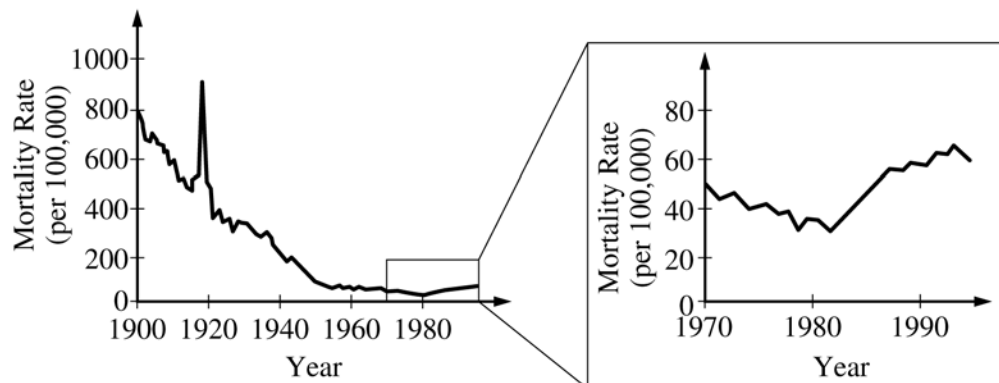


## 2005 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

### 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. Between 1950 and 2000, global meat production increased from 52 billion kilograms to 240 billion kilograms. During this period, the global human population increased from 2.6 billion to 6.0 billion.
- (a) Calculate the per capita meat production in 1950 and in 2000.
- (b) Use the values from part (a) to calculate the change in global per capita meat production during this 50-year period as a percentage of the 1950 value.
- (c) Discuss why it is more efficient to produce grain for human consumption than to produce meat for human consumption. In your answer, consider both land use and energy use.
- (d) Describe TWO environmental consequences of the increase in the production of meat for human consumption.
- (e) Identify and explain one potential advantage and one potential disadvantage for human health of a diet that contains very little meat.

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**Question 2**

Between 1950 and 2000, global meat production increased from 52 billion kilograms to 240 billion kilograms. During this period, the global human population increased from 2.6 billion to 6.0 billion.

**(a) Calculate the per capita meat production in 1950 and in 2000.**

**(2 points possible)**

*One point is earned for each year; each must include the proper set-up AND correct answer.*

$$\text{In 1950: } \frac{5.2 \times 10^{10} \text{ kg meat}}{2.6 \times 10^9 \text{ people}} = 20 \text{ kg of meat per capita}$$

$$\text{In 2000: } \frac{2.4 \times 10^{11} \text{ kg meat}}{6.0 \times 10^9 \text{ people}} = 40 \text{ kg of meat per capita}$$

**(b) Use the values from part (a) to calculate the change in global per capita meat production during this 50-year period as a percentage of the 1950 value.**

**(2 points possible)**

*One point is earned for proper set-up, and 1 point is earned for the correct answer.*

$$\frac{40 \text{ kg} - 20 \text{ kg}}{20 \text{ kg}} \times 100 = 100\% \text{ increase in global per capita meat production since 1950}$$

**OR**

$$\frac{40 \text{ kg}}{20 \text{ kg}} = 2.0. \text{ This is a 100\% increase.}$$

**OR**

The 2000 value is 200% of the 1950 value.

Note: The answer must be given as a percentage. Students may earn the point for correctly calculating the percentage using incorrect values from part (a).

**(c) Discuss why it is more efficient to produce grain for human consumption than to produce meat for human consumption. In your answer, consider both land use and energy use.**

**(2 points possible)**

*One point is earned for land use, and 1 point is earned for energy use.*

Note: Students must clearly indicate a comparison between grain production and meat production.

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**Question 2 (continued)**

**LAND USE**

When raising grain for human consumption, only land for grain growth is needed. If grain is used primarily for meat production, then land is needed for both growing grain and the raising of food animals (land for the housing, storage of feed and wastes, etc.).

A larger amount of rangeland is required for free-range livestock than for grain production.

In addition to grazing land, free-range livestock may require additional land to grow grain for fattening.

A hectare of land used for grain will feed more people than a hectare of land used for livestock.

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**ENERGY USE**

Eating “lower on the food chain” is more efficient because energy is lost from transfer between trophic levels. A given amount of solar energy will sustain more people when it is consumed as grain than when that grain is fed to livestock to be consumed.

Less energy is required for the storage of grain than for the processing and storage of meat.

Compared to producing grain for direct consumption, more energy is required to

- produce grain to be fed to livestock (fertilizers, irrigation, pesticides, farm machinery, etc.);
- manage animal wastes (pumping, treatment, transport, disposal);
- take care of and round up free-range livestock.

**(d) Describe TWO environmental consequences of the increase in the production of meat for human consumption.**

**(2 points possible)**

*One point is earned for each consequence.*

*Note: Students must correctly connect a problem with an environmental consequence. The list below includes the most common answers. A number of other correct problems could be described if linked to an appropriate environmental consequence.*

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**Question 2 (continued)**

<b>PROBLEM</b>	<b>ENVIRONMENTAL CONSEQUENCE</b>
Overgrazing or compaction of land	Desertification, increased erosion, nutrient loss
Pollution of waters from slaughter, animal wastes, grazing in riparian areas	Contamination of groundwater; increased BOD; increased turbidity; decreased DO; changes in temperature; eutrophication; fish kills; etc.
Land conversion (fencing, grassland conversion, deforestation)	Loss of habitat, habitat fragmentation, biodiversity loss, change in local precipitation patterns, increase in CO <sub>2</sub> , desertification, erosion, nutrient loss.
Methane production from livestock	Contributes to climate change/global warming
Livestock production requires more water than grain production	Water depletion, water shortage

**(e) Identify and explain one potential advantage and one potential disadvantage for human health of a diet that contains very little meat.**

**(2 points possible)**

*One point is earned for an advantage, and 1 point is earned for a disadvantage.*

<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Consuming less fat (or less red meat) reduces risk of: <ul style="list-style-type: none"><li>• heart disease</li><li>• clogged arteries</li><li>• hypertension</li><li>• diabetes</li><li>• cancer</li><li>• elevated cholesterol</li></ul> Reduced exposure to hormones, steroids, antibiotics, pesticides, PCBs, heavy metals	Meat is a concentrated, excellent source of protein (it is difficult to get <u>enough</u> protein without meat).
Reduced risk of developing diseases and infections such as: BSE (mad cow disease), <i>Salmonella</i> , <i>E. coli</i> infection, parasitic worms	Consuming very little meat <u>could</u> lead to some type of nutritional deficiency such as: <ul style="list-style-type: none"><li>• Protein deficiency (kwashiorkor)</li><li>• Vitamin A deficiency (blindness)</li><li>• B-vitamin deficiency</li><li>• Iron deficiency (anemia)</li><li>• Trace element deficiency (e.g., Zn)</li><li>• Inadequate balance of essential fats</li></ul>