

HEREDITY AND EVOLUTION CLASS 10 STUDY NOTES

Genetics: Branch of science that deals with Heredity and variation.

Heredity: It is the process of the transfer of characters/ traits from one generation to the next generation.

Variation: The differences in traits among the individuals of a species/ population are called variations

Evolution: The gradual change in the heritable characteristics of populations over successive generations. This give rise of new species.

Gregor Johann Mendel started his experiments on garden pea (*Pisum sativum*) plant to explain heredity in organism

Mendel was known as Father of Genetics

Mendel obvers variation among population of organism. Variation are accumulated due to following reason:

(a) **Reproduction:** Less variation seen in organism developed by asexual reproduction and more variation in traits seen organism developed from sexual reproduction due to in accuracy in DNA copying.

(b) **Variation seen in organism as they try to survive during change in environment.** Thus variation form the basis of heredity and give rise to new species.

He selected pea plants due to: (i) They have contrasting characters (ii) They reproduce sexually (ii) many generation of pea plants produced in short time (iv) They can be easily grown with less maintenance.

TABLE OF CONTRASTING CHARACTERS. (SEVEN PARTS)		
CHARACTER DOMINANT	CHARACTER DOMINANT	CHARACTER DOMINANT
Flower colour	Purple	White
Flower position	Axial	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf

Monohybrid Cross: Mendel Cross between two pea plants with one pair contrasting characters Example: Tall / Short Plants.

PARENT	Tall Plant		Short Plant	
Chromosomes	TT (homozygous)		Tt(homozygous)	
Gamete transferred	T		t	
F ₁ GENERATION (first filal generation)	Tt (Heterozygous)	All Tall plants (phenotypic) or appearance		
SELF POLLINATION between plants obtained from F ₁ generation				
Parents	Tall plant		Tall plant	
Chromosomes	Tt		Tt	
Gamete transferred	T	t	T	T
F ₂ GENERATION (Second Filal)	TT	Tt	Tt	tt
	Tall plant	Tall plant	Tall plant	Short plant
Phenotypic ratio	3:1		Genotypic ratio1:2:1	

Conclusions: 1. TT and Tt both are tall plants while tt is a short plant.

2. A single copy of T is enough to make the plant tall, while both copies have to be 't' for the plant to be short.

3. Characters/Traits like 'T' are called dominant trait (because it express itself) 't' are recessive trait (because it remains suppressed)

PARENT	Plants with Round and Green seeds	Plants with wrinkle and Yellow seeds
Gametes	RRYY (Round is dominant)	rryy (Yellow is dominant)
F ₁	RrYy	All plants are round and yellow seeds
Self-pollination among Plants of F ₁ generation		
	F ₁ (Rr Yy)	F ₁ (Rr Yy)
Gametes	RY Ry	rY ry

Progeny of F₂ generation

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYy	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

PHENOTYPIC RATIO: Round, yellow : Round, green : Wrinkled, yellow : Wrinkled, green = 9:3:3:1

Observations: 1. When RRYY was crossed with rr yy in F₁ generation all were Rr Yy round and yellow seeds.

2. Self-pollination of F₁ plants gave parental phenotype + two mixtures (recombinants) Round wrinkled, green yellow : seeds plants appeared in the ratio of 9:3:3:1

Conclusions: 1. Round and yellow seeds are DOMINANT characters

2. Occurrence of new phenotypic combinations show that genes for round and yellow seeds are inherited independently of each other.

Laws of Mendel

(I) Principle of paired factors: it states that each trait of the individual is determined by two factors, which are known as genes. The alternative form of gene is called allele.

(ii) Principle of dominance: It states that out of two alleles, only one expresses itself in an organism is called dominant while which does not expresses is called recessive

(III) Principle of segregation: It states that a pair of contrasting factors or genes remains together and separate or segregate at the time of gamete formation.

(iv) Principle of independent assortment: it states that inheritance of two or more genes at a time, their distribution in the gamete and in the progeny of subsequent generation is independent of each other

Sex Determination :Phenomenon of decision or determination of sex of an offspring .Factors responsible for Sex determination are:

(a) Environmental Genetic :In some animals the temperature at which the fertilized eggs are kept decides the gender.eg. In some lizards or turtle, if fertilized eggs are kept at high temperature maleness is induced and at low temperature femaleness is induced.

(b) In some animals like humans gender or individual is determined by a pair of chromosome called sex chromosome

Male – XY and Female - XX

Sex Chromosomes: In human beings there are 23 pairs of chromosome. Out of these 22 chromosomes pairs are called autosomes and the last pair of chromosomes that help in deciding gender of that individual are called sex chromosome.

PARENT	Male		Female	
GAMETES (Reproductive cells)	XY		XX	
Zygote formed after fusion of gametes	XX	XX	XY	XY
	FEMALE	FEMALE	MALE	MALE
	50% probability of a female child		50% probability of a female child	

According to Mendel: Variations arise as a result of (a) sexual reproduction or (b) errors in copying DNA.

Variations are of two types: — acquired and inherited.

- Trait which is not inherited but develops in response to the environmental conditions is called acquired traits. E.g. August Weismann removed the tails of mice by cutting them off for twenty-one generations but progeny born always had a tail. This shows that changes in body cannot pass from generation to generation or change the genes of the germ cells.
- A trait which is controlled by specific genes and is passed from one generation to another is called inherited traits. Any change in DNA sequencing of parents will be passed on to the offspring resulting in variation. These variations can either increase or decrease the chances of survival.

EVOLUTION

Charles Darwin gave the concept of evolution. He has observed that variation exist in nature and helps organism to adapt the environment passed to the next generation.

- He published his book; "The origin of species" and theory proposed by him is known as "The Theory of Natural selection". He explained that the best adapted organisms are selected by the nature to pass their characteristics to the next generation.

Evolution is defined as change in the inherited traits of a population of organisms through successive generations.

This may be may be caused by natural selection, inbreeding, hybridization, or mutation.

Natural selection: The process by which nature selects and consolidate those organisms which are more suitably adapted and possesses favorable variations. It is only one of several mechanisms that can cause evolution. During natural selection frequency of a gene having a survival advantage increases which in turn results in evolution of population. Remember that in small populations even accidents can change the frequency of some which do not have any survival value.

Genetic drift: Change in the frequency of some gene caused by chance factor alone is called Genetic drift. Genetic drift creates diversity without any adaptations. Genetic drift takes place due to (a) Severe changes in the DNA (b) Change in number of chromosomes

Gene flow: occurs between population that are partly but not completely separated .Interbreeding between local breed and migrant breed creates Variation in Local population by Gene flow.

Mutation: The permanent alteration of the sequence of the gene of an organism either due to mistakes when the DNA is copied or as the result of environmental factors

SPECIATION: Speciation is the origin of new species from the existing ones. Speciation takes place when variation is combined with geographical isolation.

Species : A group of similar individuals which can interbreed among themselves to produce fertile off springs.

Geographical isolation of a population caused by various types of barriers such as rivers, mountain and seas. It leads to the reproductive isolation due to which there is no flow of genes between separated groups of population. This is

Evolution and classification

Both evolution and classification are interlinked.

1. Classification of species is reflection of their evolutionary relationship.
2. The more characteristic two species have in common the more closely they are related.
3. The more closely they are related, the more recently they have a common ancestor.
4. Similarities among organisms allow us to group them together and to study their characteristic

TRACING EVOLUTIONARY RELATIONSHIPS

- Different organisms have similar characteristics because they are either inherited from a common ancestor or they perform a common function.
- Homologous organs are organs have same basic structure modified to perform different function in different organisms. E.g. Limbs of amphibians, reptiles, birds and mammals have same basic structure but they are modified to perform different functions. Forelimb of Horse (Running) ; Wings of bat (flying) ;Paw of a cat (walk/scratch/attack)
- Homologous characteristics also help us to identify an evolutionary relationship between apparently different species. Mammals are related to amphibians, reptiles and birds at some stage of evolution because of similarity in basic structure of their limbs.
- Analogous organs are organs which look similar because they perform same function, but they do not have same origin and basic structure. E.g. Wings of butterfly, wings of a bat and wings of birds look similar because they perform same function of flying but they do not have same origin and basic structure.

Wings of bat ® elongated fingers with skin folds and Wings of bird ® Feathery covering along the arm

FOSSILS PROVIDE EVIDENCE OF EVOLUTION

- Fossils provide us direct evidence of the types of organisms (Plants, animals and microbes) that existed at a particular geological time and help us to reconstruct the evolutionary process.
- Fossils are preserved remains or impressions of organisms that lived in the past.
- Some fossils provide us links between existing groups of plants and animals for example feather imprints preserved along with dinosaur's bones indicate that birds have evolved from reptiles. Archaeopteryx is connecting link between the reptiles and birds. It looks like birds but has many other features like reptiles.
- Age of fossils can be found out by estimation of the depth of the layer of rocks in which it is found and by the carbon-dating method

Evolution by stages: Evolution takes place in stages ie bit by bit over generations.

I. Fitness advantage

↳ Evolution of Eyes

↳ Evolution of complex organs is not sudden it occurs due to minor changes in DNA, however takes place bit by bit over generations.

Flat worm has **rudimentary eyes** ; Insects have **compound eyes**; Humans have **binocular eyes**

II. Functional Advantage

↳ Evolutions of feathers provide insulation in cold weather but later they might become useful for flight. Example : Dinosaurs had feathers, but could not fly using feathers. Birds seem to have later adapted the feathers to flight.

III. Artificial Selection: Humans have been a powerful agent in modifying wild species to suit their own requirement through out ages by using artificial selection.

For example :

- (i) Wild cabbage the dissimilar looking structures have evolved from a common ancestral design.
- (ii) Wheat (many varieties obtained due to artificial selection)

IV. Molecular Phylogeny:

↳ It is based on the idea that changes in DNA during reproduction are the basic events in evolution

↳ Organisms which are more distantly related will accumulate greater differences in their DNA

Crop plant produced by selective breeding

Human Evolution

Tools to Study Human Evolutionary Relationship are

(I)Excavating (ii) Time dating (iii) Fossils (iv) Determining DNA Sequences

Although there is great diversity of human forms all over the world get all **humans are a single species.**

GENETIC FOOTPRINTS OF HUMANS: Hundreds/thousands of years ago Earliest members arose in Africa

- ↳ They didn't go in a single line
- ↳ They went forward and backward
- ↳ moved in and out of Africa
- ↳ Sometimes came back to mix with each other.