

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

## 2008 SCORING GUIDELINES

### Question 3

- (a) **Identify TWO characteristics of forests that develop when fires are suppressed, and explain why the practice of fire suppression does not reduce, but actually increases, the risk of intense and extensive forest fires.**

(Three points can be earned: 1 point for each correct characteristic, and 1 point for a correct explanation. Only the first two characteristics given are scored.)

| <b>Characteristics of Forests</b>  |
|--|
| <ul style="list-style-type: none"><li>• Accumulation of combustible materials (layer of leaf litter and debris on forest floor, dead trees, etc.)</li><li>• Increase in understory growth (grasses, shrubs, brush, ladder trees)</li><li>• Larger trees develop</li><li>• Even-aged stands develop</li><li>• Tree density increases</li><li>• Fire-intolerant species increase in number in the understory</li><li>• Fire-tolerant species that need fire to germinate seeds decrease in population</li><li>• Increased canopy coverage eliminates understory growth</li><li>• Increase or decrease in the rate of nutrient cycling (e.g., release of nutrients of litter, lack of nutrient-rich ash)</li><li>• No loss of nutrients to burning in intense fires</li><li>• Increased susceptibility to disease/parasites</li></ul> |

| <b>Explanations for Increased Fire Risk</b>  |
|--|
| Adds to fuel load [intensity] <ul style="list-style-type: none"><li>• Increased leaf litter</li><li>• Increased density of large trees</li><li>• Increased size of trees</li><li>• Increase in brush and small trees</li><li>• Species composition change</li></ul> Adds to spreading of fire [extent] <ul style="list-style-type: none"><li>• Increased density of trees</li><li>• Increased density of understory growth</li><li>• Ladder trees leading to crown fires</li></ul> |

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE  
2008 SCORING GUIDELINES**

**Question 3 (continued)**

**(b) The effects of the HFI are expected to extend beyond fire reduction. Excluding fire reduction, describe ONE positive and ONE negative effect likely to result from the implementation of the provisions of the HFI.**

(Two points can be earned: 1 point for a correct positive effect and description; 1 point for a correct negative effect and description.)

| <b>Positive Effect and Description</b>  | <b>Negative Effect and Description</b>  |
|---|---|
| <p>Increased removal of medium and large trees/small tree brush removal will:</p> <ul style="list-style-type: none"> <li>• lead to economic growth in the lumber industry</li> </ul> <p>Increased removal of medium and large trees will:</p> <ul style="list-style-type: none"> <li>• allow understory to develop into larger trees, potentially enhancing forest habitat</li> <li>• make additional timber available to use (must indicate usage)</li> <li>• result in thinned trees resistant to pests and disease/impede spread of diseases and pests</li> <li>• enhance economic value of the surrounding areas (housing, lower insurance)</li> <li>• lower the cost of timber</li> <li>• result in a change of aesthetics (with explanation)</li> </ul> | <p>The removal of medium and large trees/small tree brush removal will:</p> <ul style="list-style-type: none"> <li>• reduce available habitat for other organisms in the forest biome</li> <li>• allow timber companies to cut in areas remote from forest communities not threatened by forest fires</li> <li>• cause a reduction in biodiversity (must include a specific example: reduction in nest sites, decrease in seed trees, etc.)</li> <li>• increase soil erosion</li> <li>• increase logging practices (e.g., roads providing access to new areas)</li> <li>• reduce public input</li> <li>• result in a change in aesthetics (with explanation)</li> </ul> |

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE  
2008 SCORING GUIDELINES**

**Question 3 (continued)**

**(c) Describe TWO ecosystem services provided for humans by forests. Explain how clear-cutting would affect each ecosystem service you describe.**

(Four points can be earned: 1 point for each correct ecosystem service, and 1 point for each correct link that describes the impact of clear-cutting. Only the first two characteristics given are scored.)

| <b>Ecosystem Service</b>   | <b>Impact of Clear-Cutting</b>  |
|--|---|
| Carbon that is removed from the atmosphere by trees helps to limit the magnitude of the atmospheric greenhouse effect. | <ul style="list-style-type: none"> <li>Some carbon will be released to the atmosphere or will not be removed</li> </ul>   |
| Forests provide oxygen (via photosynthesis).   | <ul style="list-style-type: none"> <li>Some loss of oxygen, without which we cannot live</li> </ul>   |
| Forests provide food products for human consumption (deer, nuts, fungi).   | <ul style="list-style-type: none"> <li>Can change available browsing places and sighting of animals due to species composition change, increasing their availability for humans (e.g., deer)</li> </ul> |
| Forests provide habitat for many species, some of which provide food and goods for humans, some of which cause harm.   | <ul style="list-style-type: none"> <li>Loss of habitat (biodiversity)</li> </ul>  |
| Forests provide wood (e.g., construction material, paper)  | <ul style="list-style-type: none"> <li>Increase in the short-term availability of wood, but potential long-term loss of availability</li> </ul>   |
| Forests provide wood for fuel.   | <ul style="list-style-type: none"> <li>Increase in the short-term availability of wood, but potential long-term loss of availability</li> </ul>   |
| Many products, such as glue, rubber, and medicines, are produced with forest products.                                 | <ul style="list-style-type: none"> <li>Increase in the short-term availability of these products, but potential long-term loss of availability</li> </ul>   |
| Forests influence the local microclimate affecting humans (change in temperature, shade, UV, wind breaks).             | <ul style="list-style-type: none"> <li>Change in the microclimate</li> </ul>  |
| Forests have aesthetic value (hiking, camping, photography, tourism, etc.).  | <ul style="list-style-type: none"> <li>Decreases in natural beauty</li> </ul>   |
| Forests improve the quality of soil and water used by humans. (Soil and water must be linked to a specific human use.) | <ul style="list-style-type: none"> <li>Increases in erosion and runoff and decreases in groundwater recharge, changing water quality</li> </ul>   |

**AP<sup>®</sup> ENVIRONMENTAL SCIENCE  
2008 SCORING GUIDELINES**

**Question 3 (continued)**

| <b>Ecosystem Service</b>  | <b>Impact of Clear-Cutting</b>   |
|---|--|
| Forests maintain watershed integrity (e.g., flood control with specific human application). | <ul style="list-style-type: none"><li>• Decreases in watershed integrity</li></ul> |

**(d) Identify a specific type of plant community or biome (other than a forest) that is naturally maintained by fire. Explain how the fire maintains the community or biome.**

(Two points can be earned; 1 point for identification of biome; 1 point for correct explanation of how fire maintains biome.)

Grasslands (savannah, steppe, veldt, pampas, prairie, marquis, garrigue—regional descriptions should include mention of grasslands):

- Fire destroys invasive plant species (e.g., other grasses and trees) that compete for resources with native grasses.
- Fire removes cover and allows sunlight penetration.
- Fire helps the seeds of native grasses to germinate.
- Fires enhance cycling of nutrients back into the soil.

Chaparral (Mediterranean scrubland, Mediterranean shrubland—regional descriptions should include mention of location):

- Fire removes brush, reducing competition for resources.
- Fire helps plants that require fire or lack of brush cover to germinate.
- Species that vigorously stump sprout quickly regenerate themselves.
- Fires enhance cycling of nutrients back into the soil.

Note: Any forest biome earns no credit.

3. For decades, forest fires in the United States have been suppressed. In 2003 legislation was passed under the Healthy Forests Initiative (HFI) in response to the record-breaking wildfires that had occurred in the early 2000s. Some environmental and conservation groups fear that negative impacts could result if timber companies are encouraged to harvest medium- and large-size trees in federally owned forests while clearing away the smaller trees and underbrush.

- Identify TWO characteristics of forests that develop when fires are suppressed, and explain why the practice of fire suppression does not reduce, but actually increases, the risk of intense and extensive forest fires.
- The effects of the HFI are expected to extend beyond fire reduction. Excluding fire reduction, describe ONE positive and ONE negative effect likely to result from the implementation of the provisions of the HFI.
- Describe TWO ecosystem services provided for humans by forests. Explain how clear-cutting would affect each ecosystem service you describe.
- Identify a specific type of plant community or biome (other than a forest) that is naturally maintained by fire. Explain how the fire maintains the community or biome.

a.) 1. When fire is suppressed, there is an increase of brush development on the floor of forest. This could include dead trees and bushes which are very flammable once they catch fire. It's just more fuel for the future fires, which can burn very intensely.

2. When a fire is suppressed, some forest species can't reproduce or live due to a lack of sunlight or heat necessary for them to disperse their seeds. This can lead to our very forest with many dead trees which can increase the risk of a major fire with all of the dead dry trees lying around.

b.) One Positive effect: With the removal of medium and large sized trees, there will be a steady input of wood to create products such as paper and building materials. HFI would help keep the prices of these things low.

Negative - There will be a major loss to biodiversity in the forest because certain species depend on certain plants and trees as a source of food and shelter. With these removed, the species will either need to move or die.

GO ON TO THE NEXT PAGE.

## ADDITIONAL PAGE FOR ANSWERING QUESTION 3

- c.) 1. Forests help keep the soil intact and help reduce soil erosion. If a forest was clear-cut, there would be an increase in soil erosion and land disturbance to property and agricultural areas.
2. Forests help remove large amounts of  $\text{CO}_2$  from the air and put out  $\text{O}_2$  which humans need to breathe. If forests were clear-cut, we would just increase global warming with the increased  $\text{CO}_2$  and reduce the amount of  $\text{O}_2$  we have available to breathe.

d.) Grassland - Fires help maintain the biome by replenishing nutrients vital to plant growth, back into the soil when the plants are burned. This helps ensure that future generations of plants will be able to grow in the fertile soil.

GO ON TO THE NEXT PAGE.

3. For decades, forest fires in the United States have been suppressed. In 2003 legislation was passed under the Healthy Forests Initiative (HFI) in response to the record-breaking wildfires that had occurred in the early 2000s. Some environmental and conservation groups fear that negative impacts could result if timber companies are encouraged to harvest medium- and large-size trees in federally owned forests while clearing away the smaller trees and underbrush.
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  - Describe TWO ecosystem services provided for humans by forests. Explain how clear-cutting would affect each ecosystem service you describe.
  - Identify a specific type of plant community or biome (other than a forest) that is naturally maintained by fire. Explain how the fire maintains the community or biome.

A) Two characteristics of forest when fires are suppressed is it has many lowlying bushes and brush on the forest floor. There are a lot of dead weeds and large amounts of wood that can easily catch fire. A suppressed forest has an increased risk of intense and extensive forest fires because there is a lot more to burn. The brush and low lying bushes act as a fire starter.

B) One positive of HFI is that there will be less fires because there will be no more low lying brush but only high ~~to~~ and medium trees. A negative is that it will be taking away many habitats for many different species. Many species will become extinct.

C) Trees produce oxygen, humans cannot live without oxygen. By cutting down forest it is limiting the amount of oxygen on earth. The forest also provides species diversity. Species diversity is very important on earth because there is competition which makes earth work.

GO ON TO THE NEXT PAGE.

## ADDITIONAL PAGE FOR ANSWERING QUESTION 3

D) The tundra biome is very dry. It also has low lying plants. To keep its sustainability when fire takes place it is a good thing. There could be such things as our Crandall's so fire will kill off species and new ones will arise.

GO ON TO THE NEXT PAGE.

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  - Identify a specific type of plant community or biome (other than a forest) that is naturally maintained by fire. Explain how the fire maintains the community or biome.

a) When fires are suppressed excessive underbrush develops.

Many dead trees cover the floor and there is often a lot of duff. New trees will not sprout because their seeds cannot get through the duff to fertile soil. The forests will have many older trees, but very few new, young ones. Suppressing fires leads to a lot of dry material on the ground, thus when a wildfire occurs it feeds off of this brush and becomes intense and huge, often devastating much of the forest.

b) Certain native plant species that need fire to survive could become extinct, thus ~~serio~~ severely altering the ecology of an environment or ecosystem. On the other hand, homes and urban communities will be safer without the immediate threat of a fire occurring close to their homes.

c) Forests reduce the amount of CO<sub>2</sub> in the air through photosynthesis and they hold the soil in place to prevent erosion. Clear cutting would decrease a forest's ability to reduce the amount of CO<sub>2</sub> in the air by eliminating many trees. Since the trees roots are what hold the soil in place, clear cutting would not immediately decrease the forest's ability to prevent erosion until much later.

**GO ON TO THE NEXT PAGE.**

## ADDITIONAL PAGE FOR ANSWERING QUESTION 3

when the tree stumps decayed.

d) Redwood trees need fire to survive because their bark allows them to survive through a fire and their competitors cannot it helps keep the Redwood population up and other tree populations down. It also eliminates the duff on the ground to reveal fertile soil <sup>where</sup> for new Redwoods ~~to grow~~ seeds <sup>can</sup> to sprout.

GO ON TO THE NEXT PAGE.

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

## 2008 SCORING COMMENTARY

### Question 3

#### Overview

The intent of this question was to determine the level of students' understanding of fire-suppressed forests, the impact of the Healthy Forest Initiative upon forests, ecosystem services provided by forests, and the effect of clear-cutting upon those services. In addition, students were asked to identify another plant community or biome maintained by fire, other than forests.

#### Sample: I-3A

##### Score: 10

Part (a): 3 points were earned. The student earned 1 point for identifying the characteristic that "there is an increase of brush development on the floor of [the] forest," 1 point for explaining that "dead trees and bushes . . . are . . . fuel for the future fires, which can burn very intensely [*sic*]," and 1 point for the characteristic that some species need the heat of a fire "to disperse their seeds" for reproduction.

Part (b): 2 points were earned. The student earned 1 point for describing a positive effect of the Healthy Forest Initiative by stating that "[w]ith the removal of medium and large sized trees, there will be a steady input of wood," resulting in low prices of wood products, and 1 point for a negative effect of the Healthy Forest Initiative for stating that "[t]here will be a major loss to biodiversity" due to a removal of "plants and trees as a source of food" for some species.

Part (c): 4 points were earned. The student earned 1 point for describing how forests "reduce soil erosion," 1 point for explaining that a "clear-cut" forest causes "an increase in soil erosion and land disturbance to property and agricultural areas" (this shows the forest service to humans), 1 point for stating that "[f]orests help remove large amounts of CO<sub>2</sub> from the air," and 1 point for explaining that clear-cut forests "increase global warming with the increased CO<sub>2</sub>."

Part (d): 2 points were earned. The student earned 1 point for identifying grasslands and 1 point for explaining that "[f]ires help maintain the biome by replenishing nutrients vital to plant growth, back into the soil."

The student earned all 11 points available and received the maximum score of 10 points.

#### Sample: I-3B

##### Score: 6

Part (a): 3 points were earned. The student earned 1 point for identifying the characteristic of "many lowlying bushes and brush on the forest floor," 1 point for identifying the characteristic of "alot [*sic*] of dead weeds and large amounts of wood that can easily catch fire," and 1 point for an explanation of "increased risk of intense and extensive forest fires because there is . . . more to burn."

Part (b): 1 point was earned for describing a negative effect of "taking away many habitats for many different species." The student's description of one positive effect of HFI—"that there will be less fires"—did not earn a point, as the question specifically states to exclude fire reduction.

Part (c): 2 points were earned. The student earned 1 point for stating that "[t]rees produce oxygen, [and] humans cannot live without oxygen," and 1 point for explaining that "cutting down forest [limits] the amount of oxygen on earth."

Part (d): No points were earned. The student incorrectly identifies a biome maintained by fire.

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2008 SCORING COMMENTARY**

**Question 3 (continued)**

**Sample: I-3C**

**Score: 3**

Part (a): 3 points were earned. The student earned 1 point for identifying the characteristic of “excessive underbrush develops,” 1 point for identifying the characteristic of “dead trees cover the floor and there is often a lot of duff,” and 1 point for explaining that “when a wildfire occurs it feeds off of this brush and becomes intense and huge.”

Part (b): No points were earned. The response incorrectly includes fire reduction.

Part (c): No points were earned. The response fails to describe an ecosystem service to humans and link it to clear-cutting.

Part (d): No points were earned. The student incorrectly identifies a plant community maintained by fire.