

Simulating Urinalysis

Pre-Lab Discussion

All organisms produce wastes. These waste materials must be removed so that the organism is not poisoned by its own metabolism. In humans, *urine* is the fluid produced by the kidneys as they remove waste chemicals from the blood. Urine is made up primarily of water, with some salts and organic materials dissolved in it. The concentration of each of these substances varies with a person's health, diet, and degree of activity.

By testing the chemical composition of urine, doctors can learn much about the general health of an individual. Urinary tract infections, kidney malfunction, diabetes, and liver disease are just some of the medical problems that can be diagnosed through *urinalysis*. Urinalysis involves the physical, chemical, and visual examination of a urine sample.

In this investigation, you will perform several tests to detect substances in a sample of artificial urine. You will also determine the contents of an artificial urine sample of unknown composition.

Problem

What chemical substances are found in a sample of artificial urine?

Materials (per group)

12 test tubes
Glass-marking pencil
Test tube rack
Test tube holder
10-mL graduated cylinder
Hot plate
Bunsen burner
400-mL beaker
Matches
Urine sample with glucose






Urine sample without glucose
Urine sample with phosphate
Urine sample without phosphate
Urine sample with albumin
Urine sample without albumin
Urine sample with chloride
Urine sample without chloride
Benedict's solution
Silver nitrate solution
10% acetic acid solution

Safety



Put on a laboratory apron if one is available. Put on safety goggles. Handle all glassware carefully. Use extreme care when working with heated equipment or materials to avoid burns. Always use special caution when working with laboratory chemicals, as they may irritate the skin or cause staining of the skin or clothing. Never touch or taste any chemical unless instructed to do so. Observe proper laboratory procedures when using electrical appliances. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure





Part A. Test for Glucose

-  1. Place two test tubes in a test tube rack. With a glass-marking pencil, label one test tube "G" for glucose. Allow the other test tube to remain unlabeled as it will act as the control.
-   2. Use the 400-mL beaker to prepare a hot water bath. **CAUTION:** Use extreme care when working with hot water. Do not let the water splash onto your body.
-   3. Add 3 mL of Benedict's solution to both test tubes. **CAUTION:** Use extreme care when handling Benedict's solution to avoid staining of the skin and clothing.
4. Add 3 mL of the urine sample with glucose to the test tube labeled "G." Add 3 mL of the urine sample without glucose to the unlabeled test tube. Note the appearance of the substance in each test tube. Record this information in Data Table 1.
5. Place both test tubes in the hot water bath for 2 minutes.
6. After 2 minutes, remove the test tubes from the hot water bath with a test tube holder. Place the test tubes in the test tube rack. **CAUTION:** Be careful when working with heated equipment or materials to avoid burns. Note any color changes in the test tubes. Record your observations in Data Table 1.

Part B. Test for Chloride

-  1. Place two test tubes in a test tube rack. With a glass-marking pencil, label one test tube "C" for chloride. Allow the other test tube to remain unlabeled as it will act as the control.
2. Add 5 mL of the urine sample with chloride to the test tube labeled "C." Add 5 mL of the urine sample without chloride to the unlabeled test tube. Note the appearance of the substance in each test tube. Record this information in Data Table 2.
-  3. Carefully add 3 drops of silver nitrate solution to each test tube. **CAUTION:** Use caution when working with silver nitrate solution because it can stain the skin and clothing. Observe the top surface of the liquid in each test tube. Record its appearance in Data Table 2.

Part C. Test for Albumin

-  1. Place two test tubes in a test tube rack. With a glass-marking pencil, label one test tube "A" for albumin. Allow the other test tube to remain unlabeled as it will act as the control.
2. Half fill the test tube labeled "A" with the urine sample with albumin. Half fill the unlabeled test tube with the urine sample without albumin.
-    3. Using a test tube holder, pass the top surface of each test tube over the flame of a Bunsen burner for 15 to 20 seconds. See Figure 1. **CAUTION:** Secure all loose clothing and hair when using a Bunsen burner. When heating a test tube, always point it away from yourself and other students. After heating each test tube, place it in a test tube rack. Note the appearance of each substance. Record your observations in Data Table 3.

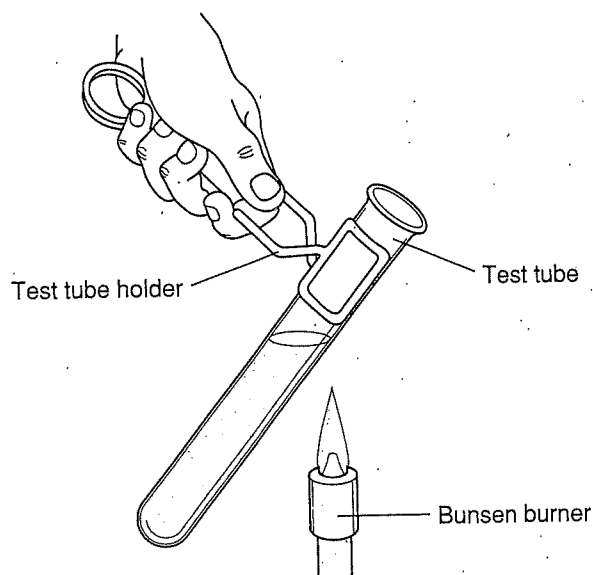


Figure 1

4. Add 5 drops of acetic acid to each test tube. **CAUTION:** *Be careful when using an acid.* Note the appearance of each substance. Record your observations in Data Table 3.

Part D. Test for Phosphate

1. Place two test tubes in a test tube rack. With a glass-marking pencil label one test tube "P" for phosphate. Allow the other test tube to remain unlabeled as it will act as the control.
2. Half fill the test tube labeled "P" with the urine sample with phosphate. Half fill the unlabeled test tube with the urine sample without phosphate.
3. Using a test tube holder, pass the top surface of each test tube over the flame of a Bunsen burner for 15 to 20 seconds. **CAUTION:** *Secure all loose clothing and hair when using a Bunsen burner. When heating a test tube, always point it away from yourself and other students.* After heating each test tube, place it in a test tube rack. Note the appearance of each substance. Record this information in Data Table 4.
4. Add 5 drops of acetic acid to each test tube. Record your observations in Data Table 4. **CAUTION:** *Be careful when using an acid.*

Part E. Testing an Unknown Urine Sample

1. Obtain a sample of artificial urine marked "unknown." Record the identification number of the sample in Data Table 5.
2. Using four clean test tubes, perform the glucose, chloride, albumin, and phosphate tests on the unknown sample. Follow the Procedures in Parts A through D of this investigation.
3. Record your results in Data Table 5.

Observations

Data Table 1

Substance	Color Before Heating	Color After Heating
Urine sample with glucose		
Urine sample without glucose		

Data Table 2

Substance	Color Before Adding Silver Nitrate	Color After Adding Silver Nitrate
Urine sample with chloride		
Urine sample without chloride		

Data Table 3

Substance	Appearance After Heating	Appearance After Adding Acetic Acid
Urine sample with albumin		
Urine sample without albumin		

Data Table 4

Substance	Appearance After Heating	Appearance After Adding Acetic Acid
Urine sample with phosphate		
Urine sample without phosphate		

Data Table 5

Composition of Unknown Urine Sample # _____	
Test	Present or Absent?
Glucose	
Chloride	
Albumin	
Phosphate	

Analysis and Conclusions

1. Why is it necessary to perform tests on the urine samples that do not contain any chemical substances? _____

2. If the top portion of a urine sample is heated and no haze forms, what conclusion can be drawn about the sample? _____

3. If you add Benedict's solution to a urine sample from a person who has diabetes and heat it, what color would you expect the heated sample to be? Explain your answer.

4. Which substances did you find in your unknown urine sample? Do you think this sample might have come from a healthy person? Explain your answer. _____

Critical Thinking and Application

1. Why does the chemical content of urine change throughout the day?

2. If a doctor finds high levels of protein in a patient's urine sample, the doctor will probably test the patient's urine several times over a week before drawing any conclusions. What might be the reason for this? _____

3. If a white haze forms at the top of a heated urine sample, how can you determine whether it is due to the presence of phosphate or albumin? _____

4. While a blood sample contains glucose, phosphate, albumin, and chloride molecules, a normal urine sample contains only phosphate and chloride molecules. What does this indicate about one of the functions of the kidneys? _____

Going Further

1. People with diseased kidneys must frequently have waste products removed from their blood by a procedure called dialysis. Use reference materials to research this procedure. You may also wish to interview a hospital dialysis technician.
2. Aquatic animals get rid of waste products by continuously excreting them directly to the outside watery environment. Design an experiment to show this using a goldfish. How is pH an important factor in maintaining tropical fish?