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**Question: write a short note on the characteristics (and components) of urine**

### **1. Color**

The color of urine is determined mostly by the breakdown products of red blood cell destruction. The "heme" of hemoglobin is converted by the liver into water-soluble forms that can be excreted into the bile and indirectly into the urine. This yellow pigment is urochrome. Urine color may also be affected by certain foods like beets, berries, and fava beans, and certain medications. Dehydration produces darker, concentrated urine.

### **2. Specific gravity**

Specific gravity is an easy way to estimate the osmolality of a urine sample. The specific gravity of urine is a ratio of the density of a urine specimen to water. The density of water is 1.000 g/ml. Because urine samples always contain solutes, even a urine sample that is very pale in color will have a density that is slightly higher than water. The urine sample of a dehydrated person will be darker in color, and will have a density that is substantially higher than water, as it will contain a great deal of solutes. As a result, the specific gravity of a well-hydrated individual's urine will be roughly 1.003, whereas the specific gravity of a dehydrated individual's urine will be closer to 1.032.

### **3. Odor**

Fresh urine often has very little odor. Most of the ammonia produced from protein breakdown is converted into urea by the liver, so ammonia is rarely detected in fresh urine. The strong ammonia odor you may detect in bathrooms or alleys is due to the breakdown of urea into ammonia by bacteria in the environment. About one in five people detect a distinctive odor in their urine after consuming asparagus; other foods

such as onions, garlic, and fish can impart their own aromas! These food-caused odors are harmless.

#### 4. pH

The pH (hydrogen ion concentration) of the urine can vary more than 1000-fold, from a normal low of 4.5 to a maximum of 8.0. A urine specimen is typically slightly acidic with a pH of roughly 6.0, but pH can vary substantially with an individual's diet. Individuals who consume a lot of meat and protein will tend to have a more acidic urine specimen (pH below 6.0). Individuals with diets low in protein and high in fruits and vegetables (such as vegan diets) will tend to have an alkaline urine specimen (pH above 7.0). Ideally, urine should be acidic, as a lower pH will limit bacterial growth and urinary tract infections.

#### 5. Urine volume

Urine volume varies considerably. The normal range is one to two liters per day. The kidneys must produce a minimum urine volume of about 500 mL/day to rid the body of wastes. Output below this level may be caused by severe dehydration or renal disease and is termed oliguria. The virtual absence of urine production is termed anuria. Excessive urine production is polyuria.

### Components of the Urinary System

The urinary system consists of the kidneys, ureters, urinary bladder, and urethra. The kidneys form the urine and account for the other functions attributed to the urinary system. The ureters carry the urine away from kidneys to the urinary bladder, which is a temporary reservoir for the urine. The urethra is a tubular structure that carries the urine from the urinary bladder to the outside.

- **Kidneys:** The kidneys are the primary organs of the urinary system. The kidneys are the organs that filter the blood, remove the wastes, and excrete the wastes in the urine. They are the organs that perform the functions of the urinary system. The other components are accessory structures to eliminate the urine from the body.

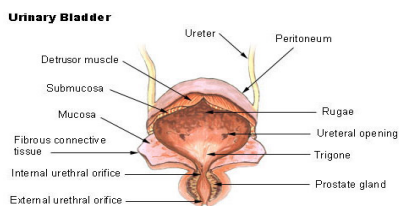
The paired kidneys are located between the twelfth thoracic and third lumbar vertebrae, one on each side of the vertebral column. The right kidney usually is slightly lower than the left because the liver displaces it downward. The kidneys, protected by the lower ribs, lie in shallow depressions against the posterior abdominal wall and behind the parietal peritoneum. This means they are retroperitoneal. Each kidney is held in place by connective tissue, called renal fascia, and is surrounded by a thick layer of adipose tissue, called perirenal fat, which helps to protect it. A tough, fibrous, connective tissue renal capsule closely envelopes each kidney and provides support for the soft tissue that is inside.

In the adult, each kidney is approximately 3 cm thick, 6 cm wide, and 12 cm long. It is roughly bean-shaped with an indentation, called the hilum, on the medial side. The hilum leads to a large cavity, called the renal sinus, within the kidney. The ureter and renal vein leave the kidney, and the renal artery enters the kidney at the hilum.

- **Ureters:** Each ureter is a small tube, about 25 cm long, which carries urine from the renal pelvis to the urinary bladder. It descends from the renal pelvis, along the posterior abdominal wall, which is behind the parietal peritoneum, and enters the urinary bladder on the posterior inferior surface. The wall of the ureter consists of three layers. The outer layer, the fibrous coat, is a supporting layer of fibrous connective tissue. The middle layer, the muscular coat, consists of the inner circular and outer longitudinal smooth muscle. The main function of this layer is peristalsis: to propel the urine. The inner layer, the mucosa, is transitional epithelium that is continuous with the lining of the renal pelvis and the urinary bladder. This layer secretes mucus, which coats and protects the surface of the cells.
- **Urinary Bladder:** The urinary bladder is a temporary storage reservoir for urine. It is located in the pelvic cavity, posterior to the symphysis pubis, and below the parietal peritoneum. The size and shape of the urinary bladder varies with the amount of urine it contains and with the pressure it receives from surrounding organs.

The inner lining of the urinary bladder is a mucous membrane of transitional epithelium that is continuous with that in the ureters. When the bladder is empty, the mucosa has numerous folds called rugae. The rugae and transitional epithelium allow the bladder to expand as it fills.

The second layer in the walls is the submucosa, which supports the mucous membrane. It is composed of connective tissue with elastic fibers. The next layer is the muscularis, which is composed of smooth muscle. The smooth muscle fibers are interwoven in all directions and, collectively, these are called the detrusor muscle. Contraction of this muscle expels urine from the bladder. On the superior surface, the outer layer of the bladder wall is parietal peritoneum. In all other regions, the outer layer is fibrous connective tissue.



There is a triangular area, called the trigone, formed by three openings in the floor of the urinary bladder. Two of the openings are from the ureters and form the base of the trigone. Small flaps of mucosa cover these openings and act as valves that allow urine to enter the bladder but prevent it from backing up from the bladder into the ureters. The third opening, at the apex of the trigone, is the opening into the urethra. A band of the detrusor muscle encircles this opening to form the internal urethral sphincter.

- **Urethra:** The final passageway for the flow of urine is the urethra, a thin-walled tube that conveys urine from the floor of the urinary bladder to the outside. The opening to the outside is the external urethral orifice. The mucosal lining of the urethra is transitional epithelium. The wall also contains smooth muscle fibers and is supported by connective tissue.

The internal urethral sphincter surrounds the beginning of the urethra, where it leaves the urinary bladder. This sphincter is smooth (involuntary) muscle. Another sphincter, the external urethral sphincter, is skeletal (voluntary) muscle

and encircles the urethra where it goes through the pelvic floor. These two sphincters control the flow of urine through the urethra.

In females, the urethra is short, only 3 to 4 cm (about 1.5 inches) long. The external urethral orifice opens to the outside just anterior to the opening for the vagina.

In males, the urethra is much longer, about 20 cm (7 to 8 inches) in length, and transports both urine and semen. The first part, next to the urinary bladder, passes through the prostate gland and is called the prostatic urethra. The second part, a short region that penetrates the pelvic floor and enters the penis, is called the membranous urethra. The third part, the spongy urethra, is the longest region. This portion of the urethra extends the entire length of the penis, and the external urethral orifice opens to the outside at the tip of the penis.