AP® ENVIRONMENTAL SCIENCE
2013 SCORING GUIDELINES

Question 4

(a) Describe TWO characteristics shared by ecosystems that have high biodiversity.
(2 points: 1 point for each description of a characteristic)

- Large number of different species
- Large number of individuals of different species
- Complex food webs
- Greater genetic diversity
- Variety of ecological roles / niches
- Abundant resources

(b) Identify TWO specific human activities that result in a loss of biodiversity and explain how each activity lowers biodiversity.
(4 points: 1 point for each activity and 1 point for each correctly linked explanation)

Activity	Explanation
Clearing land for construction/homes/roads	• Reduces habitat for many species • Results in habitat fragmentation
Logging/clear cutting/deforestation	• Reduces habitat for many species • Results in habitat fragmentation
Agriculture: • Monoculture • GMOs • Clearing forests to create pastureland • Pesticide use	• Eliminates native species; decreases genetic variation • Reduces habitat for many species • Eliminates native species and beneficial organisms
Overfishing/hunting (overhunting)/poaching	• Reduces keystone species • Reduces top predators • Depletes endangered species
Water contamination by: • Excess fertilizer • Runoff from feedlots • Runoff from construction • Untreated sewage	• Overloads sediments and nutrients • Decreases dissolved oxygen (only certain species can survive)
Burning of fossil fuels	<u>Climate change</u> • Death of coral reefs • Loss of reef habitat • Increases sea level with resulting loss of coastal habitat <u>Acid rain</u> • Increases acidity of freshwater systems (only certain species can survive)
Introduction of invasive species	• Displaces native species
Dams/hydroelectric plants	• Fragments habitat
Surface mining	• Destroys habitat

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Question 4 (continued)

(c) For each human activity you discussed in (b), propose a practical strategy (other than simply banning the activity) to reduce the loss of biodiversity.
(2 points: 1 point for each reasonable solution correctly linked to the activity or explanation in part b)

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Activity (or explanation) from part (b)	Solution
Clearing land for construction/homes/roads	• Cluster development • Smart Growth planning • Develop urban boundaries • Habitat-conservation areas
Logging/clear cutting/deforestation	• Replant trees • Selective cutting
Agriculture: • Monoculture • GMOs • Clearing forests to create pastureland • Pesticide use	• Encourage polyculture, agroforestry, intercropping • Require GMO crops to be sterile • Create wildlife/habitat corridors • Grow shade-tolerant crops • Implement IPM techniques, biological pest controls
Overfishing/hunting (overhunting)/poaching	• Regulate activities and/or establish quotas • Enforce existing laws (ESA) • Ban trade (CITES)
Water contamination by: • Excess fertilizer • Runoff from feedlots • Runoff from construction • Untreated sewage	• Regulate non-point sources of water pollution (e.g., buffer zones, swales, containment ponds, storm water treatment areas) • Secondary or tertiary treatment
Burn fossil fuels	<u>Climate change</u> • Implement the Kyoto Protocol • Carbon sequestration • Carbon cap-and-trade • Carbon tax • Switch to renewable energy sources <u>Acid rain</u> • Require scrubbers on coal burning power plants • Switch to renewable energy sources
Introduction of invasive species	• Checkpoints for agricultural inspections • Tighter enforcement on import of horticultural or exotic species • Education regarding strategies to prevent invasives
Dams/hydroelectric plants	• Steps to allow fish migration
Surface mining	• Enforce Surface Mining and Reclamation Act

Question 4 (continued)

(d) Describe ONE naturally occurring factor that could lead to a loss of biodiversity.
(1 point)

- Particulates from asteroids/volcanoes can alter the atmosphere (e.g., block sunlight, resulting in cooler temperatures and reduced photosynthesis)
- Widespread wildfires can wipe out small populations
- Natural, long-term climate change can result in warmer or cooler temperatures
- Hurricanes/tsunamis can wipe out coastal nursery/estuary areas
- Droughts (e.g., food source may be lost; populations may be unable to adapt to drier conditions)
- Mutation/evolution may lead to new diseases/predators

(e) Describe TWO ecological benefits that greater biodiversity provides.
(2 points: 1 point for each ecological benefit)

- Pollination (by insects and other organisms)
- Water/air filtration by intact ecosystems
- Stability/survivability of ecosystems
- Control of pest species
- More source material for evolution
- Soil microorganisms can contribute to nutrient recycling, leading to higher primary productivity

4 A1

4. Biological diversity, or biodiversity, has become a topic of great concern among conservationists. Biodiversity is often used by scientists and policy makers to help determine the health of ecosystems.
   (a) **Describe** TWO characteristics shared by ecosystems that have high biodiversity.
   (b) **Identify** TWO specific human activities that result in a loss of biodiversity, and **explain** how each activity lowers biodiversity.
   (c) For each human activity you discussed in (b), **propose** a practical strategy (other than simply banning the activity) to reduce the loss of biodiversity.
   (d) **Describe** ONE naturally occurring factor that could lead to a loss of biodiversity.
   (e) **Describe** TWO ecological benefits that greater biodiversity provides.

a) A system with high biodiversity is very stable because there are many species with different functions and different roles. these systems are also more adaptable as they have such a range of species and genetic diversity they can adjust quickly to changes that a storm or fallen tree may present, they are also very productive systems as they have a range of species and functions that are performed in them.
b) Urbanization directly effects biodiversity as it leads to destruction and fragmentation of an ecosystem. As urban areas grow the habitats of many animals are destroyed making it hard for that organism to persist and as organisms disappear biodiversity decreases. Another human issue is the clear cutting/logging of forests. By clear cutting a forest a habitat along with its inhabitants is destroyed. This habitat destruction destroys the ecosystem leaving it to secondary succession where diversity levels will be low for a # of years.
c) Rather than taking expanses of land, bulldozing and then building, Urban areas would do better to cluster

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buildings, by clustering buildings. It allows a greater space to be saved for wildlife habitat without it being fragmented, thus creating an urban area + preserving wildlife.

Instead of clear cut Logging, selective cutting poses a better choice for biodiversity, this makes it so the habitat remains whole also when cutting, taking trees from a range of ages, so as to promote diverse conditions.

d) A crown fire will annihilate a forest, directly affecting its biodiversity. Crown fires are large and will wipe out a forest. They can occur naturally via lightning and can rage for days destroying acres of land and many organisms, leaving the land to be reclaimed by secondary succession and lose diversity for a number of years.

e) Greater biodiversity leads to a more stable environment. A more stable environment is more sustainable and a more sustainable environment is ecologically beneficial as it is lasting.

Greater biodiversity also means more natural services. For example A diverse ecosystem will process detritus speedily returning nutrients to the soil to be used again, thus being very beneficial ecologically, as it has efficient system that promotes life.

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4B.

4. Biological diversity, or biodiversity, has become a topic of great concern among conservationists. Biodiversity is often used by scientists and policy makers to help determine the health of ecosystems.

   (a) **Describe** TWO characteristics shared by ecosystems that have high biodiversity.

   (b) **Identify** TWO specific human activities that result in a loss of biodiversity, and **explain** how each activity lowers biodiversity.

   (c) For each human activity you discussed in (b), **propose** a practical strategy (other than simply banning the activity) to reduce the loss of biodiversity.

   (d) **Describe** ONE naturally occurring factor that could lead to a loss of biodiversity.

   (e) **Describe** TWO ecological benefits that greater biodiversity provides.

a) One characteristic shared by ecosystems w/ high biodiversity is that they are usually very robust, meaning that they are strong enough to survive certain things like extreme weather or death of species. Another characteristic shared by ecosystems w/ high biodiversity is that the ecosystem is usually very complex in terms of food chains, and they usually have a high mix of k and r species.

b). One human activity that results in decreased biodiversity is when we introduce invasive species to an area. Because such species have no natural predators, they usually have plenty of food w/out any creature to mitigate them. As a result, they thrive, reproduce, eliminate species, and harm biodiversity. Another human activity that harms biodiversity is destruction of habitats through activities such as logging. When humans log, they destroy many species habitats and cut out key pieces of environments that many species depend on. As a result, animals and plants struggle to

survive and many don't.

c) One strategy to mitigate the effects of logging would be to not clear-cut vast swaths of forest, but rather leave some trees up while taking only some trees out of the forest. For example, instead of cutting down 20 trees in a small area, you could take down 5 trees from 4 separate areas, to reduce the harmful effects of logging.

A strategy to handle invasive species is to quickly track the species and attempt to remove them. If that doesn't work, you could introduce a predator to the invasive species. However, this has to be done carefully. While it could drastically reduce the # of invasive species, it could end up being an invasive species itself and do more damage than good.

d) One naturally occuring factor that could lead to a loss of biodiversity is disease. If a disease comes in that takes out, for example, a certain species of tree, then the elimination or drastic reduction of that species could affect the entire ecosystem, particularly if other plants and animals depend on it. In turn, species that depend on those species, and so on, would be harmed and the entire ecosystem could be affected.

e) One ecological benefit that high biodiversity provides is that the ecosystem is usually strong enough that if one species is eliminated or reduced, the rest of the ecosystem

4B3

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isn't drastically affected, or is at least strong enough to recover. Another ecological benefit that greater biodiversity provides is that the ecosystem can withstand [redacted] harsh weather events, [redacted] such as [redacted] forest fires, and be able to recover.

STOP

END OF EXAM

THE FOLLOWING INSTRUCTIONS APPLY TO THE COVERS OF THE SECTION II BOOKLET.

- **MAKE SURE YOU HAVE COMPLETED THE IDENTIFICATION INFORMATION AS REQUESTED ON THE FRONT AND BACK COVERS OF THE SECTION II BOOKLET.**
- **CHECK TO SEE THAT YOUR AP NUMBER LABEL APPEARS IN THE BOX(ES) ON THE COVER(S).**
- **MAKE SURE YOU HAVE USED THE SAME SET OF AP NUMBER LABELS ON ALL AP EXAMS YOU HAVE TAKEN THIS YEAR.**

4c

4. Biological diversity, or biodiversity, has become a topic of great concern among conservationists. Biodiversity is often used by scientists and policy makers to help determine the health of ecosystems.
   (a) **Describe** TWO characteristics shared by ecosystems that have high biodiversity.
   (b) **Identify** TWO specific human activities that result in a loss of biodiversity, and **explain** how each activity lowers biodiversity.
   (c) For each human activity you discussed in (b), **propose** a practical strategy (other than simply banning the activity) to reduce the loss of biodiversity.
   (d) **Describe** ONE naturally occurring factor that could lead to a loss of biodiversity.
   (e) **Describe** TWO ecological benefits that greater biodiversity provides.

a) Species are able to adapt to changes and don't need to be in a certain niche.

b) Cutting down forests to build homes causes loss of habitats for species to live, so they are forced to migrate. Hunting can lower biodiversity because it can lower populations to a point where they can repopulate quick enough & they can go extinct.

c) Ecosystems that are very highly diverse should be protected and turned into wildlife refuges and parks so that they can't get torn down or changed by humans in a negative way. Hunt during certain times when the animals aren't breeding so that they can reproduce to repopulate the animals killed and they won't be overhunted.

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d) A natural disaster such as ~~earthquakes~~ droughts, tornados, tsunamis, ~~or~~ and hurricanes can make the ecosystem change and can kill certain species or cause them to migrate from the area.

e) If the ecosystem ~~is~~ were to change, not all the species would die or migrate because some of them are able to live in the changed conditions. Also, biodiversity lets species to adapt to changes over time.

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AP® ENVIRONMENTAL SCIENCE
2013 SCORING COMMENTARY

Question 4

Overview

The intent of this question was to ascertain students' knowledge of biodiversity. Students were initially asked to describe two characteristics shared by systems with high biodiversity and later they were asked to describe two benefits of that greater biodiversity. Students were also asked to identify and explain two human activities that lower biodiversity and to propose a practical solution to each activity. Additionally, students were asked to describe one naturally occurring factor that lowers biodiversity.

Sample: 4A
Score: 10

Two points were earned in part (a) for describing a "range of species and genetic diversity." Four points were earned in part (b): 1 point was earned for identifying "urbanization" as an activity; 1 point was earned for describing how urbanization leads to the "destruction and fragmentation of an ecosystem"; 1 point was earned for identifying "clear cutting logging of forests" as an activity; and 1 point was earned for describing how "a forest habitat along with its inhabitants is destroyed." Two points were earned in part (c): 1 point was earned for describing that "by clustering buildings" fragmentation is decreased and habitat is saved and 1 point was earned for describing that "selective cutting poses a better choice." One point was earned in part (d) for describing that "A crownfire [*sic*] will annihilate a forest." One point was earned in part (e) for describing that greater diversity "leads to a more stable environment."

Sample: 4B
Score: 8

One point was earned in part (a) for describing that "the ecosystem is usually very complex in terms of foodchains." Four points were earned in part (b): 1 point was earned for identifying the introduction of "invasive species to an area" as an activity; 1 point was earned for describing how invasive species "thrive, reproduce, eliminate species, and harm biodiversity"; 1 point was earned for identifying "logging" as an activity; and 1 point was earned for describing how logging can "destroy many species habitats." One point was earned in part (c) for describing "but rather leave some trees up while taking only some trees out of the forest" as an alternative to logging by clear-cutting a forest. No points were given for the strategy of tracking invasive species or finding a predator for that invasive species because those strategies would not prevent the introduction of the invasive species. One point was earned in part (d) for describing how "disease" could lead to a loss of biodiversity. One point was earned in part (e) for explaining "that if one species is eliminated or reduced, the rest of the ecosystem isn't drastically affected or is at least strong enough to recover"

Sample: 4C
Score: 6

No points were earned in part (a). Four points were earned in part (b): 1 point was earned for identifying "Cutting down forests to build homes" as an activity; 1 point was earned for describing how cutting down forests "causes loss of habitats"; 1 point was earned for identifying hunting as an activity; and 1 point was earned for describing how hunting "can lower populations to a point where they can repopulate quick enough &[*sic*] they can go extinct" (in context, the answer means cannot). One point was earned in part (c) for describing "hunt during certain times when animals aren't breeding" as an alternative to hunting. No points were earned in part (d). One point was earned in part (e) for describing that an ecological benefit of biodiversity is "some of them [the species] could live in the changed conditions."