Edvo-Kit #
145

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Tracking Health Through Urinalysis: A Case-Based Clinical Simulation

Experiment Objective:

Students will perform simulated urinalysis on synthetic urine samples to identify potential medical conditions from five different patients. They will then evaluate follow-up patient data to assess the effectiveness of treatment plans, gaining experience in diagnostic reasoning, laboratory interpretation, and clinical decision-making.

See page 3 for storage instructions.

Version 145.251204

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Table of Contents

Safety Data Sheets can be found on our website: **www.edvotek.com/safety-data-sheets**

Experiment Components

REAGENTS		STORAGE	CHECK (✓)
A	Patient Sample #1 Synthetic Urine	Refrigerator	❑
B	Patient Sample #2 Synthetic Urine	Refrigerator	❑
C	Patient Sample #3 Synthetic Urine	Refrigerator	❑
D	Patient Sample #4 Synthetic Urine	Refrigerator	❑
E	Patient Sample #5 Synthetic Urine	Refrigerator	❑
F	pH Additive	Refrigerator	❑
G	Calcium Additive	Refrigerator	❑

SUPPLIES *(included in this experiment)*

•	15 mL Conical Tubes	Room Temp.	❑
•	Urine Dipsticks	Room Temp.	❑
•	Microscope Slides	Room Temp.	❑
•	Small Transfer Pipets	Room Temp.	❑
•	Inoculating Loops	Room Temp.	❑

Experiment #145 contains material for up to 10 lab groups.

Store Components A-G in the refrigerator.

Requirements *(NOT included in this experiment)*

- Microscopes
- Distilled or deionized water
- Automatic micropipettes (5 – 50 µL) and tips
- Scale

All experiment components are intended for educational research only. They are not to be used for diagnostic or drug purposes, nor administered to or consumed by humans or animals.

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Background Information

Urinalysis is one of the oldest diagnostic practices in the history of medicine, tracing back over 6,000 years. In ancient civilizations, including Egypt, Greece, China, and India, healers and physicians often relied on the appearance, color, and even taste of urine to assess a person's health. Early practitioners understood, long before modern science confirmed it, that the body reveals internal imbalances through waste products excreted in urine. In traditional Chinese medicine, for example, changes in urine's appearance were considered crucial clues to diagnosing diseases affecting the liver, kidneys, or digestive system.

In the 19th century, urinalysis became a standard part of medical evaluations, especially after the invention of the dipstick test (Figure 1). These test strips allowed for fast, semi-quantitative detection of multiple substances, including glucose, protein, blood, and ketones, using a single tool. As medical science progressed into the 20th century, urinalysis evolved into a precise and multifaceted diagnostic tool, capable of revealing a wide range of physiological conditions, from urinary tract infections to diabetes, liver dysfunction, and early-stage kidney disease.

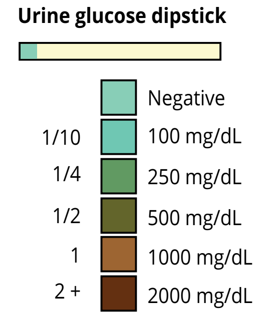


Figure 1: Dipstick urinalysis testing for glucose.

Urinalysis is one of the most powerful and accessible diagnostic tools used in medicine today. With just a simple urine sample, healthcare providers can gather critical information about how the body is functioning. Since urine is a direct byproduct of blood filtration through the kidneys, changes in its chemical composition can reflect disturbances in nearly every major body system, from the urinary tract and kidneys to the liver and even metabolic processes like glucose regulation (Figure 2).

THE MEDICAL MARKERS OF URINALYSIS

Appearance

Analyzing the appearance of urine is an important first step in a urinalysis because changes in color, clarity, and odor can provide valuable clues about a person's overall health. Normal urine typically ranges from pale yellow to amber due to the presence of urochrome, a pigment formed by the breakdown of hemoglobin. Abnormal colors, such as red, brown, or green, may indicate the presence of blood, certain medications, or metabolic conditions. Similarly, urine clarity can reveal important information: clear urine is generally normal, while cloudiness may suggest the presence of cells, bacteria, or crystals. By carefully observing these physical characteristics, we can gather initial insights before conducting chemical or microscopic tests, making appearance analysis a critical step in understanding potential underlying health issues.

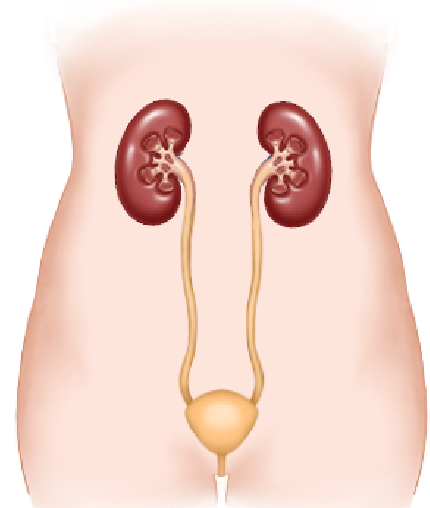


Figure 2: Overview of the urinary tract system, highlighting the kidneys and bladder.

Urobilinogen and Bilirubin

Urobilinogen and bilirubin are important indicators of liver function and overall health. Urobilinogen is formed in the intestines from the breakdown of bilirubin, a substance produced when red blood cells are degraded. Normally, small amounts of urobilinogen are present in urine, but elevated levels may indicate liver diseases such as hepatitis or conditions causing increased red blood cell breakdown, like hemolytic anemia. Bilirubin, on the other hand, is usually not found in urine; its presence may suggest liver dysfunction or obstruction of the bile ducts, which prevents bilirubin from being properly processed and excreted. Measuring these components in urine can help detect early signs of liver problems and related disorders.

Ketone

Ketones are substances produced when the body breaks down fat for energy instead of using glucose. Normally, only very small amounts of ketones are present in urine, but higher levels can occur during fasting, prolonged exercise, low-carbohydrate diets, or uncontrolled diabetes. In particular, significantly elevated ketones may indicate diabetic ketoacidosis, a potentially serious condition that requires medical attention. Testing for ketones in urine helps assess the body's metabolic state and can provide important information about energy balance and overall health.

Protein

Protein in urine, a condition known as proteinuria, can provide important information about kidney function and overall health. Normally, the kidneys filter waste while keeping essential proteins in the blood, so only very small amounts of protein are found in urine. Elevated protein levels may indicate conditions such as kidney disease, high blood pressure, diabetes, or urinary tract infections. Temporary proteinuria can also occur after intense exercise, dehydration, or stress. Testing for protein in urine is an important part of urinalysis because it can help detect early signs of kidney problems and guide further medical evaluation.

Nitrite

Nitrite in urine is an important indicator often used to screen for urinary tract infections (UTIs). Normally, urine does not contain nitrite. However, certain bacteria that cause UTIs can convert nitrate, a substance normally present in urine, into nitrite. When nitrite is detected, it may suggest the presence of these bacteria and a possible infection. Because not all bacteria produce nitrite, a negative result does not completely rule out a UTI. Testing for nitrite, especially when combined with other indicators like leukocytes, helps provide a more accurate assessment of urinary tract health.

Leukocytes (White Blood Cells)

Leukocytes, or white blood cells, in urine are an important indicator of the body's immune response to infection or inflammation in the urinary tract. Normally, urine contains little to no leukocytes. When elevated levels are detected, it may suggest a urinary tract infection (UTI), kidney infection, or other urinary tract inflammation. Leukocytes are often tested alongside nitrite levels, since the combination of both can provide a stronger indication of bacterial infection. However, leukocytes can also appear in urine without nitrite if the infection is caused by bacteria that do not produce nitrite. Testing for leukocytes helps identify potential infections and guides further evaluation or treatment.

Specific Gravity

Specific gravity measures the concentration of dissolved substances in urine and indicates how well the kidneys are balancing water and waste in the body. It reflects the kidneys' ability to balance water and solute levels in the body. Tracking specific gravity helps assess fluid balance and kidney function.

A high specific gravity (closer to 1.030) may occur during dehydration, or when excess substances like glucose or protein are in the urine (as seen in diabetes or kidney disease).

A low specific gravity (closer to 1.005) could suggest overhydration or kidney dysfunction, where the kidneys can't concentrate urine properly.

pH

Urine pH indicates how acidic or alkaline the urine is. The body normally maintains a urine pH between 4.5 and 8.0, depending on diet, hydration, and internal balance.

- A low pH (more acidic) can result from high-protein diets, diabetes, or starvation.
- A high pH (more alkaline) may suggest bacterial infections or kidney dysfunction.

Ascorbate

Ascorbate, also known as vitamin C, can appear in urine when the body excretes excess amounts that are not absorbed or used. Monitoring ascorbate levels in urine can provide insight into a person's vitamin C intake and overall nutritional status. High concentrations of urinary ascorbate may occur after supplementation or diets rich in vitamin C, while very low levels could indicate inadequate intake or increased metabolic demand. Additionally, the presence of ascorbate can sometimes interfere with certain urinalysis tests, particularly those that detect glucose or blood, leading to false-negative results. Understanding the role and impact of ascorbate in urine is therefore important both for nutritional assessment and for ensuring accurate interpretation of laboratory tests.

Calcium

Calcium is a vital mineral for bone and nerve function, but its presence in urine can signal a problem. Because calcium interacts with other markers like pH and uric acid, it's important not to assess it in isolation. Instead, it should be interpreted as part of a broader diagnostic picture.

- Elevated urinary calcium increases the risk of kidney stones, especially calcium oxalate or calcium phosphate types.
- It may also indicate hormonal imbalances, vitamin D overuse, or bone resorption disorders such as hyperparathyroidism.
- In people with chronic kidney disease, calcium loss in urine may worsen mineral balance and contribute to kidney calcification.

WHAT CAN URINALYSIS TELL US ABOUT DISEASE?

A common misconception is that a single abnormal test result directly points to a diagnosis. In reality, isolated values can be misleading. For example, multiple patients might have high calcium levels, but for different reasons. One might be forming kidney stones, another could be experiencing bone loss, and yet another might be overusing supplements.

That's why pattern recognition is the heart of urinalysis. It's not just about what markers are elevated, it's about how they appear together. Only by considering multiple markers in relation to each other can we uncover the true cause of a patient's symptoms.

Diabetes Mellitus

In people with uncontrolled diabetes, blood sugar levels become elevated, a condition known as hyperglycemia. The kidneys attempt to remove this excess glucose from the blood, which draws water along with it, leading to increased urine output (polyuria) and potential dehydration. At the same time, the body may start breaking down fat for energy due to insufficient insulin activity, producing ketones as metabolic byproducts.

Key Markers:

- Ketones: Indicate fat metabolism caused by insulin deficiency. High levels can signal diabetic ketoacidosis (DKA), a serious complication, especially in Type 1 diabetes.
- Specific Gravity: Often elevated due to dehydration from increased urination or the osmotic effect of glucose in urine, reflecting changes in kidney concentrating ability.
- Protein: May appear as proteinuria when diabetes begins to damage the kidney's filtering units (glomeruli), signaling early diabetic nephropathy.
- Glucose: Though not always tested in standard urinalysis panels, its presence in urine (glucosuria) directly reflects hyperglycemia and insufficient insulin action. The absence of insulin in those experiencing diabetic complications can be a result of overhydration to to excessive thirst or frequently needing to urinate causing the bladder to empty.

What it may mean:

These urinalysis findings can suggest Type 1 or Type 2 diabetes, particularly if ketones are present. Over time, persistent hyperglycemia can lead to long-term complications, including kidney damage, neuropathy, and cardiovascular disease. Early recognition of these patterns is critical for preventing severe outcomes and initiating proper management, such as lifestyle changes, insulin therapy, or other medications.

Urinary Tract Infections (UTIs)

Urinary tract infections occur when bacteria, most commonly Escherichia coli, invade the urinary system, including the bladder, ureters, or kidneys (Figure 3). The infection triggers an immune response, leading to inflammation and the presence of white blood cells in the urine. UTIs can also cause changes in urine composition and appearance, which can be detected through urinalysis.

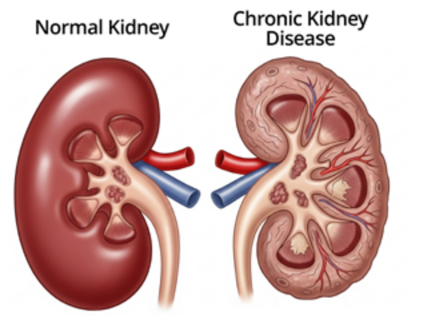


Figure 3:
Comparison of a normal kidney verses a kidney suffering from chronic kidney disease.

Key Markers:

- Leukocytes: White blood cells in urine (pyuria) indicate inflammation or infection in the urinary tract.
- Nitrites: Certain bacteria convert urinary nitrates to nitrites, so their presence suggests bacterial activity and infection.
- Protein: Mild proteinuria can appear due to inflammation in the urinary tract or kidneys.
- Specific Gravity: May be slightly altered due to changes in urine concentration from increased fluid intake or dehydration during infection.

What it may mean:
The presence of these markers together can strongly suggest a UTI, which may affect the bladder (cystitis) or kidneys (pyelonephritis) depending on severity. Early detection is important to prevent complications such as kidney damage or recurrent infections. Proper treatment usually involves antibiotics and increased hydration, and follow-up urinalysis can confirm resolution.

Kidney Stones (Nephrolithiasis)

Kidney stones are solid deposits that form when certain substances in the urine, such as calcium, oxalate, uric acid, or cystine, become highly concentrated and crystallize. These stones can obstruct urine flow, cause pain, and sometimes lead to infection or kidney damage. Urinalysis can provide important clues about stone formation and help identify underlying metabolic conditions that contribute to their development.

Key Markers:

- Calcium: Excess calcium in urine (hypercalciuria) increases the risk of calcium-based stones.
- Uric Acid: Elevated urinary uric acid can contribute to uric acid stone formation.
- Specific Gravity: High urine concentration favors crystal formation, so abnormal specific gravity may indicate dehydration or increased stone risk.
- pH: Urine pH influences stone type; acidic urine favors uric acid stones, while alkaline urine may promote calcium phosphate or struvite stones.
- Crystals: Microscopic examination can reveal crystals, helping predict stone composition.

What it may mean:
These findings suggest a predisposition to kidney stone formation and can help guide preventive strategies, such as increased hydration, dietary modifications, or medication to alter urine composition. Recurrent stones may indicate underlying metabolic disorders or chronic kidney issues.

Kidney Disease

The kidneys are vital organs that filter waste products from the blood while maintaining fluid, electrolyte, and acid-base balance. Their filtering units, the glomeruli, are particularly sensitive; when damaged, they can allow substances such as proteins or waste products to leak into the urine, signaling impaired kidney function.

Key markers in urinalysis include:

- Protein (proteinuria): Often the earliest sign of glomerular damage or strain, indicating that the kidneys' filtering capacity is compromised.
- Specific Gravity: Measures urine concentration; abnormal readings can reflect the kidneys' diminished ability to concentrate or dilute urine properly.
- Calcium: Excessive calcium in urine can precipitate as kidney stones or lead to nephrocalcinosis, further damaging renal tissue.

Clinical significance:
These markers can suggest chronic kidney disease (CKD), especially in individuals with risk factors like diabetes or hypertension. CKD is progressive, and without intervention, it can advance to end-stage renal disease, necessitating dialysis or kidney transplantation (Figure 4).

Connection to advanced therapies:
Emerging research in stem cell therapies holds promise for regenerating damaged kidney tissue. By transplanting healthy stem cells or stimulating endogenous repair mechanisms, it may be possible to restore glomerular function, reduce proteinuria, and improve overall renal performance. Linking urinalysis findings to stem cell-based interventions provides a framework for understanding both disease progression and potential regenerative treatments, illustrating the translational importance of basic lab experiments in informing cutting-edge therapies.

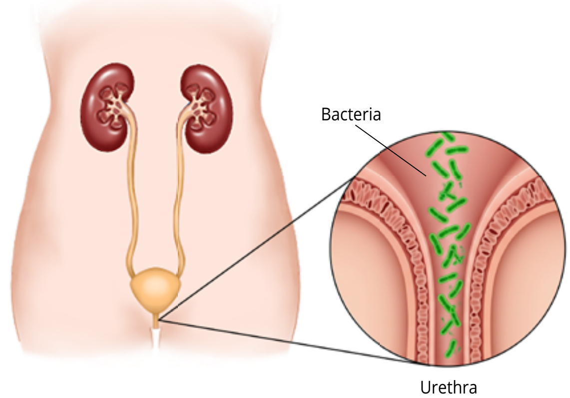


Figure 4:
Diagram of a urinary tract infection (UTI).

YOUR ROLE IN DIAGNOSIS AND TREATMENT

As you analyze urine samples in this investigation, your role goes beyond simply recording results—you are acting as a diagnostician, interpreting abnormal values and linking them to potential health conditions. Each marker in the urine, from protein and glucose to ketones, nitrites, or calcium, provides critical insight into the body's metabolic, renal, or infectious status. In real-world medicine, healthcare providers rely on this type of data to make informed decisions, such as prescribing antibiotics for a urinary tract infection, recommending dietary modifications or increased hydration to prevent kidney stones, or adjusting insulin and medication regimens in diabetes management.

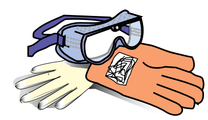
Your analysis also emphasizes the importance of pattern recognition and context: a single abnormal value may suggest a transient issue, while consistent changes over time can indicate a chronic condition requiring intervention. After an initial diagnosis, you'll track each patient's progress longitudinally, observing how their bodies respond to the treatments you recommend. This mirrors real clinical practice, where continuous monitoring allows healthcare teams to refine treatment plans, prevent complications, and improve outcomes. By engaging in this investigative process, you gain hands-on experience in critical thinking, data interpretation, and patient-centered care—all essential skills in medical and research settings.

Experiment Overview

EXPERIMENT OBJECTIVE:

Students will perform simulated urinalysis on synthetic urine samples to identify potential medical conditions from five different patients. They will then evaluate follow-up patient data to assess the effectiveness of treatment plans, gaining experience in diagnostic reasoning, laboratory interpretation, and clinical decision-making.

LABORATORY SAFETY



Wear gloves and safety goggles

1. Gloves and goggles should be worn routinely as good laboratory practice.
2. DO NOT MOUTH PIPET REAGENTS - USE PIPET PUMPS.
3. Exercise caution when using any electrical equipment in the laboratory.
4. Always wash hands thoroughly with soap and water after handling reagents or biological materials in the laboratory.

LABORATORY NOTEBOOKS:

This experiment involves recognizing patterns, providing diagnoses, and discussing treatment options for patients. Address and record the following in your laboratory notebook or on a separate worksheet.

Before starting the experiment during Module I (Introduction):

- Write a hypothesis related to the patient and what you expect to learn from this experiment.
- Predict the possible outcomes based on your understanding of how urine composition can reflect health.

During the experiment:

- Record your observations carefully. Include drawings, measurements, color changes, or any other visible results.
- Take photos of your results for reference.

After completing the experiment during Module III (Observations and Diagnosis):

- Use your results to explain what they reveal about urine composition and health indicators.
- Consider what you might change in the procedure if you were to repeat the experiment to improve accuracy or explore new questions.

Module I: Introduction

The following patients have arrived with the following symptoms. Based on their symptoms, write your initial thoughts regarding their symptoms.

PATIENT #1:	**Sophia R.** – Fatigue and Dizziness
Age:	15
Sex:	Female
Chief Complaint:	"I've been feeling weak and tired all the time. No matter how much I eat, I never feel full. I've been really thirsty lately, drinking water all day but still feeling dehydrated."
Present Illness:	Symptoms started gradually 2–4 weeks ago. Patient reports polydipsia (excessive thirst), polyuria (frequent urination), polyphagia (increased hunger), fatigue, and unexplained weight loss of ~5-10 pounds. Occasionally experiences blurred vision and mild dizziness. No history of recent illness or medication changes.
Medical History:	No known chronic illnesses. Up to date on vaccinations. No previous episodes of hyperglycemia.
Medications:	None

What are your initial thoughts on Sophia's condition?

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PATIENT #2:	**Marissa L.** – Burning Sensation While Urinating
Age:	35
Sex:	Female
Chief Complaint:	"I've been having a burning sensation when I urinate and feel like I have to go all the time. It's especially bothersome at night, and sometimes I feel mild pressure in my lower abdomen."
Present Illness:	Symptoms started 3-4 days ago. Patient reports dysuria (burning with urination), urgency, and frequency, sometimes waking at night to urinate (nocturia). Mild lower abdominal discomfort is noted. Denies fever, chills, or flank pain at this time. No recent antibiotic use.
Medical History:	Generally healthy; no known kidney problems. History of occasional UTIs in the past.
Medications:	Occasionally takes ibuprofen for headaches.

What are your initial thoughts on Marissa's condition?

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Patient #3:	**Talia N.** – Persistent High Blood Pressure and Back Pain
Age:	10
Sex:	Female
Chief Complaint:	"Lately, I've been having a weird ache in my lower back. My urine is darker than usual, though my mom thought it might be dehydration."
Present Illness:	Over the past few weeks, she has noticed an onset of dull lower back pain. She reports dark-colored urine, but denies pain or burning with urination. No recent fever, nausea, or urinary frequency. At her previous physical three months ago, Talia had elevated high blood pressure (hypertension).

Module I: Introduction, continued

Medical History:	Elevated blood pressure; Mother diagnosed with polycystic kidney disease (PKD).
Medications:	No prescribed medications.

What are your initial thoughts on Talia's condition?

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PATIENT #4:	**Tariq T.** – Sudden Flank Pain
Age:	28
Sex:	Male
Chief Complaint:	"About a few hours ago, I suddenly started having this really sharp, severe pain on my left side. It comes and goes, sometimes radiating toward my lower abdomen and groin. I also noticed my urine looks reddish and cloudy, and it's making me worried. The pain seems worse when I move or after I work out, and I just can't seem to get comfortable."
Present Illness:	Patient reports acute onset of sharp, intermittent pain in the left flank that began a few hours ago. The pain radiates toward the lower abdomen and groin. He notes reddish, cloudy urine but denies burning with urination or fever. He reports that the pain worsens after physical activity.
Medical History:	Generally healthy, no chronic conditions reported. No prior history of kidney stones or urinary tract infections.
Medications:	Protein Supplements. No prescribed medications.

What are your initial thoughts on Tariq's condition?

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PATIENT #5:	**Carlos M.** – Increased Thirst and Fatigue
Age:	65
Sex:	Male
Chief Complaint:	"I'm always thirsty no matter how much I drink, and I've been feeling really exhausted all the time. I keep waking up two, three, even four times a night just to use the bathroom. Lately, my vision has been blurry, my feet feel numb, and I've also noticed I lost about five pounds in the last month without trying."
Present Illness:	Carlos has a 12-year history of Type 2 diabetes, but admits he hasn't been consistently checking his blood sugar. Over the past few weeks, he's experienced persistent fatigue, polydipsia (excessive thirst), and nocturia (frequent nighttime urination). He reports blurry vision and unintentional weight loss of approximately 5 pounds in the past month. No nausea, vomiting, or signs of infection reported.
Medical History:	Type 2 diabetes diagnosed 12 years ago.
Medications:	Metformin (Missed many doses)

What are your initial thoughts on Carlos' condition?

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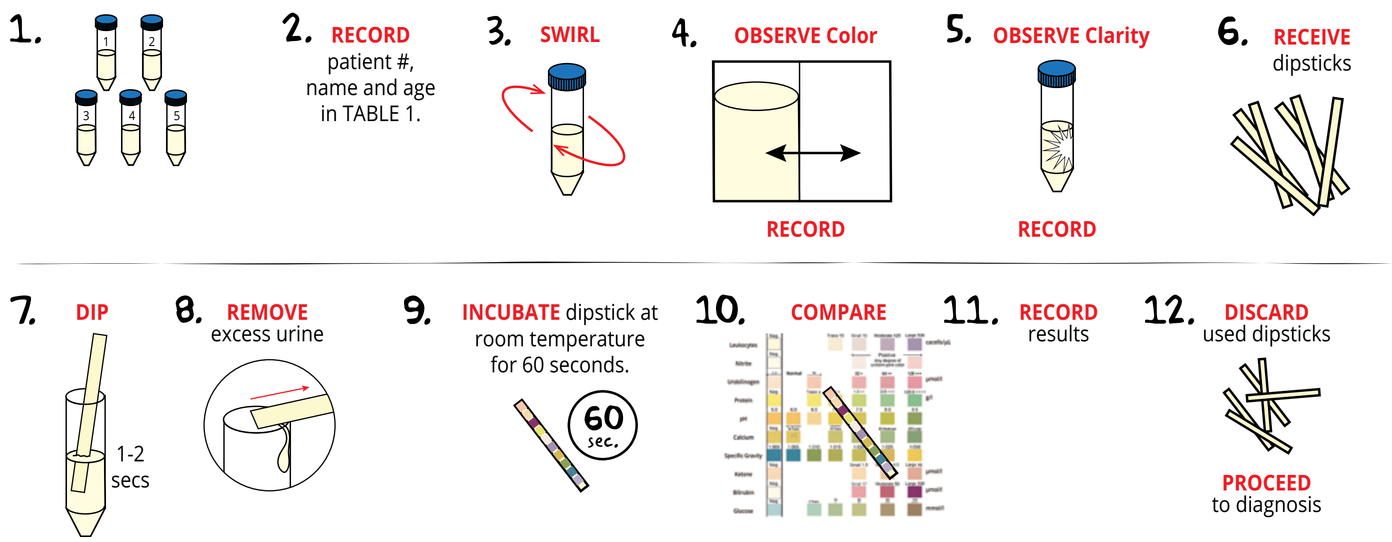
Module II-A: Macroanalysis of Urine



1. **RECEIVE** five 15 mL conical tubes from your instructor containing Patients #1 through #5.
2. **RECORD** the patient #, name, and age in Table 1 on page 13.
3. **SWIRL** each cup gently to ensure the sample is well-mixed.
4. **OBSERVE** the color of the urine against a white background and **RECORD** in the "Color" column.
5. **OBSERVE** the clarity (clear, slightly cloudy, cloudy, or turbid) and **RECORD** in the "Clarity" column.
6. **RECEIVE** a urinalysis dipstick for each patient sample, including the Control Urine Sample.
7. **DIP** the reagent pads of the strip fully into the urine sample for 1–2 seconds.
8. **REMOVE** the strip and **DRAW** it across the rim of the cup to remove excess urine.
9. **INCUBATE** dipstick at room temperature for 60 seconds.
10. **REFERENCE** Chart 1 to **COMPARE** the dipstick analysis results for each test.
11. **RECORD** the results for the following characteristics in Table 1 on page 13: Calcium, Ascorbate, pH, Specific Gravity, Leukocytes, Nitrite, Protein, Ketone, Bilirubin, Urobilinogen.
12. **DISCARD** used dipsticks in the biohazard container and **PROCEED** to the diagnosis steps.

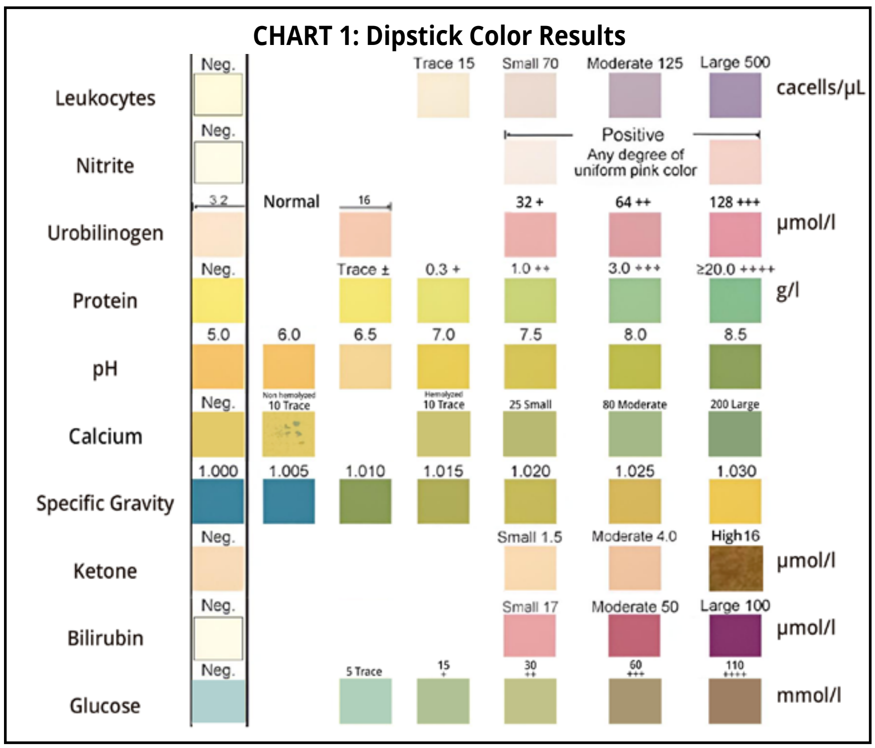
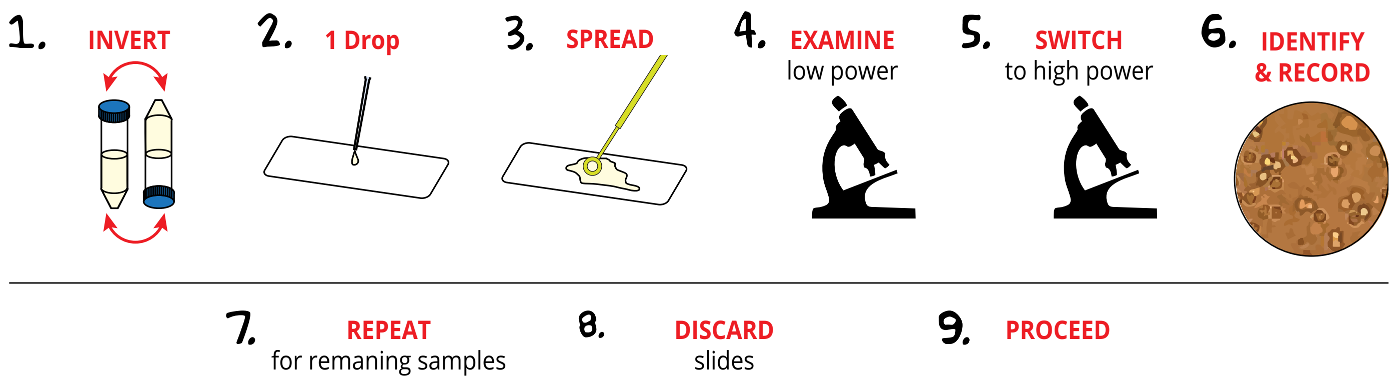


TABLE 1: Macroanalysis Data Table

Patient #	Name	Age	Color	Clarity	Leukocytes	Nitrite	Ubrobiliongen (µmol/L)	Protein (g/L)	pH	Calcium	Specific Gravity	Ketone (µmol/L)	Bilirubin (µmol/L)	Glucose (mmol/L)
1														
2														
3														
4														
5														

Module II-B: Microanalysis of Urine

In this activity, you will use patient urine samples from Module II to examine the sediment under a microscope for white blood cells (WBCs) and urinary crystals. WBCs appear as small, round cells slightly larger than red blood cells and may look grainy, indicating infection or inflammation. Crystals, on the other hand, show distinct geometric shapes depending on type, such as calcium oxalate appearing like envelopes, or uric acid forming rhomboids or rosettes, often suggesting kidney stones. Both WBCs and crystals may be present in the same sample, highlighting conditions like infection and stone formation together. Whereas some patients may have nothing discernable underneath a microscope. By recognizing these structures, you will see how microscopic findings provide important diagnostic clues.



1. **INVERT** the simulated urine sample to suspend the particles (WBCs, crystals).
2. **USE** a small transfer pipet provided by your instructor to place one drop of the sample on a clean microscope slide.
3. **USE** an inoculating loop provided by your instructor to spread the sample throughout the microscope slide.
4. **EXAMINE** the slide under low power to locate areas of interest.
5. **SWITCH** to high power to observe and count cells.
6. **IDENTIFY** and **RECORD** in Table 2: Macroanalysis Data Table whether the following are present in your sample:
    a. White Blood Cells (WBCs)
    b. Crystals
7. **REPEAT** for the remaining patient samples.
8. **DISCARD** the slides.
9. **PROCEED** to the following module.

TABLE 2: Microanalysis Data Table

Patient #	Name	WBCs	Crystals
1	Sophia R.		
2	Marrissa L.		
3	Talia N.		
4	Tariq T.		
5	Carlos M.		

Module III: Observations and Diagnosis

1. **REVIEW** your recorded dipstick and microscopic results from Module II and for each patient.

2. **COMPARE** the measured values for each parameter (Color, Clarity, Ubrobiliongen, Bilirubin, Ketone, Protein, Nitrite, Leukocytes, Specific Gravity, pH, Ascorbate, Calcium) to the provided "Control Urine Values" reference chart.

3. **IDENTIFY** any parameters that fall outside of the normal range.

4. **LIST** at least one possible diagnosis for each patient based on their combined dipstick results, visual observations, and provided patient history (age, name, and symptoms from Module I),

5. **RECOMMEND** a treatment plan or next diagnostic step for each patient. Include:
   a. Suggested medical follow-up or specialist referral
   b. Possible lifestyle changes (diet, hydration, activity)
   c. Any relevant preventative measures

6. **RECORD** your diagnosis and recommended plan in the "Diagnosis" and "Treatment" columns in Table 3.

Module III: Observations and Diagnosis, continued

TABLE 3: Diagnosis and Treatment Plan

Patient #	Name	Diagnosis	Treatment
1	Sophia R. (15)		
2	Marissa L. (35)		
3	Talia N. (10)		
4	Tariq T. (28)		
5	Carlos M. (65)		

Study Questions

1. What is urinalysis, and what kinds of information can it provide about a person's health?
2. In a longitudinal study, urine samples are collected repeatedly from the same person. How does this approach help reduce the effects of random variation or temporary changes (e.g., diet, hydration)?
3. Why is urine often used in health studies instead of blood samples?
4. What role do longitudinal urinalysis studies play in evaluating the effectiveness of interventions (e.g., antihypertensive drugs or dietary changes) in slowing the progression of Chronic Kidney Disease?
5. What ethical considerations should researchers keep in mind when designing longitudinal studies that track personal health data, such as urinalysis results?

Instructor's Guide

NOTES TO THE INSTRUCTOR

This lab is designed for ten lab groups. Class size, length of laboratory sessions, and availability of equipment are factors which must be considered in the planning and the implementation of this experiment with your students. These guidelines can be adapted to fit your specific set of circumstances.

Safety Data Sheets can be found on our website: www.edvotek.com/safety-data-sheets

OVERVIEW OF INSTRUCTOR'S PRELAB PREPARATIONS

This section outlines the recommended prelab preparations and approximate time requirement to complete each lab activity.

PREPARATION FOR:	WHAT TO DO:	WHEN?	TIME REQUIRED:
MODULE II: Macro and Microanalysis of Urine	Aliquot Urine Samples and Dipsticks	Anytime before the experiment. Cover and store at room temp.	20 min.
	Prepare Microscopic Analysis	Anytime before the experiment.	10 min.

Red = Prepare immediately before module. Yellow = Prepare shortly before module. Green = Flexible / prepare up to a week before module.

Pre-Lab Preparations: Module II

Module II-A: Preparing Urine Samples

FOR MODULE II
Each Student Group should receive:

5 Patient Urine Samples
5 Dipsticks
5 Microscope slides
5 Inoculating loops
5 Transfer pipets

1. **RETRIEVE** the five bottles of the simulated urine samples for Patients 1-5. For each bottle, place it in a separate container and add 55 mL of distilled water to each.
2. **ADD** 200 µL of pH Additive (Component F) to the Patient 2 sample mixture. **SWIRL** to mix.
3. **RETRIEVE** the vial of Calcium Additive (Component G). **CENTRIFUGE** the tube to collect contents at the bottom. **ADD** 5 µL of calcium additive to the Patient 4 sample mixture. **SWIRL** to mix. ***NOTE: This vial contains a small amount of liquid. Centrifuging will help ensure none is missed.***
4. **LABEL** five sets of 15 mL conical tubes clearly as Patient #1 through Patient #5.
5. **MEASURE** 10 mL of urine sample into each tube.
6. **DISTRIBUTE** the prepared samples and five dipsticks to students. **ENSURE** each student group receives one full set of Patient #1–5.
7. **STORE** all urine samples in the refrigerator until needed.

Module II-B: Preparation for Microscopic Analysis

1. **DISTRIBUTE** five microscope slides, five inoculating loops, and five small transfer pipets to each group.
2. **ENSURE** all student groups will have access to a microscope to examine the urine samples.

Experiment Results and Analysis

MODULE I

- **What are your initial thoughts on Sophia's condition?**

Sophia's fatigue, dizziness, increased thirst, and decreased appetite could suggest an issue related to blood sugar regulation, such as early-onset diabetes. Her clear, pale urine may indicate increased urination due to excess glucose.

- **What are your initial thoughts on Marissa's condition?**

Marissa's burning during urination, frequent urges to use the bathroom, cloudy urine, and strong odor suggest a urinary tract infection (UTI) or possibly a sexually transmitted infection (STI). Mild abdominal pain supports irritation or infection of the urinary tract.

- **What are your initial thoughts on Talia's condition?**

Talia's family history of kidney disease, dark urine, and new back pain raise concerns about possible kidney involvement, such as chronic kidney disease or polycystic kidney disease. Dehydration could contribute to the dark urine, but due to her young age, her symptoms and family history suggest testing kidney function through urinalysis, imaging, and blood work would be highly important.

- **What are your initial thoughts on Tariq's condition?**

Tariq's severe, intermittent flank pain, reddish cloudy urine, high-protein diet, and low water intake suggest possible kidney stones. The reddish urine could be due to blood from irritation as a stone passes.

- **What are your initial thoughts on Carlos' condition?**

Carlos' long-standing diabetes, increased thirst, fatigue, frequent urination, and recent weight loss point toward poorly controlled blood sugar or possible hyperglycemia. His clear urine and missed medication doses support this. There may also be a risk of diabetes-related complications, so checking blood glucose and kidney function would be important.

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Experiment Results and Analysis, continued

MODULE II-A

Patient #	Name	Age	Color	Clarity	Leukocytes	Nitrite	Ubrobiliongen (µmol/L)	Protein (g/L)	pH	Calcium	Specific Gravity	Ketone (µmol/L)	Bilirubin (µmol/L)	Glucose (mmol/L)
1	Sophia R.	15	Pale Yellow	Clear	Neg.	Neg.	Normal	Neg.	5.5-6	Neg.	1.020	Neg.	Neg.	110
2	Marissa L.	35	Yellow	Clear	Neg.	Positive	Normal	Neg..	8-8.5	Neg.	1.015	Neg.	Neg.	Neg.
3	Talia N.	10	Dark Yellow/Amber	Clear	Neg.	Neg.	Normal	20.0	6-6.5	Neg.	1.020	Neg.	Neg.	Neg.
4	Tariq T.	28	Reddish	Cloudy	Neg.	Neg.	Normal	Neg.	5-5.5	Moderate	1.015	Neg.	Neg.	Neg.
5	Carlos M.	65	Almost Clear	Clear	Neg.	Neg.	Normal	Trace	5.5-6	Neg.	1.020	High	Neg.	Neg.

MODULE II-B

Patient #	Name	WBCs	Crystals
1	Sophia R.	No	No
2	Marrissa L.	Yes	No
3	Talia N.	No	No
4	Tariq T.	Yes	Yes
5	Carlos M.	No	No

Experiment Results and Analysis, continued

MODULE III

Patient #	Name	Diagnosis	Treatment
1	Sophia R. (15)	Possible early-onset Type 1 diabetes or hypoglycemia due to her fatigue, dizziness, increased thirst, and decreased appetite.	Order blood glucose testing. If abnormal, refer for diabetes screening and management.
2	Marissa L. (35)	Likely urinary tract infection (UTI) based on burning urination, cloudy urine, strong odor, and frequent urination.	Urinalysis and urine culture. Prescribe appropriate antibiotics if bacterial infection confirmed. Increase fluid intake.
3	Talia N. (10)	Possible chronic kidney disease or polycystic kidney disease, given family history, dark urine, and back pain.	Kidney function tests, imaging (ultrasound), and ongoing blood pressure management.
4	Tariq T. (28)	Likely kidney stones due to sudden flank pain, reddish cloudy urine, high-protein diet, and low water intake.	Imaging to confirm stones. Encourage increased water intake, prescribe pain relief, and possibly stone-dissolving treatment or urology referral if stones are large.
5	Carlos M. (65)	Likely poorly controlled Type 2 diabetes with possible early diabetic complications, given increased thirst, fatigue, frequent urination, missed meds, and weight loss.	Check blood glucose and HbA1c levels. Reinforce medication adherence, adjust dosage if needed, recommend dietary changes, and monitor for complications.

Please refer to the kit insert for the Answers to Study Questions

Additional Activity

For further learning into Talia's condition, students can connect two different laboratory experiments: a urine screening and a blood typing test. **EDVO-Kit #146**, Matchmakers in Medicine: Kidney Transplant Compatibility. Together, these activities model the kinds of investigations that doctors might use when evaluating a patient with polycystic kidney disease.

The urine screening experiment helps students model how doctors would investigate her symptoms. By analyzing simulated urine samples, students look for abnormalities such as the presence of protein. Proteinuria often occurs when kidney filters are damaged, as in PKD, and serves as a critical warning sign of declining kidney health. In Talia's case, these results could suggest that her symptoms are linked to her family history and that her kidneys may not be functioning properly.

The blood typing experiment shifts focus to the challenges Talia would face if she ultimately needs a transplant. Determining her ABO and Rh blood type is one of the first steps in identifying potential donors. Blood type testing ensures that her immune system will not immediately reject a transplanted kidney. If her type is compatible with a family member or community donor, this would guide the next stages of screening, including tissue typing and crossmatching.

By using Talia as the patient for both activities, students can see how different tests connect in the bigger picture of kidney disease and transplantation. Urine testing shows whether the kidneys are healthy enough to do their job, while blood typing highlights how donor and recipient must be immunologically compatible. Together, these experiments give students a realistic picture of how clinicians begin evaluating patients with kidney disease and prepare for the possibility of transplantation.