

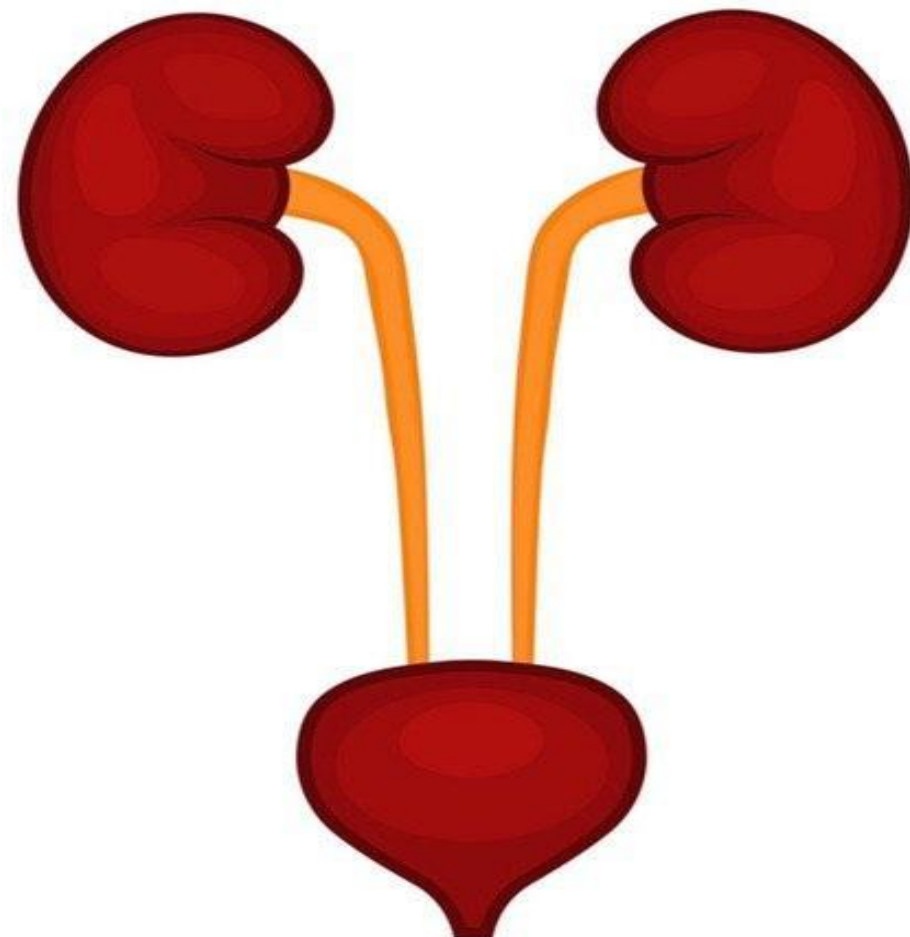


structure and function of urinary system

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Urinary system

The urinary system plays a major role in the elimination of waste from the body. In addition to removing waste products from the blood, the kidneys perform the vital function of regulating the volume and chemical composition of blood by selectively adjusting the amounts of water and electrolytes in the body. Whereas some substances are eliminated into the urine, other needed substances are retained in the bloodstream.

When the blood passes through the kidneys, waste products such as urea, uric acid, and creatinine are filtered out—whereas appropriate amounts of water and other dissolved substances (solutes) are reabsorbed into the bloodstream. Excess amounts of water and solutes are excreted as urine. This filtering-reabsorption process is necessary to maintain the balance of substances required for a relatively stable internal body environment. This stable internal body environment is known as homeostasis (home/o same; stasis control), and is necessary for the cells of the body to survive and carry out their functions effectively.

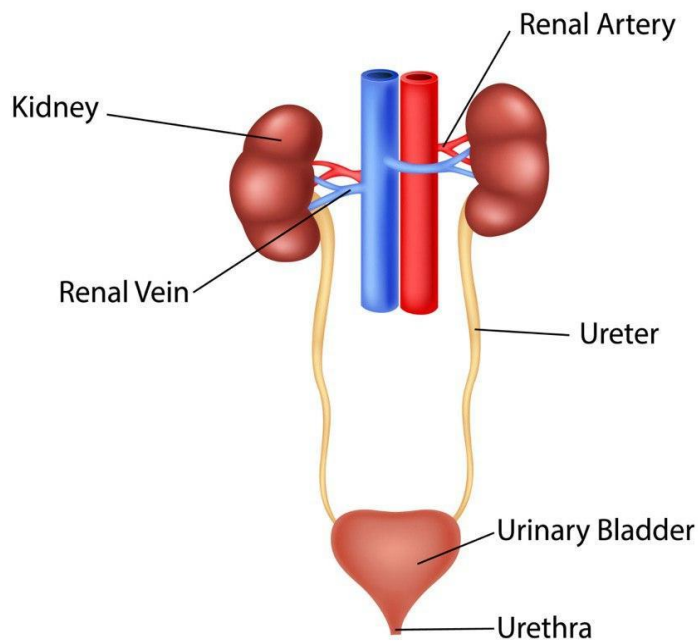
If the kidneys fail, there is no way the substances they excrete can be eliminated from the body. Consequently, the substances accumulate in the blood to toxic (poisonous) levels, upsetting the internal environment of the body to the point that the cells can no longer function. Death will ultimately follow unless the nonfunctioning kidney is replaced with a healthy kidney through kidney transplant, or unless the impurities are filtered out of the blood by means of an artificial kidney known as kidney dialysis..

In addition to producing and eliminating urine, the kidneys act as endocrine glands by secreting substances into the bloodstream that produce specific effects on the body. Erythropoietin (EPO), a hormone that stimulates the production of red blood cells within the bone marrow, is produced by the kidneys. Renin, an enzyme that aids in raising the blood pressure by causing the constriction of blood vessels, is also produced by the kidneys.

The urinary system is composed of the :

- **kidneys**
- **ureters**
- **urinary bladder**
- **urethra**

Urinary System



Kidneys

The kidneys are reddish-brown bean-shaped organs located on either side of the vertebral column at the back of the upper abdominal cavity. The kidneys lie retroperitoneal (behind) the peritoneal membrane, resting between the muscles of the back and the peritoneal cavity.

If you place your hand just above your waistline on your back, to either side of your spine, you will be touching the general vicinity of the kidneys within the abdominal cavity.

Each kidney is surrounded by a thick cushion of fatty tissues (adipose tissue), which is covered with a fibrous connective tissue layer. These tissue layers offer protection and support to the kidney and anchor it to the body wall. The adult kidney measures approximately 4 inches (10 cm) long, 2.2 inches (5.5 cm) wide, and 1.2 inches (3 cm) thick—weighing approximately 5.5 ounces (150 g). The size of the adult kidney varies little with differences in body build and weight.

The outer layer, or cortex, of the kidney contains millions of microscopic units called nephrons. The nephrons are the functional units of the kidneys, carrying on the essential work of forming urine by the process of filtration, reabsorption, and secretion. Each nephron consists of (1) a glomerulus (a ball-shaped collection of very tiny, coiled, and intertwined capillaries), (2) a renal capsule, or Bowman's capsule (a double-walled cup surrounding the glomerulus), (3) the renal tubule, and (4) the peritubular capillaries. The first portion of the renal tubule is called the proximal convoluted (coiled) tubule. The second portion is called the loop of Henle. The third portion is called the distal convoluted tubule, which empties into the collecting tubule and leads to the inner portion of the kidney.

The inner region, or medulla, of the kidney consists of triangular tissues called renal pyramids. The pyramids contain the loops and collecting tubules of the nephron. The tip of each pyramid extends into a cuplike urine collection cavity called the minor calyx, with several of the minor calyces merging to form a major calyx. The major calyces, in turn, merge to form the central collecting area of the kidney (known as the renal pelvis). The urine secreted by the nephrons finally collects in this basin-like structure before entering the ureters.

The kidneys also maintain a proper balance of electrolytes, water, and acids within body fluids. Electrolytes, such as sodium (Na^+), potassium (K^+), and calcium (Ca^+), are important to muscle and nerve function. When the level of these electrolytes is too high, the kidney secretes them into the urine. When the body needs these products, they are held back in the body fluid. The kidneys help regulate blood pressure and aid in red blood cell production. The kidneys then form urine, which is fluid containing water and dissolved substances.

Ureter

Attached to each kidney is a ureter, a muscular tubes lined with mucous membrane (usually 16 to 18 centimeters long) that transports urine from the renal pelvis to the urinary bladder. The two ureters are made up of three layers of tissue—smooth muscle, fibrous tissue, and a mucous layer. Peristalsis, a rhythmic contraction of the smooth muscle, helps to move urine into the urinary bladder. The paths taken by the ureters in men and women are somewhat different because of variations in the nature, size, and position of the reproductive organs.

Bladder

The urinary bladder is a hollow, muscular organ that stores urine until it is ready to be excreted from the body. Bladder is a general term meaning a receptacle. Urine is pumped into the bladder every few seconds. The sphincter muscles, muscles that encircle a duct to contract or expand the duct, hold the urine in place. Control of urination has to be taught to young children (usually between the ages of one and three), while in adults it is usually easily controlled. The bladder can hold from 300 to 400 milliliters of urine before emptying. The bladder's walls contain epithelial tissue that can stretch and allow the bladder to hold twice as much as it does when normally full. The walls also contain three layers of muscle that help in the emptying process. The base of the bladder contains a triangular area, the trigone, where the ureters enter the bladder and the urethra exits it. The bladder lies between the pubic symphysis and the rectum in men. In women, the bladder lies between the pubic symphysis and the uterus and vagina. The urinary bladder stores the urine until a sufficient volume causes an increase in pressure and triggers the urge to urinate via the micturition reflex. The micturition reflex is a contraction of the walls of the urinary bladder and relaxation of the urethral sphincter in response to the rise in urinary bladder pressure.

Urethra

The urine exits the bladder through the urethra. The urethra is a mucous membrane-lined tube that leads from the bladder to the exterior of the body. The external opening of the urethra is called the urinary meatus. The external sphincter, located below the neck of the bladder, controls the release of urine from the bladder. When the sphincter contracts, it closes the urethra and sends a message to the bladder to relax (releasing no urine). To void, or urinate, the sphincter relaxes and sends a message to the bladder to contract (opening the bladder neck and releasing urine from the body).

The female urethra carries only urine and is approximately 1 to 2 inches (3 to 5 cm) long. The male urethra is approximately 7 to 8 inches (18 to 20 cm) long, and serves both the urinary and male reproductive systems. It transports urine and carries semen during ejaculation.

Urine Production in the Kidney

Inside each kidney, there are approximately one million nephrons (NEF-ronz). These microscopic structures are responsible for filtering the blood and producing urine. Start at the glomerulus (gloh-MER-yoo-luss), the first part of the nephron. It filters the blood of waste products and unnecessary nutrients. The filtered blood continues through the blood vessels returning to the heart. The unwanted material combines with water to form urine. The urine travels the length of the nephron and is excreted through the collecting ducts, ureters, and urethra to the outside of the body. Notice the blood vessels around the nephron. These are called the peritubular capillaries. The close proximity of the vessels to the nephron allows waste products and nutrients to move easily between the two.

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