

PHYSICAL PROPERTIES AND DETECTION OF NORMAL CONSTITUENTS OF URINE

- OBJECTIVES:

- 1- The simple examination of urine.
- 2- To detect some of the normal organic constituents of urine.
- 3- To detect some of the normal inorganic ions present in urine.

- Urinary System :

- Kidneys remove waste product from the blood through small filtering units called **nephrons**.
- Each nephron consists of a ball of small blood capillaries, called a glomerulus, and a small tube called a renal tubule.



- **Kidneys** form urine, which passes through the **ureters** to the **bladder** for storage prior to excretion.
- Waste product of protein metabolism are excreted,
- Electrolyte levels are controlled, and
- PH (acid-base balance) is maintained by excretion of H^+ ions.

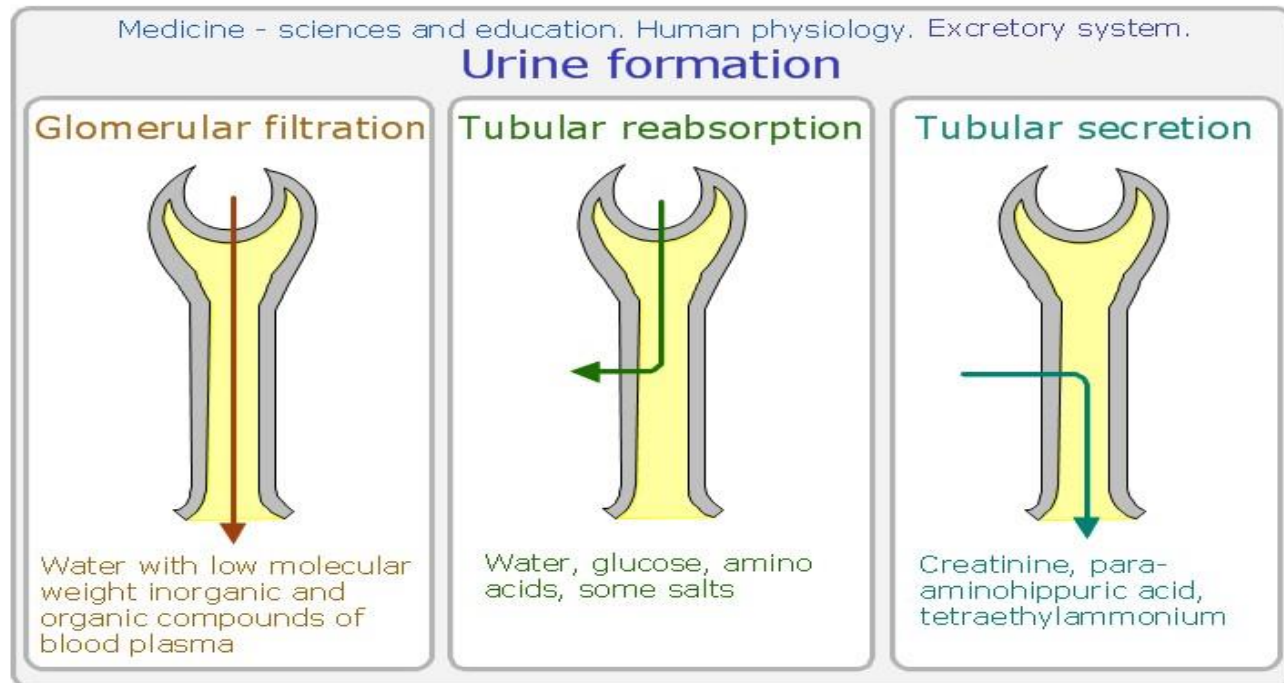
- Urine formation:

- There are three processes involved in the formation of urine:

1- Filtration.

2- Selective reabsorption.

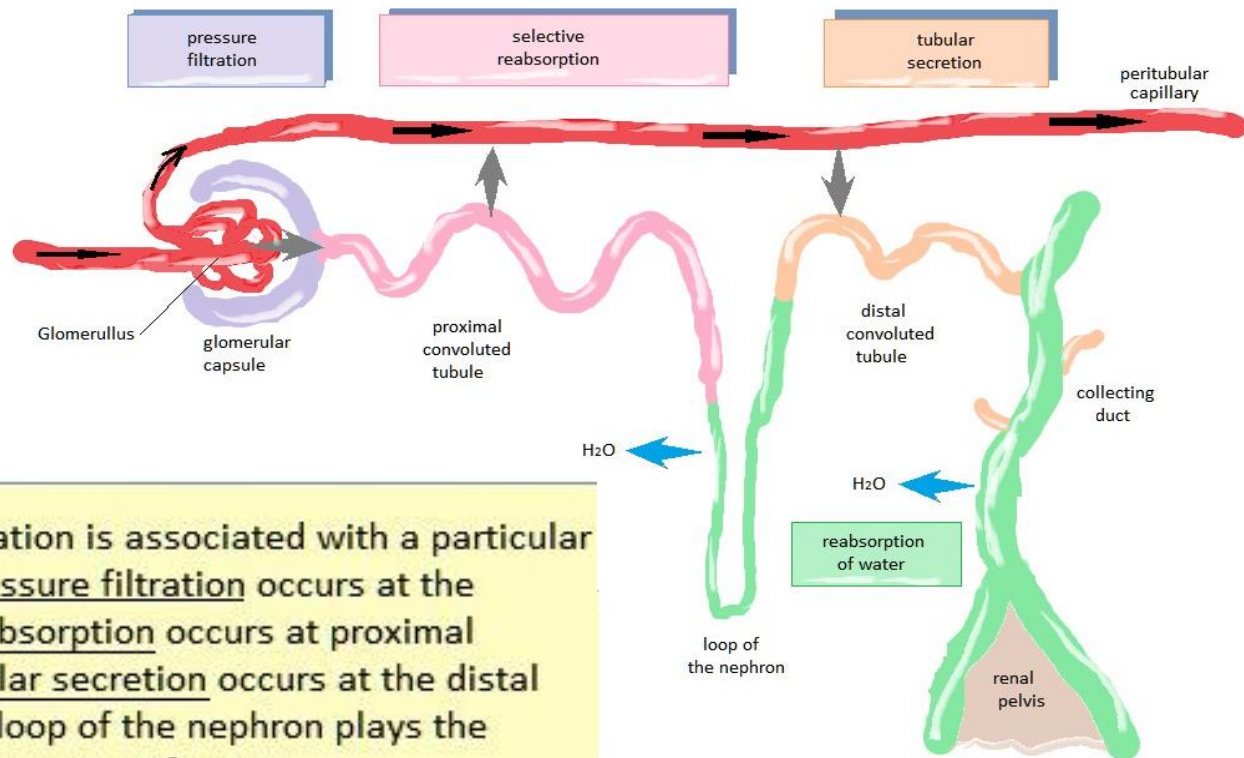
3- Secretion.



1- Filtration:

- This takes place through the **semipermeable** wall of glomerulus and glomerular capsule.
- **Water and small molecules** move from the glomerulus to the inside of the glomerular capsule.
- Molecules which have molecular weight **more** than 70,000 Dalton **can not** pass the glomerulus.
- Blood cells, plasma proteins and other large molecules are **too large** to filtrate.

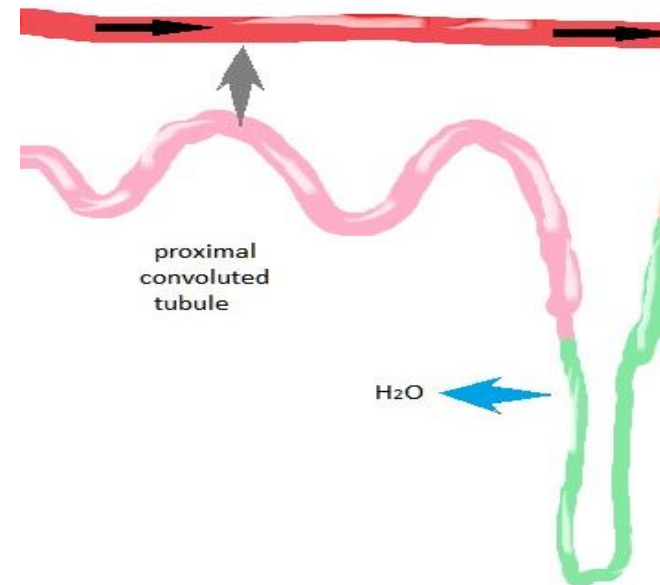
- Inside the glomerular capsule now contains **glomerular filtrate** which is very similar in composition of plasma except of **plasma proteins** and **blood cells**.
- (non-selective filtration occurs).



Each step in urine formation is associated with a particular part of the nephron. Pressure filtration occurs at the glomerular capsule; reabsorption occurs at proximal convoluted tubule; tubular secretion occurs at the distal convoluted tubule. The loop of the nephron plays the primary role in the reabsorption of water.

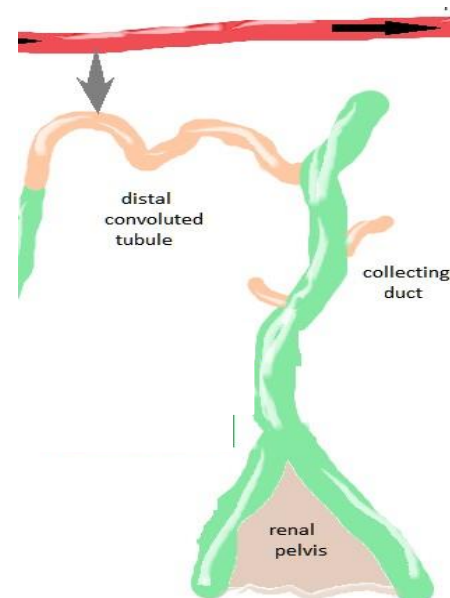
2- Reabsorption:

- Reabsorption is the movement of water and solutes from the tubule **back into the blood**.
- As molecules and ions are passively and actively reabsorbed from the nephron into the blood of the peritubular capillary network.
- **Nutrients such as glucose and amino acids** return to the peritubular capillaries almost exclusively at the proximal convoluted tubule.
- Every substance has a **maximum rate of transport**.



3- Secretion:

- Is a second way by which substances are removed from blood and added to the tubular fluid.
- Hydrogen ions (H^+), creatinine, and drugs such as penicillin are some of the substances moved by **active transport** from blood into the kidney tubule.
- In the end, urine contains :
 - 1-substances that have undergone glomerular filtration (step 1), but have **not** been reabsorbed (step 2).
 - 2-substances that have undergone tubular secretion (step 3).



Glomerular filtrate VS Urine

| Constituent Daily Excretion | Daily Excretion | |
|-----------------------------|---------------------|---------------------|
| | Glomerular Filtrate | Urine |
| Water | 130,000 ml | 1500 ml |
| Sodium | 20,000 mmol | 150 ml |
| Albumin | 4g (60 μ mol) | 0.04g (6 μ mol) |
| Urea | 900 mmol | 400 mmol |

- Composition of Normal Urine:

| | |
|---------------------|------------|
| • Water | 96% |
| • Urea | 2% |
| • Uric acid | |
| • Creatinine | |
| • Ammonia | |
| • Sodium | |
| • Potassium | |
| • Chloride | |
| • Phosphate | |
| • Sulphate | |
| • Oxalate | |

- Urinalysis:

- Two unique characteristics of urine specimens :

1- Urine is readily available and easily collected specimen.

2- Urine contain information about many of body's major metabolic functions, and this information can be obtained by simple laboratory tests.

- Laboratory testing for routine urinalysis (Type of testing):

- First, physical characteristics of the urine are noted and recorded.
- Second, a series of chemical tests is run .
- Third, the urine sediment is examined under microscope to identify components.

- Urine dipstick/ Urine test strips:

- The test strips consist of a ribbon made of absorbent microfiber cellulose pads attached to it.
- Each pad contains the dried **reagents** needed for a specific test that react with the compounds present in urine producing a characteristic colour.
- The depth of color produced relates to the concentration of the substance in the urine.
- It provides quick **Semi-quantitative determinations** of pH, protein, glucose, ketones, bilirubin, hemoglobin (blood), nitrite, leukocyte , urobilinogen, and specific gravity.
- Color changes then matched to the control chart at the correct time after each stick is dipped into the urine specimen.

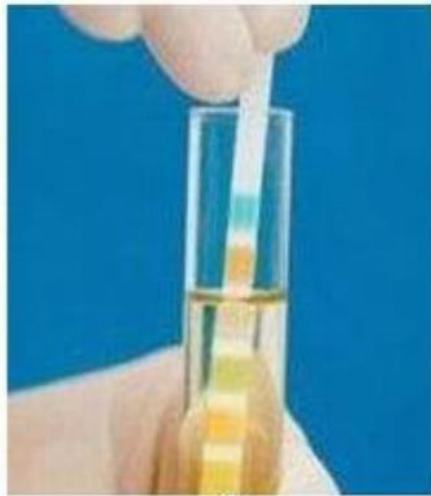


How to test your urine(visual read)?



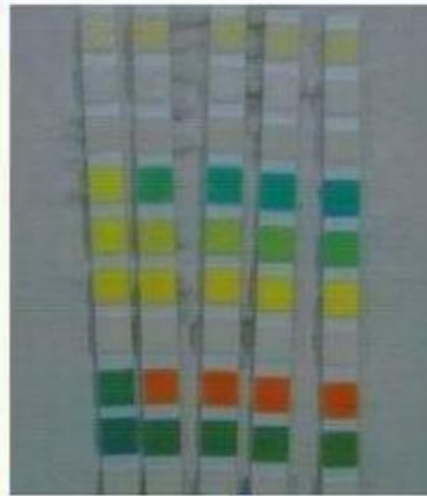
A

Prepare some fresh urine sample.



B

Dip the dry strip into the urine.



C

Absorb the excess urine with absorbent paper.



D

Contrast color chart, close to which color?

- Simple Examination of the Urine:

1- Physical examination:

- Volume, Specific gravity, Color, Appearance, odor, pH.

2- Chemical examination:

a) Organic: Uric acid, Creatinine.

b) Inorganic: Chloride, Phosphate, Bicarbonate, Sulphate, Ammonia.

- **Physical examination:**

1- Volume:

- The daily output of urine on an average diet and normal fluid intake is between 800-2500 ml with an average of 1500 ml/day.



Polyurea

- More than 2500 ml/day.
- Diabetes mellitus.
- Chronic renal insufficiency.

Oligurea

- Below 500 ml /day.
- Incase of deficient intake of water or excessive loss of fluids by other routs like haemorrhage or as diarrhea and vomiting.

Anurea

- 100 ml /day.
- Stones or tumors in the urinary tract can also cause it by creating an obstruction to urinary flow.

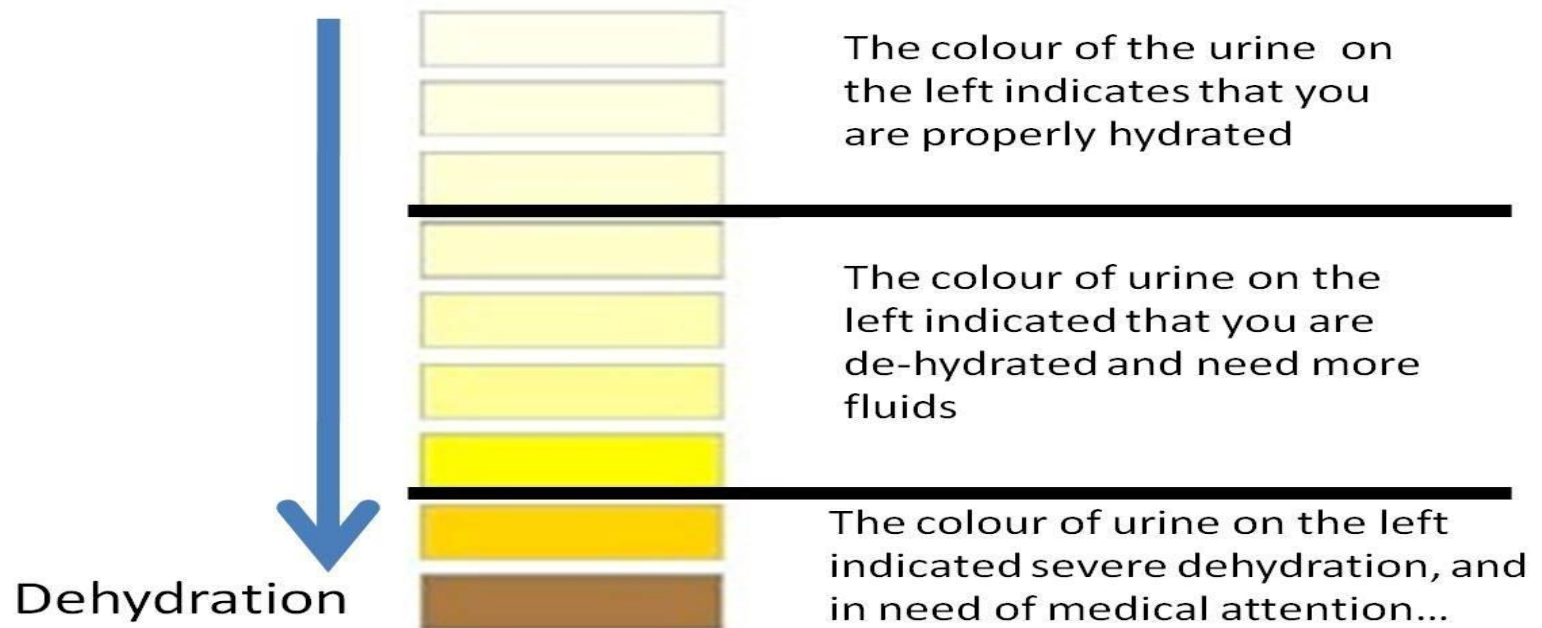
2. Colour and appearance:

- Normally, Urine is **clear** and **amber** in color due to the presence of urobilin.

*** Note:** cloudy or turbid urine can indicate dehydration, urinary tract infection or presence of RBCs, WBCs, epithelial cells or bacteria.

- **Pale** urine has a low specific gravity, a **dark** line has a **high** specific gravity (a direct relation ship between the colour and the specific gravity).

- **Coloured urines** occur in certain diseases or metabolic disorders, and after the administration of many drugs.
- The more that your body is dehydrated, the more the urine is dark.



3- Odour:

- Normally Urine smells **aromatic** due to the presence of volatile organic acids.
- The urine of patients with **diabetes mellitus** may have a fruity (acetone) odor **because of ketosis**.
- Urine which is infected with **Gram-negative organisms** often has a distinctive unpleasant smell.
- Certain drugs impart a typical odour.

4- PH:

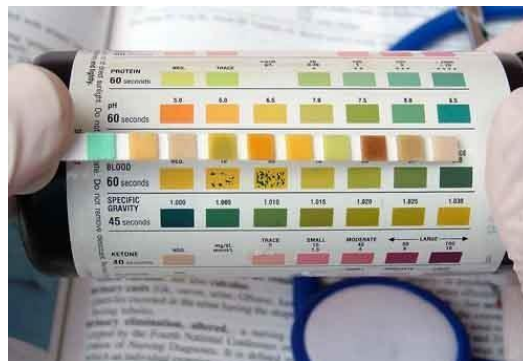
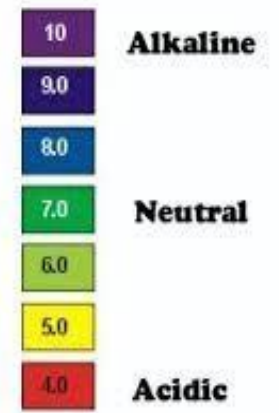
- On a normal mixed diet the urine is **usually acid**, generally varying in pH between 5.5 and 8.0 with a mean of 6 in 24 hours.

- Acidic urine:

- Diabetic ketosis, fevers, diarrheal and starvation.

- Alkaline urine:

- A vegetarian diet which causes a tendency to alkalosis.
- It may also be grossly increased by bacteria infection of the urinary tract.



- Specific gravity:

- The normal specific gravity (correctly called relative density) of a pooled 24 hour urine sample is between **1.010 and 1.025**.
- There are direct relation ship between concentration of substance in urine (Concentration of urine) and SG.
- The concentration of urine is the highest in the a morning specimen (overnight urine) and is lowest in a specimen passed an hour after much fluid has been taken.

- Method:

- **The Simple Examination of Urine**

1- Volume: Measure the volume of the 24 hour collection of normal urine.

2- Colour: Visually examine its colour.

3- Appearance: State whether it is clear, cloudy or whether deposits or precipitates are present.

4- Odour: State whether it is normal urine like ammonical, putrid, etc.

5- pH: Record the pH of the sample.

6- Specific gravity: Fill $\frac{2}{3}$ of the urinometer cylinder with the urine. Put in the urinometer ensuring that it is not touching the sides of the cylinder. Note the specific gravity and the room temperature. Make an adjustment to the specific gravity for the room temperature.

- RESULTS:

| TEST | RESULT | NORMAL |
|----------------------|--------|---------------------|
| 24 hour urine volume | ml | 750-2000 ml |
| Colour | | Pale to dark yellow |
| Appearance | | Clear |
| Odour | | Urine-like |
| pH | | 5.5-8.0 |
| Specific gravity | | 1.010-1.025 |

- To Detect some of the Normal Organic Constituents of Urine :

- Method:

1- Creatinine:

- **Put 5 ml** of urine + **4 drops** of a saturated solution of picric acid + **1 ml** of 10% sodium hydroxide solution.
- a deep red color or orange due to creatinine picrate appears

2- Uric acid:

- **Put 2 ml** of urine + **1 ml** of prarafoid, then heated in a boiling water bath for three minutes .
- White precipitate indicates the presence of uric acid.

To Detect Some of the Normal Inorganic Ions Present in Urine:

- Method:

1) Chlorides: Add **4 drops** of 2N nitric acid + **5 ml** of urine + **1 ml** of 2N silver nitrate solution.

- A white precipitate of silver chloride is formed which dissolves in 2N ammonium hydroxide solution.

2) Phosphates: Add **5 ml** of concentrated nitric acid + **5 ml** of urine + 2 ml of saturated ammonium molybdate solution.

- **Heat the mixture gently.** A yellow crystalline precipitate of ammonium phospho-molybdate appears.

3) Bicarbonate: Add **4 drops** of concentrate HCl + **5 ml** of urine. A slight effervescence occurs due to CO₂ evolution. Test the gas evolved with lime water.

4) Sulphates: Acidify **2 ml** of urine + **1 ml** dilute HCl + **3 drops** of 5% barium chloride solution.

- A white precipitate of barium sulphate is formed.

5) Ammonia: Add **1 ml** of 10% sodium hydroxide solution + **5 ml** of urine. **Boil.**

- Turning moist red litmus paper blue.

Thank you