

How Does Human Activity Affect Rivers?



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ANSWER SHEET

Alice and her classmates visited a nearby river. Their goal was to determine if pollution from cities and farms affected the water quality of the river. Water quality describes the condition of the water, including chemical and physical properties, as well as biological characteristics.

Their first task was to take water samples from five sites along the river. Alice wore long waterproof waders and collected samples at site A by submerging a container under the water. She also measured water temperature at 18 C. She took notes in her field journal about what she observed at the location. There was a small waterfall upstream from her collection site and the water was clear.

Next, she collected invertebrates from the site by placing a net in the water and disturbing the rocks nearby. The current would carry any animals into the net and then deposited into a bucket to examine back at the lab.

She returned to the lab with her samples, which would then be compared to samples taken at the other locations.

1. Summarize the data collected by Alice:

quantitative	water temperature
qualitative	clear water, waterfall

2. How did Alice collect invertebrate samples?

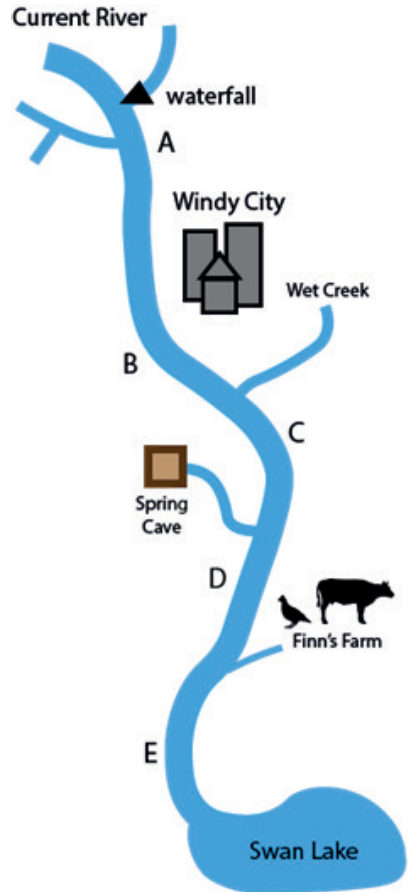
With a net

3. What is the purpose of this study?

To determine if pollution from farms and cities affect water quality

4. Examine the river map. What differences would you expect to find from water sampled at Site A to water collected at Site B

A would be cleaner than site B



River Map Showing Sample Sites (A-E)

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Back in the lab, the samples from all five sites were analyzed. For a chemical analysis, they measured the B.O.D, or biochemical oxygen demand. This measures the amount of oxygen consumed by bacteria and other microorganisms while they decompose organic matter. When leaves or trees fall into the water, microbes will consume them. These organisms need oxygen during this process, like all living things.



Alice also measured dissolved oxygen, or DO. This is simply a measure of the amount of oxygen in the water available for microorganisms and fish. Oxygen enters water systems from the atmosphere, but also from photosynthetic organisms, like plants and algae. Waterfalls can also help add air by circulating water, a process known as aeration.

Alice also measured the amount of phosphate and nitrogen was in the water sample. Both of these elements are used in fertilizer to stimulate plant growth. These elements can cause algae blooms, and at high levels, they can be toxic to living organisms. Both are measured in PPM, or parts per million. Even small amounts of phosphates and nitrogen can change the composition of a water ecosystem.

The sample was filtered to collect suspended solids. The Total Suspended Solids, or TSS, reflects particles in the water that float or are "suspended" in the water. TSS usually indicates substances like sand, algae, sediment or plastic particles. TSS can also affect the turbidity of the water, or how transparent the water is. High TSS levels will make the water less transparent, because it indicates substances floating within it.

Her final test measured fecal coliform bacteria. These are specific bacteria that living in the intestines of animals and enter the stream from animal waste. The presence of these bacteria indicate contamination from animals or even human sources where water treatment is not present. High levels of fecal coliform can make the water dangerous to drink or even swim in.

5. Based on Alice's initial observations, would you expect site A to have a high level of dissolved oxygen? Why or why not?

Yes, because the waterfall adds oxygen

6. How will a fallen (and decomposing) tree increase the BOD of the area?

Decomposers need oxygen, hence a higher oxygen demand

7. View the map of the river and focus on the water collection sites (A - E). Which area will have the highest levels of phosphates and nitrogen? Explain your choice.

E would have high levels due to being downstream from the farm

8. What observation did Alice make that would indicate her site had a low number of TSS?

The water was clear

9. Why would humans be concerned about fecal coliform bacteria?

It can make you sick

10. High levels of nitrates and phosphates might increase algae growth. How would algae growth affect each of the following?

DO	increase
BOD	increase (though algae may increase oxygen in water, demand also will increase)
Turbidity	increase

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Chemical Analysis

Sites	A	B	C	D	E
Suspended solids (ppm)	2	20	12	10	14
Phosphates (ppm)	25	50	40	35	75
Nitrogen (ppm)	0.2	1.8	1.4	0.9	2.2
B.O.D. (ppm)	1.8	2.9	2.8	2.3	3.1
Dissolved Oxygen (ppm)	6.5	2.2	2.9	3.0	3.2
Fecal Coliform (per 100 ml)	0	180	160	60	50

11. Examine the chemical analysis for the five sites. Which two areas have the most fecal coliform? **B&C** _____

Review the map and suggest a reason for this.	Location of the city
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12. Which area has the most dissolved oxygen? **A** _____

Review the map and suggest a reason for this.	Location of the waterfall (aeration)
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13. Which area has the most nitrogen and phosphates? **E** _____

Review the map and suggest a reason for this.	Location of the farm
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14. Why would areas with high nitrogen and phosphates also have a high B.O.D?
Explain the relationship between these two variables.

Algae growth increases there, also increasing consumers or other organisms that need oxygen
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15. Spring cave has a natural spring that feeds fresh water into the river. How does this spring affect the chemical nature of site D?

The spring dilutes some of the pollutants, like fecal coliform and suspended solids
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16. Using the data on the table and what you know about the chemical analysis, rank the sites from BEST quality, to WORST quality.

Answers can vary, most importantly, site A is the BEST, site B is the worst. C, D, and E, in that order based on overall pollutants. BEST answer: A, C, D, E, and then B

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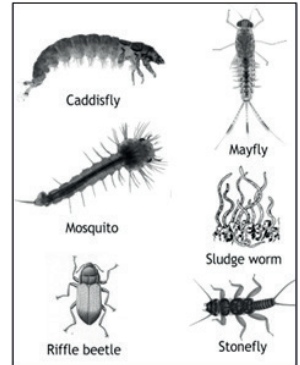
Freshwater Quality

The freshwater quality index (WQI) is a measure of the quality of a water. A pollution sensitive species would not be found in low quality water, but a pollution tolerant species may be present.

The next task for Alice is to determine the number and types of animals living in the water, which will also provide evidence regarding the water quality. Water samples from the river will include macroinvertebrates, which are small invertebrates like worms, crustaceans, and insects. Some species are “pollution tolerant,” meaning that they can survive in water that has a low quality.

Alice uses a microscope to scan the water samples and collect data on the types of organisms found at site A. Other students collected data from other sites in the study to compare them.

17. Biologists rank macroinvertebrates as “low tolerance,” “medium tolerance” and “high tolerance” with regard to pollution. Complete the last column of the table to indicate which species are LT, MT, and HT.



Invertebrate Fauna						Tolerance
Sites	A	B	C	D	E	
Mayfly Nymphs	20	4	12	18	6	
Stonefly Nymphs	16	2	4	12	2	
Caddisfly Larva	14	1	2	8	2	
Riffle Beetle	15	12	14	12	13	
Sludge Worm	2	26	24	18	16	
Mosquito Larva	4	22	26	17	15	

18. Which two species seemed to thrive in the most highly polluted areas of the river?

Sludge worm, mosquito larva

19. Which animal has the most representation in all areas of the river? Suggest a reason for this.

Riffle Beetle, it seems to tolerate most of the environments on the river

20. A rafting company wants to create a campground and swimming area for tourists. Place an X on the map where the best location would be. Defend your reasoning for choosing this location using specific details about the water quality.

Site A is a good choice because the water is clear and has the least amount of pollution. You could challenge students to pick a second site, in which case, site D would be a good choice due to the location of the cave spring which adds fresh water.