EPISTASIS

Definition :

Epistasis is a form of gene interaction in which one gene masks the phenotypic expression of another.

Or

Any gene or gene pair that masks the expression of another non-allelic gene.

Epistatic versus Hypostatic :

The alleles that are masking the effect are called epistatic alleles.

The alleles whose effect is being masked are called the hypostatic alleles.

RECESSIVE EPISTASIS:

e.g. Mouse Colour

A – R : Grey aaR- : Black

A-rr : Yellow aarr :Cream

Another allele responsible for pigment formation.

CC = normal pigment production = C dominant over c.

cc = NO pigment produced (recessive); hence 'cc' individuals are Albinos.

The 'C' is responsible for production of enzyme which oxidizes the chromogen & produce the colour.

'cc' individual lacks enzyme production, hence they are albinos although genes for colours are present.

Parental cross : **Black mouse X Albino Mouse**

RRCC X rrcc

RrCc

All F1 offspring will be black mice RrCc .

Then if we cross mice from the F1 generation

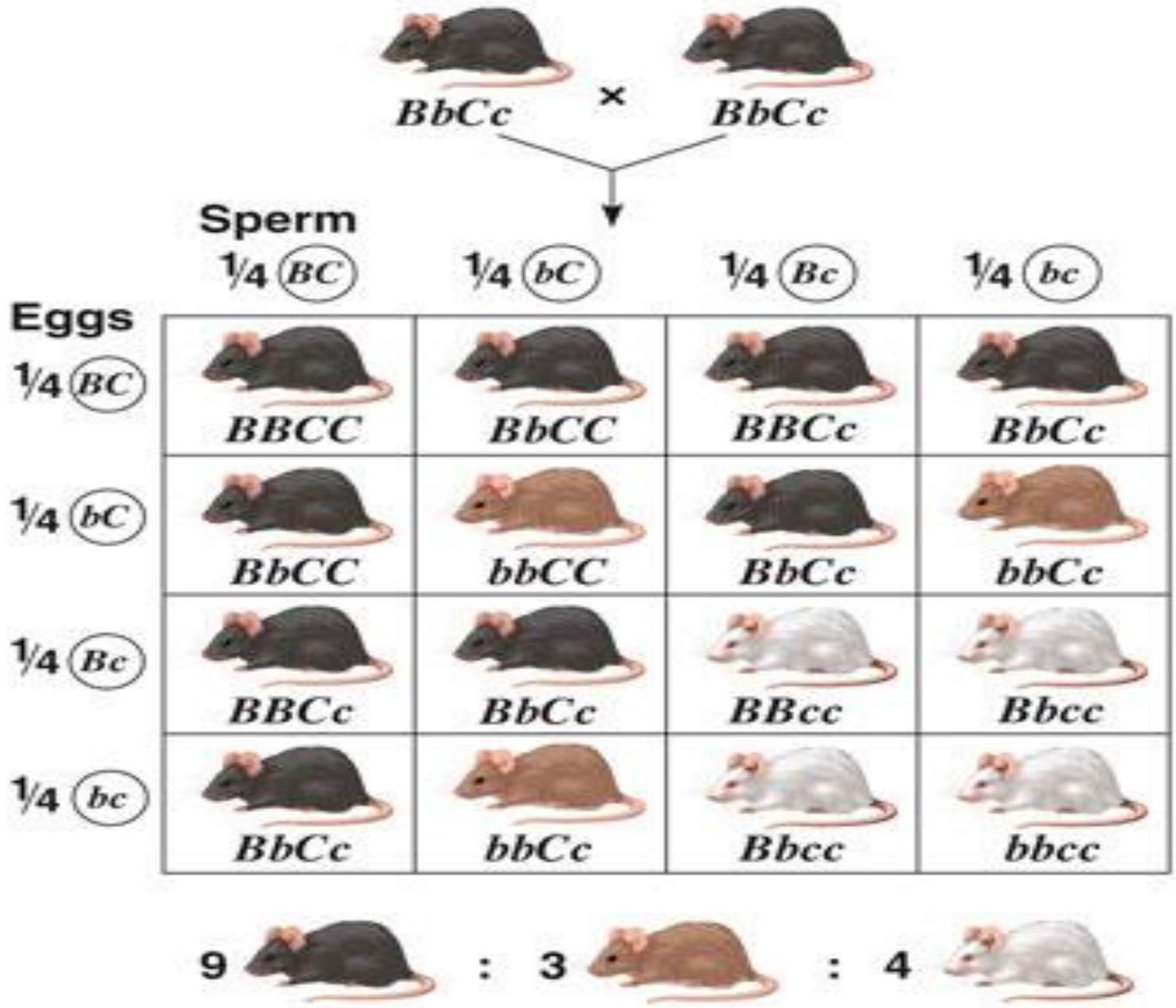
(RrCc X RrCc),

The gametes each mouse could produce would be

(RC, Rc, rC, and rc).

Male / Female	RC	Rc	rC	rc
RC	RRCC Black	RRCc Black	RrCC Black	RrCc Black
Rc	RRCc Black	RRcc Albino	RrCc Black	Rrcc Albino
rC	RrCC Black	RrCc Black	rrCC Cream	rrCc Cream
rc	RrCc Black	Rrcc Albino	rrCc Cream	rrcc Albino

The F2 would be = 9 black : 3 cream : 4 albino



Labrador Retrievers

- BBEE and BbEe --> Black retrievers
- bbEE and bbEe --> Brown retrievers
- BBee, Bbee, or bbee --> Golden retrievers

DOMINANT EPISTASIS

e.g. Dog coat colour

Black is dominant over brown.

BB : Black & bb : Brown

Another pair of genes I and i controls pigment formation.

I = prevents pigment production = I dominant over i.

For pigment production genotype ii essential (recessive)

while I individual will be White:

Parental Cross : **Brown Dog (bbii)** **X** **White Dog (BBII)**

F1 Result **Bbli (White)**

F1 X F1 **Bbli (White)** **X** **Bbli (White)**

Gametes **BI, Bi, bI and bi**

Genotypes **B-ii : – Black** **B-I- or bbI- : White**
bbii : - Brown

F2 Result **12 White : 3 Black : 1 brown**

	BI	Bi	bI	bi
BI	BBII White	BBIi White	BbII White	BbIi White
Bi	BBIi White	BBii Black	BbIi White	Bbii Black
bI	BbII White	BbIi White	bbII White	bbIi White
bi	BbIi White	Bbii Black	bbIi White	bbii Brown

DOMINANT & RECESSIVE EPISTASIS:

Dominant & recessive epistasis can occur in the cases

In white Leghorn, there are white birds and coloured birds. The coloured birds are due to a dominant gene 'C' which produces coloured pigment. But do not show colour because of Dominant gene 'I' inhibits colour formation.

White silkies are also white because of homozygous recessive 'cc' which doesn't produce colour & 'i' allows formation of pigment.

Parental Cross : White Leghorn (IICC) X White Silkies (iicc)

↓

F1 Result IiCc (White)

F1 X F1 IiCc (White) X IiCc (White)

Gametes IC, Ic, iC and ic

Genotypes:

IICC – White	IIcc – White
IiCC – White	Iicc – White
IiCc – White	IiCC – White
iicc – White	IiCc – White
iiCC – Colour	iiCc – Colour

F2 Result 13 White : 3 Colured

	IC	Ic	iC	ic
IC	IICC White	IICc White	IiCC White	IiCc White
Ic	IICc White	IIcc White	IiCc White	Iicc White
iC	IiCC White	IiCc White	iiCC Colour	iiCc Colour
ic	IiCc White	Iicc White	iiCc Colour	iicc White

DUPLICATE RECESSIVE EPISTASIS:

e.g. Daisy Yellow flowers with purple centre

Daisy Yellow flowers with yellow centre

When,

Purple centered X Yellow Centered - F1 Purple Centered

F2 ratio: 3 Purple : 1 Yellow centered flowers.

But, When 2 yellow centered from different localities

Yellow Centered X Yellow Centered - F1 Purple Centered

F2 ratio: 9 Purple : 7 Yellow centered flowers.

Indicating 2 verities are genetically different

Parental cross : Yellow Centered X Yellow Centered

PPrr X ppRR

↓

F1 Result PpRr

All F1 plants are purple PpRr .

F1 X F1 (PpRr X PpRr),

The gametes PR, Pr, pR, and pr

Genotypes P-R- : – Purple ppR- or P-rr : Yellow

F2 Result 9 Purple : 7 Yellow

	PR	Pr	pR	pr
PR	PPRR Purple	PPRr Purple	PpRR Purple	PpRr Purple
Pr	PPRr Purple	PPrr Yellow	PpRr Purple	Pprr Yellow
pR	PpRR Purple	PpRr Purple	ppRR Yellow	ppRr Yellow
pr	PpRr Purple	Pprr Yellow	ppRr Yellow	pprr Yellow

DUPLICATE DOMINANT EPISTASIS:

e.g. Black Langshan have feathered shanks

Buff Rocks have clean shanks

F & f and S & s : pair allele acting on shank feathering

as : F- - - and - - S- : Feathered shanks

Only ffss : Cleaned shanks

Parental Cross :

Feathered Shanks (FFSS) **X** **Unfeathered Shanks (ffss)**

↓

F1 Result **FfSs (Feathered Shanks)**

F1 X F1

FfSs (Feathered Shanks) X FfSs (Feathered Shanks)

Gametes **FS, Fs, fS, fs**

Genotypes **F-S- : F- ss : ffS - : (Feathered Shanks)**

ffss : - Unfeathered Shanks

F2 Result **15 (Feathered Shanks) :1 Unfeathered**

	FS	Fs	fS	fs
FS	FFSS Feathered	FFSs Feathered	FfSS Feathered	FfSs Feathered
Fs	FFSs Feathered	FFss Feathered	FfSs Feathered	Ffss Feathered
fS	FfSS Feathered	FfSs Feathered	ffSS Feathered	ffSs Feathered
fs	FfSs Feathered	Ffss Feathered	ffSs Feathered	ffss Unfeathered

DUPLICATE GENES WITH INTERACTION

e.g. **Duroc Jersey pigs : Red colour**

Duroc Jersey pigs : Sandy colour

When,

Red Colour X Sandy Coloured - F1 Red coloured

F2 ratio : 3 Red : 1 Sandy Coloured.

But, When 2 Sandy Colour from different localities

Sandy Colour X Sandy Colour - F1 Red coloured

F2 ratio: 9 Red coloured : 6 Sandy Coloured : 1 White.

Indicating 2 verities are genetically different

Parental Cross : Sandy (rrSS) X Sandy (RRss)

↓

F1 Result RrSs (Red)

F1 X F1 RrSs (Red) X RrSs (Red)

Gametes RS, Rs, rS, rs.

Genotypes R-S- : – Red rrS- or R-ss : Sandy
rrss : - White (gene interaction)

F2 Result 9 Red : 6 Sandy : 1 White

	RS	Rs	rS	rs
RS	RRSS Red	RRSs Red	RrSS Red	RrSs Red
Rs	RRSs Red	RRss Sandy	RrSs Red	Rrss Sandy
rS	RrSS Red	RrSs Red	rrSS Sandy	rrSs Sandy
rs	RrSs Red	Rrss Sandy	rrSs Sandy	rrss White

Epistatic Interaction Summary

Table 5.2 Modified dihybrid—phenotypic ratios due to gene interaction

Ratio	Genotype				Type of Interaction	Example
	*A_B_*	*A_bb*	*aaB_*	*aabb*		
9:3:3:1	9	3	3	1	None	Seed shape and endosperm color in peas
9:3:4	9	3	4		Recessive epistasis	Coat color in Labrador retrievers
12:3:1	12		3	1	Dominant epistasis	Color in squash
9:7	9	7			Duplicate recessive epistasis	Albinism in snails
9:6:1	9	6		1	Duplicate interaction	—
15:1	15			1	Duplicate dominant epistasis	—
13:3	13		3		Dominant and recessive epistasis	—

*Each ratio is produced by a dihybrid cross (*AaBb* × *AaBb*). Shaded bars represent combinations of genotypes that give the same phenotype.

Note-Review Pepper and Chicken Comb Interactions

White leghorns (Genetically coloured) x Plymouth rock (white)

CCII x **ccii**

CcIi

White

F_1 *individuals are inbred*

CcIi White x **CcIi** White

Gametes: **CI** **Ci** **cI** **ci** **CI** **Ci** **cI** **ci**

Gametes	**CI**	**Ci**	**cI**	**ci**
CI	**CCII** White	**CCIi** White	**CcII** White	**CcIi** White
Ci	**CCIi** White	**CCii** Colour	**CcIi** White	**Ccii** Colour
cI	**CcII** White	**CcIi** White	**ccII** White	**ccIi** White
ci	**CcIi** White	**Ccii** Colour	**ccIi** White	**ccii** White