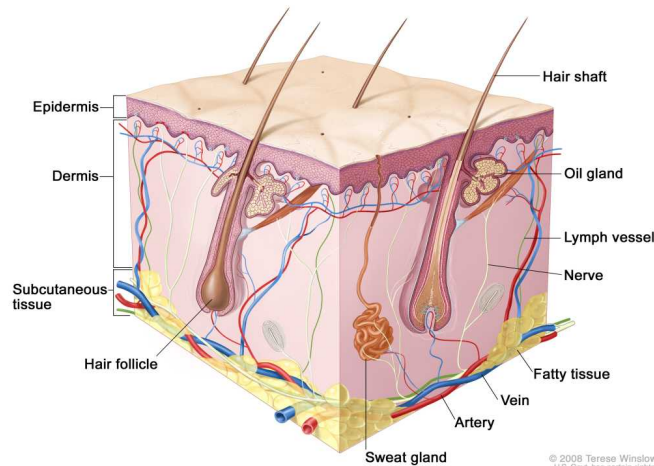
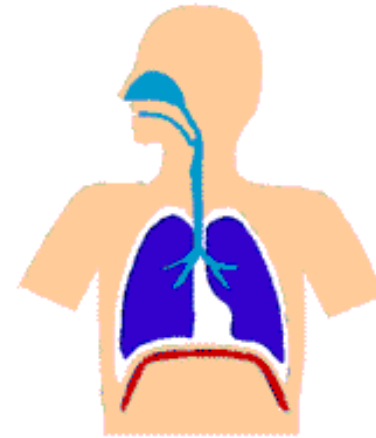


# Chapter 32 - Excretion

**Excretion** is the getting rid of waste products of metabolism.

**The main excretory organs** are:

- lungs (water and carbon dioxide)
- skin (water and salts)
- kidneys (water, salts, and urea)



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# Skin

## Epidermis

The outer layer is dead, cornified, and full of waterproof **keratin**.

The inner layer has living, granular cells.

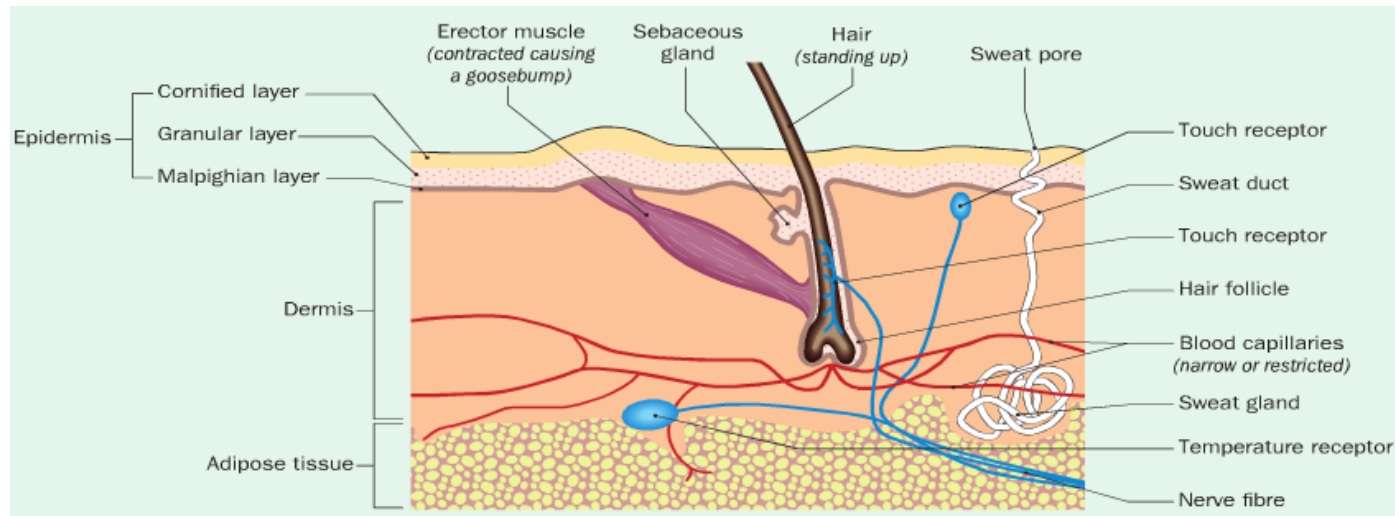
The **Malpighian** layer makes new cells and contains cells with **melanin**.

## Dermis

These cells contain a strong protein called **collagen** and has many blood vessels, sweat glands, hairs, sebaceous glands, and nerve receptors.

## Temperature Regulation

The skin cools the body with open pores and sweat and keeps the body warm by erecting hairs to close the pores (goosebumps).



# Functions of the Skin

**The functions of skin** are:

■ **protection:**

- epidermis protects against damage, water loss, and the entry of pathogens
- melanin protects against UV radiation
- sebum (oil) keeps the epidermis intact

■ **vitamin production** (vitamin D is made in the skin)

■ **food store** (fat stores energy)

■ **sense organ** (the skin is an organ of touch, e.g. it senses touch and temperature)

■ **excretion** (sweat removes water and salts from the body)

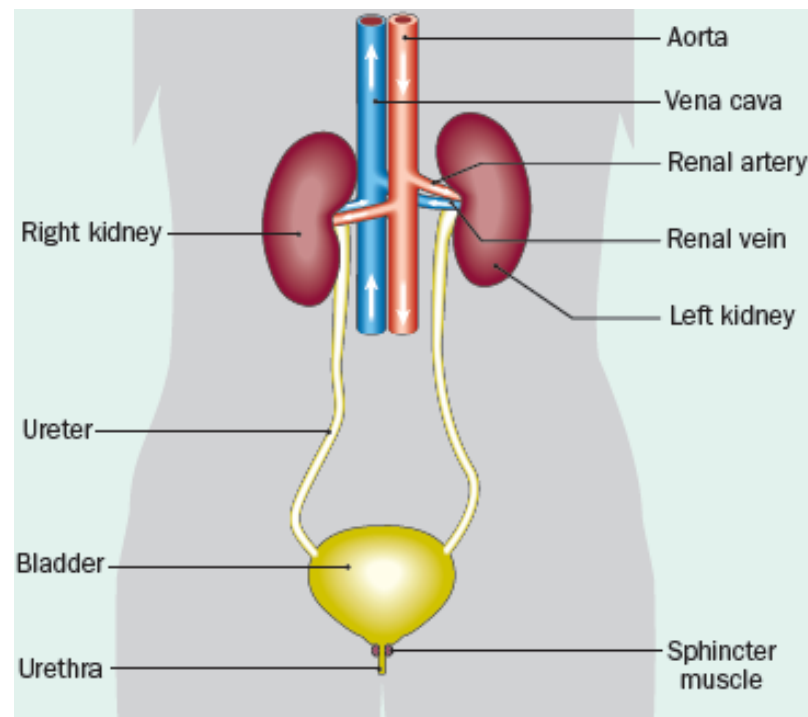
■ **temperature regulation:**

- Cold conditions cause
  - hairs to stand up to keep skin warm
  - blood vessels narrow (constrict) to retain heat
  - shivering
- Warm conditions cause
  - sweating, which cools the body due to evaporation
  - blood vessels to widen (dilate) to lose heat



# The Urinary System

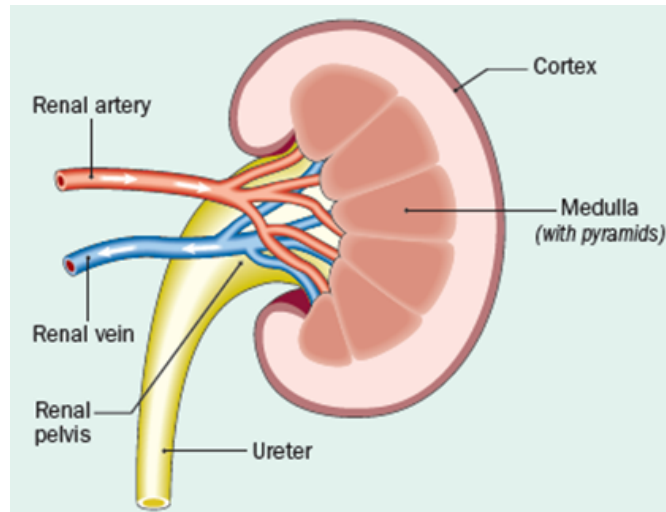
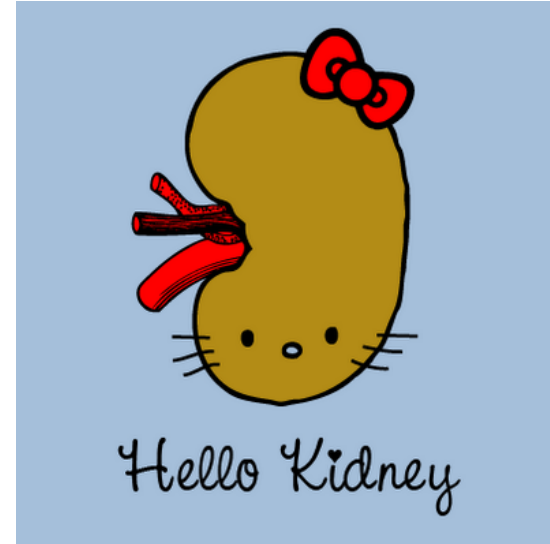
**The urinary system** consists of two kidneys, two ureters, the bladder, and urethra.



# The Kidneys

**The kidneys make urine** in the following way:

- blood (containing waste) enters the kidneys through the renal arteries
- the kidneys filter waste and useful materials from the blood
- useful materials are reabsorbed from the kidneys back into the blood
- some materials are secreted from the blood into the kidneys
- urine formed in the kidneys flows to the bladder through the ureters
- blood (low in waste) leaves the kidneys in the renal veins



**The bladder** stores urine.

**Urine is excreted** through the urethra.

**The functions of the kidneys** are:

- excretion of water, salts, and urea
- osmoregulation:
  - control the water content of the blood (and body fluids)
  - control the salt concentration of the blood (and body fluids)
- control the pH of the blood (and body fluids)

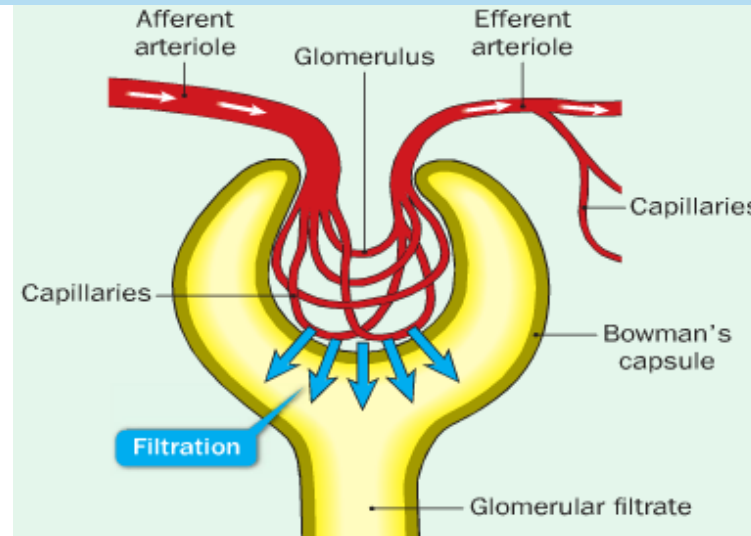
## Nephrons - Higher Level

These carry out the functions of the kidneys and are located in the cortex and medulla of the kidney.

**A nephron makes urine** as follows:

■ **filtration:**

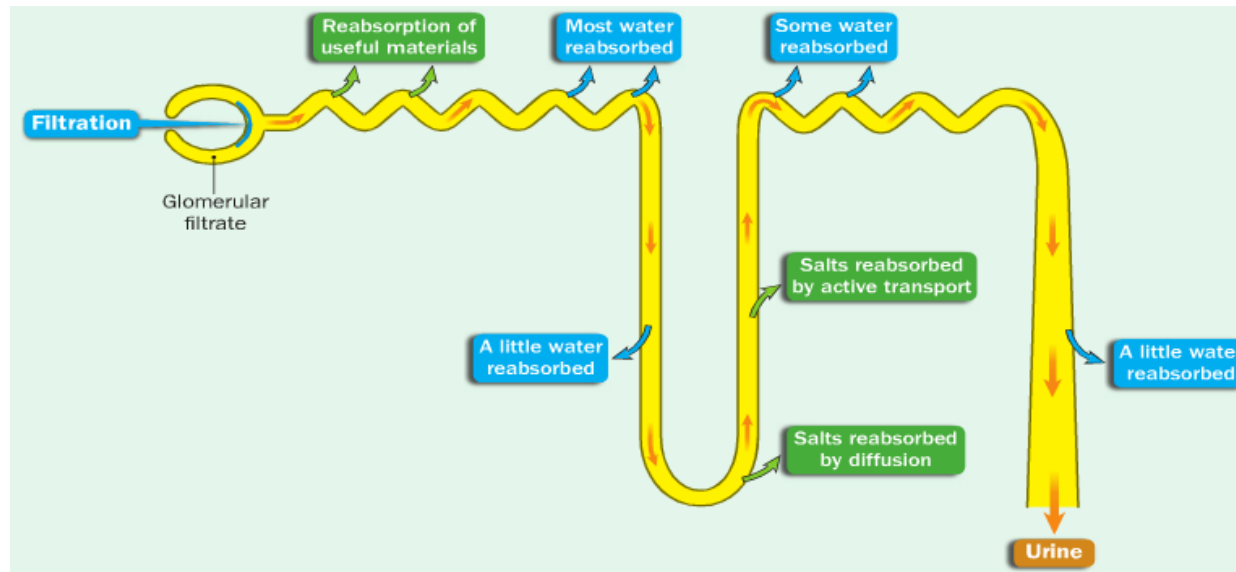
- blood enters the nephron in the afferent arteriole
- this forms many capillaries called the glomerulus
- high pressure in the glomerulus forces water and small molecules out of the blood
- glomerular filtrate is a dilute solution of waste and useful molecules



# Reabsorption

Functions of the regions of a nephron		
Location	Amount of water reabsorbed	Salts reabsorbed
Proximal tubule	Most	Most (as well as glucose, amino acids and vitamins)
Descending limb of loop of Henle	A little	None
Ascending limb of loop of Henle	None	Some
Distal tubule	Some	Some
Collecting duct	A little	None

Water is reabsorbed by **Osmosis**.  
Salt is reabsorbed by **diffusion**  
and **active transport**.



## Urine Volume Control

**ADH (Anti-Diuretic Hormone)**: is released from the pituitary gland and controls the volume of urine formed.

Lack of water in the **blood plasma** stimulates ADH.

It causes water to be reabsorbed and less urine is made.

Effects of different conditions on urine production				
Condition	Effect on blood	ADH	Distal tubule & collecting duct	Urine
<b>Thirsty</b> or <b>Salty diet</b> or <b>Hot day</b> or <b>Exercise</b>	Low water content and high salt concentration	Produced	More permeable to water	Low volume of water; Higher salt concentration (i.e. a low volume of concentrated urine)
<b>Excessive water intake</b> or <b>Very low salt diet</b>	High water content and low salt concentration	Not produced	Less permeable to water	High volume of water; Lower salt concentration (i.e. a high volume of dilute urine)
<b>High protein diet</b>	Normal water content and increased concentration of urea	No effect	No effect	Same volume of water; Increased urea concentration (i.e the same volume of concentrated urine)