(a) Diseases can devastate populations; however, most diseases do not drive their host to extinction. **Provide** one explanation for why diseases seldom cause extinction.

(b) Dr. Serach suggests that even if the impact of WNS on little brown bat populations can be reduced and the extinction of the species avoided, the bat populations are likely to remain alarmingly small.

(i) **Describe** TWO threats (other than WNS) to the survival of the bat species if the total number of bats becomes very small.

(ii) If the little brown bat species does not become extinct and can potentially recover, the rate of recovery is likely to be slow. **Discuss** one aspect of bat biology that might slow the recovery of little brown bat populations to pre-WNS numbers.

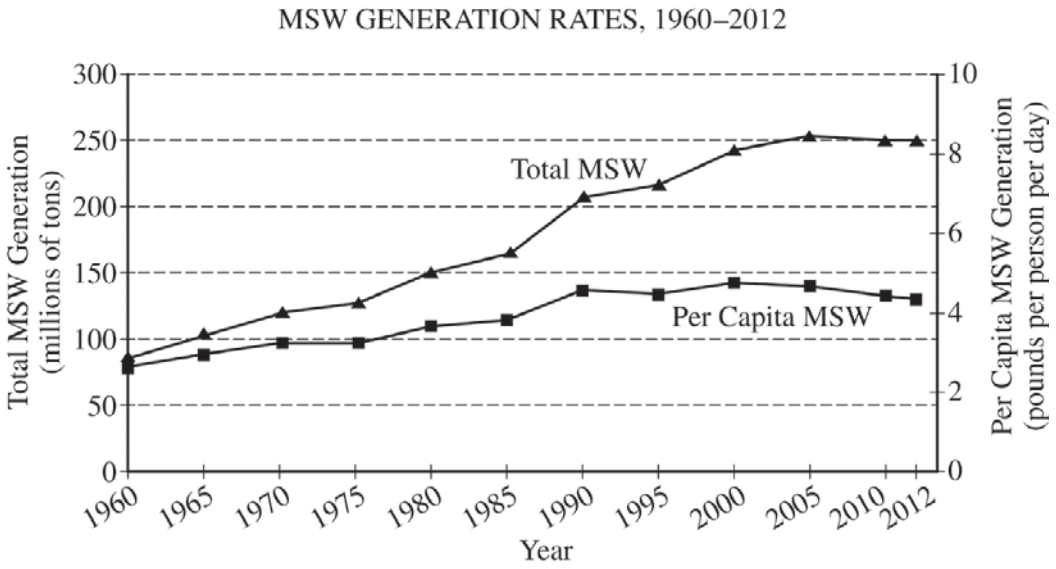
(c) Bats are found in ecosystems around the world. **Describe** TWO ways in which other organisms in an ecosystem could be affected by a decline in a bat population.

(d) The Eastern deciduous forest in which the little brown bats live is an important ecosystem. **Identify** TWO ecosystem services that forests provide, and **explain** how each service benefits human society.

WNS is an emerging disease in bats. Humans are also subject to emerging diseases, such as Ebola. A recent study suggests that the number of emerging infectious diseases affecting human populations has been steadily increasing in recent decades.

(e) **Provide** a likely reason for the increase in emerging infectious diseases affecting human populations. Include an explanation for the reason you provided.

3. Municipal solid waste (MSW) is the trash collected from households and businesses. The graph below shows MSW generation in the United States from 1960 to 2012.



(a) Use the data provided in the graph above to respond to the following.

(i) **Explain** one probable cause (other than increased composting) for the change in per capita waste generation from 2000 to 2012.

(ii) **Calculate** the percent increase in total MSW generation from 1980 to 2012.

(b) Two ways of managing MSW are incineration and disposal in landfills.

(i) **Identify** one disadvantage of waste incineration.

(ii) **Identify** one disadvantage of waste disposal in landfills.

Trash incineration is one way to generate electricity from MSW. Electricity can also be generated from waste buried in landfills.

(c) **Describe** the specific steps of a process used to produce electricity from waste buried in a landfill.

(d) Many landfills do not accept used tires. As a result, the tires are often dumped in poorly regulated piles. **Describe** one human health problem associated with piles of discarded tires.

(e) Composting is one way to reduce the amount of waste that enters a landfill.

(i) Other than reducing the volume of waste, **identify** one advantage of composting.

(ii) **Identify** one disadvantage of composting.

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Question 3

Municipal solid waste (MSW) is the trash collected from households and businesses.

(a) Use the data provided in the graph to respond to the following.

(i) **Explain** one probable cause (other than increased composting) for the change in per capita waste generation from 2000 to 2012.

(1 point for a correct explanation for the change in per capita generation from 2000 - 2012)

- People or businesses practicing one of the following: refuse, reduce, reuse, recycle, or repurpose.
- Lighter materials contribute to less MSW creation (e.g. plastic bottles not glass bottles)
- Less material used in products (newspapers smaller, aluminum cans less massive)
- Technology reduces waste generation (e.g., reading magazines online → less paper)
- Economic recession → less consumption → less MSW produced

(ii) **Calculate** the percent increase in total MSW generation from 1980 to 2012.

(1 point for the correct answer with work shown)

$$\frac{(250 \text{ million tons} - 150 \text{ million tons})}{150 \text{ million tons}} \times 100 = 66\% \text{ to } 67\%$$

(b) Two ways of managing MSW are incineration and disposal in landfills.

(i) **Identify** one disadvantage of waste incineration.

(1 point for a correct identification of a disadvantage of waste incineration)

- Specific air pollutant (e.g., CO, CO_2, dioxin, halogens, particulates, SO_x, NO_x)
- Ash disposal necessary
- Incinerator is expensive to construct and/or operate
- MSW supply and quality may be limited requiring additional fuel
- Reduced quality of life and property value due to incinerator and supply trucks

(ii) **Identify** one disadvantage of waste disposal in landfills.

(1 point for a correct identification of a disadvantage of waste disposal in landfills)

- Ground water, surface water, or soil contamination through some transport mechanism
- Reduced quality of life and property value due to landfill and supply trucks
- Release of methane or CO_2
- Odor source
- Attracts vermin
- Habitat destruction
- Preclusion of other land uses
- Explosion/seepage hazard from methane produced

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Question 3 (continued)

Trash incineration is one way to generate electricity from MSW. Electricity can also be generated from waste buried in landfills.

(c) **Describe** the specific steps of a process use to produce electricity from waste buried in a landfill.
(3 points – 1 point for each step in the process of generating electricity from landfill gas)

Step	Description of Step
Acquire fuel (chemical energy)	Methane collected or gathered
Use fuel (chemical → mechanical)	Fuel is combusted to produce steam or hot air
Generate electricity (mechanical → electricity)	Steam or hot air spins/turns/rotates a turbine/generator to generate/produce electricity

(d) Many landfills do not accept used tires. As a result, the tires are often dumped in poorly regulated piles. **Describe** one human health problem associated with piles of discarded tires.
(1 point for a correct description of a human health problem associated with piles of discarded tires)

- Discarded tires provide habitat for mosquitoes/pests that can be disease vectors.
- Tires may catch fire and release air pollutants that cause respiratory issues in humans.

(e) Composting is one way to reduce the amount of waste that enters a landfill.

(i) Other than reducing the volume of waste, **identify** one advantage of composting.
(1 point for a correct identification of an advantage of composting)

- The resulting compost can be used or sold as fertilizer or soil amendments.
- Municipal composting facilities may provide jobs.
- MSW may emit less foul odor if organic material is composted.
- Tipping fees and trash removal costs may be reduced due to removal of dense compostable material.

(ii) **Identify** one disadvantage of composting.
(1 point for a correct identification of a disadvantage of composting)

- Compost may attract undesirable animals (vermin).
- Compost may emit foul odors or spontaneously combust.
- Nutrients released from decomposing organic matter may run off into surface waters and cause water quality problems.
- Compost may release methane.
- Composting organic material requires a great investment of time and labor by humans.