

# 2005 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

## ENVIRONMENTAL SCIENCE SECTION II

Time—90 minutes

4 Questions

**Directions:** Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in this booklet. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

1. Read the following article from the *Fremont Examiner*.

FREMONT EXAMINER

### Diseases on the Rise!

Despite the fact that many old diseases have been effectively controlled by the use of antibiotics and vaccines, it appears that the world today is becoming more vulnerable to the outbreak of relatively new diseases such as severe acute respiratory syndrome (SARS) and West Nile Fever, and the reemergence and spread of old diseases such as malaria, cholera, and tuberculosis.

According to epidemiologist Dr. Amodie, “It is not possible to protect the health of Americans without addressing the problems of infectious diseases on a global scale.”

The threat of the emergence and spread of newly arising infectious diseases has become a dangerous reality. These new diseases could become the endemic diseases of tomorrow.

- (a) For one new disease and one old disease named in the article above, explain how the disease is transmitted through the human population and describe an effective method for controlling the spread of the disease.
- (b) For one of the two diseases you chose in part (a), identify one environmental factor that contributed to the emergence or reemergence of the disease and explain how that factor influenced the increased incidence of the disease.
- (c) Provide a rationale to support Dr. Amodie’s statement as quoted in the article.

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Question 1

Read the following article from the *Fremont Examiner*.

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The threat of the emergence and spread of newly arising infectious diseases has become a dangerous reality. These new diseases could become the endemic diseases of tomorrow.

- (a) For one new disease and one old disease named in the article above, explain how the disease is transmitted through the human population and describe an effective method for controlling the spread of the disease.

(4 points possible)

For each disease, 1 point is earned for how the disease is transmitted to humans, and 1 point is earned for the method of controlling its spread.

Note: Students may receive a point for the method for controlling the spread of the disease without receiving the point for how the disease is transmitted.

HOW TRANSMITTED TO HUMANS	METHOD FOR CONTROLLING SPREAD OF DISEASE
<b>SARS</b> Transmitted directly from animals to humans	Not have animals and humans in close proximity Destroy infected animals
Virus spread by respiratory droplets (coughing, sneezing, mucus) of humans/close person-to-person contact	Quarantine infected individuals/stay at home Wear facial masks/cover mouth and nose Wash hands frequently
<u>Note:</u> Not sexually transmitted, blood borne, water borne, or transmitted by insect vectors	

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**Question 1 (continued)**

<p><b>West Nile Fever</b></p> <p>Transmitted by bite of infected mosquito</p>	<p>Reduce the mosquito population or the chance of being bitten. Must mention a specific method such as wearing more clothing/physical barriers, insect repellant, insecticides, eliminating standing water (e.g., tires, gutters), staying indoors in early evening, screening or mosquito netting, clearing vegetation around dwellings.</p> <p>Eradicate infected birds</p> <p>Use biological mosquito controls such as fish, frogs, bats, birds, <i>Bacillus thuringiensis</i> (Bt)</p>
<p>Transmitted by blood transfusions, organ transplants, and from mother to child during pregnancy</p>	<p>Screen blood donations, testing of pregnant women</p>
<p><u>Notes:</u> Mosquitoes can be infected by biting an infected bird or horse.</p> <p>The disease cannot be transmitted from an infected human to an uninfected human via mosquitoes.</p> <p>Some public health advisories suggest direct transmission from birds/horses to humans.</p>	
<p><b>Malaria</b></p> <p>Transmitted by bite of infected mosquito</p>	<p>Reduce mosquito population or chance of being bitten (see scoring guidelines for <b>West Nile Fever</b>)</p> <p>Use biological mosquito controls (fish, frogs, bats, birds, Bt)</p> <p>Spray mosquito habitat with pesticides</p> <p>Take prophylactic antimalarial drugs</p>
<p>Transmitted by blood transfusions/organ transplants</p>	<p>Screen blood donations</p>
<p><b>Cholera</b></p> <p>Transmitted by ingestion of water/food contaminated with human fecal material (cholera bacteria)</p>	<p>Provide sanitary collection and treatment of sewage/black water</p> <p>Provide pathogen-free water supply</p> <p>Implement sanitary standards in food preparation</p> <p>Boil water to kill bacteria</p> <p>Shut down shellfish beds</p>
<p>Transmitted by inadequate hand washing (direct ingestion)</p>	<p>Increase practice of hand washing</p>
<p><b>Tuberculosis</b></p> <p>Bacterium spread by respiratory droplets (coughing, sneezing, mucus)</p>	<p>Immunization programs</p> <p>Quarantine</p> <p>Treatment of infected individuals with antibiotics</p>

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**Question 1 (continued)**

- (b) For one of the two diseases you chose in part (a), identify one environmental factor that contributed to the emergence or reemergence of the disease and explain how that factor influenced the increased incidence of the disease.**

**(2 points possible)**

*One point is earned for the environmental factor, and 1 point is earned for how that factor influenced increased incidence.*

Note: *The factor and the explanation must be causally linked.*

<b>ENVIRONMENTAL FACTOR THAT CONTRIBUTED TO THE EMERGENCE OR REEMERGENCE OF THE DISEASE</b>	<b>HOW FACTOR INFLUENCED THE INCREASED INCIDENCE OF THE DISEASE</b>
<b>SARS</b> High population density of humans Human contact with infected animals	Increased likelihood of transmission
<b>West Nile</b> Climate variability (El Niño, global climate change) Decrease in populations of mosquito predators Increase in mosquito habitat Environmental factors that increase availability of standing water	Led to increase of mosquito population Led to an increase in the likelihood of transmission
Increased transport of products and materials providing accidental transport of infected mosquitoes	Introduced the mosquito (vector) to new habitats
<b>Malaria</b> Decreased populations of mosquito predators Genetic resistance to pesticides	Increased mosquito population; increased transmission
Climate variability (El Niño, global climate change)	Increased mosquito habitat; increased transmission
Habitat alteration	Increased number of breeding sites for mosquitoes
Increasing human population density	Allowed for increased transmission opportunities
Emergence of microbes resistant to anti-malarial drugs	Led to increase in potential human host population

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**Question 1 (continued)**

<b>Cholera</b> Lack of sanitation (transport/treatment) Lack of access to pathogen-free water	Increased transmission of pathogen
Increasing human population density Climate variability (El Niño, global climate change) Natural disasters (e.g., tsunamis, floods)	Conditions became suitable for outbreak (e.g., bacterial contamination increases, sanitation decreases)
<b>Tuberculosis</b> Increased human population density Evolution of strains of tuberculosis bacteria that are resistant to antibiotics	Increased opportunities for human-to-human transmission
Factors that increase susceptibility of human host (immune suppressed/compromised)	Decreased ability of immune system to destroy pathogen

**(c) Provide a rationale to support Dr. Amodie's statement as quoted in the article.**

**(2 points possible)**

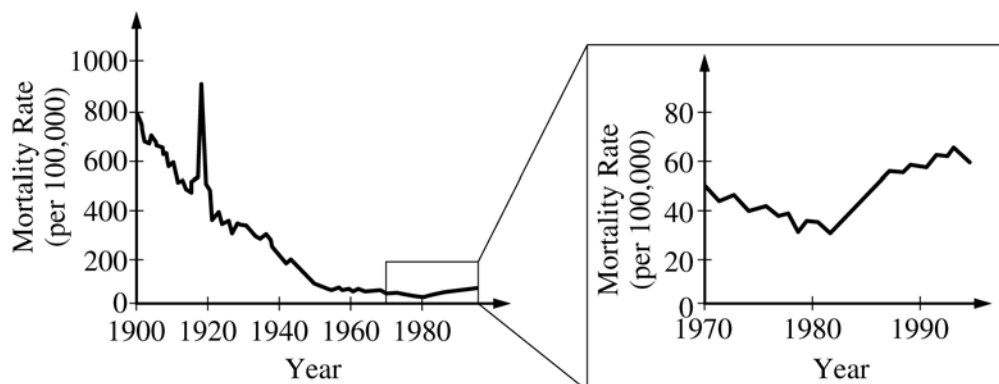
*One point is earned for the mechanism, and 1 point is earned for an appropriate explanation that includes either a specific mode of transmission or protection (e.g., screening incoming travelers, isolation/containment of the disease locally). Other modes of transmission can be found in part (a).*

MECHANISM	EXPLANATION
Increase in international travel/commerce Immigration from country to country Urbanization Ecosystem disturbance in previously uninhabited areas Deforestation in tropical regions Increased cultivation of rice Climate change High winds or hurricanes Accidental introduction of disease vectors Deliberate introduction of pathogens (bioterrorism) Flooding Natural migration of disease vectors Resistance to antibiotics or pesticides	Explanation must match mechanism.

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Question 1 (continued)

INFECTIOUS DISEASE MORTALITY IN THE UNITED STATES, 1900–1996



- (d) The graphs above show the mortality from infectious diseases in the United States since 1900. Identify an infectious disease that made an important contribution to the trend of increasing mortality rates that began in about 1980 and explain one major cause of the increased rate of mortality from that disease.

(2 points possible)

One point is earned for the disease, and 1 point is earned for the cause of the increased rate of mortality.

**Disease:** HIV/AIDS

- Cause:**
- infected blood transfusions/organ transplants
  - sharing syringes
  - having unprotected/unsafe sex and/or having multiple sex partners
  - lack of education about how the disease is spread, leading to high risk behaviors
  - transmission from mother to child
  - lack of ability to develop effective treatments/vaccine/no permanent cure
  - increased progression of disease in individuals/long incubation period
  - opportunistic infections due to compromised immune systems

**Disease:** Influenza or pneumonia

- Cause:**
- increased mortality rate due to aging population
  - drug-resistant strains of pneumonia