

Student Worksheet

Water purity and filtration – Getting down to the nanoscale

Lesson 2: What Affects the Purity of Water?

A ranch owner in Mexico is concerned that some of the people who live and work on his ranch have been getting sick. He suspects that the stream that serves as the water supply may be contaminated with disease-causing bacteria. Your team has been hired to investigate the stream to see whether the water is safe to drink and to make recommendations for further action if the water is unsafe.

Question How can you test whether this stream has disease-causing bacteria?

Make a Prediction _____

Materials

- knife or nail clipper
- pathoscreen media
- sterile bag with dechlorinating agent
- 2 antiseptic alcohol preparation pads or alcohol swabs/wipes
- permanent marker
- 1 L plastic bottle, with the top removed

Procedure

1. Wearing protective gloves, remove an alcohol swab from the foil pouch and use it to carefully clean the knife or nail clipper blade.
2. Place the swab atop a flat surface.
3. Use the knife or clipper to open the pathoscreen media and carefully place the media on top of the opened alcohol wipe. Make sure that the contents do not spill out!
4. Label the sterile bag with your name, date, and time.
5. Open the sterile bag by tearing off the top of the bag along the perforation. Be sure NOT to contaminate the inside of the bag. Leave the small tablet of sodium thiosulfate in the bag—it will remove any chlorine from the water.
6. Hold the bag by the wireless white strips at the top and pull. The bag will open.
7. If the water can flow, let the water run for about 30 s before collecting water.
8. Fill the bag to the 100 mL line with the water. If the bag fills above this line, pour out the excess water.
9. Add the pathoscreen media powder to the bag containing your water sample—this nutrient will help any bacteria present to quickly multiply and allow you to detect their presence. Be sure to add **all** of the powder to the bag.

Safety Tip

Use care when cleaning and using blades—they are sharp and can cut.



10. Pull the white wire strips taut to close the bag.
11. Firmly hold the wire strips, and carefully but quickly flip the bag 3 times so that the bag folds tightly over the wire to create a tight seal. Fold the wire strips over to seal the bag, as shown in the image at right.
12. Observe the contents of the bag. If the sodium thiosulfate has not fully dissolved, gently shake the bag. Prevent water from leaking out by not squeezing the bag.
13. Place the bag in the 1 L bottle with the top removed for safe transport. Store on a level surface where it will not tip.



Data

14. Record the color of the bag, the date, and time in the table below.
15. After 24 hours, observe the sample bag and record your observations in the table below. What color is the sample? If it is yellow, does it have black spots?
16. After 48 hours, repeat step 15.

Sample	Description at 24 hr	Description at 48 hr	Is bacteria present?	Conclusion
1				
2				
3				
4				
5				

Materials for disposal

- bucket
- bleach
- water
- straight pin
- spray bottle containing bleach and water in a 1:10 ratio
- paper towels

Disposal

17. Wear a pair of protective waterproof disposable gloves.
18. Remove the sample from the transport bottle and have a lab partner hold the bag upright as you fill the 1 L transport bottle halfway with tap water.
19. Add bleach to the transport bottle until it is $\frac{3}{4}$ full. Gently shake the bottle to mix the bleach with the water.
20. Place the sample bag in the water bottle and push it down to submerge the bag.

Safety Alert!

The contents of the bag may contain disease-causing bacteria that could cause diarrhea or other illness. Wear gloves and use caution at all times during disposal.

21. Use the straight pin to puncture the bottom corner of the bag. Allow the contents of the bag to empty into the bottle.
22. Flush the fluid contents of the bottle. Do **NOT** flush the bag.
23. Repeat steps 20–22 to disinfect the inside of the bottle and the bag. You may open the bag and rinse the inside of the bag.
24. Dispose of the bag, pin, bottle, and gloves in a way that they cannot be recovered, such as placing them in a biohazard bin. Pins should be disposed of in a closed cardboard box before placing them in a biohazard bin. Be sure that pins do not go directly in a plastic bag—they can puncture the bag.
25. Use the spray bottle containing bleach water to disinfect any surfaces that might have come in contact with the sample.

Analysis

26. If the water sample in your bag is black or has black dots in it, then bacteria has been detected. If it is yellow with no trace of black, bacteria has not been detected. Is bacteria present in your samples? For each sample, record your answer in the table on the previous page.
27. Why was it important to leave the sodium thiosulfate in the bag? _____

28. Why did you clean the cutting tools before testing the water for bacteria? _____

29. If you hadn't cleaned the tools, how would it have affected your results? _____

30. Why do you think the sample needs to be at room temperature for 24 hours before you can expect a color change? _____

31. How might doing this experiment on a very cold day affect the results? _____

32. How might doing this experiment on a very hot day (over 90°F) affect the results? _____

Conclusion

33. In your data table, notice the trend of color throughout the period of time that you tested. What conclusions can you draw about how quickly or slowly the bacteria grew? What can you conclude about how much bacteria were initially present in the sample? Record these conclusions in the data table.

34. Is the water safe for human consumption? _____

35. Based on your water analysis, what would your team recommend to the ranch owner?

Explain your answer. (**Hint:** review your answer in step 32.) _____

Water Filtration and Nanoparticles

January 29, 2020

Dear Team:

Thank you for your recommendation to get a filter for the stream on our ranch.

To save money, I would like to have you build a filter that will purify the water in the stream so that people on my ranch can drink the water.

Also, please test the filtered water to make sure that it is safe to drink.

Sincerely,

Manuel Rancho
Ranch Owner
Rancho Felicidad