

Urinalysis Lab *(adapted from Greta v. Bergen, Biologyforlife.com)*

Medical tests are often required to assess an individual's state of health. Although many sophisticated, expensive, highly technological tests have recently become available and popular (e.g., MRI, genetic screening), the most common and useful tests are still the ones that are simple, inexpensive, and non-invasive. Examples include patient history, body temperature, heart rate and blood pressure, and the analysis of blood and urine samples.

In this lab, you will test (simulated) urine solutions to see what substances are present and diagnose two patient urine samples. For an overview of urinalysis tests, visit [Urinalysis](#).

To begin, you will need to research the following 4 diseases, each of which has symptoms that are detectable in urine: **Diabetes insipidus, diabetes mellitus, Bright's disease, and severe dehydration.**

Set Up

1. Wear safety goggles.
2. Label plastic cups with the names of the 5 types of simulated urine to be tested.
3. Fill each cup about $\frac{1}{2}$ ways full with the corresponding type of simulated urine for use throughout the lab.
4. Complete the following table as you work:

Table 1: Urine Test Results

Simulated Urine Sample						
Urine Test		Control	Patient A	Patient B	Patient C	Patient D
Color						
pH						
Specific Gravity	Base					
	Calibration					
	Adjusted					
Glucose						
Protein						

Color Test

Record the color of each urine in the table. Table 2 lists normal and abnormal urine colors and their possible causes.

TABLE 2

Urine Color and Possible Causes

Color	Diet	Drugs	Disease
Light yellow to amber	Normal		
Clear to light yellow	Alcohol	Phosphate, carbonate	Uncontrolled diabetes mellitus
Yellow orange to dark green	Carrots	Antibiotics	Bilirubin from obstructive jaundice
Red to red brown	Beets	Laxatives	Hemoglobin in urine
Smoky red	Beets	Anticonvulsants	Unhemolyzed red blood cells from urinary tract
Dark wine	Beets	Antiinflammatory drugs	Hemolytic jaundice
Brown black	Rhubarb	Antidepressants	Melanin pigment from melanoma
Brown	Rhubarb	Barbituates	Anemia or liver infections
Green	Green food dyes	Diuretics	Bacterial infection

Specific Gravity Test – completed as a class

A hydrometer is a device that is used to measure the specific gravity of a solution or liquid. Specific gravity is the ratio of the density (mass of a unit volume) of a substance to the density (mass of the same unit volume) of a reference substance.

Obtain the urine hydrometer and jar and rinse both pieces well. Fill the jar $\frac{3}{4}$ full of a urine sample. Place the hydrometer in the jar for that it is not touching the sides and read the level of urine on the hydrometer scale. Record this as the base specific gravity. Repeat for each urine sample.

Distilled water should give a reading of 1000 specific gravity. We might need to calibrate measurements. For example, if the water test gives a reading of 1004, every reading you take that day will have to have 4 subtracted from it to be accurate. If the water test gives a result of 990, then all the remaining results for the day should have 10 added to it. If necessary, record the calibration factor and determine the adjusted urine specific gravity.

Specific Gravity

Interpretation

1.000	Pure water (baseline calibration)
1.001–1.005	Very dilute urine — possible over-hydration or diabetes insipidus
1.010–1.025	<i>Normal range</i>
≥ 1.030	Concentrated urine — dehydration, glucose/protein presence, kidney issues

TABLE 3

Abnormal Urinalysis Results and Possible Causes

Test result	Possible causes	
	Diet	Disease
Low pH (<4.5)	High protein diet, cranberry juice	Uncontrolled diabetes mellitus
High pH (>8.0)	Diet rich in vegetables, dairy products	Severe anemia
Low specific gravity (<1.010)	Increased fluid intake –	Severe renal damage
High specific gravity (>1.025)	Decreased fluid intake, loss of fluids	Uncontrolled diabetes mellitus, severe anemia
Glucose present	A large meal	Uncontrolled diabetes mellitus
Protein present	High protein diet	Severe anemia

pH Test

Test each simulated urine by dipping a pH strip into it three consecutive times. Shake off excess liquid and compare color of the strip to the color on the pH chart. Record the pH that most closely matches your strip. The pH of normal urine averages 6.0, which is slightly acidic. Foods and diseases that can affect urine pH are listed in Table 3.

Glucose Test

1. Obtain one **glucose test strip** and a clean plastic cup or vial containing the urine sample.
2. **Dip the test strip** briefly into the urine, ensuring the reactive pad is fully wetted.
3. **Remove the strip** and gently tap it on the edge of the cup to remove excess liquid.
4. **Wait 30–60 seconds**, or the time indicated on the test strip bottle, for the color to develop.
5. Compare the color of the reactive pad to the **glucose color chart** on the test strip container.
6. Record whether glucose is **absent**, **trace**, or **present** at a measurable concentration.

Because simulated urine is yellow, the strip test is easier to interpret than Benedict's test.

However, you should make sure **only the strip's reactive pad** is used for comparison—do not interpret the colour of the urine itself.

7. Repeat the procedure for all other urine samples.
8. Dispose of used glucose strips in the designated waste container.
Use a **new strip** for each sample to avoid contamination.

Note: Glucose should not normally be present in urine.

A positive glucose result often indicates **diabetes mellitus** (see Table 3).

Protein Test

Add one pipette full (about 1mL) of urine sample to a clean glass vial. Add 2 mL of biuret reagents to the vial. Not the pale blue color of the biuret reagent. Gently swirl the vial to mix the contents. After 10 minutes, hold the vial against a white background and observe the color. A color change from light blue to pale violet indicates the presence of protein. Repeat the protein test for each of the urine samples.

Normally, protein should not be present in the urine. Erythropoietin is a glycoprotein cytokine secreted mainly by the kidney in response to cellular hypoxia, which can be caused by anemia. Factors associated with excretion of protein into the urine are listed in Table 3.

Analysis:

1. Determine which disease may be indicated by the urine test results for Patient A and Patient B. Provide evidence to support your answer.
2. What causes the chemical content of urine to change throughout the day?
3. Why is it important to perform tests on a control sample of urine?