Eye colour in drosophila and self incompatibility genes in plants are also the example of multiple allelism.

Lethal gene

Gene which cause death of individual in early stage when it comes in homozygous condition called lethal gene lethal maybe dominant or recessive both but mostly recessive for lethality.
Many of these genes which donot cause definite lethality are called semilethal .
IN semilethal gene death occurs in late stage.

1. Letthal gene was discovered by L.Cuenot in coat colour of mice
Yellow body colour (y) was dominant over normal brown colour (y)
Gene of yellow body colour is lethal.
So homozygous yellow mice are never obtained in population it dies in embryonal stage.
When yellow mice were crossed among themselves segregation for yellow and brown body colour was obtained in 2:1 ratio.

Yy x Yy

	Y	y
Y	YY	Yy
y	Yy	yy

YY- death in embryonal stage modified ratio=2:1

2. In plant lethal gene was first discovered by E.Baur in snapdragon(Antirrhinum mujus)

Snapdragon → Golden leaves (G)
Snapdragon → Green leaves (g)

Golden Gg × Golden Gg

	G	g
G	GG	Gg
g	Gg	gg

Modified Ratio : 2 : 1

Homozygous golden leaves are never obtained.

3. **Sickle cell anaemia in human .In human** gene of sickle cell anaemia Hb^s is the example of lethal gene
When two carrier indivudials of sickle cell anaemia are crossed then offsprings are obtained in 2:1 ratio

$Hb^s Hb^A$ × $Hb^s Hb^A$

	Hb^S	Hb^A
Hb^S	Hb^SHb^S	Hb^SHb^A
Hb^A	Hb^SHb^A	Hb^AHb^A

Sub lethal gene but ration 2:1

Pleiotropic gene

Gene which controls more than one character is called pleiotropic gene
This gene shows multiple phenotypic effect.
For example:
(1) In pea plant :single gene influences → seed coat colour, Red spot on leaf, Flower colour

(2) In drosophila recessive gene of vestigial wing also influence the some another character-

- structure of reproductive organs
- Longevity (Length of body)
- Bristles on wings
- Reduction in egg production.

(3) Sickle cell anaemia- Gene Hb^{s}_{β}provide a classic example of pleiotrophy. It not only cause hemolytic anaemia but also result increased resistance to one type of malaria that caused by the parasite plasmodium falciparum,

The sickle ell Hb^{s}_{β} allele also has pleiotropic effect on the development of many tissues and organs such as bone.longs,Kidney ,spleen ,heart.

(b) Cystic fibrosis- Hereditary metabolic disorder that is controlled by a single aoutosomal recessive gene The gene specifies on enzyme that produces a unique glycoprotein The glycoprotein results in the production of mucous. More mucous interfere with that normal functioning of several exocrine glands including those in the skin lung liver and pancreas.

Gene interaction

Gene interaction in two types (i) Allelic interaction –allelic interaction takes place between allele lof same gene which are present at same locus.

eg. 1. Incomplete dominance

2. Co- dominance

Non allelic gene interaction- when interaction takes place between non allele is called non allelic interaction it changes or modifies other non allelic gene.

Example of nonallelic interaction

1. Epistasis:- When agene prevents the expression of another non allelic gene then it is known as epistatic gene and this phenomenon is known as Epistasis

   Gene which inhibit the expression of another non allelic gene is called epistatic gene and expression of gene which is suppressed by epistatic gene called hypostatic gene.

   Example:- Hair colour in Dog.

   B=Dominant allele for black colour of hairs.

   b=Recessive allele for brown colour of hairs

   I=Epistatic gene

   If the genotype bbii for brown colour and BBII for white colour

   Following types of generation will be obtained by following crosses.

bbii × BBII

↓

F_1generation BbIi white colour

↓ F_2Generation

	BI	Bi	bI	bi
BI	BBII white	BBIi white	BbII white	BbiI white
Bi	BBIi white	Bbii white	BbIi white	Bbii white
bI	BbII white	BbIi white	bbii white	BBIi white
Bi	BbIi white	Bbii white	bbii white	bbii white

It is obviously clear by above analysis the phenotypic ratio of F_2Generation in epistasis is 12:3:1

2. **Inhibitory gene**- inhibitory gene itself have no phenotype but inhibits the effect of other non allelic gene No allelic gene behave as recessive

☞ Inhibitory gene must be in dominant stage &inhibit the effect of only dominant gene.

Ex. Leaf colour in Rice.
R-Purple
r-Green
I-inhibitory
R-I-Green-9
R-ii-purple-3
rr-I-Green-3
rr-ii-Green-1
13(Green):3(purple)

3. **complementary gene :-** two pair of no allelic genes are essential in dominant form to produce a particular character.
Such genes that act together to produce an effect that neither can produce it effect separately are called complementary genes
Both type of gene must be present in dominant form.

Example :- colour of flowers in lathyrus odoratus :-

C - P purple coloured
C - PP colour less
Cc - P colour less
Cc - pp colour less

Raw material $\xrightarrow{Genec}$ chromagen $\xrightarrow{Genep}$ Anthocyanin (purple)

CCPP × ccpp
(colour) (colourless)

F_1generation → CcPp(coloured)

	CP	Cp	cP	Cp
CP	CCPP coloured	CCPp coloured	CcPP coloured	CcPp coloured
Cp	CCPp coloured	CCpp colourless	CcPp coloured	Ccpp colourless
cP	CcPP coloured	CcPp coloured	ccPP colourless	ccPp colourless
cp	CcPp coloured	Ccpp colourless	ccPp colourless	ccpp colourless

Thus phenotypic ration of complementary genes =-Coloured :clourless 9 : 7

4. Duplicate Genes :- two pairs of no allelic genes require are for character .If any one of them gene is dominant then this character is expressed such type of gene is called duplicate gene

Example:- Fruit shape in capsella Tow pair of non allelic genes are present in capsella for triangular shape of fruits.

If any one gene out of them is dominant the shape of fruit is triangular and no one gene is dominant than fruits will be elongated.

If TTDD =for triangular shape

Ttdd=for top shape of fruits

TTDD × ttdd

TtDd → F_1generation

F_1

	TD	Td	tD	Td
TD	TTDD triangular	TTDd triangular	TtDD triangular	TtDd triangular
Td	TTDd triangular	TTdd triangular	TtDd triangular	Ttdd triangular
Td	TtDD triangular	TtDd triangular	ttDd triangular	ttDd triangular
Td	TtDd triangular	Ttdd triangular	ttDd triangular	ttdd triangular

Phenotypic ration of f_2> triangular Top shaped 15:1

5. Additive gene effect: In additive gene effect if non allelic gene separately in dominant stage phenotype is same but both gene come dominants stage together phenotype is change due to additive effect

Eg. Fruit shape in cucumber

A-bb→spherical

aaB→spherical

A-B discoid(new phenotype)

aa bb- cylindrical

A-B-	A-bb	a-BB	aabb
9	3	3	1
9 :	6 :	1	New phenotypic ratio
Discoid	Spherical	Cylindrical	

6. Collaboratory Gene:- Two pairs of non allelic gene interaction together to produce a new phenotypic character

Example:- comb-shape in chickens

If,RR=for Rose comb

PP=For pea comb

Both R&P =for walnut comb

rrpp =for single comb

A new type of phenotype walnut (Rr-Pp) comb is produced by the cross in between rose comb (RRpp)and pea comb (rrPP)

Rose comb RRpp × pea comb rrPP

F_1generation→ RrPp=(walnut comb)

F_2

	RP	Rp	rP	Rp
RP	RRPP walnut	RRPp walnut	RrPP walnut	RrPp walnut
Rp	RRPp walnut	RRpp Rose	RrPp walnut	Rrpp Rose
rP	RrPP walnut	RrPp walnut	rrPP pea	rrPp pea
Rp	RrPp walnut	Rrpp Rose	rrPp pea	rrpp single

Thus phenotypic ration of collaboration gene =walnut :Rose:pea:single=9:3:3:1

7. Supplementary gene or recessive epistasis :-A pair of gene change the effect of another non gene is called supplementary gene

Example:- coat colour in mice.

If alleles ,C=Black coat colour

c = Albino (colourless coat) or (it has no effect)

A = Supplementary gene

When black coat mice crossed with albino mice the f_1 generation is Agouti.

It means here the effect of no allelic gene is changed.

Black albino
CCaa × ccAA

↓

F_1 Generation → Cc Aa (Agouti)

	CA	**Ca**	**cA**	**CcAa**
CA	CCAA Agouti	CCAa Agouti	CcAA Agouti	CcAa Agouti
Ca	CCAa Agouti	CCaa Black	CcAa Agouti	Ccaa Black
cA	CcAA Agouti	CcAa Agouti	ccAA	ccAa albino
ca	CcAa Agouti	Ccaa Black	ccAa albino	ccaa albino

Thus Recessive epistasis or supplementary gene ratio in F_2 Agouti : Black : Albino
9 : 3 : 4

Polygenic inheritance

Inheritance of characters in which on character is controlled by may genes and intensity of character depends upon the number of dominant allele.

Polygenic inheritance first described by Nilsson –Ehle in kernel colour of wheat.

Nillsson –Ehle said that kernel colour of wheat is regulated by two pairs of gene.

RRBB × rrbb
Red White

↓

F_1gen RrBb(intermediate)

↓

F_2gen

1	:	4	:	6	:	4	:	1
Full red		light red		intermediat red		every light		white

Number of dominant gene - 4 3 2 1 0

1Red :14 intermediate : 1 white

Example -2 Colour of the skin in human

The inheritance of colour of skin in human studied by davenport.

Five types of phenotype of colour of skin are found in human

When a Negro (AA BB) phenotype crossed with white (aabb) phenotype intermediate produced in F_1generation phenotypes of$_2$ generation as follows.

Negro × White

AA BB ↓ aa bb

F_1generation → Aa Bb (intermediate)

↓

	AB	Ab	aB	Ab
AB	AABB Negro	AABb Dark	AbBB Dark	AaBb intermediate
Ab	AABb Dark	AAbb intermediate	AaBb intermediate	Aabb Light
aB	AaBB Dark	AaBb intermediate	aaBB intermediate	aaBb Light
ab	AaBb intermediate	Aabb	aaBb Light	Aabb white

Thus,

Phenotypic ration of F_2generation of quantitative inheritance as.

Negor : Dark : Intermediate : Light : white

1 : 4 : 6 : 4 : 1

-In new discovery human skin colour and kernel colour in wheat is regulated by 3 pairs of alleles so phenotypic ration of F_2 generation.

Ratio 1 : 6 : 15 : 20 : 6 : 1

Full black Intermediate full white

