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Biology 1306/1406 – Modern Concepts in Bioscience II
Week of February 8, 2021

Hey everyone! I hope that Exam I went well for those who have taken it, and that those who haven't are feeling confident! If you need any additional help, group tutoring sessions are a great resource, as is making a 30-minute appointment through the tutoring center.

Keywords: Kidney, nephron, heart, circulatory system, tissues, and osmoregulation!

Our Group Tutoring sessions will be every Thursday from 7:00-8:00 PM. You can reserve a spot at https://baylor.edu/tutoring. I hope to see you there!

This week in Biology 1306, we will be covering Campbell Chapters 40, 42, and 44.

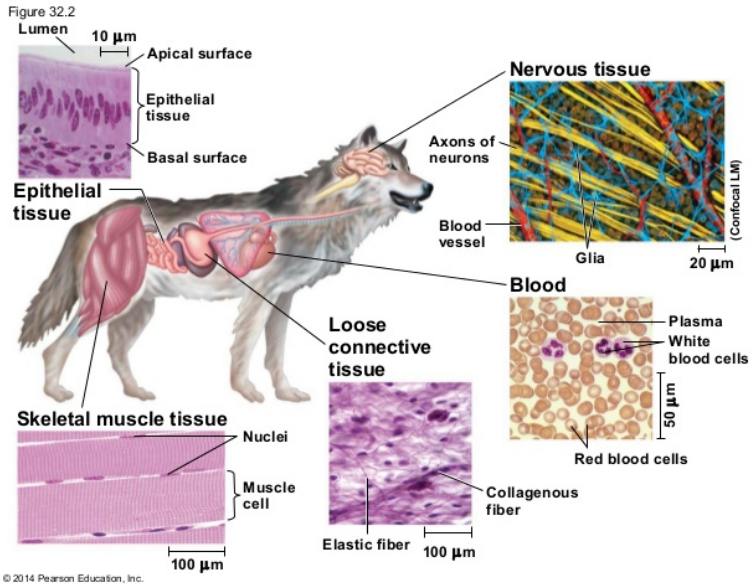
Basic Principles of Animal Form and Function : Campbell chapter 40

This chapter is very definition heavy. One thing that is important to remember as we learn different types of cells is the order of different levels of body plan organization. In order of increasing complexity, they are **cells, tissues, organs, organ systems and bodies.** By increasing complexity, organisms are able to maximize their **Surface Area to Volume** ratios. This is important because it enables organisms to exchange nutrients, water and other materials with their environment.

Within these complex organisms are different tissues:

Epithelial Tissue- lines organs, covers the body and is held together by tight junctions

- Polarized: when something is found on one side and not the other, meaning that there is an apical and basal side
- Functions as a barrier
- Avascular (no blood vessels)
- Stratified squamous, cuboidal, simple columnar, simple squamous, pseudostratified



Connective tissue- lies underneath epithelial tissue, has blood vessels (vascular)

- Blood, cartilage, adipose (fat), bone, fibrous (tendons and ligaments), and loose (found in skin)
- Collagenous fibers: provide strength and flexibility
- Reticular fibers: join connective tissue to adjacent tissue
- Elastic Fibers: make tissue elastic

Muscle Tissue- all muscles cells consist of filaments containing the proteins **actin** and **myosin** which enable the muscles to contract

- Skeletal muscle, smooth muscle, and cardiac muscle

Nervous Tissue- makes up the Central Nervous System and the Peripheral Nervous System

- Neurons and Glia (the support cells which make up myelin)

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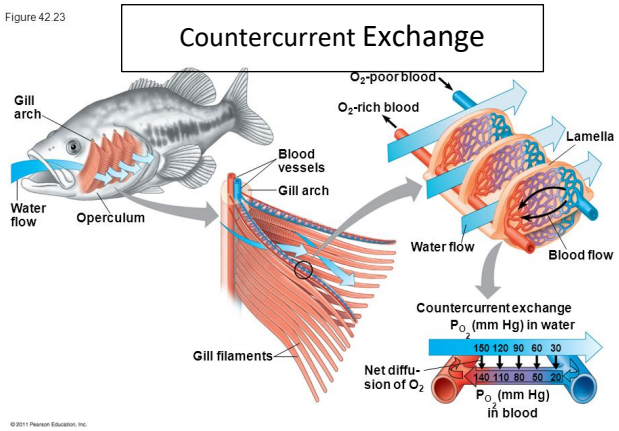
Animals must also balance heat gain and heat loss. Different animals do this in different ways, but for the purposes of this class, we will focus on specific terms including:

Poikilotherm: organism which has a varying body temperature
Homeotherm: organism which has a constant body temperature
Exotherm: organism which gains their heat from external sources
Endotherm: organism which is warmed by heat generated through metabolism
All endotherms are homeothermic, but some exotherms can be as well, depending on their external environments.

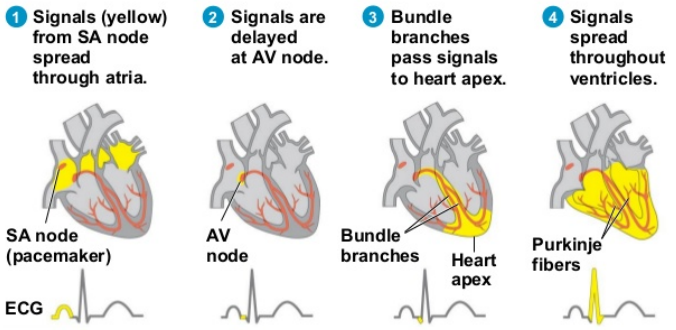
- **Insulation:** prohibits heat loss, ex. Blubber or fur
- **Circulatory Adaptations:** changing the width of blood vessels to conserve heat through Vasoconstriction and Vasodilation
- **Countercurrent Exchange:** arterial and venous blood flow close to each other in two different directions, allowing for thermoregulation, gas exchange, and fluid exchange.

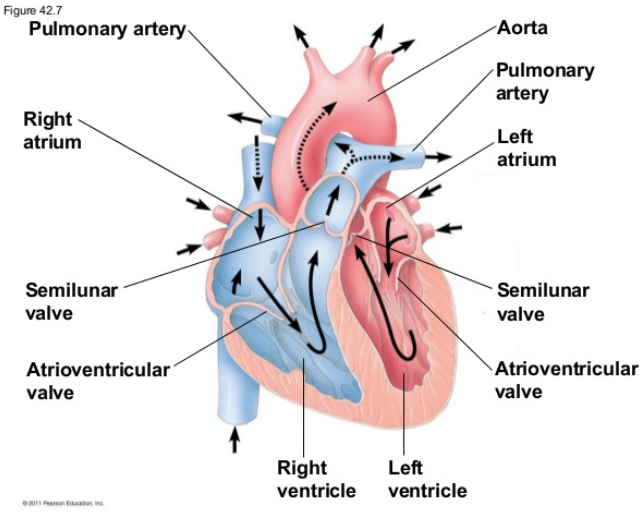


Circulatory and Gas Exchange: Campbell chapter 42

Every cell in an organism must be able to exchange gases with the environment. For this to be possible, organisms must either have a **simple body plan** which places many or all of the cells in direct contact with the environment or must have a **circulatory system** which moves fluid between each cell's surrounding tissues.

Check out this video to learn more about the Cardiac Cycle: https://www.youtube.com/watch?v=7XaftdE_h60





Structure of Blood Vessels:

Endothelium- minimizes resistance to fluid flow
Capillaries- smallest vessels, thin walls for diffusion; low pressure to allow for gas exchange
Made of only endothelium and basal lamina, **no smooth muscle**

- Arteries feeding into capillaries are like a hose connected to a sprinkler system: There is very high velocity and pressure in the hose, but lowered pressure in the capillaries as blood is sent into many different vessels
- **Pre-capillary sphincters** regulate blood flow into capillaries

Arteries- thick, strong and elastic; high blood pressure to pump blood throughout the body; made of endothelium, smooth muscle, and connective tissue

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Veins- thinner walls and lower pressure than arteries, uses valves to ensure unidirectional flow; made of endothelium, thin smooth muscle and connective tissue

It is impossible to cover everything in chapter 42 given the length of this resource, but here are links to videos that explain concepts I did not cover above:

Clot Formation: https://www.youtube.com/watch?v=RQpBj8ebbNY
Positive and Negative Feedback: https://www.youtube.com/watch?v=Iz0Q9nTZCw4
Countercurrent Exchange (shown in fish): https://www.youtube.com/watch?v=cVFqME-NW9s
Amphibian Breathing: https://www.youtube.com/watch?v=uYoElFVvL5U
Bird Breathing: https://www.youtube.com/watch?v=yDvWlDmCKcU
Transportation of CO2: https://www.youtube.com/watch?v=BShB8_1oCGk

Osmoregulation and Excretion : Campbell chapter 44

Osmoregulation is achieved by actively pumping solute in and out of cells to move water passively. There are two ways to maintain water balance: **Osmoconformance** and **Osmoregulation.** Most invertebrates are osmoconformers and all osmoconformers are marine animals. Here are a few definitions to be familiar with:

Osmoregulation: active transport of solutes to passively move water
Osmoconformer: does not transport solute, takes on the conditions of the external environment (isosmotic with its surroundings) **ALL OSMOCONFORMERS ARE MARINE ANIMALS**
Osmoregulator: will actively move solute to create a new ideal environment for the organism
Stenohaline: organism that cannot tolerate changes in external osmolarity
Euryhaline: organism that can survive large changes in osmolarity (ex. Salmon)

Animals face different challenges related to osmolarity and therefore regulate differently:
Marine animals' main issue is water loss due to higher solute concentration in their environment, so they excrete **urine with a high concentration of salt** and very little water. **Land Animals** face the same issue, instead worrying dehydration. They **convert NH3 to urea** prior to excretion as a way to conserve water. **Freshwater Animals** face the opposite problem. Due to the higher concentration of salts in their bodies, as compared to their outside environments, they are worried about water gain. Thus, they take in salt through their gills and **excrete large amounts of very dilute urine**.

THE MAIN PURPOSE OF EXCRETION IS TO ELIMINATE NITROGEN WASTE

Fish eliminate nitrogen in the form of **Ammonia** because it is highly soluble in water, but it is also highly toxic. **Mammals, amphibians, sharks and some fish** eliminate **Urea**. Though it is not as soluble as ammonia, it helps prevent water loss in terrestrial animals. **Birds, insects, and reptiles excrete Uric Acid.** Though it requires much more energy to process, it is much less toxic and thus will not poison an organism while it is still growing inside an egg. **The form of nitrogen waste excreted will always match its function!!!**

Diverse Excretory Systems are Variations on a tubular theme:

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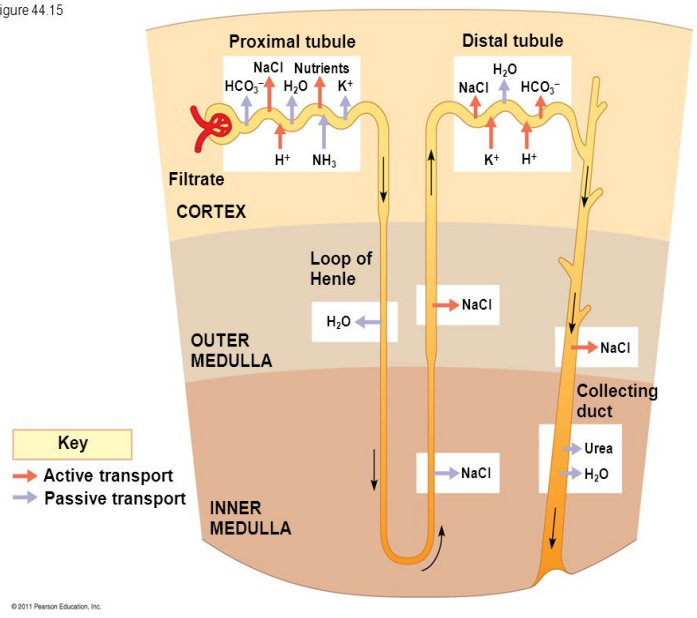
Protonephridia- seen in flatworms which lack a body cavity. Cellular units called **flame bulbs** cap the ends of the protonephridia and each bulb has tubule projections covered in cilia which beat water and solutes from the interstitial fluid before excreting it (purely osmoregulatory)
Metanephridia- seen in earthworms where each segment gathers its own wastes and excretes it through holes in the skin
Malpighian Tubules- seen in insects and arthropods; Out pockets dump nitrogenous wastes into the digestive system to be excreted. Some of the salts are reabsorbed in the rectum

Nephrons are the functional unit of the Kidney.

There are 5 steps in the nephron process. It is important to remember that we discuss "in" and "out" in relation to the filtrate, not the body.

1. Blood is filtered and filtrate is pushed out of the **Glomerulus** and into **Bowman's Capsule**
2. In the **proximal tubule**, H+ is actively transported in, NaCl and nutrients actively out, NH3 passively in, and water, K+, and HCO3 out
3. Next the filtrate enters the **Loop of Henle,** where 90% of reabsorption happens
   a. **Descending:** water is transported out passively
   b. **Ascending:** the vessel is impermeable to water and NaCl is actively transported out to re-establish the concentration gradient in the kidney
4. Then the K+ and H+ are actively transported in, NaCl and HCO3 actively out, and water passively out at the **Distal Tubule**

Figure 44.15



5. Finally, the filtrate reaches the **Collecting Duct**, the most important position for finalizing the filtrate. The collecting duct can be regulated by a couple of hormones
   a. **Anti-Diuretic Hormone (ADH)-** makes the collecting duct permeable to water, causing water to be reabsorbed into the body (OUT of filtrate)
   b. RAAS- acts similarly, increasing the Collecting Duct's permeability to water thus increasing blood volume

Study Tips:

1. **Make sure that you are familiar with the different types of excretory and circulatory systems and how they work.**
2. **Watch the videos on different types of beathing to get a grasp on the key differences between them.**
3. **Make flashcards with the different types of cells and be sure that you know the differences between the epithelial and muscular cell types.**

That's all for now folks.

If you have any questions, feel free to reach out to the tutoring center or use the link at the top of the resource to make a Microsoft Teams appointment.