

1. General Information

These systems help maintain homeostasis, the balanced internal environment inside the body
Gasses need to be exchanged in order for you to survive, wastes must have a way to leave the body
All organisms except anaerobic need to obtain oxygen and remove carbon dioxide
The **TRACHEA** is the primary air duct in humans vertebrates that leads to the lungs
The **TRACHEAE** is the air transport system in insects and grasshoppers that carries air throughout body
Metabolism – all the chemical reactions that go on inside the body

2. Gas Exchange

Respiration – the process of inhaling O₂, producing energy, and exhaling CO₂
Small organisms give off CO₂ and obtain O₂ from the environment directly
Earthworms obtain and give off gasses through diffusion through the skin
Aquatic Animals – breathe through gills, don't have to worry about dehydration
Gills – respiratory organs that are composed of many filaments leading to capillaries
Water enters through the mouth, is forced through the gills, O₂ and CO₂ diffuse
Not very efficient, water contains only 0.5% gaseous oxygen, requires a constant supply of water
The gills and blood vessels are constructed to maximize diffusion
Countercurrent exchange – Blood inside and outside gills are flowing in opposite directions
Maximizes diffusion as it maximizes the concentration gradient
Terrestrial Organisms – Breathe through lungs, in constant threat of becoming dehydrated
Lungs – organ that extracts O₂ from air, less efficient than gills, but doesn't lose as much water
Gills collapse in the air because the water supports it's filaments from crushing each other
Land animals can't take the water loss from the gills
Grasshoppers – tracheae – a system of small branched air ducts that carries gasses
Spiracles – mechanisms that prevent water loss when CO₂ levels reach a certain point
Mammals, birds, other higher vertebrates – breathe using lungs
Diaphragm – two groups of muscles that force air into and out of the lungs
During inhalation, the chest cavity increases in size, lowering pressure, air flows in
During exhalation, the chest cavity decreases in size, raising pressure, air flows out
Trachea – the primary air duct, branches to the **bronchial tubes**
The Bronchial Tubes branch into **alveoli**, which are connected to capillaries
Alveoli – small air sacks that maximize diffusion surface area. Each lung has millions
Oxygen Transport – oxygen is transported through the blood by hemoglobin (Ch 19)
Hemoglobin contains iron that makes a temporary bond to oxygen molecules
When hemoglobin combines with oxygen (oxyhemoglobin), it goes from dark red to bright red
Oxygen can diffuse through the thin wall of the capillaries into the cells
Carbon Dioxide Transport – CO₂ is brought back to the lungs
However, some of the CO₂ reacts with water to form Carbonic Acid (H₂CO₃)
The carbonic acid is unstable, and breaks down into H⁺ and HCO₃⁻, and carried back to lungs
There, it reforms CO₂, and is exhaled. Some water is also exhaled

3. Homeostasis and Balance

pH, salt, and water levels must be maintained inside the body
Wastes must be removed quickly and efficiently
Saltwater fish tend to lose water, freshwater fish tend to lose salt
Terrestrial animals need to retain water, lose salt

4. Removal of Wastes

Nitrogenous Wastes - Ammonia (NH₃) – the byproduct of metabolism of proteins and nucleic acids
Fish excrete it directly due to the presence of large amounts of water to dilute the normally toxic waste
Urea – not as toxic as NH₃, don't need as much water to excrete safely, soluble
Uric Acid – non toxic, insoluble, an adaptation of desert dwelling animals and needs almost no water
Small organisms use vacuoles to excrete waste directly with the environment
Larger organisms need specialized systems
Planarians – water constantly flush through their body, removing waste and CO₂
Grasshoppers – it can't lose water, so it excretes uric acid crystals, CO₂ through tracheae
Fish - excrete NH₃ directly into the water, and CO₂ through the gills
Sea Turtles and Marine Birds – excretes salt through special glands in their heads, CO₂ from lungs

5. The Human Urinary System – used to remove waste from the body

Kidneys – main organs of the urinary system, containing many nephrons. Processes waste

Nephrons – the excretory tubules of humans, packed into the kidneys, about 1 million each

A long, coiled structure with one end that's shaped like a cup over a mass of capillaries

The other end opens into the duct that collects urine

Glomerular Capsule (Bowman's Capsule) – the cup at the end of the nephron

Glomerulus – the ball of capillaries that connects to the Glomerular Capsule

The Glomerular Capsule and the Glomerulus are located in the cortex

The walls of the nephrons are only 1 cell layer thick, in direct contact w/ the capillaries

Nephron Loop (Loop of Henle) – a section that goes from the cortex to medulla and back

From the nephron loop, the tubules goes to a collecting duct, which leads to the urethra

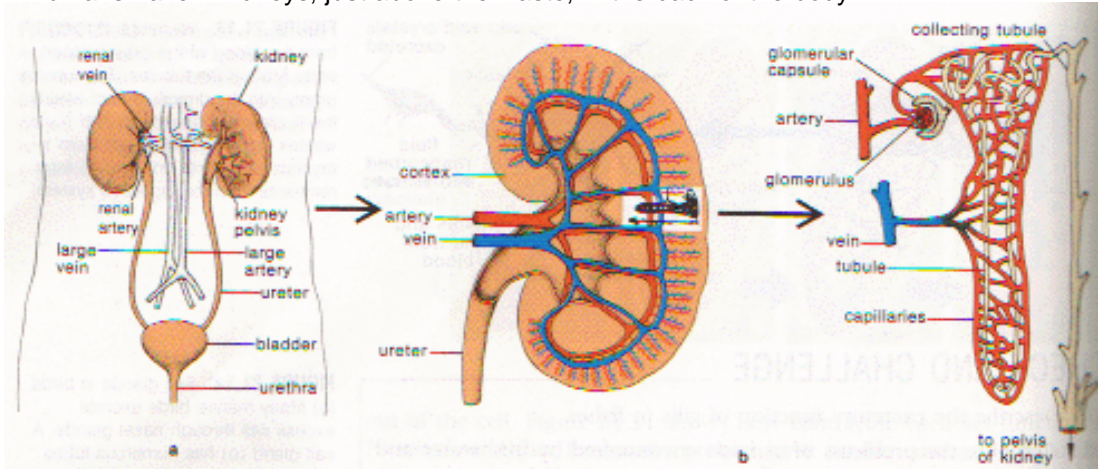
Cortex – the outer part of the kidney

Medulla – the inner part of the kidney

The kidneys filters the blood, removing wastes

Urine – waste fluid. Leaves the kidneys through the **ureter**, and goes to the **urinary bladder** to be temporarily stored, and leaves the body through the **urethra**

Humans have 2 kidneys, just above the waste, in the back of the body



The jobs of the nephrons – filtration, reabsorption, and secretion

The glomerulus filters the blood for nitrogenous wastes, salts, urea, ions, glucose, amino acids
However, most of it is returned to the blood. Out of the 180L of fluid filtered, only 1.5 is excreted
Reabsorption takes place in the tubule of the nephron

Water is reabsorbed by osmosis, active transport is needed for the sodium and potassium ions
The tubule walls secrete selective substances from the surround capillaries that were not filtered

Control of Nephron Function

Reabsorption accounts of 85% of all substances processed by the kidney

Aldosterone – secreted by adrenal gland – regulates Na^+ , K^+ , and H^+ concentrations

ADH – secreted by pituitary gland – controls water loss of urine and blood water level

If a person is dehydrated, more ADH is released, more water is allowed into the blood

The Kidneys can also remove salt, but only in small amounts, and it takes a lot of water

Drinking sea water is worse than drinking nothing because more water is lost trying to remove the salt from the seawater

Urine can be used as a detoxifier, water source (it's non toxic, believe it or not), and it's sterile