

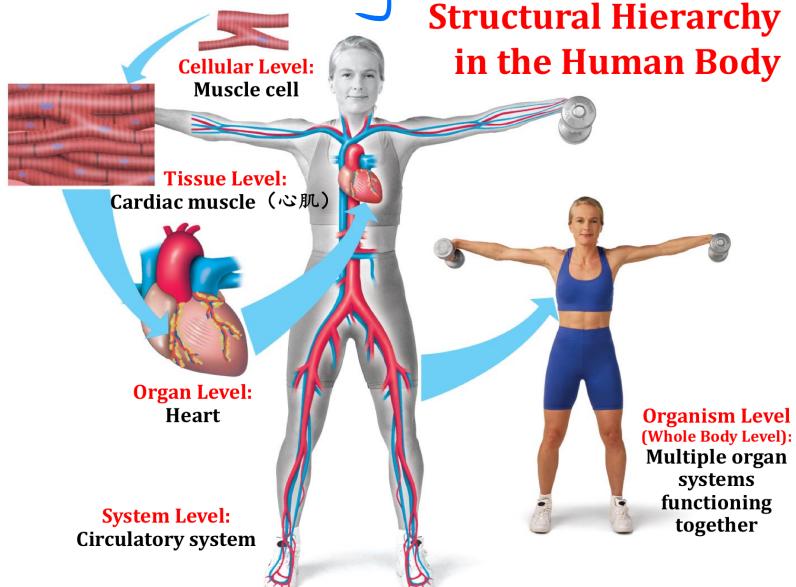
Lecture 17 Unifying Concepts of Animals Structure and Function & Urinary System

§1 The Structural Hierarchy

1. The structural organization of animals

- 1° Individual cells are grouped into tissues.
- 2° Tissues combine to form organs.
- 3° Organs are organized into organ systems.
- 4° Organ systems make up the entire organism

2. Structural hierarchy in the human body



3. "Form fits function"

- 1° **Anatomy** (解剖学): the study of the structure of an organism's parts.
- 2° **Physiology** (生理学): the study of the function of those parts.

§2 Tissues

1. Overall introductions

- 1° A tissue is an integrated group of similar cells that

jointly perform a specific function.

2^o Animals have 4 main categories of tissue:

- {
 - Epithelial Tissue (上皮组织)
 - Connective Tissue (结缔组织)
 - Muscle Tissue (肌肉组织)
 - Nervous Tissue (神经组织)

2. Epithelial tissue

1^o Epithelial tissue, also known as epithelium,

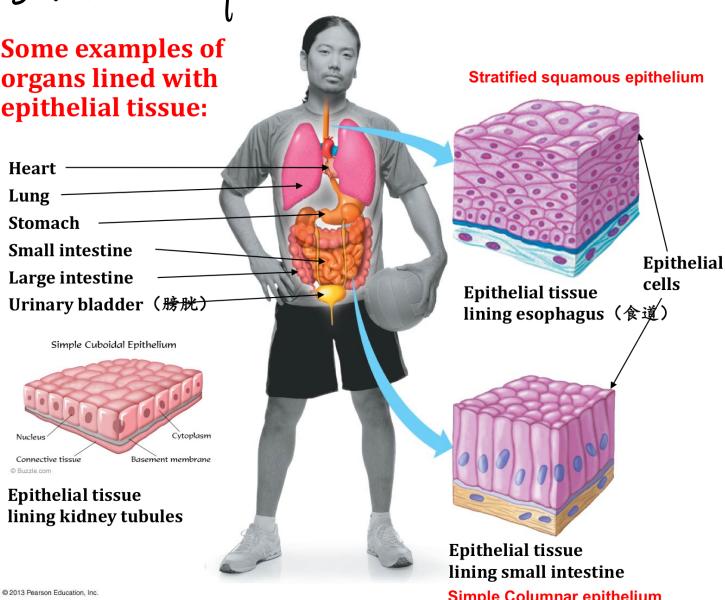
- ① covers the surface of the body
- ② lines organs and cavities within the body.

2^o Cells of epithelial tissues

- ① are tightly linked together
- ② form a protective barrier
- ③ continuously renewed

3^o Some examples

Some examples of organs lined with epithelial tissue:



① Simple epithelium (单层上皮)

- (1) a single layer of cells (thin and leaky)

- (2) suitable for **exchanging** materials by diffusion
- (3) can be find in small intestine, tubes in kidneys, lining capillaries (毛细血管壁), air sacs of lungs.

② **Stratified epithelium** (复层上皮)

- (1) multiple layers of cells
- (2) suitable for lining surfaces subject to abrasion (磨损)
- (3) can be find in outer skin, lining of mouth (口腔黏膜), esophagus (食道)

3. Connective tissue

1^o Brief introduction

- ① Connective tissue is the **most diverse** tissue
- ② Never expose to outside environment.

2^o Three basic components

- ① **Specialized cells** : fibroblast (成纤维细胞), adipose cells (脂肪细胞) -----
- ② **extracellular protein fibers** (collagen (胶原))
 - * exception: blood
- ③ **ground substance** (基质): liquid / jellylike (胶质) / solid
 - * **extracellular matrix** (细胞外间质) = ② + ③

3^o Functions

- ① to **bind** (connect)
- ② and to **support** other tissues

4^o Different types of connective tissues

Different Types of Connective Tissues

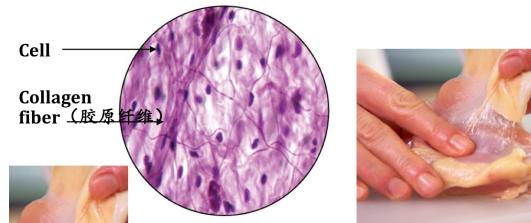


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5^o Loose fibrous connective tissue (疏松纤维结缔组织)

- ① The most widespread connective tissue
- ② Bind epithelia and underlying tissues
- ③ Hold organs in place
- ④ Have fibroblasts

Loose connective tissue
(under the skin)

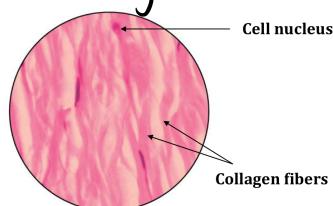


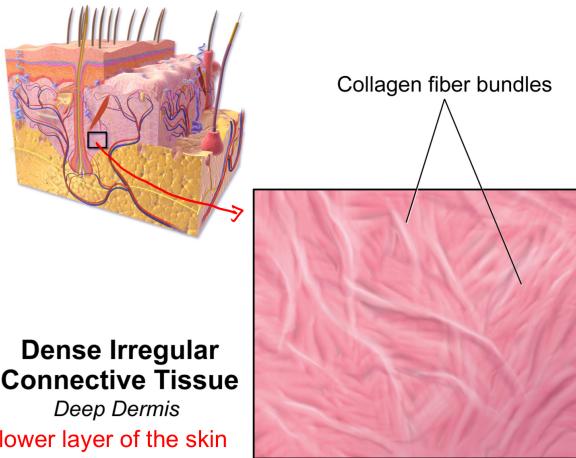
6^o Dense fibrous connective tissue (密集纤维结缔组织)

- ① has a dense matrix of collagen
- ② form tendons (肌腱) and ligaments (韧带)
- ③ have fibroblasts

* Tendons: connect muscles to bones

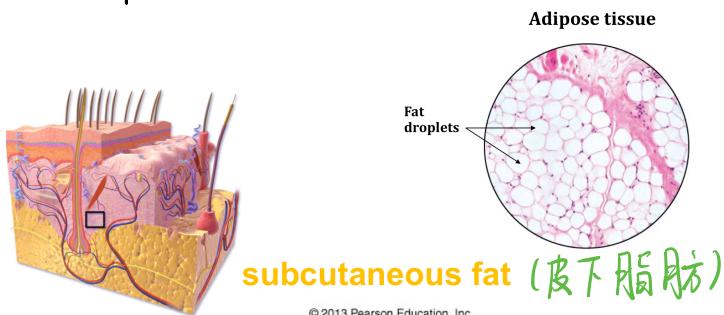
Ligaments: connect bones to bones





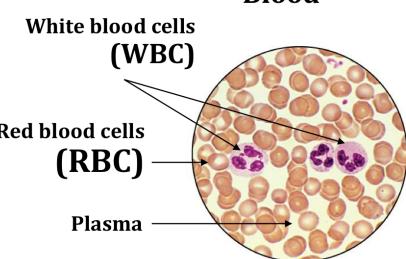
7^o Adipose tissue (脂肪组织)

- ① stores fat
- ② stockpile (大量储备) energy
- ③ pads (缓冲) and insulates (隔热) the body



8^o Blood

- ① is a connected tissue
- ② contains red and white blood cells suspended in a liquid called plasma (血浆)

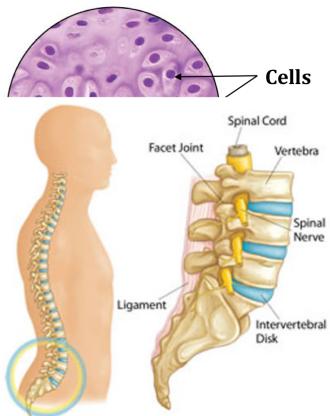


9^o Cartilage (软骨)

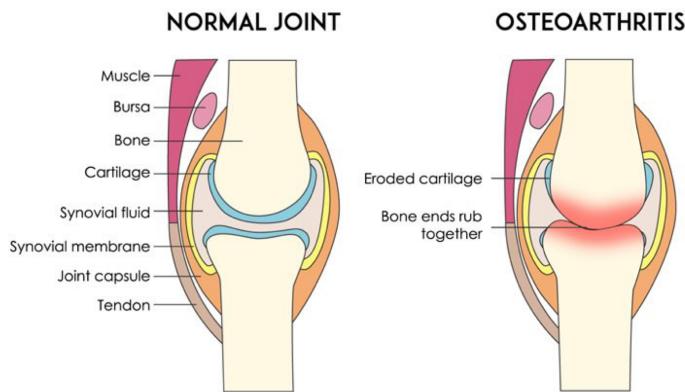
- ① is strong but flexible
- ② has no blood vessels, so it heals very slowly

- ③ functions as a flexible, boneless skeleton
- ④ forms the **shock-absorbing pads** that cushion the ends of bones including the **vertebrae** (脊椎) of the spinal column (脊柱)

Cartilage
(at the end of a bone)



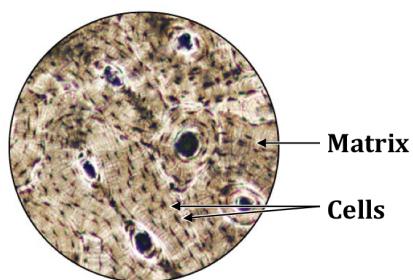
Articular cartilage damage



10^o Bone

- ① a rigid **connective tissue**
- ② has a matrix of collagen fibers hardened with **deposits of calcium salts**.
- ③ very **dynamic**, constantly remodeling, can be repaired after damage.
 - { bone building cell (**osteoblast** (造骨细胞))
 - { bone eating cell (**osteoclast** (破骨细胞))

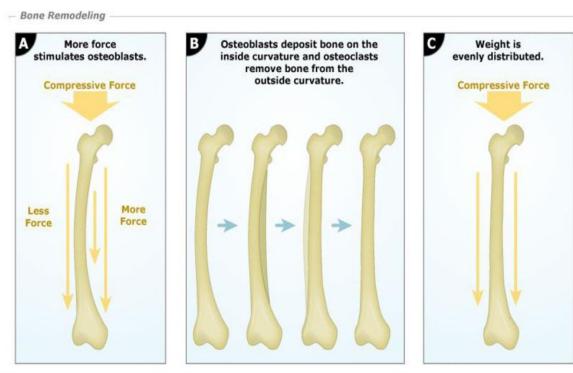
Bone



Weight Bearing exercises

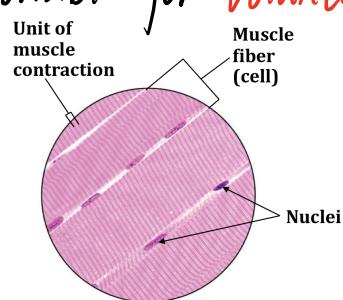
- 1] **Bones** work harder against gravity, such as walking or climbing stairs resulting in new **bone** tissue to form, and this makes **bones** stronger.
- 2] Bones become stronger when muscles push and tug against **bones** during **physical activity**.

Weight bearing exercise



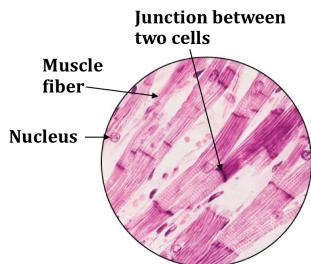
4. Muscle tissue

- 1° is the most abundant tissue in most animals.
- 2° consists of bundles of long, thin, cylindrical cells called **muscle fibers** (肌肉纤维) (contain **actin** (肌动蛋白) and **myosin** (肌凝蛋白) **filaments**). Interaction accounts for sliding movements)
- 3° has specialized proteins arranged into a structure that contracts when stimulated by a signal from a nerve.
- 4° **Skeleton muscle** (骨骼肌)
 - ① is attached to bones by **tendons**.
 - ② is long (up to 0.3 m)
 - ③ has **multiple nuclei**. (myoblasts (成肌细胞) fuse together to form muscle fibers.
 - ④ **striated** (有条纹的) because contractile proteins (伸缩性蛋白质) form a banded pattern.
 - ⑤ responsible for **voluntary movement**.



5° Cardiac muscle (心肌)

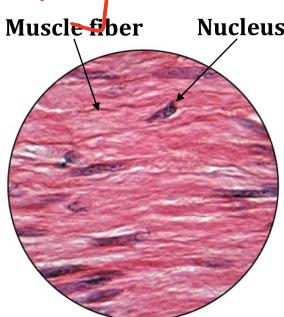
- ① found only in heart tissue
- ② composed of cells that are short, branched, and striated (to disperse pressure)
- ③ specialized pacemaker cells (起搏细胞) establish a regular rate of contraction.
- ④ involuntary, do not rely on nerve activity to start contraction.



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6° Smooth muscle (平滑肌)

- ① lack of obvious stripes.
- ② found in the walls of viscera (内脏) and blood vessels.
- ③ involuntary

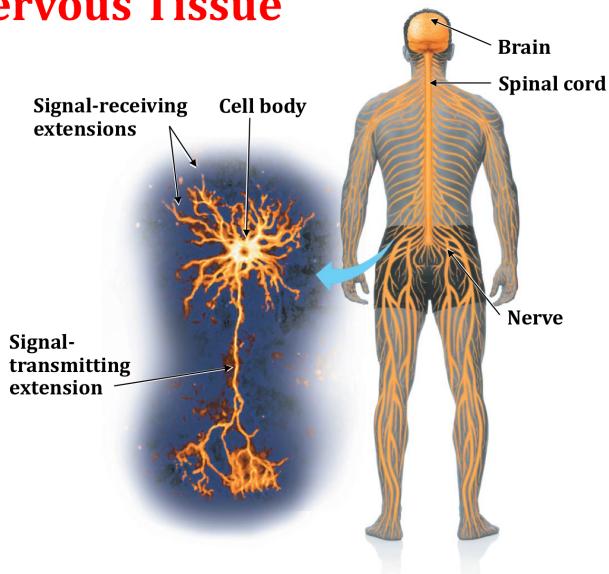


5. Nervous tissue

- 1° makes communication of sensory information possible.
- 2° is found in your brain and spinal cord (骨骼)
- 3° consists of a network of neurons (神经元) (nerve

cells), which is the basic unit of nervous tissue.

Nervous Tissue

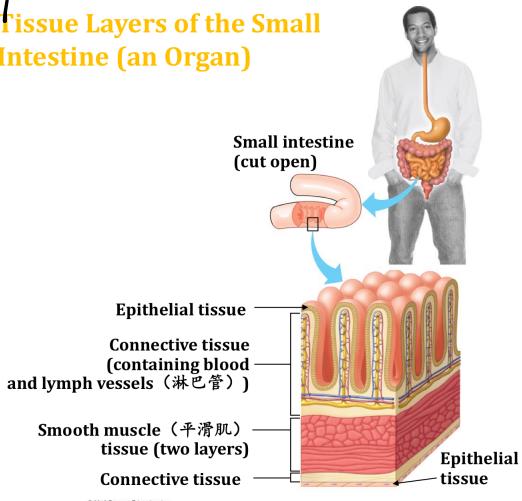


§3 Organs and Organ Systems

1. Organ

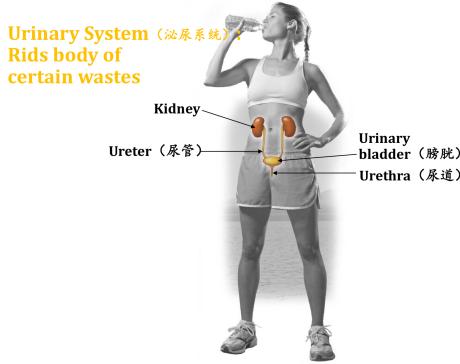
- 1^o An organ consists of **two or more tissues** packaged into one working unit that performs a specific function.
- 2^o Examples: heart, liver, stomach, brain, small intestines.

Tissue Layers of the Small Intestine (an Organ)



2. Organ systems

- 1^o Teams of organs that work together and perform vital body functions.



§4 Homeostasis in the Urinary System

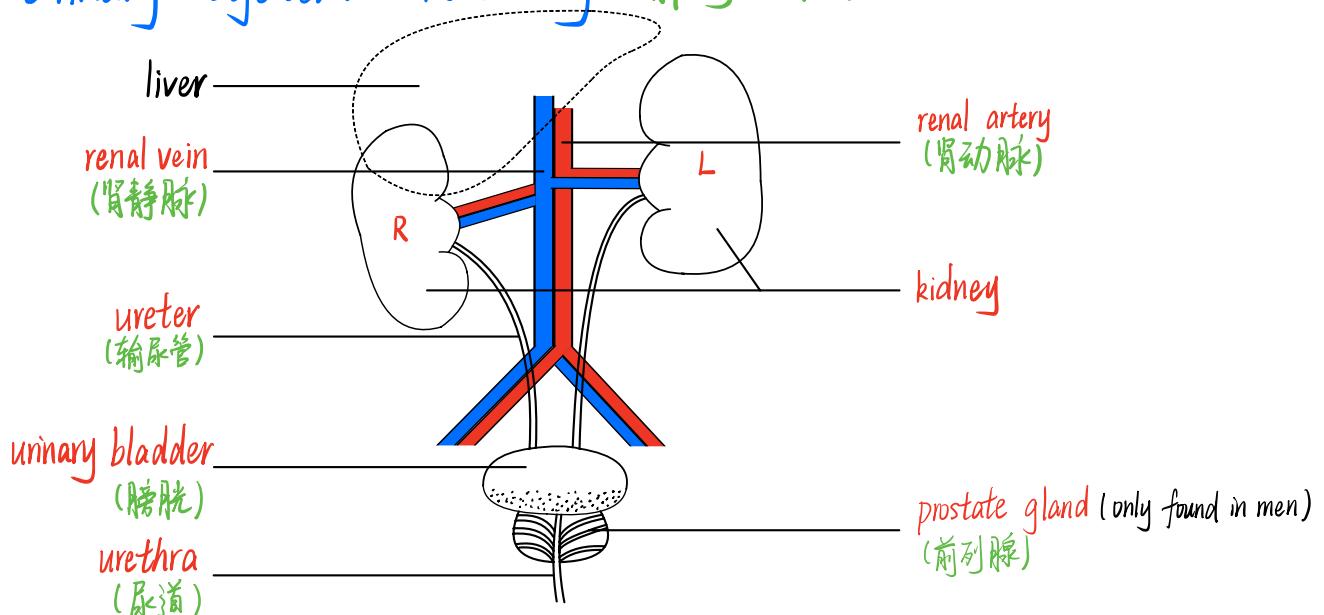
1. Urinary system: Function

- 1° plays a central role in homeostasis (动态平衡)
- 2° forms and excretes (排泄) waste-carrying urine (尿)
- 3° regulates the amount of water & solutes in body fluids (体液)

2. Urinary system: Components

- 1° the circulatory system (循环系统)
- 2° the kidney (肾)
- 3° nephrons (肾元)
- 4° the urinary bladder (膀胱)

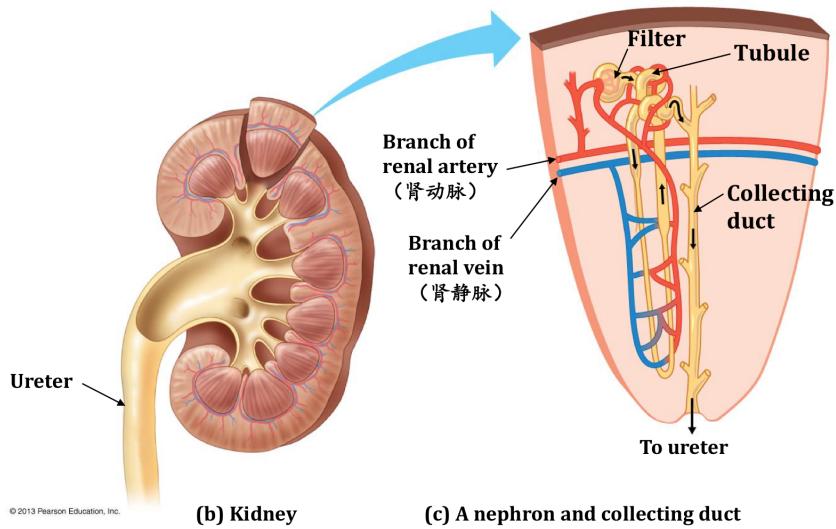
3. Urinary system: Anatomy (解剖结构)



- 1° female's **urethra** is shorter (4 cm), making female more susceptible to urethra and bladder infections
- 2° the right kidney sits slightly **lower** than the left one, beneath the liver.
- 3° **prostate gland** enlarges when aging, making it difficult to excrete urine.

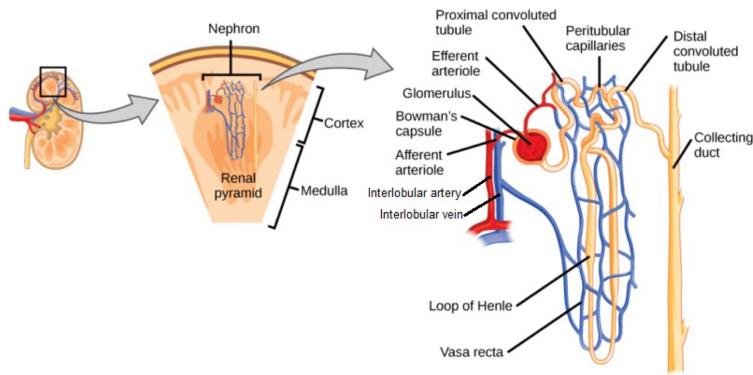
4. Kidneys

- 1° are the main processing centers
- 2° contain many fine tubes called **tubules** (细管)
- 3° contain an intricate network of **capillaries** (毛细血管)
- 4° As blood circulates through the kidneys :
 - ① a fraction (部分) of blood is **filtered** (滤过)
 - ② the **filtrate** (滤出液) enters the kidney tubules.
 - ③ filtrate contains
 - 1) valuable substances that need to be **reclaimed** (重吸收) (such as **water** and **glucose**)
 - 2) substances to be **eliminated** (排出) (such as **urea** (尿素))



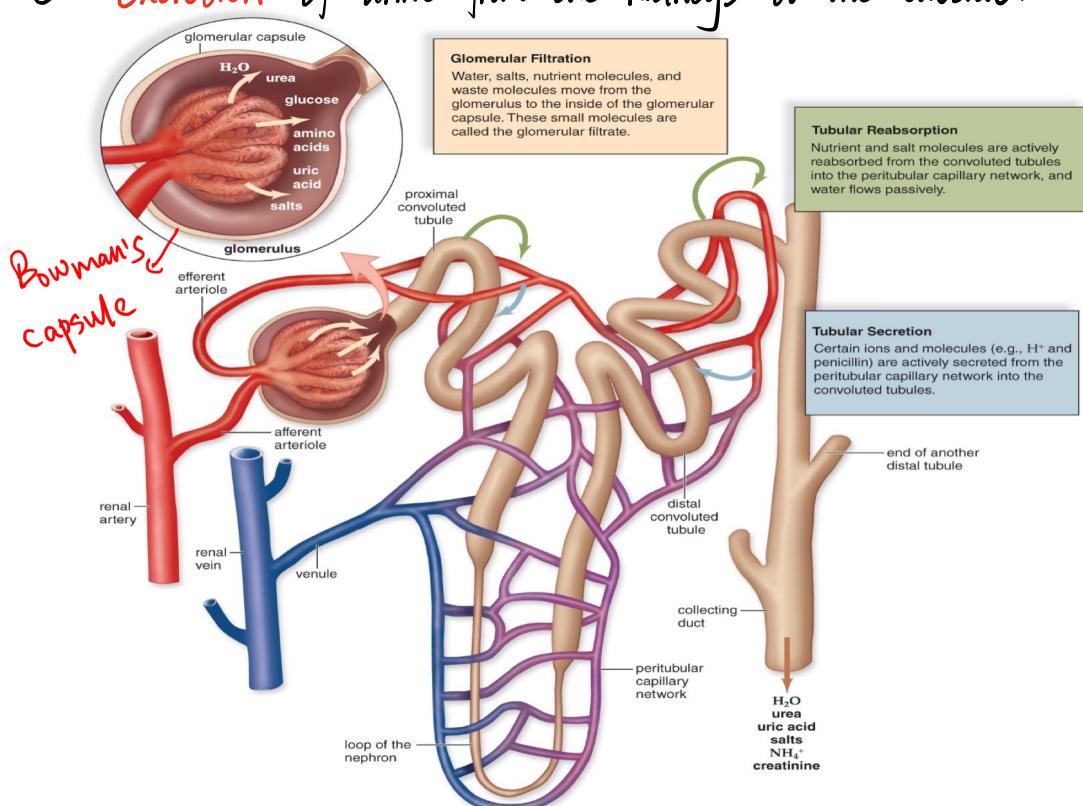
5. Nephrons

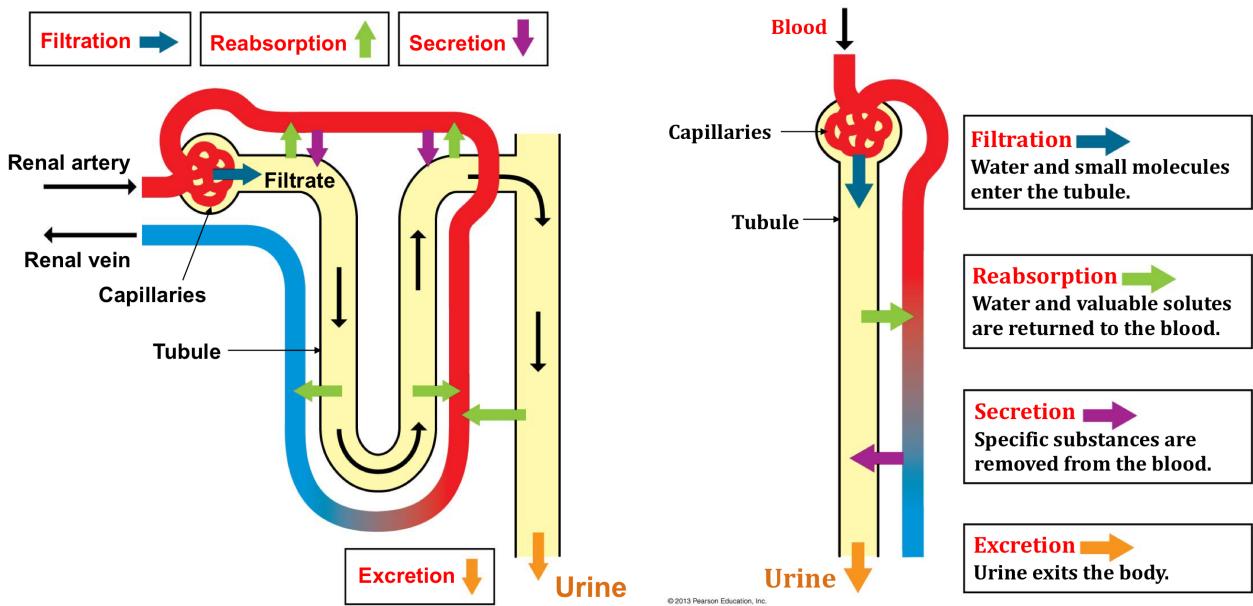
- 1^o consist of a tubule and its associated blood vessels
- 2^o more than a million in a kidney



- 3^o perform four key functions.

- ① **Filtration**, forcing water and other small molecules from the blood to form filtrate.
- ② **Reabsorption** of water and valuable solutes back into the blood.
- ③ **Secretion** of certain substances, such as **ions** and **drugs** into the filtrate
- ④ **Excretion** of urine from the kidneys to the outside.





4^o Glomerular filtration (肾小球过滤)

Filterable Blood Components	Nonfilterable Blood Components
Water	Formed elements(blood cells and platelets)
Nitrogenous wastes	
Nutrients	Plasma proteins
Salts(ions)	

5^o Reabsorption from nephrons

Substance	Amount Filtered (per day)	Amount Excreted (per day)	Reabsorption(%)
Water (liters)	180	1.8	99.0
Sodium (g)	630	3.2	99.5
Glucose (g)	180	0.0	100.0
Urea (g)	54	30.0	44.0

6^o Tubular secretion (肾小管分泌)

- ① is a second way to remove substances from blood and add to tubular fluid.
- ② Hydrogen ions, potassium ions (钾离子), creatinine (肌氨酸酐), many drugs actively transported from the blood.

b. Kidney failure

1^o can be caused by

- ① injury

- ② illness
- ③ prolonged use of pain relievers (鎮痛药) (including aspirin), alcohol, or other drugs.
- 2^o One option for treatment is **dialysis** (透析)

