Chapter 17 Urinary System

Urinary System:
The urinary system consists of two _____ that filter the blood, two _____, a urinary _____, and a _____ to convey waste substances to the outside.

Kidney Structure:
The kidney is a reddish brown, _____- shaped organ 12 centimeters long; it is enclosed in a tough, fibrous _____.
The kidneys are positioned behind the serous membrane called the _____.
A medial depression in the kidney leads to a hollow renal _____ into which blood vessels, nerves, lymphatic vessels, and the ureter enter.
Inside this space lies a basin called the renal _____ that is subdivided into tubes called major and minor _____.
Two distinct regions are found within the kidney: an inner renal _____ and an outer renal _____.

Kidney Function:
The kidneys function to regulate the volume, _____, and pH of body fluids and remove _____ wastes from the blood in the process.
The kidneys also help control the rate of _____ blood cell formation by secreting erythropoietin, and regulate _____ by secreting renin.

Kidney Blood Vessels:
The abdominal aorta gives rise to _____ arteries leading to the kidneys.
As these arteries pass into the kidneys, they branch into successively smaller arteries: _____ arteries, _____ arteries, interlobular arteries, and finally _____ arterioles leading to the nephrons.
Venous blood is returned through a series of vessels that generally correspond to the arterial pathways.

Nephron Structure:
A kidney contains about one million nephrons, each of which consists of a renal _____ and a renal _____.

Renal corpuscle:
What two structures make this up?

What are their functions?

What blood vessel leads into the corpuscle?

Which vessel takes blood away from it?

Renal tubule:
What three sections comprise the renal tubule?

What structure does the last section empty into?

Juxtaglomerular apparatus:

At the point of contact between the afferent and efferent arterioles and the distal convoluted tubule, the epithelial cells of the distal tubule form the _____.

Near this area on the afferent arteriole are smooth muscle cells called _____ cells.

These two structures together form the juxtaglomerular apparatus.

Path of filtrate/urine:

Starts with glomerulus, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, to outside the body.

Renal blood vessels:

Renal artery → → → _____, _____, _____, _____,

→ → _____ back to vena cavae.

Formation of Urine:

There are three processes, filtration, tubular reabsorption and tubular secretion.

Filtration:

Where does it occur?

The main force responsible for moving substances by filtration through the glomerular capillary wall is the _____ pressure of the blood inside.

Due to plasma proteins, _____ pressure of the blood resists filtration, as does _____ pressure inside the glomerular capsule.

Filtration Rate:

The factors that affect the filtration rate are filtration pressure, glomerular plasma osmotic pressure, and hydrostatic pressure in the glomerular capsule.

When the afferent arteriole _____ in response to sympathetic stimulation, filtration pressure, and thus filtration rate, _____.

When the efferent arteriole constricts, filtration pressure increases, _____ the rate of filtration.

When osmotic pressure of the glomerular plasma is high, filtration rate _____.

When hydrostatic pressure inside the glomerular capsule is high, filtration rate _____.

On the average, filtration rate is 125 milliliters per minute or 180 liters in 24 hours, most of which is reabsorbed further down the nephron.

Glomerular filtration rate is relatively constant, although sympathetic impulses may _____ the rate of filtration.

Another control over filtration rate is the renin-angiotensin system, which regulates _____ excretion.

When the sodium chloride concentration in the tubular fluid decreases, the macula densa senses these changes and causes the juxtaglomerular cells to secrete _____.

This secretion triggers a series of reactions leading to the production of _____, which acts as a vasoconstrictor; this may, in turn, affect filtration rate.

The heart can also increase filtration rate when blood volume is high.

Tubular reabsorption:

Because the only selective mechanism in filtration is the size of the substances, a more careful sorting must be done before urine can be excreted. Much of this is accomplished through the processes of tubular reabsorption.

Most of the reabsorption occurs in the _____ convoluted tubule, where cells possess microvilli with _____ proteins.

These proteins have a limited transport capacity, so excessive amounts of a substance will be excreted into the urine.

Glucose and amino acids are reabsorbed by _____ _____, water by _____, and proteins by _____.

Sodium ions are reabsorbed by _____ _____, and negatively charged ions follow passively. As sodium is reabsorbed, _____ follows by osmosis.

Regulation of Urine Concentration and Volume:

Most of the sodium ions are reabsorbed before the urine is excreted, and sodium is concentrated in the renal medulla by the _____ mechanism.

Normally the distal convoluted tubule and collecting duct are impermeable to water unless the hormone _____ is present.

Urea and Uric Acid Excretion:

Urea is a by-product of _____ metabolism; uric acid is a by-product of _____ metabolism.

How are they reabsorbed?

Tubular secretion:

Tubular secretion transports certain substances from the plasma into the _____ _____. _____ _____ mechanisms move excess hydrogen ions into the renal tubule along with various organic compounds.

_____ ions are secreted both actively and passively into the distal convoluted tubule and the collecting duct.

Study Analogy:

Pretend you are cleaning your garage but the big door is stuck. You can only move things through the smaller "people" door. So the cars and riding lawn mower have to stay in the garage. This is analogous to the pores in the glomerulus. They are larger than ordinary capillary pores but still not large enough to let everything out. So large things like proteins stay in the blood. You have decided to haul almost everything out that you can fit through the smaller door. Out goes the hoses, garden implements, lawn chemicals recycling etc., without any sorting. You do this until you run out of energy. (Filtration — what fits goes through filters and it is controlled by size and the pressures.) After a short rest, you realize that you need some of this stuff. So you exert some more energy (active transport!) and put some of the materials back into the garage. For example, 13 of the 27 hoses are still good so they go back (like tubular reabsorption!!) The others are put out for the trash pickup (analogous to going to the bladder). After sorting, returning and discarding, you take one last look at what is now in the garage. Do you really need 13 hoses? Isn't that one a little holey? So you take it back out of the garage and put it in the trash pile with the others. (Just like tubular secretion, a last chance to excrete something we don't need.) And Wow! Now your garage (and your blood) are clean!

Urine:
What substances are found in normal urine?

Ureter:
The ureters are muscular tubes extending from the kidneys to the base of the _____ _____.
The wall of the ureter is composed of three layers, what are they?

Muscular _____ waves convey urine to the _____ _____ where it passes through a flaplike valve in the mucous membrane.

Urinary bladder:
The urinary bladder is a hollow, distensible, muscular organ lying in the _____ cavity.
The internal floor of the bladder includes the triangular shaped _____, which is composed of the openings of the two ureters and the urethra.
The wall of the urinary bladder is made up of four coats: inner _____ coat, _____ coat, _____ coat made up of _____ muscle, and outer _____ coat.
The portion of the muscle that surrounds the neck of the bladder forms an _____ _____ muscle.
There is also a voluntary sphincter, the _____ sphincter.

Micturition:
Urine leaves the bladder by the micturation reflex.
The _____ muscle contracts and the external urethral sphincter must also relax.
Stretching of the urinary bladder triggers the micturation reflex center located in the sacral portion of the _____ _____.
Return parasympathetic impulses cause the muscle to contract in waves, and an urge to urinate is sensed.
When these contractions become strong enough, the _____ _____ sphincter is forced open.
The _____ _____ _____ is composed of skeletal muscle and is under conscious control.

Urethra:
The urethra is a tube that conveys urine from the urinary bladder to the _____.
It has two sphincters. What are they called?

Which one is voluntary and which is involuntary?