Animal's Urinary and Osmoregulatory systems

Maintenance Introduction

Your Goal

- Be able to tell the story of kidney evolution as an essay.
- **The Benefit of an essay outline!**
  - **Save time**
  - **Organize**

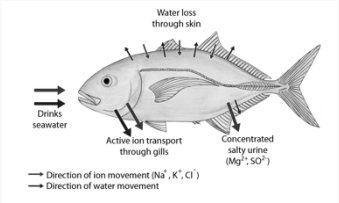
Paragraph 1: Introduction

Goal introduce the paper

- Homeostasis is the Maintenance of A Stable internal environments. It is maintained in this "Happy Zone" by Negative Feedback loops.

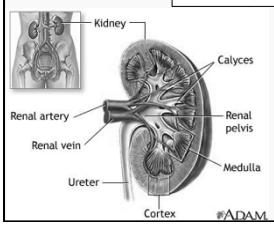
Paragraph 1: Introduction

- One example of homeostasis is Osmoregulation, which is maintaining your Water Balance in your body.



Paragraph 1: Introduction

- The key organ in charge of osmoregulation is the kidney, which is located On your back side, lower in the abdominal cavity



Paragraph 1: Introduction

- All organisms have some organs or cells to help them regulate water concentrations but Amphibians (frogs, salamanders, etc), Reptiles (snakes, turtles, etc), Birds (albatross, ducks, etc) And Mammals (Dogs, bears, etc), Have actual fully formed kidneys.

Paragraph 1: Introduction

- Kidneys perform many functions including
  (1) Homeostasis,
  (2) Excretion,
  (3) Regulation of salts in the body,
  (4) Regulation of pH,
  (5) Production of a hormone (EPO),
  and my paper will focus on
  Osmoregulation

Paragraph 1: Introduction

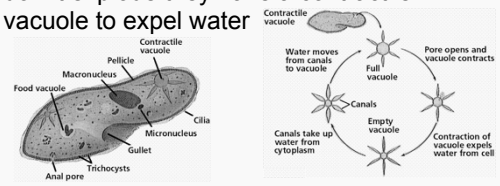
- The ability to regulate water balance is important to animals because it

Do some research

End of Intro

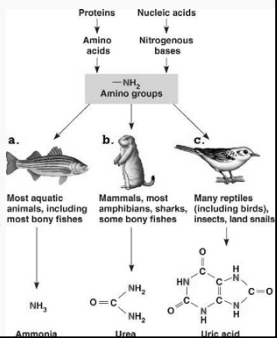
Paramecium

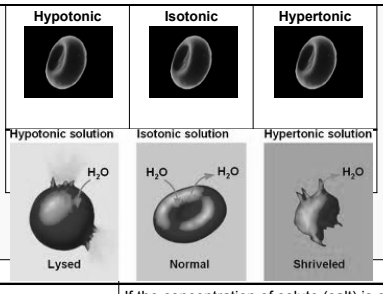
- Paramecium live in freshwater and have a problem of water being transported into them because of Osmosis. To ensure they don't explode they have a contractile vacuole to expel water



Kindney's Function

- Remove Waste from blood:
  - Salt
  - Urea
  - Concentrate Urine (remove water)
  - Remove Ammonia
    - Ammonia is neurotoxic. Marked brain damage is seen in cases of failure to to eliminate urea through the kidneys. The result of either of this event is a buildup of circulating levels of ammonium ion.

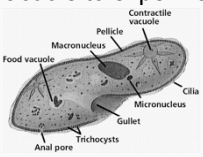


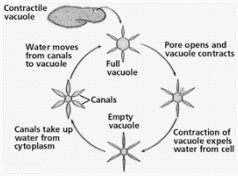


Solution	
ISOTONIC **"ISO"** means the same	If the concentration of solute (salt) is equal on both sides -No net movement of water
HYPOTONIC **"HYPO"** means less	In this case there are less solute (salt) molecules outside the cell -The cell will gain water and grow larger
HYPERTONIC	The word in this case there are more solute

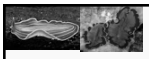
Paramecium

- Paramecium live in freshwater and have a problem of water being transported into them because of Osmosis. To ensure they don't explode they have a contractile vacuole to expel water

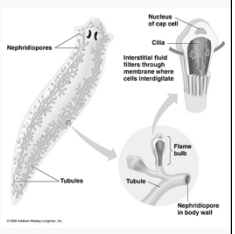




Planaria

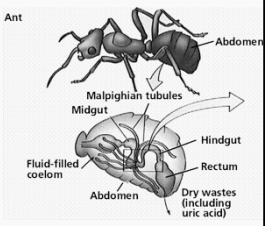


- Planaria and other **flatworms** (Phylum Platyhelminthes) live in freshwater.
- They have a special excretory system called the flame cell, which is the simplest animal that has a dedicated excretory system. The beating of these cilia resemble a flame, giving the cell its name.



Insects

- The **Malpighian tubule system** is a type of excretory and osmoregulatory system found in Insects.
- The system consists of branching tubules that absorbs solutes, water, and wastes from the hemolymph (there version of blood). The wastes then are released in the form of solid nitrogenous compounds



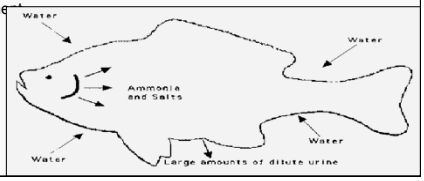
Evolution of the Kidney

Evolution of the Kidney

●Only the Birds and mammals can reabsorb enough water from the filtrate to produce urine that is hypertonic to blood (more concentrated than blood)

Kidneys and Freshwater Fish

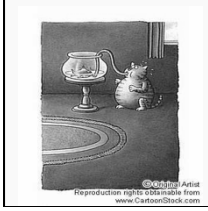
- Fi[illegible] rely heavily on their gills for excreting ammonia. (Nitrogen waste)
- evolved 1st in freshwater fish (bony fish)
  - Problem 1- Water enters the body from the environment
  - Problem 2- Solutes (particles) tend to leave the body to enter the environme[illegible]

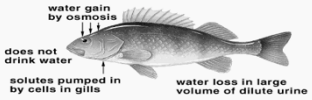


Freshwater fish

Solution

1. Freshwater fish **DON'T** drink w
2. Freshwater fish actively reabsorb ions across the nephron from the filtrate into the blood

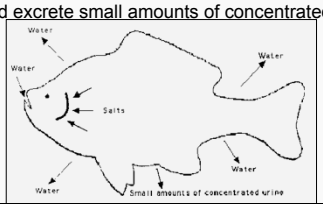




a. Freshwater bony fish (body fluids far saltier than surroundings)

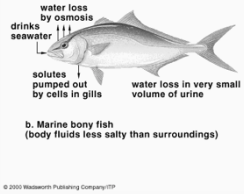
Saltwater fish (Marine bony fish)

- Saltwater fish probably evolved from freshwater fish.
- Direction of water, ammonia, and salt movements into and out of saltwater fish. Saltwater fish drink large amounts of water and excrete small amounts of concentrated urine.



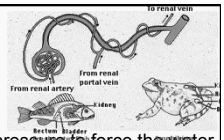
Saltwater Fish

- Solution
  1. Gills actively secrete NaCl that is being absorbed from the water
  2. Fish DRINK water and produce very little urine



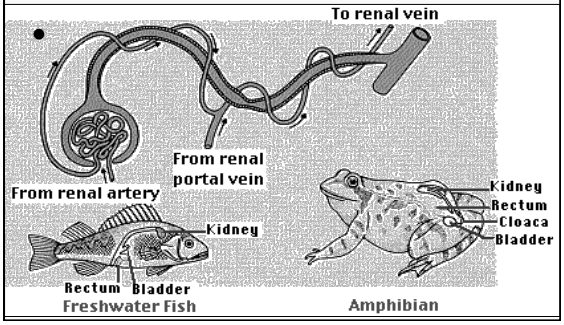
b. Marine bony fish (body fluids less salty than surroundings)

Amphibians



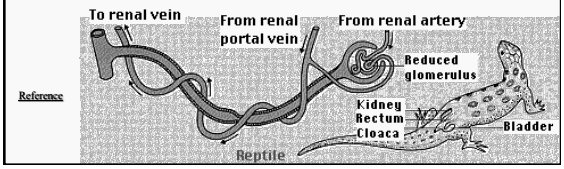
- Contraction of its heart provides the pressure to force the water and ions into the glomerulus as nephric filtrate.
- Most of the nitrogenous wastes (including large amounts of ammonia, NH_3) leave by diffusion out of the gills.
- So, the kidney is mostly a device for maintaining water balance in the animal, rather than an organ of excretion.
- Identical to kidney of freshwater fish.
- Not surprisingly they spend a lot of time in freshwater and produce very diluted urine and actively transport Na^+ in across the skin

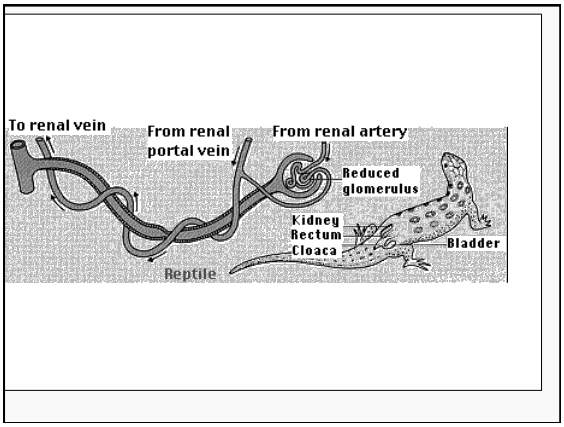
Amphibians



Terrestrial (Land) Reptiles

- Many reptiles live in dry environments (e.g., rattlesnakes in the desert). Among the many adaptations to such environments is their ability to convert waste nitrogen compounds into **uric acid.**
  - Their nephrons helping to conserve
- Some have the ability to convert waste nitrogen compounds into **uric acid**.

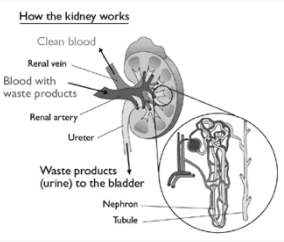




Birds

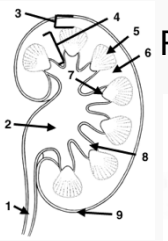
- Since birds are a descendent of the reptiles they have a very similar excretory system
- Some birds drink saltwater when fishing and have a salt gland, located just above the bill, filters out much of the salt before it gets to the kidneys.

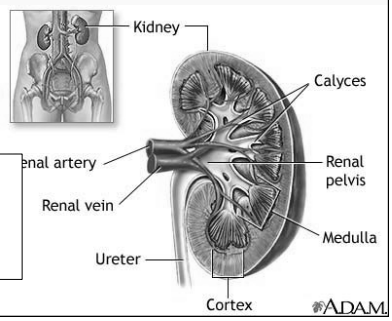
Vertebrate Kidney Form



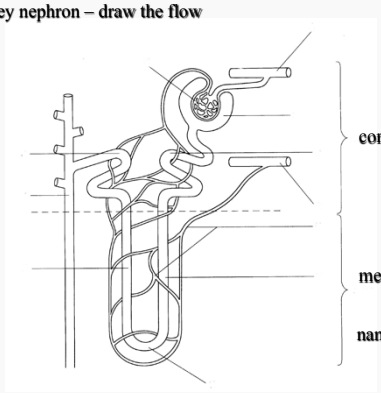
- The kidneys receive blood through the renal artery and filters out waste from the blood.
- The blood is passed through the structure of the kidneys called nephron, where waste products and excess water pass out of the blood stream, as shown in the diagram.

Renal Structure

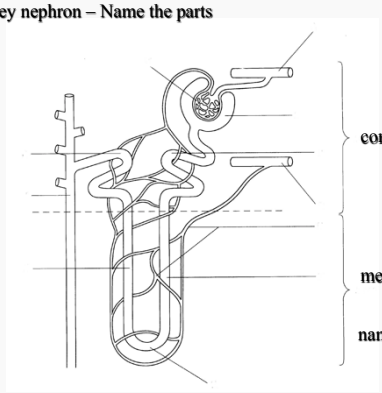


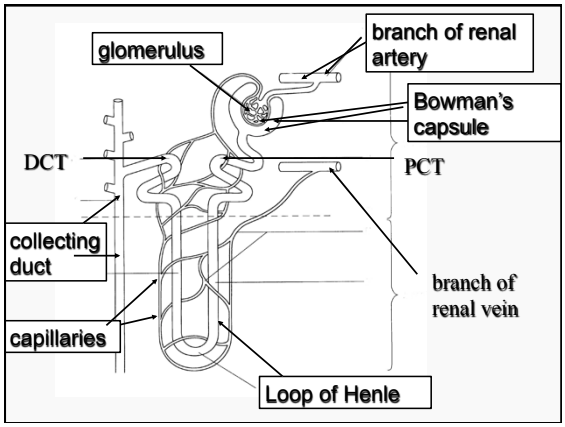


Kidney nephron – draw the flow

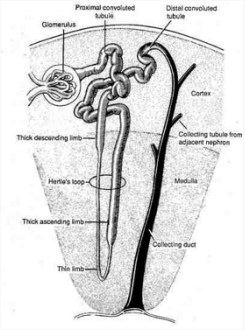


Kidney nephron – Name the parts



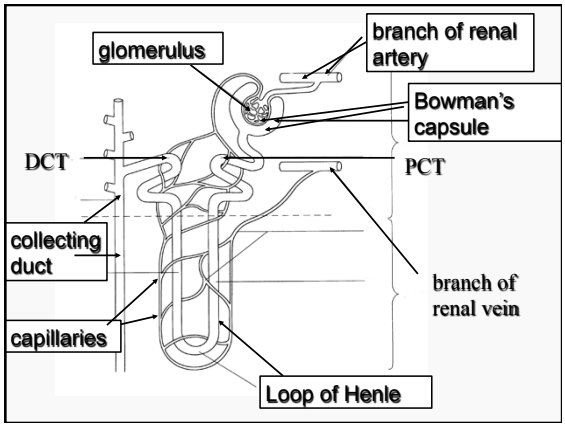


This WHOLE THING = The Nephron



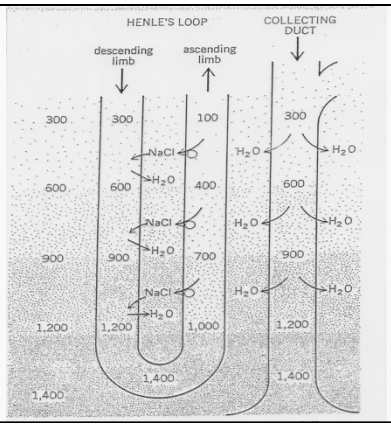
Nephron

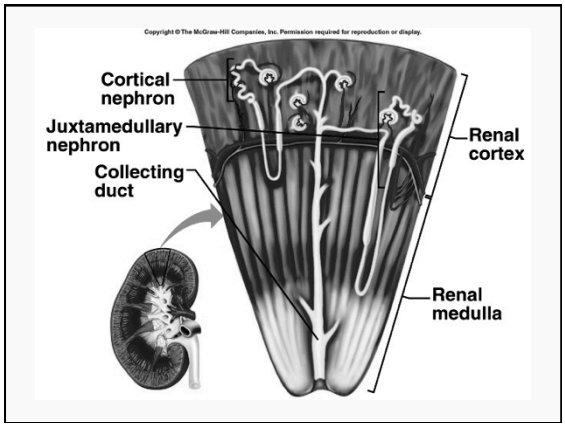
- Functional unit of the kidney
- Filtration, tubular reabsorption, tubular secretion
- Renal corpuscle:
  - Glomerulus – capillaries
  - Glomerular or Bowman's capsule

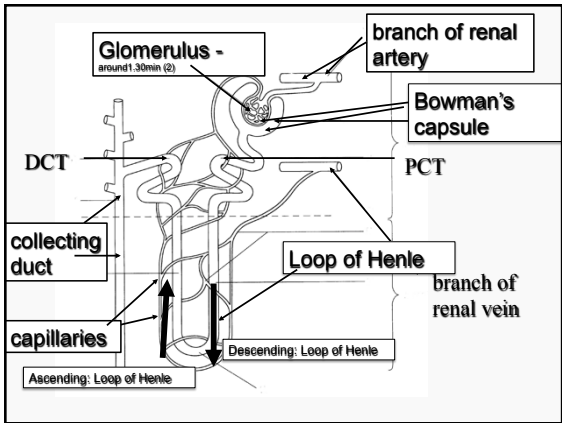


Loop of Henle

- Responsible for producing a concentrated urine by forming a concentration gradient within the medulla of kidney.
- A higher concentration on the outside of the loop pulls out water for re-absorption.
- The deeper the loop the more concentrated the pee will be.







- Bowman's capsule
  - What: knot of capillaries inside the glomerular capsule
  - Fct: Receives filtrate
- Nephron loop or Loop of Henle
  - Regulates concentration of urine

Descending	Ascending
Water leaves – OSMOSIS	Salt Leave – Active Transport (uses energy)

- Collecting duct
  - Re-absorption of water and electrolytes
  - Re-absorption stimulate by Anti-Diuretics Hormone (ADH)
- Capillaries & branch of renal artery:
  - Supply blood to be filtered

To Make Concentrated Urine

- You need:
  - Long loop of henle:
    - With extreme concentrtion gradient to pull out ater and salt
  - ADH
    - Anti-diuretic hormone at collecting duct to make it soluble to water so more water can leave.