

**Background Information**

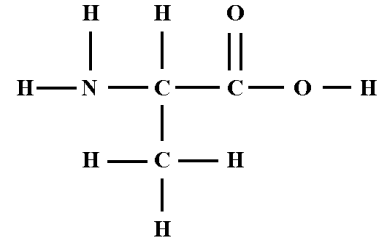
In humans, waste materials from the cells diffuse into the blood. As the blood circulates through the body, four different organs remove the wastes. The four organs of excretion are the **liver, kidneys, lungs, and skin**.

**Liver**

The liver removes worn-out red blood cells and excess amino acids from the blood and breaks them down. Iron compounds and bile are produced from the breakdown of the hemoglobin of the red cells. The iron is reused by the body. The bile is stored temporarily in the gallbladder. It then passes into the small intestine where it aids in the breakdown of fats. Most of the bile is eventually eliminated from the body with the other indigestible wastes of the digestive system.

Excess amino acids entering the liver are broken down by a process called **deamination**. This separates the nonamino portion of the molecule from its amino group. The nonamino portion may be used in the synthesis of carbohydrates or fats or further oxidized for energy through cellular respiration. The amino group,  $\text{NH}_2$ , combines with a hydrogen atom to form **ammonia**,  $\text{NH}_3$ . Then, through a series of enzyme-controlled reactions, the ammonia is quickly converted to **urea**, which is less toxic to the cells than ammonia. Urea is carried from the liver to the kidneys by the blood and is excreted from the body in the form of urine. The reaction to form urea looks like this:  $2 \text{NH}_3 + \text{CO}_2 \rightarrow (\text{NH}_2)_2\text{CO} + \text{H}_2\text{O}$

1. What happens to worn-out red blood cells in the liver?
2. The structural formula at the right is an example of one of the 20 amino acids that form our proteins. Circle the atoms that will be removed by deamination and converted into ammonia by the liver.



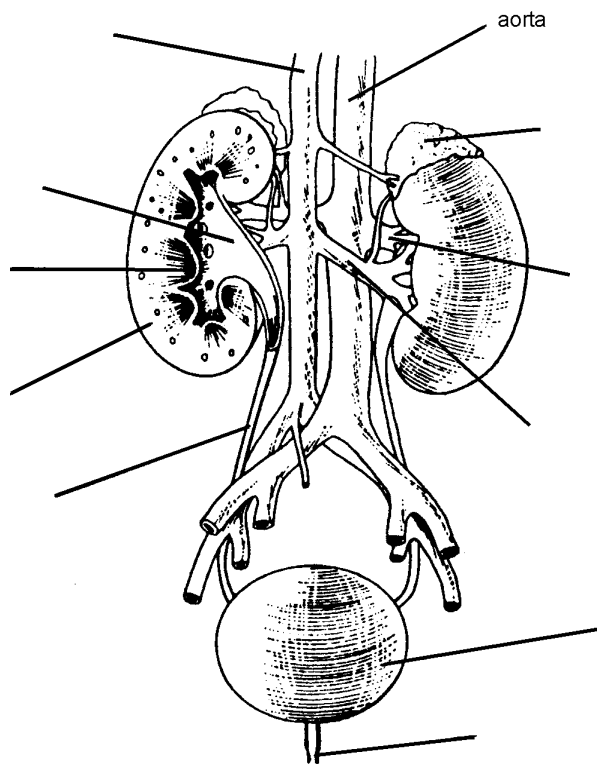
3. What happens to excess amino acids in the liver?
4. What nitrogenous waste passes from the liver to the urinary system?
5. Create a flow pattern similar to a food chain that shows what happens to excess amino acids in our body. Fill in the blanks below.

Amino acids  $\rightarrow$  \_\_\_\_\_  $\rightarrow$  \_\_\_\_\_  $\rightarrow$  \_\_\_\_\_ which is excreted in urine.

## Urinary System

The urinary system consists of the kidneys and associated structures - the **ureters**, **bladder**, and **urethra**. The renal arteries, which branch off the aorta, carry blood to the kidneys, which filter out urea, salts, and water. These substances form the urine which passes from the kidneys into the ureter, a tube leading to the urinary bladder. The urine is stored temporarily in the bladder, and then excreted from the body through the urethra.

1. What structures make up the urinary system in humans?
2. Which blood would be the cleanest - the blood of the renal artery or renal vein?
3. Label the parts of the urinary system indicated on the drawing below.



4. The urinary system is involved with what nitrogenous waste product?

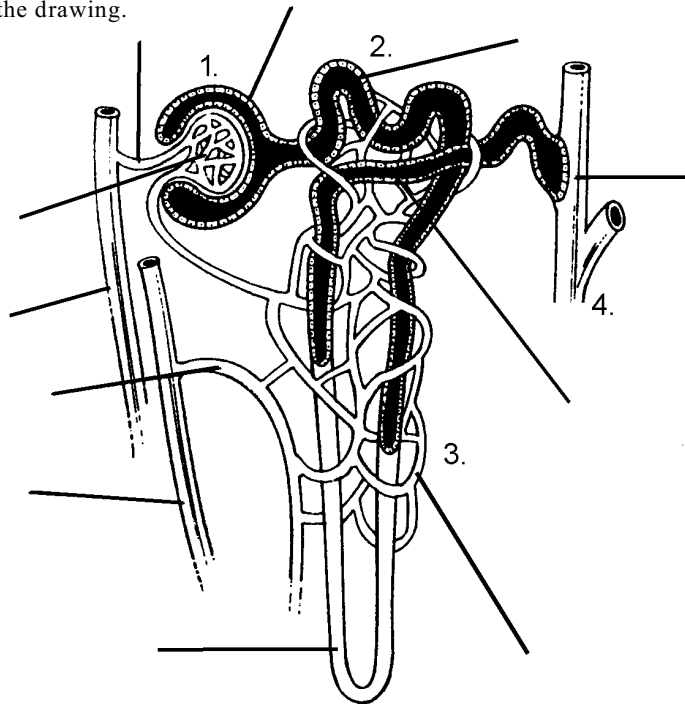
## Kidneys

The kidney is divided into two distinct regions. The outermost region is the **renal cortex**, which consists of filtering structures called **nephrons**. The inner region, the **renal medulla**, consists of collecting ducts and the loops of Henle. The beginning of the ureter is called the **renal pelvis**, where urine is drained from all of the collecting ducts. The urine then trickles down the ureter and into the urinary bladder.

The **nephron** is the basic filtration unit of the kidney. Each kidney has over one million nephrons. A nephron begins with an arteriole that leads into a cup-shaped structure called **Bowman's capsule**. Within the capsule, the arteriole divides, forming a ball of capillaries called the **glomerulus**. The blood in the glomerulus is under high pressure which causes small molecules to be forced out of the blood and into the Bowman's capsule. The fluid is called filtrate and will contain both good and bad substances. Water, salts, minerals, sugar, amino acids, urea and vitamins are commonly found in the filtrate.

From Bowman's capsule the filtrate passes into the **proximal convoluted tubule** where most of the amino acids and glucose are reabsorbed into the blood. As the filtrate travels down the **loop of Henle**, most of the water is drawn from the filtrate and returns to the capillaries that are tightly wrapped around the loop of Henle. The kidneys require a constant supply of ATP because the process of reabsorbing some of the substances requires active transport. The filtrate then moves up the loop of Henle and into the **distal convoluted tubule** where reabsorption of some minerals and salts occurs. The remaining filtrate will pass into collecting ducts and then drain from the kidney as **urine**. While blood is circulating through the capillaries that surround the nephron, the body may secrete certain substances into the filtrate, like acids, bile salts, penicillin, and histamines. Secretion is the opposite process as reabsorption.

1. The two layers of the kidney are the \_\_\_\_\_ and \_\_\_\_\_.
2. Label the parts indicated on the drawing.

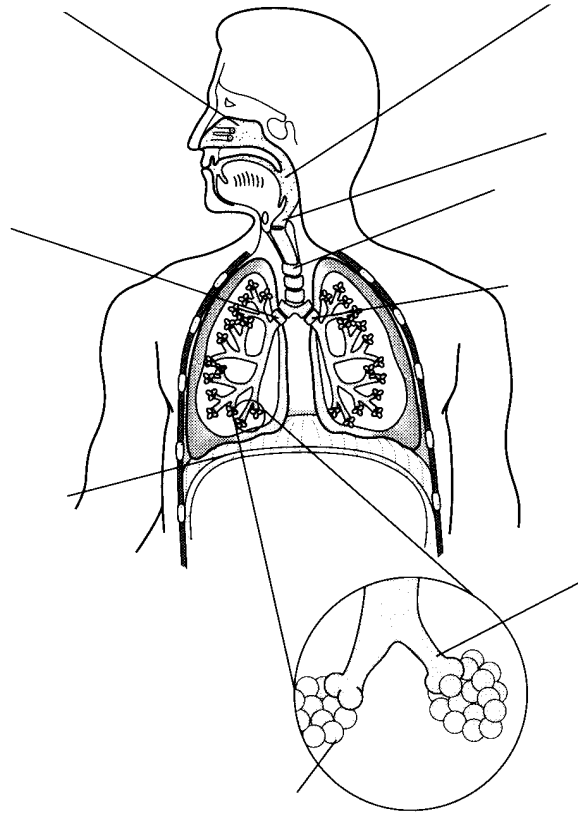


3. What materials are filtered out of the blood in the glomerulus?
4. What materials are reabsorbed back into the blood from the filtrate?
5. What substances are found in urine?

## Lungs

The lungs are considered to be excretory organs because water vapor and carbon dioxide, by-products of cellular respiration, are excreted from the body by the lungs.

1. What metabolic wastes are excreted by the lungs?
2. During which life process are these wastes produced?
3. Label the drawing of the human respiratory system.



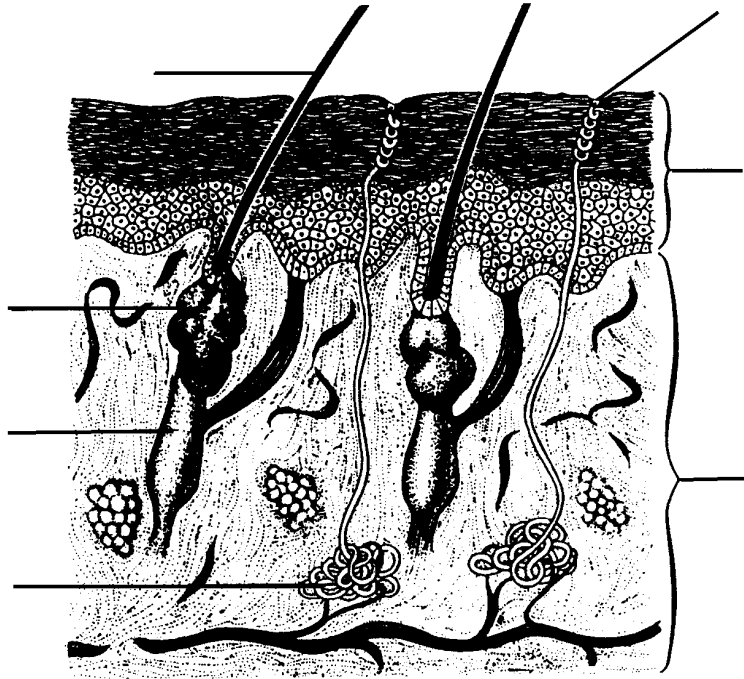
4. Distinguish between the following types of respiration:
  - a) external respiration -
  - b) internal respiration -
  - c) cellular respiration -

5. Balance the equation for aerobic respiration:  $C_6H_{12}O_6 + \text{\_\_\_\_\_\_} O_2 \rightarrow \text{\_\_\_\_\_\_} CO_2 + \text{\_\_\_\_\_\_} H_2O$

## Skin

The skin is an excretory organ because sweat glands filter water, urea, and salts from the blood, and these substances, in the form of sweat, pass to the surface of the skin and are removed. In addition to removing some metabolic wastes, the skin is involved in regulation of body temperature.

1. Label the parts indicated on the drawing.



2. What metabolic wastes are excreted by the skin?
3. How is sweat similar to the composition of urine?
4. List three functions of the skin.
  - a)
  - b)
  - c)