HEREDITY

Introduction

- All living organisms give rise to new individuals (offspring) by a process of reproduction.
- The offspring produced as a result is similar to their parent but not identical i.e. they also show some differences.
- The mechanism of transmission of character is called Heredity or Inheritance while the differences seen among individuals is called variations

Accumulation of Variation during Reproduction

Variation

- The differences in the characters (or traits) among the parents and their offspring, the offspring or the individuals of same specs is called as variation.
- Some amount of variation is produced during asexual reproduction while the number of successful variations are maximized by the process of Sexual Reproduction.

Importance of Variation

- Depending on the nature of variation, different individuals of a species can have different advantages. E.g; Bacteria that can withstand heat will survive better in a heat wave.

- Main advantage of variation to a species is that it increases the chances of its survival in a changing environment.

Heredity

- The transmission of characters from parents to offspring is called heredity.

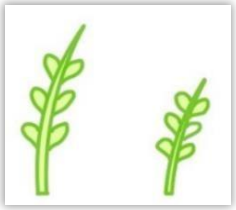
Traits

Inherited Traits	Acquired Traits
- Traits that are received from parents are called Inherited Traits.	- Traits that are obtained during lifetime are called acquired traits.
- These can be passed on to the next generation.	- They cant be passed on to the next generation.
- They occur due to change in DNA.	- No change in DNA is involved.
- Inherited traits lead to evolution.	- They don't result in evolution.
- E.g, - Nose Shape, Hair Colour	- E.g, - Learning a new language, playing tennis etc.

Rule of Inheritance of Traits -

Gregor Mendel

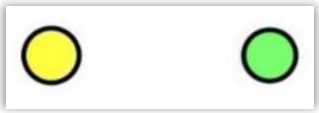
- Considered as the "Father of Genetics".
- He was the first Scientist to make a systematic study of patterns of inheritance.
- He used pea plants Pisum sativum for his experiments.



Tall Short

Plant Height

Round
Wrinkled



Yellow Green

Seed Color

Important Terms

Factor/Gene - It is a segment of DNA that determines a particular character. Genes are represented by letters. A capital letter shows that the gene is dominant, and a small one that it is recessive.

Alleles - Alternate forms of a gene. E.g, Pea plant height - Tall(T) & Short (t) Allele

Dominant Allele - A dominant allele expresses itself in the presence or absence of recessive allele. Example - Allele for tallness (T).

Recessive Allele - A recessive allele is able to express itself only in the absence of a dominant allele. Example – Allele for shortness (t)

Genotype – It is the genetic composition of an individual. Example TT, Tt or tt

Phenotype – It is the characteristic which is visible in an organism. Example Tall or Short plant height.

Homozygous – An individual having identical alleles. Example TT or tt

Heterozygous – An individual having contrasting alleles. Example Tt

Monohybrid Cross

- In monohybrid cross, we consider one pair of contrasting trait.

1. Mendel selected true breeding tall pea plant (TT) and crossed it with Short (tt) plant.
2. The plants formed as a result of the cross represented first filial or F_1 generation.
3. All the F_1 plants obtained were tall.
4. Mendel self-pollinated the F_1 plants (selfing) and observed that plants in the F_2 generation were 75% tall and 25% Short i.e. phenotypic ratio 3:1

Parental Generation

Tall X Short

TT tt

Gametes

T T t t

F_1 Generation

Tt Tt Tt Tt

Phenotype – All tall

Genotype - Tt

Selfing F_1 Generation

Tall X Tall

Tt Tt

Gametes

T t T t

F_2 Generation

	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Short

Phenotypic Ratio - 3 Tall : 1 Short

3:1

Genotypic Ratio - 1 TT : 2 Tt : 1 tt

1:2:1

Dihybrid Cross

- In Dihybrid cross, We consider two pairs of contrasting traits. (Seed shape and Seed Colour)

Experiment

1) Mendel crossed pea plants bearing Round & Yellow seeds (Rryy) with wrinkled green (rryy).

2) He obtained F1 generation with all pea plants having Round and Yellow seeds (RrYy).

3) On Selfing F1 offspring, Mendel obtained 4 different types of progeny in F2 generation: Round & Yellow, Round and Green, Wrinkled & green and Wrinkled green in the ratio 9:3:3:1

Parental Generation Round & Yellow X Wrinkled & Green

RRYY rryy

Gametes RY Ry ry ry

F_1 Generation

	ry	ry
RY	RrYy	RrYy
RY	RrYy	RrYy

Phenotype – Round & Yellow

Selfing F_1 Generation RrYy X RrYy

Gametes RY Ry rY ry RY Ry rY ry

F_2 Generation

	RY	Ry	rY	ry
RY	RRYY Round Yellow	RRYy Round Yellow	RrYY Round Yellow	RrYy Round Yellow
Ry	RRYy Round	RRyy Round	RrYy Round Yellow	Rryy Round Green
rY	RrYY Round Yellow	RrYy Round Yellow	rrYY Wrinkled Yellow	rrYy Wrinkled Yellow
ry	RrYy Round Yellow	Rryy Round Green	rrYy Wrinkled Yellow	rryy Wrinkled Green

Round & Yellow	9
Round & Green	3
Wrinkled & Yellow	3
Wrinkled & Green	1

Phenotype Ratio- 9:3:3:1

Mendel's Laws

Law of Dominance -

Mendel's Law of dominance states that in a heterozygote, one trait will conceal the presence of another trait.

E.g. Tall (TT) X Short (tt)

Tall (Tt)

Law of Segregation -

When an organism makes gametes, each gamete receives just one gene copy, which is randomly. This is known as the law of Segregation.

E.g. - Tall (Tt)

Gamete T t

Law of Independent Assortment -

Mendel's law of independent assortment that the alleles of two more (or more) different genes get sorted into gametes independently of one another.

E.g. - In a dihybrid cross, the shape of seed doesn't depend on the colour of seed.

How do traits get expressed?

- Cellular DNA is the information source for making proteins in the cell.

- A part of DNA that provides information for one particular protein is called a gene for that protein.

- Example
  Height of a plant depends upon growth hormone which in turn is controlled by the gene. If the gene is efficient and more growth hormone is s ecreted, the plant will grow tall. If the gene gets altered and less hormone is secreted, then the plant will remain short. Thus, genes control characteristics or traits.

Sex Determination

- The process by which sex of a new born individual is determined is called Sex Determination.

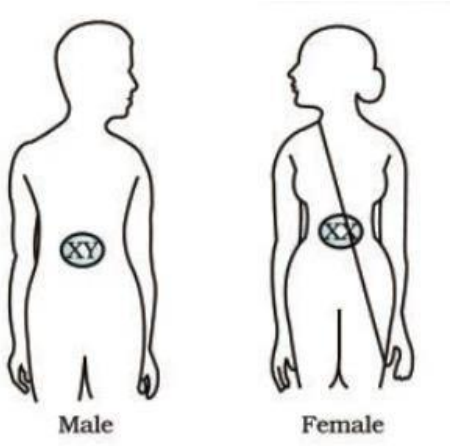
Factors determination Sex Determination

Non - Genetically	Genetically
- Environmental cues : In turtles, Alligators, Crocodile, temperature at which fertilized eggs are kept determines sex. - In Snails, individuals can change sex.	- In humans, genes inherited from parents decide the sex of the offspring.

Sex determination in humans

- In humans, sex of the child depends on the father or we can say, the male gamete that fuses with the female gamete.

- Humans possess 23 pairs of chromosomes out of which one pair comprises the sex chromosomes.
  (XX in females - perfect pair)
  (XY in males - Mis-matched pair)



- At the time of fertilization, the egg cell fuses with sperm resulting in the formation of Zygote.

- During fertilization,

  i) If the egg cell carrying X chromosome fuses with sperm carrying X chromosome, the offspring would be a girl.

  ii) If the egg cell carrying X chromosome fuses w ith sperm carrying Y chromosome, the offspring would be a boy.

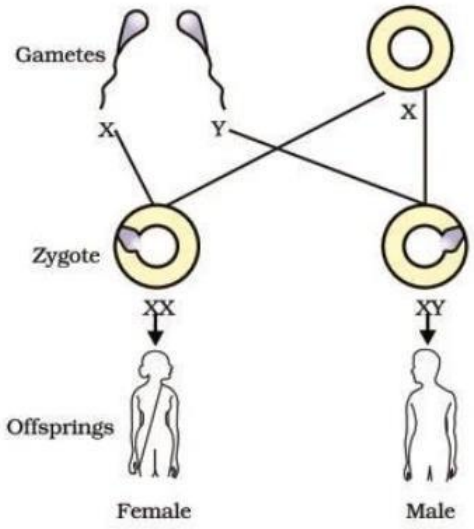


Figure 9.6
Sex determination in human beings