describing the cost of mitigation of the excess fertilizer in the Gulf because this point was too vague. A strategy point was earned in (c)(iii) for saying “plant trees and other plants alongside of the river to act as a barrier. The plants can slow the runoff, which would mean less fertilizer would enter the waterway.”

Sample: 1B

Score: 8

A point was earned in (a) for the identification of levees, and an explanation point was earned for stating that a levee “blocks the flow of sediments from land around the river . . . and down to the coast.” A second identification point in (a) was earned for identifying dams, and an explanation point was earned for stating that dams “create a buildup of sediment behind them.” No point was earned in (b) for stating that “sediments carry nutrients that are vital for many organisms” because they do not specify that nutrients are needed by plants/producers. No additional point was earned in (b) for stating that “they also help to establish habitats for many organisms” because it does not describe organisms specific to a wetland. An environmental impact point was earned in (c)(i) for describing “eutrophication, caused by nitrates in the fertilizer,” and a second point was earned for stating “decreased DO (dissolved oxygen) content in the water.” An economic consequence point was earned in (c)(ii) for stating that “the fish may not be safe to eat. Fertilizer runoff threatens this industry,” but no additional point was earned for stating that farmers upstream will need to spend more money on fertilizer because it has been washed away. A strategy point was earned in (c)(iii) for stating “rules that set a minimum distance away from the river that fertilizer can be used.”

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Question 1 (continued)

Sample: 1C

Score: 6

A point was earned in (a) for identifying dams, and an explanation point was earned in (a) for stating that a dam “stops the sediment.” An additional point in (a) was earned for identifying water use and an explanation point was earned for stating that the water use “may slow the flow of water and along with it the flow of the sediments.” No point was earned in (b) for stating “the sediments might contain minerals needed to keep the ecosystem running” because it does not identify nutrients and it does not specifically state that they are going to plants. No environmental impact points were earned in (c)(i) because there is not a clear explanation of the cause of fish kills and making the water “unhealthy” is too vague. An economic consequences point was earned in (c)(ii) for stating “there would be less fish to catch and sell,” but no additional point was earned for stating that “they would have to pay to have the water treated” because treating the Gulf is not feasible. A point was earned in (c)(iii) for the strategy “plant more tree[sic] around the rivers.”