The Excretory System

http://www.youtube.com/watch?v=TZMJeZL-BVg&safe=active
Introduction

❖ Every body activity uses energy and generates wastes.
❖ If waste products were not removed, they would quickly accumulate in harmful proportions.
❖ Some wastes are poisonous and pose a serious threat to health if they are not removed promptly.
❖ The process of getting rid of metabolic wastes is called excretion.
❖ The chemical composition of intercellular fluid is for the life of the cells.
❖ If it becomes too salty, the cells can become dehydrated.
❖ If it gets too watery the cells can bloat.
If too much acid or base accumulates, the cells' enzymes can stop working.

If urea and other wastes collect, the cells can die of poisoning.

Homeostatic mechanisms within the body keep the chemical composition of the intercellular fluid constant when conditions change.
Excretion and Homeostasis

- Excretion aids homeostasis by removing wastes and regulating the salt and water balance.

- The blood picks up **carbon dioxide, excess salts, urea, and any excess water** that may be present and carries them to the excretory organs, which channel the wastes out of the body.
Fortunately, atoms and molecules do not wear out, but may be changed or rearranged and used over and over again.

Many of the end products of various cell activities can be recycled and used in other processes.

As a result, the amount of waste that actually needs to be discharged from the body is very small in relation to the amount of work done by all the cells of the human body.

Several organs take part in human excretion. The lungs, skin, liver, and the transport system play important roles; however, the main excretory organs are the kidneys.
The Skin

❖ the skin is the **largest organ** of the body
❖ The skin covers an area of **1.5 to 2 square meters** on an average adult
❖ the thickness of the skin varies from 0.5mm on the eyelids to 6mm on the soles of the feet
❖ there are 2 general layers of the skin: **epidermis and dermis**
Epidermis

- the **outer** layer is called the epidermis and is made up of layers of flat cells
- the surface of cells of this layer are **dead**
- they are constantly rubbing and being replaced by the cells below them
- this outer layer of skin provides a **waterproof** shield against germs and bacteria
Dermis

❖ this layer is under the epidermis
❖ the cells in this layer are still **alive**
❖ this layer contains blood vessels, nerve endings, sweat and oil glands, hair follicles, and fat cells
❖ the sweat glands have tubes that lead to the surface of the skin at points called sweat pores
❖ **perspiration** is released at these sweat pores
water, urea and inorganic salts are included in perspiration.

Besides ridding the body of these wastes, perspiration also cools the body and helps maintain a proper body temperature.

The evaporation of sweat on the surface of the skin requires heat to turn liquid into gas.

This heat comes from the body, which results in a cooling of the body.
The Lungs

- Gas exchange occurs between the microscopic capillaries and the **alveoli** in the lungs.
- Oxygen is diffused into the blood stream from the alveoli into the **capillaries**.
- Oxygen is attracted to, and held by, the hemoglobin in the red blood cells of the body.
- Oxygen is released into living cells and used in cellular respiration - the releasing of energy from food and oxygen within the individual cells.
- The waste product from cellular respiration is **carbon dioxide** which is diffused out of the cell and carried back to the lungs and diffused from the capillaries into the alveoli and **exhaled** by the lungs.
- **Water vapour** is also exhaled during this process.
The Liver

- The liver is located just to right of the stomach.
- **Sugar** (glucose) in the blood is removed in the liver and stored as **glycogen**.
- When the sugar level in the blood goes down, the liver breaks down the glycogen and releases sugar back into the blood.
- If there is no room for the liver to store glycogen, the liver changes the sugar to **fat** and stores it in other parts of the body.

[https://www.youtube.com/watch?v=GYFJ8oqNdCE](https://www.youtube.com/watch?v=GYFJ8oqNdCE)
the liver also removes from our bodies *poisonous substances*, such as poisons in fish, poisonous fumes from paint, and chemicals sprayed on food

the liver is our bodies main defence from poisons like those mentioned above

the liver also changes the hemoglobin from dead red blood cells into *bile*, which is used in the small intestine to break down fats

*bacteria* from the large intestine is removed from the body by the liver
The Kidneys

https://www.youtube.com/watch?v=CX_kF0bKoTk
The kidneys are the main organs of the excretory system as they are the body’s filtration system. The kidneys help maintain a balance among the elements inside the body-this balance is referred to as homeostasis. The kidneys perform the following important jobs:

✓ They remove urea and other wastes from the blood
✓ They regulate the amount of water in the circulatory system
✓ They adjust the amounts of certain substances in the blood
❖ The kidneys filter wastes and poisons from the blood at an incredible rate
❖ The entire blood supply of the body passes through the kidneys once every 30 minutes
❖ Within each kidney are an estimated one million microscopic nephrons where filtering actually takes place
❖ Each nephron contains a cluster of capillaries known as a glomerulus
A cup shaped sac called a **Bowman’s** capsule surrounds each glomerulus.

The blood that flows through the glomerulus is under great pressure.

This causes water, urea, glucose and minerals into the Bowman’s capsule.

Red blood cells, white blood cells, and protein remain in the blood.

As blood continues through the blood vessels, it winds around the **renal tubule**—during this time **reabsorption** occurs.
- Glucose and chemicals such as potassium, sodium, hydrogen, magnesium, and calcium are reabsorbed into the blood.
- Almost all of the water removed during filtration returns to the blood during the reabsorption phase—the water and mineral composition of the body is actually regulated in the kidneys.
- The kidneys control the amount of liquid in our bodies.
- Now, only wastes are in the nephrons.
These wastes are called **urine** and include **water, urea, and inorganic salts**.

There may also be some sugar and nutrients present if there is an excess of these substances in the blood.

The cleansed blood goes into the veins that carry the blood from the kidneys and into a major vein that carries the blood back to the **heart**.

From the heart, the **cleansed** blood will circulate throughout the **body**.
<table>
<thead>
<tr>
<th>Waste Product</th>
<th>Origin of Waste Product</th>
<th>Excretory Organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>Breakdown of amino acids in the liver</td>
<td>Kidneys</td>
</tr>
<tr>
<td>Urea</td>
<td>Conversion of ammonia in the liver</td>
<td>Kidneys, Skin</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>Cellular Respiration (breakdown of glucose in cells)</td>
<td>Lungs</td>
</tr>
<tr>
<td>Water</td>
<td>Cellular Respiration (breakdown of glucose in cells)</td>
<td>Kidneys, Intestines, Skin, Lungs</td>
</tr>
<tr>
<td>Mineral Salts</td>
<td>Food and water</td>
<td>Kidneys, Skin</td>
</tr>
</tbody>
</table>
Why is excrement (poop) not included in this list of metabolic wastes?

Excrement is not a product of cellular metabolism. It is a leftover after the body absorbs what nutrients it needs from the small intestine.
The Kidney and Bladder: An Overview

http://www.youtube.com/watch?v=qxb2_d9iLEw
Kidneys

The kidneys remove **metabolic wastes** from the body by **filtering the blood**.

They work continuously, processing all of the blood in the body every 30 minutes.

Every 24 hrs they kidneys filter approximately **200 liters** of fluid and return to the bloodstream all but **1-2 liters**, which are excreted as urine.
The Excretory System consists of:

- **2 kidneys**: bean-shaped organs lying near the back of the abdominal cavity
- **2 ureters**: lead from kidney to the urinary bladder
- **1 bladder**: lies low in the abdominal cavity
- **1 urethra**: extends from the bladder to the exterior of the body, carrying urine though the urogenital organs
The kidney, bean-shaped and about **10 cm long**, has a dark coloured core which is densely packed with **blood vessels**.

These vessels form a network of capillaries and small tubes known as the **medulla**.

The medulla is divided up into a number of triangular shaped sections called **pyramids**.
Each pyramid consists of arterioles, which branch into smaller and smaller arterioles, the tiniest of which delivers blood to the nephron.

Likewise many tiny venules, taking blood away from the nephron join together making larger and larger venules, finally making up the renal vein.

The pyramid also contains a great number of urine carrying collecting tubules which empty the urine into the central cavity, known as the renal pelvis.
The three basic Renal Processes:

1. **Filtration** – the passage of protein free substances through the capillaries of the glomerulus into the Bowman’s Capsule.

2. **Tubular re-absorption** – the removal of water and useful solutes from the filtrate

3. **Tubular secretion** – the addition of certain substances to the filtrate
Filtration

Blood is filtered by nephrons.

Each nephron begins in a renal corpuscle, composed of a glomerulus enclosed in a Bowman’s Capsule.

Cells, proteins and other large molecules are filtered out of the glomerulus by a process of filtration.

The filtrate continues on through the proximal tubule all the way through to the collecting duct to form urine.
Re-absorption

- Process by which **solute**s and **water** are removed from the tubular fluid (filtrate) and transported to the blood.
- Two step process:
  a) Begins with the **active** or **passive** extraction of substances from the filtrate into the **renal interstitium** (connective tissue that surrounds the nephrons)
  b) **Transport** of these substances from the interstitium into the **bloodstream**
- Water and solutes such as Na (sodium) are reabsorbed
Tubular Secretion

The cells of the tubules remove certain molecules and ions from the blood and deposit these into the fluid within the tubules.

Tubular secretion of $H^+$ is important in maintaining control of the pH of the blood.

- When the pH of the blood starts to drop, more hydrogen ions are secreted.
- If the blood should become too alkaline, secretion of the hydrogen ions is reduced.
- In maintaining the pH of the blood within its normal limits of 7.3-7.4, the kidney can produce a urine with a pH from 4.5 to 8.5.
The Nephron

There are **5 parts** each with a specific function in the nephron.

The parts of the nephron are as follows

(LABEL DIAGRAM):

1. Renal Capsule – Ultrafiltration
2. Proximal Convoluted Tubule – Reabsorption
3. Loop of Henle – Formation of a Salt Bath
4. Distal Convoluted Tubule – Homeostasis and Secretion
5. Collecting Duct – Concentration control

https://www.youtube.com/watch?v=8UVIXX-9x7Q
https://www.youtube.com/watch?v=H2VkJW9L5QSU
1. Renal Capsule – Ultrafiltration

- The renal artery splits into numerous arterioles, each feeding a nephron.
- The arteriole splits into numerous capillaries, which form a knot called a glomerulus.
- The glomerulus is enclosed by the renal capsule (of Bowman’s capsule): the first part of the nephron.
- The arteriole leading into the glomerulus (afferent arteriole) is wider than the one leading out (efferent arteriole), so there is a high blood pressure in the capillaries of the glomerulus.
- The blood pressure in the capillaries is 60-70 mm Hg, whereas elsewhere in the body capillary pressure is only 25 mm Hg.
- This pressure forces plasma out of the blood by ultrafiltration.
- Those substances that do pass from the glomerulus into the capsule comprise what is called the filtrate.
- Blood cells and large protein molecules are too big to pass through the tiny pores in the capsule capillaries.
- Substances such as salts, sugars, water, wastes are made up of smaller molecules which can pass easily through the pores to enter the capsule.
2. Proximal Convoluted Tubule – Re-absorption

- **Longest** (14 mm) and **widest** part of the nephron.
- It is lined with epithelial cells containing microvilli and numerous mitochondria.
- In this part of the nephron over **80% of the filtrate is reabsorbed** into the tissue fluid and then to the blood.
- This ensures that all the **“useful” materials** that were filtered out of the blood (such as glucose and amino acids) are now returned to the blood.
- **All glucose, all amino acids, and most mineral ions** are reabsorbed by active transport from the filtrate to the tissue fluid. They then diffuse into the blood capillaries.
- **80% of the water** is reabsorbed to the blood by osmosis.
3. Loop of Henle – Formation of a Salt Bath

- The job of the loop of Henle is to make the tissue fluid in the medulla **hypertonic** compared to the filtrate in the nephron.
- The purpose of this **“salt bath” is to reabsorb water**.
- The loop of Henle does this by pumping sodium and chloride ions out of the filtrate into the tissue fluid.
- The first part of the loop (the descending loop) is **impermeable to ions**, but some water leaves by osmosis.
- This makes the filtrate more **concentrated** as it descends.
- The second part of the loop (the ascending loop) contains Na\(^+\) and Cl\(^-\) pumps, so these ions are actively transported out of the filtrate into the surrounding tissue fluid.
- Water would follow by osmosis, but it cannot because the ascending loop is **impermeable to water**.
- Therefore the **tissue fluid becomes more salty** (hypertonic) and the **filtrate becomes less salty** (hypotonic).
- Since the filtrate is most concentrated at the base of the loop, the tissue fluid is also more concentrated at the base of the medulla.
4. Distal Convoluted Tubule – Homeostasis and Secretion

• Certain substances are actively transported from the blood into the filtrate, in other words they are **secreted**.

• It is relatively short and has a boarder of microvilli with numerous membrane pumps for active transport.

• The important point about this secretion is that it is **regulated by hormones**, so this is the **homeostatic** part of the kidney.

• Substances secreted include **H^+** (for pH homeostasis), **K^+** (for salt homeostasis), **toxins**, and other **foreign substances**.
5. Collecting Duct – Concentration

• As the collecting duct passes through the hypertonic salt bath in the medulla, water leaves the filtrate by osmosis, so concentrating the urine and conserving water.
• The water leaves through special **water channels** in the cell membrane called **aquaporins**.
• These aquaporin channels are controlled by a hormone called **ADH** so allowing the **amount of water in the urine to be controlled**.
The Nephron at Work

http://www.biologymad.com/resources/kidney.swf
The Role of Kidneys in Maintaining Homeostasis

Each drop of blood in your body passes through a kidney about 350 times per day.

The kidney is able to fine tune the composition of blood and thereby help maintain homeostasis.

Kidney failure results in the breakdown of homeostasis and death occurs shortly thereafter (approximately 2 weeks).
The kidneys regulate the water content of the blood:

- Human kidneys filter out about **half a cup** of fluid from the blood each **minute**.
- Without reabsorption of water you would urinate about **45 gallons (170.34 litres!!!)** of water a day.
- Reabsorption of water into the blood occurs through **osmosis** when the filtrate (fluid which has been filtered) travels through the tubule and the collecting duct.
- Reabsorption is controlled by a **negative feedback mechanism** that involves the amount of **ADH (antidiuretic hormone)** circulating in the blood. This hormone increase the permeability of the distal tubule and the collecting duct to water, allowing more water to be reabsorbed from the urine.
The release of ADH is regulated by receptor cells in the **hypothalamus** (area of the brain). The release of ADH increases water reabsorption and produces urine more concentrated than the blood.

If a person does not have sufficient water, the lowered level of water in the blood signals the hypothalamus to **release more ADH**.

The ADH travels through the blood to the body. Upon reaching the kidney tubule it stimulates the cell membranes to become **more permeable to water**. As a result more water is reabsorbed into the blood and the urine becomes more concentrated.

If a person has too much water **less ADH is released**. Then the cell membranes of the tubules become **impermeable to water**. They do not allow water to return to the blood and urine is very diluted.
Water Regulation by the Kidneys

http://www.youtube.com/watch?v=vB7tSHqR1eY&safe=active
THE BLADDER

• Your bladder is the **hollow muscular organ** that collects and stores urine. As your bladder fills, it expands to store the **urine**.

• On average, your bladder can hold **400-600 ml** of urine for up to about five hours.

• The muscle in your bladder wall is called the **detrusor** muscle. The detrusor muscle relaxes to allow your bladder to fill. When you go to the toilet, it contracts to squeeze out urine.
What would happen if you didn’t drink water?

https://www.youtube.com/watch?v=9iMGFqMmUFs
Sphincters associated with Excretion:

There are two sphincter mechanisms:

The internal sphincter is a ring of muscle that holds the neck of the bladder in place. Your body opens and shuts it automatically without you thinking about it.

**Internal urethral sphincter:**
- Smooth muscle
- Involuntary control
- More superiorly located

The external sphincter acts like a tap and keeps urine in the bladder. It is controlled by the pudendal nerve, which is controlled by the voluntary nervous system. This means it’s under your control - you decide when to let it open. The external sphincter is also called the distal sphincter.

**External Urethral sphincter:**
- Skeletal muscle
- Voluntary control
- Posteriorly located
How do you know when to empty your bladder?

• The **micturition reflex** tells you when you need to empty your bladder. This happens on average **four to eight times** a day. The reflex is controlled by your **central nervous system**.

• When your bladder is about half full, the stretch receptors in the walls of your bladder become active and send signals along your pelvic nerves to your spinal cord.

• A reflex signal is sent back to your bladder, which makes the detrusor muscle in the bladder wall contract. The contraction increases the pressure in your bladder, and this is what makes you want to pass urine.

• Because the external sphincter is under voluntary control, you don’t urinate until you decide to relax this muscle.

http://www.youtube.com/watch?v=qMR-rAVIbV0
Homeostasis – Water Balance and Urine Concentration

Homeostatic mechanism involved in regulating levels of materials in the blood is called **negative feedback** and involves two very important hormones: **Antidiuretic Hormone** (ADH), and **Aldosterone**.

**Antidiuretic hormone (ADH):**

- Maintains **water** balance in the body.
- When the **hypothalamus** in the brain detects a lowering of **water volume** in the body.
- It signals the **pituitary** gland to release ADH into the **bloodstream**.
- ADH increases the reabsorption of **water** by the kidneys (by **increasing** the permeability of the **collecting tubules**).
- If too much **water** is present, the hypothalamus decreases the secretion of **ADH**.
- $\uparrow$ADH = $\uparrow$H$_2$O reabsorption
Aldosterone:

- Maintains **blood pressure** in the body.
- **Blood pressure** drops when the level of **sodium** in the blood falls.
- **Renin**, an enzyme produced by the **kidneys** causes the **adrenal** gland to release the hormone aldosterone.
- Promotes the reabsorption of **sodium**.
- Blood vessels **constrict**, blood pressure rises as a result, **ADH** is released, and a sensation of **thirst** are all part of this process.
- When **blood pressure** and **sodium** concentration in the blood returns to normal, renal **renin** secretion is turned off.
- $\uparrow \text{Na}^+ \text{ reabsorption} = \uparrow \text{H}_2\text{O reabsorption}$
Diuretics:

Diuretics increase the output of urine, leaving the body below normal water levels:

• Caffeinated Beverages: Such as coffee, tea and Coke all stimulate arteries to contract, which raises blood pressure, and more water is forced under pressure out of the glomerulus into the nephron for excretion.

• Alcohol: Inhibits the flow of ADH, therefore not enough water is reabsorbed in the tubule, and water loss occurs.

• Drugs: Can act as a diuretic, or an antidiuretic (opposite effects).
How does caffeine keep us awake?

https://www.youtube.com/watch?v=foLf5Bi9qXs
Characteristics of Urine:

- about 95% water
- usually contains urea, uric acid, and creatinine (breakdown product from creatine phosphate used up in muscles)
- may contain trace amounts of amino acids and varying amounts of electrolytes
- volume varies with fluid intake, diuretics (caffeine & alcohol) and environmental factors (heat, humidity)
- pH - 4.5-8, avg. 6.0
  - vegetarian diet - urine is alkaline
  - protein rich and wheat diet - urine is acidic
- Color - pigment is urochrome
  - Yellow color due to metabolic breakdown of hemoglobin (by bile or bile pigments)
  - affected by what we eat: salty foods, vitamins
  - Beets or rhubarb - might give a urine pink or smoky color
  - Vitamins - vitamin C - bright yellow
  - Infection - cloudy
- odor - normal is ammonia-like
<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>This urine color chart is a simple tool you can use to assess if you are drinking enough fluids throughout the day to stay hydrated. If your urine matches the colors numbered 1, 2, or 3, you are hydrated.</td>
</tr>
<tr>
<td>2</td>
<td>If your urine matches the colors numbered 4 through 8, you are dehydrated and need to drink for more fluid.</td>
</tr>
<tr>
<td>3</td>
<td>Be Aware! If you are taking single vitamin supplements or a multivitamin supplement, some of the vitamins in the supplements can change the color of your urine for a few hours, making it bright yellow or discolored.</td>
</tr>
<tr>
<td>4</td>
<td>If you are taking a vitamin supplement, you may need to check your hydration status using another tool like Handout #15: Hydration Check: Body Weight Log.</td>
</tr>
</tbody>
</table>
Why is urine yellow?

https://www.tigtagworld.co.uk/film/why-is-urine-yellow-PRM00161/
Urine Tests

A urinalysis is a group of chemical and microscopic tests. They detect the by-products of normal and abnormal metabolism, cells, cellular fragments, and bacteria in urine.

Urine is produced by the kidneys, two fist-sized organs located on either side of the spine at the bottom of the ribcage. Urine is generally yellow and relatively clear, but each time someone urinates, the color, quantity, concentration, and content of the urine will be slightly different because of varying constituents.

Many disorders can be diagnosed in their early stages by detecting abnormalities in the urine. Abnormalities include increased concentrations of constituents that are not usually found in significant quantities in the urine, such as: glucose, protein, bilirubin, red blood cells, white blood cells, crystals, and bacteria.
The abnormalities that may be present arise because:

- there are elevated concentrations of the substance in the blood and the body is trying to decrease blood levels by "dumping" them in the urine,

- kidney disease has made the kidneys less effective at filtering or,

- an infection, as in the case of bacteria and white blood cells.
How is a Urine Test used?

The urinalysis is used as a screening and/or diagnostic tool because it can help detect substances or cellular material in the urine associated with different metabolic and kidney disorders. It is ordered widely and routinely to detect any abnormalities that require follow up.

Often, substances such as **protein** or **glucose** will begin to appear in the urine before patients are aware that they may have a problem. It is used to detect **urinary tract infections (UTI)** and other disorders of the urinary tract. In patients with acute or chronic conditions, such as kidney disease, the urinalysis may be ordered at intervals as a rapid method to help monitor organ function, status, and response to treatment.
1. Glucose

When present in urine condition called **glycosuria** (non-pathological). [Glucose is not normally found in urine]

Indicative of:
- **Excessive carbohydrate intake**
- **Stress**
- **Diabetes mellitus (high blood sugar)**
2. Albumin

Abnormal in urine; it’s a very large molecule, too large to pass through glomerular membrane. Condition called **albuminuria**.

Non-pathological conditions:
- **excessive exertion**
- pregnancy
- overabundant protein intake-- leads to physiologic albuminuria

Pathological condition:
- kidney trauma due to blows
- **heavy metals**
- **bacterial toxin**
What does the test result mean?

Urinalysis results can have many interpretations.

Generally, the greater the concentration of the atypical substance, such as greatly increased amounts of glucose, protein, or red blood cells, the more likely it is that there is a problem that needs to be addressed.

A normal urinalysis does not guarantee that there is no illness. Some people will not release elevated amounts of a substance early in a disease process, and some will release them sporadically during the day, which means that they may be missed by a single urine sample. In very dilute urine, small quantities of chemicals may be undetectable.
How the Kidneys change with age:

- Kidneys appear scarred and grainy
- Kidney cells die
- By age 80, kidneys have lost a third of their mass
- Kidney shrinkage due to loss of glomeruli
- Proteinuria may develop (protein in urine)
- Renal tubules thicken
- Harder for kidneys to clear certain substances
- Bladder, ureters, and urethra lose elasticity
- Bladder holds less urine
Excretory Disorders
Nephritis:
Inflammation of the kidney, which causes impaired kidney function.

Causes:
- allergic reaction to medication or antibiotic
- bacteria
- infections

Symptoms:
- pain in the pelvis
- pain or a burning sensation while urinating
- a frequent need to urinate
- cloudy urine
- blood or pus in the urine
- pain in the kidney area or abdomen
- swelling of the body, commonly in the face, legs, and feet
- vomiting
- fever
- high blood pressure

Treatments:
- Medication
- Supplements
- Dialysis
Cystitis/ UTI
inflammation of the bladder

Causes:
- When women insert a tampon there is a slight risk of bacteria entering via the urethra.
- When a urinary catheter is changed there may be damage to the area.
- The patient does not empty his/her bladder completely, creating an environment for bacteria to multiply in the bladder. This is fairly common among pregnant women, and also men whose prostates are enlarged.
- Part of the urinary system may be blocked.

Symptoms:
- Urine may have traces of blood
- Urine is dark and/or cloudy
- Urine has a strong smell
- Pain just above the pubic bone
- Pain in the lower back
- Pain in the abdomen
- Only small amount of urine is passed each time
- Frequent need to urinate
- Burning sensation when urinating
- Older women may feel weak and feverish but have none of the other symptoms mentioned above
- When children have cystitis they may have any of the symptoms listed above, plus vomiting and general weakness
Treatments:
• Painkillers, such as ibuprofen may help with the discomfort.
• Drink plenty of fluids. This will help flush the bacteria from the system.
• Do not consume alcohol.
• Cranberry juice has been shown to be good for the urinary tract and effective in fighting urinary tract infections (2010 study). Drinking some cranberry juice each day may prevent recurrences - some people have even experienced relief of symptoms.
Kidney Stones

Kidney stones (renal lithiasis, nephrolithiasis) are small, hard mineral deposits that form inside your kidneys. The stones are made of mineral and acid salts.

Causes:

- Kidney stones often have no definite, single cause, although several factors may increase your risk.
- Kidney stones form when your urine contains more crystal-forming substances — such as calcium, oxalate and uric acid — than the fluid in your urine can dilute. At the same time, your urine may lack substances that prevent crystals from sticking together, creating an ideal environment for kidney stones to form.
Symptoms:
• Severe pain in the side and back, below the ribs
• Pain that spreads to the lower abdomen and groin
• Pain that comes in waves and fluctuates in intensity
• Pain on urination
• Pink, red or brown urine
• Cloudy or foul-smelling urine
• Nausea and vomiting
• Persistent need to urinate
• Urinating more often than usual
• Fever and chills if an infection is present
• Urinating small amounts of urine
Treatment:

- Drinking water.
- Pain relievers.
- Medical therapy.
- Using sound waves to break up stones.
- Surgery to remove very large stones in the kidney.
- Using a scope to remove stones.
- Parathyroid gland surgery. Some calcium phosphate stones are caused by overactive parathyroid glands, which are located on the four corners of your thyroid gland, just below your Adam's apple. When these glands produce too much parathyroid hormone (hyperparathyroidism), your calcium levels can become too high and kidney stones may form as a result.
Viral hepatitis, including hepatitis A, hepatitis B, and hepatitis C, are distinct diseases that affect the liver and have different hepatitis symptoms and treatments. Other causes of hepatitis include recreational drugs and prescription medications. Hepatitis type is determined by laboratory tests.

Causes:

- **Hepatitis A.** You usually get it when you eat or drink something that's got the virus in it.
- **Hepatitis B.** This type spreads in several ways. You can get it from sex with someone who's sick or by sharing a needle when using street drugs. The virus also can pass from a mother to her newborn child at birth or soon afterward.
- **Hepatitis C.** You get this type if you have contact with contaminated blood or needles used to inject illegal drugs or draw tattoos.
Symptoms:

• Diarrhea
• Fatigue
• Loss of appetite
• Mild fever
• Muscle or joint aches
• Nausea
• Slight abdominal pain
• Vomiting
• Weight loss.
• Circulation problems
• Dark urine
• Dizziness
• Hives
• Itchy skin
• Light colored feces, the feces may contain pus
• Yellow skin, whites of eyes, tongue (jaundice).

Treatment:

• There is no treatment specifically for hepatitis A. The doctor will advise the patient to abstain from alcohol and drugs during the recovery. The vast majority of patients with hepatitis A will recover spontaneously.
• A patient with hepatitis B needs to rest. He will require a diet that is high in protein and carbohydrate - this is to repair damaged liver cells, as well as to protect the liver. If this is not enough, the doctor may prescribe interferon. Interferon is an antiviral agent.
• Patients with hepatitis C will be prescribed drugs.
Herpes Simplex Virus

The herpes simplex virus, also known as HSV, is an infection that causes herpes. Herpes can appear in various parts of the body, most commonly on the genitals or mouth. There are two types of the herpes simplex virus. HSV-1, also known as oral herpes, can cause cold sores and fever blisters around the mouth and on the face. HSV-2 is generally responsible for genital herpes outbreaks.

Cause:
The herpes simplex virus is a contagious virus that can be passed from person to person through direct contact. Children will often contract HSV-1 from early contact with an infected adult. They then carry the virus with them for the rest of their life.

Symptoms:
• blistering sores (in the mouth or on the genitals)
• pain during urination (genital herpes)
• itching
• fever
• swollen lymph nodes
• headaches
• tiredness
• lack of appetite.
Treatment:

There is currently no cure for this virus.

Treatment focuses on getting rid of sores and limiting outbreaks. It is possible that your sores will disappear without treatment.

However, your doctor may determine that you need one or more of the following medications:

- acyclovir
- famciclovir
- valacyclovir

These medications can help infected individuals reduce the risk of spreading the virus to other people. The medications also help to lower the intensity and frequency of outbreaks. These medications may come in oral (pill) form, or may be applied as a cream. For severe outbreaks, these medications may also be administered by injection.
Dialysis

https://www.youtube.com/watch?v=lNX65X2iQCA

https://www.youtube.com/watch?v=mi34xCfmLhw
NERVOUS SYSTEM OVERVIEW

Action Potential
https://www.youtube.com/watch?v=HYLyhXRp298

Synapse
https://www.youtube.com/watch?v=L41TYxYUqq

Reflex Arc
https://www.youtube.com/watch?v=Nn2RHLWST-k