### Suggested Answers to End of Chapter Questions

The following are examples of the material that should be contained in possible student answers to the end of chapter Critical Thinking questions. They represent only a summary overview and serve to highlight the core concepts that are addressed in the text. It should be anticipated that the students will provide more in-depth and detailed responses to the questions depending on an individual instructor’s stated expectations.

1. What were two important roles played by the scientists who studied Lake Washington as discussed in the **Core Case Study** that opens this chapter? Explain how the story might have been different if the scientists had not fulfilled each of these roles?

Scientists were the first to identify the presence of cyanobacteria in the lake and then to link the growth of the cyanobacteria to sewage treatment plants. The scientists also made the public aware of changes in the lake. Without this observation of cause and effect and efforts to educate the public, the lake would have continued to decline.

2. Lake Washington and Puget Sound now face new problems similar to those of the past, as suggested in the **Core Case Study**. Describe the nature of those problems and suggest possible solutions?

Both Lake Washington and Puget Sound now face problems of cultural eutrophication. These problems, like the earlier ones, are caused by excess loading of nitrogen and phosphorus into the lakes. Now the loading is from a variety of sources including agricultural settings, air pollution, and local fertilizer use so any solutions will require approaches that include all of these potential causes as well as new scientific studies to identify the most important problems.

3. A large number of dead fish are found floating in a lake. How would you determine whether they died from cultural eutrophication or from exposure to toxic chemicals?

Test the water for the presence of dissolved organic matter that may be impacting the BOD of the lake. Test the dissolved oxygen concentrations in the lake at different locations and at different depths. Perform a full toxicological analysis of the lake water to determine if any chemical pollutants are present in the lake. Only then can any determination be made as to the cause of the fish kill.

4. If you were a regulator charged with drawing up plans for controlling water pollution, briefly describe one idea for controlling water pollution from each of the following sources: **(a)** an effluent pipe from a factory going into a stream, **(b)** a parking lot at a shopping mall bordered by a stream, **(c)** a farmer’s field on a slope next to a stream.

(a) I would identify, monitor, and regulate organic and inorganic contaminants in the effluent stream coming out of the pipe from the factory. Laws would be introduced and enforced to control harmful discharges from such point sources from industry to prevent it entering and damaging ecosystems.

(b) It is difficult to regulate nonpoint sources of pollution from areas such as parking lots from shopping malls. However, measures could be taken to help with this problem. Petroleum, oil, rubber particles from tires, and litter may all be contaminants in the parking lot runoff. The construction of an onsite water treatment facility that collects and treats all of the runoff before it is discharged into the stream could be a solution. The cost of the facility would be shared between the mall owners and the companies that occupy the space in the mall. The surface of the parking lots could be assessed to make sure that it channels the water to a drainage system that deliverts the water to the treatment facility. Rather than infiltrate into the groundwater through cracks in the surface, the parking lot would need to be checked periodically.

(c) Runoff from farms and agricultural activities is a leading cause of water pollution. Regulations that could be introduced that would limit the amount of fertilizers and pesticides that are used; not allow cattle to graze on the slope close to the stream; mandate the practice of contour farming, strip cropping, and no-till agriculture on the slope, and plant a vegetative buffer zone along the bottom of the sloping field near the stream bank.

 5. What role does population growth play in **(a)** groundwater pollution problems and **(b)** coastal water pollution problems?

(a) Groundwater pollution is caused by a variety of different activities, but one of the most important causes is fertilizer leaching from agricultural field. The use of fertilizers in agriculture is one of the consequences of increased demand for food to feed a growing population so increased pollution can, in this sense, be linked back to population issues.

(b) Coastal water pollution is caused also by fertilizer use, so for the same reasons as described above, population growth can lead to problem with agricultural fertilizer runoff. In addition, growth of populations in coastal areas, and particularly the development of areas such as mangroves and wetlands, reduces the ability of these systems to filter out contaminants before they reach the open water.

6. When you flush your toilet, where does the wastewater go? Trace the actual flow of this water in your community from your toilet through sewers to a wastewater treatment plant and from there to the environment. Try to visit a local sewage treatment plant to see what it does with your wastewater. Compare the processes it uses with those shown in Figure 20-19. What happens to the sludge produced by this plant? What improvements, if any, would you suggest for this plant?

In my rural community everyone has a septic tank system, which is used for the disposal of domestic sewage and household wastewater. The septic tank is pumped out every few years and the sludge is taken to a sewage treatment plant for disposal. The septic tank drains into a leach field, which lies underneath the vegetable garden. We have our own well so the groundwater that is used by our household goes through the leach field and then percolates back into the ground to recharge the aquifer.

The nearest local sewage treatment facility disposes of the sludge produced by sending it to a landfill. This is because of the contaminants in the sludge that arise from the toxic materials from the local businesses and industries that have discharges entering the wastewater stream. I would separate the discharges from the factories and have that water treated in another facility. This would allow the sludge produced by the “household” sewage to possibly be used as a soil additive on local farms. It does not make sense that the sewage that is pumped from septic systems from houses in our area gets mixed in with the contaminated sewage at this facility. We are not using the sustainable principle of nutrient recycling.

7. In your community, **a.** What are the principal nonpoint sources of contamination of surface water and groundwater? **b.** What is the source of drinking water? **c.** How is drinking water treated? **d.** How many times during each of the past 5 years have levels of tested contaminants violated federal standards? Were violations reported to the public? **e.** What problems related to drinking water, if any, have arisen in your community? What actions, if any, has your local government taken to solve such problems? **f.** Is groundwater contamination a problem? If so, where, and what has been done about the problem? **g.** Is there a vulnerable aquifer or critical recharge zone that needs protection to ensure the quality of groundwater? Is your local government aware of this? What action (if any) has it taken?

(a) Farmlands and local strip malls along the roads.

(b) Most people have their own wells.

(c) Some houses have water softening systems in the basement.

(d) A few years ago, the water in the nearest town center was found to be contaminated with a microorganism and the water had to be boiled before use. Some local restaurants had to close for several days until the problem was dealt with. The public was kept aware of the problem and the situation at all times.

(e) Yes, the public is strongly urged not to eat fish that is caught in local rivers and lakes due to potentially high levels of toxic materials such as mercury. Those people who choose to eat fish, such as local trout, have been told that they should not eat more than one fish per month. It has been broadly communicated that children, the elderly, and pregnant women should never eat any fish from these local rivers and lakes.

(f) The only groundwater problem that I have heard of in my area was from a leaking underground gas tank at a local service station. The tank had to be dug up and replaced and the contaminated soil was taken away and incinerated.

(g) There are signs along the roadside in my area that let people know they are entering a protected watershed area that is used for supplying drinking water. I have not specifically heard of any problem with the aquifer recharge area, although whenever any new construction takes place I imagine it is affecting the amount of water that infiltrates the ground. The signs by the road do make people aware of the importance of the watershed and how we depend on it for our drinking water. Being educated about the aquifer will hopefully help protect it.

8. List three ways in which you could apply **Concept 20-5** to make your lifestyle more environmentally sustainable.

1. I can use organic rather than industrial fertilizers in my yard.

2. I can support the protection of wetlands as a natural mechanism for sewage treatment.

3. I can work with and/or support organizations committed to reducing poverty and slowing population growth.

9. Congratulations! You are in charge of the world. What are three actions you would take to **(a)** sharply reduce pointsource water pollution in developed countries, **(b)** sharply reduce nonpoint-source water pollution throughout the world, **(c)** sharply reduce groundwater pollution throughout the world, and **(d)** provide safe drinking water for the poor and for other people in developing countries?

(a) Point-source/developing countries: 1. Build sewage and water treatment plants. 2. Introduce laws to control water pollution from businesses and industry. 3. Regulate industrial waste discharges.

(b) Nonpoint/worldwide: 1. Restore degraded wetlands. 2. Mandate and support best management practices for all agricultural operations. 3. Regulate household fertilizer and pesticide use on lawns and gardens.

(c) Groundwater/worldwide: 1. Ban all hazardous waste disposal in landfills. 2. Keep toxic chemicals out of the environment and use/search for non-toxic alternatives. 3. Use above-ground tanks for storage of hazardous chemicals and gasoline/oil, which have leak detector and spill collection systems.

(d) Safe drinking water/poor/developing countries: 1. Implement the WHO suggestions for tropical countries-put water in plastic containers (provided free) and expose them to the sun to kill bacteria. 2. Provide filtering systems to remove bacteria from drinking water (using the latest micropore and nanotechnology filters). 3. Supply purifying chemical sachets free of charge as part of an international aid program while water treatment facilities are being constructed.

10. List two questions that you would like to have answered as a result of reading this chapter.

Student answers will vary