

4.6 Inheritance, Variation and Evolution

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

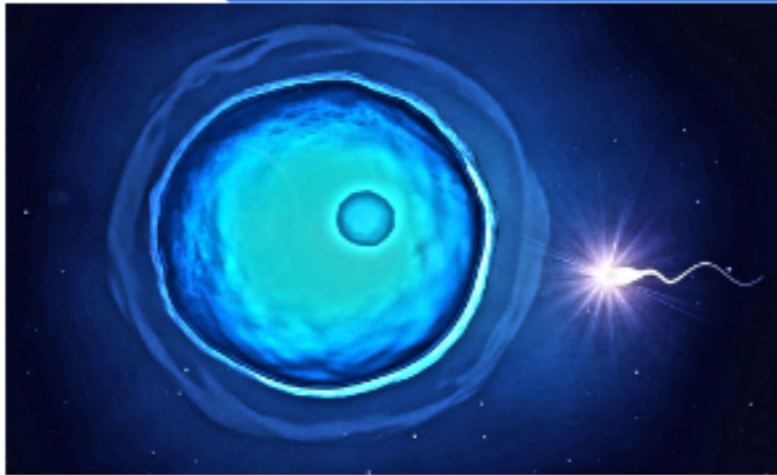
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REPRODUCTION

making more offsprings.

SEXUAL

Involves meiosis



Require both parents and involve fusion of gametes

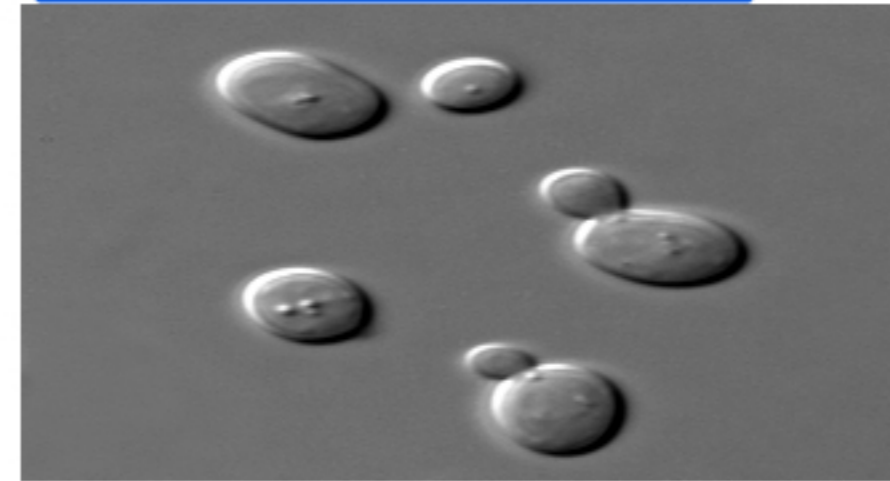
The offsprings are not genetically identical.

Produce Variation and lead to evolution

eq human reproduction

ASEXUAL

Involves mitosis



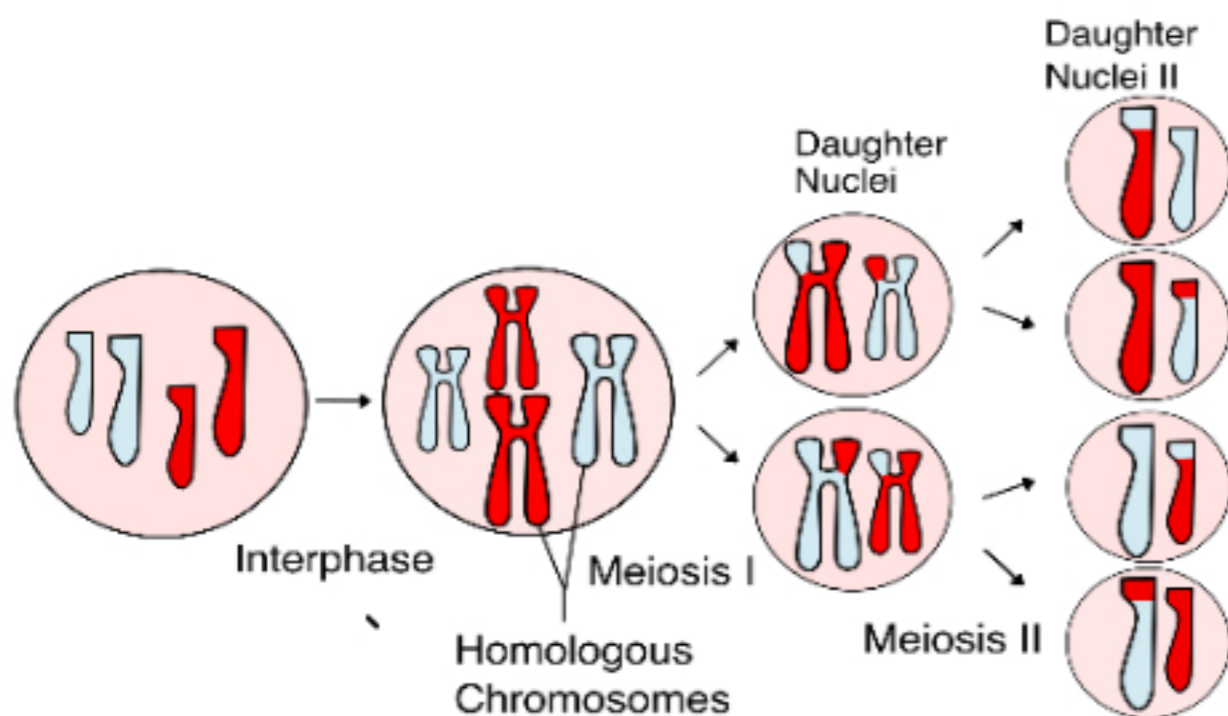
Require single parent and no fusion of gametes

The offspring are clone and genetically identical.

No Variation and Evolution

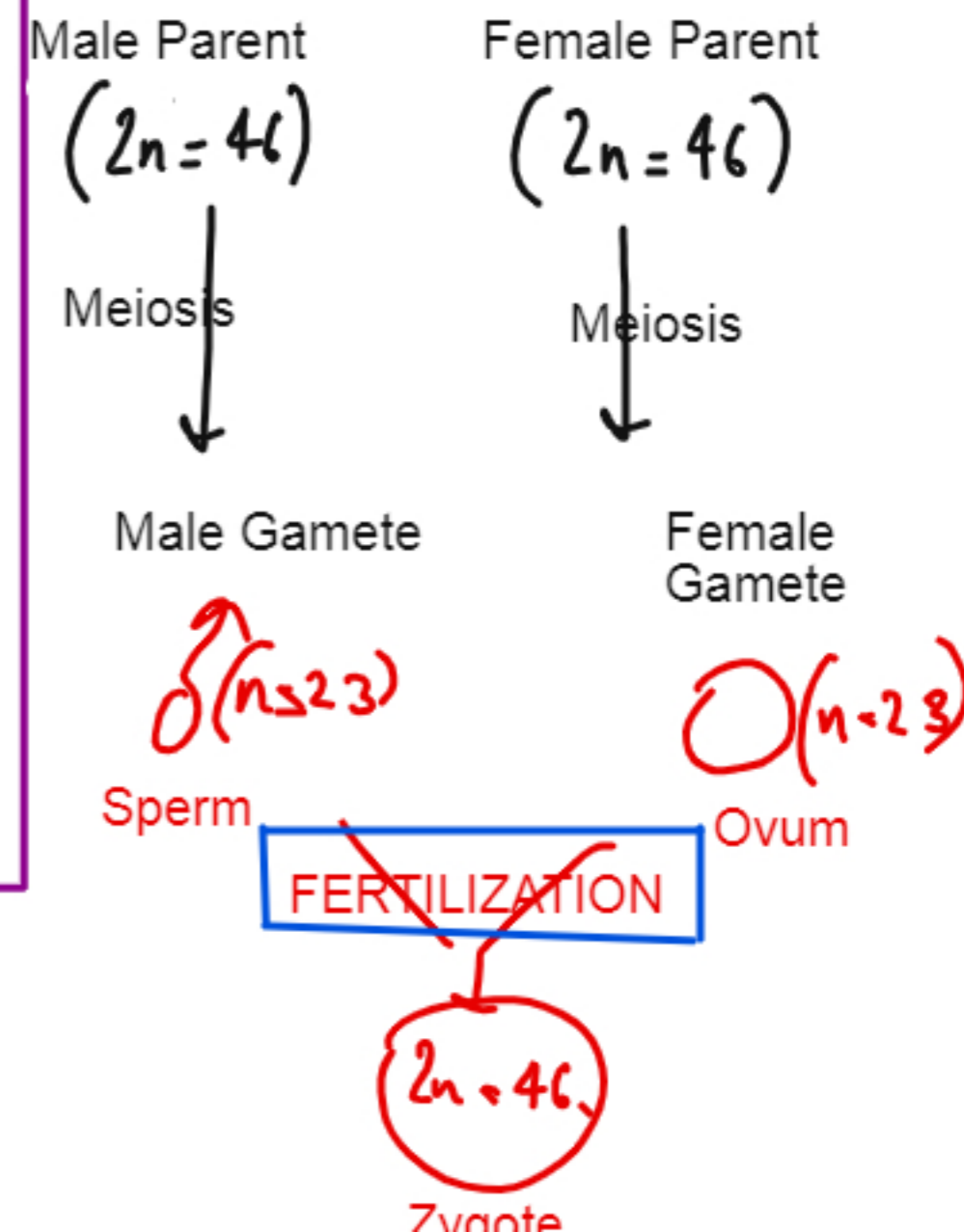
eq budding in yeast, cutting, runners in plants

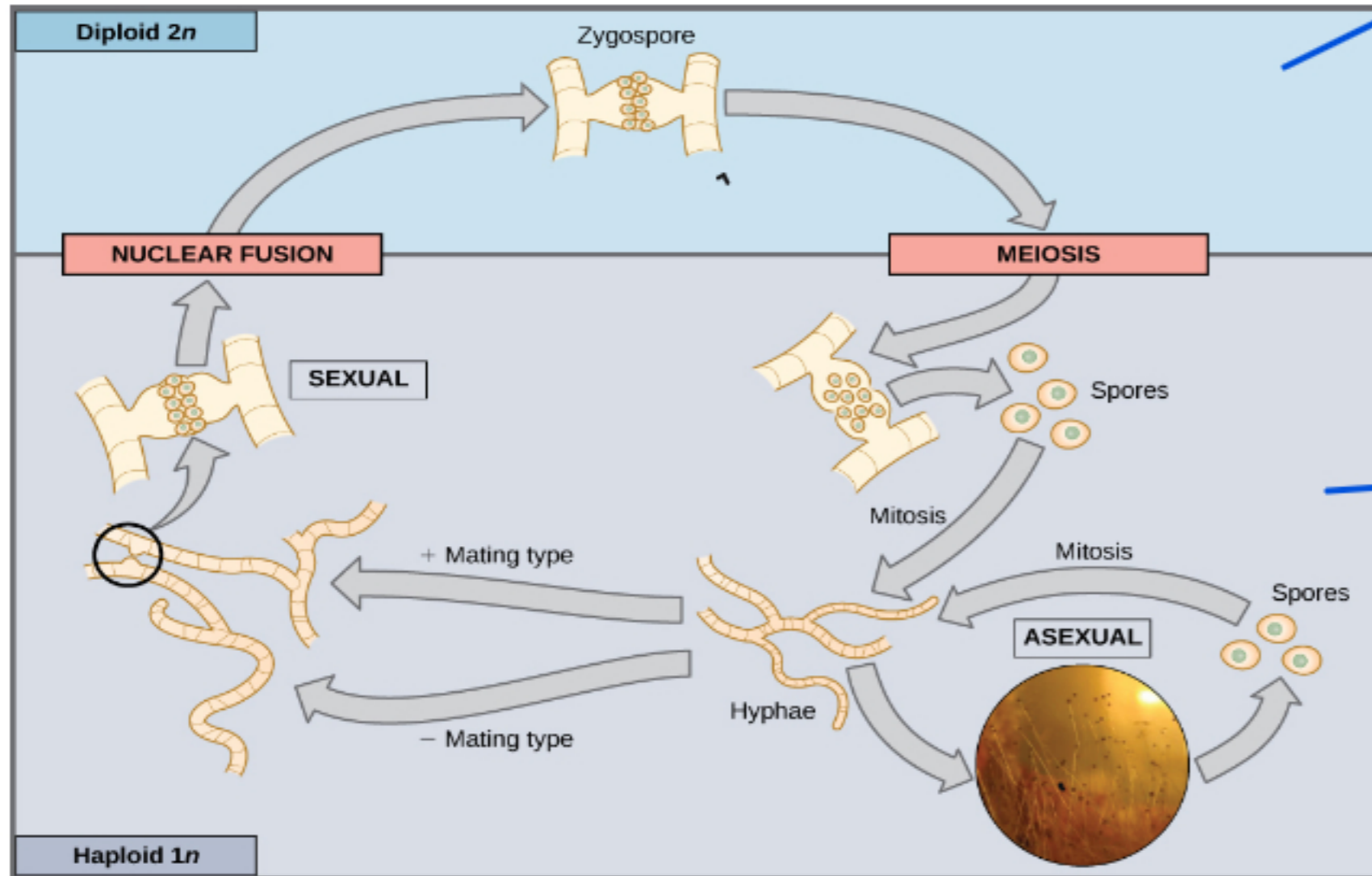
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Source: Wikimedia Commons

- 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.



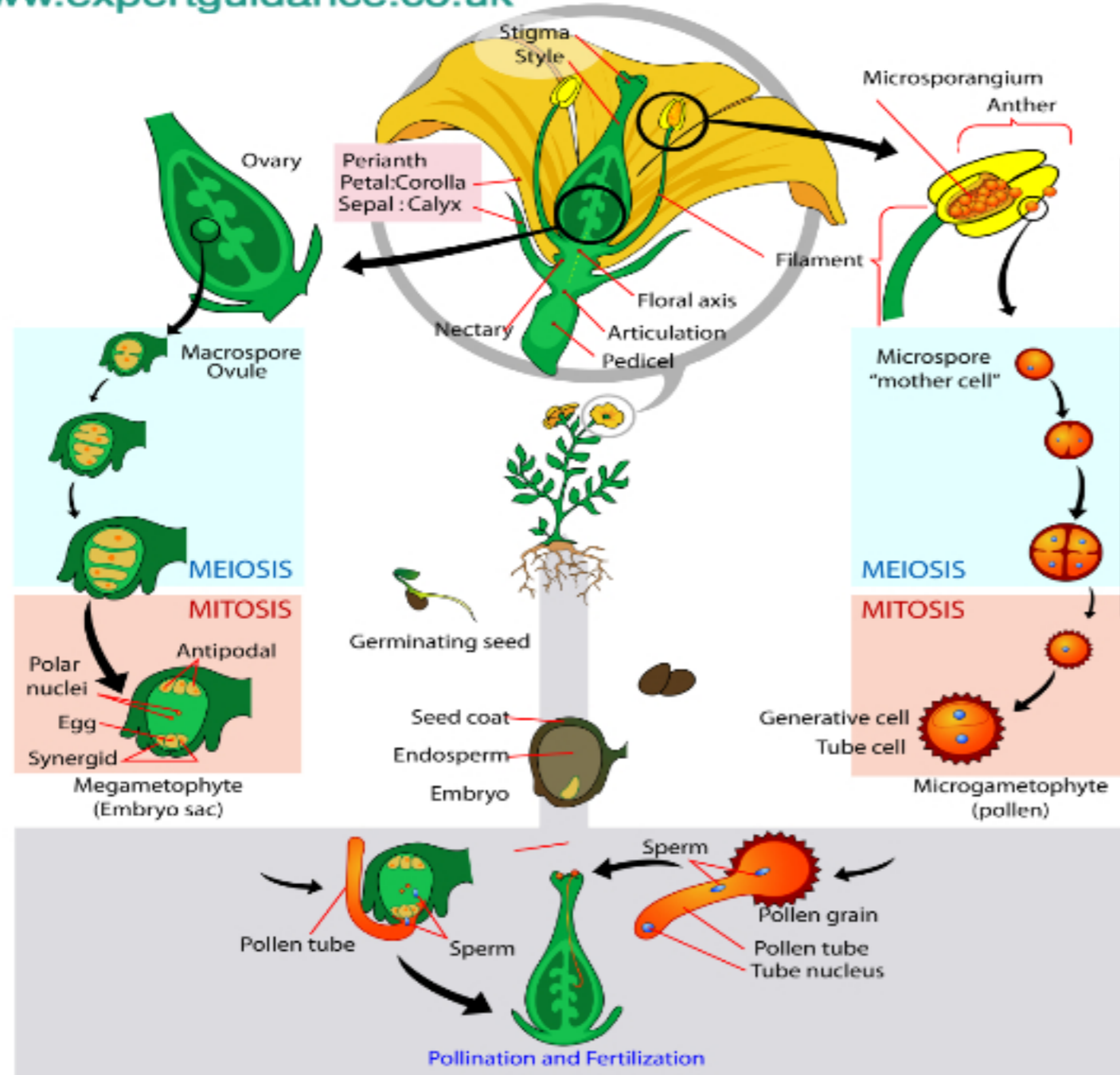


Sexual reproduction in which two nuclei fuses and then undergo meiosis to form haploid spores which grows to form the hyphae.

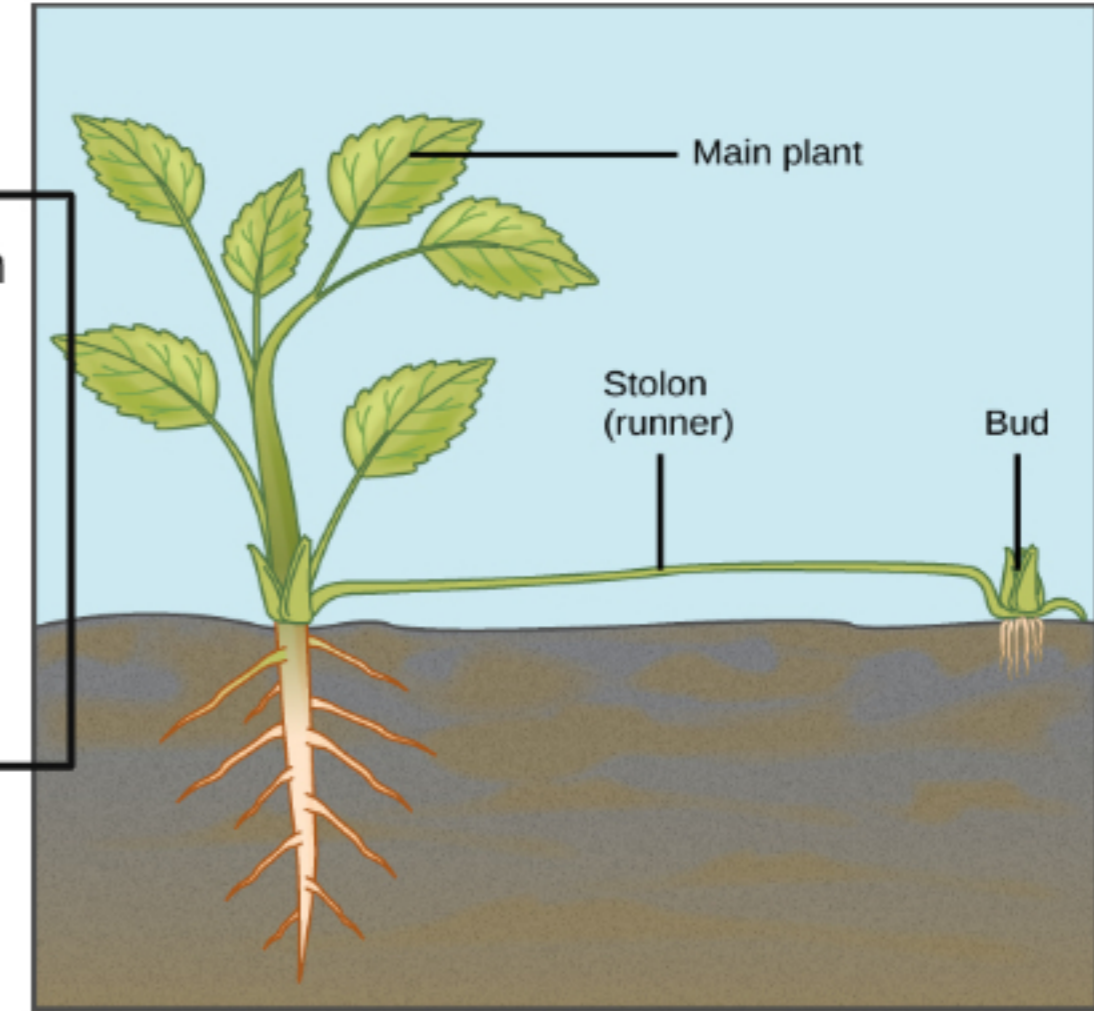
Most Common is asexual where it releases spores which germinates to form the fungal hyphae.

Source: Wikimedia Commons

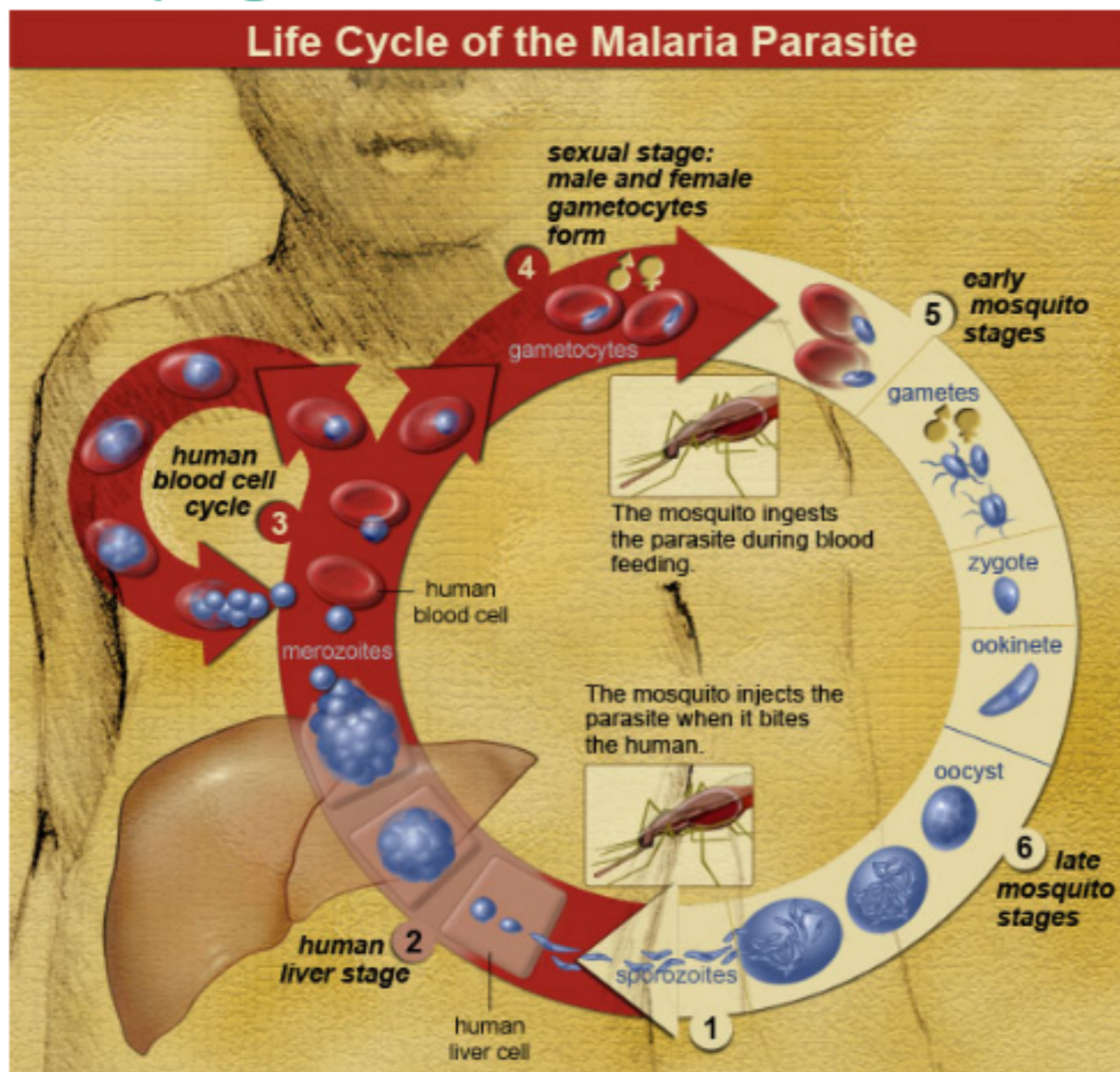
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Sexual reproduction involves the fusion of pollen grain with the egg nuclei forming zygote which forms the seeds and germinate to form a new plant.



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



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.

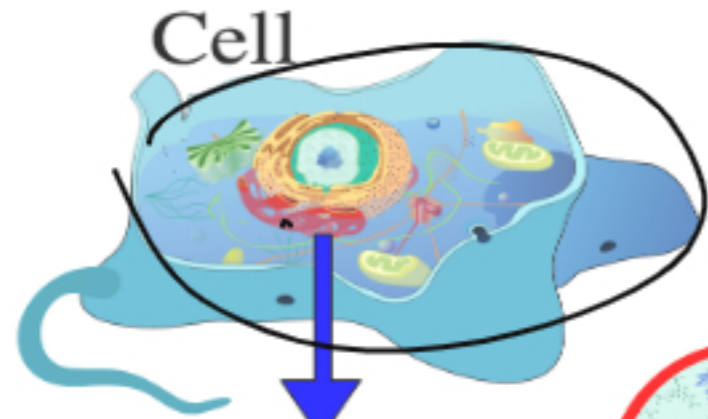


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DNA

= Deoxyribonucleic Acids.



Nucleus

Chromosome

These are the structure that holds our genetic information

DNA

Double Helical Structure which contains genetic information

Gene

It is the segment of DNA that code for proteins

DNA
Phosphate
Sugar



= Adenine

= Thymine

= Cytosine

= Guanine

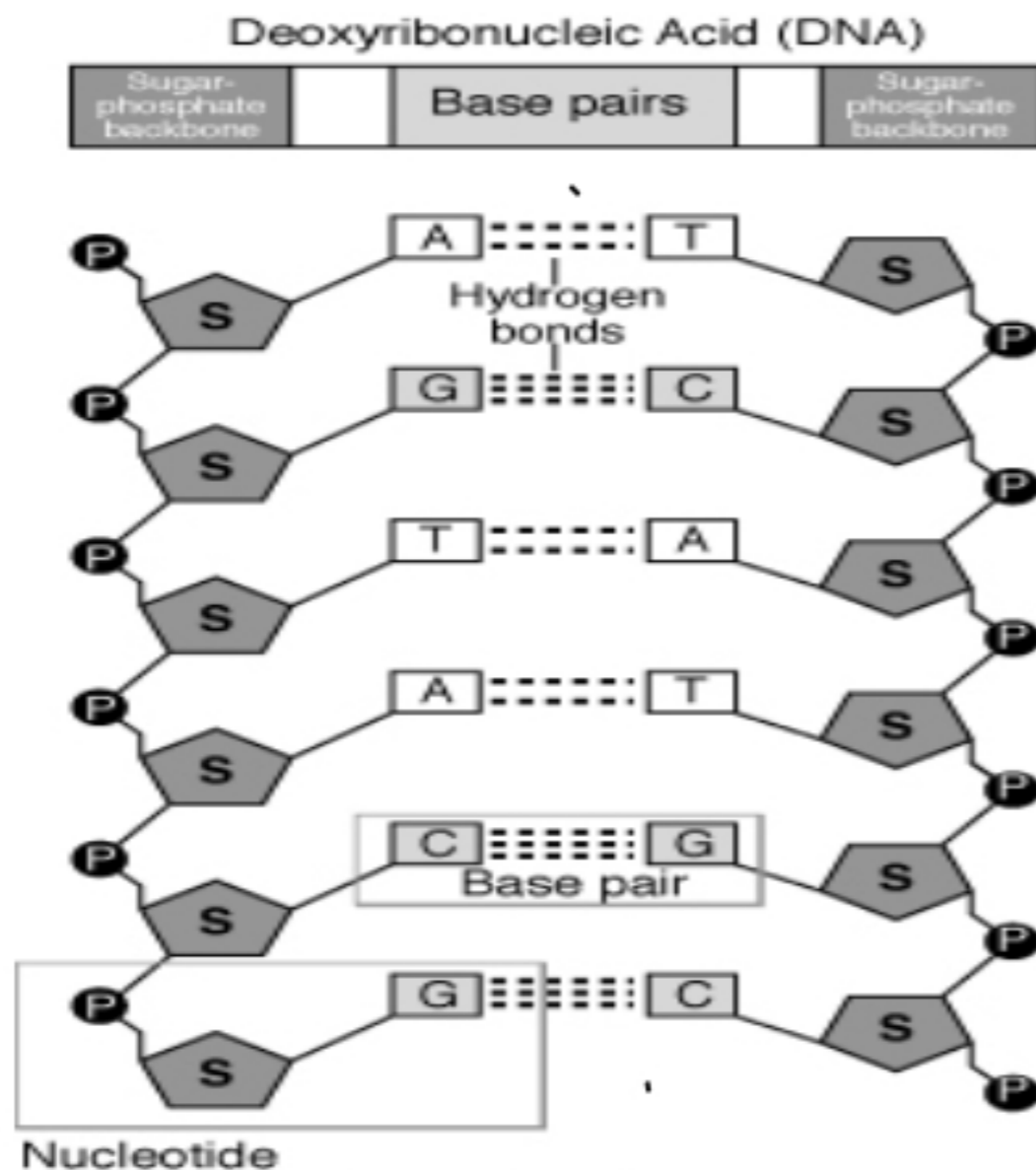
= Phosphate backbone

Nitrogenous bases

$A = T$ (Adenine = Thymine)

$G \equiv C$ (Guanine \equiv Cytosine)

Complimentary Base Pairing Principle



Sourc: Wikimedia Commons

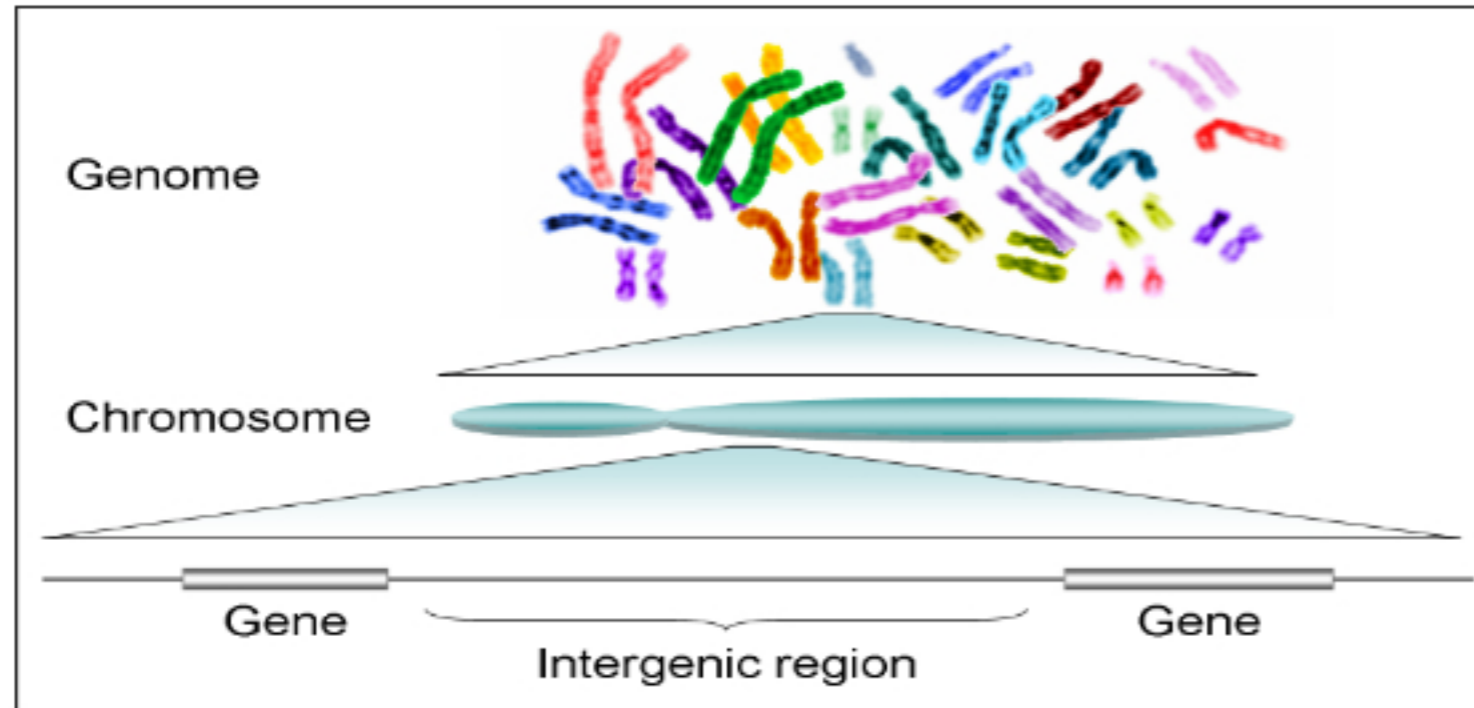
Phosphate + Sugar + Nitrogenous Base = Nucleotide

Deoxyribose

Adenine
Thymine
Guanine
Cytosine



Genome is the complete genetic materials of the organism.

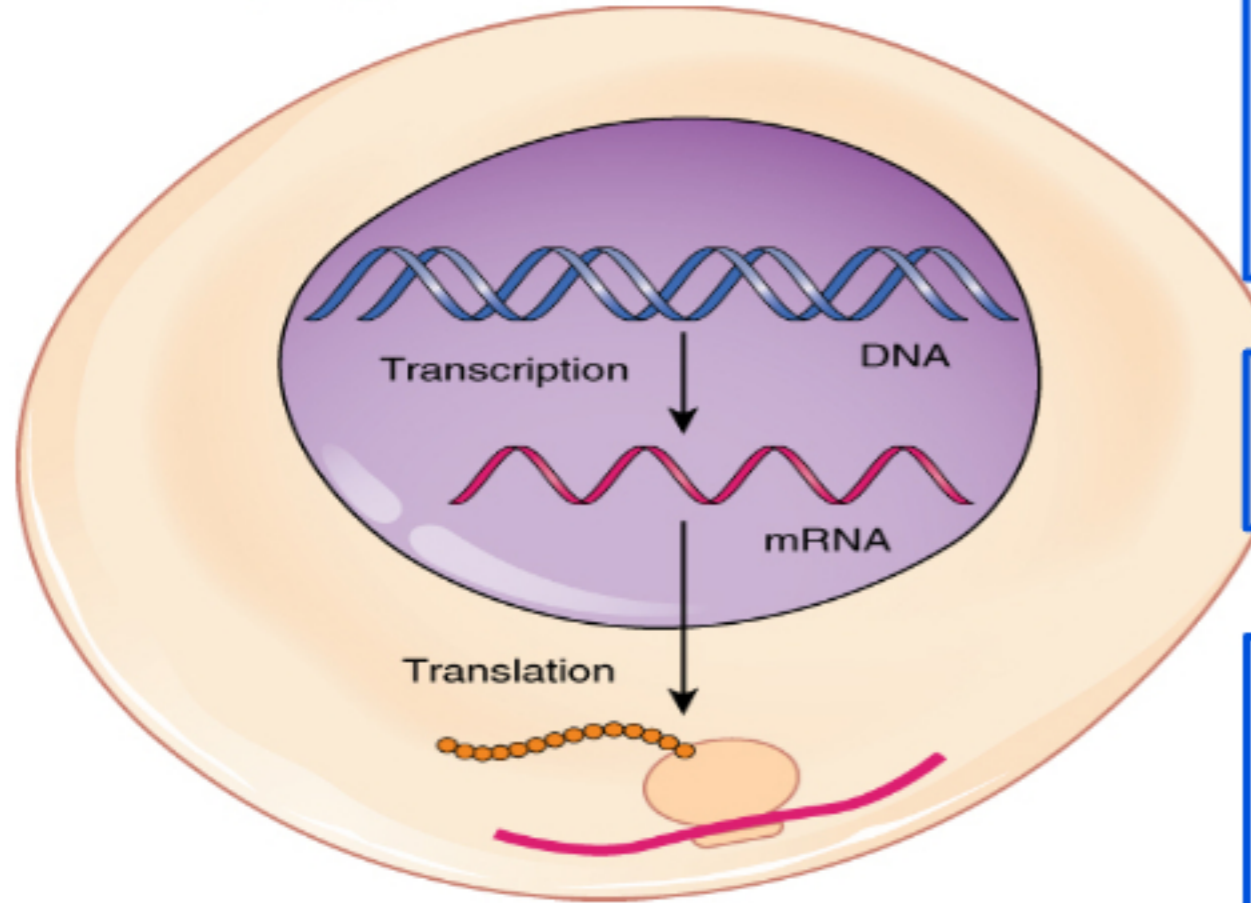


Source: Wikimedia Commons

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) Identifying new drugs target.



Section of DNA that codes for proteins is a gene.

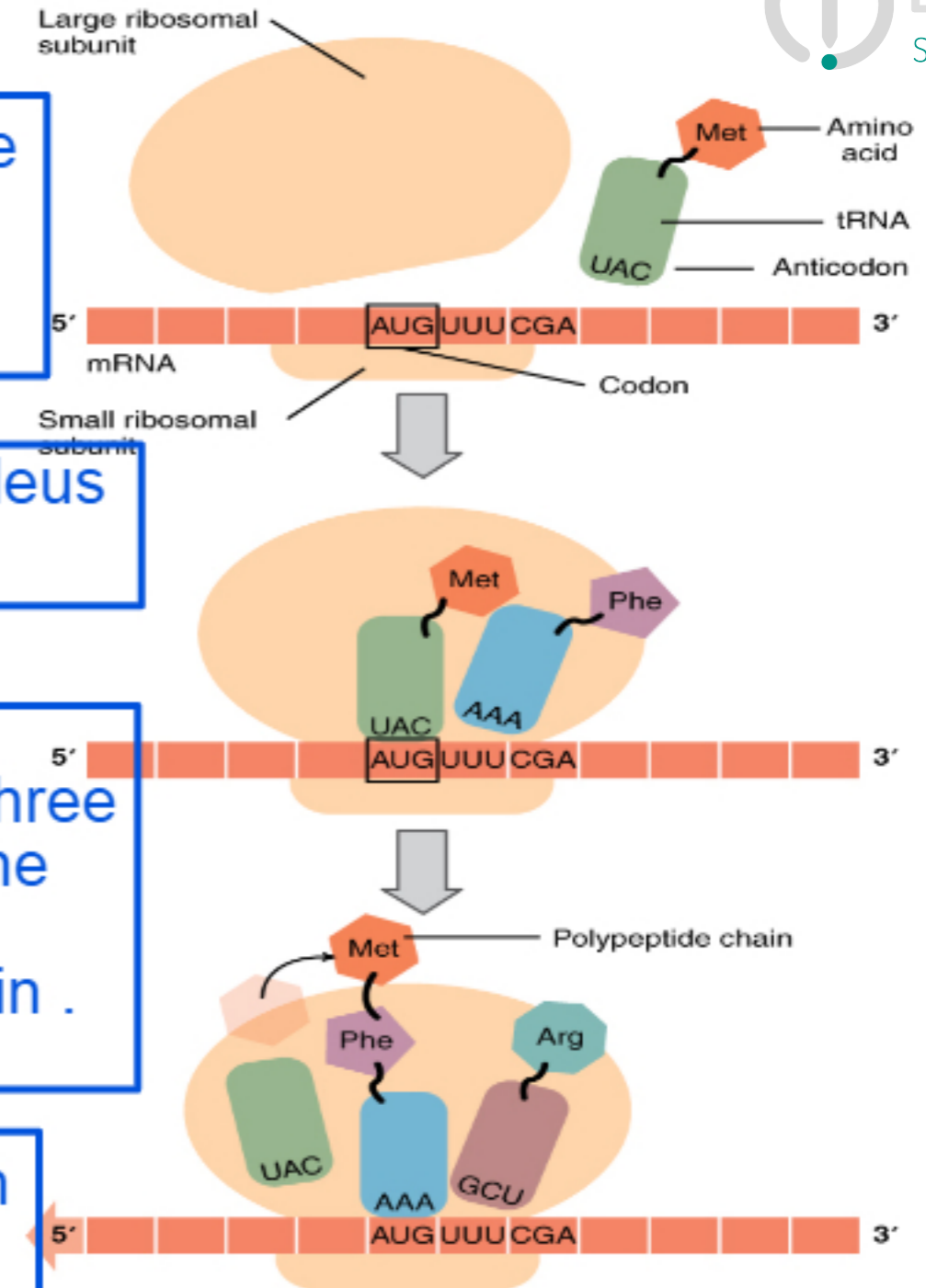
PROTEIN SYNTHESIS

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

The mRNA leaves the nucleus and reaches the ribosome.

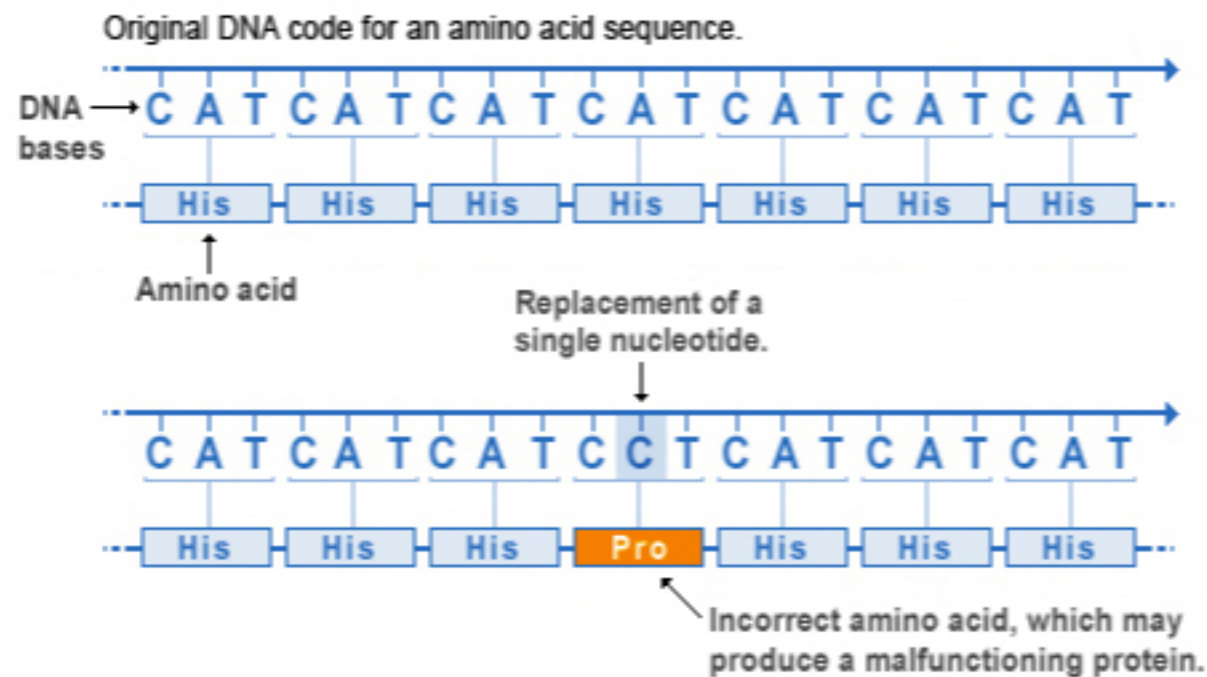
The ribosomes reads the bases in the sequence of three bases. The t-RNA brings the corresponding amino acid and forms polypeptide chain .

The polypeptide chain than forms proteins.





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

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

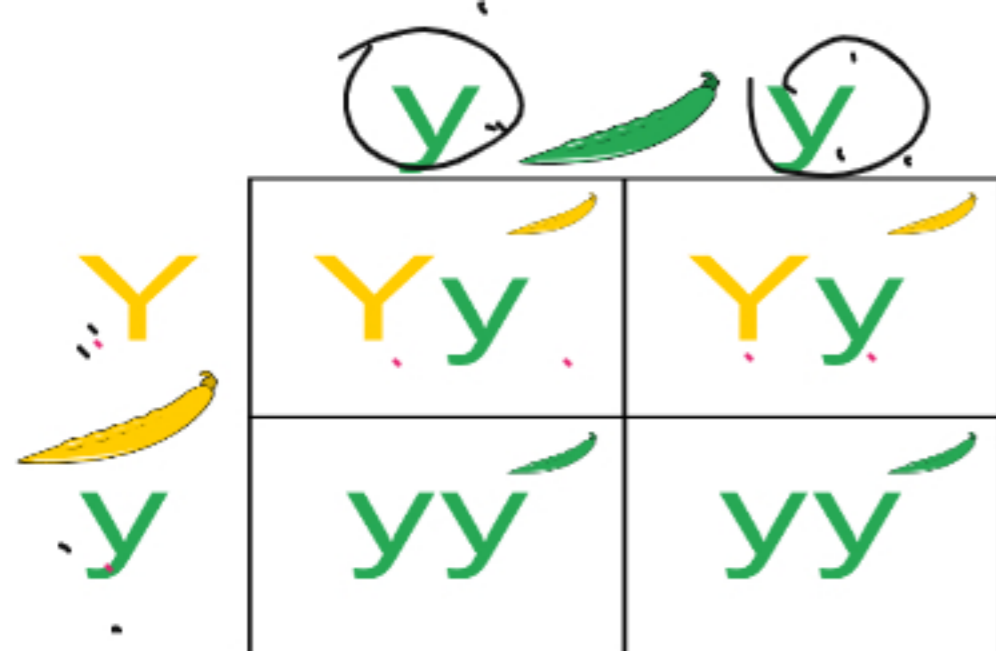
Phenotype

The physical characteristic expressed by a genotype

Punnett Square

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

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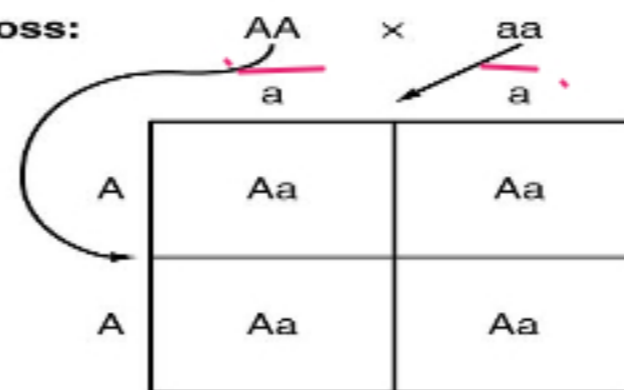


Heterozygous yellow plant
with green plant.

Dominant= yellow
Recessive =green

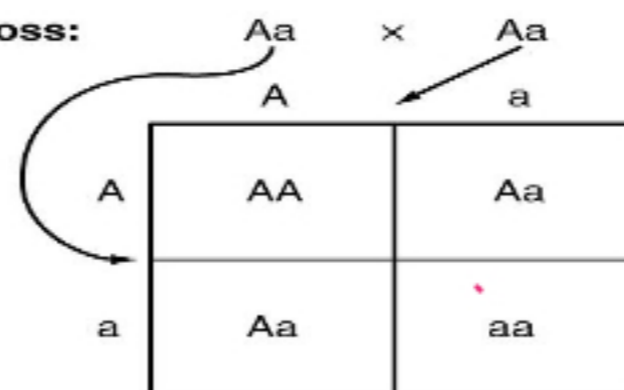
50% green and 50% yellow

Generation 1 Cross:

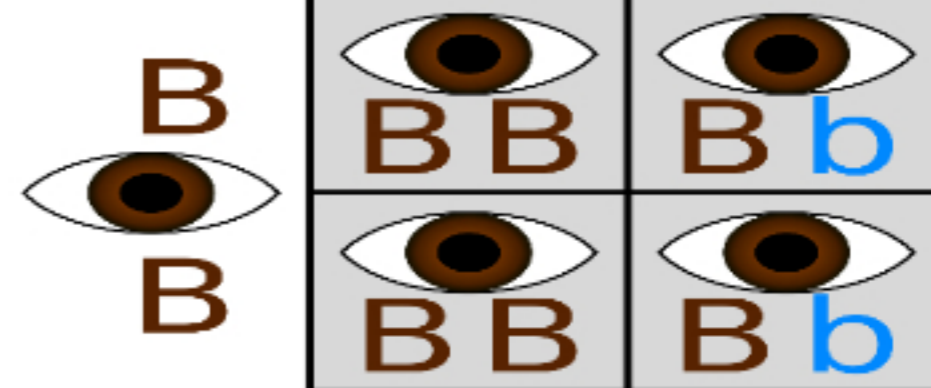


Generation 2:
100% of offspring
are AA (dominant)

Generation 2 Cross:



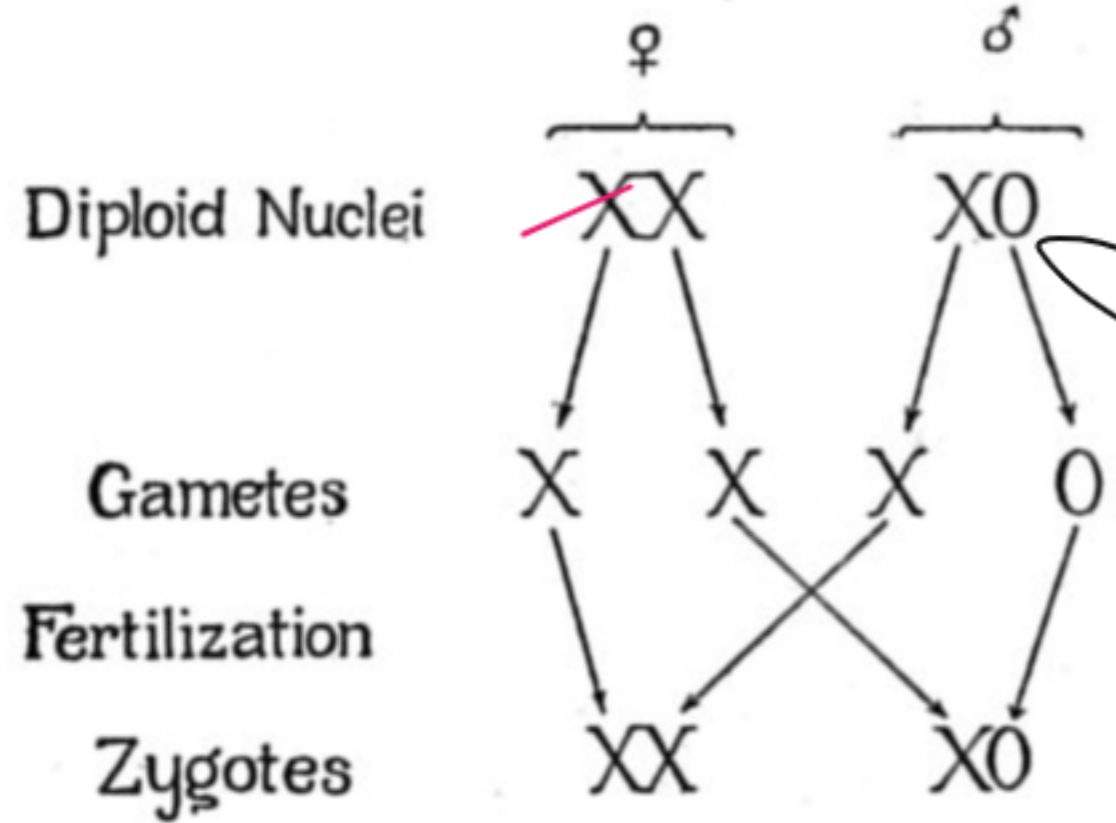
Generation 3:
75% AA or Aa
(dominant)
25% aa recessive



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

B= Brown = Dominant
b= Blue= Recessive

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Females = XX

Male = XY

50% changes of the offspring to be male or female

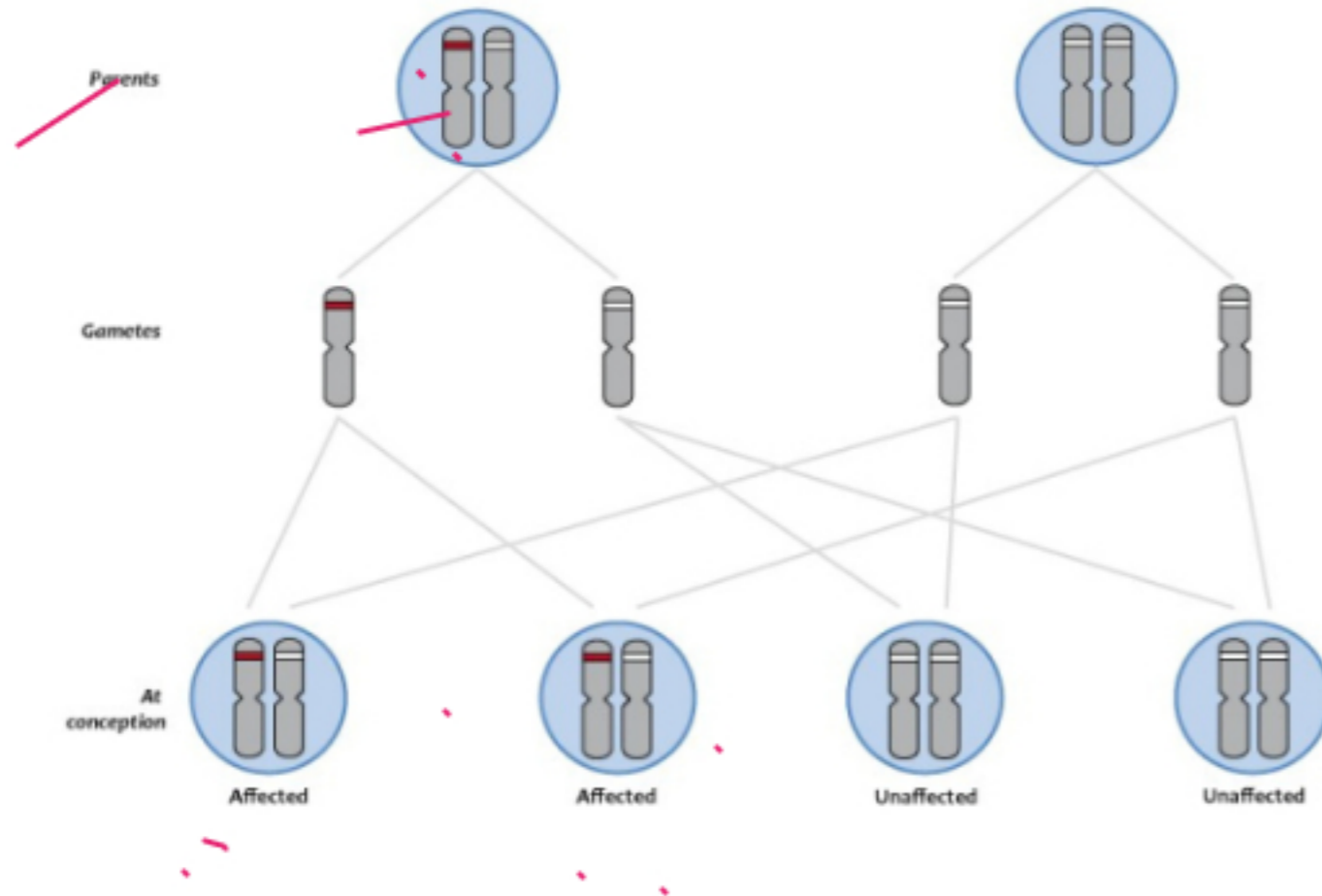
	X	Y
X	XX	XY
X	XX	XY

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



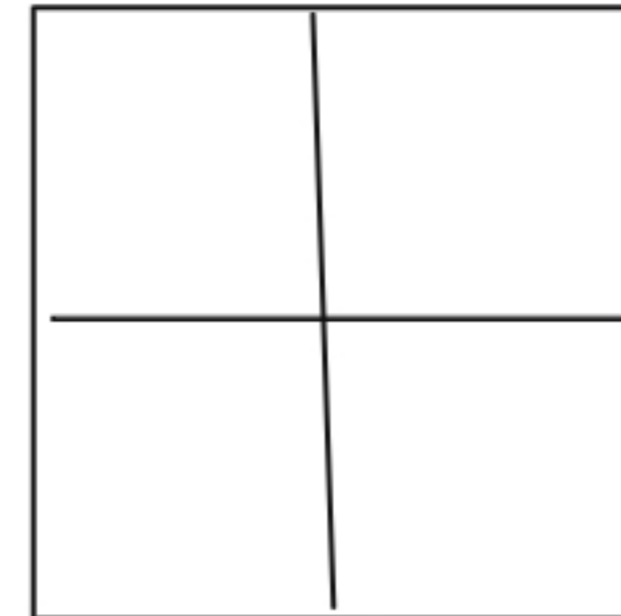
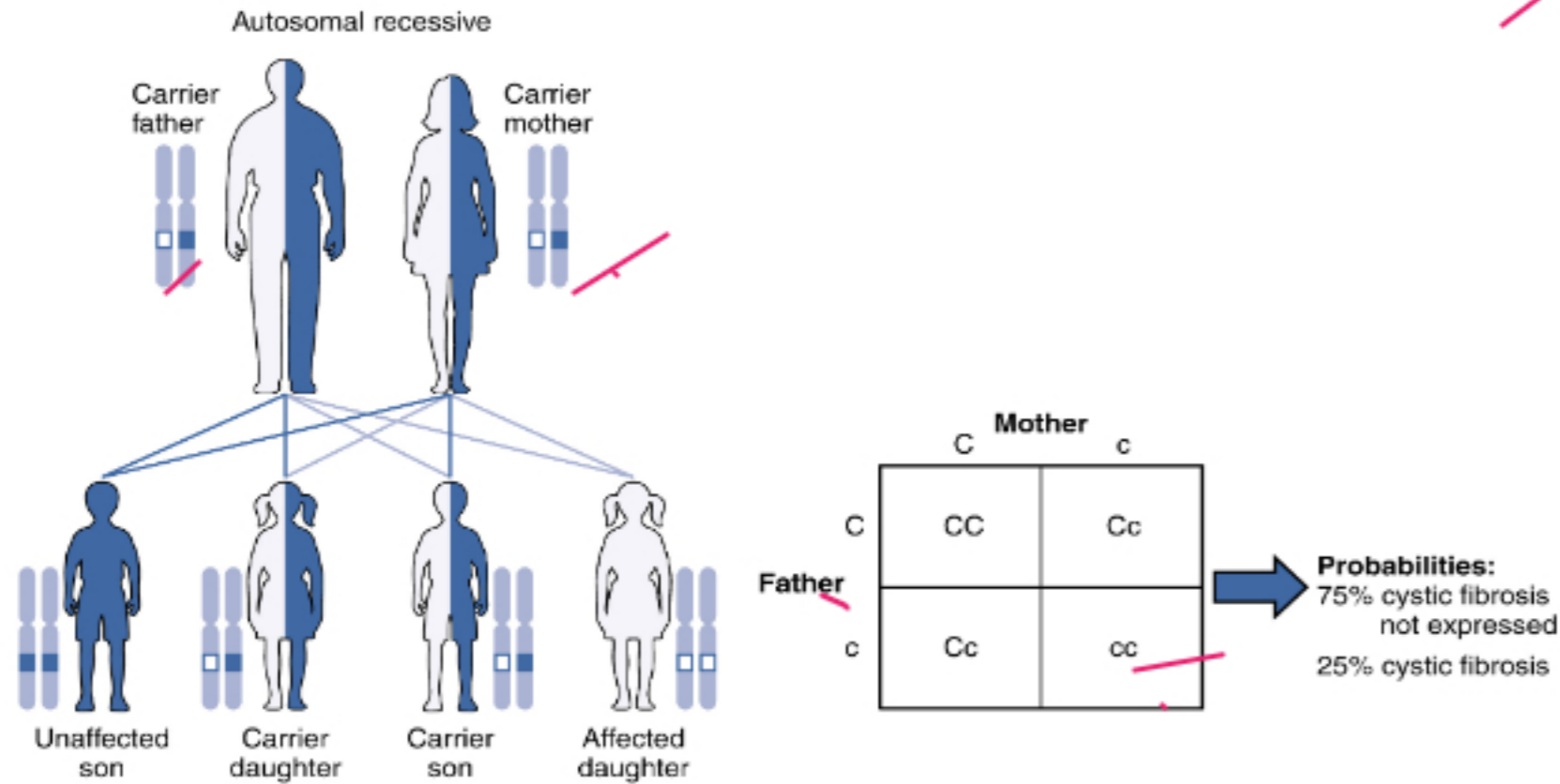
Autosomal Dominant Inheritance

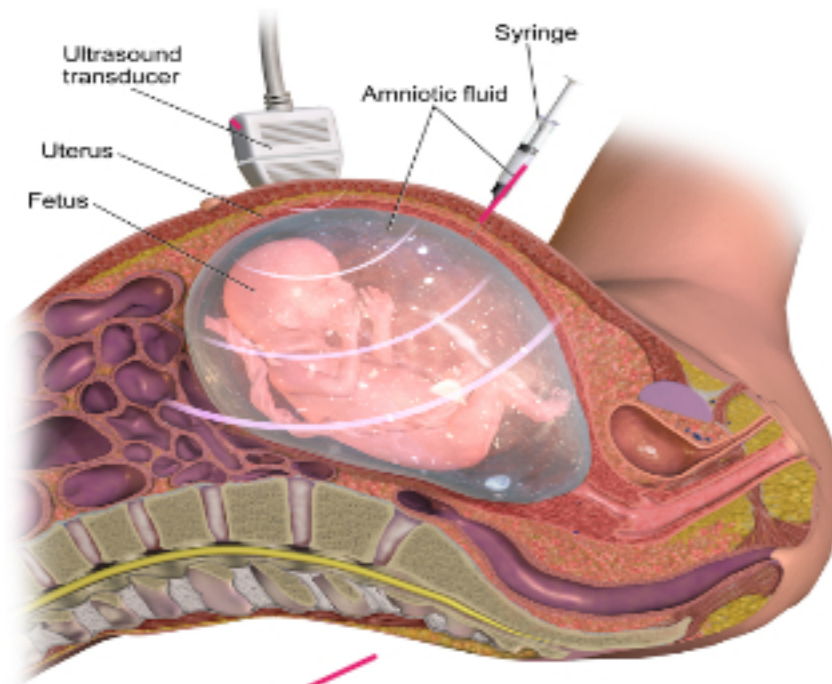


→ Caused by recessive allele

→ Both the parent should have the allele to infect the offspring.

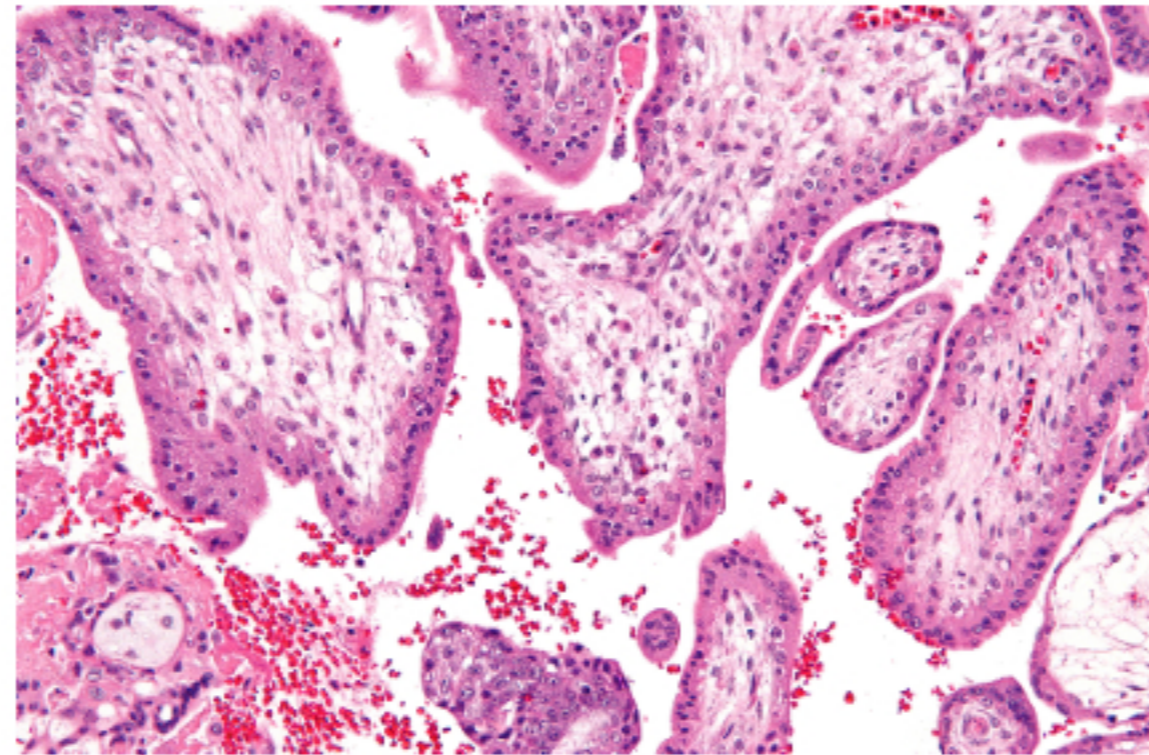
→ The mucous becomes sticky and thick. It blocks the airways, reproductive tract and digestive tract.





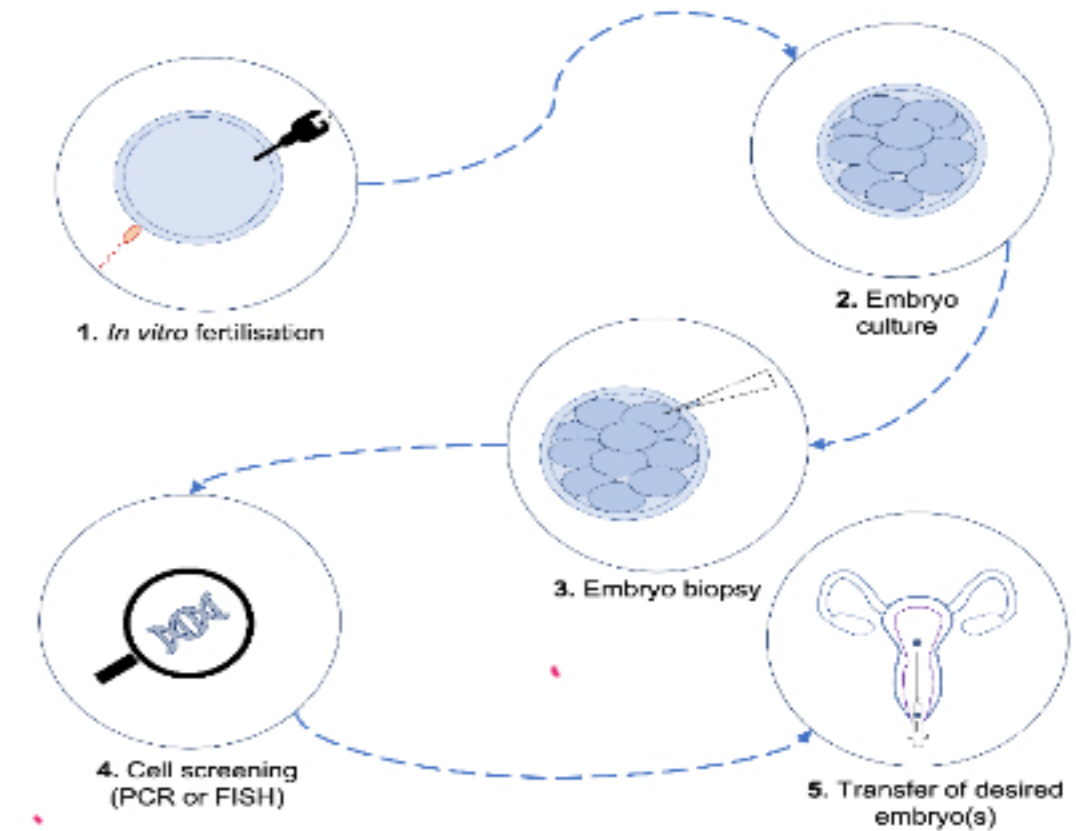
Amniocentesis

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.



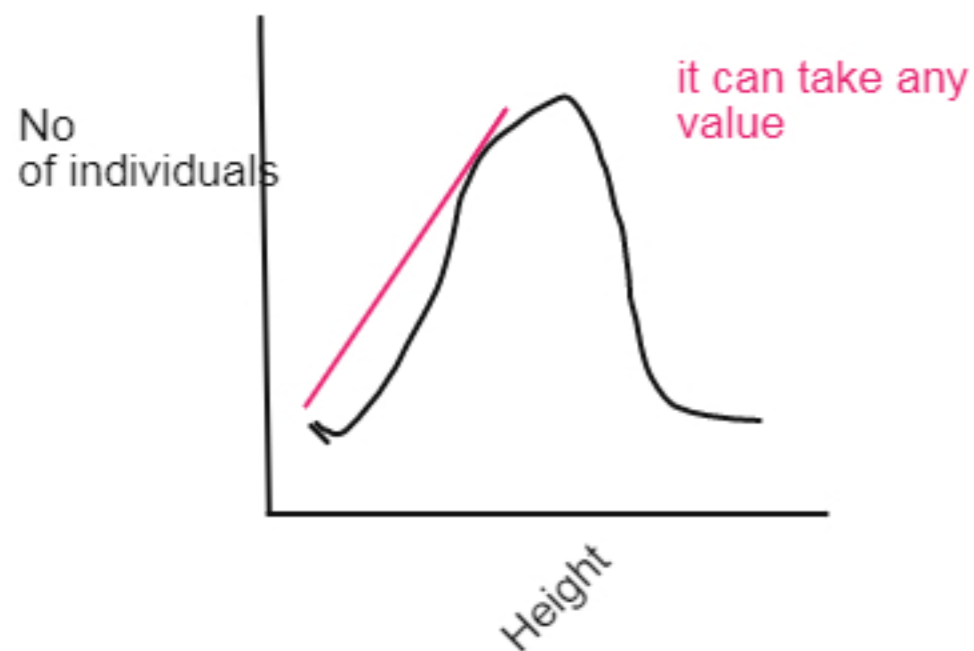
IVF Screening

Involves screening of the embryo after in vitro fertilization.

Differences amongst the individual

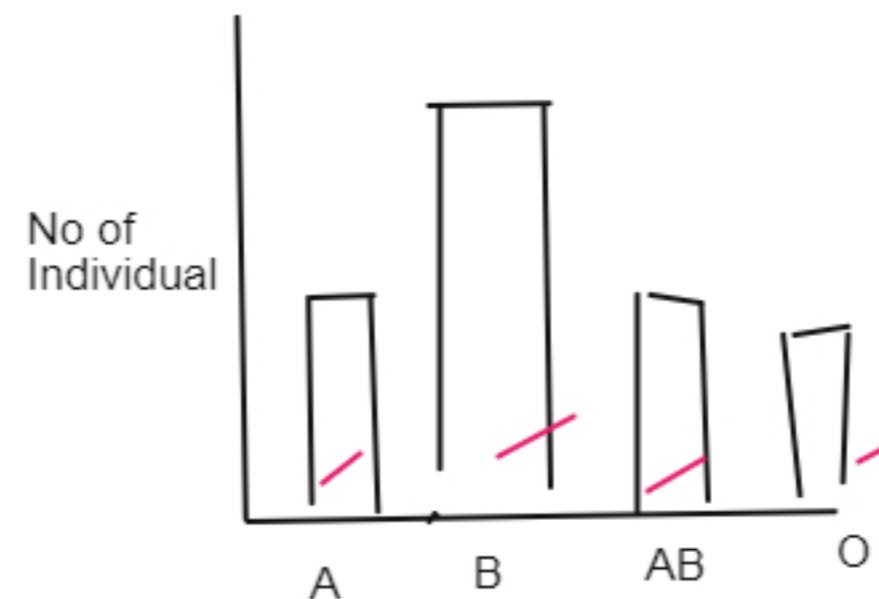
CONTINUOUS VARIATION

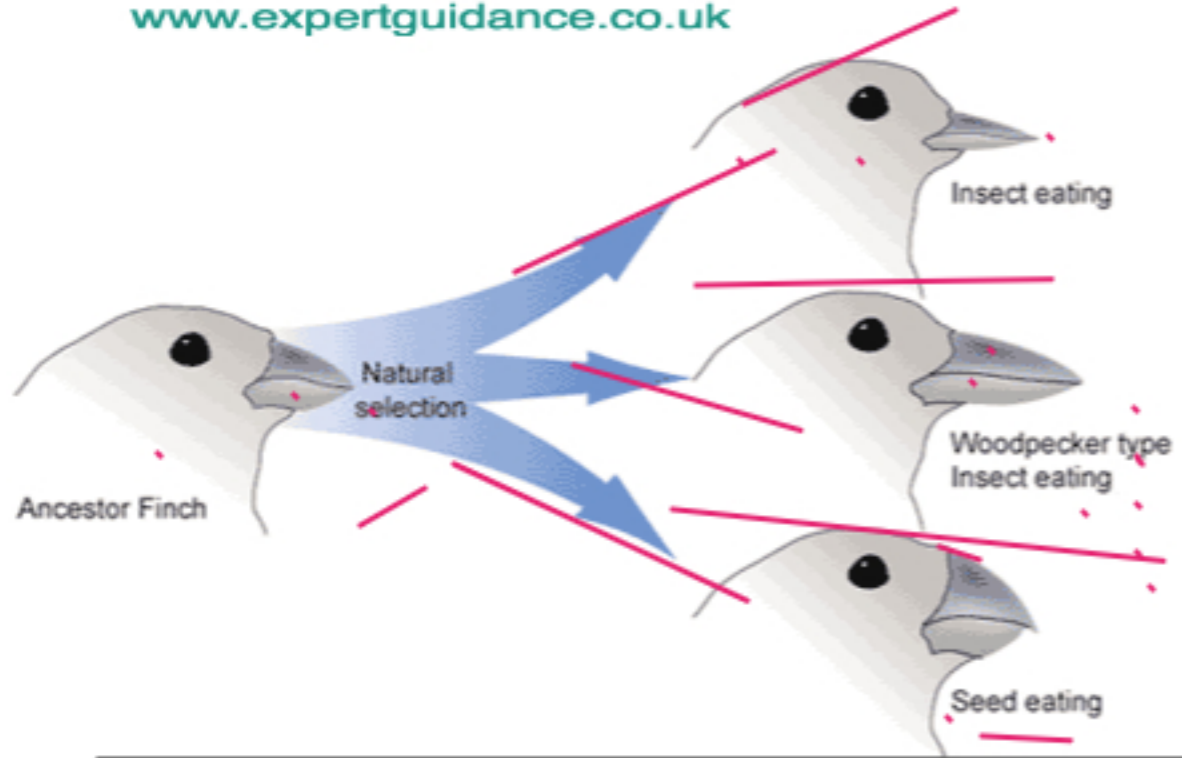
It is environmental like height, weight.
Graph is a bell shaped curve



DISCONTINUOUS VARIATION

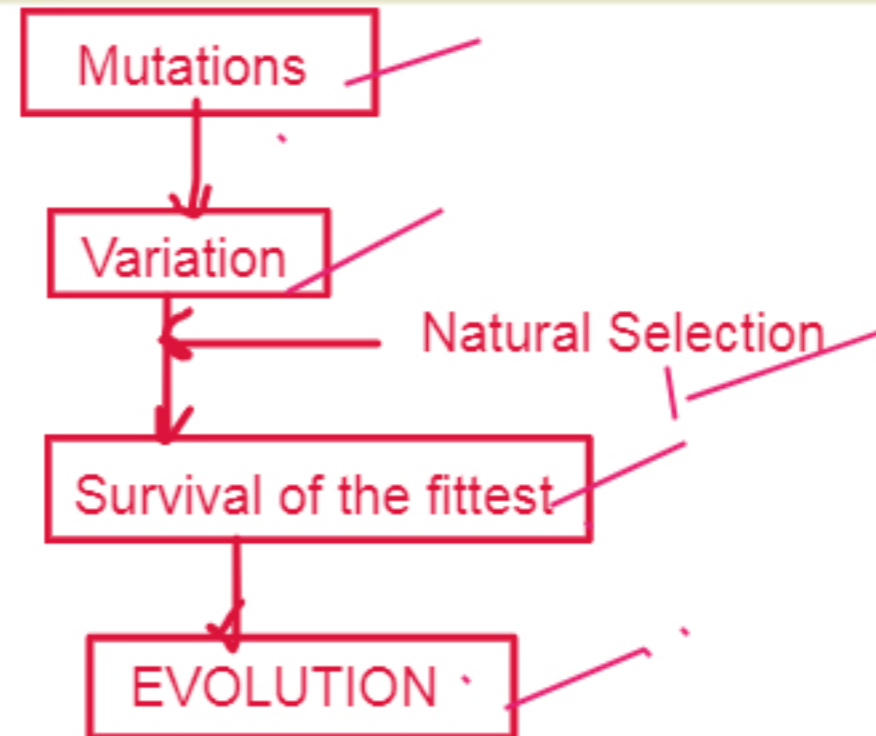
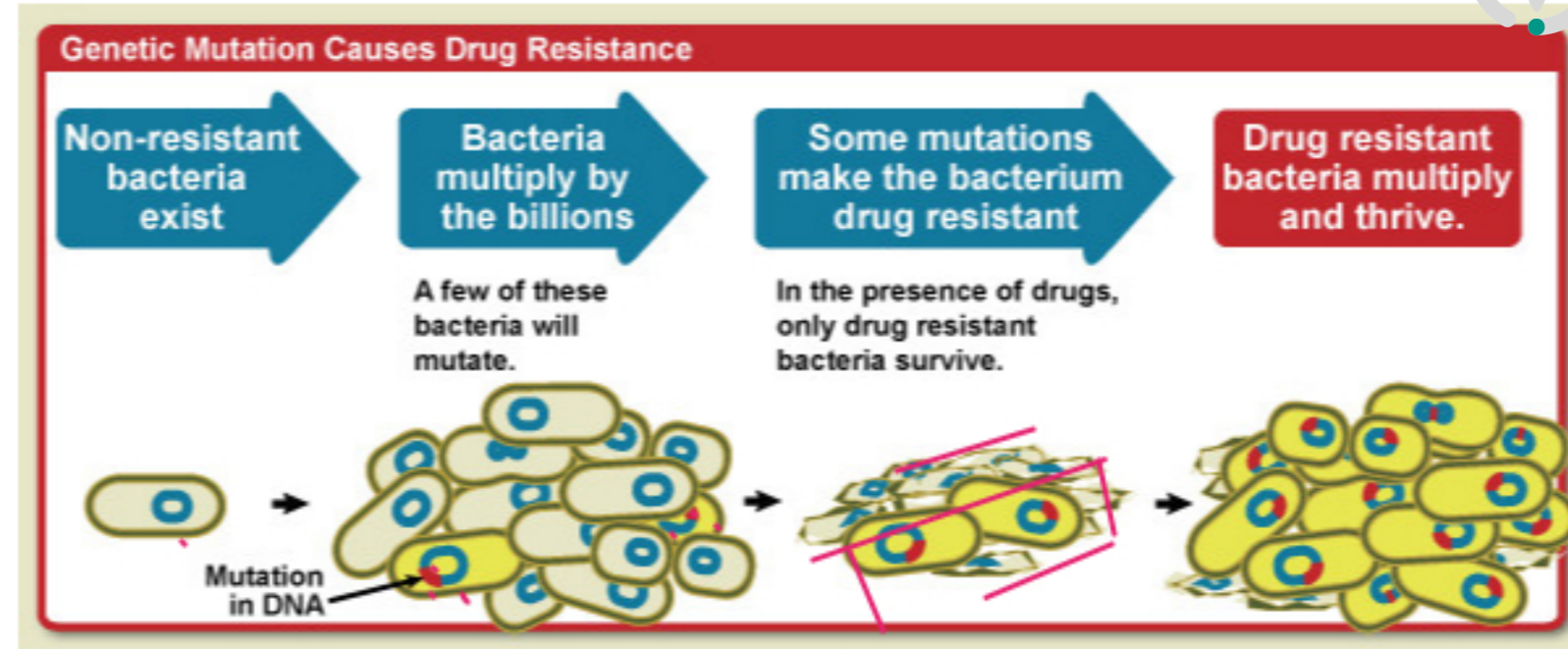
It is genetic like blood group.
Graph is like column graph having discrete values.





"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

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Applications

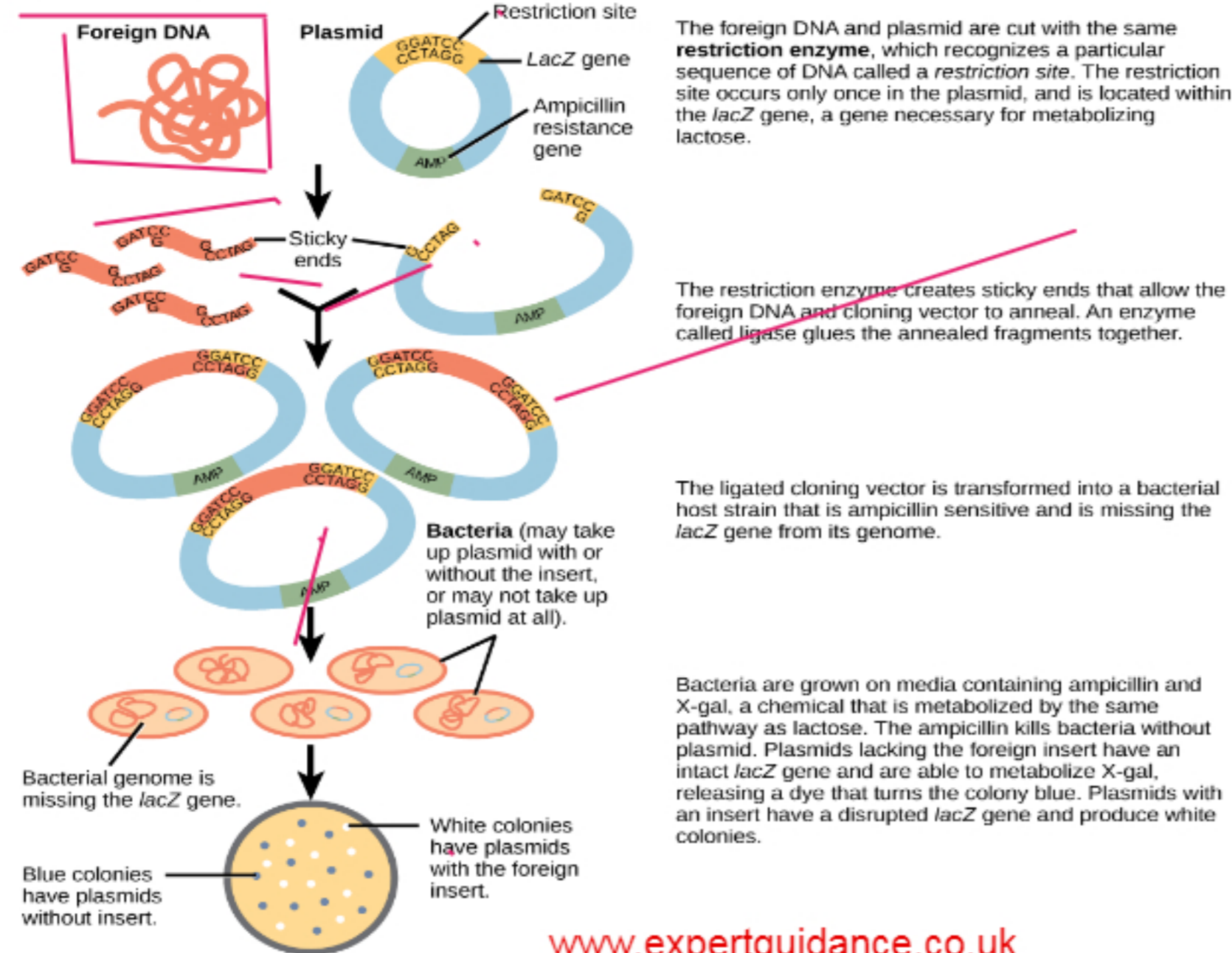
- a) Producing high milk yielding cow
- b) Producing diseases resistance and high yield crops.

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

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

Molecular Cloning



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

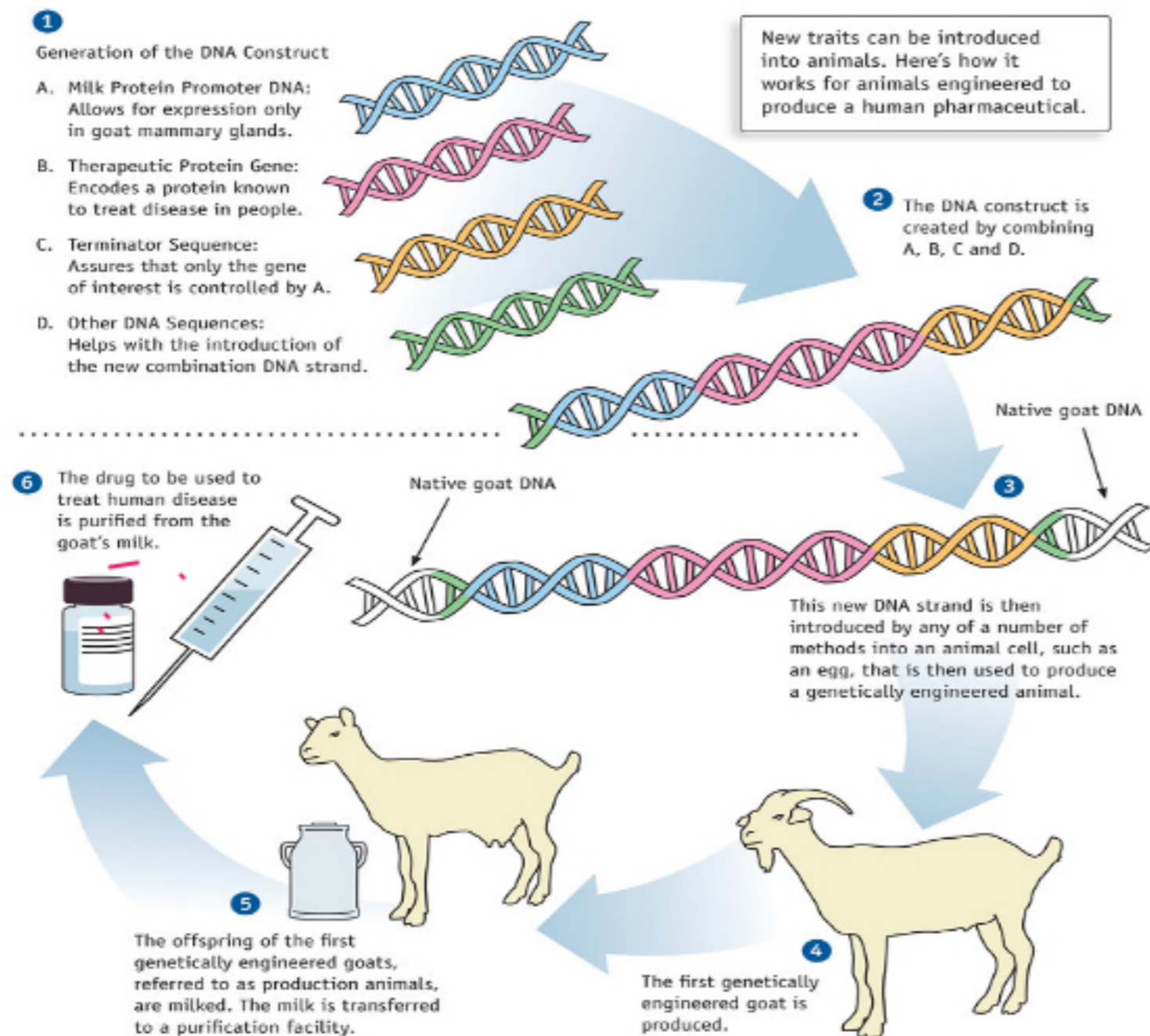
Isolation

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

Introducing the recombinant into bacteria - Transformation

Selecting transformed bacteria

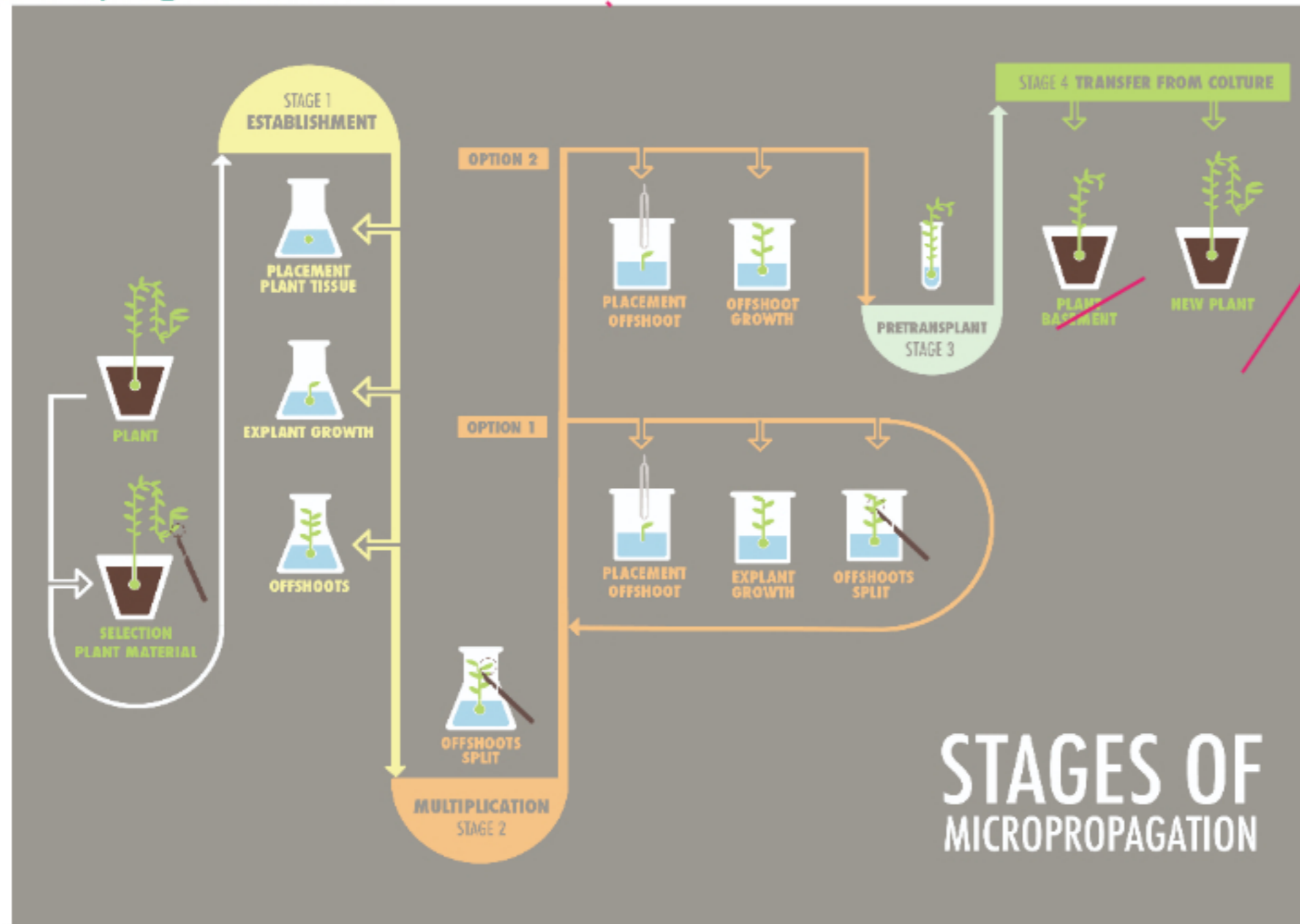
Growing transformed bacteria



Examples

- / a) Tomato with greater shelf life
- b) Golden Rice which is rich in Vitamin A
- c) Gently engineered Insulin
- d) Disease resistant crops
- e) Insects resistant crops

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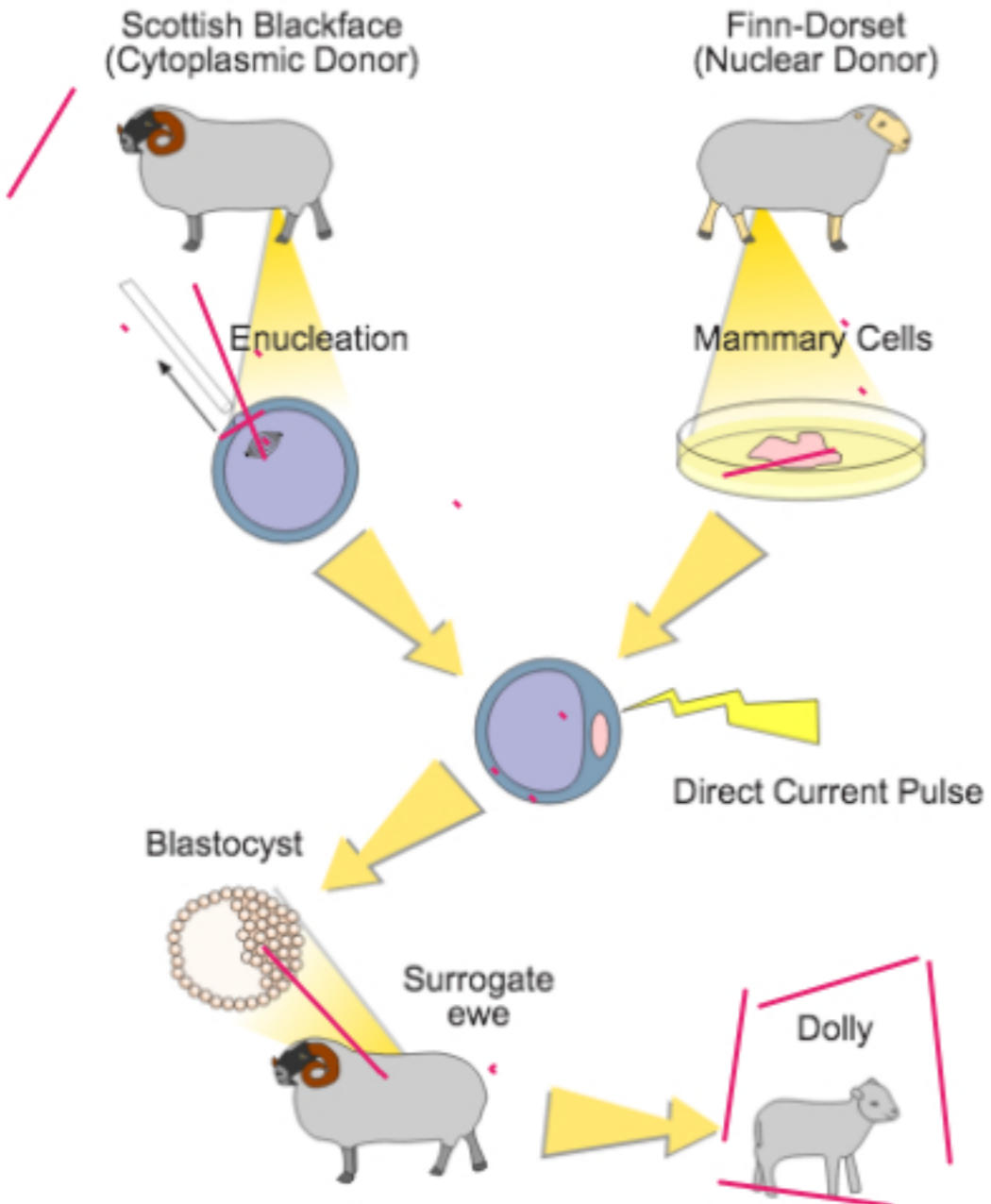
Taking Explant

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

Source: Wikimedia Commons



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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.

DISADVANTAGES

- 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 religious concerns of playing with the nature.
- f) It is irreversible

GREGOR MENDEL

Genes → Protein → Expression

Seed		Flower	Pod		Stem	
Form	Cotyledons	Color	Form	Color	Place	Size
						
Grey & Round	Yellow	White	Full	Yellow	Axial pods, Flowers along	Long (6-7 ft)
						
White & Wrinkled	Green	Violet	Constricted	Green	Terminal pods, Flowers top	Short ~1 ft
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 certain characters are inherited from one generation to another.

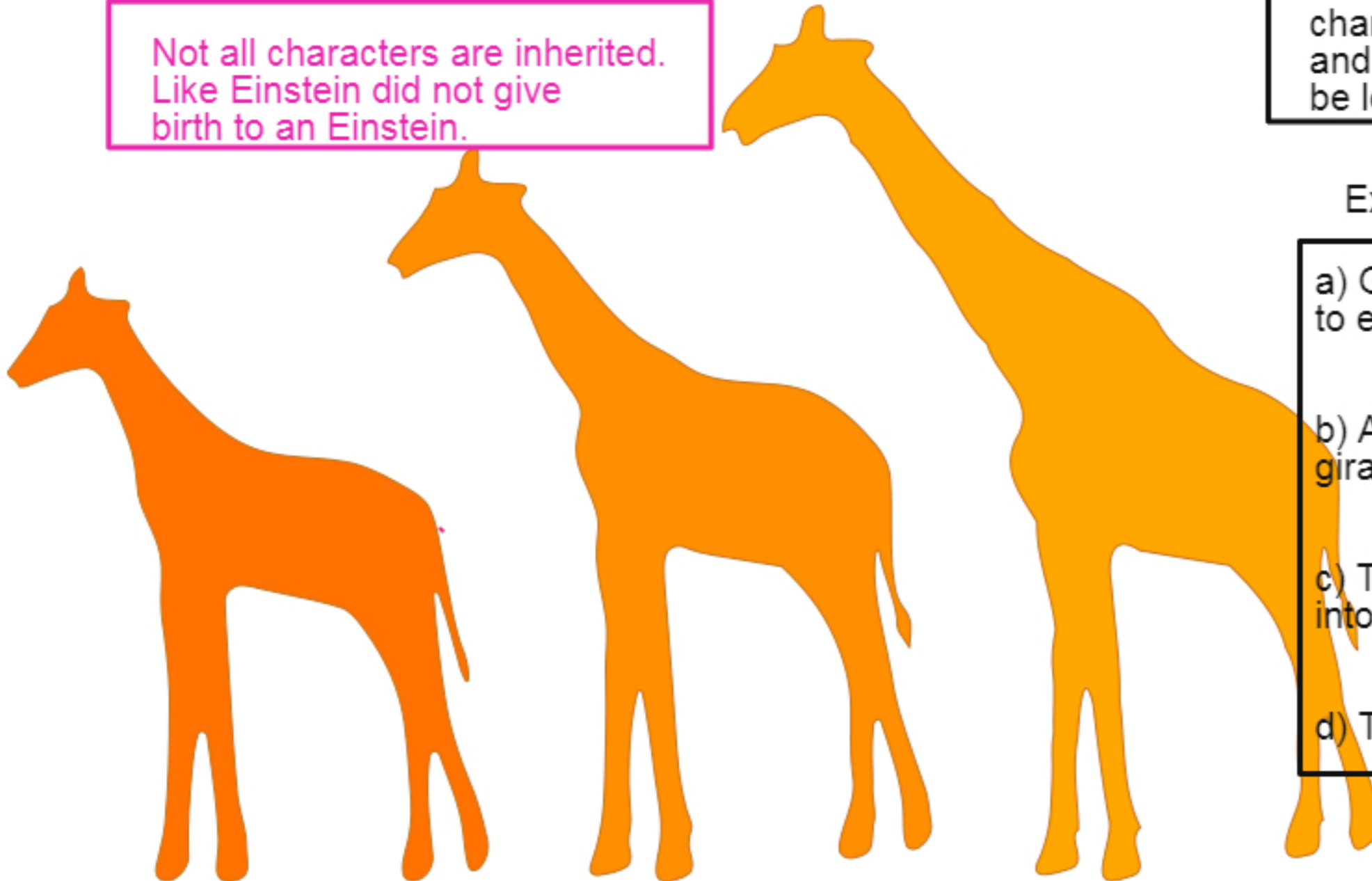
In the 20th Century, the structure of DNA and the genes were discovered to build on Mendel's ideas

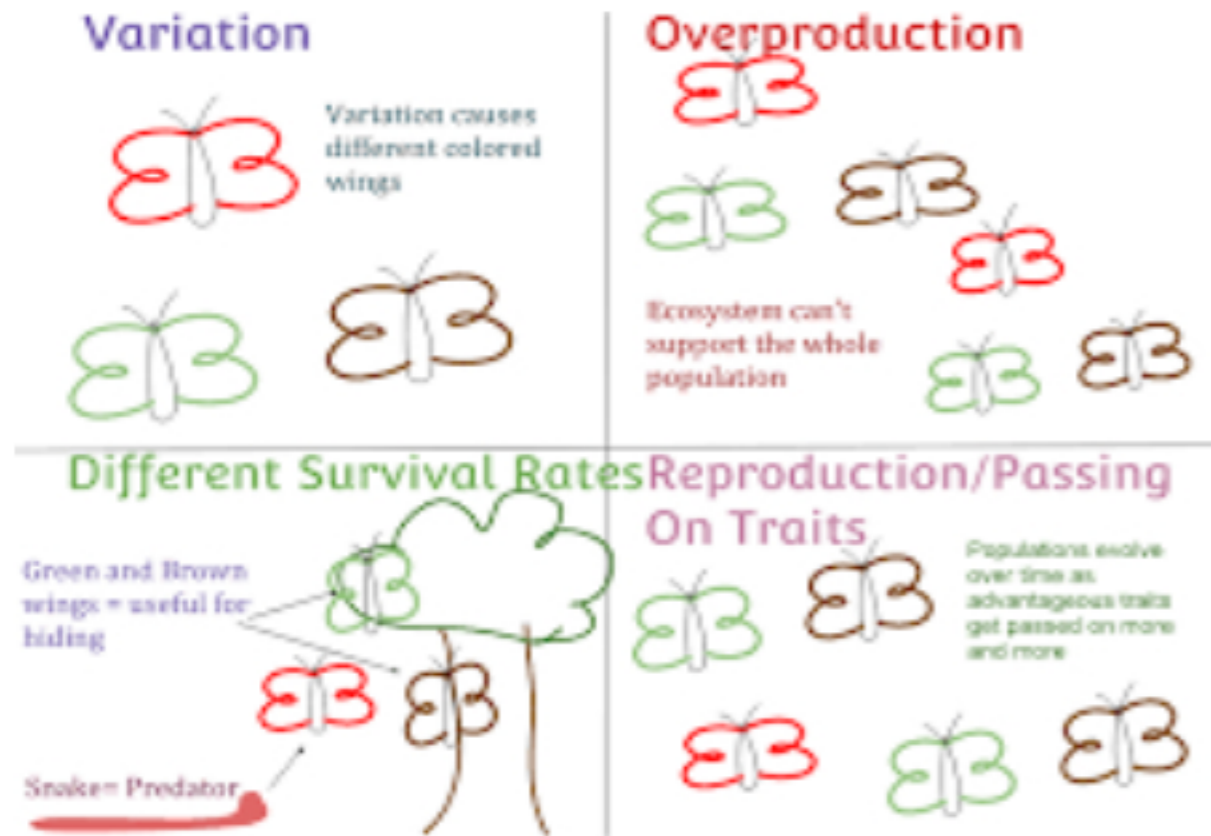
Not all characters are inherited.
Like Einstein did not give
birth to an Einstein.

Theory of Use and Disuse- If any
characters in use 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.





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

The population remains constant due to natural selection

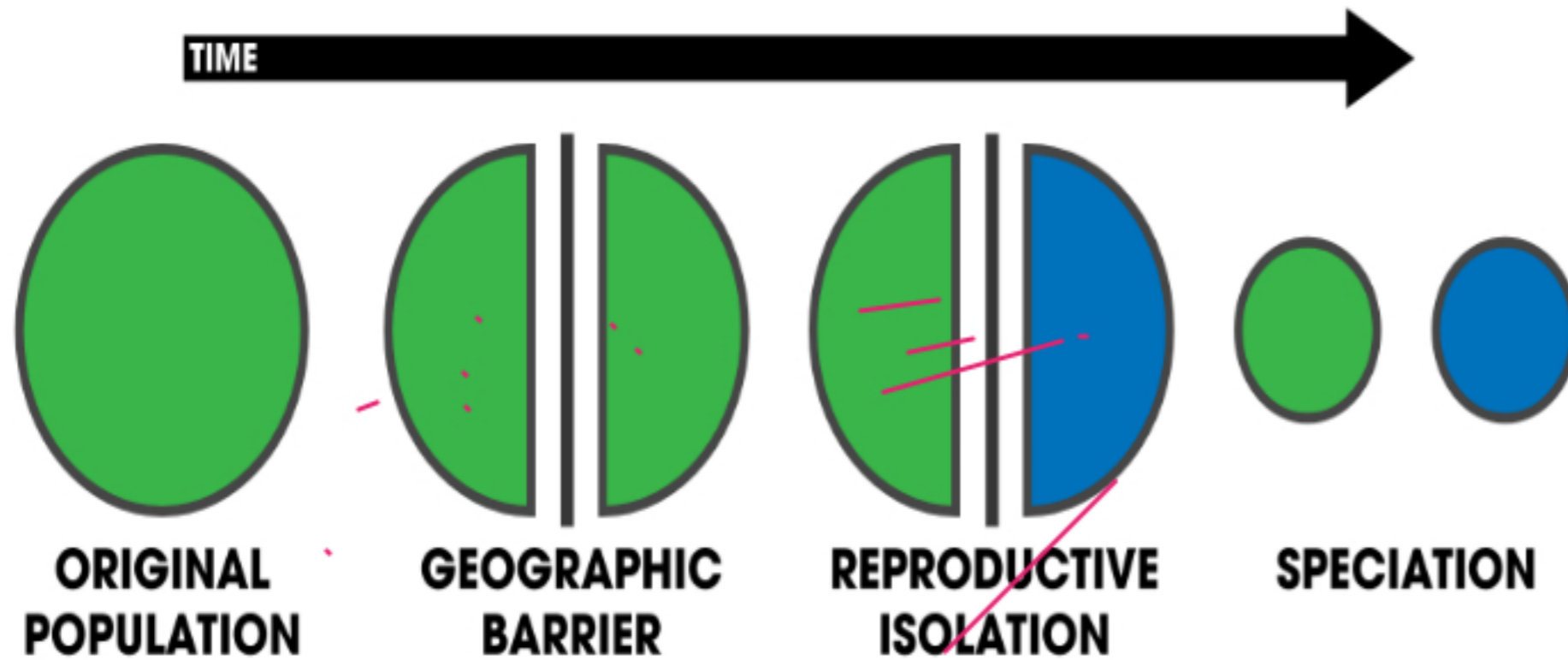
Organisms show variation and nature selects the one which has desired characteristics.

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

The fittest one reproduce and pass the traits to next generation

EVOLUTION

Formation of new species



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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 organisms due to hostile conditions for the decomposers.
- The harder parts 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

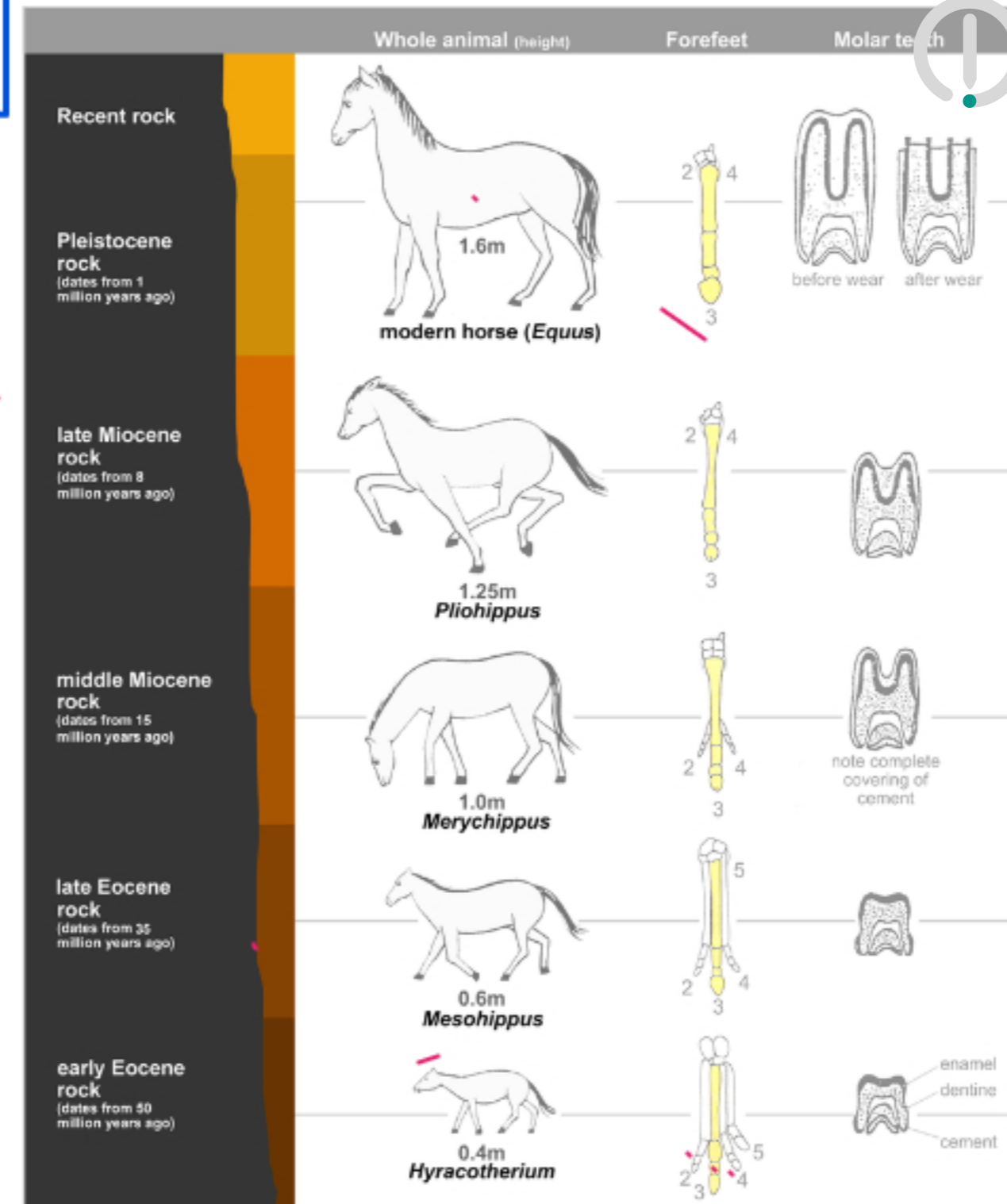
- Most of the animals that are soft bodies have no fossils
- Some of the fossils are yet to be discovered.
- No fossil record for some species

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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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It the permanent loss of species

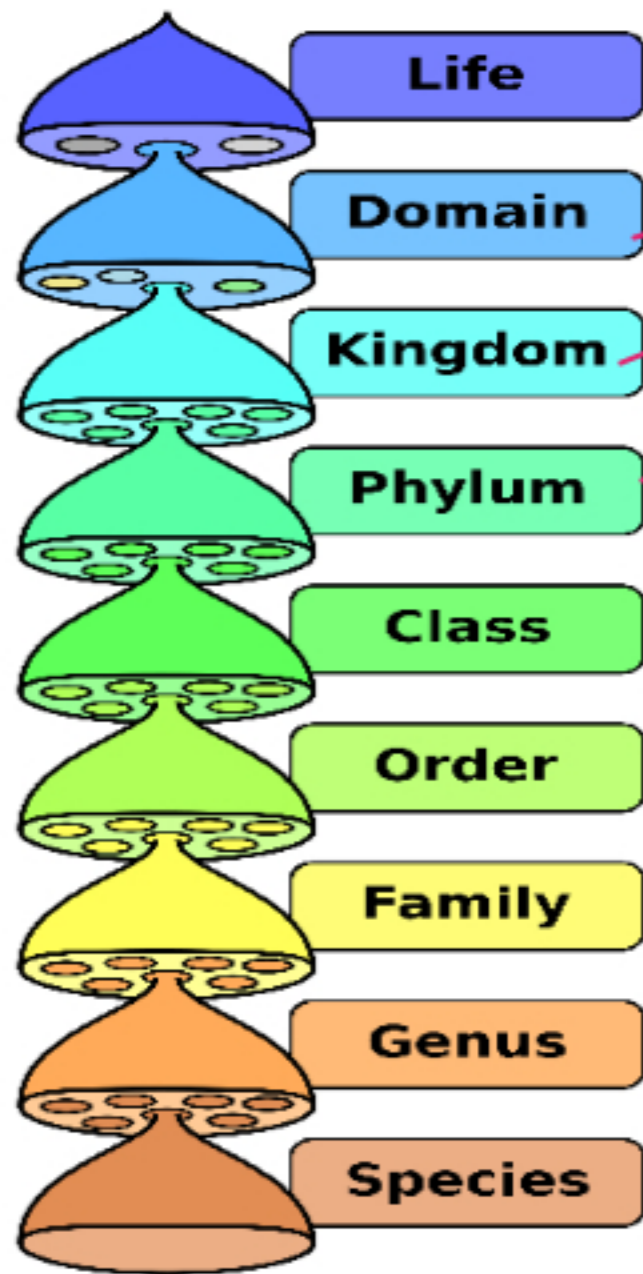
Causes

- ~~a) Environmental Changes~~
- ~~b) Diseases~~
- ~~c) Predator~~
- ~~d) Competition~~
- ~~e) Catastrophic Event~~

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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

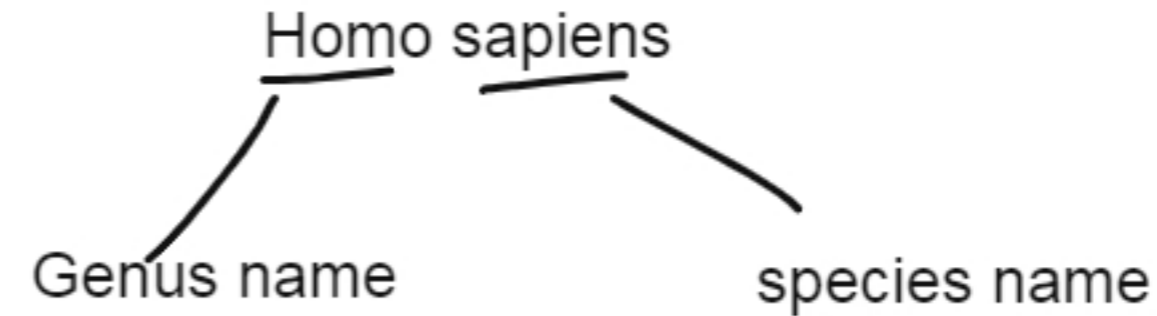
- a) Earlier organims were classified on the basis of obeservable Characteristics
- b) Evolutionary Relationship
- c) DNA or protein sequencing

Each species is given two name

The first name is Genus and is always capital

The second name is species and it is written in lower case

The name is italicised and if handwritten is underlined.

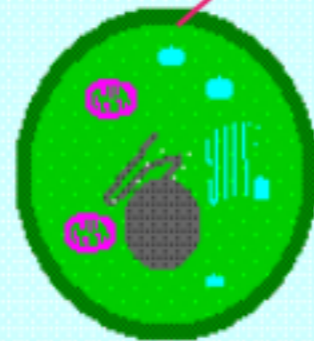


Universally accepted

Helps the scientists to communicate

Cell Type	Average Size	Characteristics	Domains
Eukaryotes	10-100mm	Distinct membrane-bound nucleus Presence of organelles	Eukarya
Prokaryotes	1-10mm	Absence of distinct membrane-bound nucleus Absence of Organelles	Bacteria
			Archaea

Examples: (1: Eukaryotic Cells, 2: Eubacteria, 3: Archaeobacteria)



(1)



Spheres



Rods

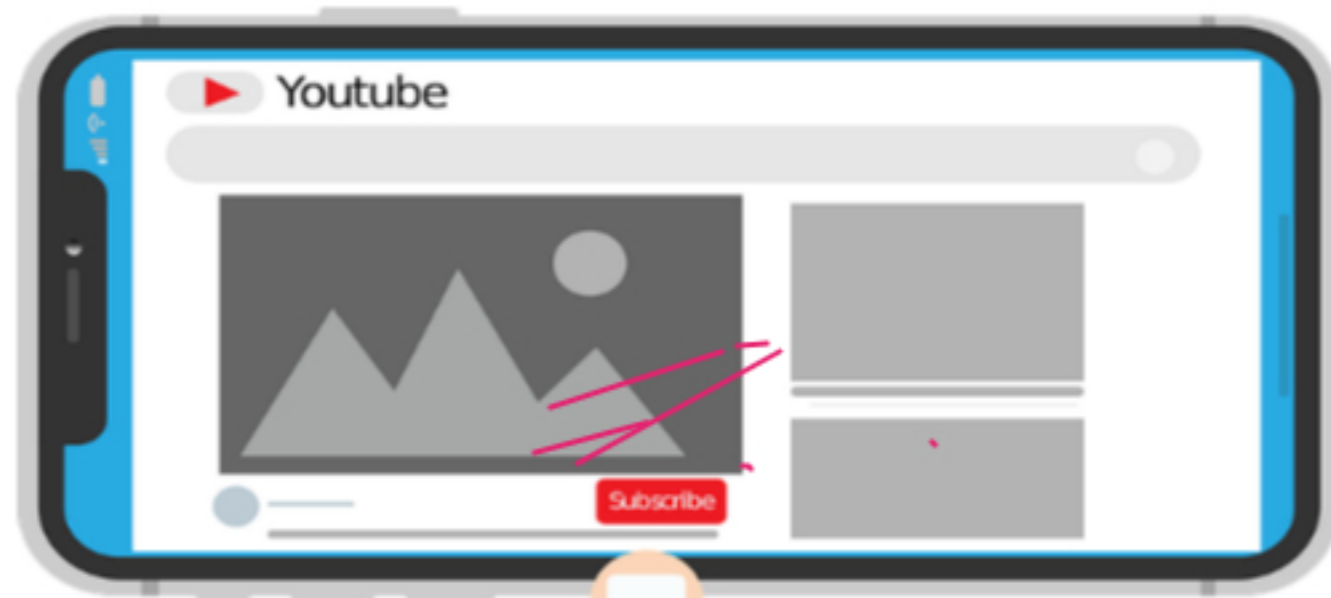


Spirals

(3) similar to Eubacteria,
but can also have unusual shapes

KEY TERMS !!!

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



CHECK SPECIFICATION



EXAM QUESTIONS ON THIS TOPIC



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