Organism - visible to the naked eye

Microorganism - microscope needed to see

Mold - member of the fungus kingdom

Rhizopus - bread mold

All fungi are decomposers

- kilo 10^3
- **base**
- centi 10^-2 ---.01
- milli 10^-3---.001
- micro 10^-6---.000001
- nano 10^-9---.000000001
- pico 10-12 ---.000000000001

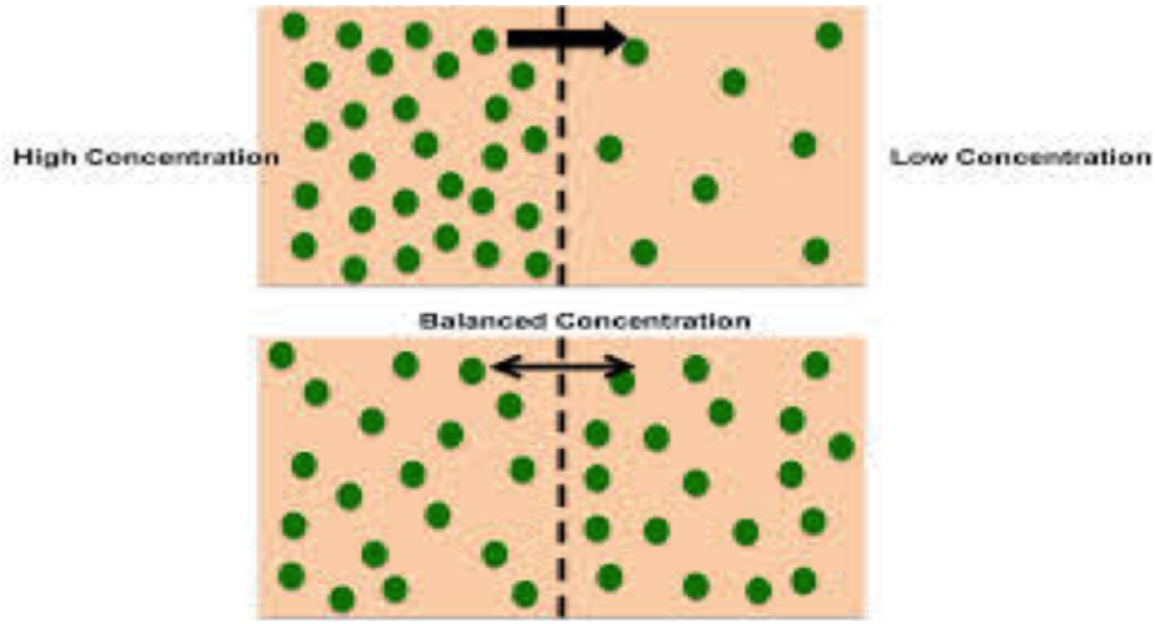
ALPHABETICAL ORDER

Volume Measurements

- Water displacement- Irregular shape
- Calculate using measurements and formula- regular geometric shapes

<u>Characteristics of living things</u>

1.All living things require energy



Less concentration of solute means more water

Diffusion: the movement of molecules (solute) from an area of high concentration to an area of a lower concentration, to eventually spread out evenly. The difference of concentration between the two areas is often termed as the concentration gradient, and diffusion will continue until this gradient has been eliminated.

The molecules are always moving back and forth because they hit each other but it is more balanced than the start

Difference in concentration between one side of the cell and another or one area of the cell versus another **concentration gradient**

Osmosis: the diffusion of water molecules, where there is a semi-permeable membrane and there is water molecules going from one side to the other, but the solute (sugar) can't go through. the concentration of water is going from High to low because The net movement of the water is to where the solutes are so

Osmotic Pressure- The pressure that pushes the water from one side of the 'cell' to the other

Passive transport- the movement of molecules from an area of high concentration to an area of low concentration

- Diffusion
- Osmosis
- **Facilitated (helps it)**- Many large and polar molecules items take more effort to pass through the cell membrane. So instead of just passing through the cell membrane like small non polar molecules, the proteins that act as channels to send these larger polar molecules through the cell membrane. This process in which molecules cannot directly diffuse across the membrane is called facilitated diffusion

Aquaporins are channels that water molecules go through, in and out of the cell, while preventing the passage of ions and other solutes.

Active transport- requires ATP molecules move from an area of low concentration to high concentration

Neurons- can make 10 -50,000 connections

Dendrite- where info comes in from the axon of the neuron before
Axon- Where information is sent our to the dendrite of the next neuron
Synapse- Space between the axon ending and the dendrite of the next neuron

Neuron receives signals through **transmitters**. Neuron transmitters comes from one specific axon and is going to one specific dendrite,

Metabolism- The sum total of all chemical reactions in an organism

Enzymes – organic catalyst

Catabolic pathway- break down molecules
Ex. Cellular respiration
- $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

Anabolic pathway- build molecules

Ex. Photosynthesis (energy = made)

- $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Anabolism + Catabolism = Metabolism

Law of Conservation of Energy

Energy is never created nor destroyed but it can be converted to different to different forms

Energy- Changes forms

Mitochondria produces energy

Potential Energy – Stored energy
Kinetic Energy – The energy of motion
Thermal Energy- Energy in the form as heat.
Potential energy becomes kinetic energy when the energy is used

Cofactor or Coenzyme in Cellular Respiration is **NAD** of **FADH**

The enzymes in cellular respiration that release energy from glucose pass the energy to NAD of FADH because in CR the enzymes take the glucose apart very slowly and energy is released

When energy is given to NAD and FADH it is given in the form of H+

NAD + H+ —> NADH (Oxidyzing)

NADH —> NAD+ H+ (Reduction)

FADH + H+ —> FADH2 (Oxidyzing)

FADH2 —> FADH+ H+ (Reduction)

Oxidized means losing e-, or the negative charge (which means also gaining protons and more positive charge) so the NADH+ FADH2 are oxidized because they lose the e- the e- that help the cytochromes push the H+ into the inner membrane space
Reduction is the gain of e- or a decrease in oxidation (opposite of oxidation)

When the energy is given back to the enzymes it is used to to form the ATP
The overall goal of CR is breaking the the carbon-carbon bond

38 ATP molecules are produced from a molecule of Glucose, and there is a net gain of **36 ATP molecules**

Glycolysis- splits a 6 carbon molecule into two three carbon molecules
2 ATP molecules are given and 4 are produced = NET GAIN of 2
Give 2 NAD and produce 2 NADH

Going from 2 Pyruvic Acid (3) —-> 2 Acetyl CoA (2C)
2 NAD and produce 2 NADH
Give off 2CO2

#1-23 from Mom (Egg)
#1-23 from Dad (Sperm)

A male baby is XY , A female baby is XX

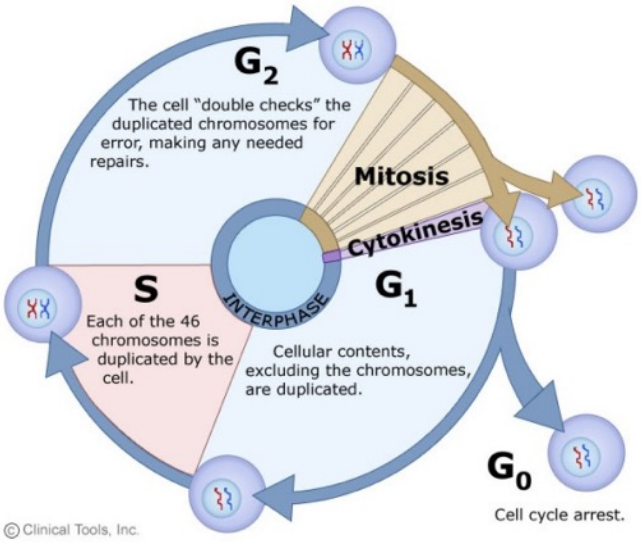
So the sperm can carry an X or Y, The egg can only carry an X

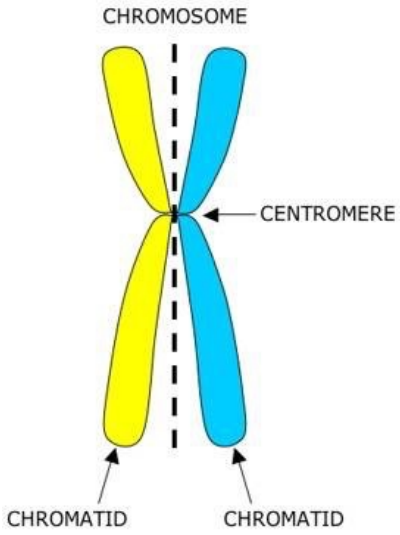
The one cell that divides came directly from the Sperm and Egg

When the cell divides the 46 chromosomes are copied, in order for each daughter (2 total) cell to have 46 chromosomes

What is necessary for a parent cell to split?

- Number of chromosomes must be equal
- Create 2 new nuclei
- Copy each chromosome
- Copy all the DNA (Replication)
- More cell membrane
- Replicate Organelles
- Make additional proteins
- Membrane for the organelles
- Organize the DNA (chromosomes)
  -each cell gets 2 of each type of chromosome (23 types of chromosomes one from sperm and one form egg,)





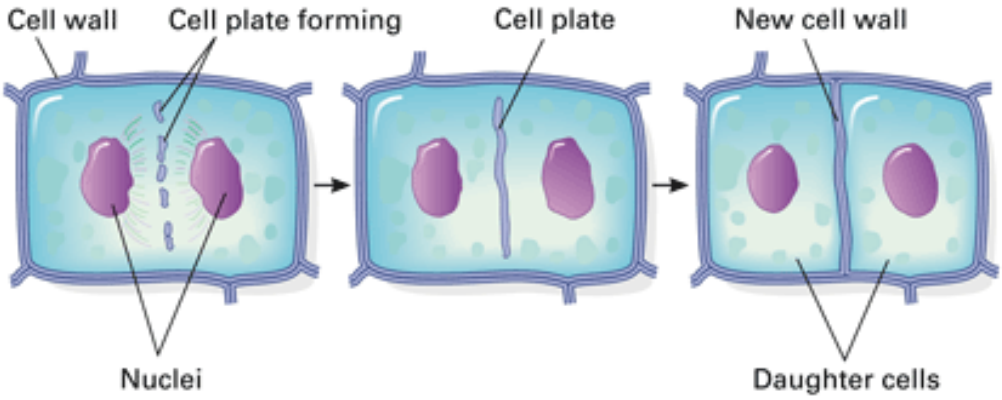
Before mitosis- the chromosomes have already been divided

Interphase is followed by Mitosis = Interphase → Mitosis

<u>Phases of Mitosis:</u>

Prophase-the appearance of chromosomes
Metaphase- (before this process there are already duplicate chromosomes in pairs held by centromere) Chromosomes line up at the equator of the cell
Anaphase- sister chromatids separate (from being held together by centromere), migrate to opposite poles
Telophase- pinching in of membrane

Mitosis is followed by Cytokinesis = Mitosis→ Cytokinesis



In a dividing plant cell the growing cell plate eventually fuses with the plasma membrane of the parent cell, and the cell wall material joins the existing cell wall. (Telophase of Plant cell) Two daughter cells result, each with its own plasma membrane and cell wall.

Molecular Biology: DNA and Protein Synthesis

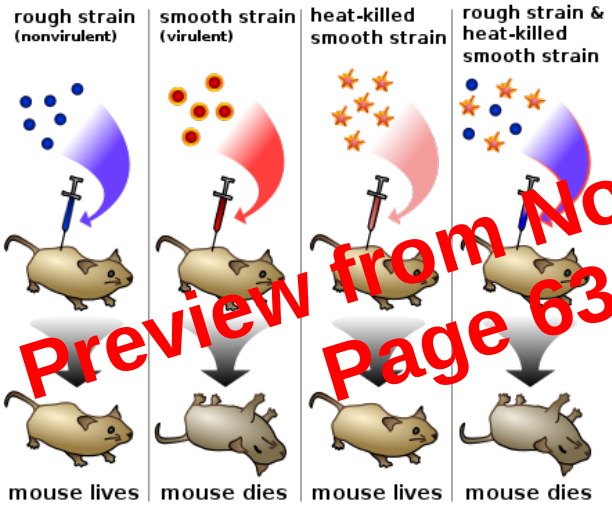
Central Dogma- the most central aspect of the whole field

DNA → more DNA is Replication

DNA → mRNA is Transcription

mRNA → protein is Translation or Protein Synthesis

DNA as genetic material was discovered by three different experiments:
1. Griffith's Experiment- 1928,



Hypothesis: Material in dead deadly bacterial cell (S bacteria) can genetically transform harmless bacteria (R bacteria) into deadly bacteria

- **S bacteria**, has a coat of molecules, and is deadly; the genetic information (DNA) makes the outer coat and makes the bacteria deadly. It is Virulent is deadly

- **R bacteria**, doesn't have a coat of molecules on the outside, harmless Non-virulent is not deadly

- The dead S bacteria will still have genetic material that makes it deadly and the genetic material in the dead S bacteria that makes the bacteria

have a coat and deadly is still in the S bacteria and transforms that genetic material to the R bacteria so it can reproduce to a deadly point, by having a coat the bacteria is stronger

- **Bacterial Transformations-** Bacteria can take small pieces of DNA from its surrounding use the genetic information for its own cell

- The reason why this experiments shows it's DNA in the bacteria not protein, because when you heat the bacteria all the protein is destroyed and in the 4th picture if it was protein then the dead protein of the heated S bacteria couldn't transmit the information to the R-strain and then the R-strain wouldn't be deadly. But the scientists didn't know that then.

2. **Avery, McCarty + Macleod,**

   What part of component of the S bacteria can transform the R bacteria to the deadliness of the S bacteria?
   Is it protein?
   Is it DNA?
   Is it RNA?

- **First Experiment:** Control Group: Liquid and R bacteria, R bacteria stays R bacteria, to make sure R bacteria

- **Second Experiment:** S and R bacteria, R goes to deadliness of S (Meaning the DNA transformed), Can tell that because though the DNA is transformed the R bacteria "is" S bacteria

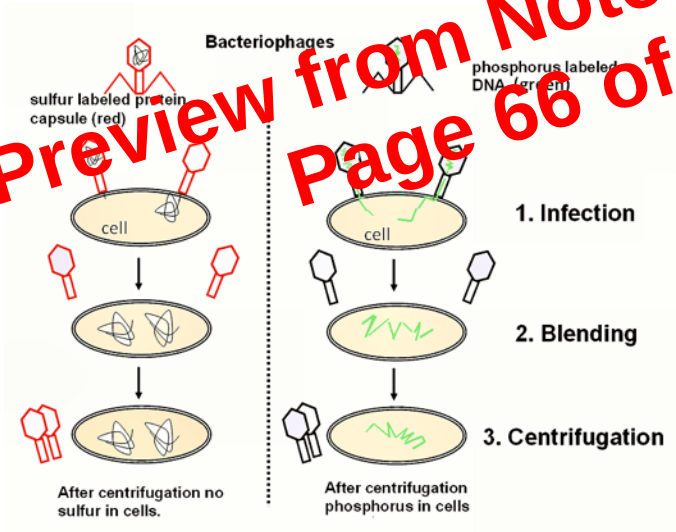
- **Third Experiment:** Destroyed Proteins in S bacteria Extracts (with trypsin to hydrolyze proteins, which kills the protein) in S bacteria R bacteria, the R bacteria go to S bacteria deadliness, showing that Protein doesn't consist of the genetic material because even though the protein was destroyed, the genetic material in the S bacteria still transformed to the R bacteria

- **Fourth Experiment:** Destroyed RNA in S bacteria Extracts (with RNase, which kills RNA) in S and R bacteria, R bacteria goes to deadliness of S bacteria, showing that RNA doesn't consist of the genetic material because even though the RNA was destroyed, the genetic material in the S bacteria still transferred to the R bacteria

- This was done by a series of two experiments in which different sets of non-radioactive bacteria were incubated with phages that had either their protein or their DNA labeled They allowed the phages to infect the bacteria for a short time, they agitated the incubations to dislodge any loose parts of the phages. The bacteria cells were then pelleted in a centrifuge and the location of the radioacivity (in the pellet with the bacteria or in the supernatant). They found that the radioactive DNA was always found with the bacteria cells and that the radioactive protein was always in the bacteriophage. This suggested that the DNA was injected into the bacteria but the protein coat was not. Thus all of the information needed to produce new viruses was contained in the DNA and not the protein.

Radioactive Protein
- 35 Sulfur (All protein has Sulfur, but not phosphorus)

Radioactive DNA
-32 phosphorus (All DNA has phosphorus, but not sulfur)



Phenotype- Physical characteristic of an organism
Genotype- The set of genes which produce your characteristic
Example
Blue- Phenotype
Blue/Brown- Genotype, (2 genes for every characteristics one from the mom on from the dad. 2 dominants, 2 recessive, Or one dominant and one recessive)

Example.
Allele- genetic possibility for a particular trait
Fur Color- Trait or characteristic color of an animals for its phenotype
An allele is a genetic possibility for a phenotype within a population
Pea plant height is caused by inheriting one of two possible alleles from each parent. In pea plants, either a tall allele or a short allele for plant height can be inherited

Mendel's pea plants
Crosses a tall pea plant with a tall pea plant and does this for many generations and all the pea plant are all tall

Crosses a short pea plant with a tall pea plant (The parental generation) and does this for many generations and all the pea plant are all tall

	T	T
t	Tt	Tt
t	Tt	Tt

Blood type in humans, there is one gene that makes up blood trait

Phenotype: A, B, AB, O

3 alleles that determine blood type

Alleles- I^A produces A protein,
I^B produces B protein,
i produces no protein
A protein and B protein are found of the surface of red blood cells

A- I^A i or I^A I^A
B- I^B i or I^B I^B
AB- I^A I^B
O- ii

2 genes that are ii- don't have protein on their red blood cells
It is a codominance because I^A and I^B are not dominant over each other

Rhesus factor-Rh+ and or

Rh+ is dominant over Rh-

A + blood type can't give to a -blood type, but a negative can give to negative and positive, and a positive can give to positive
(but all depending on the blood type)

A rhogam is given to a Rh negative women whose baby is Rh positive (from the dad, because + is dominant over -, in this situation the possibility of the baby being RH+ varies whether the ad is heterozygous0 or homozygous for RH+) to keep the baby's blood from interacting from the mom's blood, because in a RH- blood, a RH+ is seen as a foreign substance

- When you say you are blood type A, what you are telling people is that the cells in your body make antibodies only to type B antigens. The A-type

- Through Natural Selection, the organisms that don't have traits that help them survive they die out.

- But the organisms that do have traits that make them survive, are then passed on to the next generation and so on, and over time those traits are more frequent in the population,

- Also, when the environment changes, the characteristics that helped an organism then didn't help them now and die out, which is a part of natural selection

- **Adaption-** Any heritable characteristics that an increases an organism's ability to survive and reproduce in it's environment

- **Fitness** describes how well an organism can survive and reproduce in its environment

- For example if there are squirrels who have slightly different hair color, (due to different breeds etc.) one with black and one with brown, hypothetically speaking all the brown fur colored squirrels will die out and the ones with black fur color will live and the rest of the generation will have black hair color

- **Survival of the Fittest-** characteristics or traits that help organisms survive out of everyone else,

Species evolve and change over time because of genetic variation and natural selection, (seperate concepts)

4.7 billion years ago, the earth was formed, and living things couldn't be supported.
On Primitive Earth There Was:

Unity of Life- All organisms on earth descended from one ancestors, and through evolution we became different species

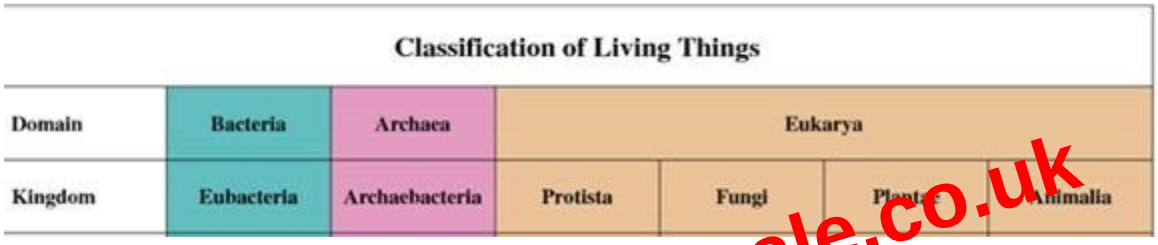
Darwin's finches-
n the Galapagos Islands in the Pacific Ocean, close to the equator, there are a variety of different finches, which vary in the shape and size of their beaks.

Finches – type of bird. Galapagos finches were different than mainland finches (beak shape + size, different diet).

How do you end up with different types of species?

- The finches ended up in the Galapagos (different habitat than mainland)
- Different food resources – they started eating other foods when lacking the foods they were used to
- Pressure of new habitat makes you eat certain foods with the modification of the genetic beaks
- Descent with Modification – all finches descended from a common ancestor in south America – changed over time

Classification of Living Things



Classification of Living Things						
Domain	Bacteria	Archaea	Eukarya			
Kingdom	Eubacteria	Archaebacteria	Protista	Fungi	Plantae	Animalia

Domains:
Bacteria- Archaea-
Eukaryote

Kingdoms:
Eubacteria- All Prokaryotic
All Unicellular

Archeabacteria- All Prokaryotic
All Unicellular

Protists- All Eukaryotic,
All unicellular

Fungus-All Eukaryotic,
A;; organisms which depend on dead and decaying organic materials (such as plants and animals)

Plants -All Eukaryotic,
All organisms which are capable to prepare their own food by raw inorganic (Usually sunlight)