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*	• 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	• Prevents deposition in wetlands • Increases velocity, decreases deposition in floodplain/coast starved if sediments carried offshore
Building levees*	• Prevents deposition in wetlands • Increases velocity, sediments carried offshore
Loss of riparian/buffer zones and degraded stream banks*	• Increases erosion, increases sediment load to river • Decreases sediment trapping due to root loss, increases sediment load to river
Agriculture/irrigation practices	• Increases erosion, increases sediment load to river
Construction/urbanization	• Increases erosion, increases sediment load to river • Decreases infiltration leading to greater runoff, increases sediment load to river
Deforestation/logging*	• Increases erosion, increases sediment load to river • Decreases sediment trapping because of root loss, increases sediment load to river
Water use/extraction	• Over pumping/use of water reduces river flows, decreases sediment load to Gulf
Dredging/ditching*	• Removes sediment from the ecosystem • Increases erosion, increases sediment load to river
Draining of wetlands*	• 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*	• Increases erosion, increases sediment load to river
Mining (strip mining)*	• 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

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

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Question 4

4. (a) 3 points maximum

1 point for indicating that animal waste is likely to be contaminating the water **IF** it is supported by a rational explanation of the data.

1 point for linking the decrease in dissolved oxygen level to decomposition of animal waste and/or an increase in biochemical oxygen demand.

1 point for linking the increase in nitrate level and/or an increase in phosphate level to their presence in animal waste.

1 point for using the trend in stream recovery, in regard to the water quality results, as evidence of contamination by animal waste.

4. (b) 3 points maximum

1 point for stating **each** water test **and** an appropriate pattern expected from sites A through D for that test. Only the first **two** tests given are graded.

1 point only for a descriptive elaboration of the parameter, **OR** method of testing, of ONE or BOTH of the stated tests.

Examples of suitable water tests include:

Fecal Coliform/Coliform, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Temperature, Turbidity/Total Suspended Solids (TSS), Heavy metals, (e.g., lead, mercury, cadmium), Carbon dioxide, Nitrite, Salinity, Ammonia, Other macro or micronutrients (e.g., K, S), Chlorine, Iron, Selenium, Hardness, Sulfate, Sulfite, Methane, Conductivity/Total Dissolved Solids (TDS), Alkalinity/Acid Neutralizing Capacity (ANC), Color, Odor, Synthetic organics, (e.g., pesticides, PCBs), Qualitative Habitat Evaluation Index (e.g., stream substrate analysis), Biodiversity Index – the different numbers and types of species, (e.g., macroinvertebrates, bacteria, algae, amphibians, fish, plants).

Question 4 (cont.)

4. (c) 3 points maximum

Only the **first** described sequence is graded. Credit will only be given for ecological changes that are **linked** to the presence of animal waste and are **connected** to a single sequence.

0 points would be awarded for simply stating that 'eutrophication' occurs.

An example of a suitable sequence could be:

1 point for indicating that as stream fertility increases due to higher nitrate/phosphate levels, an algal bloom occurs.

1 point for indicating that as the dead algae and/or organic materials are decomposed, a reduction in the level of dissolved oxygen occurs.

1 point for indicating that an increase in suspended solids could lead to an increase in temperature and/or a decrease in the rate of photosynthesis, resulting in lower dissolved oxygen levels.

1 point for indicating that a shift in benthic plants, phytoplankton, macroinvertebrates, and/or fish communities would result from a specific cause.

1 elaboration point is possible for identifying a suitable species as the example of a shift in biodiversity.

Suitable examples of an indicator species could be:

Pollution sensitive	**Somewhat pollution tolerant**	**Pollution tolerant**
caddisfly larvae	beetle larvae	aquatic worms
hellgrammite	clams	blackfly larvae
mayfly nymphs	crane fly larvae	leeches
gilled snails	crayfish	midge larvae
riffle beetle adult	damselfly nymphs	pouch (and other) snails
stonefly nymphs	dragonfly nymphs	catfish
water penny larvae	scuds	carp
trout	sowbugs	
	fishfly larvae	
	alderfly larvae	
	atherix	
	bass	

Question 4 (cont.)

Other acceptable species could include: duckweed, pfiesteria.

1 point only would be awarded for indicating that a human health effect could occur from the contaminated water. For example, if humans are exposed to water with high fecal coliform counts, from human or animal wastes, other organisms may also be present that could lead to diseases such as typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections.

4. (d) 2 points maximum

1 point each for describing any **two** of the following provisions of the Clean Water Act. Only the first **two** stated examples are graded.

The Clean Water Act serves to:

- regulate the discharge of pollutants into U.S. waterways
- attain water quality levels that make these waterways safe to fish and/or swim in
- restore and maintain the chemical, physical, and biological integrity of the nation's water
- set water quality standards to limit pollutants
- require states and tribes to complete an assessment of all state rivers impacted, or potentially impacted, by non-point pollution (Section 319)
- reduce polluted runoff from urban areas and animal feeding operations (Section 319)
- provide enforcement mechanisms (e.g. civil actions/criminal penalties) to ensure compliance
- develop management plans to address problems
- establish ongoing monitoring of local waterways
- require discharge permits for effluent emissions
- provide financial assistance to fund improvements/education/training
- prevent habitat destruction
- establish best practical control technology (BPT) to reduce pollution
- establish best available, economic achievable technology (BAT) to reduce toxics
- establish best management practices (BMPs) to reduce pollution.