Urinary System

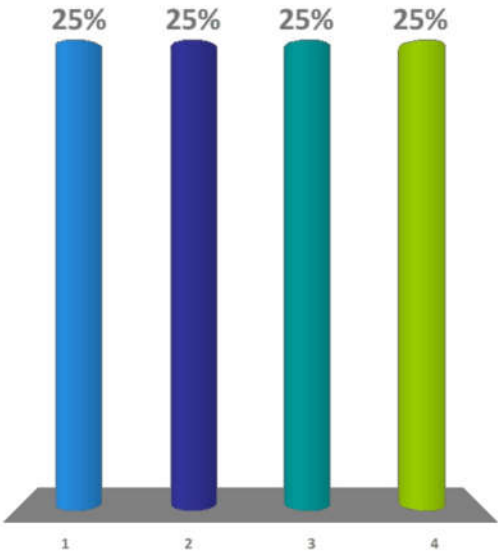
Water control and nitrogen disposal

Homeostasis

- The urinary system maintains homeostasis in several ways:
  - Removal of urea (nitrogenous waste) from the bloodstream.
  - Control of water and salt balance in the bloodstream.
  - Involved in blood pressure regulation.

The kidneys produce two important hormones. What do they control?

1. Blood pressure and volume
2. Blood clotting
3. Blood sugar
4. Blood oxygen



Blood pressure

Renin

- Renin is an enzyme released by the kidneys in response to a drop in blood pressure.
- Renin catalyzes the production of angiotensin, a hormone that causes arterioles to constrict, raising blood pressure. This also causes water retention. How does this maintain homeostasis of blood pressure?

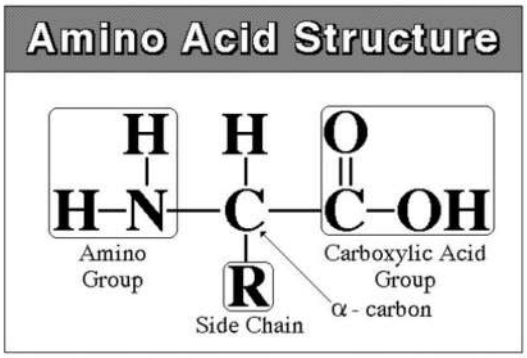
Erythropoietin

- A second response to low blood pressure is the release of erythropoietin, another hormone.
- Erythropoietin travels to the bone marrow and stimulates the production of new blood cells. How does this maintain homeostasis?

Urea removal

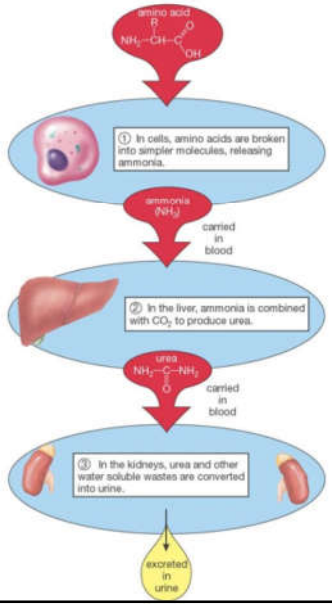
Amino acid metabolism

- Amino acids are the building blocks of protein. If not needed for building protein, then can be metabolized for energy, or broken apart and the carbon chains used to make fat.
- Metabolism requires removal of the amine unit (NH_3).



Ammonia and Urea

- Ammonia is toxic and highly water soluble.
- The liver turns ammonia into urea, which is less toxic and less soluble.

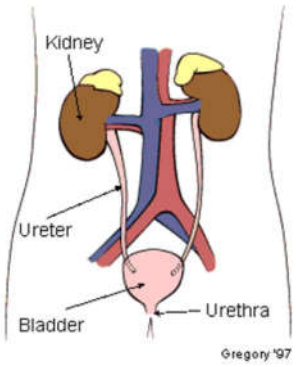


- Besides toxicity, why is it advantageous for land animals to convert highly water-soluble ammonia into less-soluble urea?
- What could be a health risk of going on an extremely high protein diet?

WORK TOGETHER

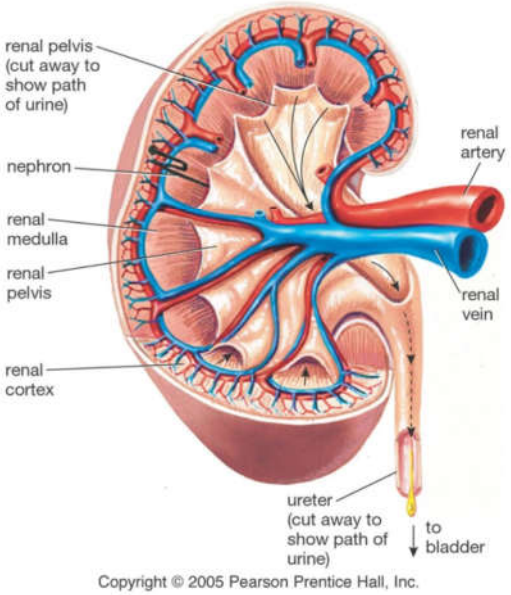
Urinary system anatomy

- Main structures of the urinary system:
- kidneys
- ureters
- bladder
- urethra



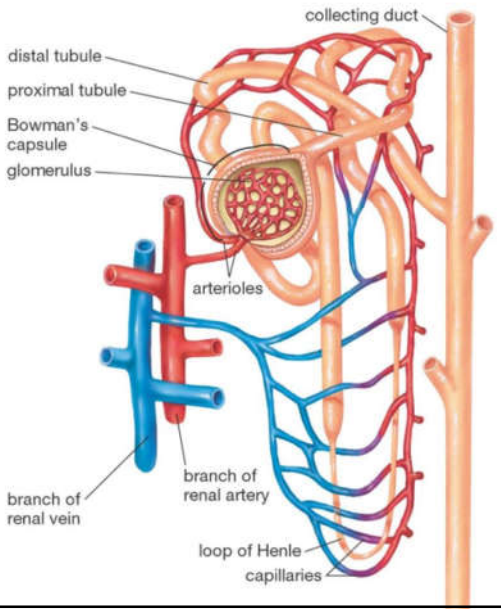
Anatomy of the Kidney

- Main structures of the mammalian kidney:
- renal cortex
- renal medula
- renal pelvis
- nephrons



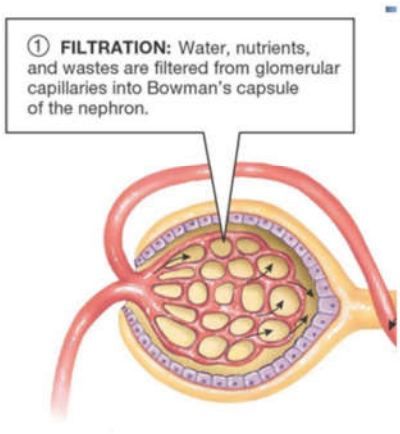
Anatomy of the Nephron

- Glomerulus
- Proximal tubule
- Loop of Henle
- Distal tubule



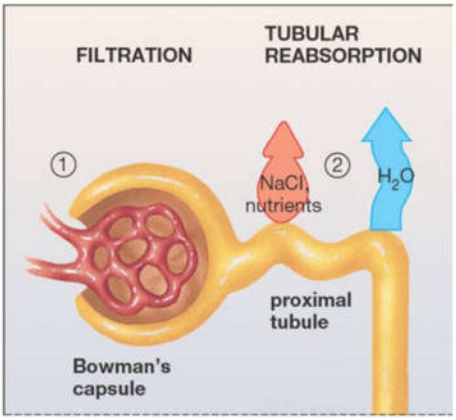
Glomerulus

- This is the only place in the system where the blood is actually "filtered."
- Blood pressure is used to push plasma through capillary walls and into the Bowman's capsule.



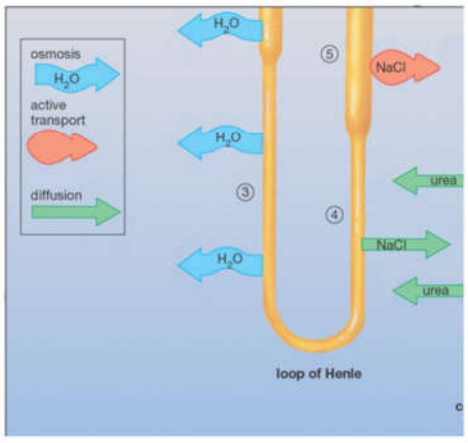
Proximal tubule

- Nutrients (salts, vitamins, etc.) are moved out of the tubule through active transport.
- Water follows the nutrients by osmosis.

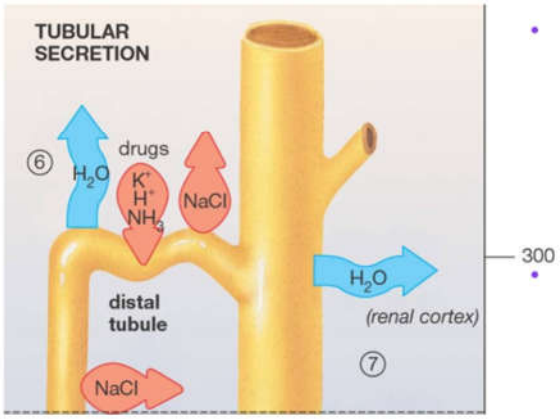


Loop of Henle

- Tissue around the Loop of Henle is salty, from active transport and diffusion of sodium chloride.
- The salty conditions allow water to diffuse out of the loop.

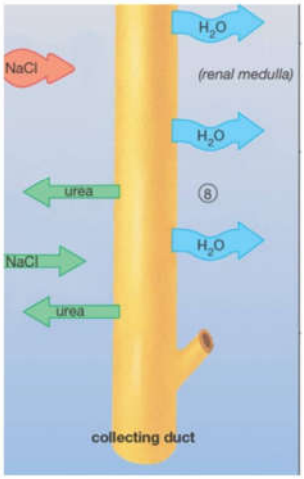


Distal tubule

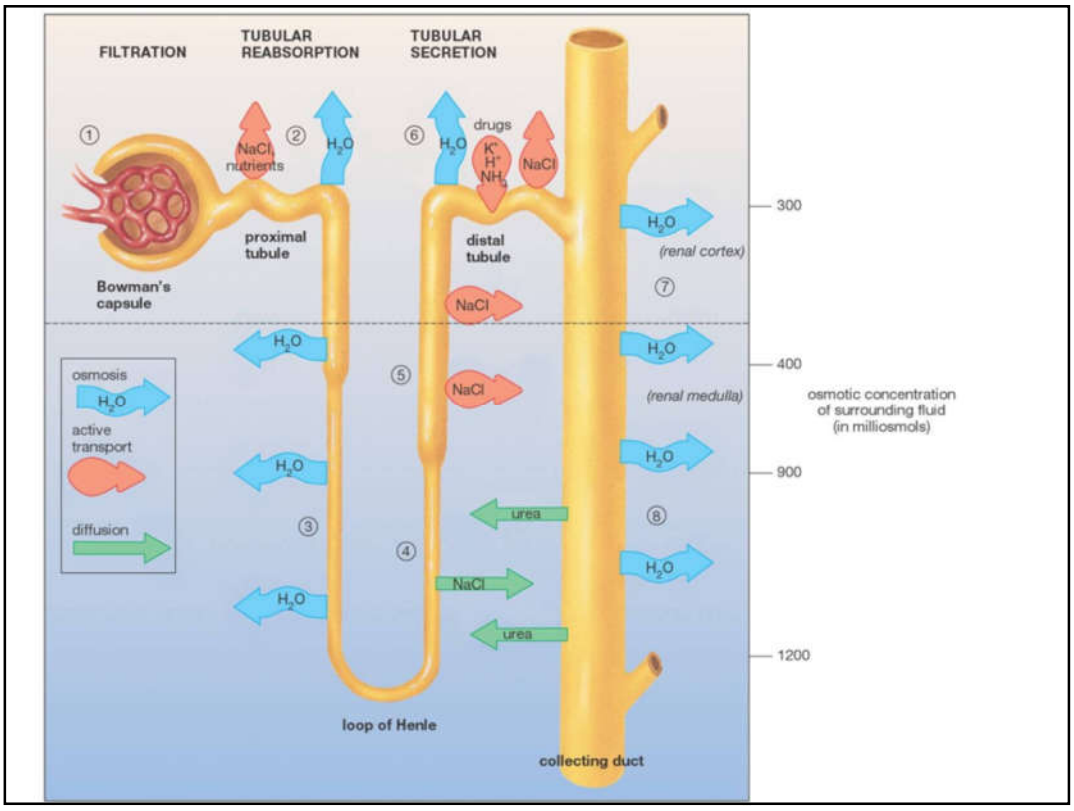


- Active transport is used to move more nutrients out of the concentrated urine.
- Some ions, drugs, and toxins are actively pumped into the tubule.

Collecting Duct

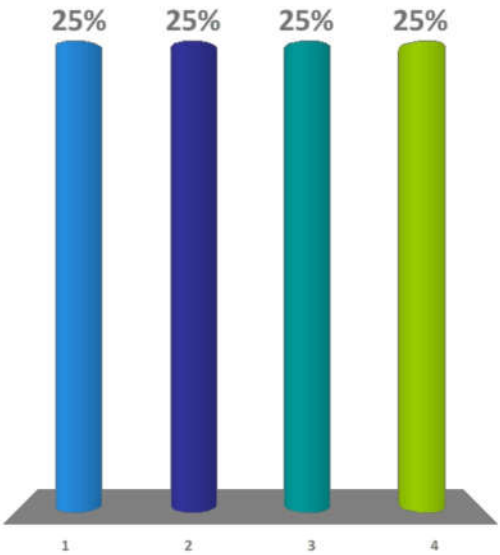


- More water leaves the tube by osmosis, since the tube is surrounded by salty tissue.
- Some urea leaves by diffusion, and may be cycled through the system.



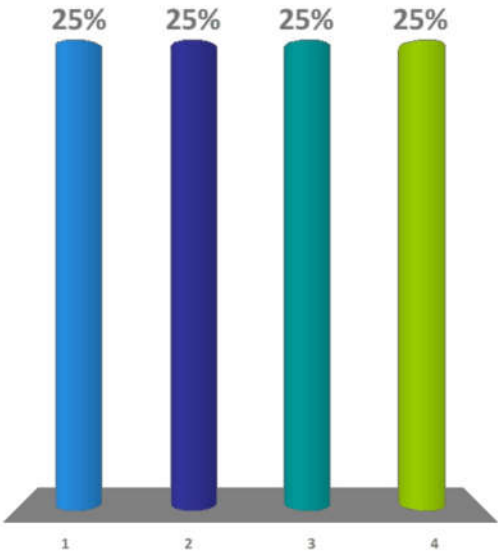
Which of these happens during filtration?

1. Salt is actively pumped out.
2. Water is removed osmotically from the filtrate.
3. ✓ Plasma moves from capillaries into the capsule.
4. Toxins are actively removed from plasma.



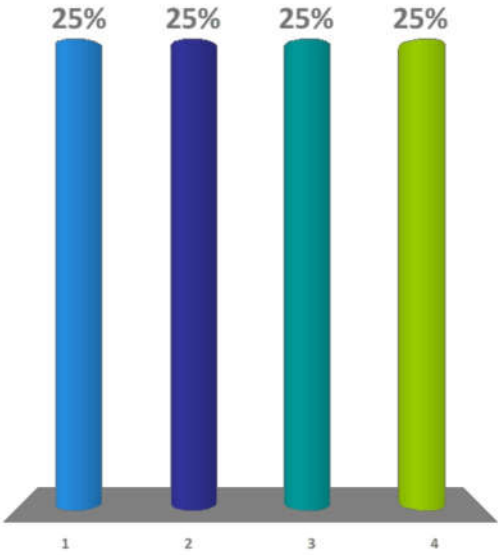
What drives filtration in the glomerulus?

1. Osmosis
2. Smooth muscle contractions
3. Salt gradients
4. ✓ Blood pressure



Which of these aids in water recovery from the filtrate?

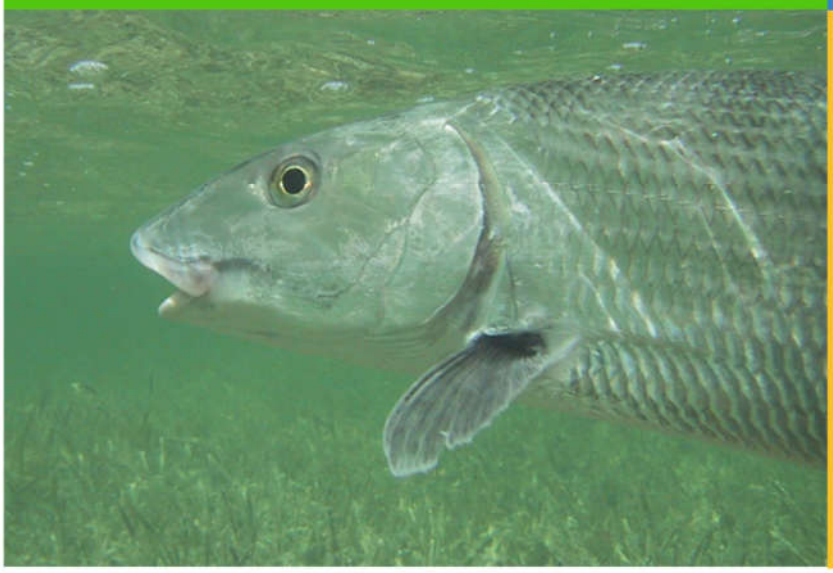
1. Active transport of water out of the tubules.
2. ✓ Active transport of sodium out of the filtrate.
3. Peristalsis in the Loop of Henle.
4. Concentration of urea in the urine.



- Notice that sodium is actively recovered in the system, while potassium may be pumped out. A "natural" diet such as hunter-gatherers eat (mostly fresh plant material supplemented with lean meat) is low in sodium and high in potassium. How is this system adaptive when eating a "natural" diet? Why does our salty, low-vegetable American diet cause problems?

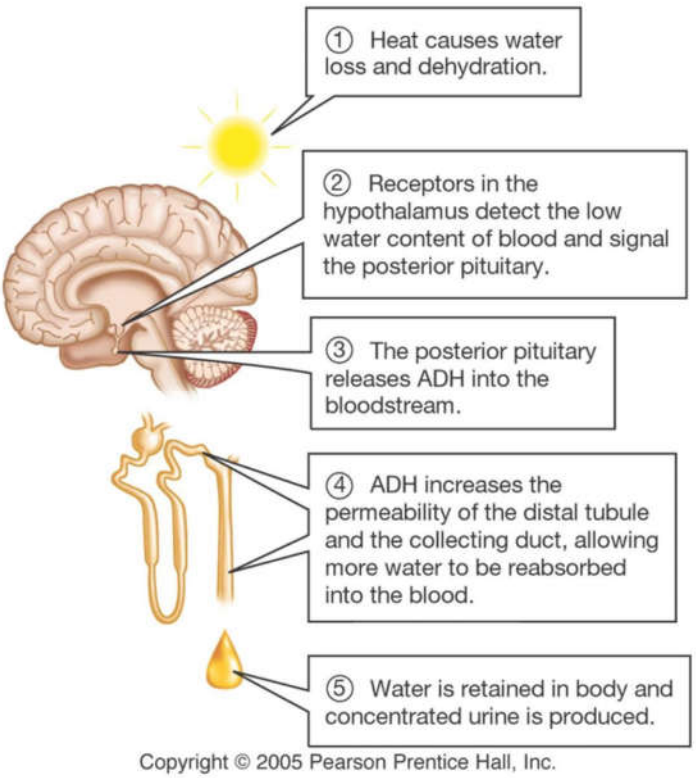
WORK TOGETHER

Water Regulation



Regulating water

- Antidiuretic hormone (ADH, also called vasopressin) is part of a negative feedback system that regulates water in the mammalian body.
- ADH increases the permeability of the distal tubule, allowing greater water recovery.

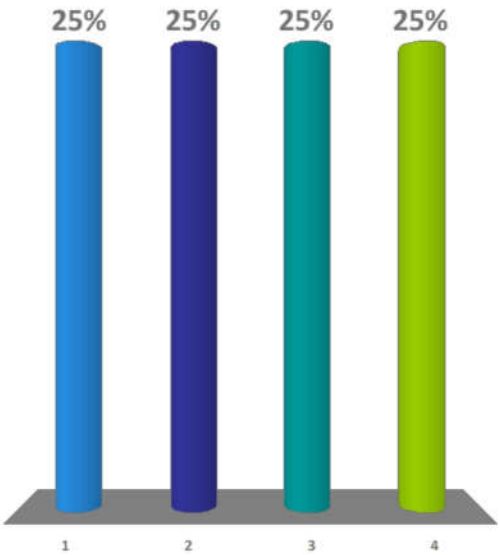


WORK TOGETHER

- Caffeine and alcohol are diuretics. Alcohol inhibits ADH release, while caffeine interferes with its activity. Part of the symptoms of a hangover are due to dehydration. What causes the dehydration? And why is a cup of coffee not a good cure for a hangover?

If a person were given a dose of ADH, what would happen?

1. More water lost through kidneys.
2. More potassium secreted by nephron.
3. More water retained in the kidneys. ✓
4. More sodium secreted by nephron.

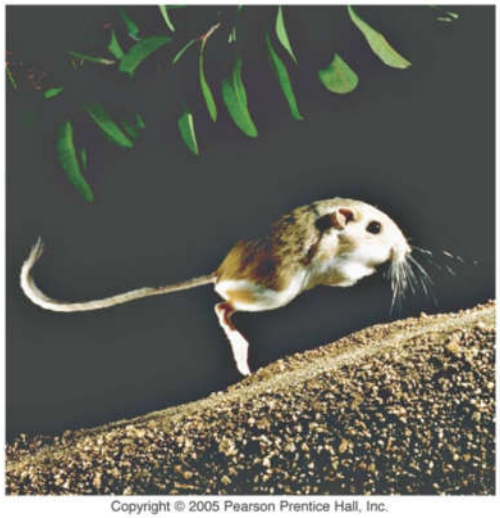


WORK TOGETHER

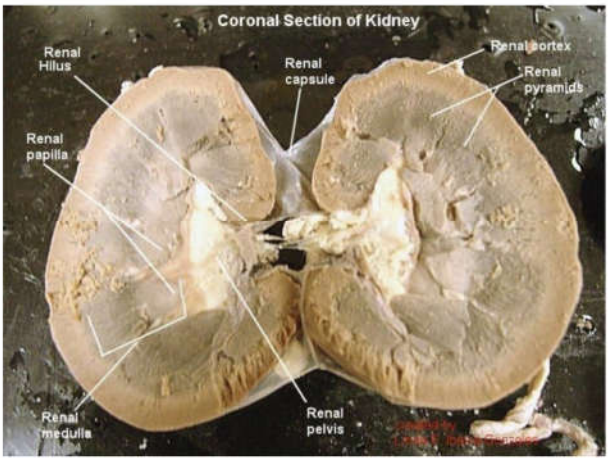
- Many over-the-counter herbal diet aids claim to "detoxify" the body or "flush fat." Many of these contain dandelion leaves, parsley, or other herbs known to be diuretics. If a person tries these products and appears to lose pounds, what is actually lost? Could there be health problems with using these products?

Final thinking question:

- The kangaroo rat is adapted to desert life. It survives on very little water. List some ways in which its kidneys might be different from the human kidney to allow it to conserve as much water as possible.



Application: Dissection Of The Sheep Kidney Dissection of The Sheep Heart For Gross Anatomical Examination



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