

Question: What physical and chemical tests can you use, and what data do they provide, in the analysis of urine?

Safety Precautions

- Do not taste the simulated urine.
- If observing odour, follow safe and proper methods.
- Be careful when handling the simulated urine. Clean up spills immediately, and notify your teacher if a spill occurs.

Materials

- 1 medicine dropper
- 10 mL graduated cylinder
- 100 mL beaker
- universal indicator paper with colour charts
- glucose test strips with colour charts
- simulated urine samples
- 1 test tube rack
- 5 test tubes
- hot water bath

Procedure

Consider this scenario. A theft was committed in the washroom of a community building. Forensic specialists collected a urine sample at the scene of the crime. The police have four suspects in custody. Your task is to find out who committed the crime.

1. You will start by doing a trial run of four tests to find out what information they provide. This will serve as the control for this investigation.
2. Perform the following tests on your simulated urine sample.

Test 1—Colour, Odour, Clarity: Normal urine is a clear, straw-coloured liquid. Urine may be cloudy because it contains red or white blood cells, bacteria, or pus from a bladder or kidney infection. Normal urine has a slight odour. Foul-smelling urine is a common symptom of urinary tract infection. A fruity odour is associated with diabetes mellitus. Determine the colour, odour, and clarity of your simulated urine.

- a) Use the graduated cylinder to obtain 20 mL of the Control Urine Sample.
- b) Place the Control Sample into the beaker.
- c) Examine the urine carefully. Record the colour and the clarity (clear or cloudy) in the data chart on the following page.
- d) Using the proper technique, determine the odour of the urine. Record your observations in the data chart on the following page.

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| Test | Control tests | Crime scene | Suspect 1 | Suspect 2 | Suspect 3 | Suspect 4 |
|--|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|
| 1. Colour/ odour/ clarity | | | | | | |
| 2. Protein | | | | | | |
| 3. pH | | | | | | |
| 4. Glucose | | | | | | |

Test 2—Protein: One sign of kidney damage is the presence of protein in urine. Find out if the sample contains protein by doing the following.

- a) Use the graduated cylinder to divide the sample equally between two test tubes (10 mL into each test tube).
- b) Put one tube into the hot water bath, and leave the other at room temperature.
- c) After a few minutes, remove the test tube from the hot water bath and compare the heated and unheated urine.
- d) If the heated sample is cloudier, it contains protein. Record your observations.
- e) Dispose of the heated sample as directed by your teacher. Use the unheated sample for the next test.

Test 3—pH: The wide range of pH values (pH 4.7 to 8.5) makes this is the least useful parameter for diagnosis of kidney disorders. Kidney stones are less likely to form and some antibiotics are more effective in alkaline urine. There may be times when acidic urine may help prevent some kinds of kidney stones. Bacterial infections also increase alkalinity, producing a urine pH in the higher 7–8 range.

- a) Use a clean medicine dropper to place a drop of the urine on a small piece of universal indicator (pH) paper.
- b) Leave the paper for about 30 seconds.
- c) Determine the pH by comparing the new colour with the colour chart provided.
- d) Record the pH of your urine sample in your data table.

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(cont'd)

Test 4—Glucose: One sign that a person has diabetes mellitus is the presence of glucose in urine. Find out if the sample contains glucose by doing the following.

- a) Dip a glucose test strip into the test tube of unheated urine sample and immediately take it out.
 - b) Count to 10, then check the colour with the glucose colour chart.
 - c) Record whether the results are negative, light, medium, or dark. (The darker the colour, the greater the amount of glucose.)
3. Your group will be assigned to test one of the remaining samples of simulated urine. One sample was collected at the crime scene. The others have been provided by the four suspects in police custody. Run the four urinalysis tests and record your observations on a class data sheet provided by your teacher.

Analysis

1. Which suspect do you think committed the crime?

2. Explain how you arrived at this conclusion.

Conclusions

3. Based on your urinalysis, identify the disease that Suspect 4 might have. Explain.

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- List at least three other characteristics of urine that you would expect to observe (or not) in a healthy urine sample.

- In what ways were the data that you collected in this urinalysis limited? What additional data would provide a more comprehensive picture of a urine sample?

Extension

- Explain why you would not expect to find evidence of glucose or protein in a urine sample from someone whose kidneys are healthy. (Use details of nephron anatomy in your answer.)

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7. The urine of athletes is routinely tested for evidence that they may have taken performance-enhancing drugs. Based on your understanding of urine formation, describe how molecules of a drug could appear in a person's urine.