

Objectives

1. Conduct a urinalysis to determine whether unknown simulated urine samples contain glucose or protein.
2. Identify the kidney structures and functions while performing dissection of a pig's kidney.
3. Explain the filtrate pathway from the nephron until it reaches the outside of the body.

Anatomy of the Urinary System

The urinary system consists of two kidneys, two ureters, a urinary bladder, and the urethra. The ureters connect the kidneys to the bladder. Urine is formed in the kidneys and is then transported to the bladder by the ureters. From the bladder, urine travels through the urethra to be excreted.

Macroscopic View of the Kidney

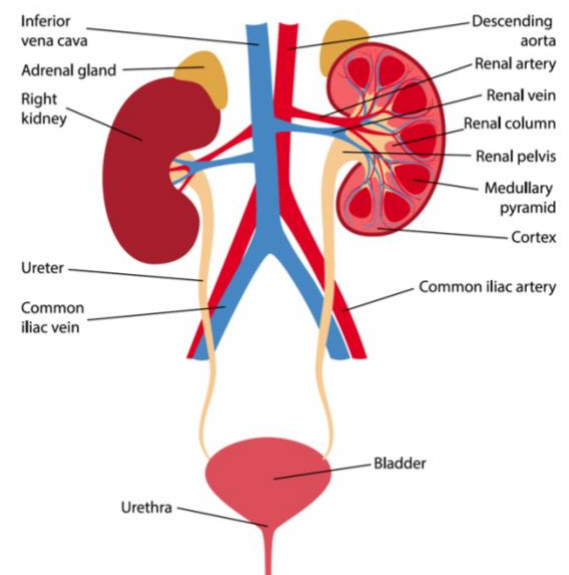
The kidney is divided into the cortex and the medulla. The **cortex** is the outer layer of the kidney while the **medulla** is the inner region. The cortex contains the **renal corpuscles** (glomerulus and Bowman's capsule) and parts of the **renal tubules**. The medulla is divided into sections called **renal pyramids**. These pyramids contain the **loops of Henle** as well as the **collecting ducts**. These collecting ducts drain to the **minor calyces** and then **major calyces**, which drain to the **renal pelvis** which then takes urine into the **ureter**.

Microscopic Anatomy of Kidney

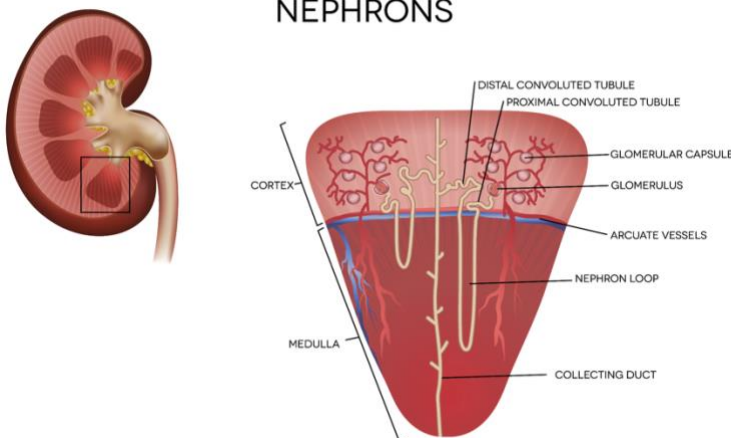
The functional units of the kidney are nephrons.

Nephrons are found in the renal pyramids of the kidney. The function of the nephron is to filter blood and form urine. This is the urine that then travels to the collecting ducts into the ureters and then the bladder. From the bladder they pass through the urethra before reaching the outside of the body.

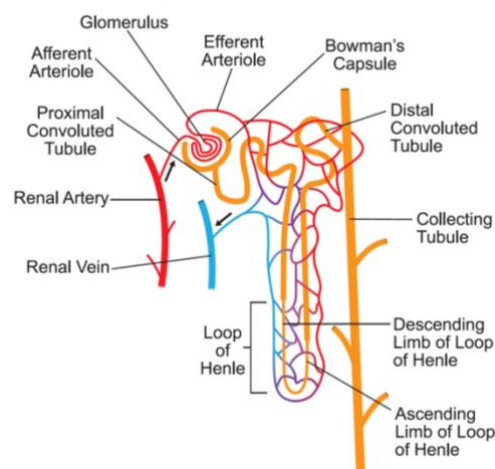
Anatomy of the urinary system



NEPHRONS



Nephron Structure



Activity 1: Urinalysis

In this activity, we will do an analysis of the chemical properties of urine. Specifically, we will be conducting two tests to look for the presence of glucose and proteins in a set of unknown urine solutions. In addition, we will test the pH of these urine samples.

YOU SHOULD BE WEARING SAFETY GOGGLES AND GLOVES AT ALL TIMES DURING THIS ACTIVITY.

Procedures:

A. Benedict's Test for Glucose:

1. Obtain 4 test tubes and label them P₀, P₁, P₂, and P₃.
 2. Fill an empty 250 mL beaker halfway with water.
 3. Heat the beaker with a hot plate until boiling. **REDUCE THE HEAT** once it starts to boil.
 4. Add 1 mL of the different urine solutions to their corresponding test tubes labeled P₀, P₁, P₂, and P₃.
 5. Now add 1 mL (about 20 drops) of Benedict's reagent to each test tube. Note the color change, if any.
 6. Place all four test tubes in the beaker with boiling water and leave them for 2-5 minutes. Note any color changes as the samples are being heated.
 7. Using the test tube tongs remove the test tubes from the beaker and note any color changes. A positive result for glucose is cloudy orange and a negative is transparent blue (The cloudier the orange, the higher the concentration of glucose).
- ** When looking at urine directly (without Benedict's Reagent), a positive test is cloudy yellow, and a negative test is a transparent yellow.

B. Biuret's Test for Proteins:

1. Obtain 2 test tubes and label them P₄ and P₅.
2. Add 1 mL of the unknown urine sample, P₄, into the test tube labeled P₄.
3. Add 1 mL of the unknown urine sample, P₅, into the test tube labeled P₅.
4. Now add 1 mL (about 20 drops) of Biuret reagent to each test tube.
5. Note the color change. A positive test for protein is violet. The higher the concentration of protein, the stronger the color. The reagent is blue in color and will remain blue if no proteins are present.

C. pH test:

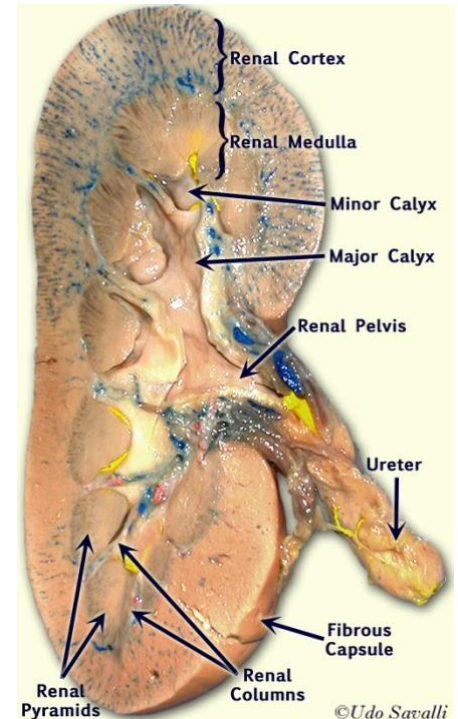
For this test, you will be examining the pH of the unknown simulated urine samples. You will need to determine if these urine samples are acidic, neutral, or basic in nature.

1. Once given instruction by your TA, place one drop of each of the simulated urine solutions onto its own respective pH strip.
2. You will compare these results with a known acid and base.
3. Examine the color of the pH strips and discuss the results with your group members

Activity 2: Pig Kidney Dissection

Procedures:

- Examine the outside of the kidney and identify the ureter, renal artery, and renal vein, if they are present. The ureter, renal artery, and renal vein all enter/exit the kidney in the same area, specifically at the *renal hilum*. The ureter can be identified by the larger amount of fat tissue that is usually attached to it. When comparing the renal artery versus the renal vein, remember that arteries have a thicker muscular wall in comparison to veins.
- Identify the structures as seen in the picture above.
- When you have finished using the kidney, dispose of it in the biohazard waste. Clean all your equipment thoroughly with soap and water and return it to your table. Clean up your work area. All group members are responsible for clean-up.



Activity 3: Filtrate Pathway

Using the terms in the table below, list them in the order in which filtrate/urine will pass through until it reaches the outside.

Connecting Tubule	Collecting Duct	Renal Pelvis
Major Calyx	Renal Papilla	Ureter
Urethra**	Minor Calyx	Urinary Bladder
Proximal convoluted tubule	Loop of Henle	Distal convoluted tubule

***It is important to know that men have a very long urethra that is divided into **three** compartments, while women only have one, since it is shorter. Men have a **prostatic**, **membranous**, and **spongy urethra**.*

Order	Structure
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	