

Urinalysis is the physical, chemical, and sometimes microscopic examination of urine. Many diseases with no obvious symptoms can be revealed during urinalysis. Long before modern techniques such as chemical dipsticks and microscopic analysis were developed, medical practitioners used the appearance, odour, and even taste of urine to help them make inferences about a person's health. In this investigation, you will test samples of simulated urine to identify an imaginary criminal. In doing so, you will perform several of the tests that are performed when health professionals do a urinalysis.

Question

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

Materials

6 medicine droppers	test tube rack	graduated cylinder
6 test tubes	100 mL beaker	hot water bath
simulated urine samples	universal indicator paper	glucose test strips

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.

Test 1—Colour, Odour, and 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.

- 1) Use the graduated cylinder to obtain 20 mL of the Control Urine Sample.
- 2) Place the Control Sample into the beaker.
- 3) Examine the urine carefully. Record the colour and the clarity (clear or cloudy) in your data chart.
- 4) Using the proper technique, determine the odour of the urine. Record your observations in your data chart.

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.

- 1) Use the graduated cylinder to divide the sample equally between two test tubes (10 mL into each test tube).
- 2) Put one tube into the hot water bath, and leave the other at room temperature.
- 3) After a few minutes, remove the test tube from the hot water bath and compare the heated and unheated urine.
- 4) If the heated sample is cloudier, it contains protein.
- 5) 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 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 to 8 range.

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

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.

- 1) Dip a glucose test strip into the test tube of unheated urine sample and immediately take it out.
- 2) Count to 10, then check the colour with the glucose colour chart.
- 3) Record whether the results are negative, light, medium, or dark. (The darker the colour, the greater the amount of glucose.)

Test 5 – Ketone: A sign that a person is on a diet is the presence of Ketones in urine. Find out if the sample has ketones by doing the following.

- 1) Dip a ketone test strip into the test tube of urine sample and immediately take it out.
- 2) Count to 10, then check the colour, it will turn purple in the presence of ketones.
- 3) Record whether the results are negative, light, medium, or dark. (The darker the colour, the greater the amount of ketones.)

Complete each test for all of the samples and record them in the table below

Table 1.0 _____

Test	Control	Crime Scene	Suspect 1	Suspect 2	Suspect 3	Suspect 4
Colour						
Odour						
Clarity						
Protein						
pH						
Glucose						
Ketones						

Analysis

1. Which suspect do you think committed the crime? Explain how you arrived at this conclusion.

Conclusions

2. Based on your urinalysis, identify the disease that Suspect 1 might have. Explain.

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

4. 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

6. 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.)

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. (use google)
