GCSE Biology Complete Revision Summary

Natural selection and gentic modification

Homeostasis and Response

Inheritance, Variation and Evolution

Ecology

Key Ideas

Sexual and Asexual Reproduction

Meiosis
DNA
Mutation
Inheritance
Genetic Diseases
Sex Determination
Variation
Evolution
Selective Breeding
Genetic Engineering
Speciation
Theories of Evolution
Speciation

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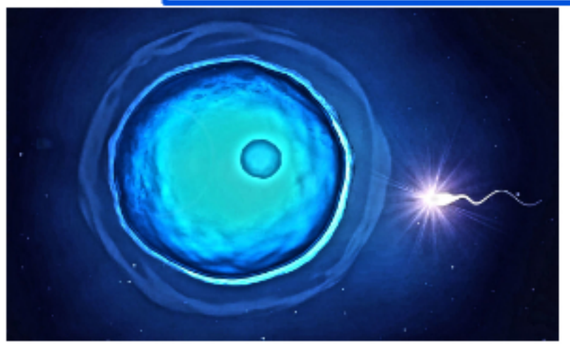
REPRODUCTION

making more offsprings.

SEXUAL

Involves meiosis



Require both parents and involve fusion of gametes

The offsprings are not genetically identical.

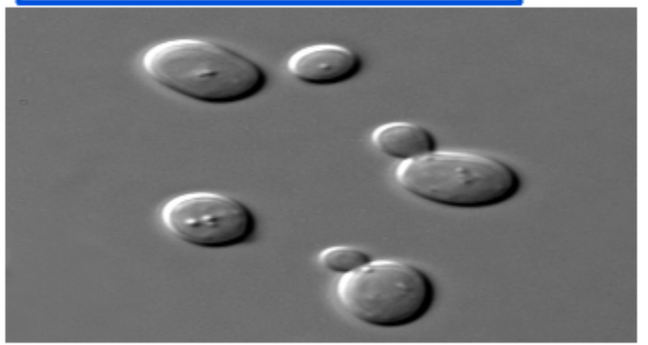
Produce Variation and lead to evolution

eq human reproduction

Source: Flickr.com

ASEXUAL

Involves mitosis



Require single parent and no fusion of gametes

The offspring are clone and genetically identical.

No Variation and Evolution

eq budding in yeast, cutting, runners in plants

Source: Wikimedia commons

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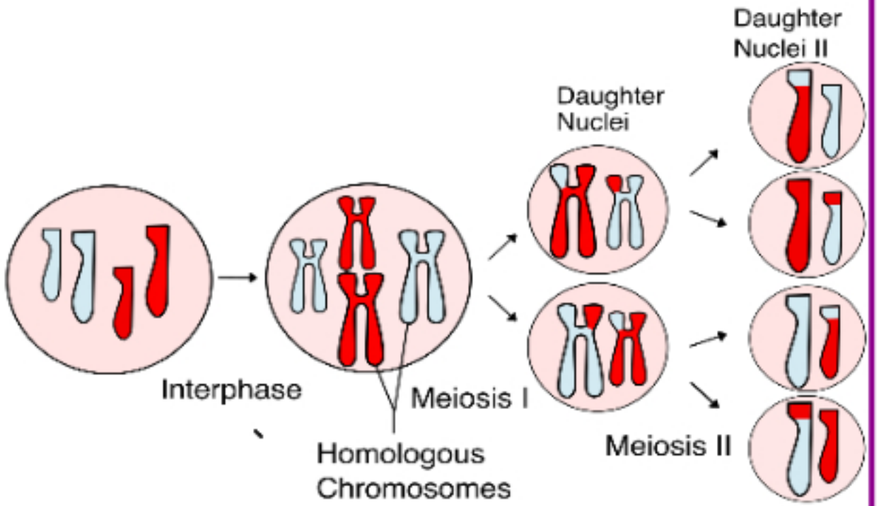
MEIOSIS



Source: Wikimedia Commons

a) It takes place in the sex cells

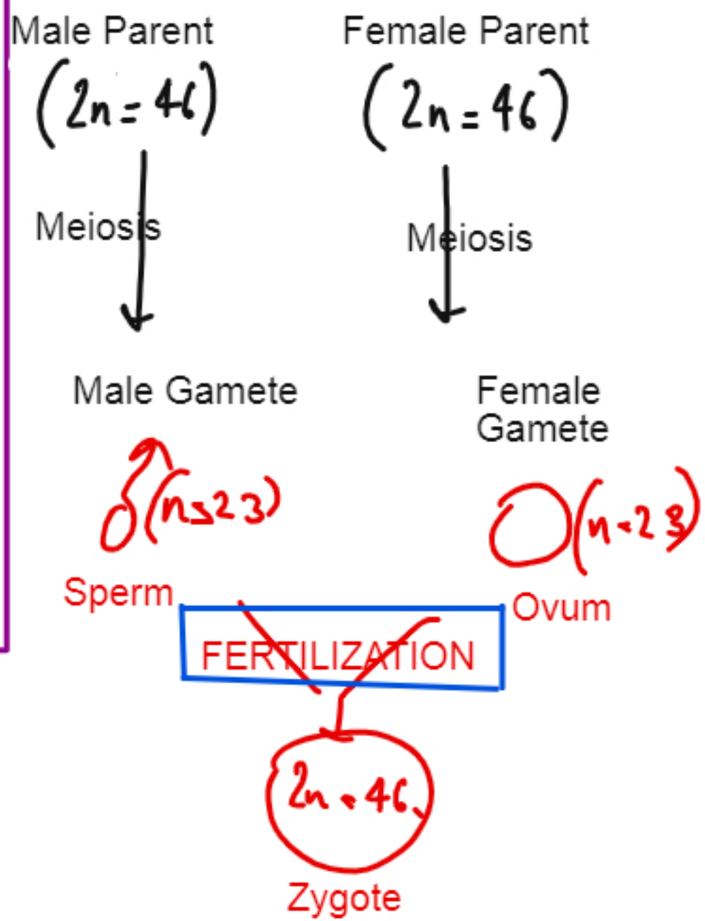
b) It is involved in the production of gametes

c) One parent cell divide to form four daughter cells

d) Daughter cells are not genetically identical to the parent.

e) Daughter Cells have half the number of chromosome than the parent.

f) It produces Variation as it results in crossing over and it leads to evolution.



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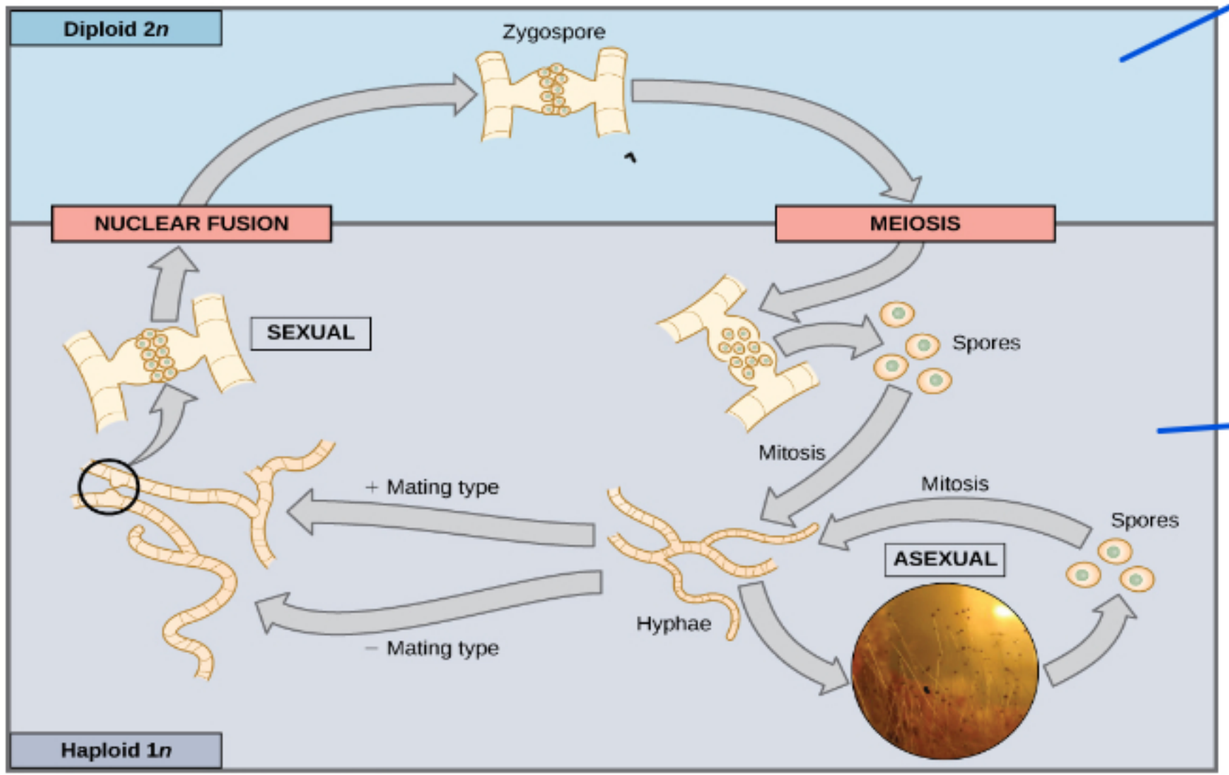
REPRODUCTIVE CYCLE IN FUNGI



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Sexual reproduction in which two nuclei fuses and then undergo meiosis to form haploid spores which grows to form the hyphae.

Most Common is asexual where it releases spores which germinates to form the fungal hyphae.

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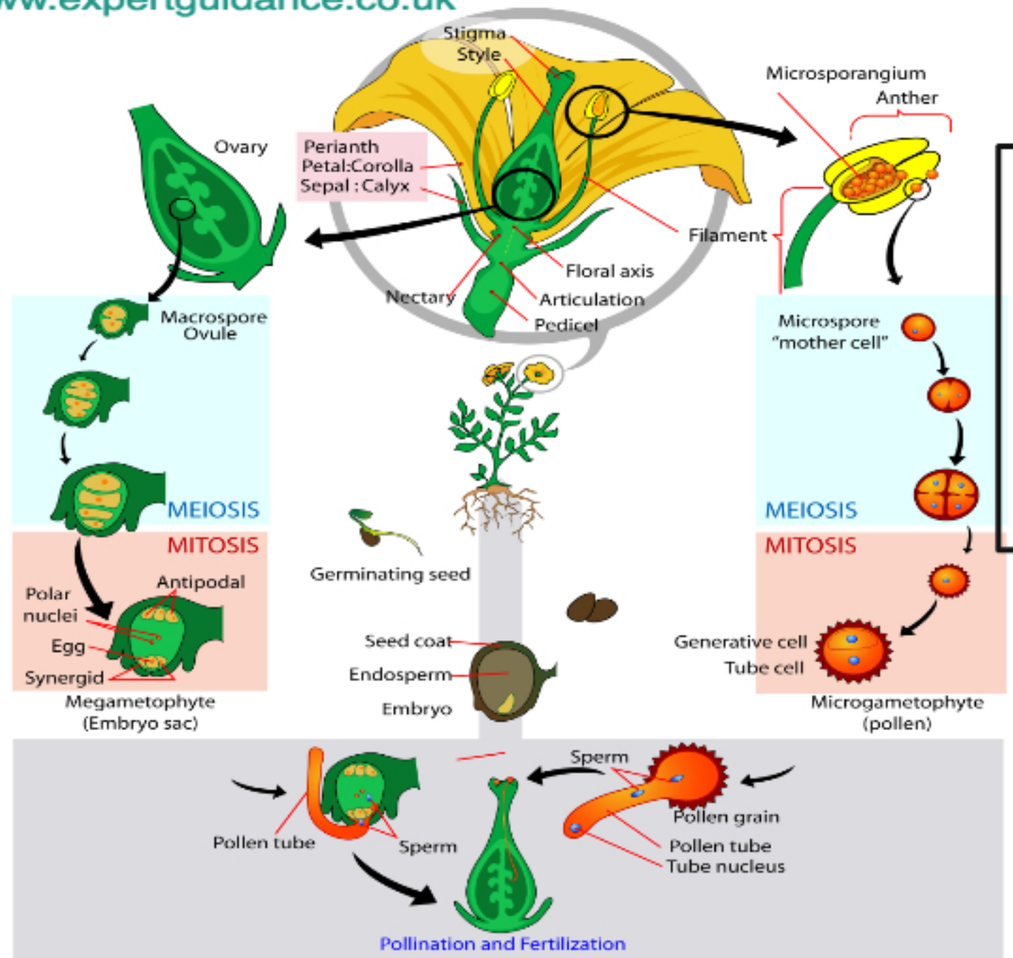
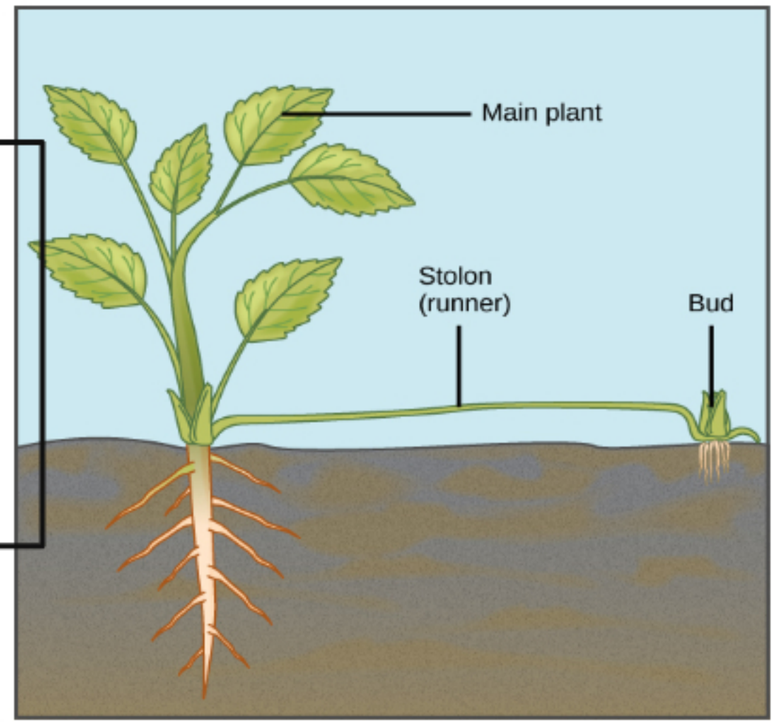
REPRODUCTIVE CYCLE IN PLANTS



Sexual reproduction involves the fusion of pollen grain with the egg nuclei forming zygote which forms the seeds and germinate to form a new plant.



Sexual reproduction in plants in the form of runner, stolon or tuber which produces genetically identical plants.

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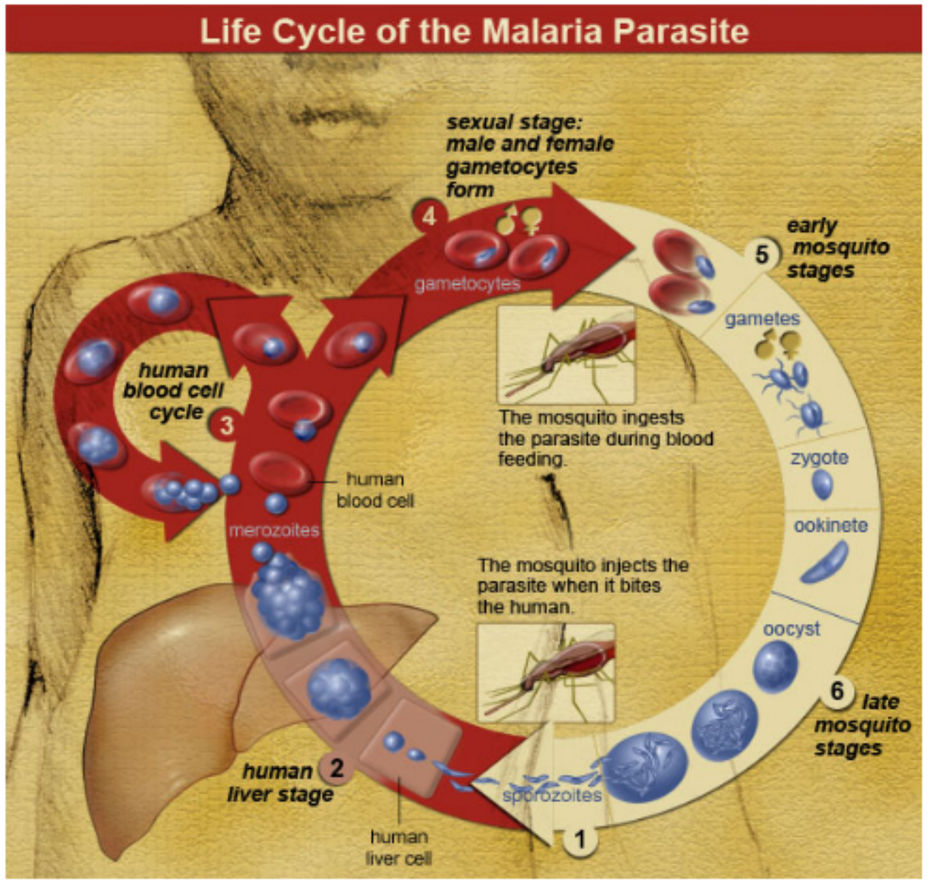
Source: Wikimedia Commons

REPRODUCTIVE CYCLE IN MALARIA



Source: Wikimedia Commons

Liver Cell

Asexual reproduction to form lot of malarial parasite spores

Blood Cells

Formation of male and the female gamete of the parasite.

Mosquito

Sexual reproduction in the mosquito forming zygotes and it divides to form spores of pathogens which enters saliva and then is injected into healthy person.

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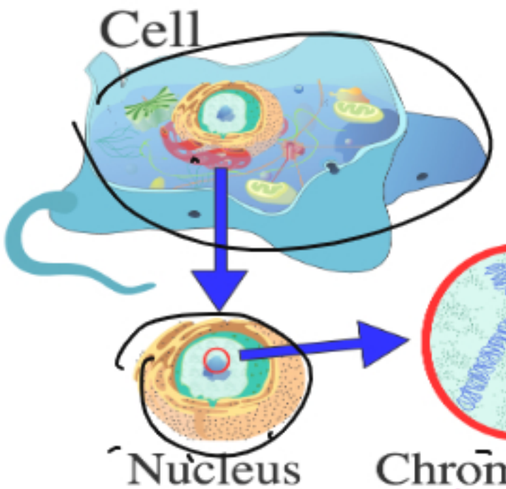
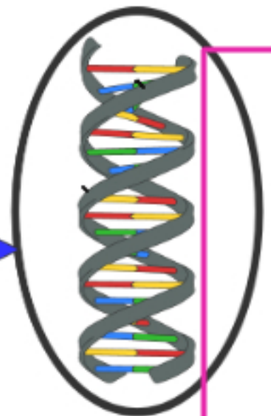
DNA = Deoxyribonucleic Acids.



These are the structure that holds our genetic information



Double Helical Structure ~~which~~ contains genetic information

Gene

It is the segment of DNA that code for proteins

DNA

Phosphate

Sugar

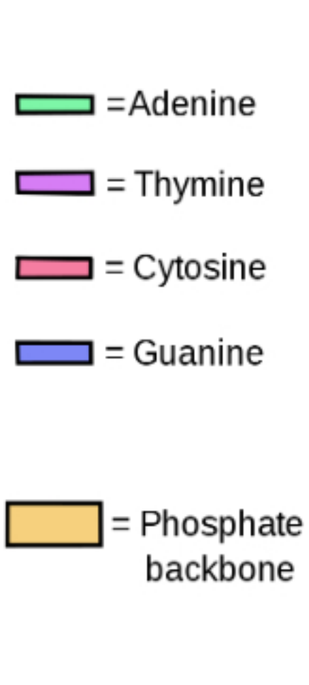
Nitrogenous bases

DNA

$A = T$ (Adenine= Thymine)

$G \equiv C$ (Guanine≡Cytosine)

Complimentary Base Pairing Principle



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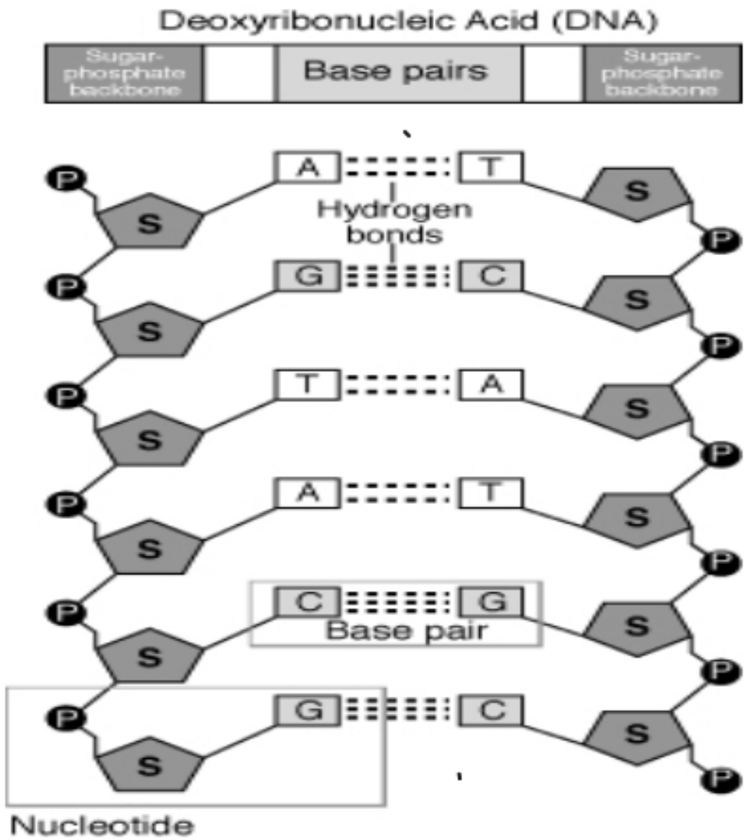
DNA : A POLYNUCLEOTIDE



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Phosphate + Sugar + Nitrogenous Base = Nucleotide

Deoxyribose

Adenine
Thymine
Guanine
Cytosine

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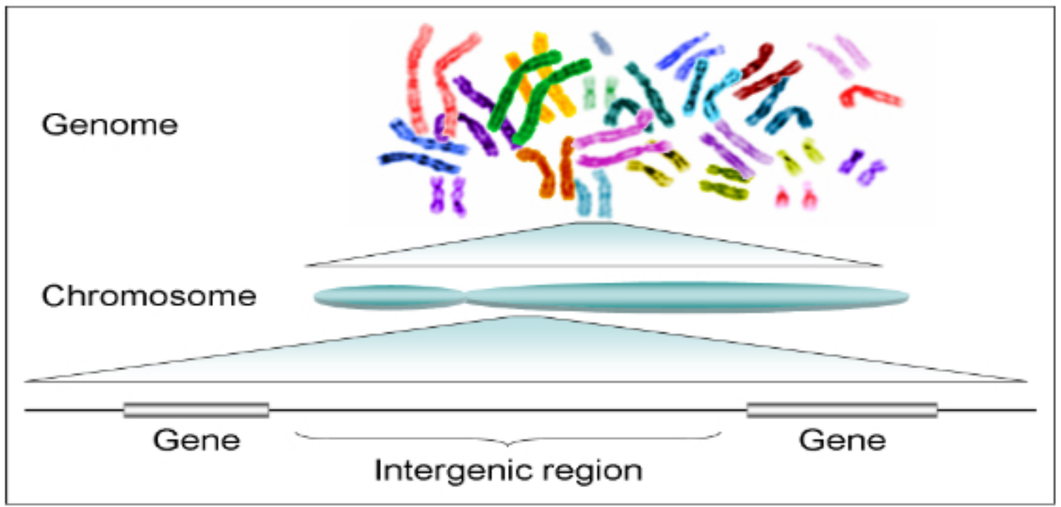
HUMAN GENOME

Genome is the complete genetic materials of the organism.



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International collaboration to sequence around three billion bases and more than 20,000 genes.

Importance of Human Genome Project

a) Understanding of genetic Diseases and inherited disorders

b) Better personalised medicines

c) Understanding Evolution

d) Indentifying new drugs target.

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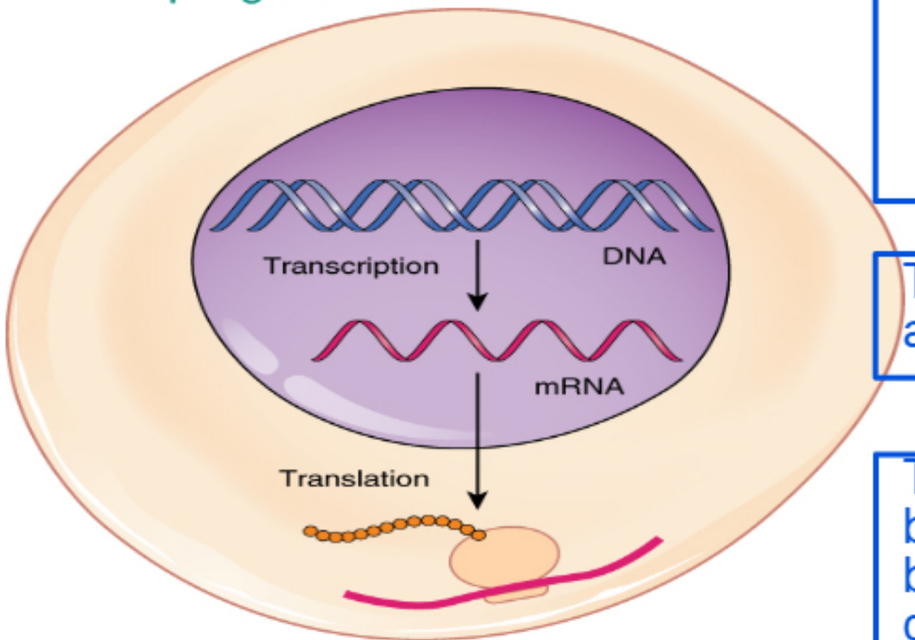
PROTEIN SYNTHESIS



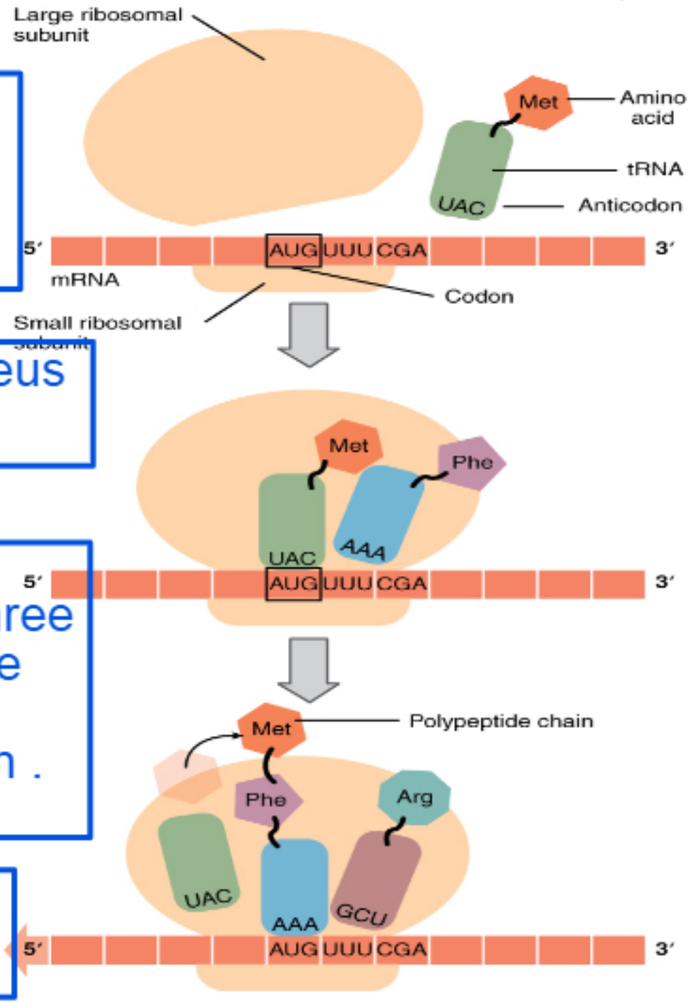
Section of DNA that codes for proteins is a gene.

The DNA copies the code and form mRNA by the process of transcription.

The mRNA leaves the nucleus and reaches the ribosome.

The ribosomes reads the bases in the sequence of three bases. The t-RNA brings the corresponding amino acid and forms polypeptide chain .

The polypeptide chain than forms proteins.



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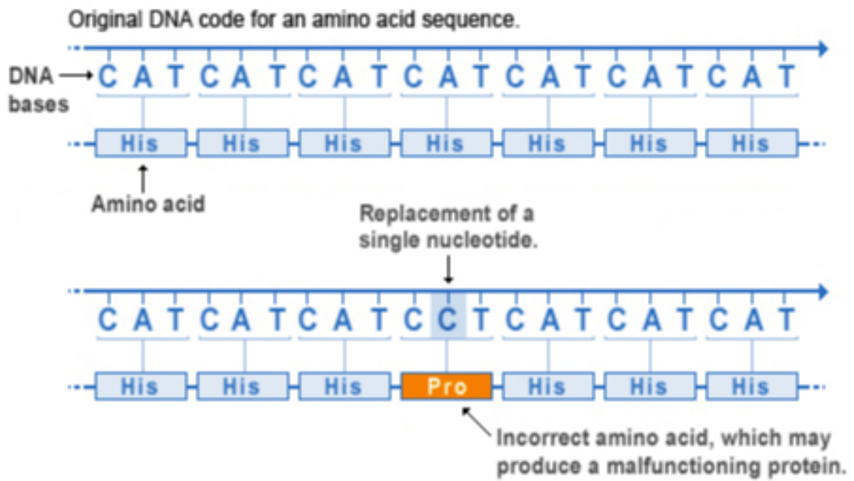
MUTATIONS

can be silent, harmful or beneficial

Missense mutation



U.S. National Library of Medicine

Source: Wikimedia Commons

A change in sequence of a gene or DNA

↓

Results in the change in the sequence of the mRNA

↓

Result in the change in amino acid

↓

Result in the formation of non functional protein or enzyme.

Change the structure of protein, the active site substrate can no longer fit into it

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GENETIC TERMS

Chromosome

Structures present in the nucleus of the cells which holds the DNA.

DNA

Deoxyribonucleic Acid which is present in the chromosome and holds our genetic information.

Gene

Section of the DNA that codes for amino acids.

Allele

Alternative form of a gene.

Dominant Allele

The allele which always express itself when present.

Recessive Allele

The allele which express when present in pairs.

Homozygous

When both the alleles are same

Heterozygous

When both the alleles are different.

Genotype

The genetic make up

Phenotype

The physical characteristic expressed by a genotype

Punnett Square

A square that shows all the possible genotype from the parent gemetes.

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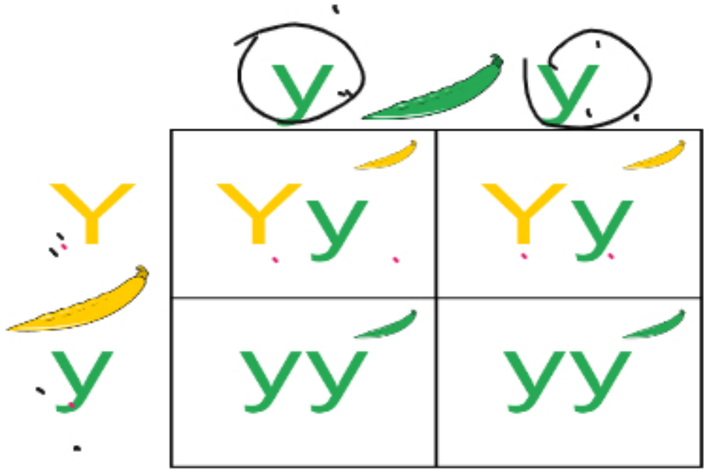
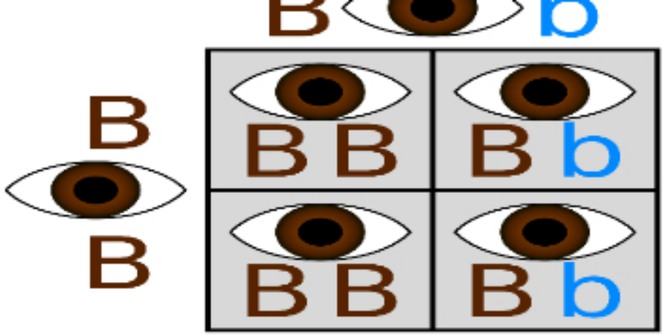


Heterozygous yellow plant with green plant.

Dominant= yellow
Recessive =green

50% green and 50% yellow



Heterozygous brown eyes with homozygous bown eyes.
it has discrete values

B= Brown = Dominant
b= Blue= Recessive

Generation 1 Cross: AA × aa

	a	a
A	Aa	Aa
A	Aa	Aa

Generation 2:
100% of offspring are AA (dominant)

Generation 2 Cross: Aa × Aa

	A	a
A	AA	Aa
a	Aa	aa

Generation 3:
75% AA or Aa (dominant)
25% aa recessive

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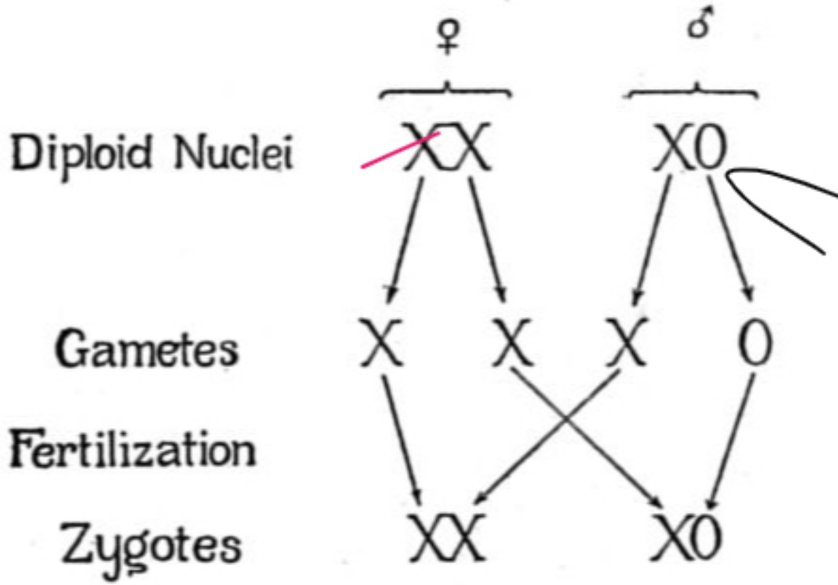
SEX DETERMINATION



Females = XX

Male = XY

50% changes of the offspring to be male or female

	X	O
X	XX	XO
X	XX	

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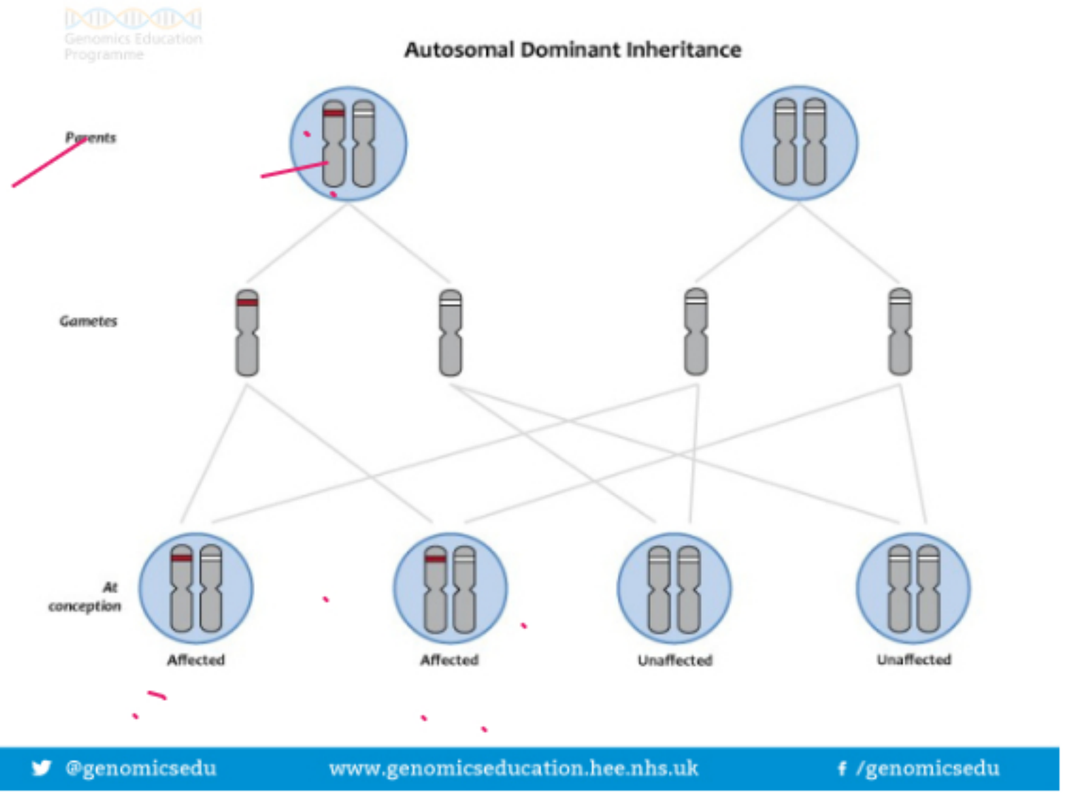
POLYDACTYLY

- Caused by dominant Allele
- If one of the parent has the allele offspring will have a disease.



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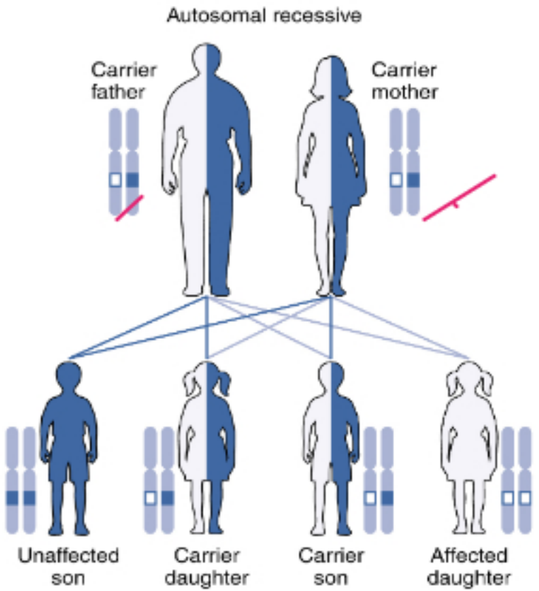
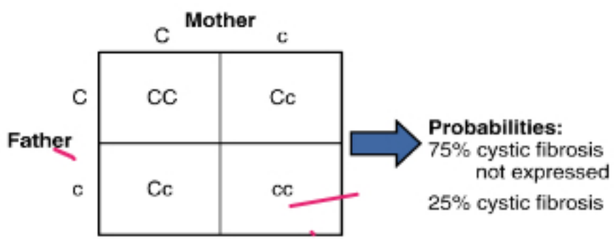
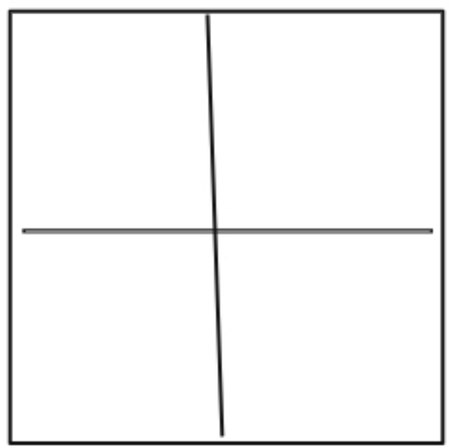
GENETIC DISORDER

- Caused by recessive allele
- Both the parent should have the allele to infect the offspring.
- The mucous becomes sticky and thick. It blocks the airways, reproductive tract and digestive tract.







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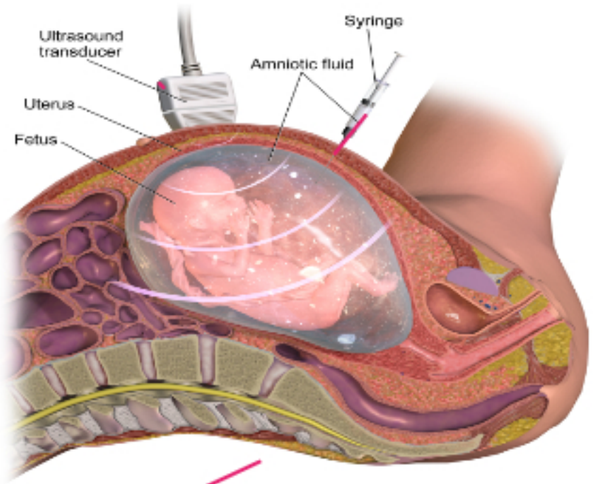
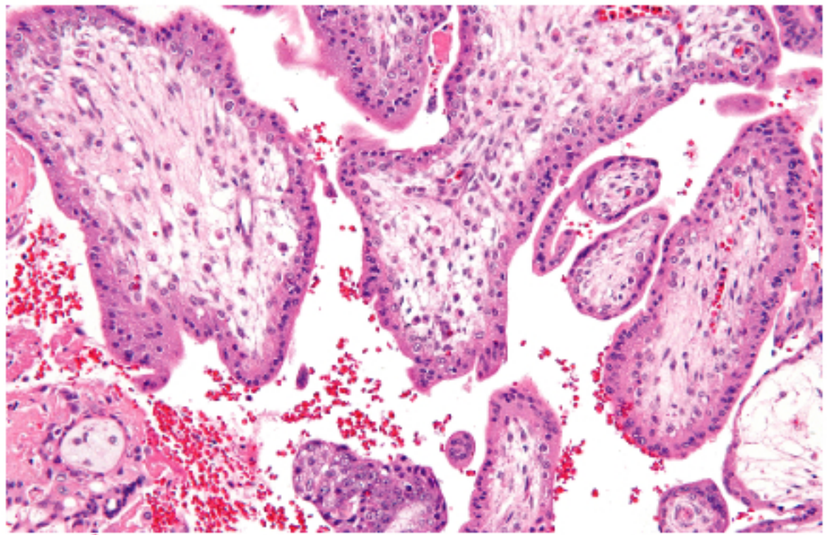
GENETIC SCREENING

Provides genetic counselling to the couple and helps to diagnose any problem before birth.



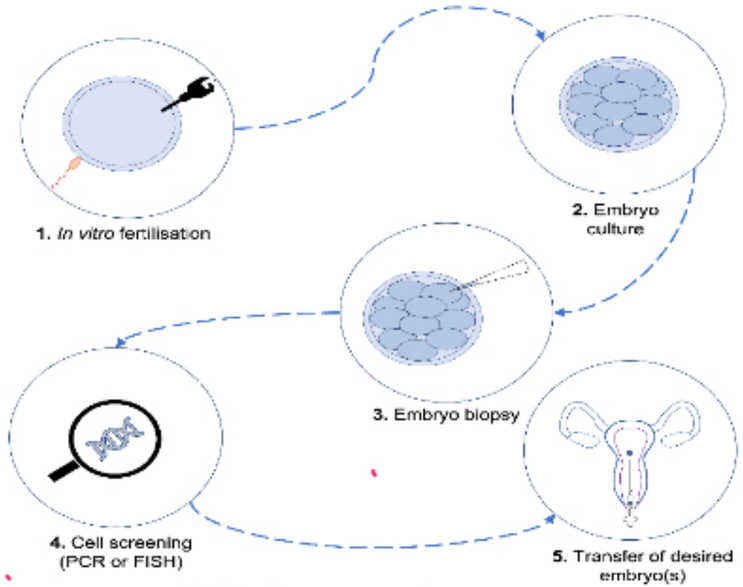
Amniocentesis

Done at later stages
Taking amniotic fluid which has fetal cells .
The cells are then screened for genetic disorders.



Chorionic villi Sampling

Done at early stage and involve taking fluid from the placenta which contains fetal cells.



IVF Screening

Involves screening of the embryo after in vitro fertilization.

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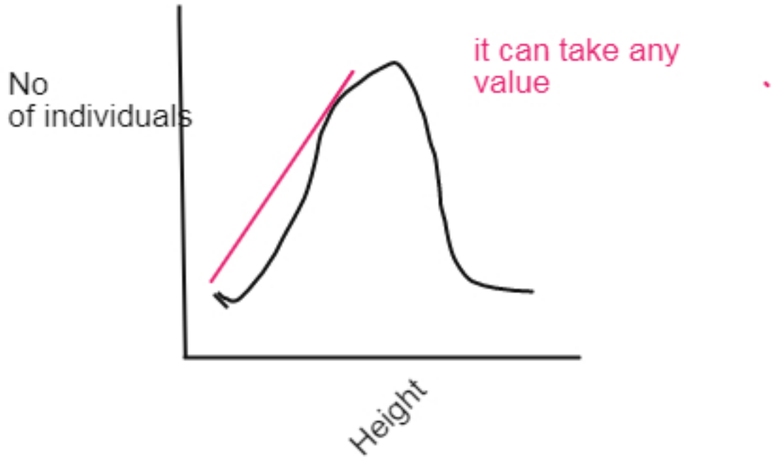
VARIATION

Differences amonst the individual

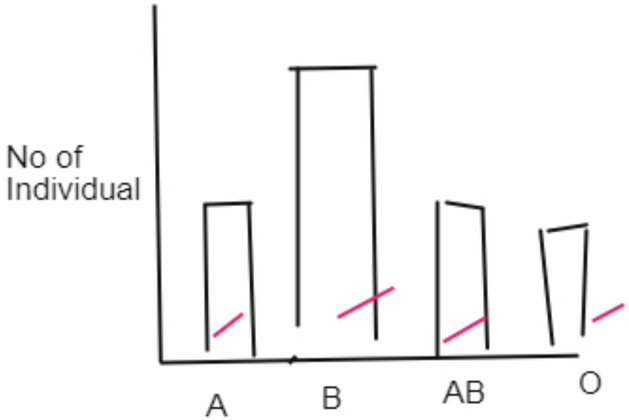
CONTINIOUS VARIATION

It is environmental like height, weight.
Graph is a bell shaped curve



DISCONTINOUS VARIATION

It is genetic like blood group.
Graph is like column graph having descrete values.



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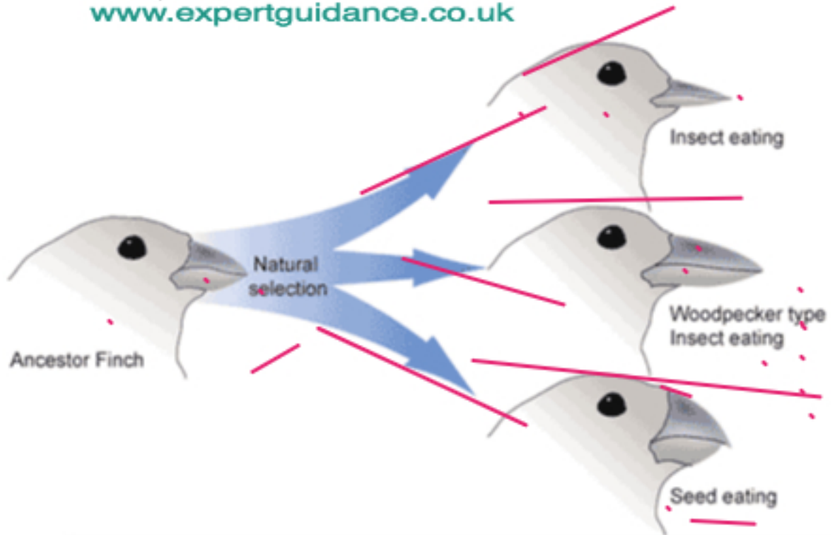
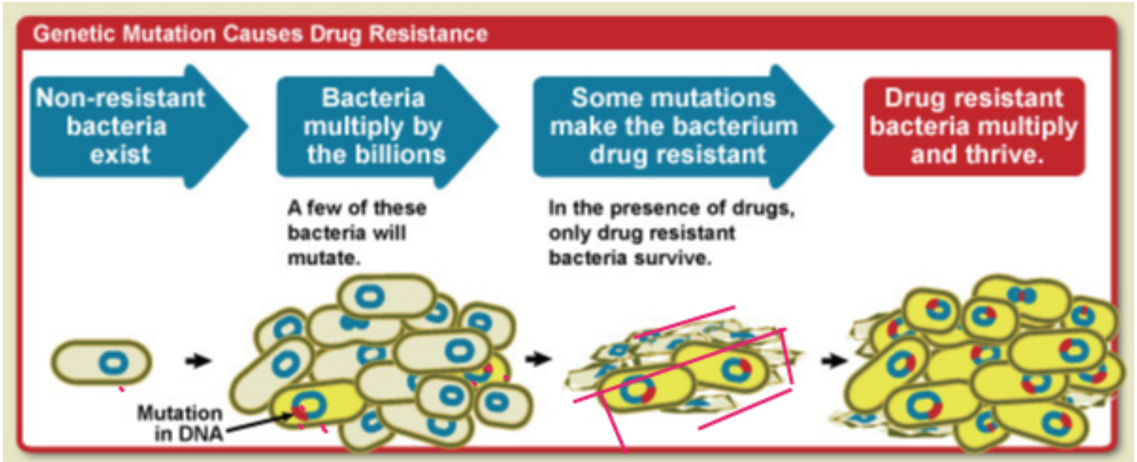
NATURAL SELECTION



"Natural selection is the differential survival and reproduction of individuals due to differences in phenotype. It is a key mechanism of evolution, the change in the heritable traits characteristic of a population over generations."- Wikipedia



Mutations → Variation → Natural Selection → Survival of the fittest → EVOLUTION

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SELECTIVE BREDDING

Artificially mating the two desirable characters parents to produce required offspring and selecting the ones with the best characteristics.

Applications

a) Producing high milk yielding cow

b) Producing diseases resitance and high yield crops.

DISADVANTAGES

a) Slow process

b) Time consuming

c) Causes reduction in gene pool

d) Undesirable traits can also get selected.

e) A disease can result in elimination of whole population

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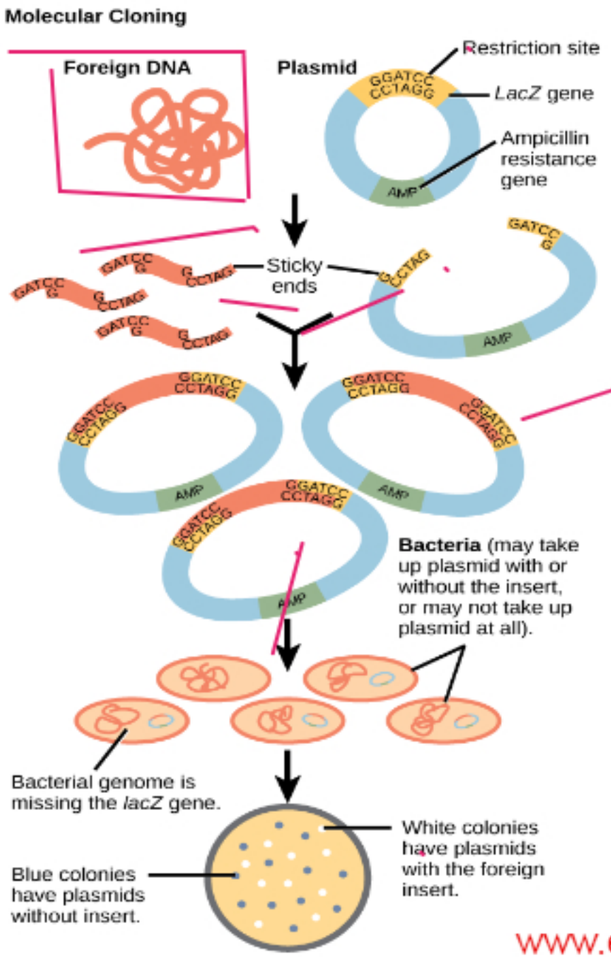
GENETIC ENGINEERING



The foreign DNA and plasmid are cut with the same **restriction enzyme**, which recognizes a particular sequence of DNA called a *restriction site*. The restriction site occurs only once in the plasmid, and is located within the *lacZ* gene, a gene necessary for metabolizing lactose.

The restriction enzyme creates sticky ends that allow the foreign DNA and cloning vector to anneal. An enzyme called ligase glues the annealed fragments together.

The ligated cloning vector is transformed into a bacterial host strain that is ampicillin sensitive and is missing the *lacZ* gene from its genome.

Bacteria are grown on media containing ampicillin and X-gal, a chemical that is metabolized by the same pathway as lactose. The ampicillin kills bacteria without plasmid. Plasmids lacking the foreign insert have an intact *lacZ* gene and are able to metabolize X-gal, releasing a dye that turns the colony blue. Plasmids with an insert have a disrupted *lacZ* gene and produce white colonies.

Altering the gene by inserting the desired gene to produce genetically modified organisms..

Isolation

↓

Inserting the gene with the vector (plasmid) to form recombinant DNA

↓

Introducing the recombinant into bacteria - Transformation

↓

Selecting transformed bacteria

↓

Growing transformed bacteria

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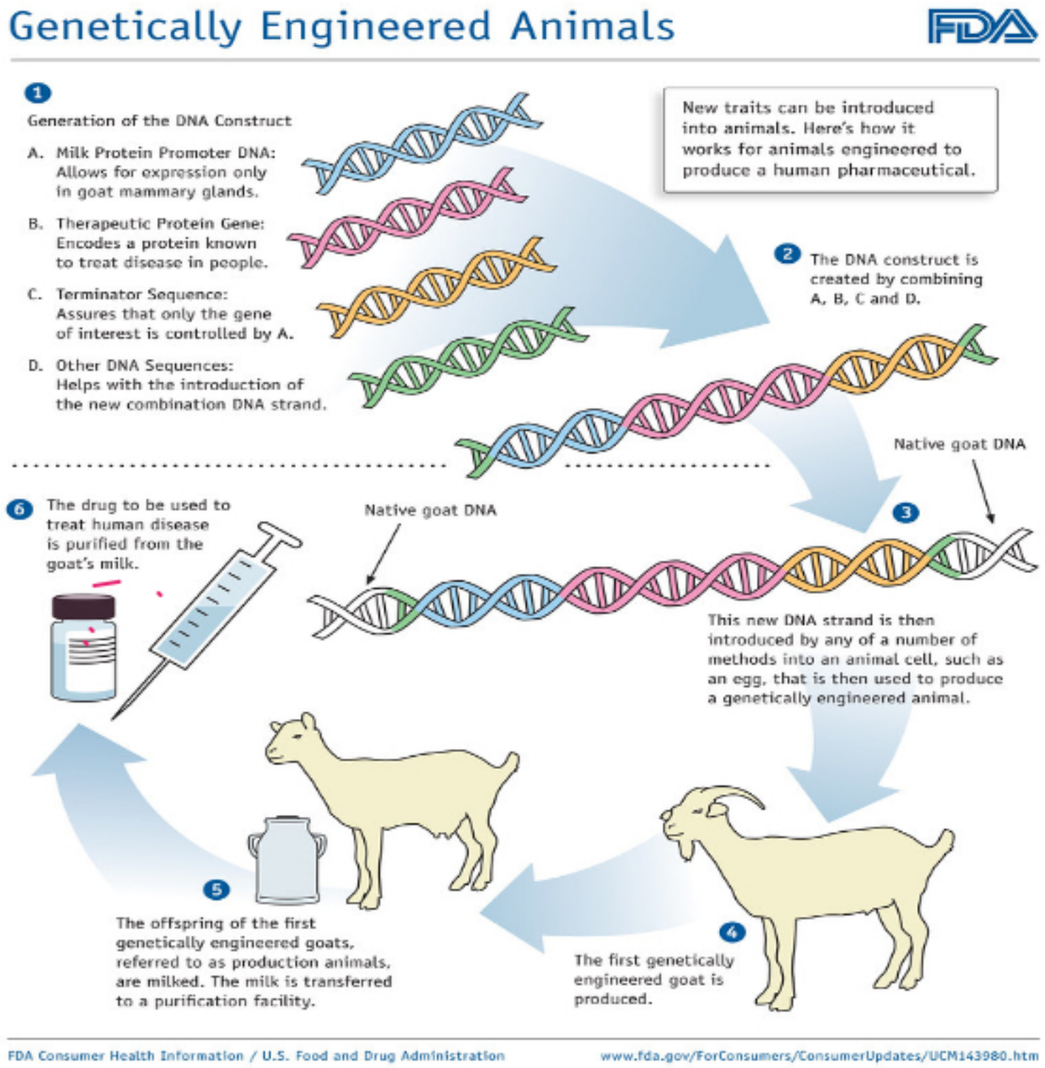

Examples

a) Tomato with greater shelf life

b) Golden Rice which is rich in Vitamin A

c) Gentically engineered Insulin

d) Disease resistant crops

e) Insects resistant crops

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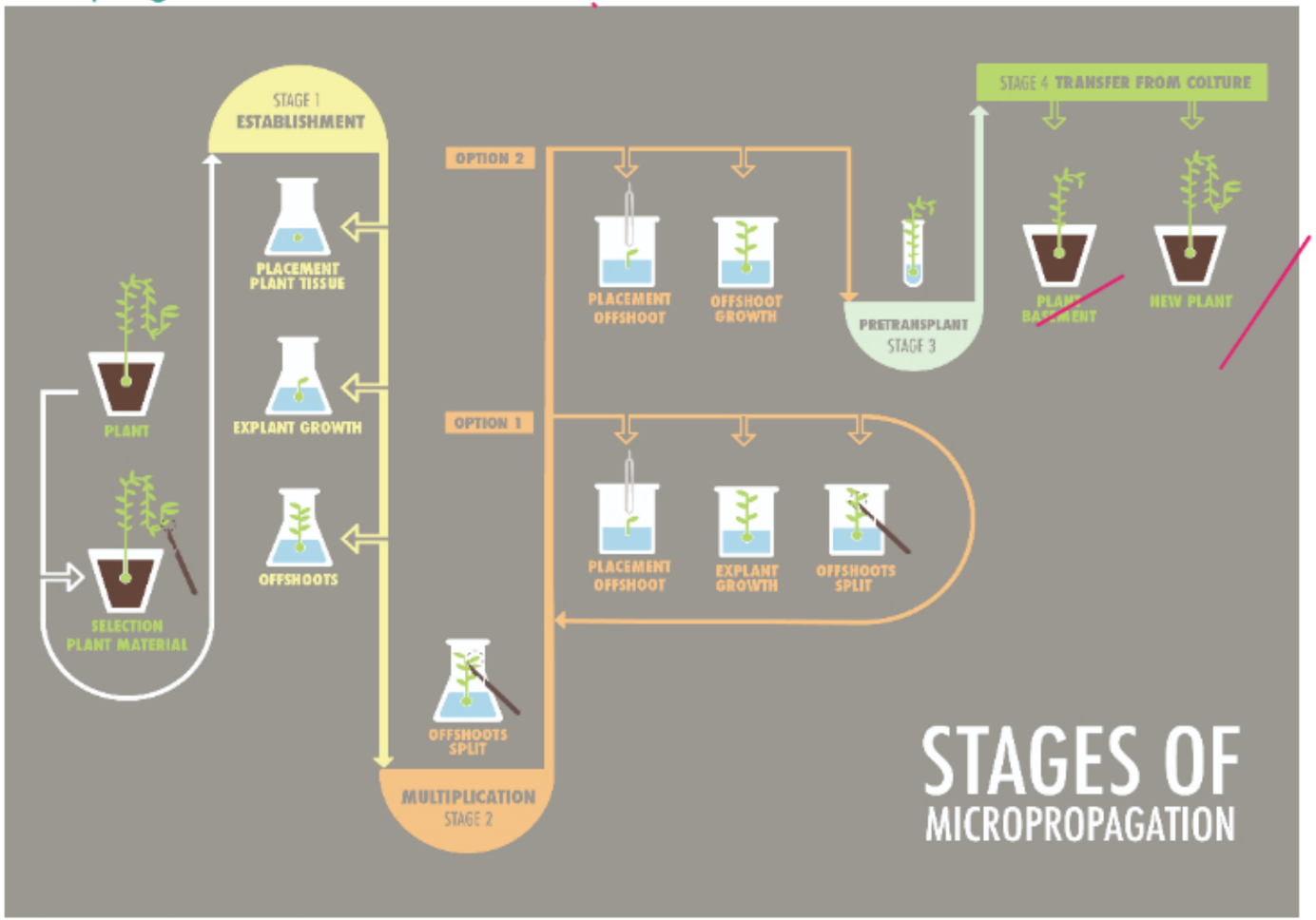
CLONING



Source: Wikimedia Commons

Taking Explant

↓

Growing and multiplying it in the nutrient medium

↓

Nutrient medium has all the hormones and minerals

↓

The new tiny plantelets formed are grown in the field

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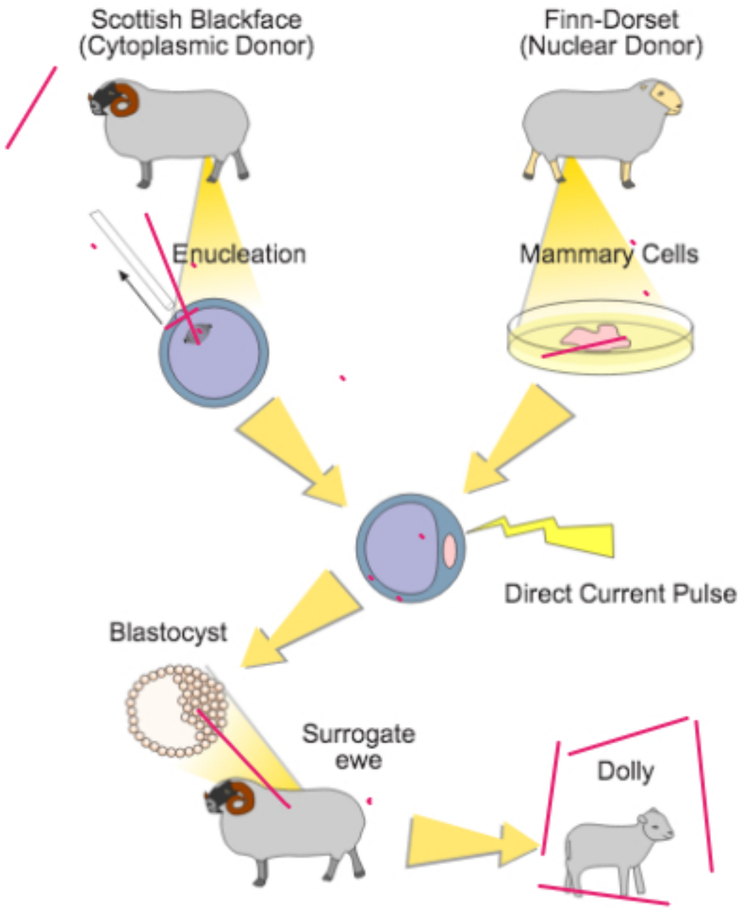
ADULT CELL CLONING



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GENETIC ENGINEERING DEBATE

ADVANTAGES

a) Produce Genetically Engineered crops which are high yielding

b) Produce nutrient rich crops

c) Produce high meat and high milk producing cows.

d) Cure genetic disorders

e) Can be used to produce medicines

f) Can be used to produce food through microorganisms.

DISADVATANGES

a) Reduce genetic diversity and variety

b) Can result in sterile offspring

c) Faulty genes or traits can also be transmitted

d) It is expensive

e) Ethical and religous concerns of playing with the nature.

f) It is irreversible

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GREGOR MENDEL

Gene → Protein → Expression

Seed		Flower	Pod		Stem	
Form	Cotyledons	Color	Form	Color	Place	Size
						
Grey & Round	Yellow	White	Full	Yellow	Axial pods, Flowers along	Long (6-7ft)
						
White & Wrinkled	Green	Violet	Constricted	Green	Terminal pods, Flowers top	Short -1ft
1	2	3	4	5	6	7

In the 19th Century

Father of Genetics

He studied inheritance pattern in the pea plant

He said that certains chacters are inherited from one generation to another.

In the 20th Century, the structure of DNA and the genes were discovered to build on Mendel Ideas

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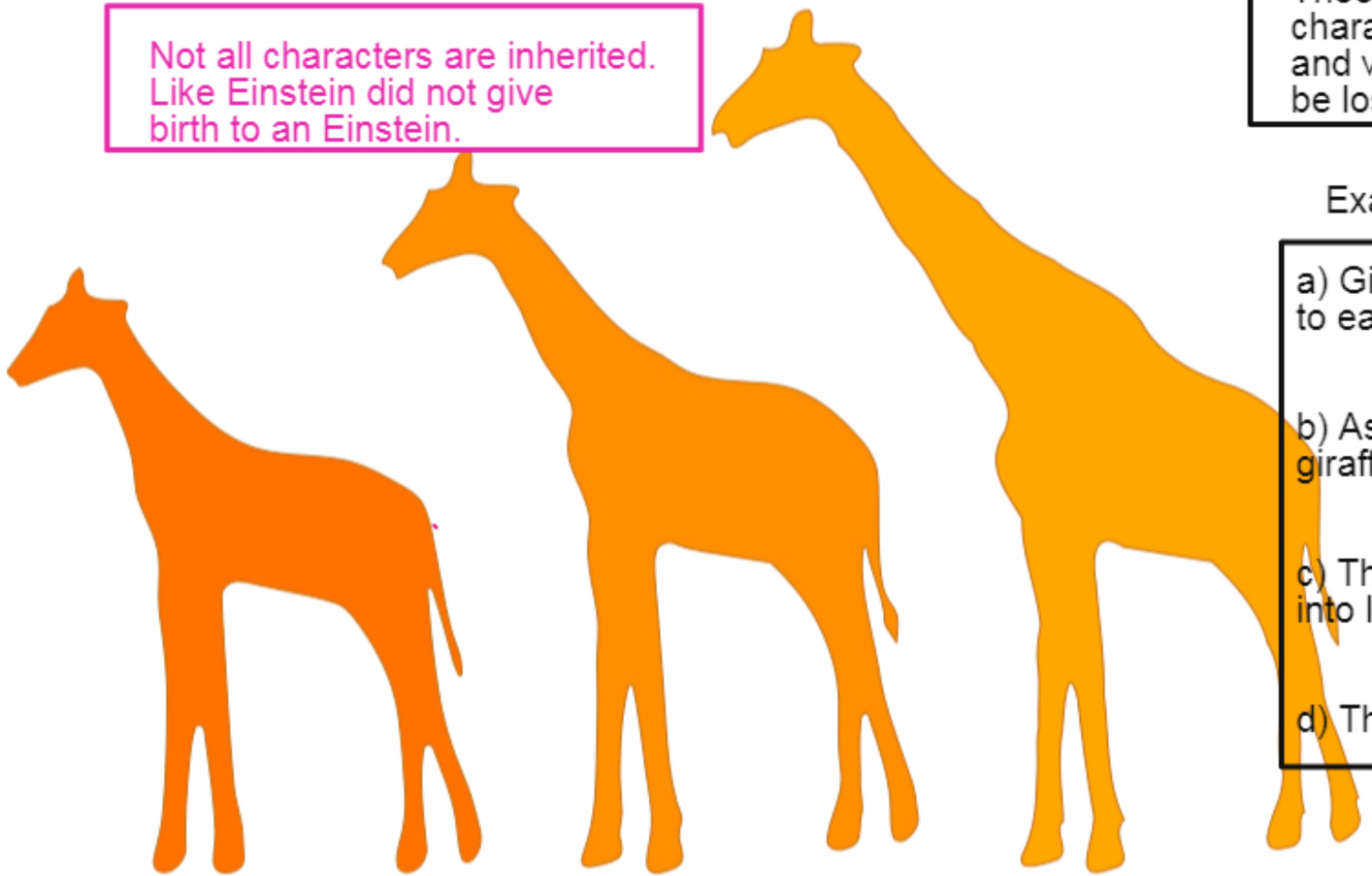
LAMARCK THEORY

Not all characters are inherited. Like Einstein did not give birth to an Einstein.



Theory of Use and Disuse- If any charaters in used it will develop and will be inherited others will be lost.

Example

a) Giraffe had short necks and use to eat the grass

b) As all grass were eaten away the giraffe stretched its neck to reach trees.

c) The necks was used more and developed into long necks

d) The giraffe now acquired long necks.

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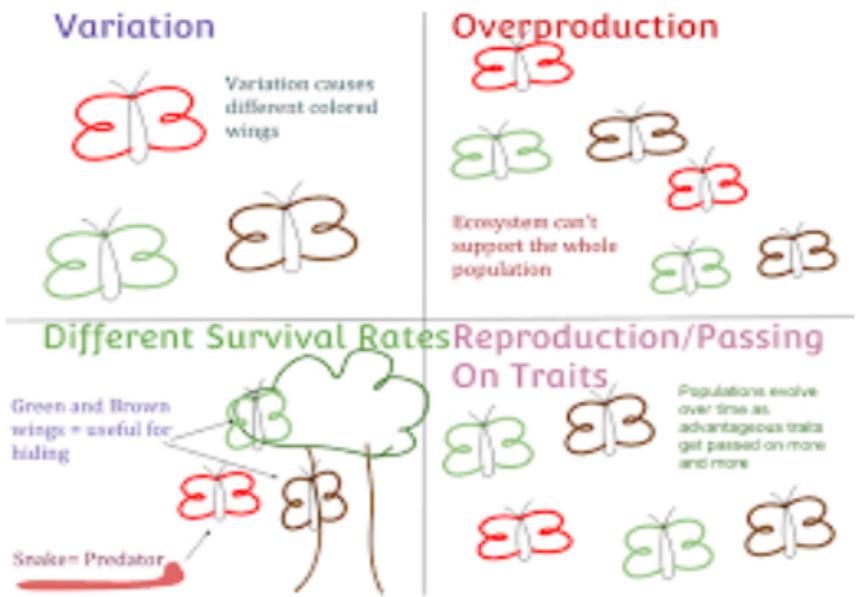
CHARLES DARWIN THEORY OF EVOLUTION



Each Organims has potential to reproduce more than an environment can sustain

↓

The population remains constant due to natural selection

↓

Organisms show variation and nature selects the one which has desired chacteristics.

↓

The one with desired chacters survive and reproduce= Survival of the fittest

↓

The fittest one reproduce and pass the traits to next generation

→ EVOLUTION

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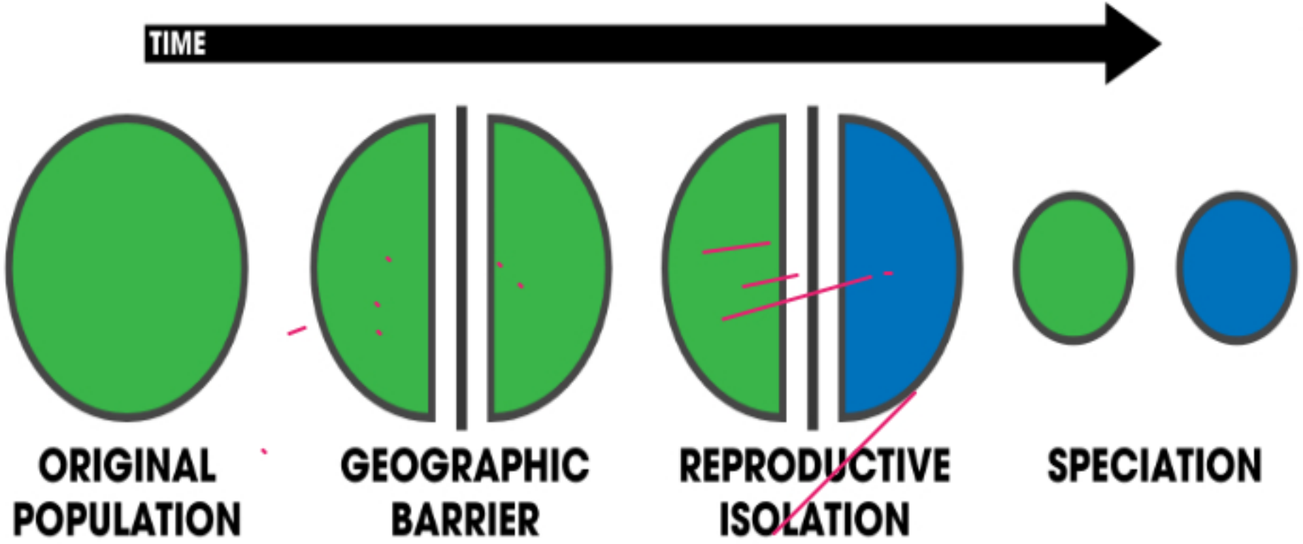
SPECIATION

Formation of new species



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EVIDENCE OF EVOLUTION – Fossils

What are Fossils ?

- Fossils are the preserved remains of dead plants and animals that existed millions of years ago.
- Impressions, tracers or foot prints on the rocks are also considered as fossils.

How are Fossils formed ?

- They are formed by incomplete decay of the dead organsims due to hostile conditions for the decomposers.
- The harder part are replaced by minerals and are preserved as rocks.
- Impression on mud or rocks

Advantages

Can give the information about extinct species.

It can give the information about Evolution.

Problems with Fossils

- Most of the animals that are soft bodies have no fossils
- Some of the fossils are yet to be discovered.
- No fossil record for some species

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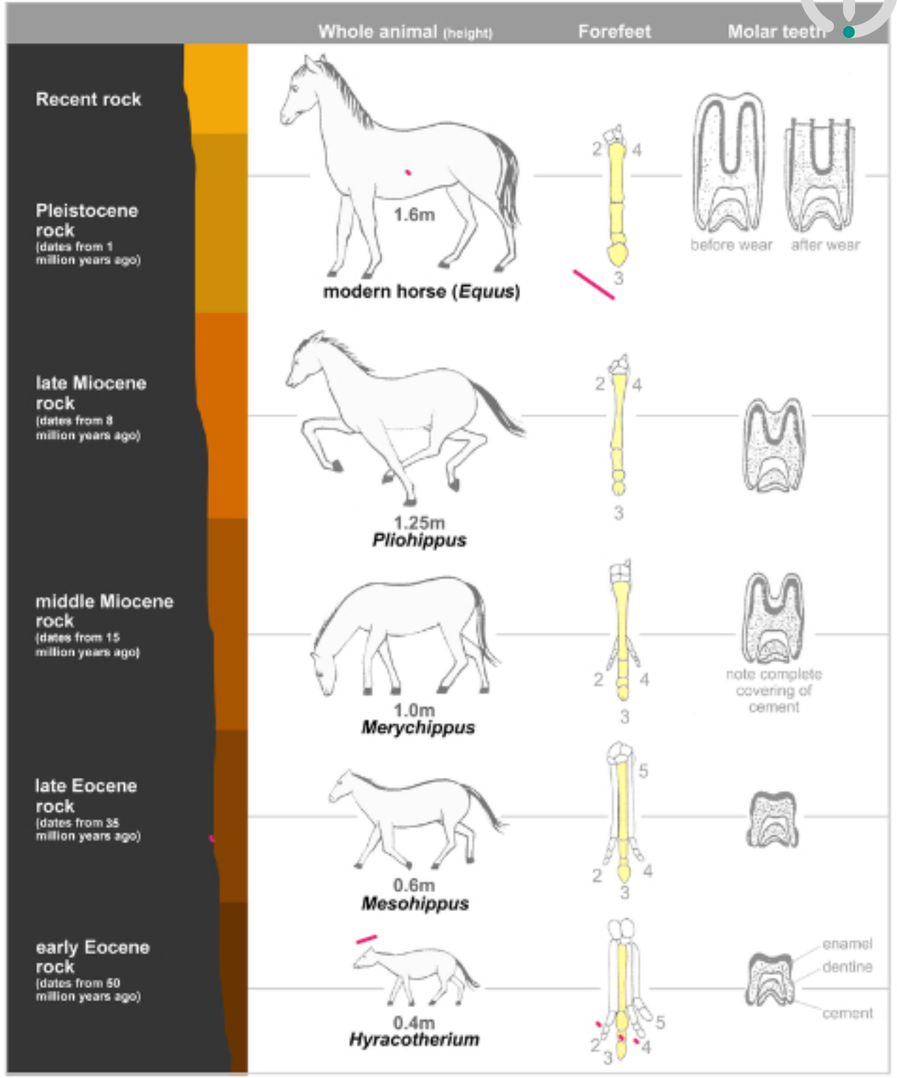
FOSSILS AS EVIDENCE OF EVOLUTION

Horse fossils record gives us the evidence of evolution

From five digits it has developed hoofed limb and adapted to run on hard ground



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EXTINCTION

It the permanent loss of species

Causes

a) Environmental Changes

b) Diseases

c) Predator

d) Competition

e) Catastrophic Event

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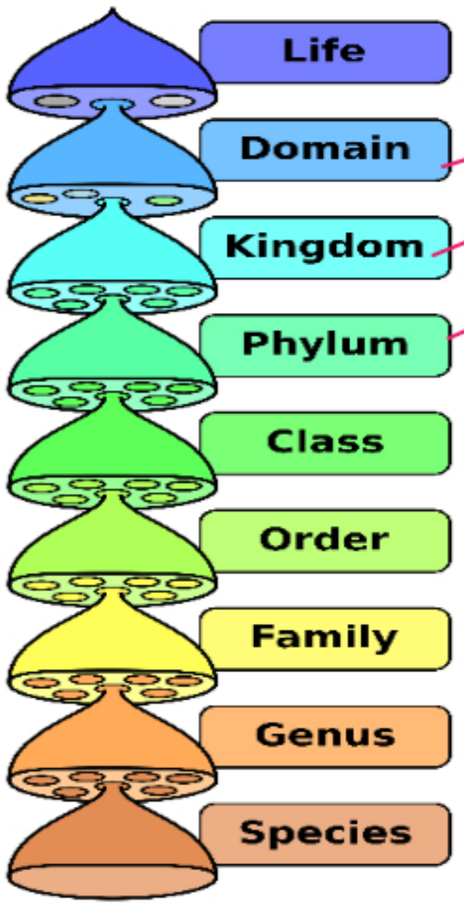
CLASSIFICATION

Organising the species into groups according to the similar chactersitics.



Advantages

a) Helps to study the organisms easily

b) Easy to identify unknown species

Basis

a) Earlier organims were classified on the basis of obeservable Characteristics

b) Evolutionary Relationship

c) DNA or protein sequencing

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KEY TERMS !!!

- Asexual Reproduction
- Sexual Reproduction
- Mitosis
- Meiosis
- Fertilization
- Variation
- Natural Selection
- Genome
- DNA
- Chromsome
- Gene
- Allele
- Nucleotide
- Nitrogenous Bases
- Transcription
- Translation
- Gene Expression
- Mutations
- Allele
- Homozygous
- Heterozygous
- Genotype
- Phenotype
- Dominant Allele
- Recessibe Allele
- Punette Square
- Sex determination
- Cystic Fibrosis
- Embryo Screening
- Genetic Engineering
- Variation
- Evolution
- Natural Selection
- Selective Breeding
- Cloning
- Tissue Culture
- Genetics
- Speciation

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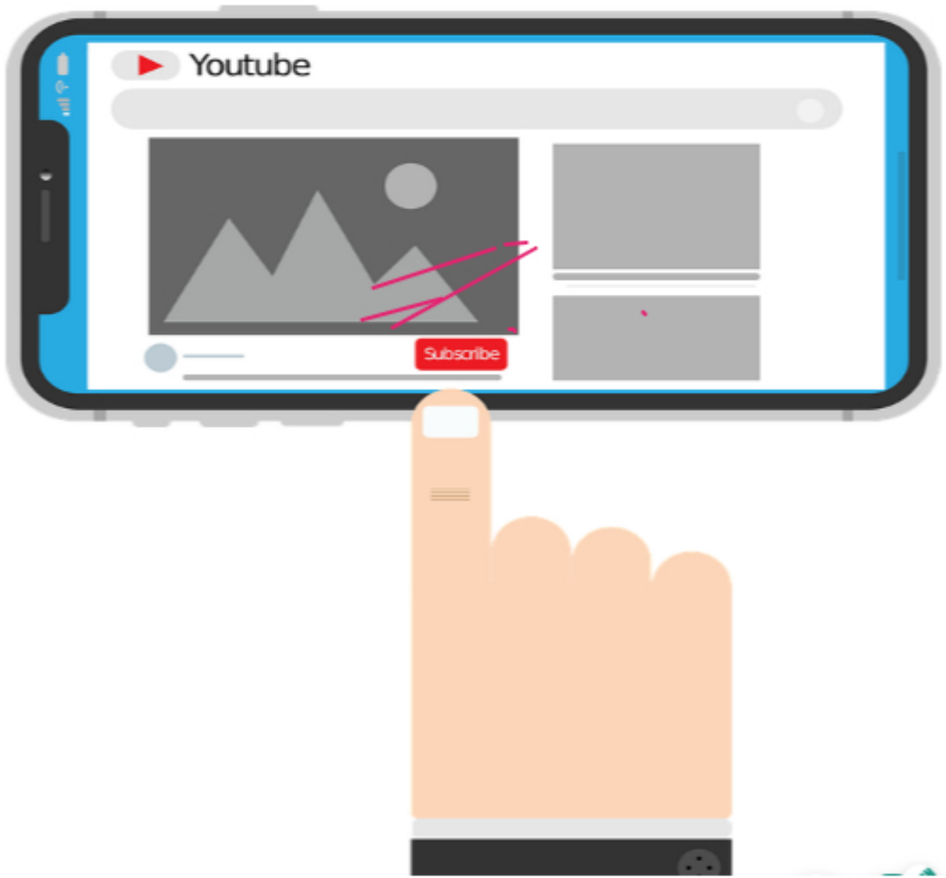
NEXT STEP



- CHECK SPECIFICATION
- EXAM QUESTIONS ON THIS TOPIC

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