

# [The urinary system essay](https://assignbuster.com/the-urinary-system-essay/)

The Urinary System is a group of organs in the body concerned with filtering out excess fluid and other substances from the bloodstream. The substances are filtered out from the body in the form of urine.

Urine is a liquid produced by the kidneys, collected in the bladder and excreted through the urethra. Urine is used to extract excess minerals or vitamins as well as blood corpuscles from the body. The Urinary organs include the kidneys, ureters, bladder, and urethra. The Urinary system works with the other systems of the body to help maintain homeostasis. The kidneys are the main organs of homeostasis because they maintain the acid base balance and the water salt balance of the blood. One of the major functions of the Urinary system is the process of excretion.

Excretion is the process of eliminating, from an organism, waste products of metabolism and other materials that are of no use. The urinary system maintains an appropriate fluid volume by regulating the amount of water that is excreted in the urine. Other aspects of its function include regulating the concentrations of various electrolytes in the body fluids and maintaining normal pH of the blood. Several body organs carry out excretion, but the kidneys are the most important excretory organ. The primary function of the kidneys is to maintain a stable internal environment (homeostasis) for optimal cell and tissue metabolism. They do this by separating urea, mineral salts, toxins, and other waste products from the blood.

They also do the job of conserving water, salts, and electrolytes. At least one kidney must function properly for life to be maintained. Six important roles of the kidneys are regulation of plasma ionic composition, regulation of plasma osmolarity, regulation of plasma volume, regulation of plasma hydrogen ion concentration (pH), removal of metabolic waste products and foreign substances from the plasma, and secretion of hormones. The kidneys are a pair of bean shaped, reddish brown organs about the size of your fist.

It measures 10-12 cm long. They are covered by the renal capsule, which is a tough capsule of fibrous connective tissue. Adhering to the surface of each kidney is two layers of fat to help cushion them. There is a concaved side of the kidney that has a depression where a renal artery enters, and a renal vein and a ureter exit the kidney. The kidneys are located at the rear wall of the abdominal cavity just above the waistline, and are protected by the ribcage. They are considered retroperitoneal, which means they lie behind the peritoneum.

The ureters are two tubes that drain urine from the kidneys to the bladder. Each ureter is a muscular tube about 10 inches (25 cm) long. Muscles in the walls of the ureters send the urine in small spurts into the bladder, (a collapsible sac found on the forward part of the cavity of the bony pelvis that allows temporary storage of urine). After the urine enters the bladder from the ureters, small folds in the bladder mucosa act like valves preventing backward flow of the urine. The outlet of the bladder is controlled by a sphincter muscle. A full bladder stimulates sensory nerves in the bladder wall that relax the sphincter and allow release of the urine.

However, relaxation of the sphincter is also in part a learned response under voluntary control. The released urine enters the urethra. The urinary bladder is a hollow, muscular and distensible or elastic organ that sits on the pelvic floor (superior to the prostate in males). On its anterior border lies the pubic symphysis and, on its posterior border, the vagina (in females) and rectum (in males).

The urinary bladder can hold approximately 17 to 18 ounces (500 to 530 ml) of urine; however the desire to micturate is usually experienced when it contains about 150 to 200 ml. When the bladder fills with urine (about half full), stretch receptors send nerve impulses to the spinal cord, which then sends a reflex nerve impulse back to the sphincter (muscular valve) at the neck of the bladder, causing it to relax and allow the flow of urine into the urethra. The Internal urethral sphincter is involuntary. The ureters enter the bladder diagonally from its dorsolateral floor in an area called the trigone.

The trigone is a triangular shaped area on the postero-inferior wall of the bladder. The urethra exits at the lowest point of the triangle of the trigone. The urine in the bladder also helps regulate body temperature. If the bladder becomes completely void of fluid, it causes the patient to chill.

The urethra is a muscular tube that connects the bladder with the outside of the body. The function of the urethra is to remove urine from the body. It measures about 1. 5 inches (3. 8 cm) in a woman but up to 8 inches (20 cm) in a man.

In the human female, the urethra is about 1-2 inches long and opens in the vulva between the clitoris and the vaginal opening. In the human male, the urethra is about 8 inches long and opens at the end of the head of the penis. Men have a longer urethra than women. This means that women tend to be more susceptible to infections of the bladder (cystitis) and the urinary tract.

The functional unit of the kidney is the nephron. It contains a glomerular (Bowman’s) capsule, a cup-shaped structure that surrounds a glomerulus (group of capillaries). Together, the glomerular capsule and glomerulus form a unit called the renal corpuscle. Attached to the Bowman’s capsule is a long, twisting renal tubule that has four parts: the proximal convoluted tubule, the loop of Henle, the distal convoluted tubule, and a collecting duct.

Filtration of the blood occurs in the renal corpuscle between the Bowman’s capsule and glomerulus. In this nonselective process, fluid and tiny particles in the glomerulus pass from the blood into the Bowman’s capsule and renal tubules. The liquid substance within the renal tubules is filtrate. Blood reaches the kidney through the renal arteries, a branch of the aorta. The path from the renal artery to the glomerulus runs as follows: lobar artery, interlobar artery, arcuate artery, interlobular artery, and afferent arterioles. “ Afferent” means that the arteriole is carrying blood toward the glomerulus.

Small openings called fenestrations fill the capillaries that make up the glomerulus. Fenestrations allow tiny particles and water to pass into the filtrate. Surrounding the glomerulus are cells called podocytes. The interlocking pedicels (foot processes) of these cells surround the capillaries to form the filtration barrier. This barrier prevents the passage of blood cells, platelets, and protein molecules into the filtrate. Seven types of matter are small enough to pass through the filtration barrier: blood plasma (the liquid part of blood), glucose, amino acids, potassium, sodium, chloride, and urea (nitrogenous waste).

Some materials in filtrate are needed to maintain homeostasis (a stable internal environment); the reabsorption process returns these materials to the bloodstream. Reabsorption begins after blood leaves the glomerulus through the efferent arteriole. “ Efferent” means that the arteriole is carrying blood away from the glomerulus. The efferent arteriole forms a peritubular capillary bed that envelops the renal tubule.

As the peritubular capillaries pass near the renal tubule, useful substances in the filtrate such as glucose, vitamins, amino acids, water, and ions are reabsorbed into the bloodstream. Urine, the fluid that enters the collecting duct, passes to the urinary bladder through the ureters. Antidiuretic hormone (ADH) and aldosterone control how much urine the body produces. If the body becomes dehydrated, the pituitary gland releases ADH. This hormone reduces urine volume by causing the collecting tubules to allow more water to be reabsorbed into the bloodstream. If too much fluid is in the body, the pituitary gland stops releasing ADH and the excess water passes out of the body as dilute urine.

Aldosterone enhances sodium reabsorption, which increases water reabsorption into the blood from the collecting tubules. Because of the effect of aldosterone on the collecting tubules, the amount of water excreted in the urine decreases and blood volume and blood pressure increase. Endocrine cells in the kidneys produce the hormone erythropoietin, which controls erythrocyte production. The adrenal glands are located in the retroperitoneum situated atop the kidneys, one on each side.

Each adrenal gland is separated into two distinct structures, the adrenal cortex and medulla, both of which produce hormones. The cortex mainly produces cortisol, aldosterone, and androgens, while the medulla chiefly produces epinephrine and norepinephrine. When blood volume is low, the kidneys secrete renin. Renin stimulates the production of angiotensin. Angiotensin causes blood vessels to constrict, resulting in increased blood pressure. Angiotensin also stimulates the secretion of the hormone aldosterone from the adrenal cortex.

Aldosterone causes the tubules of the kidneys to increase the reabsorption of sodium and water into the blood. This increases the volume of fluid in the body, which also increases blood pressure. If the renin-angiotensin-aldosterone system is too active, blood pressure will be too high. ADH is a peptide hormone that controls the reabsorption of molecules in the tubules of the kidneys by affecting the tissue’s permeability. It plays a key role in homeostasis, and the regulation of water, glucose, and salts in the blood. It is derived from a preprohormone precursor that is synthesized in the hypothalamus and stored in vesicles at the posterior pituitary.

Most of it is stored in the posterior pituitary to be released into the bloodstream; however, some AVP is also released directly into the brain. One of the most important roles of AVP is to regulate the body’s retention of water; it is released when the body is dehydrated and causes the kidneys to conserve water, thus concentrating the urine, and reducing urine volume. In high concentrations, it also raises blood pressure by inducing moderate vasoconstriction. ANF is a powerful vasodilator, and a protein (polypeptide) hormone secreted by heart muscle cells. It dilates the afferent glomerular arteriole, constricts the efferent glomerular arteriole, and relaxes the mesangial cells. This increases pressure in the glomerular capillaries, thus increasing the glomerular filtration rate (GFR), resulting in greater excretion of sodium and water.

ANF increases blood flow through the vasa recta which will wash the solutes (NaCl and urea) out of the medullary interstitium. The lower osmolarity of the medullary interstitum leads to less reabsorption of tubular fluid and increased excretion. It decreases sodium reabsorption in the distal convoluted tubule and cortical collecting duct of the nephron via guanosine 3′, 5′-cyclic monophosphate (cGMP) dependent phosphorylation of ENaC. ANF also inhibits renin secretion, thereby inhibiting the renin-angiotensin system, and reduces aldosterone secretion by the adrenal cortex. Erythropoietin (EPO) is a hormone produced by the kidney that promotes the formation of red blood cells in the bone marrow.

EPO is a glycoprotein (a protein with a sugar attached to it). Human EPO has a molecular weight of 34, 000. The kidney cells that make EPO are specialized and are sensitive to low oxygen levels in the blood. These cells release EPO when the oxygen level is low in the kidney. EPO then stimulates the bone marrow to produce more red cells and thereby increase the oxygen-carrying capacity of the blood.

Calcitriol is 1, 25[OH]2 Vitamin D3, the active form of vitamin D. It is derived from calciferol (vitamin D3) which is synthesized in skin exposed to the ultraviolet rays of the sun precursors (“ vitamin D”) ingested in the diet. Calciferol in the blood is converted into the active vitamin in two steps: calciferol is converted in the liver into 25[OH] vitamin D3 this is carried to the kidneys (bound to a serum globulin) where it is converted into calcitriol. This final step is promoted by the parathyroid hormone (PTH).