

Ask Weber
Session 1 (25-03-21)

Key concepts in medical science

Weber Liu



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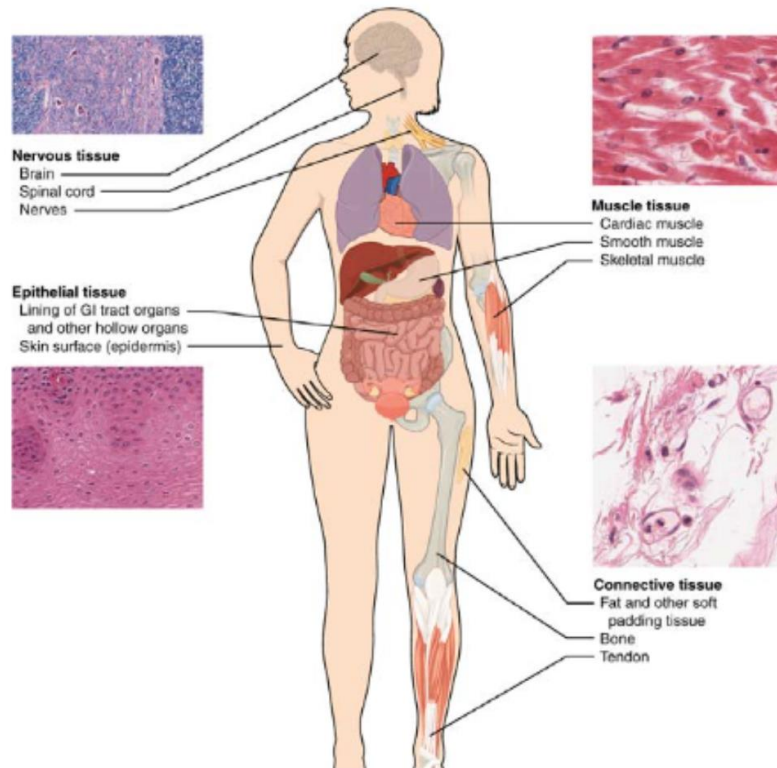
Topic 1

Cell diversity



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Lecture 1: Types of tissues



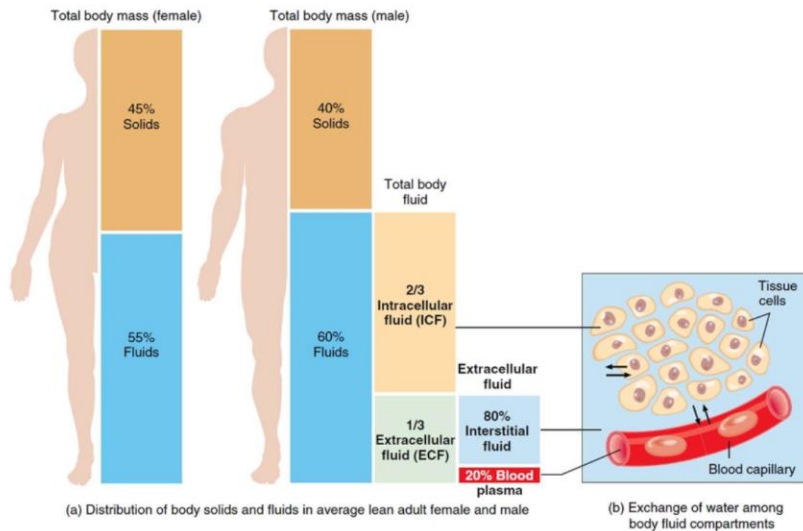
1. Identify the three types of muscle tissue
2. This type of cell lines the GIT as well as the skin. What type of tissue is this?

Lecture 1 - Apoptosis



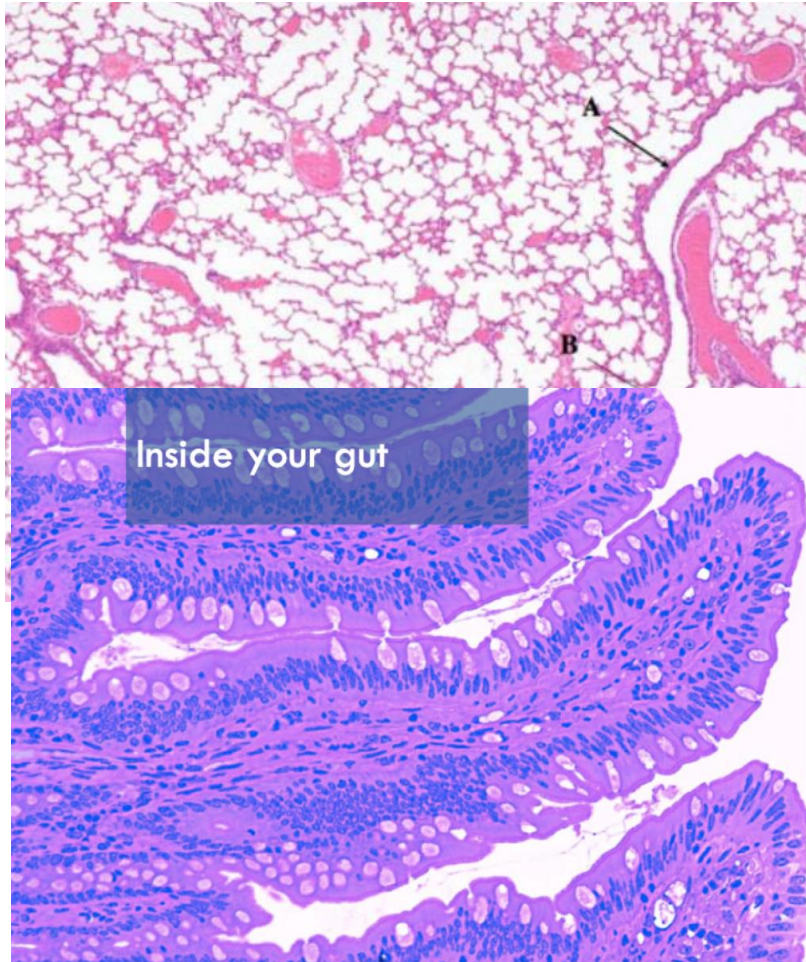
1. In the figure to the left, the child has experienced Syndactyly - the fusion of digits. In fact, when we are all developing in our mother's wombs, our toes are all joined and webbed together. Explain what apoptosis is and how this sign relates to apoptosis.

Lecture 1 – Fluid distribution



1. Describe how much of our mass (as humans) is fluid, how much is intracellular and how much is extracellular
2. What is the difference between extracellular and intracellular fluid?

Lecture 1 – High surface area ratios



1. What structure in the lung is responsible for the massive surface area allowing for diffusion of O_2 into and CO_2 out of the blood?
2. What is the structure in the gastrointestinal tract (mainly in small intestine) which allows for absorption of nutrients from digested food?

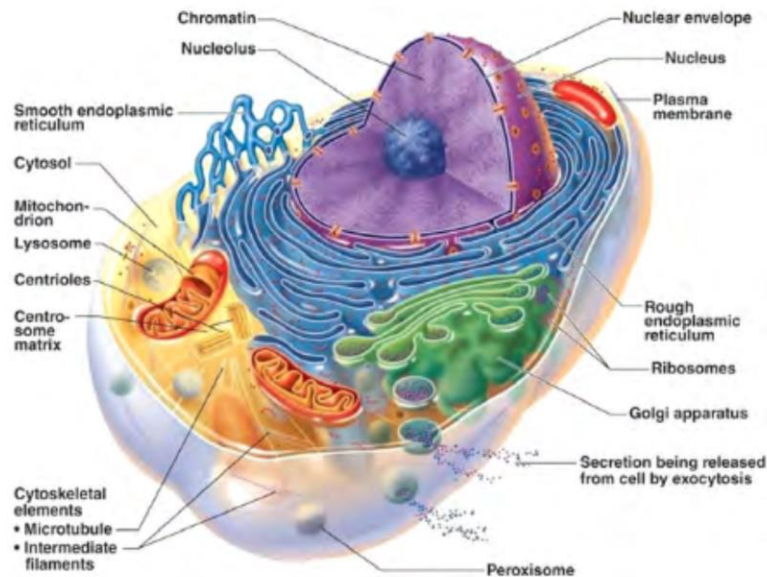
Topic 2

Cell structure



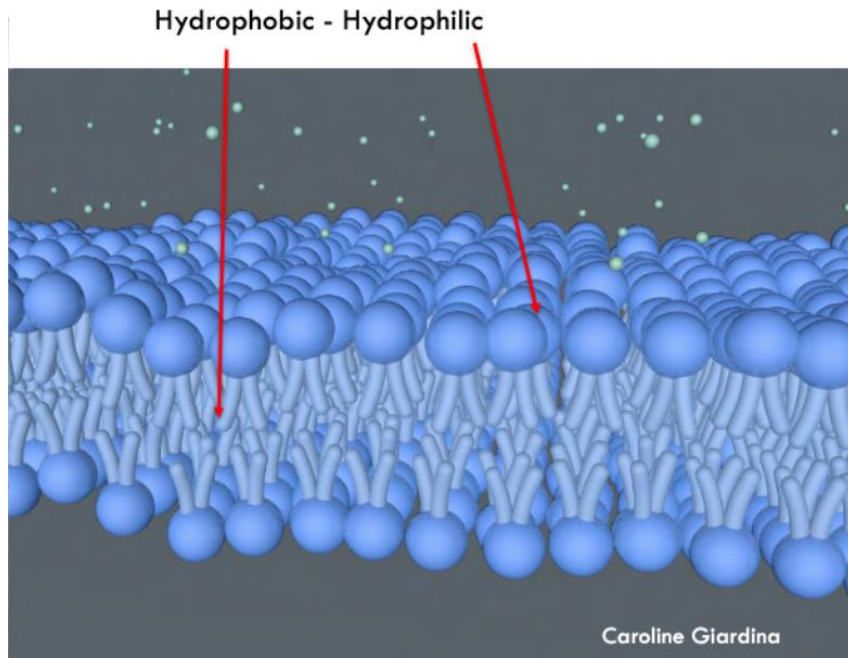
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Lecture 2 – Cell components



1. What is the function of the RER?
2. What is the function of the SER?
3. What is the order in which DNA is converted into proteins?
4. What cell component/organelle is involved in the destruction of waste

Lecture 2 – Cell components



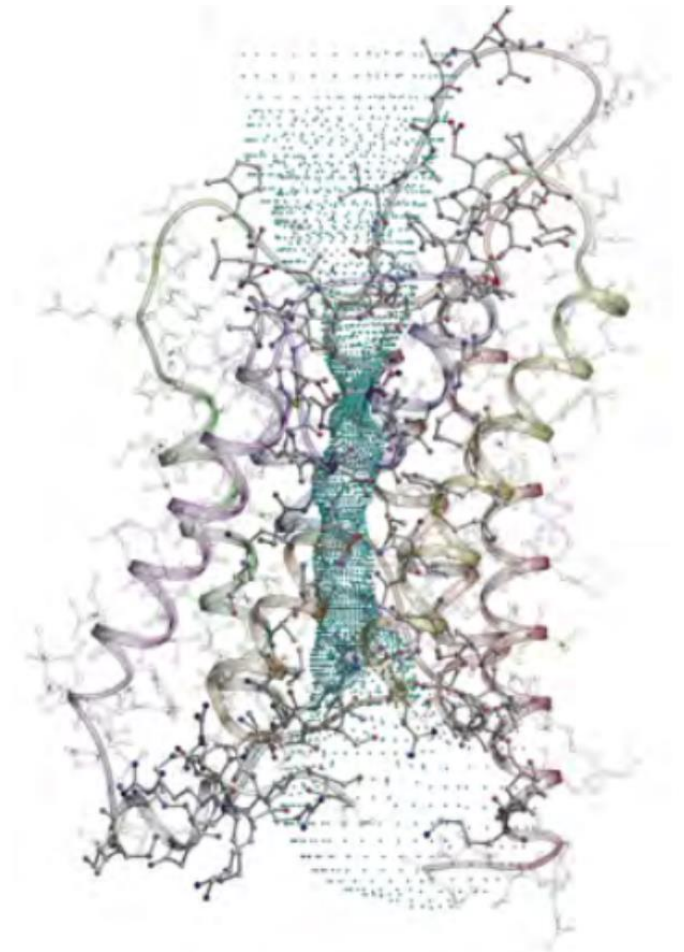
1. In a phospholipid bilayer, is the hydrophobic layer in the inside (sandwiched in the middle) or the outside (doing the sandwiching)?
2. What substances are the lipid bilayer NOT permeable to?

Lecture 2 - Tonicity



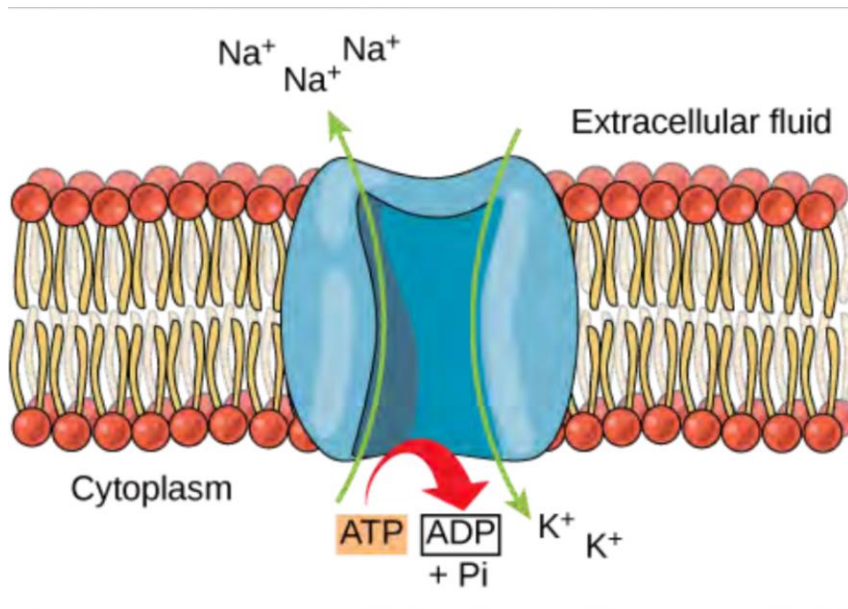
1. In the image to the left, red blood cells have been placed in a solution. Is the solution hypertonic, isotonic or hypotonic compared to the red blood cells?
2. Define hypertonic, isotonic and hypotonic

Lecture 2 – ion movement



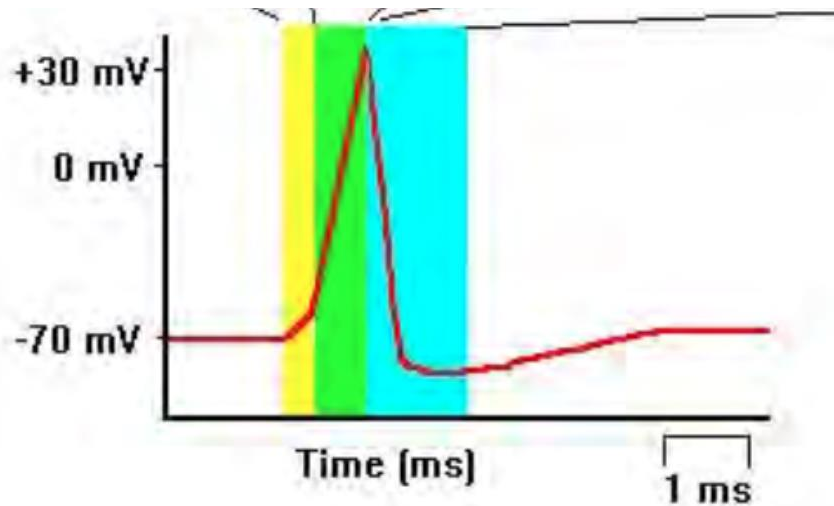
1. In the disorder known as SIADH (Syndrome of Inappropriate ADH), a hormone (ADH) is released in excess. At the kidney, ADH plays a role in upregulating AQP2 (Aquaporin). This process tends to concentrate the urine. Describe in as much detail as possible what you know about Aquaporin.
2. Is Aquaporin an example of facilitated diffusion or active transport?

Lecture 2 - NKA



1. In most cells, a membrane potential is maintained at the basolateral surface typically by a Na⁺-K⁺-ATPase. This will pump 3 Na⁺ ions out of the cell and 2 K⁺ ions into the cell, whilst using up an ATP molecule. Is this an example of active or passive transport?
2. Explain how this transporter results in a positive/negative membrane potential for the cell

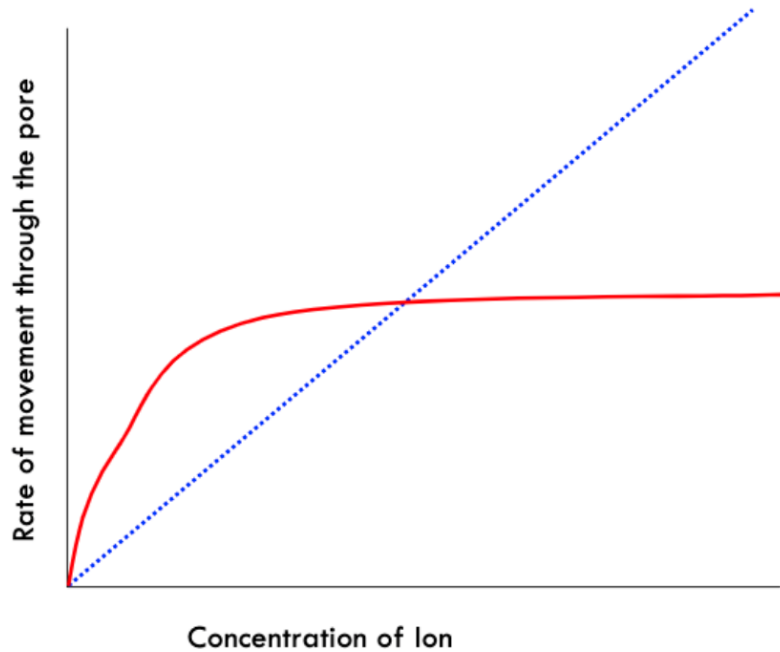
Lecture 2 – Action potential



1. In the following AP diagram, explain
 1. What channel(s) open in the yellow
 2. What channel(s) close in the yellow
 3. What channel(s) open and close in the green
 4. What channel(s) open and close in the blue

Lecture 2 – graph interpretation

Interpret the figure to the left.



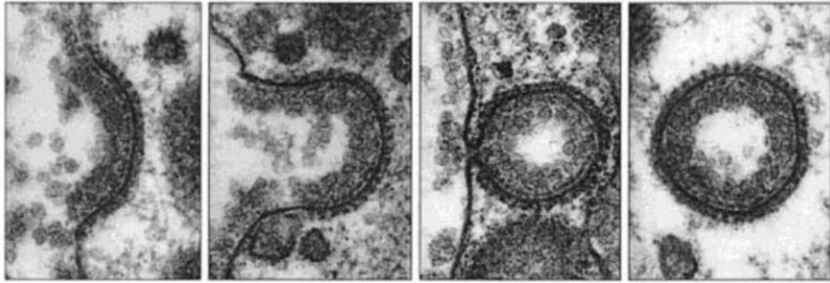
Topic 3

Cell movement



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Lecture 3 - Endocytosis



To the left is a figure of a (x1) coated vesicle. This is an example of receptor-mediated (x2). In this process, the vesicle itself is made up of a (x3) with (x1) embedded throughout.

x1:

x2:

x3:

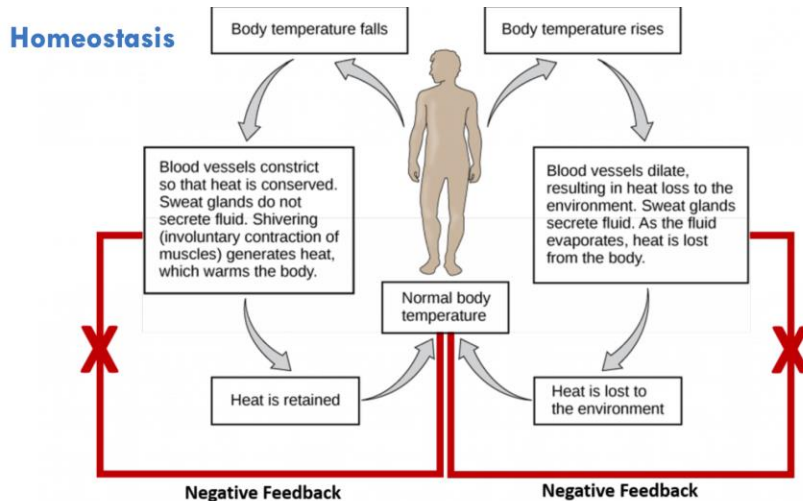
Topic 4

Cell to cell



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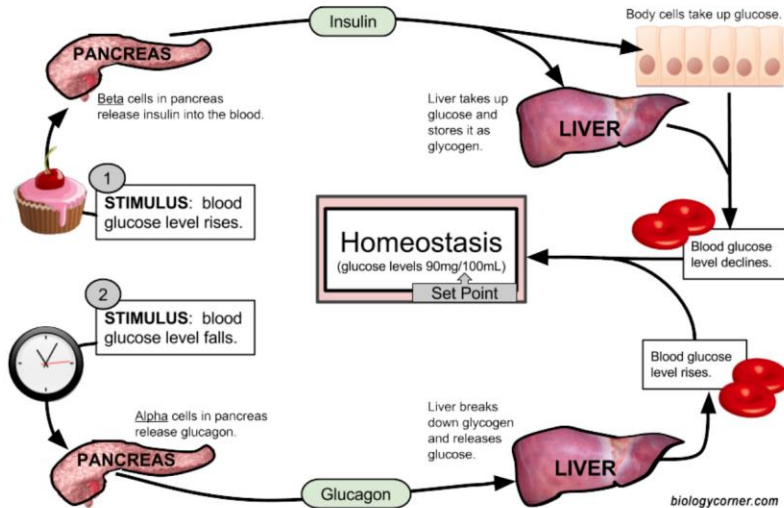
Lecture 4 - Homeostasis



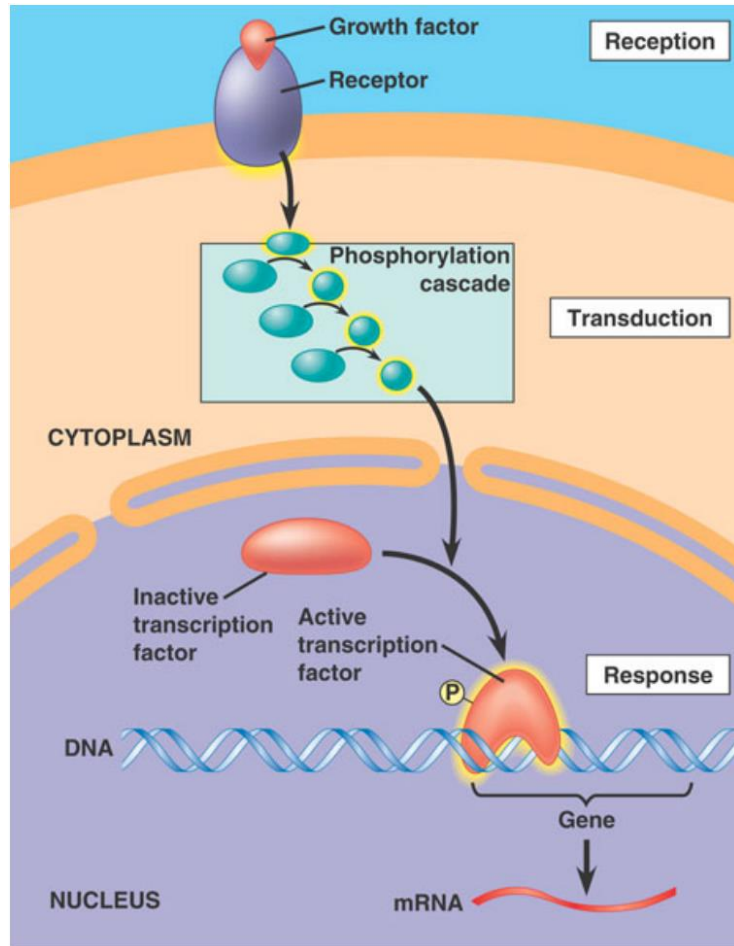
1. Explain the homeostatic mechanisms the body implements to prevent hyperthermia.
2. Colloquially, we use 'physiology' to describe when systems implement negative feedback loops (i.e. homeostatic mechanisms). What are 2 situations which are physiological positive feedback loops?

Lecture 4 – glucose homeostasis

1. In response to eating (and elevated glucose levels in the blood), the pancreatic beta cells tend to activate. Describe the function of the pancreatic beta cells in the maintenance of blood glucose homeostasis.
2. In diabetes, the homeostatic mechanism of insulin breaks down. Describe some mechanisms through which this could occur.

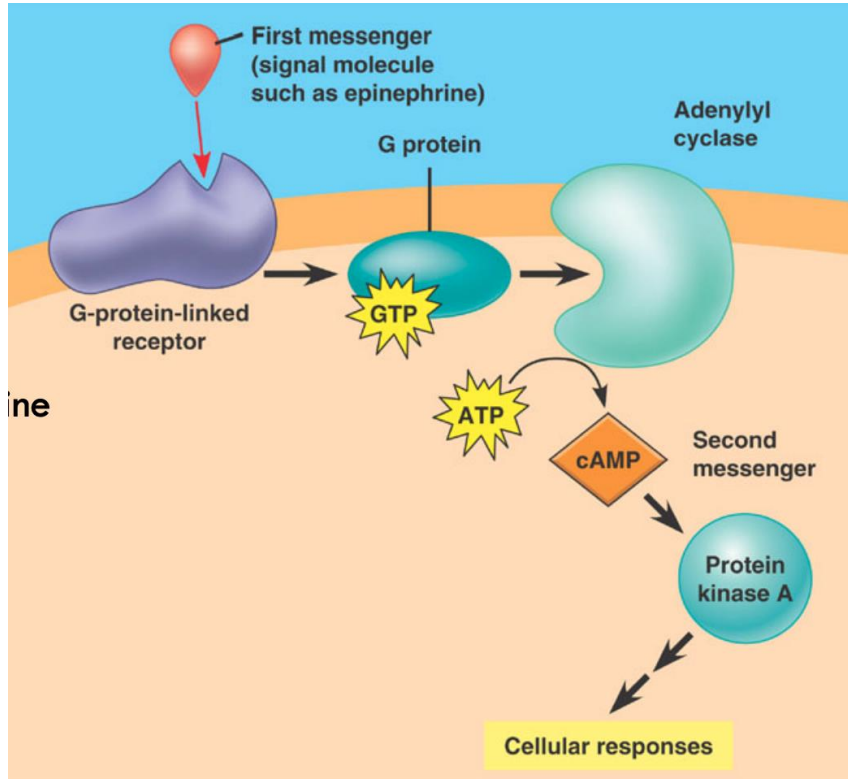


Lecture 4 – Cell signalling



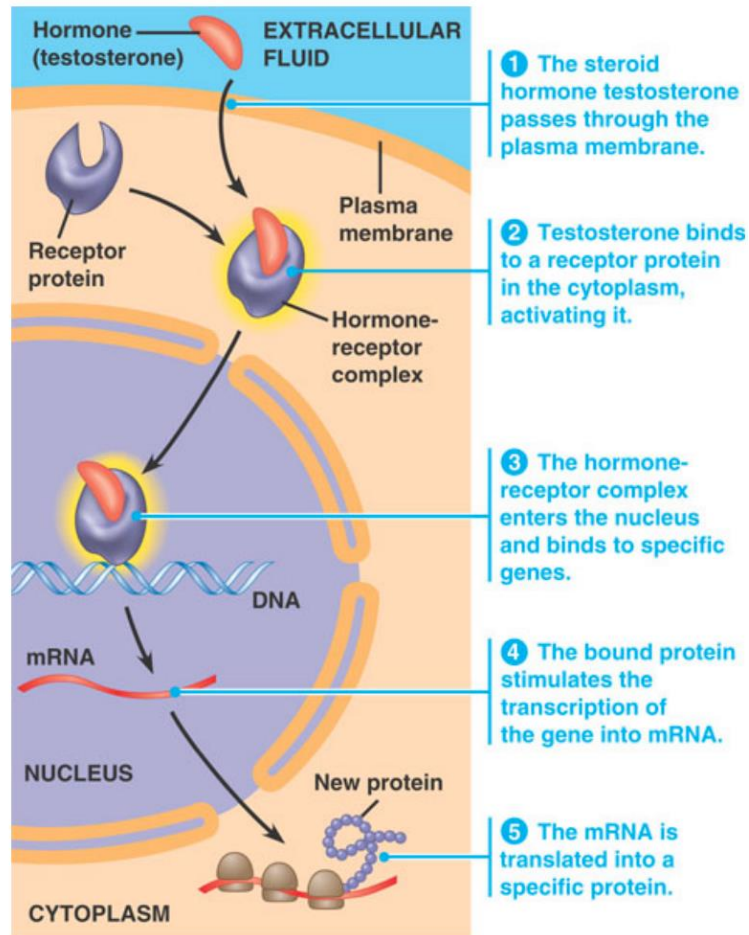
1. Within certain cells, there are a series of proteins/enzymes named MAP Kinase Kinase Kinase, MAP Kinase Kinase, MAP Kinase. One example is RAS/RAF/MEK/ERK (I learnt this when I did 3rd year physiology in undergrad). The function of these proteins are to phosphorylate each other in order to move a signal from outside of the cell to the inside (Note that kinases work by phosphorylation). What is this part of the cell signalling process called?

Lecture 4 – Cell signalling



1. Describe 4 features of a 2nd messenger. Give 2 examples of secondary messengers.
2. Explain the mechanism of action of G_{α} -Protein coupled receptor ($G_{\alpha s}PCR$)

Lecture 4 - Hormones



1. Describe the differences in signalling mechanisms between a protein hormone (give an example) and a steroid hormone (give an example).

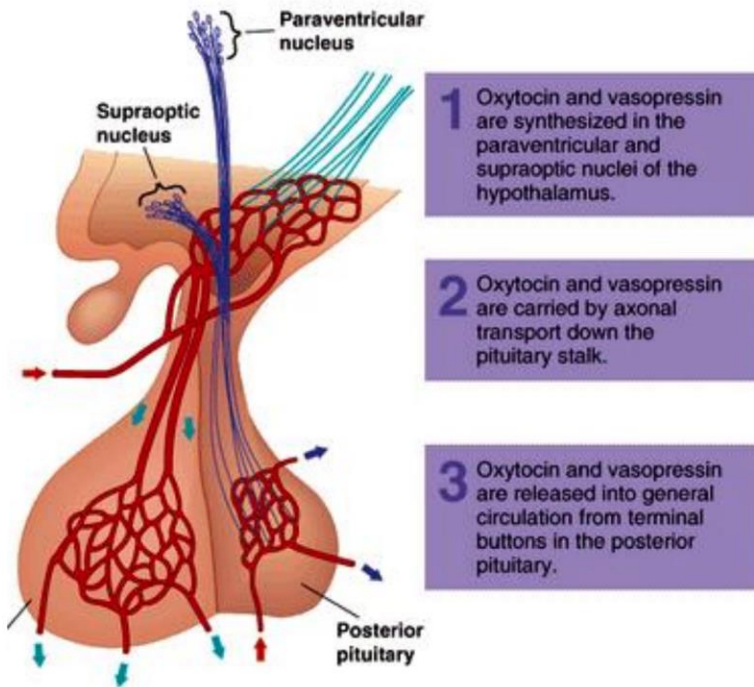
Topic 5

Cell control



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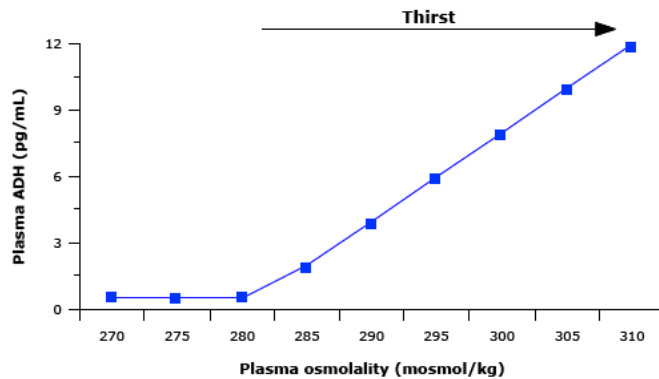
Lecture 5 – Feedback loops



1. Identify the hormones released by the anterior pituitary and the posterior pituitary
2. Which hormone(s) are synthesized by the neurons whose cell bodies are located within the supraoptic nucleus of the hypothalamus?

Lecture 5 – blood osmolarity feedback

Describe the figure to the left and identify 3 stimuli which will result in an increase in plasma ADH.



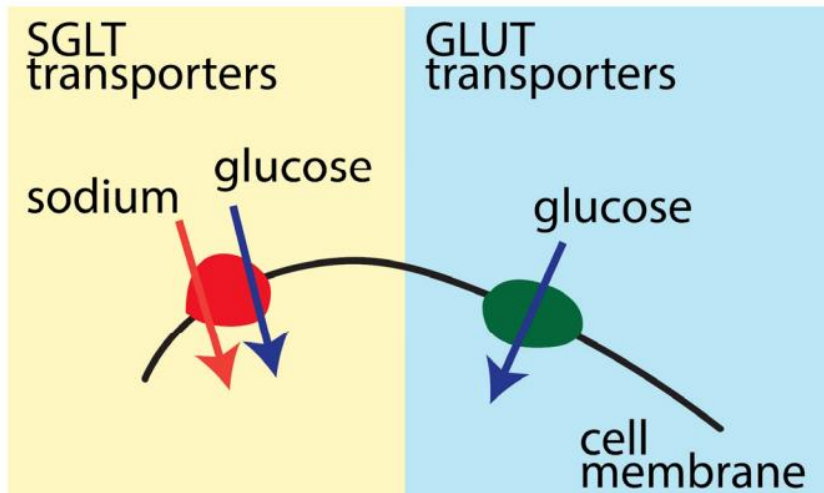
Topic 6

Homeostasis



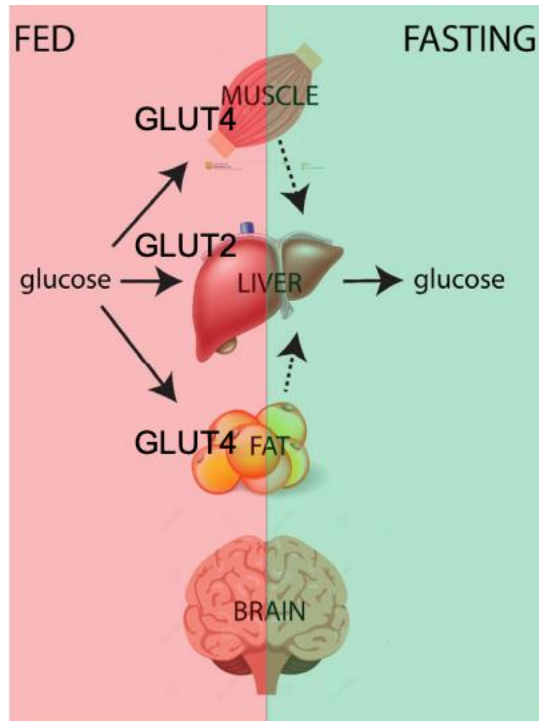
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Lecture 6 – glucose transport



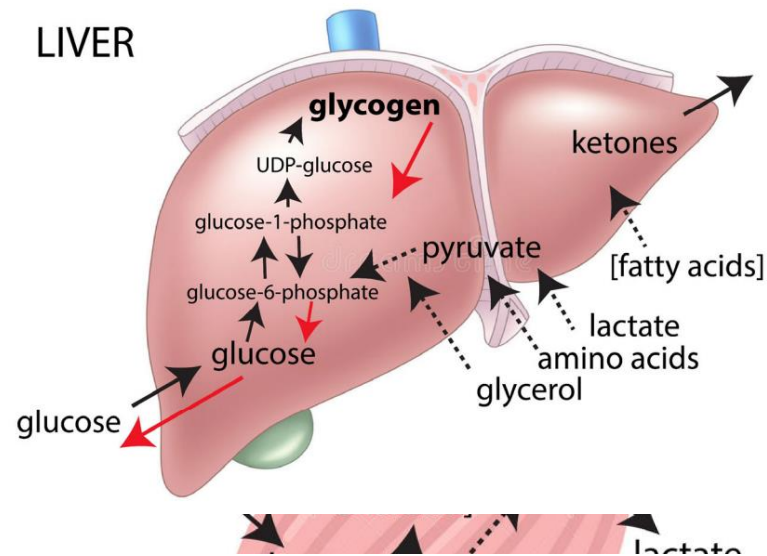
1. When drinking Gatorade, on the bottle it says that the drink is 'scientifically proven'. Theoretically, hydralyte (a fluid replacement solution for diarrhoea) would also be 'scientifically proven' – the basis behind the two would be very similar, if not the same. Both essentially are sugar and electrolyte solutions. Why is it that we drink sugar/salt drinks to rehydrate (note that intestinal absorption of salt and sugar also results in better water absorption)

Lecture 6 – glucose transporter

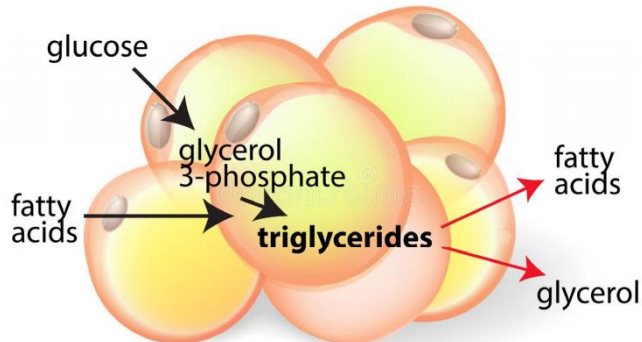


1. Once glucose is absorbed into the blood stream, it can be stored/used in muscle, fat, liver and brain. Which organs have the GLUT4 transporter?

Lecture 6 – Glucose biochemistry



FAT

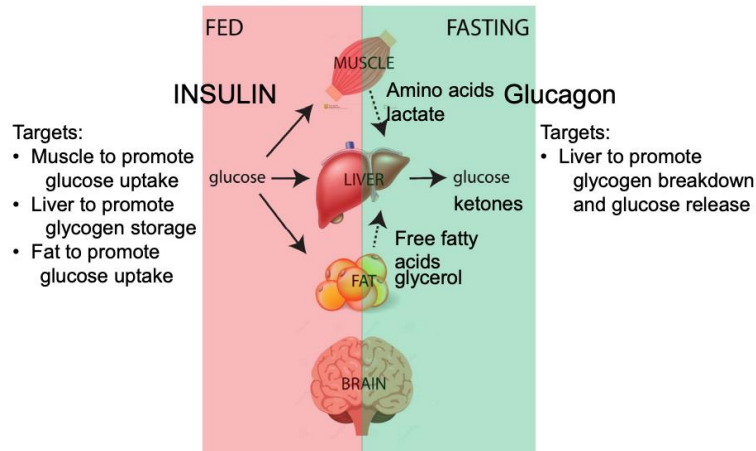


1. Describe the process in which glucose is used in muscle tissue
2. Describe the process in which glucose is turned into fats in fat cells
3. Describe the process in which glucose is stored in the liver
4. In the ketogenic diet, the participant aims to stop intake of carbohydrates (i.e. anything that will produce glucose). Describe the process in which ketones are made

Lecture 6 – Glucose regulation

1. List the targets of insulin and the 'action' insulin takes at these targets

2. List the targets of glucagon and the 'action' it takes at these targets.



Topic 7

Hormonal regulation



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Lecture 7 – beta cells

1. Describe the MOA of how glucose in the blood can result in the release of insulin

