The Urinary System

Your cells are constantly carrying out chemical reaction to maintain <u>homeostasis</u> (maintain and regulate all bodily functions). Many of these chemical reactions produce wastes that must be removed from cells and from your body. Many of these wastes are <u>small</u>, <u>water-soluble</u> molecules that become dissolved in your blood along with other small molecules that are not wastes. How is your body able to separate and excrete waste products of Metabolism?

EXCRETION

The urinary system works with the **<u>lungs</u>**, **skin**, and **<u>intestines</u>** to keep chemicals and water in your body balanced.

The urinary system is the organ system that **produces, stores**, and **eliminates** urine. In humans it includes two kidneys, two ureters, the bladder, and the urethra.

Did you know?

Adults eliminate about a <u>litre and a half</u> or urine each day? Of course the amount of fluid <u>consumed</u> and <u>lost</u> (through sweat/breathing) is a factor in this!

The kidney is the main organ of **excretion** – the **process** of removing **<u>nitrogen wastes</u>** from the body

Do a google search – come up with your own interesting fact about the urinary system!

What are the organs involved in excretion?

Organ	Chemical(s) Excreted
Kidneys	Nitrogenous wastes (ammonia, urea, uric acid, creatinine)
Liver	Bile pigments (breakdown of RBC)
Lungs	Carbon dioxide, some water
Skin	Urea, mineral salts, water (for cooling)
Intestines	Fe ⁺ and Ca ²⁺ salts

Think/pair/share: Why is excretion not the same as defecation (solid waste)?

- Digestion is the process which rids the body of undigested and unabsorbed food remains and bacteria – not metabolic end products – it is a leftover after the body absorbs what nutrients it needs from the small intestine
- Excretion metabolic wastes

NITROGENOUS WASTES

- <u>Ammonia (NH₃) is a product of deamination</u> of the amino acids (<u>protein</u> breakdown) and nucleic acids
- Ammonia is very **toxic** so it is combined with **carbon dioxide** in the liver to produce urea

• Urea is <u>water-soluble</u> \rightarrow excreted in urine

 If left to <u>accumulate</u>, the body would be overwhelmed within days and the major organs would stop <u>functioning</u>

 \rightarrow As a result, the <u>kidney</u> is an essential organ in the body!

- <u>Creatinine</u> creatine phosphate is a phosphate <u>storage</u> molecule in muscles; the <u>breakdown</u> of this molecule makes creatinine (excreted)
- Urine is composed of ~3% urea , ~2% salts and ~95% water

Thinking question: What is urea so important?

- Ammonia is very toxic, it quickly combines with carbon dioxide to produce urea. If ammonium was to accumulate, the body would be overwhelmed and major organs would stop functioning. Therefore, the kidney is a very important organ.

OTHER EXCRETED SUBSTANCES

- <u>**Carbon dioxide**</u> excreted from the lungs (majority)
- Kidneys excrete HCO₃⁻ to <u>regulate pH</u> levels
- <u>Ions</u> Salts K⁺, Na⁺, Ca²⁺, Mg²⁺, Fe⁺ these ions are <u>not</u> metabolic products, but they are needed for various biochemical processes and must be maintained at specific concentrations are excreted to maintain proper <u>balances</u> of these ions (<u>osmoregulation</u> maintenance of water and salt levels in the blood)
- Water metabolic end product, maintains blood pressure and consumed with food

What if your kidneys fail?

People who have kidney <u>failures</u> must submit to <u>artificial</u> removal of wastes by **dialysis**, or have their kidneys replace with a donated kidney.

As well as excretion, the kidneys <u>regulate</u> water concentration and pH (acid/base balance). Additionally, the kidneys also release <u>hormones</u> important in Na⁺ regulation (<u>renin</u> - an enzyme that leads to the reabsorption of Na⁺) and <u>red blood cell</u> production (erythropoietin).

Fill out the following chart based on the notes we have completed so far. The first line has been done for you as an example.

Waste Product	Origin of Waste Product	Excretory Organ
Ammonia	Breakdown of amino acids in the liver	Kidneys
Urea	Conversion of ammonia in the liver	Kidneys, skin
Carbon dioxide	Cellular respiration (breakdown of glucose in cells)	Lungs
Water	Cellular respiration (breakdown of glucose in cells)	Kidneys, lungs, skin
Mineral Salts	Food and water	Kidneys, skin

URINARY SYSTEM ANATOMY

The urinary system consists of two kidneys (flattened fist-sized organs), the ureters that carry urine to the bladder (stores urine), and a single urethra (carries urine out of the body).



Label the following diagram and give each label a short definition based on what you have learned.



Notice how the blood vessels that service the kidneys are <u>directly</u> connected to the two major blood vessels of the <u>abdomen</u>. About 20% of the blood flowing through these vessels is diverted through the kidneys. As a result, all the blood in the body is filtered <u>two</u> or <u>three</u> times every minutes. This filtration produces about 1-2 mL of urine in this time. Of course this volume depends on the body's level of <u>hydration</u>. With more water in the blood, the volume of urine output <u>increases</u> and its concentration of urea <u>decreases</u>.

Work with a partner to fill out the following chart on functions of the urinary system parts. You may use your textbook (pg. 412-413) to help if you need.

Structure	Function		
Renal Vein	Carries blood from the kidneys back to the heart		
Renal Artery	Carries blood to the kidneys		
Kidneys	Reddish-brown organs about 4 inches long, 2 inches wide, 1 inch thing; anchored against the dorsal body wall by connective tissue		
Ureter	Muscular tubes, move urine from kidneys to bladder via peristalsis		
Bladder	Holds up to 600 mL to 1000 mL urine, can expand and contract; has stretch receptors that indicate when it is full and then it notifies the brain		
Urethra	Tube connecting bladder to outside – it is ~6 inches long in a man and also transports semen (never at the same time as urine); in a woman it is ~1 inch long		

Thinking question: Why do you suppose women are more prone than men to get bladder infections?

- The urethra in women is only 1 inch in comparison to 6 inches for men – it is easier for bacteria to invade because it is a shorter distance

Vocabulary terms to know: make flash cards/define these words on a separate page so you can be sure you are familiar with their meanings

• Dialysis

• Renal cortex

• Renal medualla

- Erthropooietin
- Renal pelvis

•

• Excretion • Kidneys

Renal pyramid •

- Renin
- Ureter
- Urinary bladder
- Urethra

• Renal artery

- Renal vein
- **Practice:** Select the best answer to each question.
 - 1. The primary structure of excretion in the body is the:
 - a. Kidney
 - b. Intestine
 - c. Lung
 - d. Bladder
 - 2. The structure that carries urine out of the kidney is the:
 - a. Urethra
 - b. Ureter
 - c. Renal vein
 - d. Renal artery
 - 3. How important are the kidneys to survival?
 - a. We can live without them
 - b. They would be missed but we could survive without them
 - c. They are essential
 - d. We would die immediately without them
 - 4. The structure carrying wastes to the kidney, so that they can be removed, is the:
 - a. Ureter
 - b. Urethra
 - c. Renal artery
 - d. Renal vein
 - 5. We have two kidneys. The best explanation for this is:
 - a. We need two functioning kidneys
 - b. We have a spare kidney in case something goes wrong with one
 - c. We are bilaterally symmetrical, and our body design includes two of most organs
 - d. We did have many kidneys, but we have lost most of them over time