

$1\text{nm} = 10^{-9}\text{m} = 1\text{billionth of a meter}$

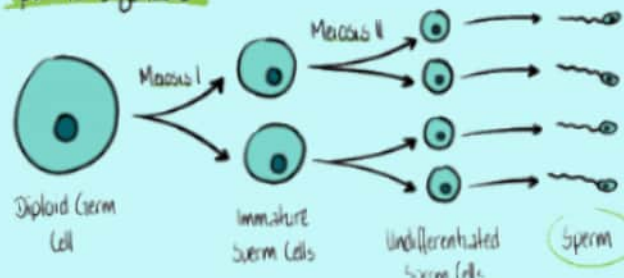
mus  100 nm

bacteria  500 nm

human cell  5,000 nm

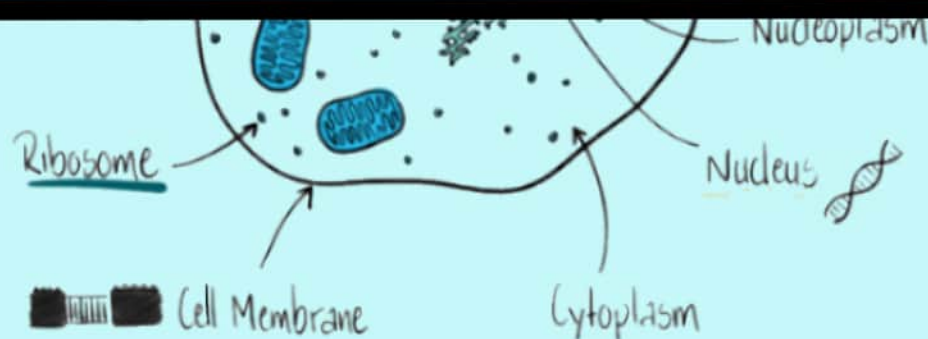
hair  100,000 nm

Spermatogenesis



Greg Landry's

Biology Sketchnotes



like an animal cell, but has additionally

Cell wall → gives structure 

Chloroplasts → do photosynthesis 

Diffusion

movement of atoms or molecules from an area of higher concentration to an area of lower concentration



If an illness is affecting breathing in the upper part, a tracheostomy can be placed 

Osmosis

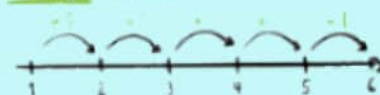


movement of solvent (typically water) across a semi-permeable membrane from an area of lower solute concentration to an area of higher solute concentration

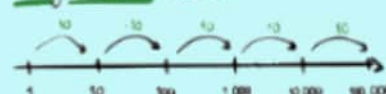


Scales

Linear scale



Logarithmic scale



Diabetes types

1. the pancreas produces no insulin
2. the cells are less sensitive to insulin → reversible

Greg Landry's

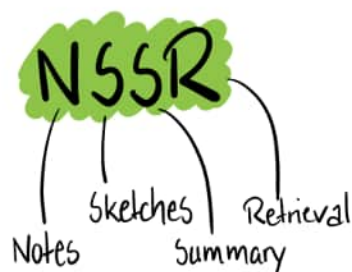
Biology Sketchnotes

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1 Take Notes

While class write every-thing down. You can use your own abbreviations because they are your notes.

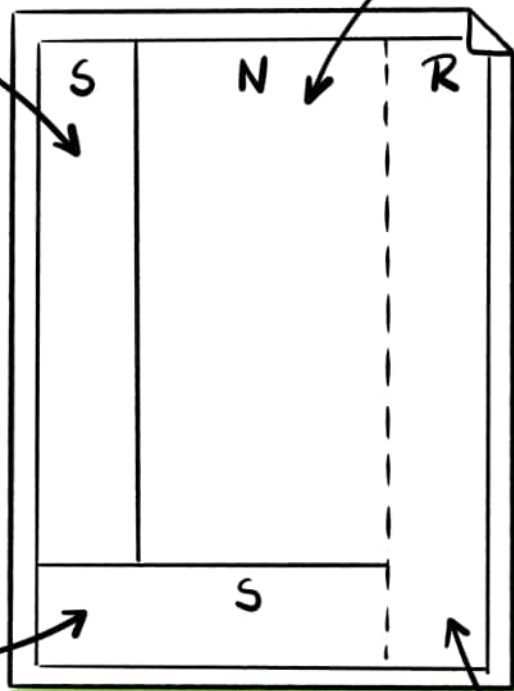
2 Draw Sketches

Draw what was most important in this class. It's best to do it on the same day. Remember, it's not about art! You'll get better at it with more practise.



3 Write Summary

Write 2-4 sentences that summarize the notes above.



4 Retrieval

You can practise different types of retrieval:

- let somebody ask you questions
- teach others
- make a test & solve it
- use flashcards or use the folded back retrieval column as flashcard

Learning for a test

Learning & retrieving takes time! Your brain is like an athlete training for a competition.



You need your notes to go back to the content



Make sketches from memory



or write down from memory

Why is retrieval important?

By pulling pieces of information often from your brain, you tell your brain that they are important. This way they are saved in the long term memory.





Biology Notes



2



Base units

Mole  Candela
quantity of substance light

Ampere  Kelvin
electric current temperature

Second  Liter
time volume

Gram  Meter
mass length

Mass ↔ weight (like pound)
Is the same everywhere Depends on the gravity & changes

1g = 1/1000 or 0.001
454 g = 1 Pound

Probability

likelihood of something happening

coin flip → 50% ($\frac{1}{2}$) head
→ 50% ($\frac{1}{2}$) tail

each individual event stands on its own & has the same probability

Combining events means combining individual probabilities

5 times head in 5 flips:

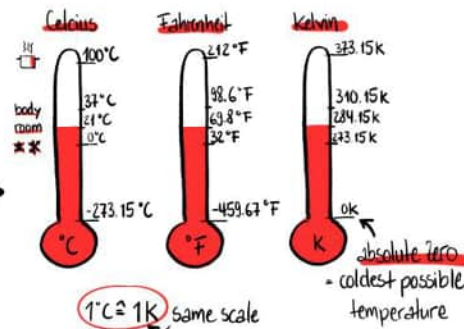
1 × 50% = 50%
2 × 50% · 50% = 25%
3 × 50% · 25% = 12.5%
4 × 50% · 12.5% = 6.25%
5 × 50% · 6.25% = 3.12%



Professor Landry

Measurements

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Volume = how much space something takes up

1L is a little more than a quart

1m is a little less than a yard

Metric Prefixes

They are put before a base unit to change the amount of it

Name	Symbol	Factor
Mega	M	1,000,000 10^6
Kilo	k	1,000 10^3
Hecto	h	100 10^2
Deka	da	10 10^1
Base unit		1 10^0
Deci	d	0.1 10^{-1}
Centi	c	0.01 10^{-2}
Milli	m	0.001 10^{-3}
Micro	μ	0.000,001 10^{-6}
Nano	n	0.000,000,001 10^{-9}

Statistics

Example: 2, 2, 5, 6, 8, 13

Mean = average $\bar{x}$

$$\text{Mean } \bar{x} = \frac{2+2+5+6+8+13}{6} = \frac{36}{6} = 6$$

Median = middle number or average of two middle numbers

$$\text{Median } \frac{5+6}{2} = \frac{11}{2} = 5.5$$

Mode = the most often number

Mode 2

Accuracy & Precision

Accuracy: the closeness of a measured value to a known or standard value

Precision: the closeness of two or more measured values to each other

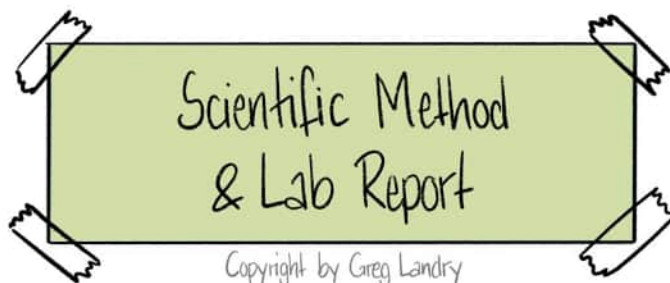
! → Accuracy & Precision can occur together but they don't have to!



Biology Notes



This is how research
is done!



Scientific Method

Lab Report

The written version of the scientific method

Purpose



→ why is the experiment done?
what question should be answered?

Research



→ Learn about the topic of the
experiment, do the background
research

Hypothesis



→ The educated guess about
the outcome of the experiment

Experiment



→ Develop a method to test the
hypothesis & do the experiment

Analysis



→ Record the results & analyze
them

Discussion



→ Is the hypothesis supported?
Errors
Future research
Conclusions

← **IMMRD**
(the five major topics)

← write enough
information

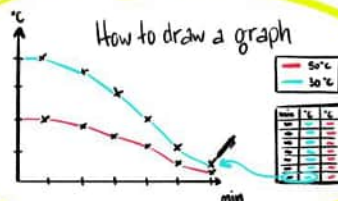
← don't leave any
step out

← sketch is nice but
not required

← data table with
all information

← graph **required!**

← openly discuss the
errors made



I LOVE this!



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Scientific Theory: a hypothesis that is supported by repeated experiments

Scientific Law: a very specific statement that has been tested very often



Biology Notes



6



Chemistry of Biology

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Macromolecules

Carbohydrates
you know them from food!



Lipids or fats
You know them from food!

Proteins

consist of amino acids
about 20 common amino acids exist

High-Energy Compounds

ATP is "the fuel" for our body



polysaccharides
→ "many"

disaccharides
→ "two"

monosaccharides
→ "one"

= Glucose $C_6H_{12}O_6$

Nucleic Acids
Genetic material



needed to produce ATP!

The Mole

(Avogadro's number)

1 mole = $6.02 \cdot 10^{23}$

= 602,000,000,000,000,000,000,000

Periodic Table of elements

everything we know consists
of these 92 natural elements!

everything we know consists
of these 92 natural elements!

1	H																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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The number of protons
determines the element.
The number of neutrons
& electrons can vary.

of protons

molar mass
= mass of 1 mole
of this element in g

36 83.80
Kr
krypton

Symbol
Name

The periodic table is ordered
by the number of protons

Density of the elements

Density is expressed by mass per volume $D = \frac{m}{V}$

Gases: $\frac{g}{L}$ Fluids/Solids: $\frac{g}{mL}$

denser than
gold !!

Lithium $0.534 \frac{g}{mL}$

Osmium $22.6 \frac{g}{mL}$



I LOVE this!



Professor Landry

Biology Notes



Magnitudes

$$1\text{nm} = 10^{-9}\text{m} = 1\text{billionth of a meter}$$

virus 100 nm

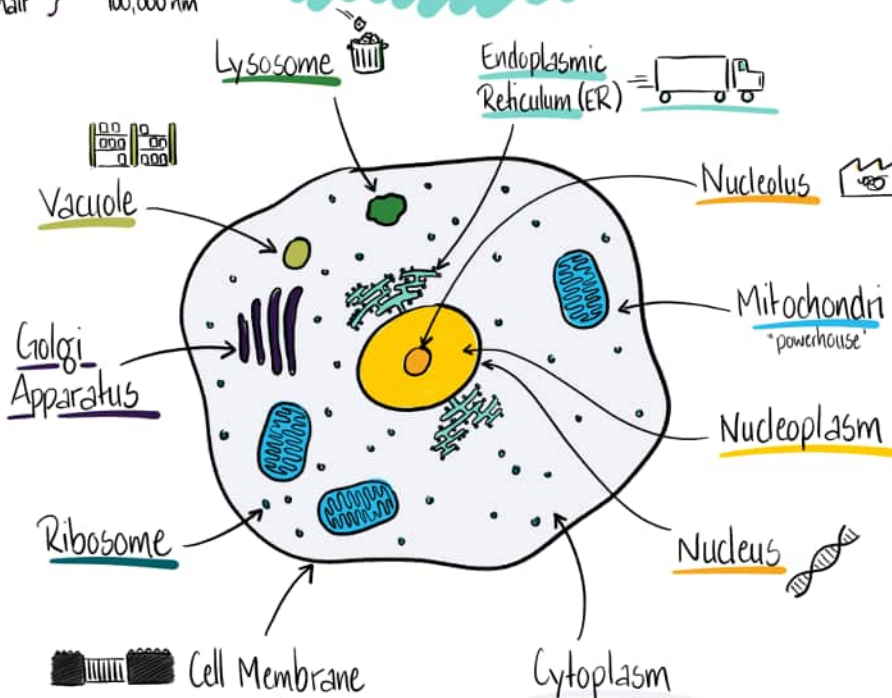
bacteria 950 nm

human cell 5,000 nm

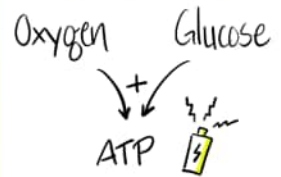
hair 100,000 nm



Animal Cell (Eukaryote)



Cellular respiration:



Plant Cell (Prokaryote)

like an animal cell, but has additionally:

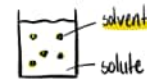
- Cell wall → gives structure
- Chloroplasts → do photosynthesis

Diffusion

movement of atoms or molecules from an area of higher concentration to an area of lower concentration

Osmosis

movement of solvent (typically water) across a semi-permeable membrane from an area of lower solute concentration to an area of higher solute concentration



Scientific Notation

A way to write big or small numbers easier

$$10^2 = 100 \quad 10^6 = 1,000,000$$

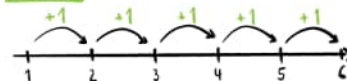
2 zeros 6 zeros

$$10^{-2} = 0.01 \quad 10^{-6} = 0.000,001$$

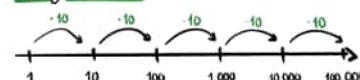
2 zeros 6 zeros

Scales

Linear scale



Logarithmic scale



Biology Notes

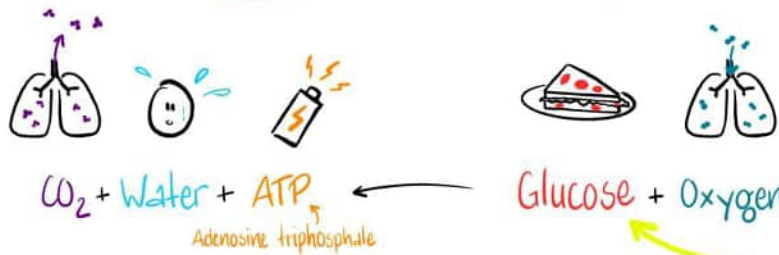
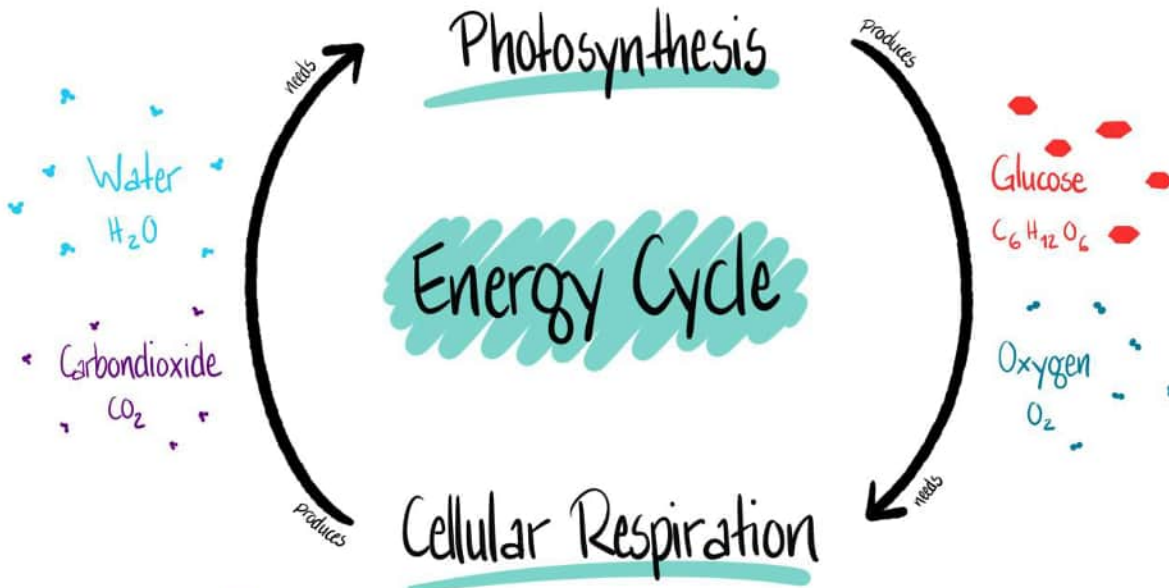
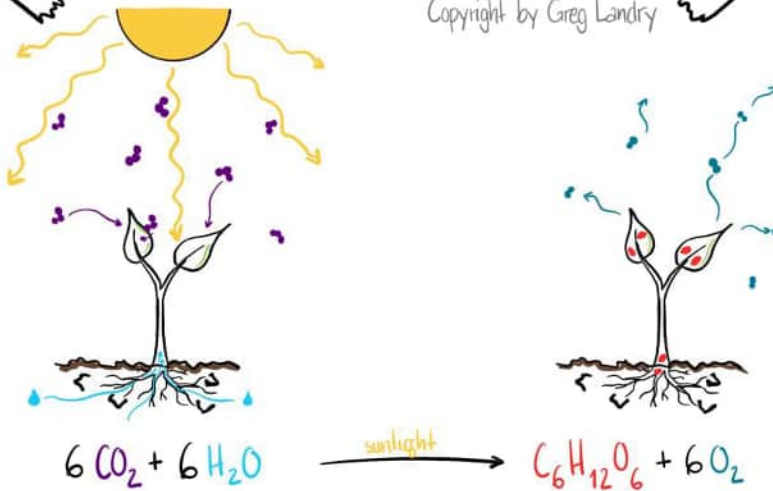


Significant figures

- ① Nonzero figures 1 - 9
- ② Sandwiched zeros (4005)
- ③ Zeros left of nonzero digits are not significant (0.0034)
- ④ Zeros right of a decimal point & at the end of a number (657.700)
- ⑤ Zeros right of a number & left of a decimal point are not significant (900)
- ⑥ Anything counted (3270, 313) pens

Photosynthesis & Cellular Respiration

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Pancreas is monitoring the glucose level very closely. 24/7!

Professor Landry

Aerobic cellular respiration

efficient way to produce ATP
 1 Glucose molecule $\rightarrow$ 34 ATP



Anaerobic cellular respiration

inefficient "emergency" way to produce ATP
 1 Glucose molecule $\rightarrow$ 2 ATP



Biology Notes



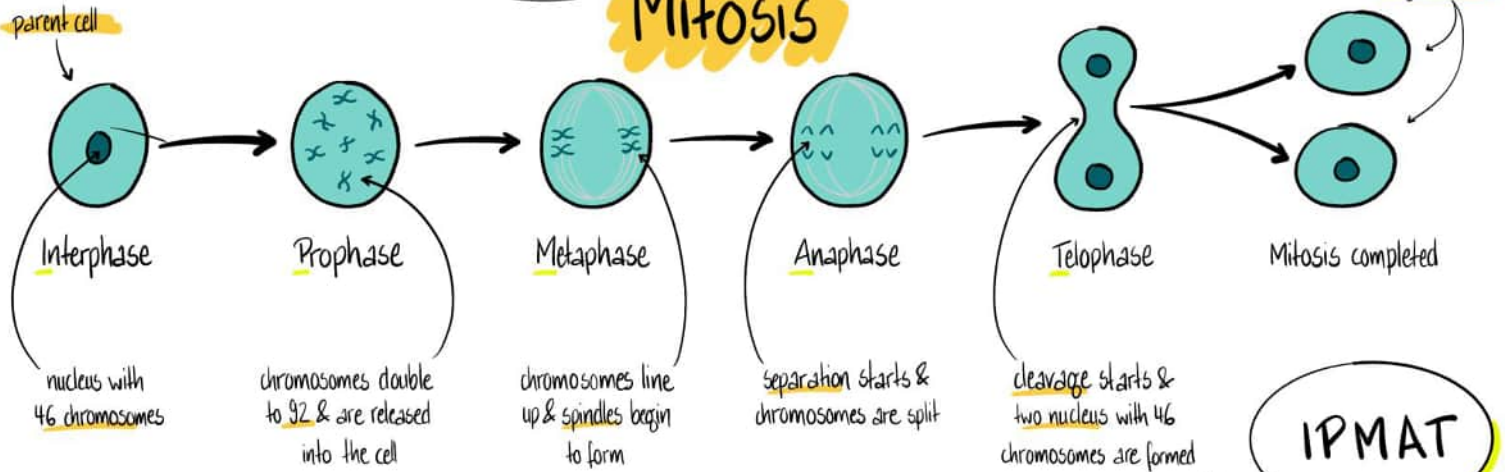
The process of cell replication that's constantly happening to produce new cells. It happens everywhere in the body except the gonads & ovaries!

Mitosis & Meiosis

Copyright by Greg Landry

The cell replication rate is regulated by the body. If the regulation goes wrong & the cells replicate unrestricted it's called **cancer**!

Mitosis



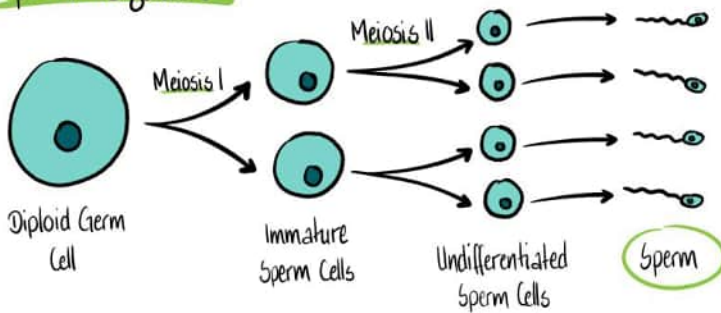
Meiosis

happens only in gonads & ovaries

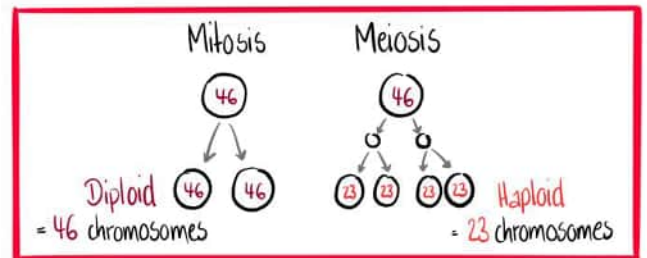
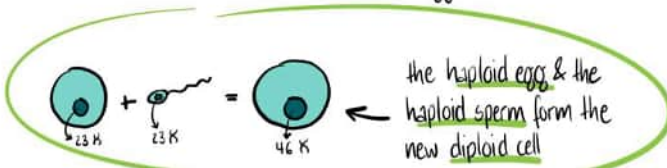
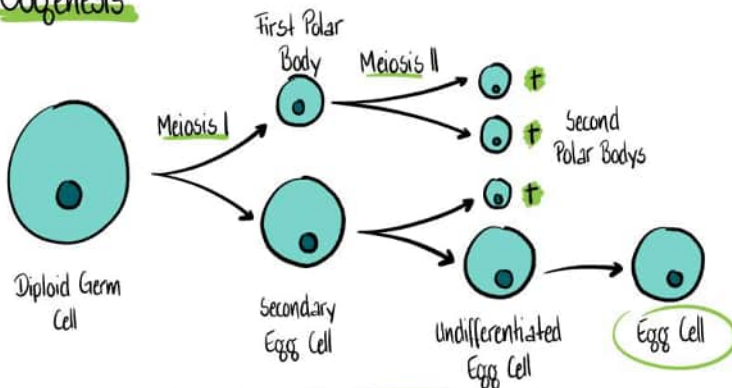
IPMAT



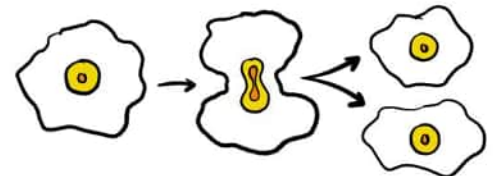
Spermatogenesis



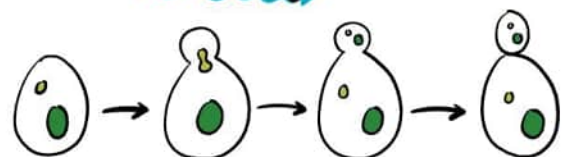
Oogenesis



Binary Fission (Amoeba)



Budding (yeast)



Biology Notes



Deoxyribonucleic Acid

DNA

DNA is the unique "instruction book" for building a human body.

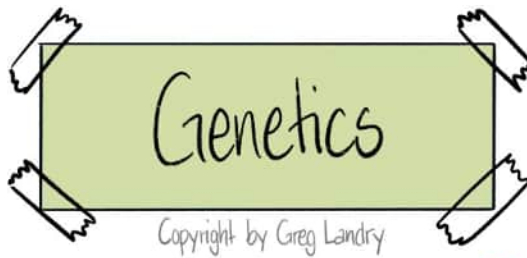
The only exception are identical twins!



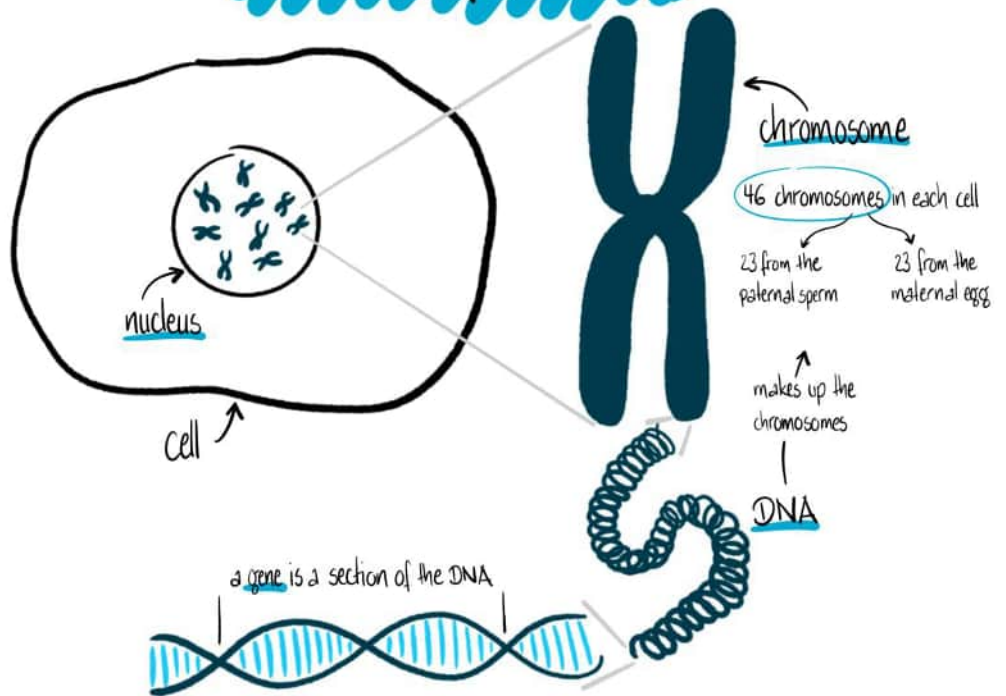
This shows the probability of the distribution of a characteristic among a family. BUT: reality can be completely different!



Professor Landry



Where to find DNA



How DNA works

upper case letters indicate dominant alleles

lower case letters indicate recessive alleles

phenotype is the physical representation of the genotype

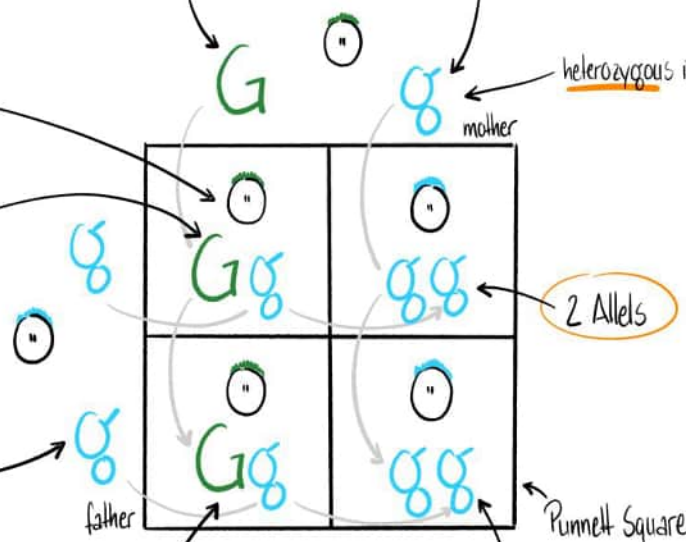
genotype are the letters that represent a genetic trait

heterozygous is mixed dominant & recessive alleles

homozygous is only dominant or only recessive alleles

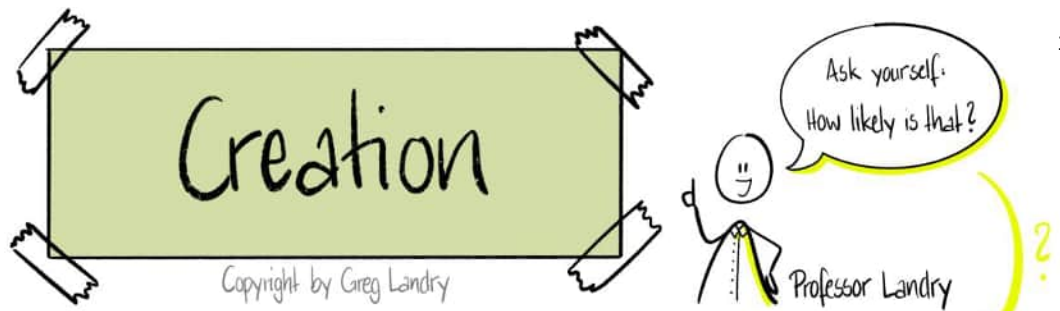
dominant is always "winning" in the phenotype

recessive only shows in the phenotype if it's homozygous

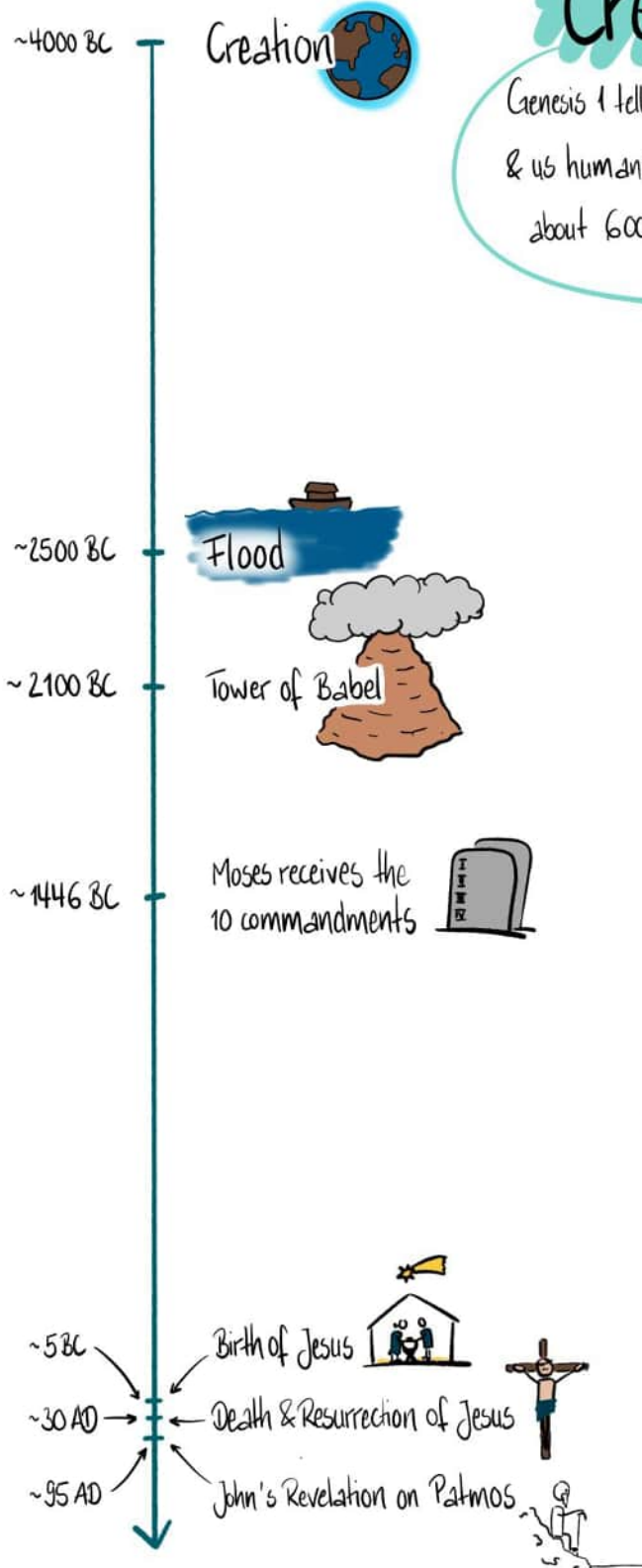


Biology Notes





Timeline after creation



Creation

Genesis 1 tells us how the world & us humans were created by god about 6000 - 7000 years ago.

Evolution

Over millions of years humans developed from "mud"



There is no proof for either view, but as believers we know that god created us!

Day 1

Earth, Space, Time & Light



Day 2

Atmosphere



Day 3

Dry Land & Plants



Day 4

Sun, Moon & Stars



Day 5

Sea & Flying Creatures



Day 6

Land Animals & Humans

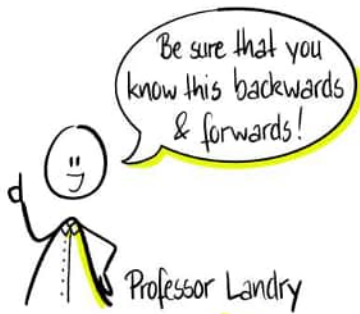


Day 7

God rested

Biology Notes

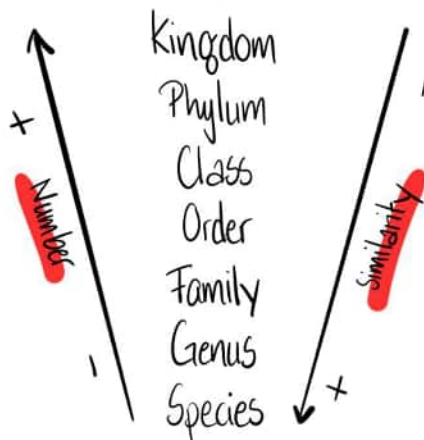




Plants & Classification

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Classification of living things

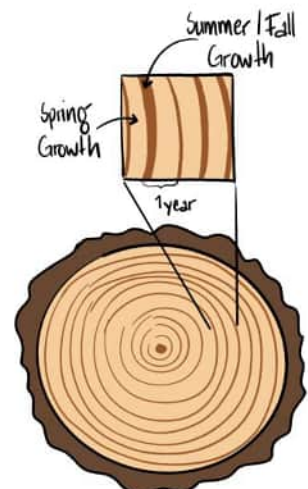
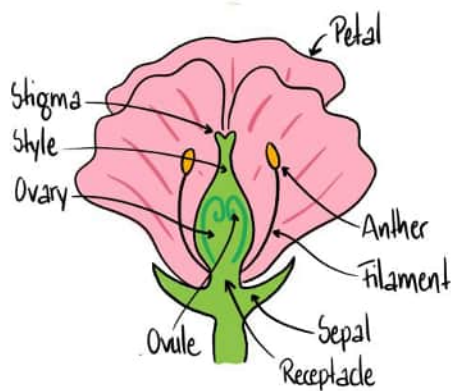
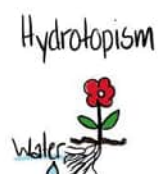
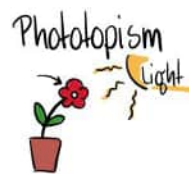
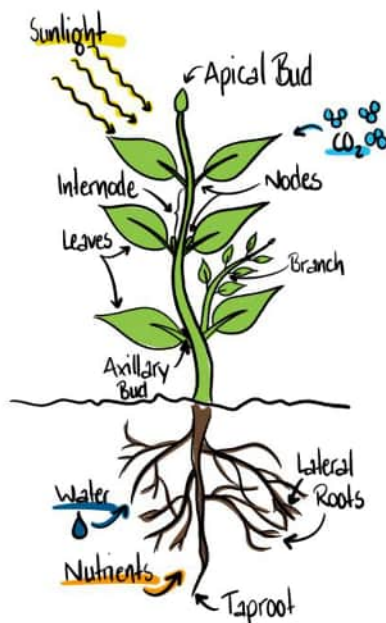


Bacteria	Archaea	Protista	Fungi	Plantae	Animalia
simple, unicellular	simple, unicellular, living in extremes	unicellular, more complex	uni- or multi-cellular & absorb food	multicellular & make own food	multicellular & takes in food

Plants

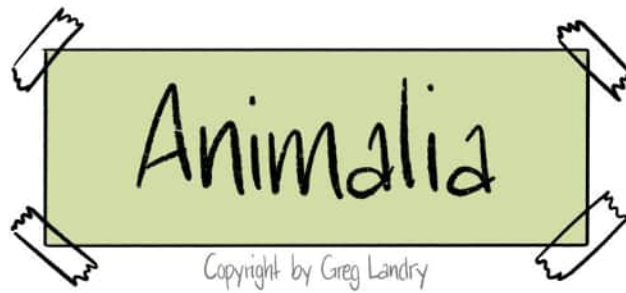
Plant Tropisms

responses of plants to influences



Biology Notes





The Invertebrates have 1 Million species. All of kingdom Animalia, except the Chordata, are Invertebrates.



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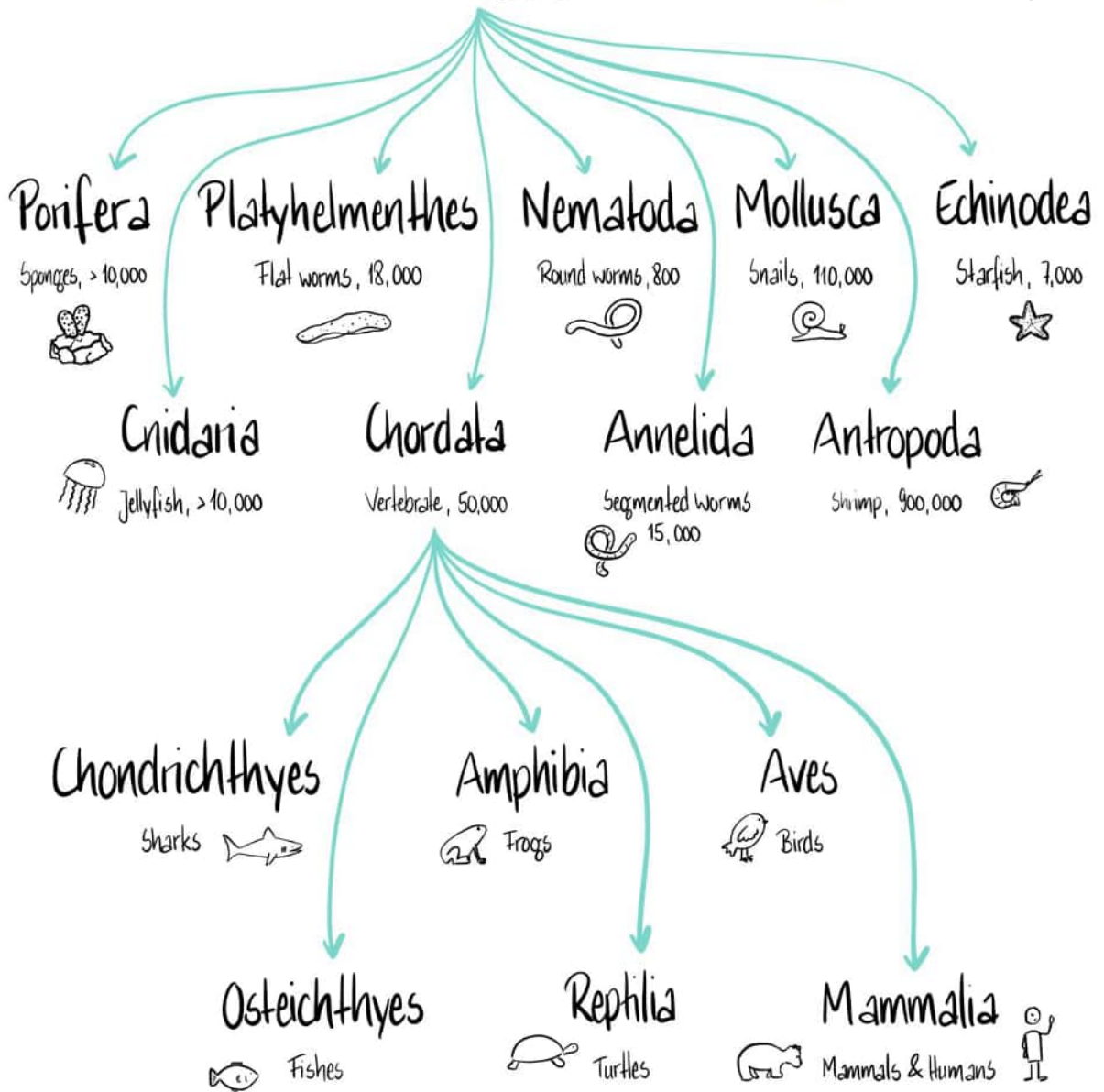
Animalia

Kingdom

Phylum

Class

more similarities



Biology Notes

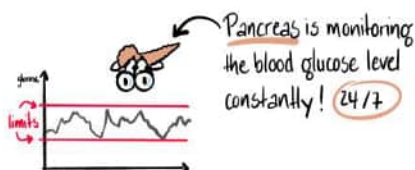


Homeostasis & Body Systems

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Blood glucose level

Needs to stay within its limits, so the cellular respiration can work properly



Blood oxygen level

For the proper function of cellular respiration there needs to be enough oxygen in the blood

The rate & depth of breathing increases when not enough oxygen is present



Homeostasis

a balanced state of the body

The body heat is produced as a byproduct of cellular respiration

Body temperature

37°C (98.6°F) is the normal body temperature
If the temperature is too high or too low for a period of time the metabolic processes get disturbed.



Evaporation is cooling!

Professor Landry

Sources of heat

- When being active the body produces more ATP & more heat



- High temperature



- Solar Radiation



- High relative humidity



When the humidity is really high, the air can take up less water. This means that evaporation is not working well & the body can overheat!



The body needs to be cooled!

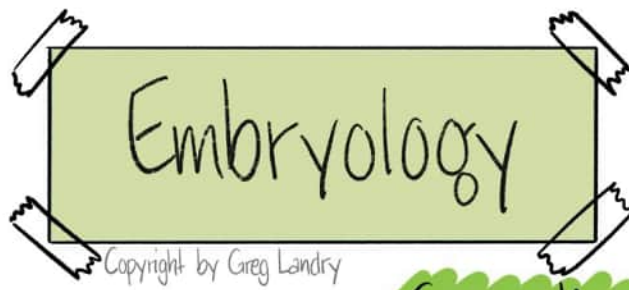
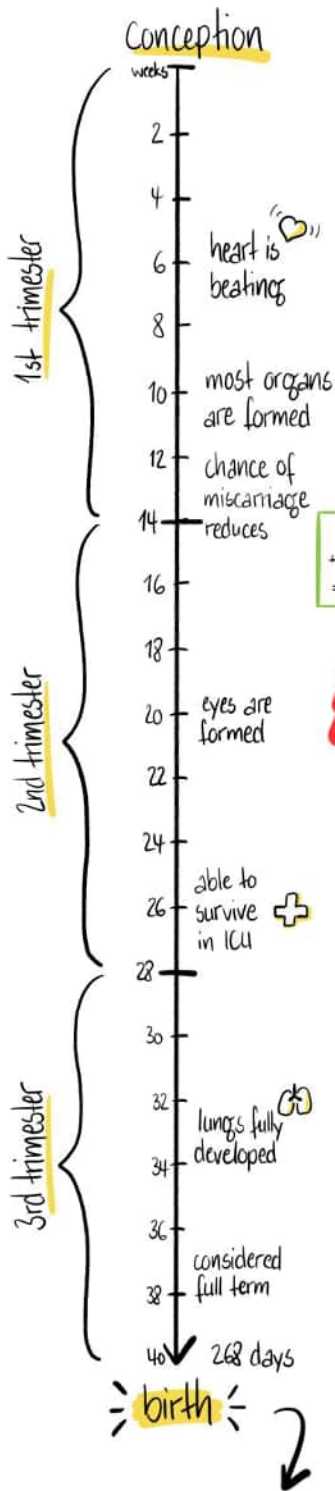
- respiratory evaporation
- radiation from body
- convection from wind
- evaporation of sweat



Biology Notes



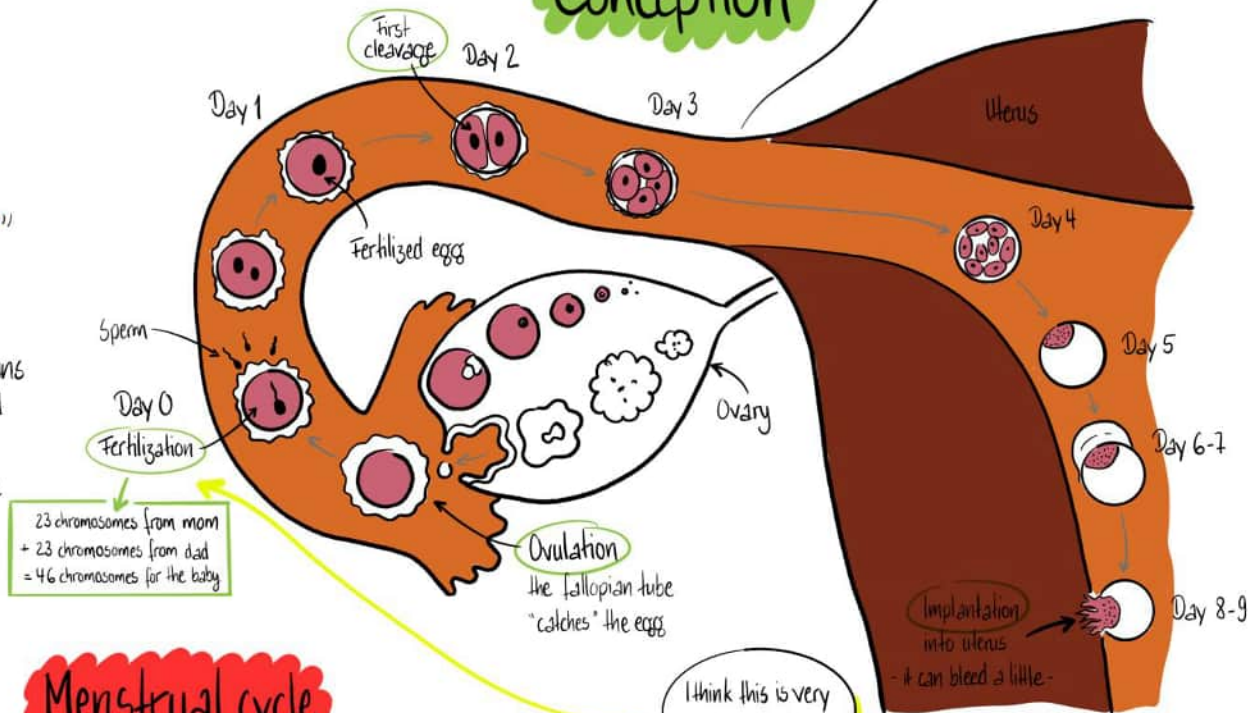
Pregnancy



Conception

Tubal pregnancy

When the fertilized egg starts to grow in the fallopian tube instead of the uterus the pregnancy has to be terminated.

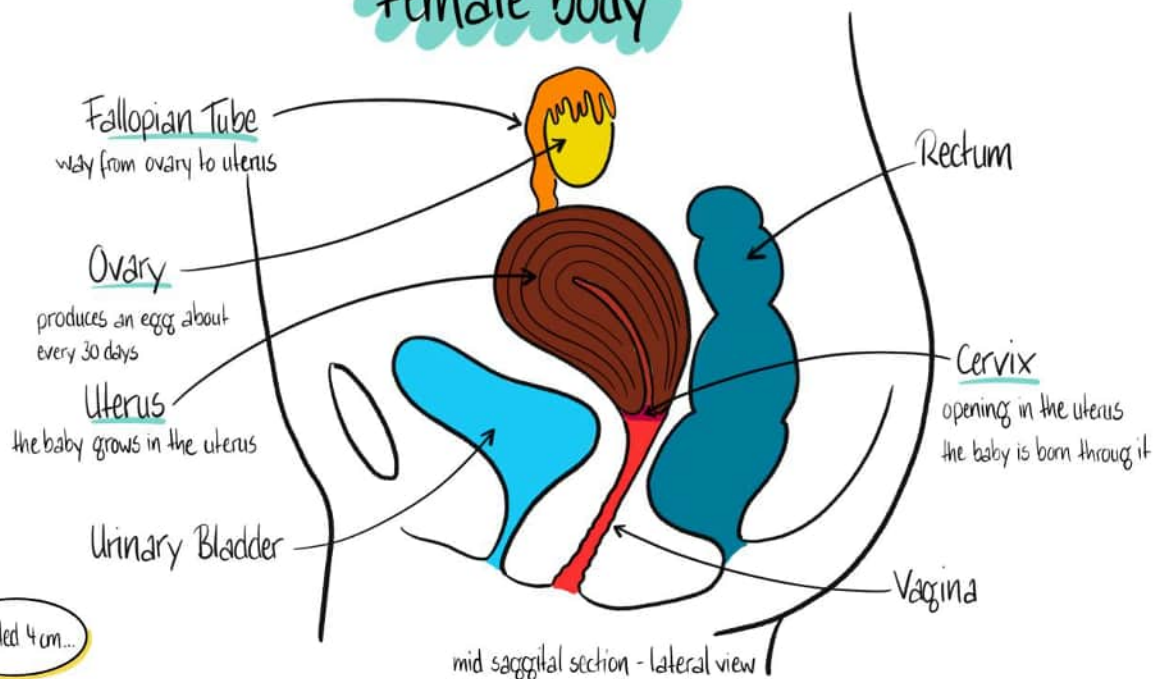


Menstrual cycle

Every 30 days an egg leaves the ovary. To be able to nourish a baby, the tissue of the uterus is built up. If no pregnancy begins, the tissue is shed along with some blood - period



Female body



Labor pain is the contraction of the strong uterus wall muscles. The cervix opens while labor & the mucus plug dissolves.

Biology Notes



Skeletal System

Copyright by Greg Landry



This is one of my fav facts!

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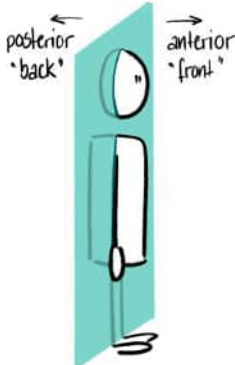
Anatomical Planes

Sagittal Plane

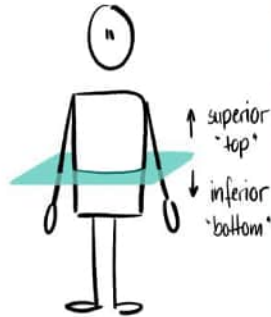


not necessarily in the middle!
But if "mid-sagittal"

Frontal Plane

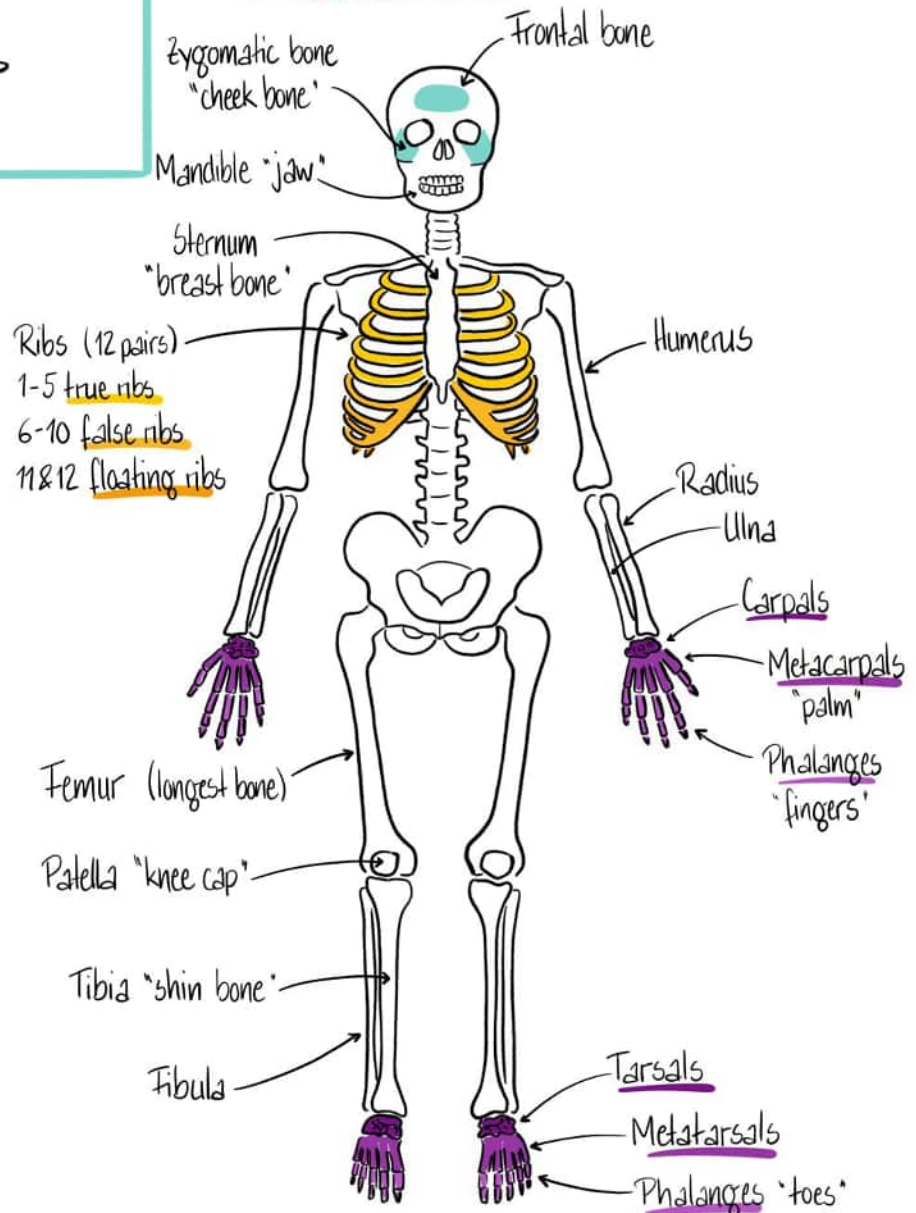


Transversal Plane



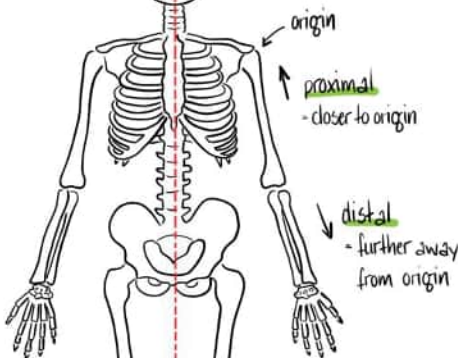
Bones provide the structure
Muscles provide the movement
Ligaments connect the bones

Important bones



Terminology

Anatomical position:
standing, arms by side,
palms forward



medial = closer to midline
lateral = away from midline
midline of body

Biology Notes



Skeletal System

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Be careful with your neck! It's the most sensitive part of the vertebral column.



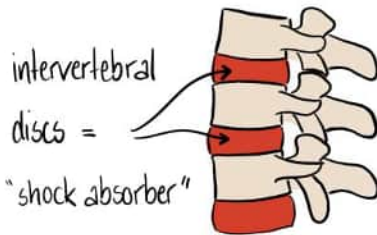
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Vertebrae



hole in all vertebrae
for the spinal cord
= good protection

24 separate vertebrae
bones held together by
tough ligaments & muscles

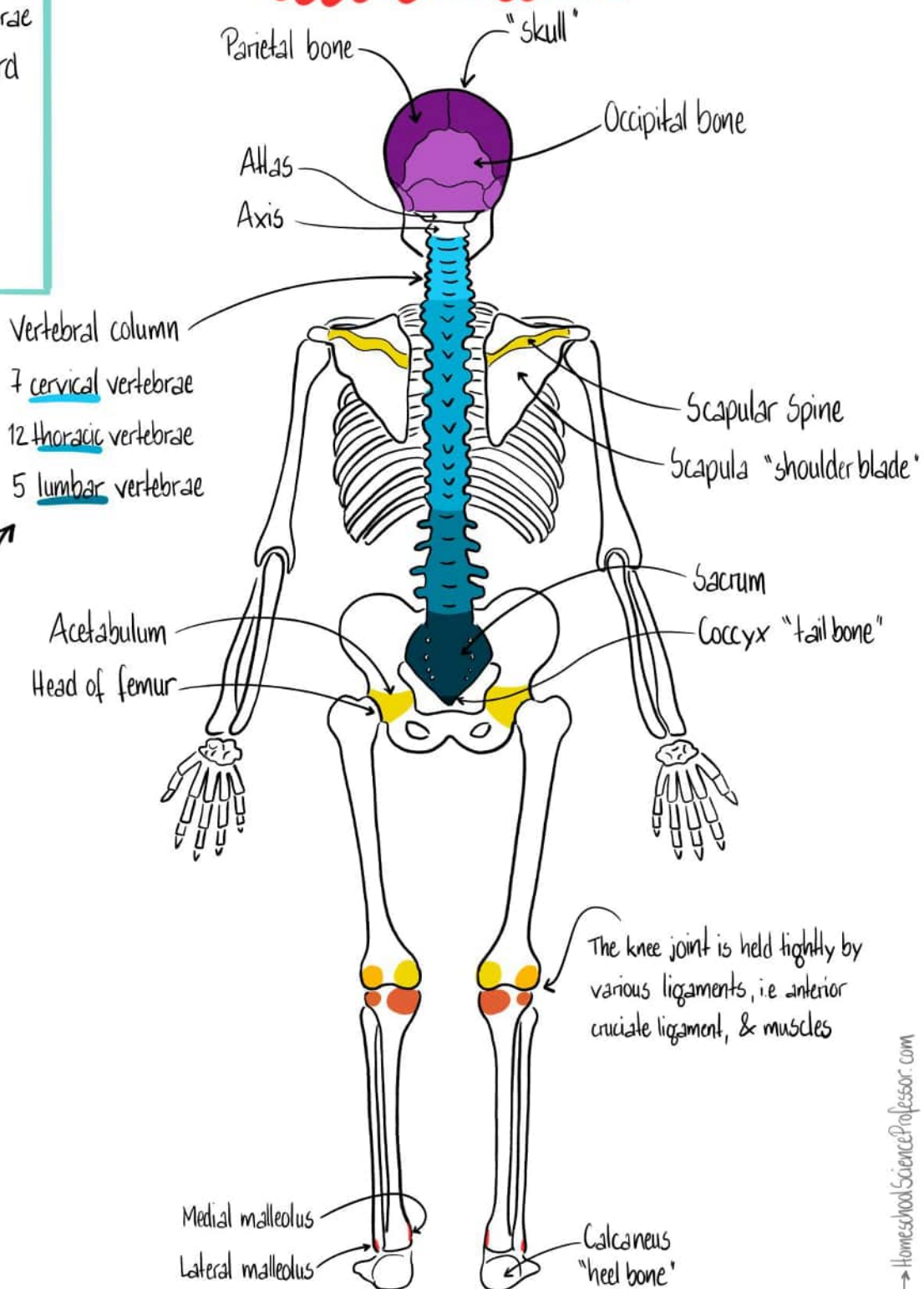


intervertebral
discs =
"shock absorber"

Remember the numbers.

- breakfast at 7
- lunch at 12
- dinner at 5

Important bones



Joints

Shoulder: shallow joint
big range of movement
less stable

Hip: deep joint
stable joint
less movement

Biology Notes



Muscle cells are
~60,000 nm in size

Muscular System

-Anterior-

Copyright by Greg Landry

I like this!



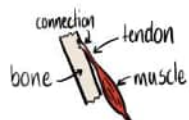
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How muscles work

Muscle cells have the ability to contract so they shorten the whole muscle

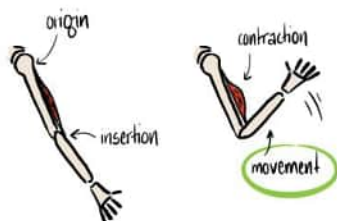


Muscles are connected to bones on both ends. The tissue at the end of the muscles is called "tendons". The tendons are meshed into the bones.



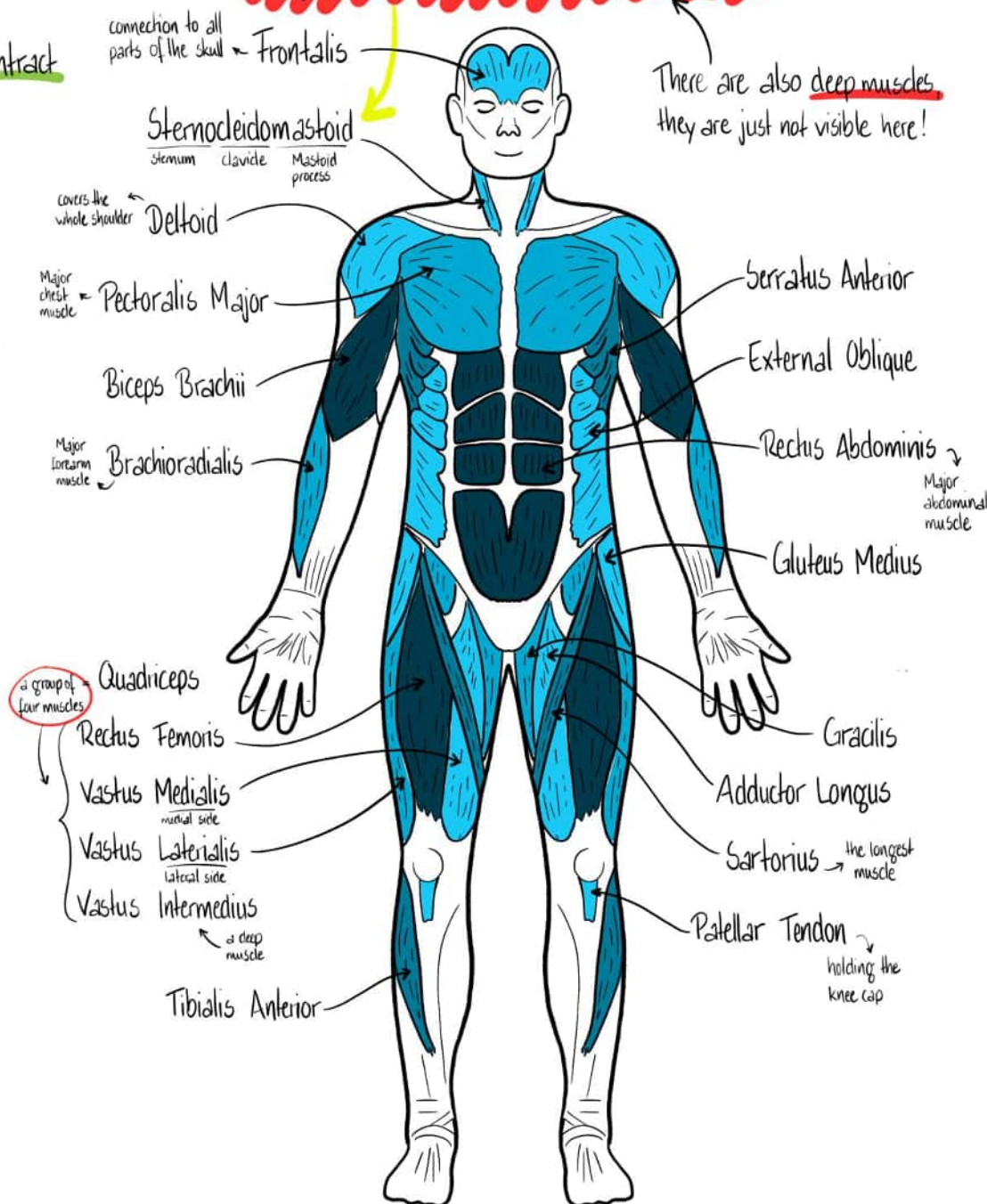
The connection that doesn't move when the muscle contracts is called "origin".

The moving side is called "insertion".



Important superficial muscles

There are also deep muscles they are just not visible here!



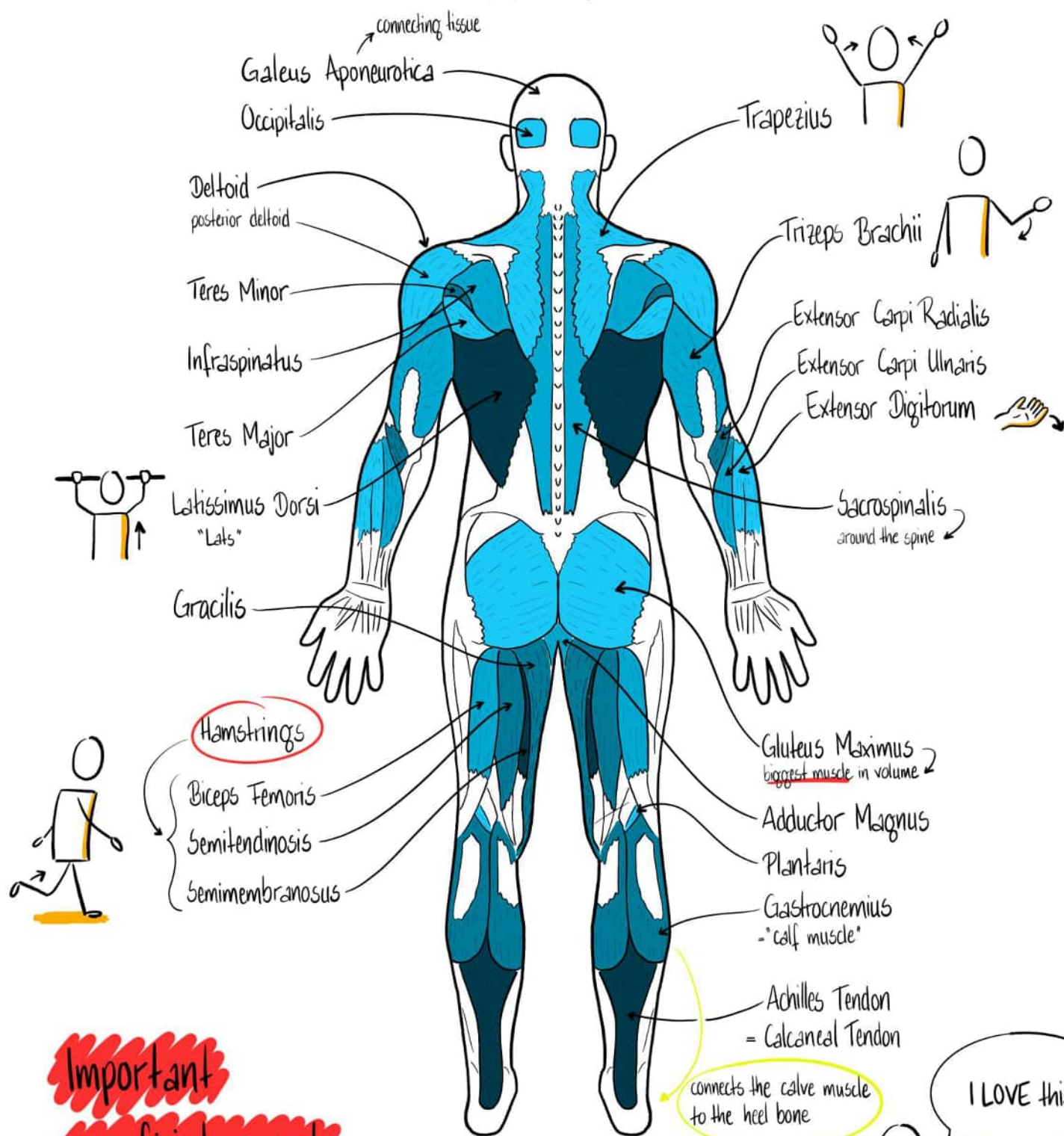
Biology Notes



Muscular System

-Posterior-

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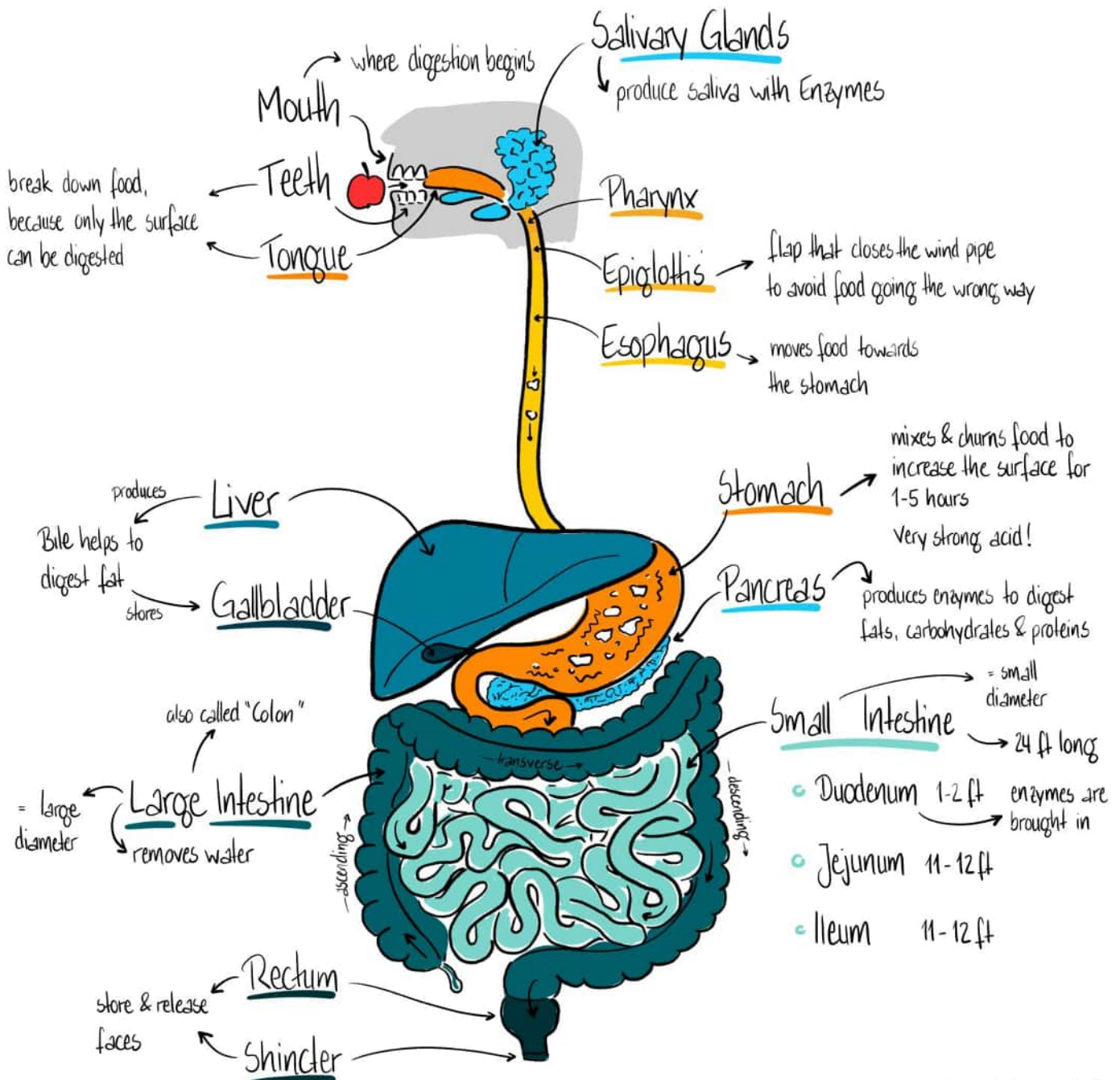
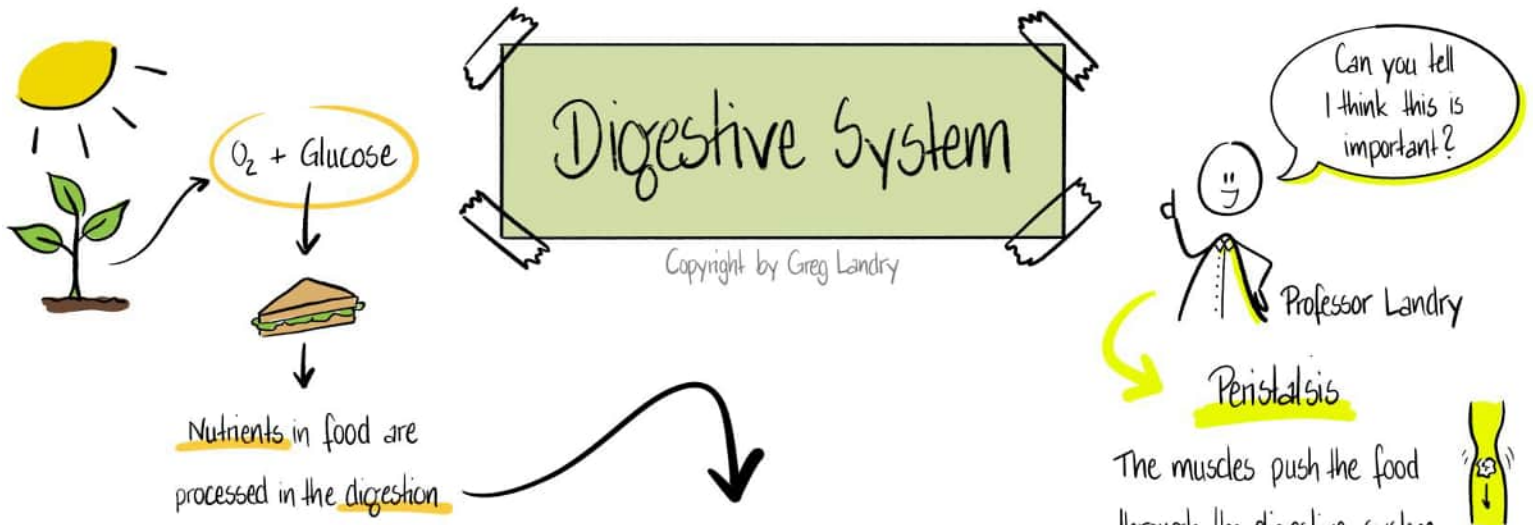
**Important
superficial muscles**

I LOVE this!



Biology Notes



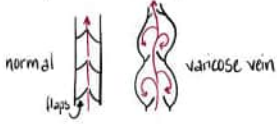


Biology Notes



Varicose veins

Veins in the legs that are damaged & expanded in the process



to the heart

Veins

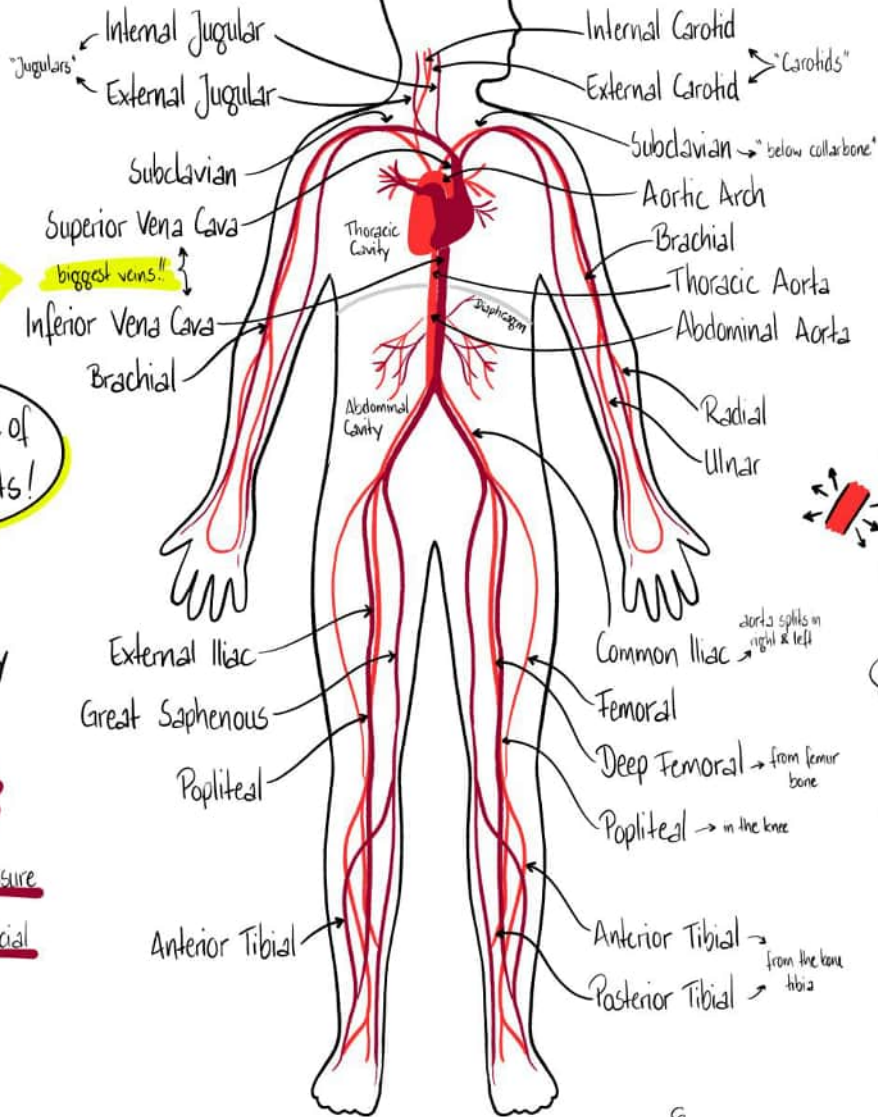
Arteries & Veins

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Capillaries are the smallest blood vessels & the place where the exchange of blood gases happens

Arteries

from the heart



This is one of my fav facts!

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Vein facts

- veins have a lower pressure
- veins are more superficial

Artery facts

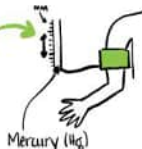
- arteries are thicker walled because the pressure is higher
- arteries have smooth muscles that are able to dilate & constrict depending on where the blood is needed the arteries dilate
- the arteries lie deeper

Blood pressure

Systolic = pressure while the heart beats (high)

Diastolic = pressure between heart beats (low)

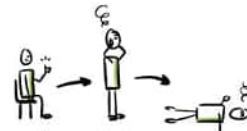
Normal pressure: Systolic 120 mmHg
Diastolic 80 mmHg



→ HomeschoolScienceProfessor.com

Low pressure

okay to a certain degree,
below dizziness & fainting



orthostatic hypotension

High pressure

a constantly too high pressure is
not good for the health!!

Heart Rate

Average heart rate (beats per minute)

is 50 - 80 bpm

Maximum heart rate = 220 bpm - age

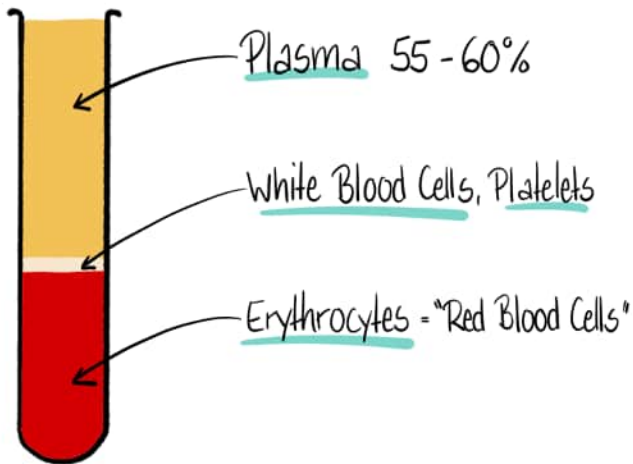
Biology Notes





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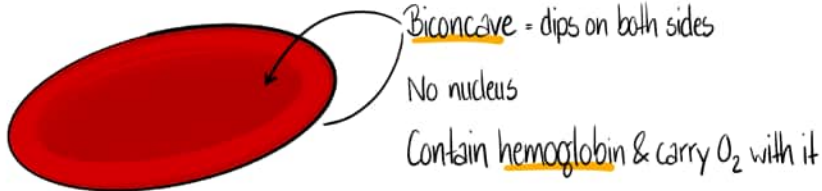
What's in the blood?



Knowing the blood type is essential for transfusions!
An incompatible type is seen as an invader



Erythrocytes

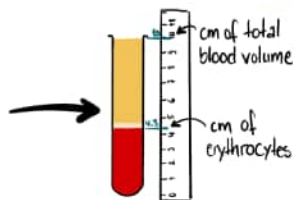


Hematocrit = percentage of erythrocytes as a function of total blood volume

the "%" is not needed as unit

How hematocrit is measured

The blood is spun in a centrifuge to separate it into its parts

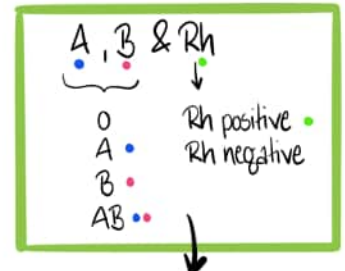


$$\frac{\text{erythrocytes (cm)}}{\text{blood volume (cm)}} = \frac{4.3 \text{ cm}}{10 \text{ cm}} = 0.43$$

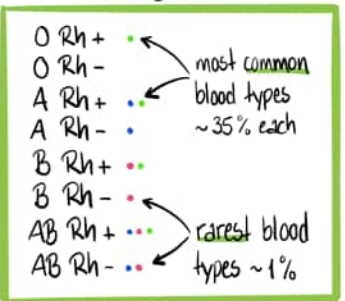
Hematocrit: 43

Antigens

There are three possible antigens on the surface of the erythrocytes.



these possible antigens are combined to the blood types



Clumping means the antigen is present in the blood = blood type **A+**

Normal range

male: 40-50

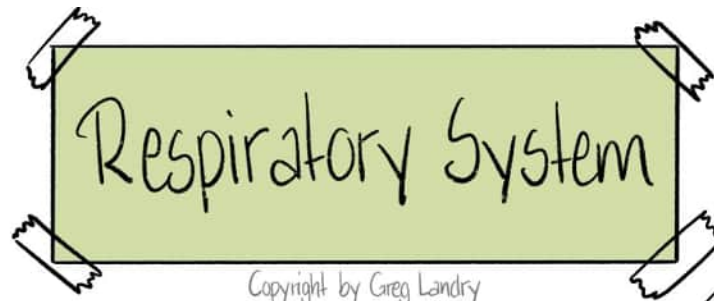
female: 35-45

A too low hematocrit is called anemia & can cause tiredness & dizziness

Biology Notes



A hole in the thoracic cavity is called "sucking wound". It gets a problem for breathing!



ambient air = the air around us

78 % Nitrogen

21 % Oxygen

1 % Mixed gases

needed for cellular respiration in the mitochondria

If an illness is effecting breathing in the upper part, a tracheotomy can be placed



Very sensitive nerves in the beginning of the trachea to detect food / fluids going down the wrong pipe. Reflex to cough if something is detected. Use the Heimlich maneuver if needed!



I like this!

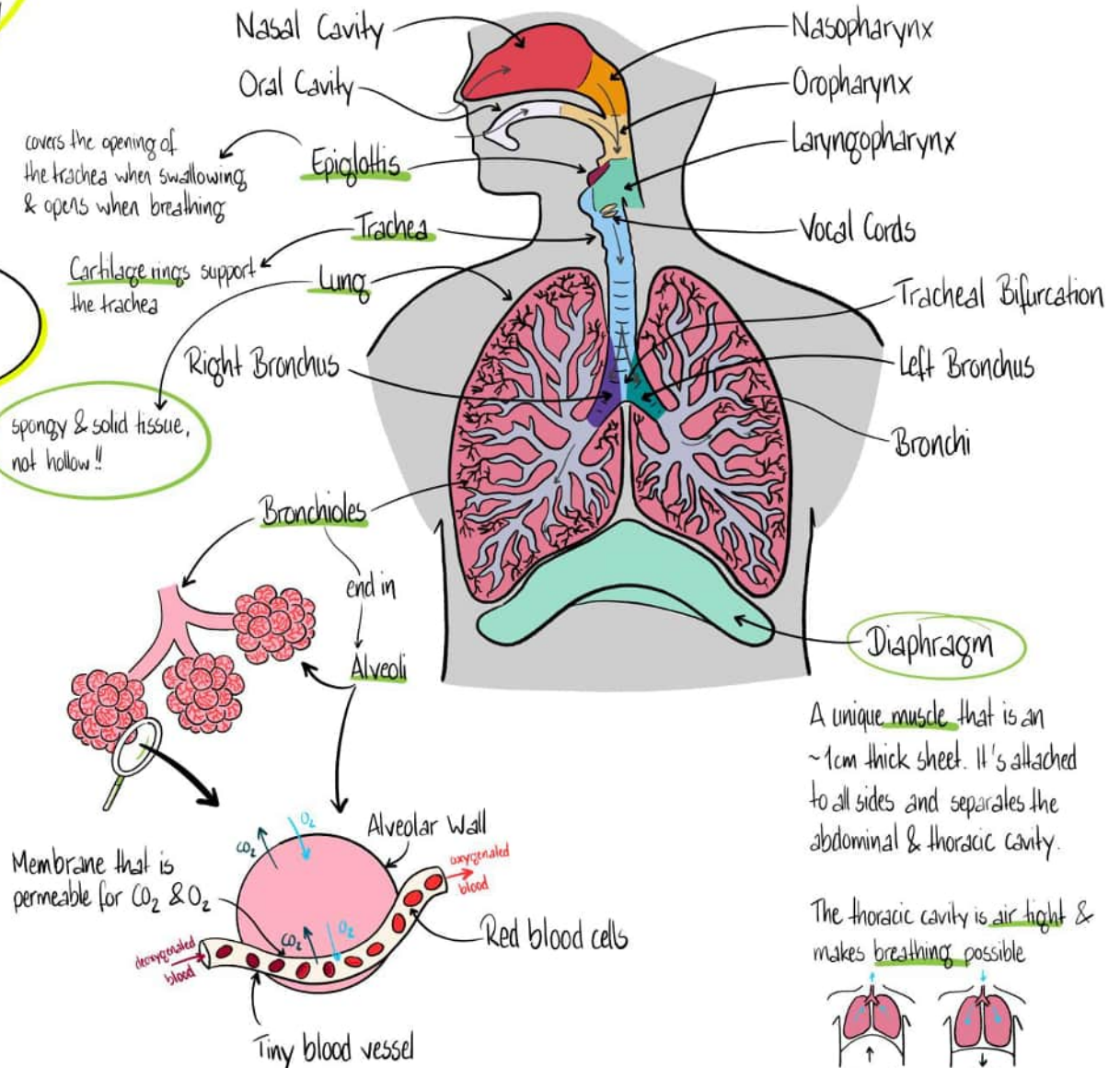


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covers the opening of the trachea when swallowing & opens when breathing

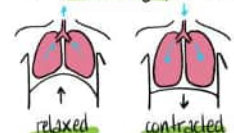
Cartilage rings support the trachea

spongy & solid tissue, not hollow!!



A unique muscle that is an ~1cm thick sheet. It's attached to all sides and separates the abdominal & thoracic cavity.

The thoracic cavity is air tight & makes breathing possible



relaxed
smaller volume, air flows out

contracted
larger volume, air flows in

Biology Notes



Endocrine system

A group of endocrine glands that send signals through the body over the blood to the organs

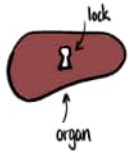
Endocrine System

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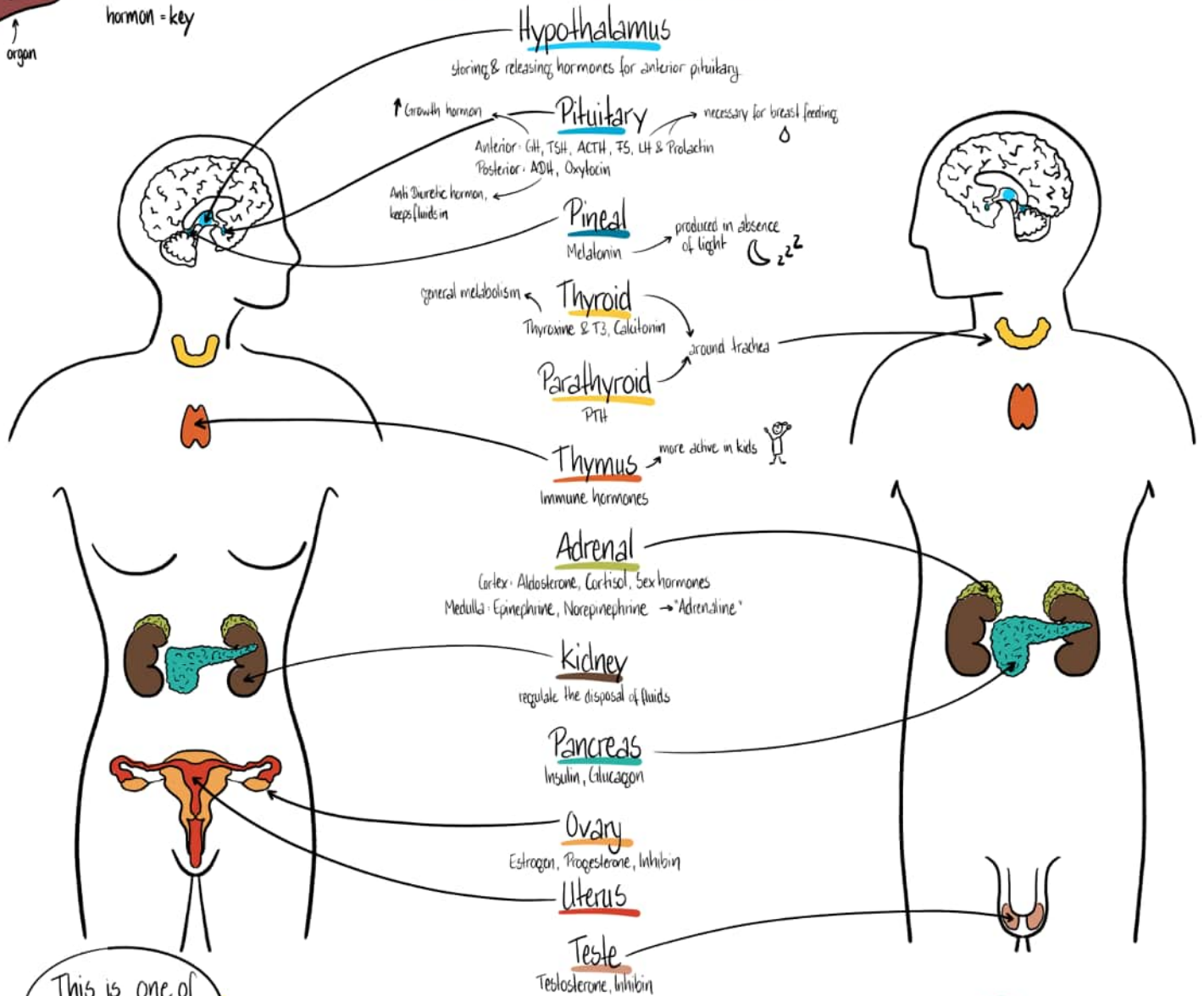
Exocrine glands

Glands that release their secrets into a duct instead of the blood

The endocrine glands



lock
organ
hormone = key



This is one of my fav facts!



Professor Landry

The pancreas is the only gland that is endocrine & exocrine!
hormones digestive enzymes

The blood sugar is closely monitored by the pancreas

too high blood sugar

insulin

store the glucose in the form of glycogen

too low blood sugar

glucagon

release glucose from glycogen

Diabetes types

- 1: the pancreas produces no insulin
- 2: the cells are less sensitive to insulin → reversible

Biology Notes





Reproductive System

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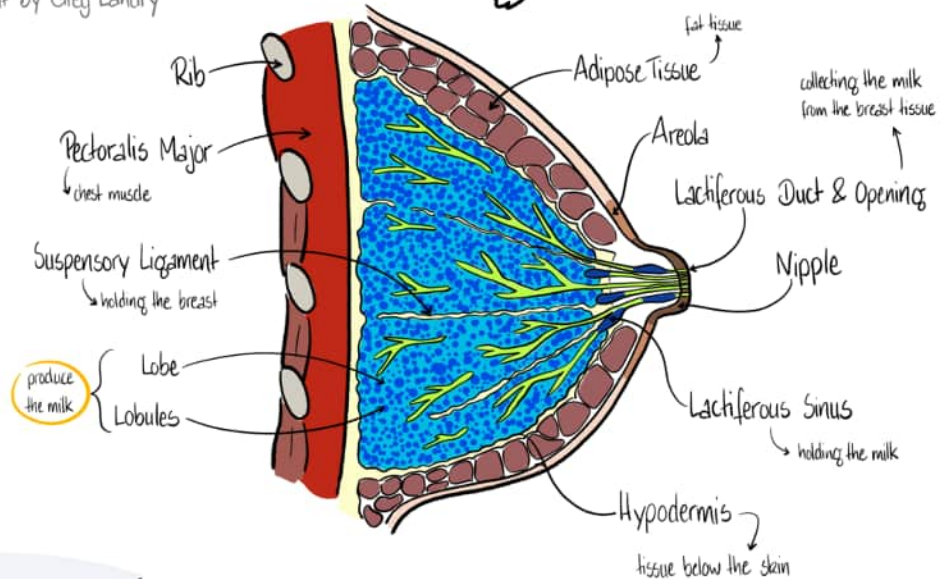
The breast

While the pregnancy the breast is preparing for breast feeding. The hormones are active in the production & the release of the milk.

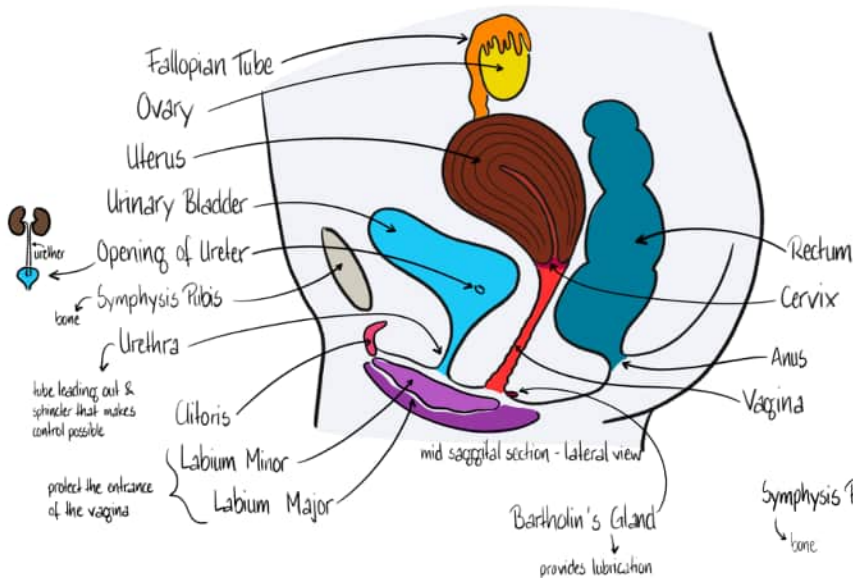
Menstrual cycle

Every 30 days an egg leaves the ovary.

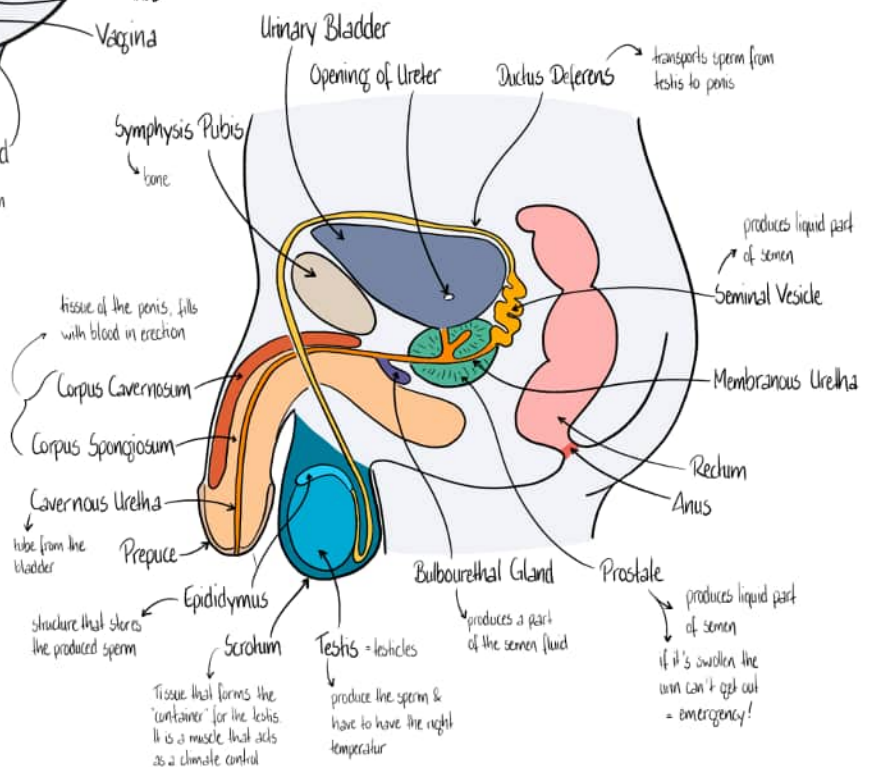
To be able to nourish a baby, the tissue of the uterus is built up. If no pregnancy begins, the tissue is shed along with some blood = period



Female body



Male body



Biology Notes



VO₂ Max

VO₂ measures the amount of oxygen the body can use to produce ATP. It's a kind of fitness test.



$$VO_2 = \frac{\% \text{ of } O_2 \text{ inhaled}}{\% \text{ of } O_2 \text{ exhaled}} = \text{ml/kg/min}$$

Sports Physiology

Copyright by Greg Landry

Heart Rate

("♥")
beats/minute

Max. heart rate = 220 - age

The heart rate & the VO₂ correlate



low effort

low heart rate
low VO₂



higher effort

higher heart rate
higher VO₂



highest effort

highest heart rate
highest VO₂



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Glucose

The body always needs glucose for the ATP production. Not having enough will cause serious problems! ⚠️

→ Hitting the wall

Ergogenic Aids

Ergogenic aids improve the performance



Illegal aids = doping

Steroids are artificial testosterone that increase the muscle growth.



Legal aids

Protein drinks, powder, Gatorade,...

Best way of action:

good nourishment & good training



Altitude Training

"live high - train low"

Living at high altitude increases the red blood cell count

training at sea level makes the necessary intensity possible

at sea level the body is easily capable to get enough oxygen for the ATP production



sea level



high altitude

at a high altitude the body is not able to get enough oxygen for the ATP production

The body reacts in two ways:

- ① deeper & more frequent breaths (short term)
- ② more red blood cells (long term)

Biology Notes

