OCR (A) Biology A-level

5.1.2 - Excretion as an example of homeostatic control

Flashcards

What is excretion?

What is excretion?

Process of removing metabolic wastes e.g. carbon dioxide & nitrogen-based byproducts to maintain metabolism.

Enables organisms to maintain pH balance & regulate osmotic pressure.

Describe the gross structure of the mammalian liver.

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Liver lobules (cylinders of hepatocytes arranged in rows & connected at the centre) are connected to:

hepatic vein takes deoxygenated blood away from the liver & is attached to → **hepatic portal vein**: contains products of digestion & **hepatic artery**: supplies oxygenated blood via **Sinusoid capillaries.**

And **bile duct**: transports bile to gall bladder for storage.

Describe the histology of the mammalian liver.

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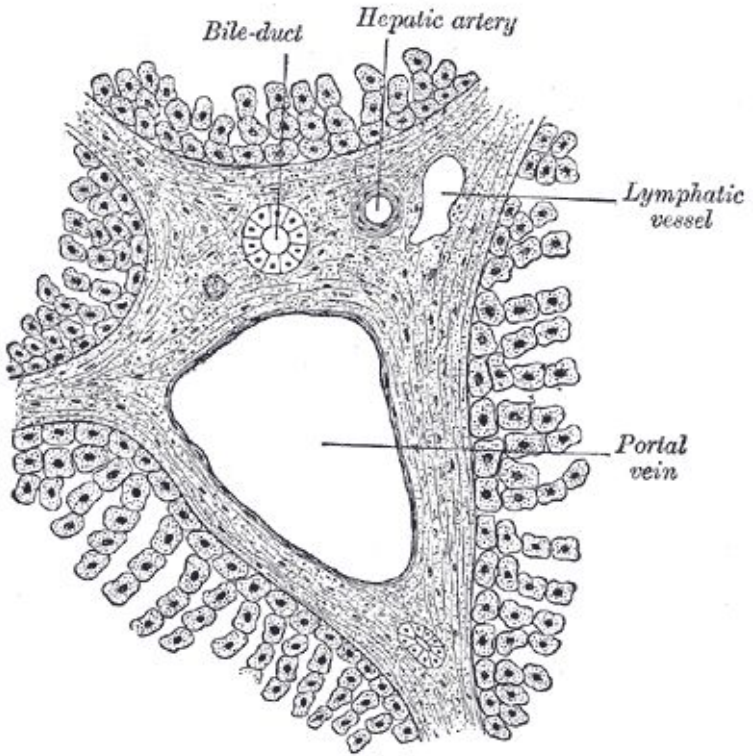

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Outline the functions of the mammalian liver.

Outline the functions of the mammalian liver.

- Site of gluconeogenesis, glycolysis, glycogenesis.
- Stores glycogen.
- Deaminates excess amino acids, forming ammonia & organic acids. Acids can be respired or converted into glycogen. Ammonia is detoxified by addition of CO_2 in ornithine cycle.
- Detoxifies chemicals e.g. converts alcohol to ethanal then acetic acid.

Describe the gross structure of the mammalian urinary system.

Describe the gross structure of the mammalian urinary system.

A: kidney

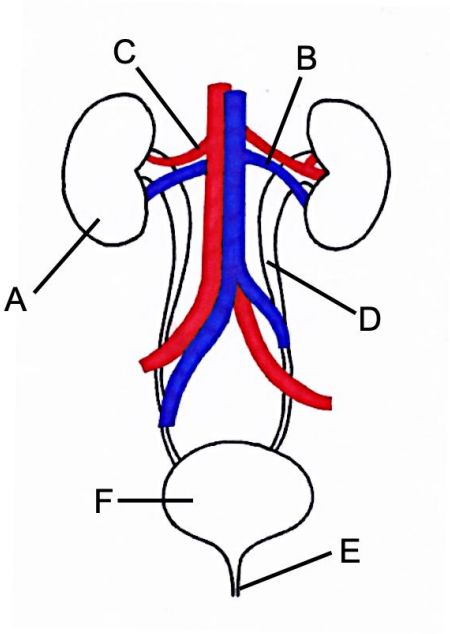
B: renal vein

C: renal artery

D: ureter

E: urethra

F: bladder



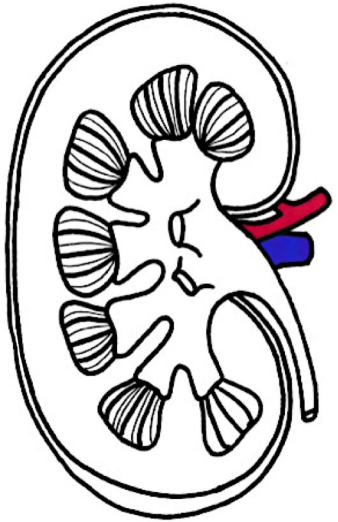
Describe the gross structure of a mammalian kidney.

Describe the gross structure of a mammalian kidney.

Fibrous capsule: protects kidney.

Cortex: outer region consists of Bowman's capsules, convoluted tubules, blood vessels.

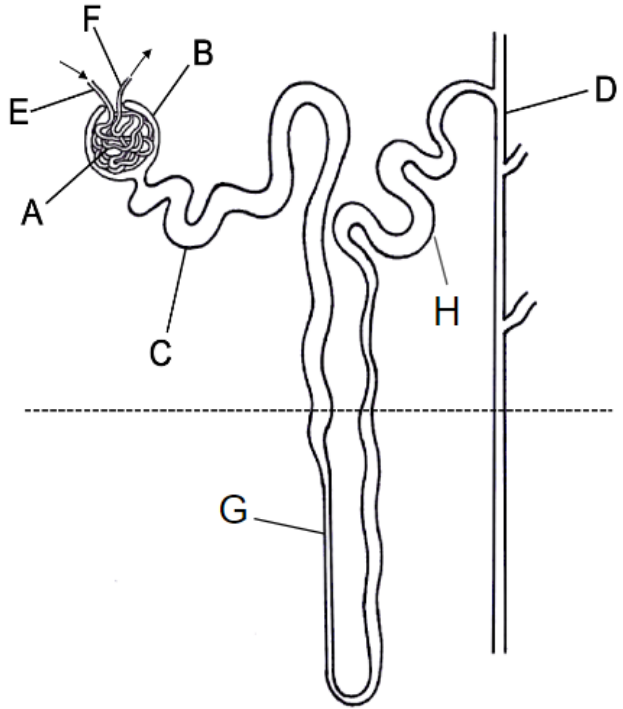
Medulla: inner region consists of collecting ducts, loops of Henle, blood vessels.



Describe the structure of a nephron.

Describe the structure of a nephron.

A: glomerulus
B: Bowman's capsule
C: proximal convoluted tubule
D: collecting duct
E: afferent arteriole
F: efferent arteriole
G: loop of Henle
H: distal convoluted tubule



Describe the blood vessels associated with a nephron.

Describe the blood vessels associated with a nephron.

Wide afferent arteriole from **renal artery** enters renal capsule & forms **glomerulus**: branched knot of capillaries which combine to form **narrow efferent arteriole.**

Efferent arteriole branches to form **capillary network** that surrounds tubules.

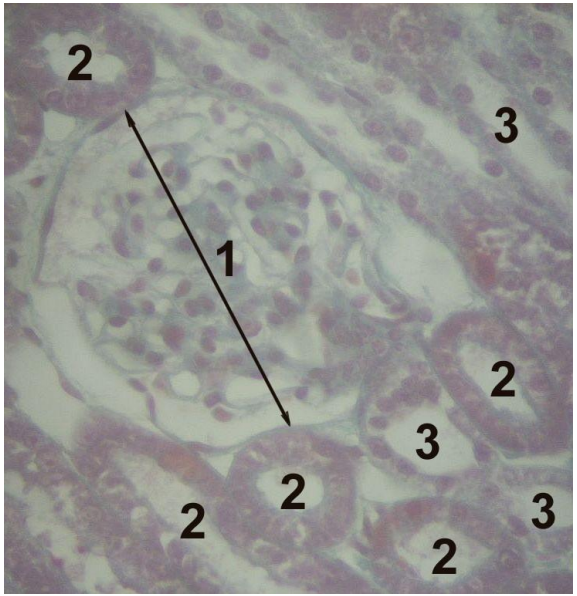
Describe the histology of the kidney.

Describe the histology of the kidney.

1: glomerulum

2: proximal tubule

3: distal tubule



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Describe the sections of a nephron.

Describe the sections of a nephron.

Bowman's capsule at start of nephron: cup-shaped, surrounds glomerulus, inner layer of podocytes.

Proximal convoluted tubule (PCT): series of loops surrounded by capillaries, walls made of epithelial cells with microvilli.

Loop of Henle: hairpin loop extends from cortex into medulla.

Distal convoluted tubule : similar to PCT but fewer capillaries.

Collecting duct: DCT from several nephrons empty into collecting duct, which leads into pelvis of kidney.

Describe the process of ultrafiltration.

Describe the process of ultrafiltration.

Occurs in **Bowman's capsule.**

High **hydrostatic pressure in glomerulus** forces small molecules (urea, water, glucose, mineral ions) out of capillary fenestrations AGAINST osmotic gradient.

Basement membrane acts as filter. Blood cells & large molecules e.g. proteins remain in capillary.

How are cells of the Bowman's capsule adapted for ultrafiltration?

How are cells of the Bowman's capsule adapted for ultrafiltration?

- Fenestrations between epithelial cells of capillaries.
- Fluid can pass between & under folded membrane of podocytes.

State what happens during selective reabsorption and where it occurs.

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Useful molecules from glomerular filtrate e.g. glucose are reabsorbed into the blood.

Occurs in proximal convoluted tubule.

Outline the transport processes involved in selective reabsorption.

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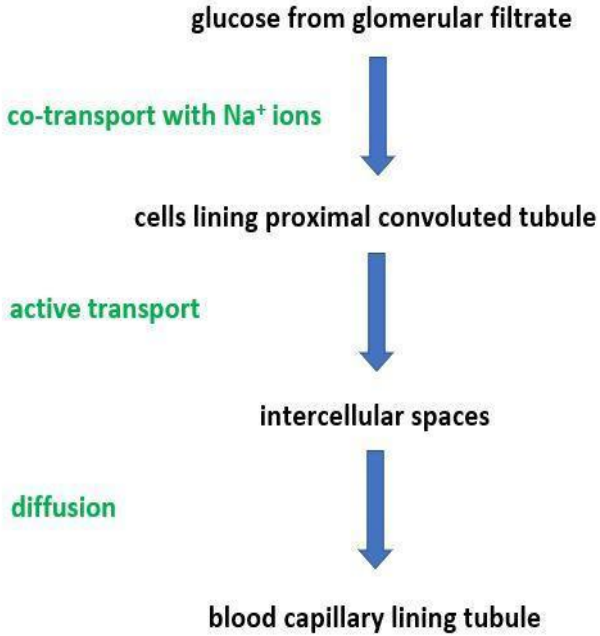

How does the kidney produce urine?

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After selective reabsorption, filtrate passes through Loop of Henle, which acts as countercurrent multiplier & then through distal convoluted tubule, where water & mineral ions are reabsorbed.

More water is reabsorbed in collecting duct. Remaining fluid (urine) contains only waste materials & water.

What happens in the loop of Henle?

What happens in the loop of Henle?

1. Active transport of Na^+ & Cl^- out of **ascending limb.**
2. Water potential of **interstitial fluid** decreases.
3. Osmosis of water out of **descending limb** (ascending limb is impermeable to water).
4. Water potential of **filtrate** decreases going down descending limb: lowest in **medullary region**, highest at top of ascending limb.

Explain the role of the distal convoluted tubule.

Explain the role of the distal convoluted tubule.

Reabsorption:

a. of water via osmosis
b. of ions via active transport

permeability of walls is determined by

action of hormones

Define osmoregulation.

Define osmoregulation.

Control of plasma water potential via negative feedback homeostatic mechanisms.

Explain the role of the hypothalamus in osmoregulation.

Explain the role of the hypothalamus in osmoregulation.

1. Osmosis of water out of **osmoreceptors** in hypothalamus causes them to shrink.
2. This triggers hypothalamus to produce more **antidiuretic hormone (ADH)**.

Explain the role of the posterior pituitary gland in osmoregulation.

Explain the role of the posterior pituitary gland in osmoregulation.

Stores and secretes the ADH produced by the hypothalamus.

Explain the role of ADH in osmoregulation.

Explain the role of ADH in osmoregulation.

Forms hormone-receptor complex on surface membrane of cells in collecting duct. Triggers activation of cAMP as secondary messenger.

Triggers cellular processes that increase reabsorption of water. Urine becomes more concentrated.

How does ADH increase reabsorption of water?

How does ADH increase reabsorption of water?

1. Makes cells lining collecting duct more permeable to water:
   Binds to receptor → activates phosphorylase → vesicles with aquaporins on membrane fuse with cell-surface membrane.
2. Makes cells lining collecting duct more permeable to urea: water potential in interstitial fluid decreases.

What can cause kidney failure?

What can cause kidney failure?

- Kidney infections cause inflammatory damage = change in glomerular filtration rate (rate at which filtrate flows through kidney).
- Kidney stones.
- Uncontrolled diabetes.
- High blood pressure damages capillaries of glomeruli = larger molecules pass into urine.

Describe the effects of kidney failure.

Describe the effects of kidney failure.

- Build-up of toxic waste products e.g. urea causes symptoms such as vomiting.
- If kidneys cannot remove excess water from blood, fluid accumulation leads to swelling.
- Disruption to electrolyte balance can make bones more brittle or increase water retention.

Name potential treatments for kidney failure.

Name potential treatments for kidney failure.

- **Renal dialysis**: haemodialysis/ peritoneal dialysis (short-term solution repeated several times a week so toxic waste products do not accumulate).
- **Kidney transplant** (long-term solution, but difficult to find suitable donor with same blood/ tissue type & patient requires immunosuppressants).

Describe haemodialysis.

Describe haemodialysis.

Removes blood from body & pumps it through a machine.

Blood runs countercurrent to dialysis fluid. Artificial membrane separates fluids = diffusion gradient enables molecules to move.

Add blood thinning agent to avoid clotting outside body.

Describe peritoneal dialysis.

Describe peritoneal dialysis.

Dialysis fluid is put into body cavity.

Exchange of molecules happens across the body's own peritoneal membrane.

Fluid must be drained and replaced.

How can urine samples be used to test for pregnancy?

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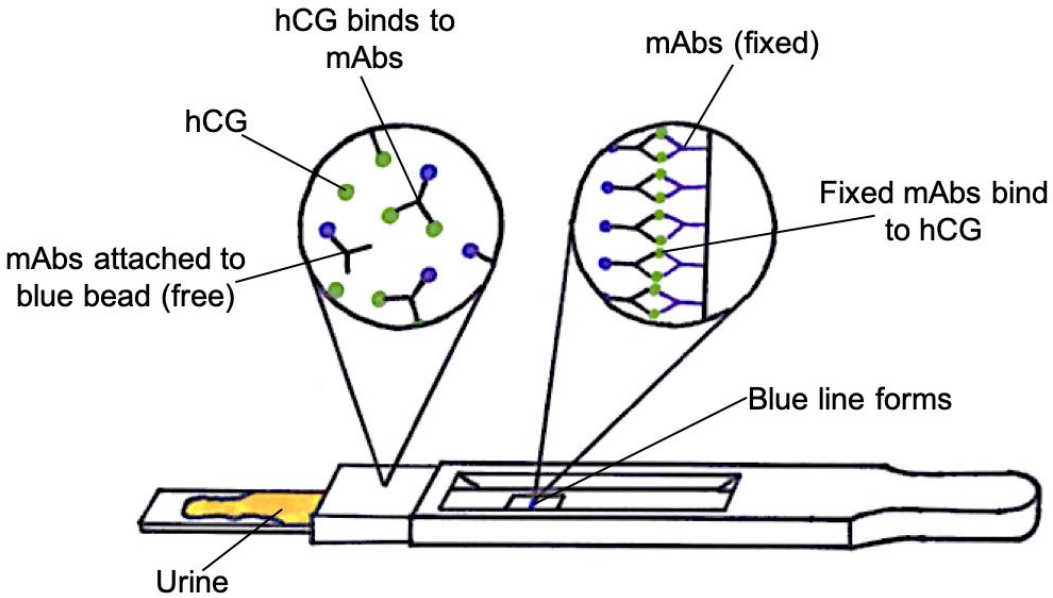
Monoclonal antibodies bind to the hormone human chorionic gonadotropin (hCG) in the urine of pregnant women.



How can urine samples be used to test for drugs such as anabolic steroids?

How can urine samples be used to test for drugs such as anabolic steroids?

Gas chromatography measures the time it takes for the urine sample to pass through the column compared to the time taken for a steroid to pass through.

What are anabolic steroids?

What are anabolic steroids?

Drugs used to build muscle mass.

Banned from sporting events due to their dangerous side effects & to ensure competition is fair.