Genetics

This is a branch of biology that tries to explain the cause of similarities and difference between parents and their off springs. The first quantitative experiments on heredity of any significance were carried out in the middle of the nineteenth century by Gregor Mendel on the garden pea

Terminologies.

1. **Agene**
   This is the basic unit of hereditary and occupies a discrete position on the chromosomes. The gene control the production of enzyme which in turn determine the process that go on in a cell and eventually in the organ and the entire organism. In sexually reproducing organism, genes occur in pairs, where each member of a pair is contributed by the female and male parents.

2. **Alleles (Allelomorphs)**
   This is one of the pair of a gene that occupy the same locus (position). Alleles are genes that are responsible for the production of contrasting characteristics such as tallness and shortness in plants and animals.

3. **Genotype**
   This is the genetical constitution of an organism i.e. the particular set alleles, leading to observable characteristics

4. Phenotype
   This is the physical characteristic of an organism determined by the genotype and the environment.

Monohybrid inheritance

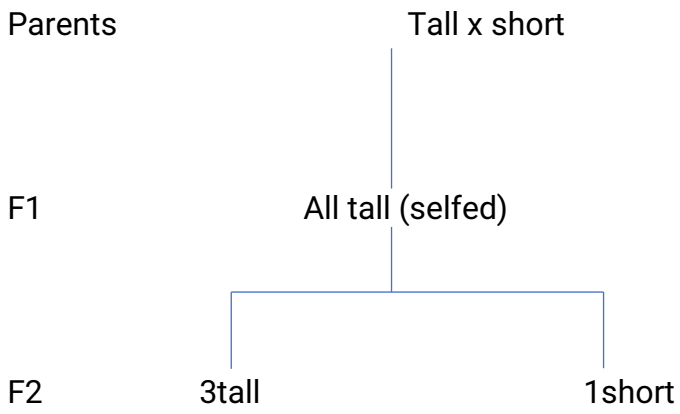
This an inheritance that deals with a single pair of contrasting characteristics such Tallness and shortness when concerned with height of peas.

In his investigation of a single pair of contrasting characteristics, Mendel observed that,

in the first filial (F1) generation one of the characteristic never appeared only to appear in the second filial (F2) generation in small proportion compared to the one that appeared in the first filial (F1) generation.

For example; he crossed peas with long internode, with peas of short internode. He observed that in the F1 generation, all plants had tall internodes. When selfted to produce F2, the peas with short internodes then appeared in small proportions.

The result of these crosses can be illustrated as follows,

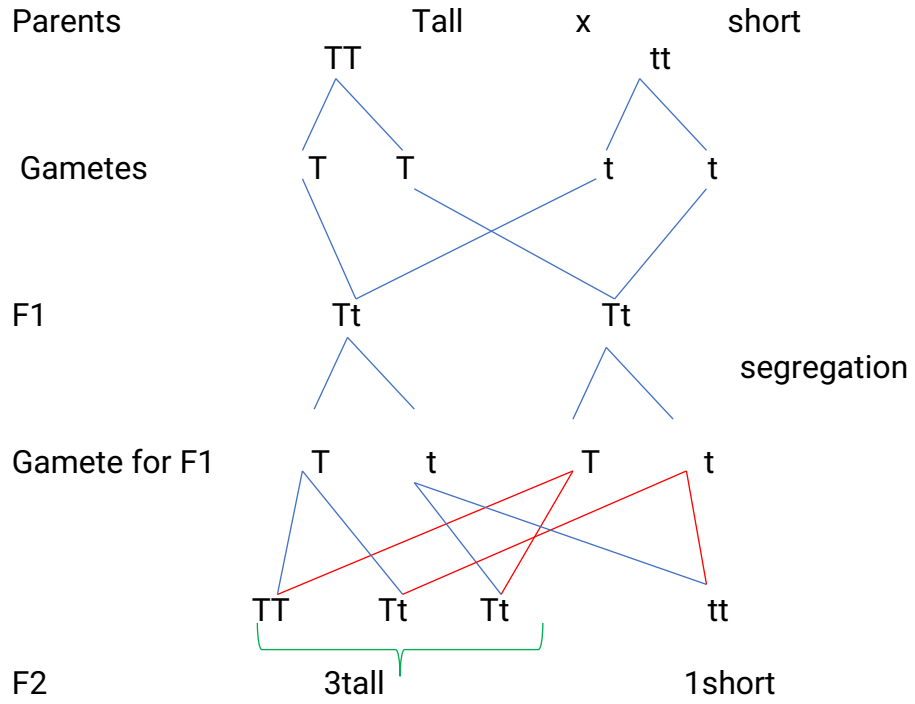


It was concluded from the results that inheritance is a process in which discrete structure or particle (genes) which may or may not show themselves in the outward appearance of the organism are transmitted from parent to off spring. The evidence of existence of inheritable particles is got from the observation that they can be combined in one generation but separate in the next, as in witness by the recovery of the short form in F2 generation despite it's absence in the F1 generation,

The characteristic that show in F1 generation is described as being **dominant** and while that which masked F1 generation is said to be **recessive.**

Genes and their transmission

Gene normally occur in pair each of which is obtained from each parent. The cross of a tall plant and short plant is shown diagrammatically by the two methods below. The allele for tallness (dominant) character is represented by a capital letter T while the allele s for shortness (recessive character) is represented by small letter t. It is assumed that each parent plant contains a pair of identical alleles; TT in case of tall plant and tt in case of short plant.



Pannet square to show fusion of F1 gametes

	½ T	½ t
½ T	¼ TT	¼ Tt
½ t	¼ Tt	¼ tt

F_2

In terms of probability there are 3 chances out of four for a tall plant to appear in F2 generation; and one chance of four for a short plant to appear.

Mendel's first law of segregation states that an organism's characteristics are controlled by two genes (alleles) and only one can be carried by in a gamete.

This achieved by Synapsis of homologues (prophase – I) and separation of homologous pairs (anaphase I) cause segregation of alleles. Assuming a diploid individual has two alleles for a particular gene, carried on two separate chromosomes (maternal and paternal), the allele on maternal chromosome segregates / separates from the allele on paternal chromosome (Anaphase – I) so that each allele is passed on to different gamete.

Mendel's second law of Independent Assortment: During the formation of gametes, alleles of gene segregation /separate independently without affecting/being affected by

alleles of any other gene on a separate chromosome.
HOW THE LAW OF INDEPENDENT ASSORTMENT OPERATES Crossing over and the random separation of chromosomes cause independent assortment. Assuming an organism has 23 pairs of homologous chromosomes, the maternal and paternal chromosomes of pair – 1 separate randomly during anaphase – I with respect to maternal and paternal chromosomes of pair – 2 or all the other pairs. There is no fixed chance that all the paternal or maternal chromosomes (alleles) will be passed to one gamete. This allows (1) independent assortment of genes (2) for gametes, and thus offspring, to be much more genetically variable.

Breeding True
Phenotypically TT and Tt are the same i.e. Tall. When an organism contains identical alleles like TT and tt is said to be **homozygous** and with dissimilar allele is **heterozygous**. Since the homozygous (TT) and heterozygous (Tt) peas are both tall there is no way we can distinguish between the two genotypes from their external appearance.

One way of establishing whether a given tall plant is homozygous or heterozygous is to self-pollinate it. If the resultant off springs are all tall, we can conclude that the parent has the genotype TT. If, however, we get a mixture of Tall and short plants; the parent plant must have the genotype Tt

The point is that when an organism which is homozygous at a particular locus is self-fertilized it produce off spring all of which are identical with parent. Exactly the same results occur if 0rganismis crossed with another organism that is homozygous is said to breed true, The organism is said to belong to a pure line for the characteristics in question.

Test crosses
In the last section we saw that one way of establishment whether an organism is homozygous dominant or heterozygous at a particular locus is to self-fertilize it. The other method is cross the individual whose genotype is un know with an individual that is **homozygous recessive** at the in question. When all of the off spring have a dominant characteristic then the unknown genotype is homozygous and otherwise, it is heterozygous. Because this experiment is carried out in order to determine the organisms genotype, it is called a **test cross.**

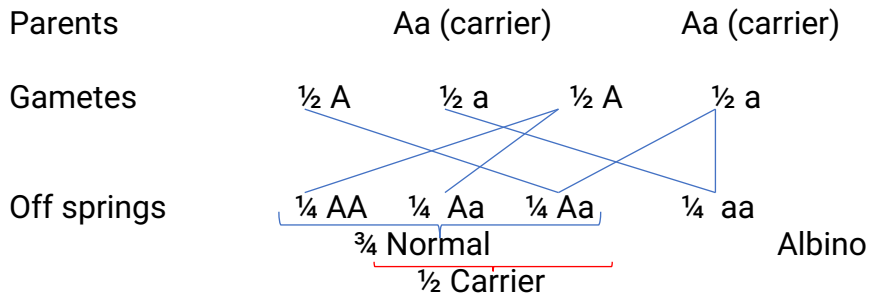
Back cross
This is across between hybrids in F1 generation with one of the parents or an organism genetically equivalent to the parents. Back crossing is mainly aimed at increasing the genetic contribution of one particular parent to the off spring.

Monohybrid inheritance human
A number of human condition are known to be associated with a single pair of alleles which are inherited in Mendelian fashion.

1. **Albinism** is a condition in which the skin is pink and fails to tan, the hair is white and

Irish pink. The reason is that albinos are unable to make the black pigment melanin because they lack an enzyme required for its synthesis.

The allele for albinisms recessive [a] and so only exert it's effect in the homozygous state [aa]. The allele for melanin production [A] is dominant. Suppose a couple each with normal pigmentation have an albino child. For this to happen the child must have [aa]. Therefore, unless for rare mutation, the parents must both heterozygous [Aa] so each produces A and a gametes in about equal number. Therefore, randomly to produce three type of genotype AA, Aa, aa.



2. Congenital disease such as cystic fibrosis in which the connective tissue develops in glands of the body.

3. Chondrodystrophic dwarfs are characterized by shortened and deformed legs and arms. It is cause by a dominant gene and hence affect in homozygous and heterozygous state

Dihybrid inheritance

This is the inheritance of 2 pairs of characteristics. It's characterized by a phenomenon called independent assortment i.e. each of the alleles of one gene may combine independently with each of the alleles of another gene.
For instance, when a pure breed tall pea plant possessing purple flowers was crossed with a short plant possessing white flowers and the F1 generation plants were tall and had purple flowers.
These were self-pollinated, in F2 generation there were four different phenotypes observed; tall plants with purple flowers, tall plants with white flowers, short plants with purple flowers and short plant with white flowers.

TTCC x ttcc
Tall, Purple dwarf, white

F1 TtCc (Tall and ourple

F1 selfed (TtCc X TtCc)

5 Possible gametes could be: TC, Tc. tC and tc

	TC	Tc	tC	tc
TC	TTCC	TTCc	TtCC	TtCc
Tc	TTCc	TTcc	TtCc	Ttcc
tC	TtCC	TtCc	ttCC	ttCc
tc	TtCc	Ttcc	ttCc	ttcc

Phenotypic ratio is
Tall and colored 9
Tall and white 3
Short and colored 3

Modification of the ratio 9: 3: 3: 1. In F2 generation in hybrid inheritance.

Epistasis
This a condition where one gene on a different chromosome interacts or modifies or masks the action of another gene.

Example;
1. Gene T on chromosome 9 of gives a pigment that is brown and gene C on chromosome 7 gives the same pigment but when gene T and C are both present they give another pigment purple.

   Assuming that Brown dominant to purple what would be the phenotypic ratio of the off spring.

A – B	purple	9	
A – bb	brown	3	Phenotypic ratio: 9: 6: 1
aa-B	brown	3	
aabb	colorless	1	

2. Gene T on chromosome 2 given an eyeless drosophila whereas gene C on chromosome 4 give a brown eyed drosophila. What would be the phenotypic.

A-B	eyeless		9
A-bb	eyeless		3
aa-B	Brown	3	
aa-bb	colorless or white-		1

Eyeless	brown	another color
12	:3	:1

3. Dominant complementary genes
   This is where gene T and C are necessary for the color to be expressed.
   A-B 9 colored
   A-bb 3 colorless

aa-B 3 colorless
aabb- 1coluorless

Ratio colored 9:
colorless; 7

4. Recessive complementary gene; is where the recessive alleles must be together before a pigment is formed
   Ratio 15: 1

5. Gene G in a mouse give a grey coat while gene B in mice give a black coat. But when both gene occur G is epistatic to B find the phenotypic ratio.
   G-B 9 grey
   G-bb 3grey
   Ggbb 1 any other time

   Ratio Grey 12
   black 3
   colorless 1

6. In maize a gene C is necessary for coloration of the grain while gene P gives purple color to the grain and its recessive gives a red color. Find the phenotypic ratio

   C-P 9 purple
   C-pp 3 red
   Cc-P 3colourless
   ccpp 1 red .

   Phenotypic ratio
   purple : red :colorless
   9 : 4 : 3

Gene linkage & chromosomes

Gene linkage is the existence of many genes as a unit and not as separate individuals. Linked gene occur on the same chromosome and will always segregate together during meiosis and gamete formation.

Dihybrid inheritance and linked genes

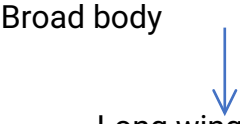
In Drosophila melanogaster [fruit fly] Broad body B is dominant to narrow body [b] and normal sized wing A is dominant to vestigial wing a.

When homozygous dominant drosophila for the 2 characters was crossed with a homozygous recessive for the two characters above mentioned, all the F1 generate drosophila were grey bodied with normal wings.

When two of F1 generation flies were mate the F2 generation failed to yield 9: 3: 3: 1 ratio we expected. Instead about ¾ of the off spring had long wings and broad body and nearly the remaining flies about ¼ of the total had vestigial with and narrow body.

Thus

Parents long wing with Broad body x Vestigial wing narrow body

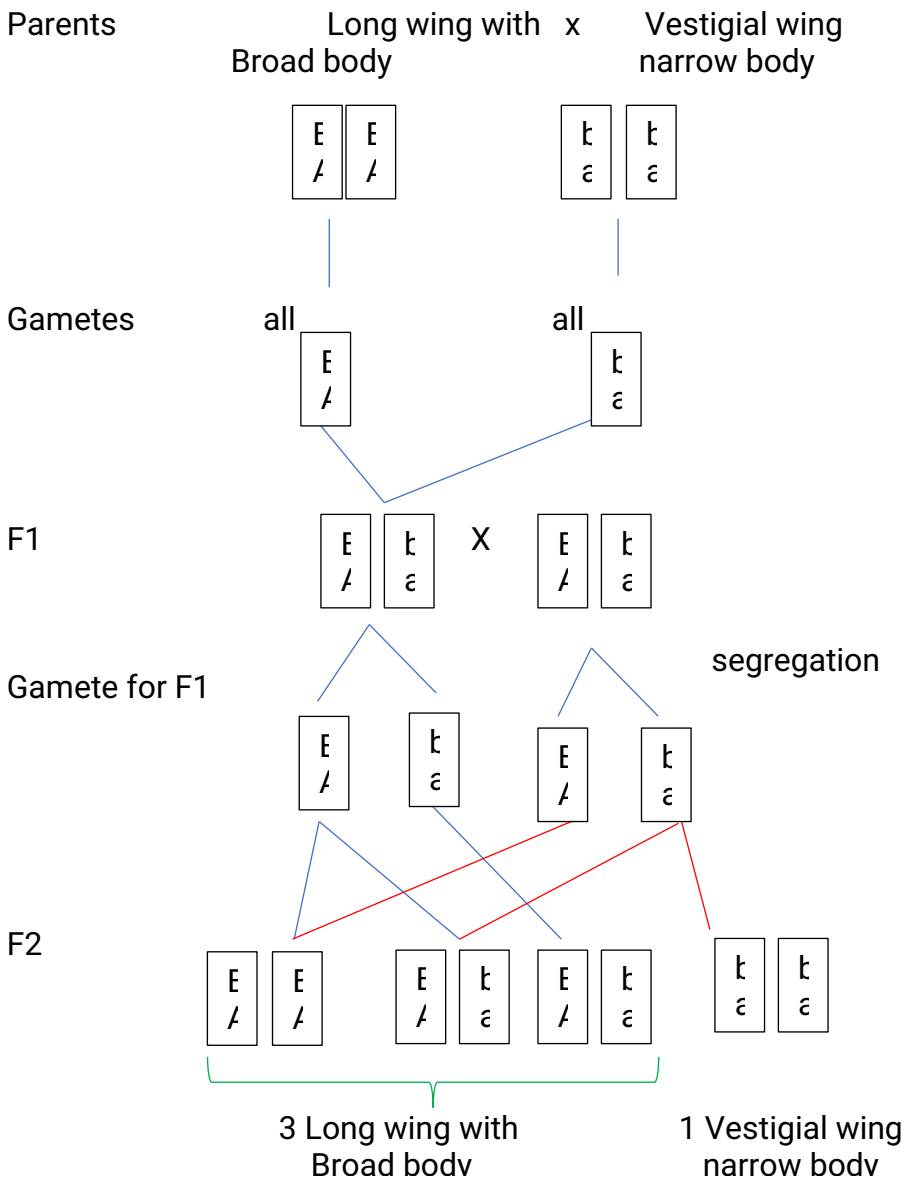


F1 Long wing
Broad body (interbreed)

Long wing
Broad abdomen
3

Vestigial wing
narrow abdomen
1

The explanation is that the gene determining the length of the wings and the width of the abdomen are locate on the same chromosome. This result in their being transmitted together. Such gene are said to be **linked** and the general phenomenon is known as gene linkage

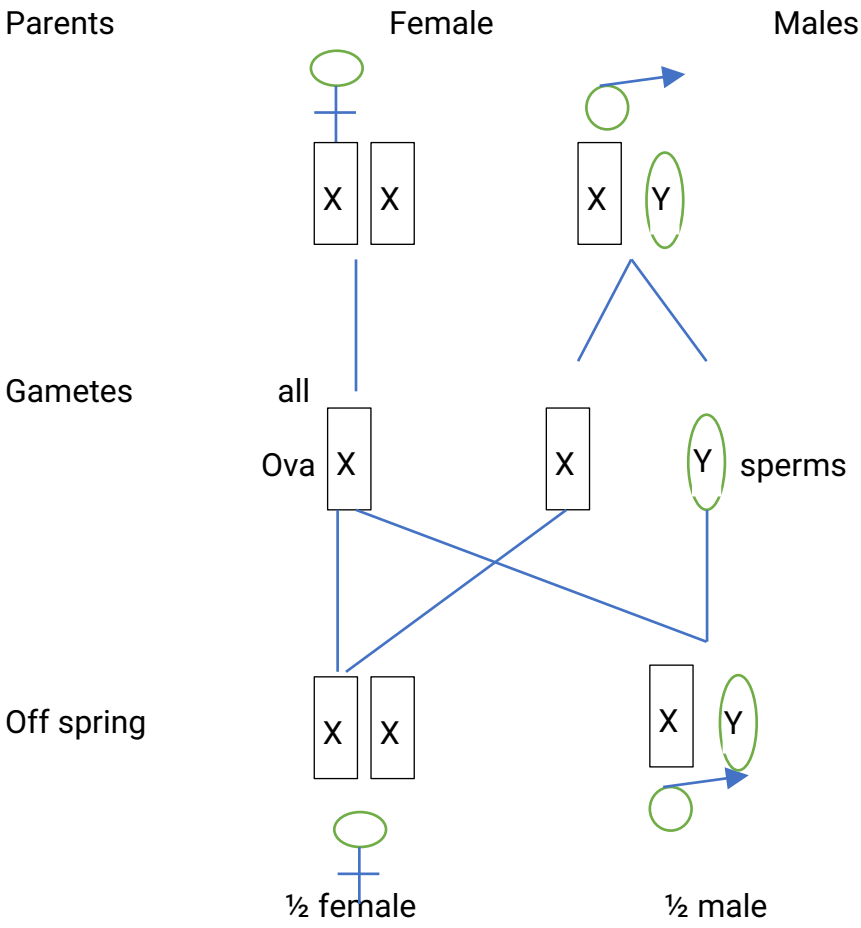


Sex determination.

The medium size chromosome in drosophila melanogaster determine the individual's sex for which reason they are called the **sex chromosome**. In the female the two sex-chromosome, both rod shaped in appearance, are identical and are known as **X-chromosomes**. In the male, however the two sex-chromosome differ from each other one is rod- shaped X-chromosome, the other is hook- shaped and is called **Y-chromosome**.

The sex chromosomes are exception to the rule that homologous chromosomes are identical in appearance. Being different they are described as **heterosomes**; All the other chromosomes, which are identical in appearance, are called **autosomes**.

Despite this difference, the sex chromosomes are transmitted in a normal mendelian manner as shown below.



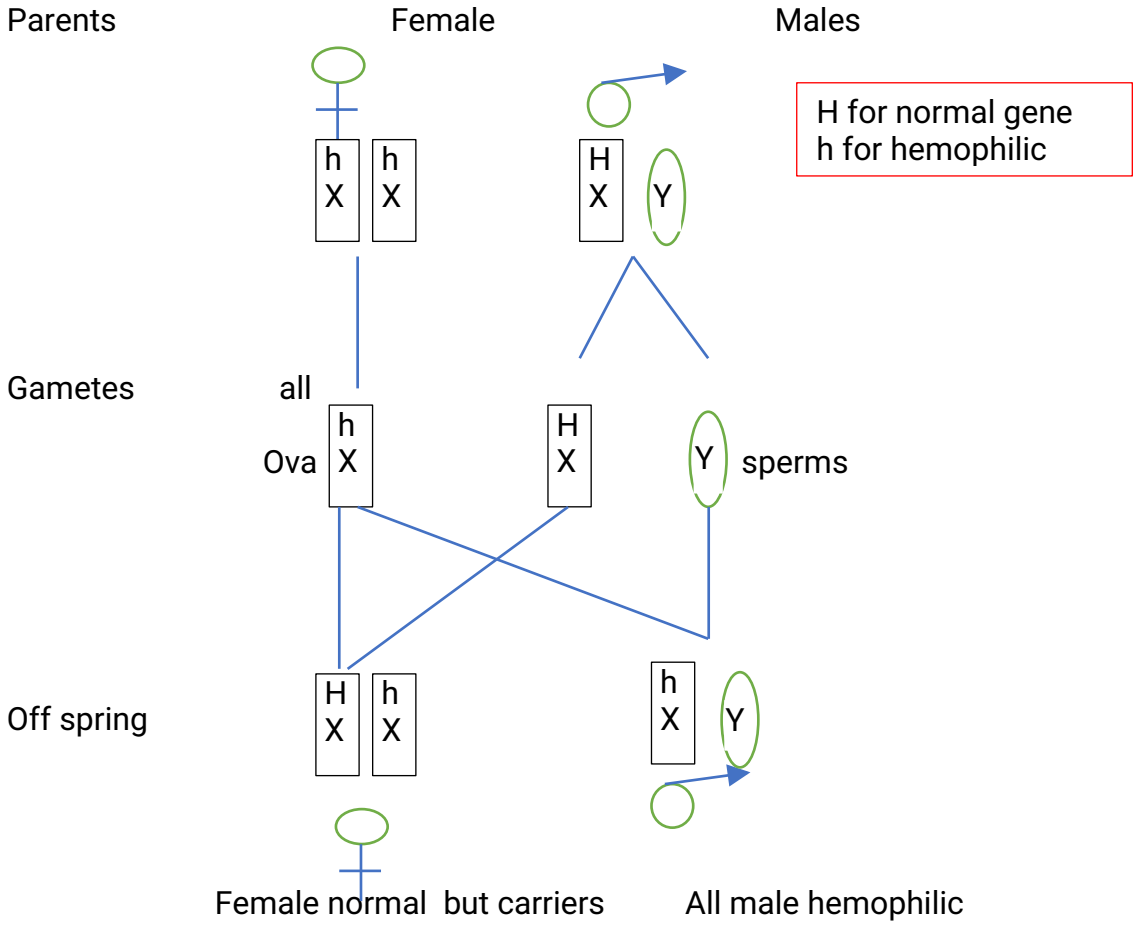
Generally, a female produces only one kind of gamete as the chromosomes are concerned; all her eggs contain an X chromosome. For this reason, in human and many other species, the female is said to be homogametic (same gametes). A male on the other produces two kinds of gametes as far as chromosome are concerned: half of the sperm contain an Y chromosome, the other half a Y. The male is therefore heterogametic (different gametes) on fusing randomly, approximately half the zygotes receive two X chromosome and develop into female, the rest receive Y chromosomes and give rise to males. In some insects, females are XX and male XO

Sex linkage

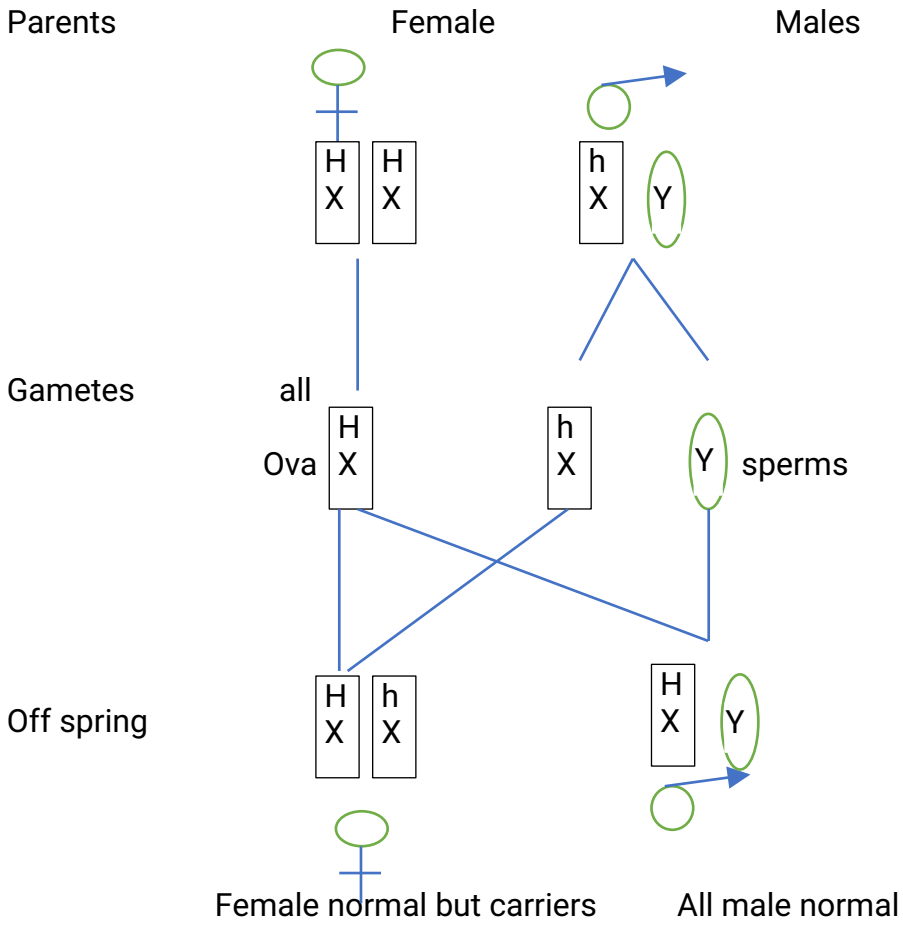
Sex linked characters are those whose genes that are carried of sex chromosomes usually X-chromosomes for example red-green color blindness, hemophilia and eye color in drosophila

Transmission
Hemophilia can be represented as follow

(a) Female hemophilic and normal man



(b) Female normal X male hemophilic



THE Y-CHROMOSOME.
1.If a sex-linked trait is associated exclusively with Y-chromosome, it is expected to show up exclusively in males. In general, most Y-chromosome are empty. However, the 'porcupine' man is said to have transmitted hard and spine skin exclusively to his male children.

2.The hair pinna or ear is a characteristic common in India and it is transmitted to male off spring only.

Sex limited characters
These are characters that that show up exclusively in one sex only e.g. ovary in female

Crossing over.
In maize smooth kennels are dominant to shrunken ones and colored kennels are dominant to colorless. The gene for texture and color are linked. When a maize plant homozygous for kennel which are Smooth and colored is crossed with that with shrunken and colorless kennels; F1 generation yields all colored smooth kennel. However, F2 generation contains small proportions of maize with smooth and colorless or colored and shrunken kennels as opposed to what is expected,

These small proportions are explained by cross over; During prophase 1in meiosis, homologous chromosomes become intertwined and at chiasmata chromatids break and rejoin. The result is that portions of the chromatids belonging to the two homologous chromosomes change places taking their alleles with them, So the chiasmata result in crossing over.

Crossing over value

$$= \frac{\text{numbe of organisms with small proportions of echanged characer}}{\text{total numbe r of individuals}}$$

Example

Multiple alleles

A phenotypic characteristic is controlled by a pair of alleles occurring at specific locus. In multiple alleles however, more than two alleles are responsible for the same phenotype but one of the two can occupy the position of the pair of locus on homologous chromosome at a time

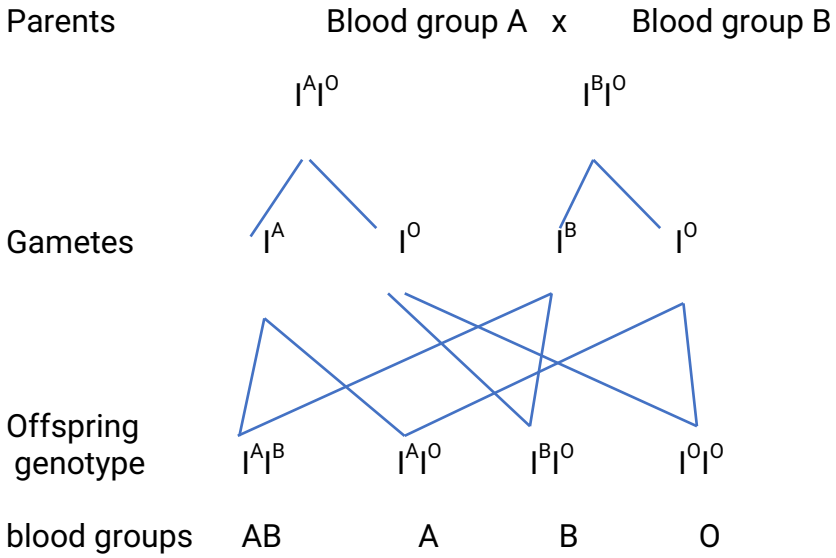
An example of such multiple allele is provided by the alleles controlling the ABO blood group system in humans. The ABO system is controlled by three alleles generally referred to as I^A, I^B, and I^O.

The I^A allele is responsible for production of type A antigens in the person's red blood cells, and the I^B allele for type B antigen. The I^0 produces neither antigen. As only type two of the three alleles can be present at any one time, an individual may possess any of the following six genotype I^AI^A, I^AI^0, I^BI^B, I^BI^O, I^AI^B, and I^OI^O.

I^A and I^B show equal dominance with respect to one another [i.e. they are codominant] but each is dominant to I^O thus;

- A person belongs to blood group A has genotype I^AI^A or I^AI^0
- A person belongs to blood group B has genotype I^BI^B or I^BI^O
- A person belong to blood group AB has genotype I^AI^B
- A person belongs to blood group O has genotype I^OI^O

The fact that there more than two alleles responsible for determining the blood group makes no difference to their transmission, which take place in a normal mendelian fashion. Thus, a child whose parents are both blood group O must be group O. However, a parent with blood A or B, the child may have any of the blood group has shown below.



Lethal alleles

The color inheritance in mice.
Yellow furs are dominant to grey. If a pair or yellow mice are mate, the results are always the same i.e. 2/3 of off spring being yellow and 1/3 grey. They occur in ratio of 2: 1 instead of 3: 1. This because homozygous individual for yellow die off before birth. i.e. genotype YY present a lethal combination of genes. This has to be confirmed
(i) the present or dead embryo in the uterus
(ii) the yellow mice do not breed true i.e., crossing yellow mice with yellow mice does not produce exclusively yellow mice.

Question.

	Objective type question	
1.	2015/1/10	Which one of the following representations of genotypes would produce only one type of gametes? A. TtHh B. TtHh C. TTHh D. tthh
2.	2015/1/23	A man with allele for normal color vision married a woman whose father was color blind. The probability of a couple getting a child with a defective allele is A. ¼

		B. ½ C. 1/3 D. ¾
3.	2015/1/32	A couple had children with a disorder that appeared only in sons. Which one of the following is true about this occurrence? The disorder is A. Sex linked and the mother is a currier B. Caused by multiple allele C. Sex linked and both parents are carrier D. Sex limited to males and the father is a carrier
4.	2014/1/20	When a tall red flowered plant was crossed with a short and white flowered plant, all the offspring were tall and red flowered. When F1 plants were selfed, the F2 plants' phenotypes were in the ration of 3:1. This occurrence suggests the occurrence of A. Epistasis B. Recombination C. Crossing over D. linkage
5.	2014/1/30	A man of blood group B married a woman of blood group AB. Which one of the following blood group types would not be of their child? A. AO B. BO C. AA D. BB
6.	2014/1/11	Sickle cell anemia is caused by a double recessive gene and sufferers usually die before maturity. This continued existence of the sickle cell allele among the human population demonstrates A. Drug resistance B. Heterozygous advantage C. In-breeding D. Genetic drift
7.	2014/1/26	Albinism in corn plant is due to double recessive gene which causes them to die before maturity. The trait however continues to appear in generation because A. Albina plant can develop chlorophyll when exposed to light B. Normal green plants may carry recessive alleles C. New varieties may be produced by crossing-over in albino plants D. Mutation may occur to change albino plant to green
8.	2014/1/38	An occurrence of phenotypic ratio of 3:1 in a dihybrid cross is an indication of A. Linkage B. Crossing of over of chromosome C. Failure of homologous chromosome to separate

		D. Dominance
9.	2001/11	In flowers, the heterozygous condition of the alleles for red petal [R] and white [W], are pink. Which one of the following proportions and color of petals is correct if a pink flowered plant is crossed with a red flowered plant A. 3red : 1 white B. 3 red : 1pink C. 1pink : 1 red D. 1 pink: 1 white
10	2001/1/33	Use the information to answer questions 10 and 11 In mice, yellow for [Y] is dominant over grey for [y] when two mice were mated, the off spring were in the ratio of 2 yellow :1 grey. From the results, which of the following were likely genotype of the parents? A. Both were homozygous dominant B. Both are heterozygous C. one was heterozygous and the other homozygous dominant D. Both were homozygous recessive
11		Which of the following best explains results? A. Double recessive allele for color is lethal B. Heterozygous condition for color is lethal C. For color could be sex link D. Double dominant allele for color is lethal.
12	2012/1/30	According to Mendel, all the following are correct except A. Each characteristic of an organism is controlled by a pair of alleles B. Each allele is transmitted from generation to generation in a discrete unit C. There are several varieties of allele of each from each parent D. Each organism inherits one allele of each pair, from each parent
13.	2008/1/25	Which one of the following statement is not correct about a test cross? A. It is carried out on an organism with dominant phenotype B. The offspring of the cross may all have dominant phenotype C. The organism of unknown genotype is crossed with a homologous dominant individual D. The offspring of the cross may have the ratio of 1 dominant phenotype: 1 recessive phenotype
14.	2007/1/8	Mendelian expected probabilities of genotypes in a cross occur when A. Small number of offspring are produced B. Migrations occur in the population

		C. Mutation arise D. Fertilization is random
15.	2007/1/28	Establishing the genotype of an organism by crossing it with a homologous recessive individual is carrying out a A. Test cross B. Dihybrid cross C. Back cross D. Monohybrid cross
16.	2007/1/29	In guinea pigs, the allele for rough coat (R) is dominant over one for smooth coat (r) and that for black coat (B) is dominant over one for white coat (b). the alleles for coat type and color are not linked. A cross between rough black pig and rough white one produced 28 rough black, 31 rough white, 11 smooth black and 10 smooth white. Which one of the following could be the genotype of the parent? A. RrBb xRrbb B. RRBB x RRbb C. RRBb x Rrbb D. RrBB x Rrbb
17.	2006/1/15	Which one of the following is true about sex-linked characters in human? A. Female never suffers from the trait B. Father do not pass on the character to their son C. Females are either normal or carriers D. Male are either carriers or sufferers
18.	2006/1/18	Which of the following cannot be a parent of a child of blood group O? A. Man, of blood group A and woman of blood group B B. Both man and woman of blood group A C. Both man and woman of blood group B D. Man of blood group AB and woman of blood group O
19.	2005/1/32	A rhesus positive fetus whose mother is rhesus negative may not be born alive because the A. Mothers body produces antigens against fetal antibodies B. Fetus lack antibodies against the mothers' antigens C. Mother's body produces antibodies against the fetal antigens D. Mother's red blood cells mix with the fetal blood
20.	2005/1/35	Which one of the following is true of linked characteristics? They A. Are always transmitted as a single block B. Are allelic to each other C. Occur on non-homologous chromosomes D. Can be transmitted independently
21.	2004/1/30	Assuming than in humans, allele for the length and color of hair are linked and the ones for long and brown hair are dominant over those for short and dark hair. A child with long and dark hair from a mother who is homozygous for long and brown hair and a

		father with short and dark hair would be due to A. Mutation B. Crossing over C. Recombination D. Closeness of the alleles on the chromosome
22.	2003/1/10	Which one of the following hereditary characteristics is known to be sex linked? A. Hemophilia B. Baldness C. Albinism D. Color blindness
23.	2003/1/18	In a plant species, the allele for tallness (T) and blue flower (B) is dominant to that for shortness (t) and white flowers (b). A tall plant with blue flowers was crossed with sort plants with white flowers. The results obtained are: 1tallblue: 1tallwhite: 1shortblue: 1short white The genotype of the blue flowered plant was A. TtBb B. ttBB C. TTBB D. TtBB
24.	2002/1/3	Which one of the following is caused by a defect on a recessive sex linked allele? A. Albinism B. Color blindness C. Sickle cell D. ABO blood group sysytem
25.	2001/1/11	In flower, the heterozygous condition of allele for red petal (R) and white petal (W), is pink. Which of the following proportions and color of petals is correct if a pink plant is crossed with a red flowered plant? A. 3 red: 1white B. 3 red: 1 pink C. 1pink:1 red D. 1pink: 1 white
26	2001/1/1/33	Use the information below to answer 26 and 27 In mice, yellow fur (Y) is dominant over grey fur (y), when two yellow mice were mated, the offspring were in ratio of 2 yellow to 1 grey From the results, which of the following were the likely genotype

<table>
<tr><td></td><td></td><td>of the parent
A. Both were homozygous dominant
B. Both were heterozygous
C. One was heterozygous and the other homozygous dominant
D. Both were homozygous recessive</td></tr>
<tr><td>27.</td><td>2001/1/34</td><td>Which of the following best explains the result?
A. Double recessive allele for color are lethal
B. Heterozygous condition for color is lethal
C. Fur color could be linked
D. Double dominant alleles for fur is lethal</td></tr>
<tr><td>28.</td><td>2000/1/38</td><td>What would be phenotypes of children born of a colorblind man and a normal worm?
A. All normal
B. Only girls normal
C. Only boy color blind
D. All color blind</td></tr>
<tr><td>29.</td><td>1997/1/28</td><td>A woman produces five children. The first two children were girls, followed a boy. The last two are girls. What is the probability that the sixth child will be a boy
A. ¼
B. ½
C. 1/6
D. 1/8</td></tr>
<tr><td>30.</td><td>1996/1/4</td><td>A boy has blood group A and his sister has blood group B. which combination of genotype cannot belong to their parents?
<table>
<tr><td></td><td>Mother</td><td>Father</td></tr>
<tr><td>A</td><td>I^AI^A</td><td>I^BI^O</td></tr>
<tr><td>B</td><td>I^AI^B</td><td>I^BI^B</td></tr>
<tr><td>C</td><td>I^OI^O</td><td>I^AI^B</td></tr>
<tr><td>D</td><td>I^BI^O</td><td>I^AI^O</td></tr>
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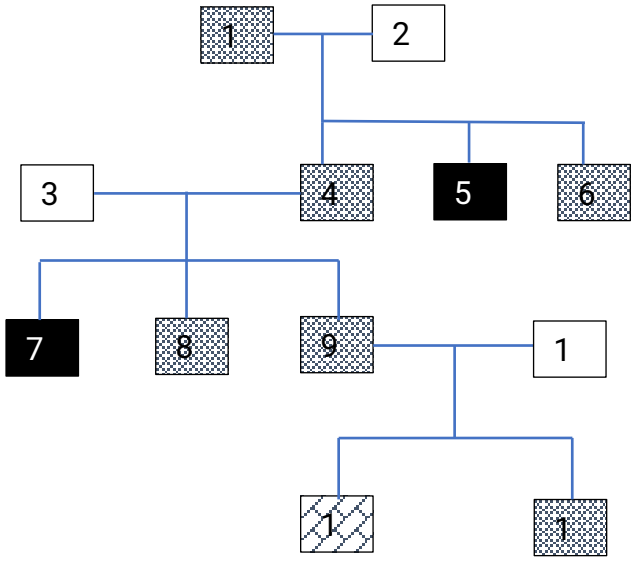
	Structured questions	
1.	2001/1/4 4	In poultry feather color is controlled by two sets of alleles, **W** [white] dominant over **w** [colored] and B [black] dominant over b [brown] A foul heterozygous for both alleles [WwBb] is white. a. Explain why the genetic constitution of WwBb is white? .... b. Work out to show the phenotypic ratio of crossing a white cock (WwBb), with brown hen.
		c. State the possible genotype of a black fowl ....

		. ...
2.	2000/1/46	The figure below shows how sickle cell anemia has affected a family line. Sickle cell anemia is a recessive genetic defect which is not sex linked individuals are numbered 1 2 3……..12  Key Affected Unaffected male Unaffected female Affected male (a) State the number of all individuals in the family line that are certain to be heterozygous for this gene (2marks) .....

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.....

(b) What is the probability that individual 6 is heterozygous for this gene? (show your working)

.....

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(c) The parasite which cause malaria digest hemoglobin in the red blood cells. Suggest two reasons an individual who is heterozygous for this gene may show resistance to malaria.

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(d) State the difference between individuals who have sickle cell anemia and those that have sickle cell trait. (3marks)

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3.	2012/1/4 3	(a) State four situations where Mendel's laws do not apply. (4marks) .... (b) In animal species, individual that are homologous for gene S or its alleles die. Another independent gene B in homozygous blocks this lethal effect, otherwise B has no effect on the organism. (i) Work out the expected phenotypic ratio of the viable offspring in a cross of individual of AaBB and AaBB genotype. (5marks) ....

		.... **(ii)** State the type of gene interaction in (b)(i) (1mark) ....
4.	2009/1/4 6	In an oil seed plant species, the allele for tallness is dominant over that for dwarfness. Meanwhile the allele for chlorophyll production and non-chlorophyll show incomplete dominance. Heterozygous plants are variegated. (a) Using appropriate symbols, construct a diagram of a cross between a tall plant with green leaves and a dwarf plant with variegated leaves, to show the genotype and phenotype of the offspring. (8marks) (b) Explain why 25% of the offspring of the cross in (a) would fail to survive (2marks) …… …….. …… ……

5.	2005/1/4 5	In drosophila, the gene for Broad abdomen and long wings are dominant over the genes for narrow abdomen and vestigial wings. Pure breeding strains of the double dominant variety were crossed with a double recessive variety and a test cross was carried out on F1 generation. (a) Using suitable symbols, work out the expected phenotypic ratio of the test cross of the F1generation. If the genes for abdomen and length of the wing are liked. (7marks) …… …….. …… …… …… …….. …… …… (b) It was however observed that when the test cross of F1 generation was carried out, the following results were obtained (3marks) Broad abdomen, long wings 380 Narrow abdomen, vestigial wings 396 Broad abdomen, vestigial wing 14 Narrow abdomen, long wing 10 Calculate the distance in units between the genes for abdomen width and wing length …… …….. …… ……
6.	1999/1/4	(a) Define the following terms: backcross, sex linked and sex

	4	limited characters …… …… …… …… …… …… …… …… (b) Which cells in in cereals are haploid, diploid and triploid? Haploid ..... Diploid ..... Triploid ..... (c) Describe one method by which polyploidy can be artificially induced …… …… …… …… …… …… (d) In sugarcane the gene for yellow midrib (y) and long internode (n) are recessive to green midrib (Y) and short internode (N), and are on the same chromosomes. A yellow sugar cane with long internodes was crossed with sugar cane heterozygous for yellow midrib and long internodes. The off spring were 256 YyNn, 38Yynn 272yynn, 34 yyNn Calculate the cross over value …… …… …… ……

		…… ……
7.	1998/1/4 5	(a) What is a sex-linked character? …… …… …… (b) (i) Why are sex linked traits most common in males among humans? …… …… …… …… …… …… (iii) Hemophilia is a condition caused by a recessive gene carried on X -chromosome. Determine the phenotype of the children from a carrier mother and normal father. …… …… …… …… …… ……
8.	1997/1/4 1	Mary a student with blood group A had a baby with blood group O. peter, a fellow student who she named as a responsible for the pregnancy, denied responsibility. The case was taken to court. The following facts were determined. Peter's mother was of blood group A, and father of blood group B. state whether the court will find peter guilty or innocent. Show how you reached your conclusion. ……

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9.	1997/1/4 4	(a) State Mendel's first law of inheritance and explain what it means …… …… …… (b) (i) state the stages of meiosis that illustrate this law …… …… …… (ii) explain what takes place in the stages you have named in (a)(ii) above …… …… …… (c) In human beings, brown eyes are usually dominant over blue eyes. Suppose a blue-eyed man marries a brown-eyed woman whose father was blue-eyed. What proportion of their children would predict that will have blue eyes? Show your working. …… …… …… ……

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	Paper2 Questions	
1	2005/2/4	Both hemophilia and color blindness are transmitted in the same way (a) What is the effect of each disease? (04marks) (b) Describe the transmission of the diseases (08marks) (c) Explain why there are more color-blind individuals than hemophilic among the population in spite of similar way of transmission (8marks)

Answer to objective type questions

1	D	11	D	21	B				
2	B	12	C	22	D				
3	A	13	C	23	A				
4	D	14	D	24	B				
5	C	15	A	25	C				
6	B	16	A	26	B				
7	B	17	B	27	D				
8	A	18	D	28	A				
9	C	19	C	29	B				
10	B	20	A	30	B				