

AP[®] ENVIRONMENTAL SCIENCE

2015 SCORING GUIDELINES

Question 4

The term “urban sprawl” describes the expansion of cities into rural areas. This phenomenon has occurred around the world and has had economic, health, and environmental consequences.

(a) Describe TWO causes of urban sprawl.

(2 points: 1 point for each reasonable cause; only the first two causes can earn a point)

Transportation

- Increased use of/reliance on automobiles
- Improved/expanded roads
- Low gas prices promote driving
- Telecommuting has made it possible to work remotely

Economic

- Increasing wealth/affluence providing choice
- Higher taxes in inner city
- High land/property costs in city vs. less expensive land prices outside the city (cannot earn both)
- Tax deductions for home mortgages interest
- Jobs move out and employees follow
- Home buying subsidies/reduced interest rates e.g., GI Bill
- Lack of/poor city-regional planning: (urban centers plan in isolation; lack of cohesive plan for growth)
- Lower cost of living in suburbs

Quality of Life

- Desire for property/yard/lower density
- Better quality suburban schools
- Urban blight/declining infrastructure in inner cities
- High crime rates in inner cities
- Seek natural environments, aesthetics, cleaner air, less noise pollution, etc.

(b) Discuss TWO human health effects associated with urban sprawl.

(2 points: 1 point for each human health effect, which can be positive or negative)

- Asthma, bronchitis, emphysema, airway inflammation, irritation of mucus membranes, respiratory irritation, lung irritation, aggravated heart disease from increased air pollution
- Obesity, impaired immune response, diabetes, hypertension, high blood pressure from less exercise due to auto travel time and/or a commuter diet
- Depression, anxiety, suppressed immune response from social isolation due to spread out housing
- Personal injuries associated with automobile crashes due to increased driving
- Hearing loss, high blood pressure, impaired immune response from noise pollution
- Survival rate/recovery rate hindered due to delays in emergency medical services response and fire department response times due to spread out housing
- Reduction in disease spread in lower density areas

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Question 4 (continued)

- (c) The graph below shows the relationship between population density and petroleum use in selected cities. **Describe** the relationship between population density and petroleum use shown in the graph.

(1 point for a description)

- Petroleum use is inversely proportional to population density;
- Petroleum use increases as population density decreases;
- Petroleum use and population density are inversely related
- There is a negative (exponential) relationship between petroleum use and population density

- (d) Smart growth focuses on ways to encourage sustainable urban development. **Describe** TWO steps a municipality could take to encourage smart growth in order to limit urban sprawl.

(2 points: 1 point for each step; only the first two steps can earn a point)

Transportation

- Subsidize mass transit to encourage less automobile use
- Build bike paths to encourage less automobile use
- Establish moratoria on highway and new road construction
- Develop master plans which direct new residents/jobs to busy hubs

Zoning/Design

- Modify zoning ordinances to encourage multi-use/mixed land uses, create minimum development densities; promote compact communities; a range of housing opportunities; vertical development
- Establish development barriers surrounding cities and towns (Urban Growth Boundaries)
- Preserve and protect farms/agricultural lands by designating these areas as agricultural land reserves or conservation easements
- Create a range of housing opportunities & choices (Urban Village Strategy): dense, multi-family- and single-family housing near shops, cafes, & public transit
- Foster communities that provide a sense of place: promote appreciation of unique environments, community involvement, and social context of cities
- Promote gentrification
- Promote reclamation of brownfields

Tax Incentives

- Create tax incentives/reduced taxes for living in city

Increased Amenities

- Enhance the quality of living/increase amenities in cities (e.g., schools, parks, pools, recreation to encourage people to remain in cities); efforts to reduce pollution/improve air quality

Other

- Carry out public education campaign

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Question 4 (continued)

(e) Highway systems and urban sprawl often threaten wildlife populations. **Describe** TWO methods to reduce harmful effects on wildlife populations from highways and urban sprawl.

(2 points: 1 point for each correct method; only the first two methods can earn a point)

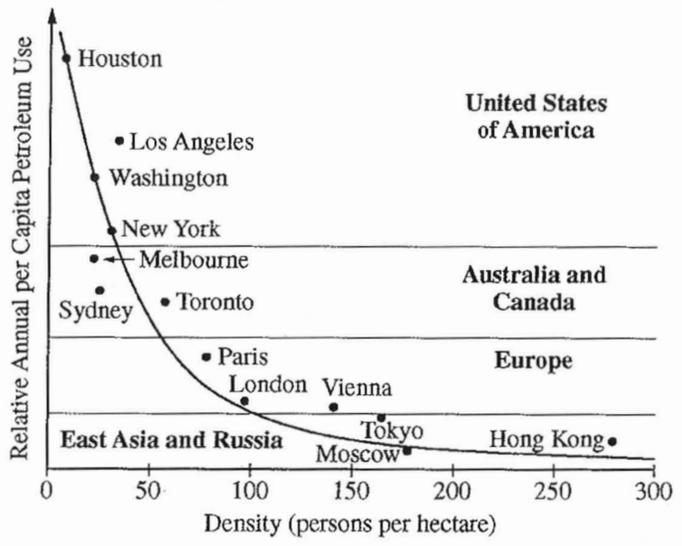
- Create wildlife corridors/tunnels between green areas
- Create wildlife crossing zones/tunnels/overpasses, etc.
- Plan highways around existing migratory routes and prime habitats
- Avoid fragmentation of habitat by housing developments
- Set aside land for/increase size of refuges; increase green space and buffer zones along highways
- Construct highway fencing, especially along migratory routes
- Promote planting of native plants to provide habitat
- Enforce anti-littering laws along highways; reduce highway speed limits; “wildlife caution signs”
- Encourage carpooling (fewer cars, fewer wildlife collisions)

(f) Urban sprawl often results in the loss of productive agricultural land near cities. **Describe** one practical way to increase food production within urban areas.

(1 point for a practical way to increase urban food production, such as one of the following)

- Gardens/victory gardens; roof-top gardens; vertical farming, hydroponics, greenhouses
- Edible gardens in public/open spaces
- Green roofs can include edible plants (“green roof” by itself should not earn a point)
- Zoning to allow the raising of bees, chickens, microlivestock
- Provide incentives for: use of greenway/area gardens, vacant lots for community agriculture; land under power lines, in floodplains;
- Brownfield reclamation and conversion to gardens

4. The term "urban sprawl" describes the expansion of cities into rural areas. This phenomenon has occurred around the world and has had economic, health, and environmental consequences.
- (a) Describe TWO causes of urban sprawl.
 - (b) Discuss TWO human health effects associated with urban sprawl.
 - (c) The graph below shows the relationship between population density and petroleum use in selected cities. Describe the relationship between population density and petroleum use shown in the graph.



- (d) Smart growth focuses on ways to encourage sustainable urban development. Describe TWO steps a municipality could take to encourage smart growth in order to limit urban sprawl.
- (e) Highway systems and urban sprawl often threaten wildlife populations. Describe TWO methods to reduce harmful effects on wildlife populations from highways and urban sprawl.
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4. a) Urban Decay - A lack of money and infrastructure in inner cities causes problems with crime and job opportunities. These problems cause people to move away from urban areas into more rural ones.

Increased Prosperity - As income in countries such as the U.S. increases, people seek more land and larger homes. This desire for more property pushes people to the suburbs for room to live.

b) i. Urban sprawl means that cities are spread out further. Increased

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use of automobiles to get around means an increase in air pollution. In big cities, photochemical smog causes many health issues such as asthma.

2. Increased automobile use means less physical activity for the average person. When they drive places, people don't walk or get as much exercise. This can cause obesity, heart disease, and cancer, among other things.

c) There's an inverse relationship between population density and annual petroleum consumption. Greater population density results in less petroleum use. Lesser population density results in greater petroleum use.

d) One step could be to encourage construction of apartment complexes/high rises. Apartment complexes have more people in less space, meaning there is less expansion. This limits sprawl and also preserves ecosystems from destruction.

Another example of smart growth could be to improve/expand park systems. A good public park system allows people to share a common space. This means they don't feel the need to purchase large houses with land of their own. A park system with a bike trail also allows for bike commuting, which lessens traffic congestion and stress on infrastructure.

e) Creating animal crossing overpasses could allow animals to travel from one area to another safely, without having to cross a road. This lessens damage to cars because of impacts, as well as ~~save~~ facilitating wildlife movement.

Another way to help animals is to carefully plan highway and ~~road~~ building systems. Fragmentation of habitat is often dangerous to wildlife, and if animals are forced to travel across highways or through neighborhoods they

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can become a nuisance. Keeping large areas of habitat intact would lessen human-wildlife interactions.

f) Living roofs can help to supplement rural agricultural yields. Many square miles of urban areas exposed to the sun are simply flat rooftops. Building rooftop gardens can help to make these spaces useful, and contribute food to local markets. Additionally, putting plants on buildings can reduce cooling costs by reducing sunlight exposure, and decrease the amount of runoff the building must handle.

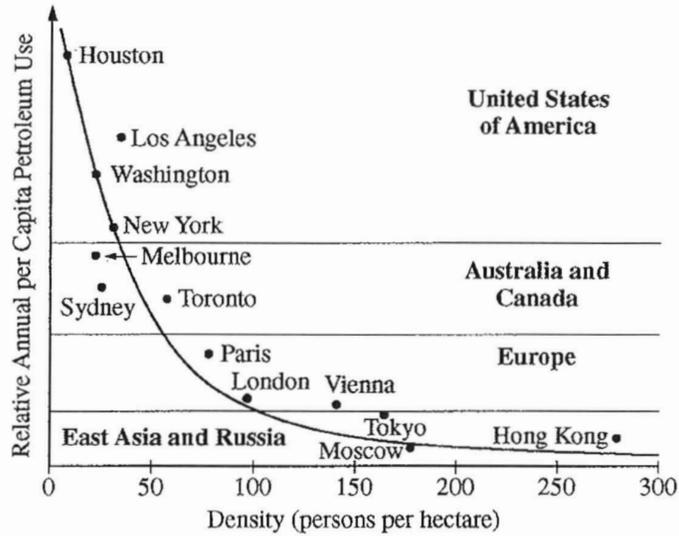
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- (d) Smart growth focuses on ways to encourage sustainable urban development. Describe TWO steps a municipality could take to encourage smart growth in order to limit urban sprawl.
- (e) Highway systems and urban sprawl often threaten wildlife populations. Describe TWO methods to reduce harmful effects on wildlife populations from highways and urban sprawl.
- (f) Urban sprawl often results in the loss of productive agricultural land near cities. Describe one practical way to increase food production within urban areas.

a. Two causes of urban sprawl are increased population, which produces more people who need a place to live, and an increase in automobile use, which allows people to live further from the main urban center in which they work.

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b. Human health effects associated with urban sprawl include increased respiratory illnesses because of the increased automobile use, and increased automobile accidents because of the increased distance vehicles must drive and the greater volume of vehicles on the roads.

c. As population density increases, relative annual per capita petroleum use decreases - there is a negative correlation.

d. In order to limit urban sprawl, a municipality could support the building of more ~~houses~~ condos and apartments rather than freestanding houses because this will allow more people to live in a smaller amount of space. The municipality could also implement bike paths and public ^{mass} transportation in order to reduce the congestion and traffic in the streets and encourage people to stay in the city rather than seeking space by moving to nearby rural areas.

e. One way to reduce harmful effects on wildlife populations would be to make greenways, or natural bridges over highways that animals can cross in order to reduce habitat fragmentation. Another way would be to establish wilderness preserves that are legally protected from

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being developed. These would provide a sanctuary for the wildlife.

F. One practical way to increase food production in urban areas is to encourage the establishment of rooftop gardens, which can provide fresh fruits and vegetables to several families.

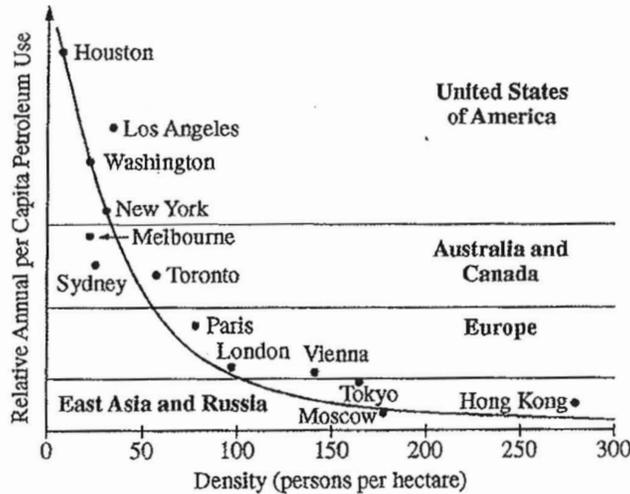
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- ✓(f) Urban sprawl often results in the loss of productive agricultural land near cities. Describe one practical way to increase food production within urban areas.

(a) One cause of urban sprawl is population growth. With growth in population comes a need for more space to live, and businesses to provide goods and services, which in turn causes the growth of cities. Another cause of urban sprawl is growth in the economy. When the economy is doing well, companies and developers can afford to develop new apartment buildings and office buildings.

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and stores, and people can afford to live in them and shop at them.

b) One harmful human health effect associated with urban sprawl is the increase in respiratory irritants like particulate matter and ozone. With more cars and businesses in close proximity, they are releasing more pollutants, like ~~PM and SO₂~~.

c) Another harmful human health effect is a decrease in water quality. This close proximity of people, ~~to~~ also creates more waste, which can ~~flow~~^{run off} into nearby bodies of water and hurt the quality of drinking/^{municipal} water ~~sources~~ ^{reservoirs}.

d) According to the graph, as population density increases, petroleum use per capita decreases.

e) A municipality could encourage the development of taller buildings that were closer together, ^{by providing subsidies to developers} in order to cause more vertical growth of cities and not horizontal growth into rural areas.

A municipality could also tax developers trying to build buildings in/near rural areas.

f) One way to reduce the harmful effects would be to build overpasses over/under highways ~~to~~ that allowed animals to pass over/under highways from one place to another without getting harmed.

Another way to reduce the harmful effects of

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highways/urban sprawl on wildlife populations would be to establish wildlife preserves and ~~restrict the type of building~~ ~~the~~ in and around the urban area.

(f) One way to increase food production would be to create rooftop gardens. This way, you could take advantage of the abundant ^{sunlight} rooftop space that cities so often have.

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2015 SCORING COMMENTARY

Question 4

Overview

This question was intended to determine students' knowledge regarding the causes of urban sprawl. Students were asked to discuss two human effects associated with urban sprawl. Students were next asked to describe the relationship between population density and petroleum use shown in the graph provided. Students were asked to describe two steps a municipality could take to encourage smart growth in order to limit urban sprawl and to describe two methods to reduce harmful effects on wildlife populations from highways and urban sprawl. Students were next asked to describe one practical way to increase food production within urban areas.

Sample: 4A

Score: 10

Two points were earned in part (a): 1 point for describing urban decay and 1 point for describing the desire for more land, property, and a larger home. Two points were earned in part (b): 1 point for discussing asthma as a human health effect from increased air pollution and 1 point for discussing obesity as a health effect associated with increased automobile use and less physical activity. One point was earned in part (c) for describing the inverse relationship between population density and petroleum use. Two points were earned in part (d): 1 point for describing the construction of apartment complexes/high rises and 1 point for describing improved/expanded park systems. Two points were earned in part (e): 1 point for describing the construction of animal crossing overpasses to allow safe wildlife movement and 1 point for describing the careful planning of highways to prevent fragmentation of habitat. One point was earned in part (f) for describing rooftop gardens.

Sample: 4B

Score: 8

One point was earned in part (a) for describing an increase in automobile use, which allows people to live further from the main urban center in which they work. One point was earned in part (b) for discussing increased automobile accidents because of the increased distance vehicles must be driven and the greater number of vehicles on the road. One point was earned in part (c) for describing the negative correlation between population density and petroleum. Two points were earned in part (d): 1 point for describing the building of more condos and apartments and providing more housing in less space than freestanding houses and 1 point for implementing bike paths and public transportation to reduce congestion and traffic. Two points were earned in part (e): 1 point for describing greenways and natural bridges over highways that animals can cross to reduce fragmentation and 1 point for establishing legally protected wilderness preserves. One point was earned in part (f) for describing rooftop gardens as one practical way to increase food production within urban areas.

Sample: 4C

Score: 6

No points were earned in part (a). One point was earned in part (b) for discussing respiratory irritation as a human health effect associated with particulates/ozone. One point was earned in part (c) for describing the following relationship: as population density increases, petroleum use per capita decreases. One point was earned in part (d) for describing the development of taller buildings that are closer together/vertical growth.

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Question 4 (continued)

The second point was not earned for the tax description because municipalities typically cannot levy taxes on rural land outside the city. Two points were earned in part (e): 1 point for describing the building of highway overpasses/underpasses and 1 point for establishing wildlife preserves. One point was earned in part (f) for describing rooftop gardens to increase food production within urban areas.