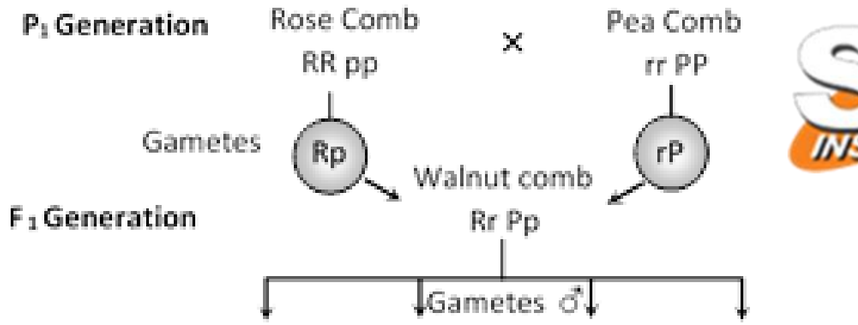
CHAPTER 8

Principles of inheritance-Gene interactions

Collaborator genes

- In collaboration two gene pairs, which are present on separate loci but influence the same trait, interact to produce some totally new trait or phenotype that neither of the genes by itself could produce.

Example : Inheritance of combs in poultry, where two genes control the development of comb.



♀ \ ♂	RP	Rp	rP	rp
RP	RR PP walnut 1	RR Pp walnut 2	Rr PP walnut 3	Rr Pp walnut 4
Rp	RR Pp walnut 5	RR pp rose 6	Rr Pp walnut 7	Rr pp rose 8
rP	Rr PP walnut 9	Rr Pp walnut 10	rr PP pea 11	rr Pp pea 12
rp	Rr Pp walnut 13	Rr pp rose 14	rr Pp pea 15	rr pp single 16

Gametes ♀

F_2 Generation = Walnut : 9, Rose : 3, Pea : 3, Single : 1

Inheritance of rose and pea comb in poultry

Polygenic inheritance

- When one phenotypic character is controlled by more than one gene, it is called **polygenic inheritance**

- **Kolerenter** is known as father of polygenic inheritance

- It is also called **Quantitative inheritance**
- The quantity of inheritance depends on dominant alleles
- Dominant alleles have **cumulative effect** each expressing part of trait

- Gene involved in quantitative inheritance is known as **polygenes**
- Polygenic inheritance don't follow the **mendelian ratio**
- Eg; **skin color of man, wheat kernel colour**

Ratio :

- when 2 polygene are considered-

  1:4:6:4:1

- when 3 polygene are considered-

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

- **Parents-** **Negro** (high melanin) AABB — **Albino** (no melanin) aabb
- **Gametes-** AB × ab
- **F1--** AaBb

Mulleto

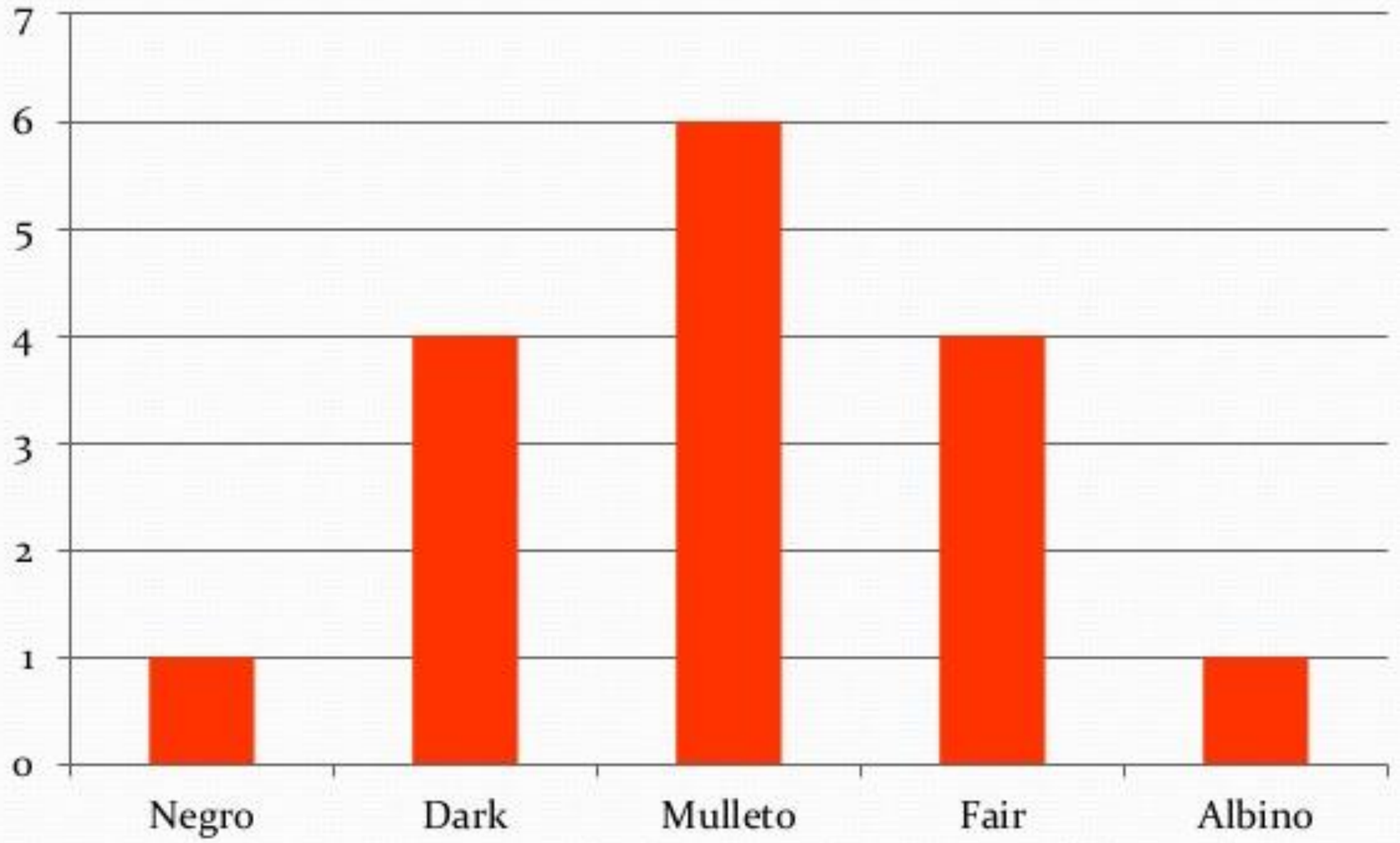
F2-Gametes- AB, Ab, aB, ab

♂ / ♀	**AB**	**Ab**	**aB**	**ab**
AB	AA BB (Negro)	AA Bb (Dark)	Aa BB (Dark)	Aa Bb (Mulleto)
Ab	AA Bb (Dark)	Aa bb (Mulleto)	Aa Bb (Mulleto)	Aa bb (Fair)
aB	Aa BB (Dark)	Aa Bb (Mulleto)	aa BB (Mulleto)	aa Bb (Fair)
ab	Aa Bb (Mulleto)	Aa bb (Fair)	aa Bb (Fair)	aa bb (Albino)

Albino	Fair	Mulleto	Dark	Negro
				
aabb	aaBb Aabb	AAbb AaBb aaBB	AaBB AABb	AABB

F2 Ratio- 1:4:6:4:1

Number of Dominant allele	Phenotype	Ratio
No of dominant alleles	Albino	1/16
One dominant alleles	Fair	4/16
Two dominant alleles	Mulleto	6/16
Three dominant alleles	Dark	4/16
Four dominant alleles	Negro	1/16



Graphical representation of polygenic inheritance of skin colour in human

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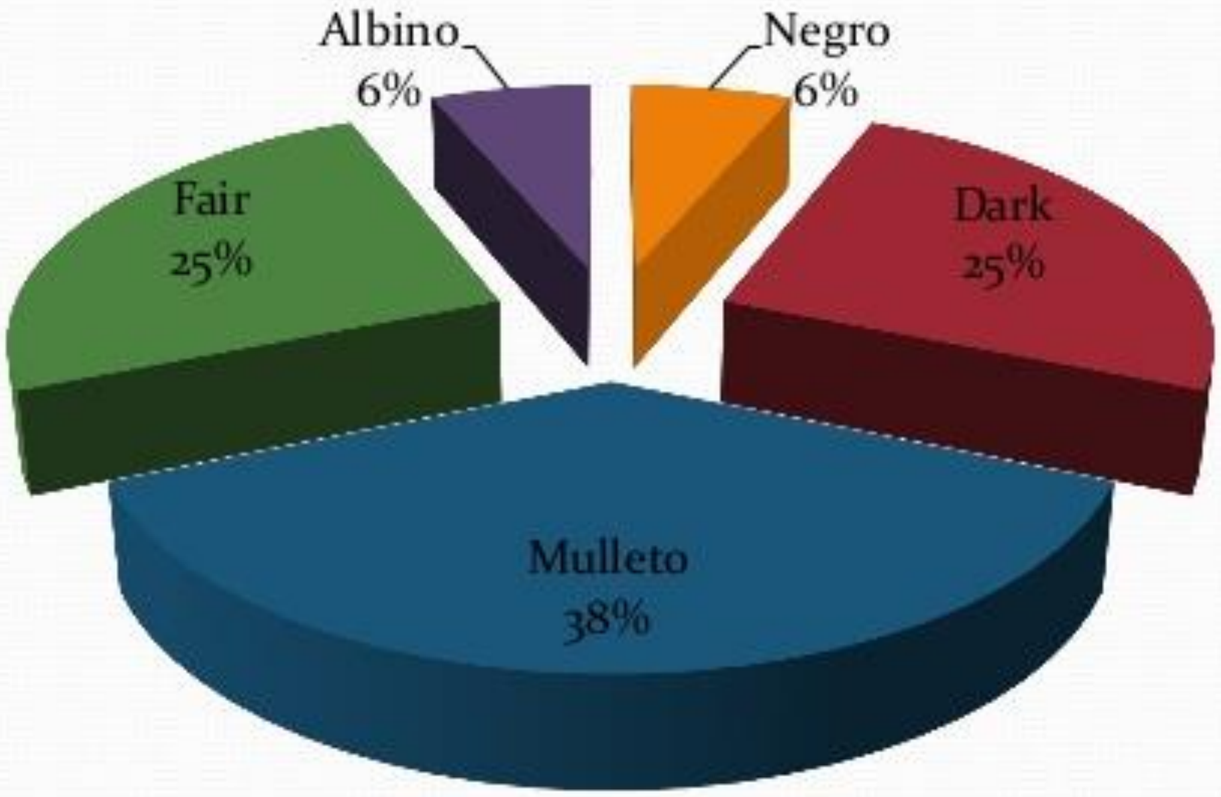

Polygenic inheritance of skin colour in human

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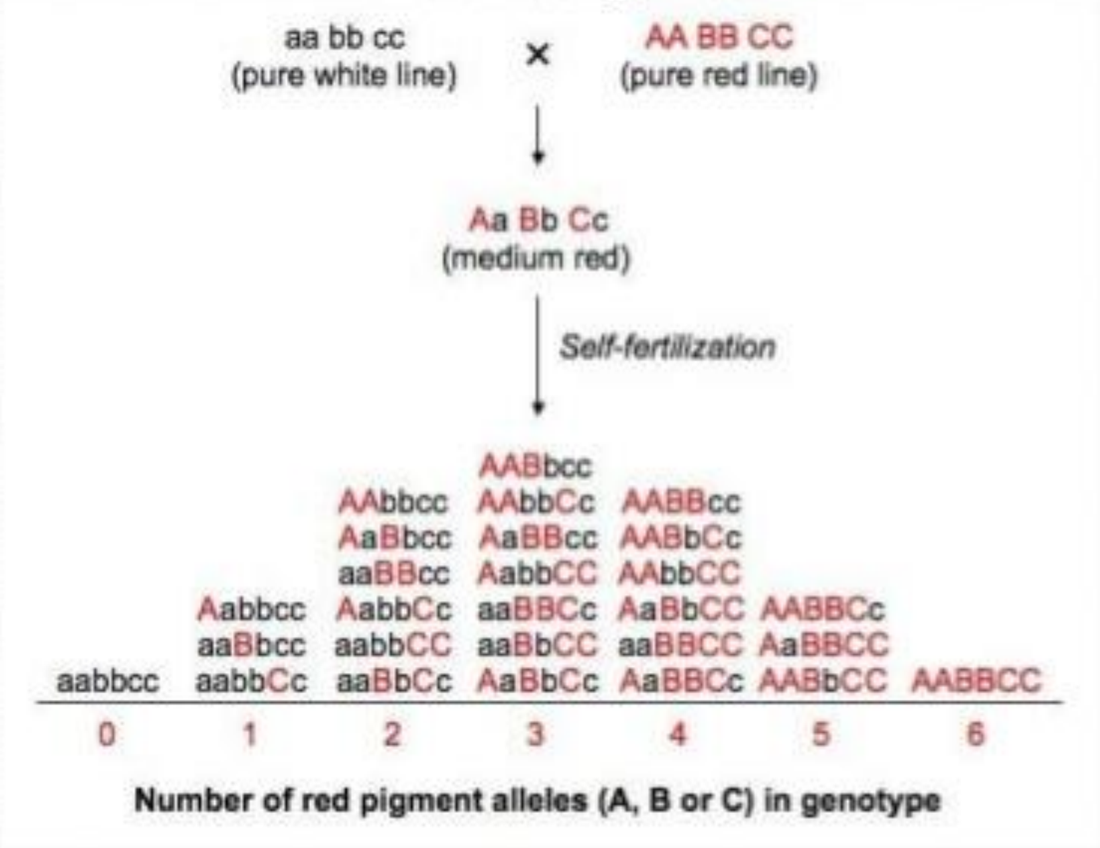
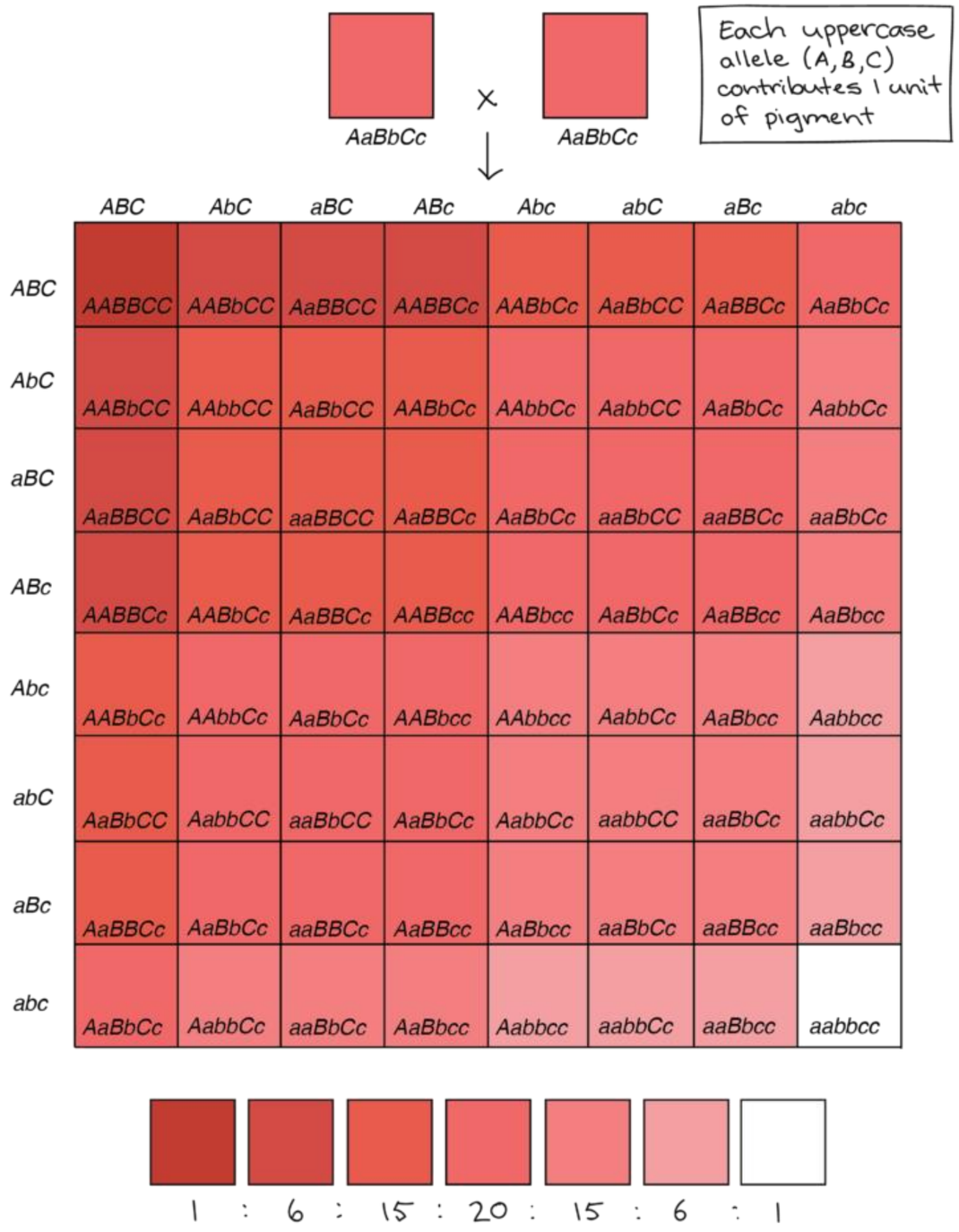
Wheat kernel colour

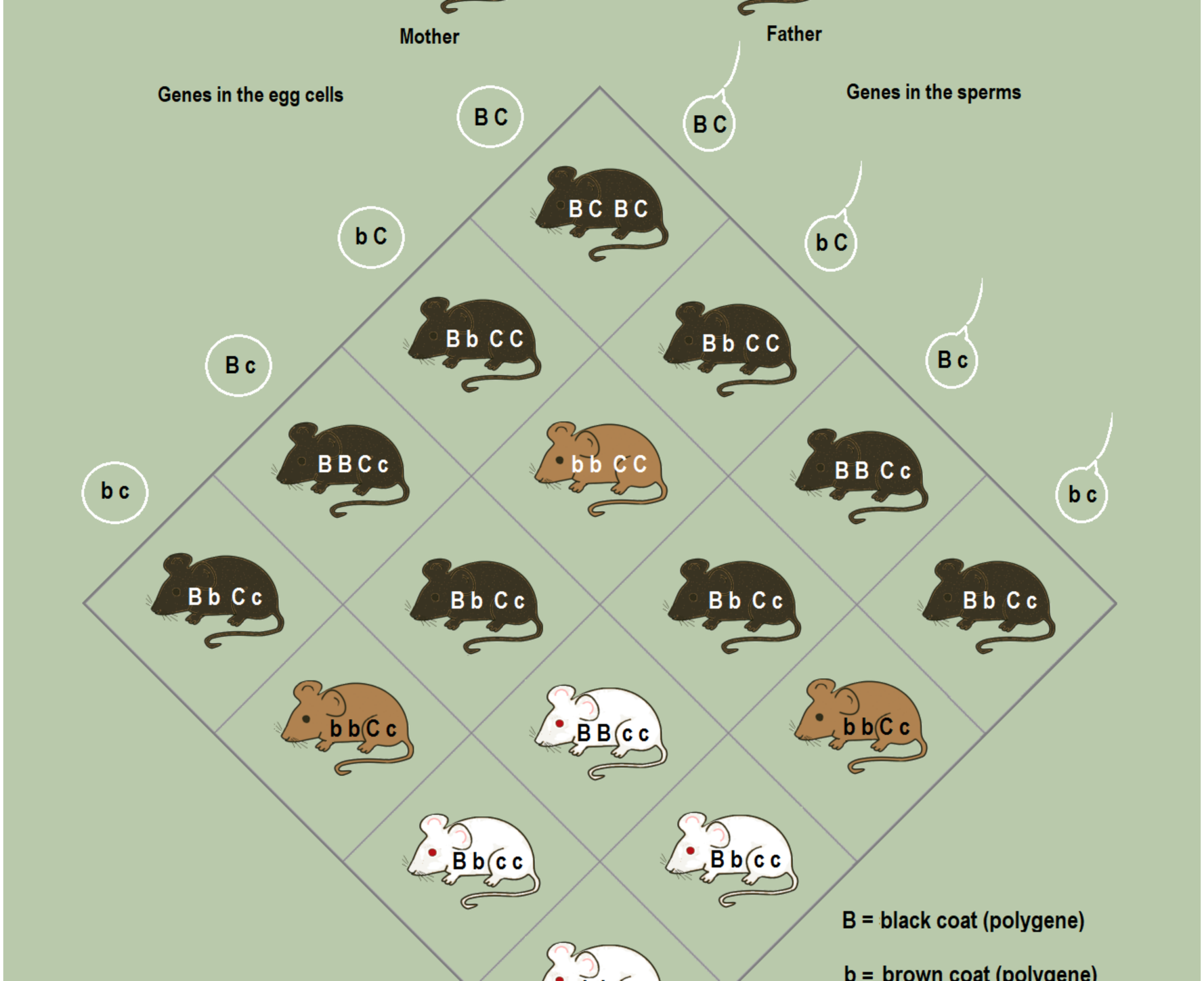
with three genes



How to detect the skin colour genetically?

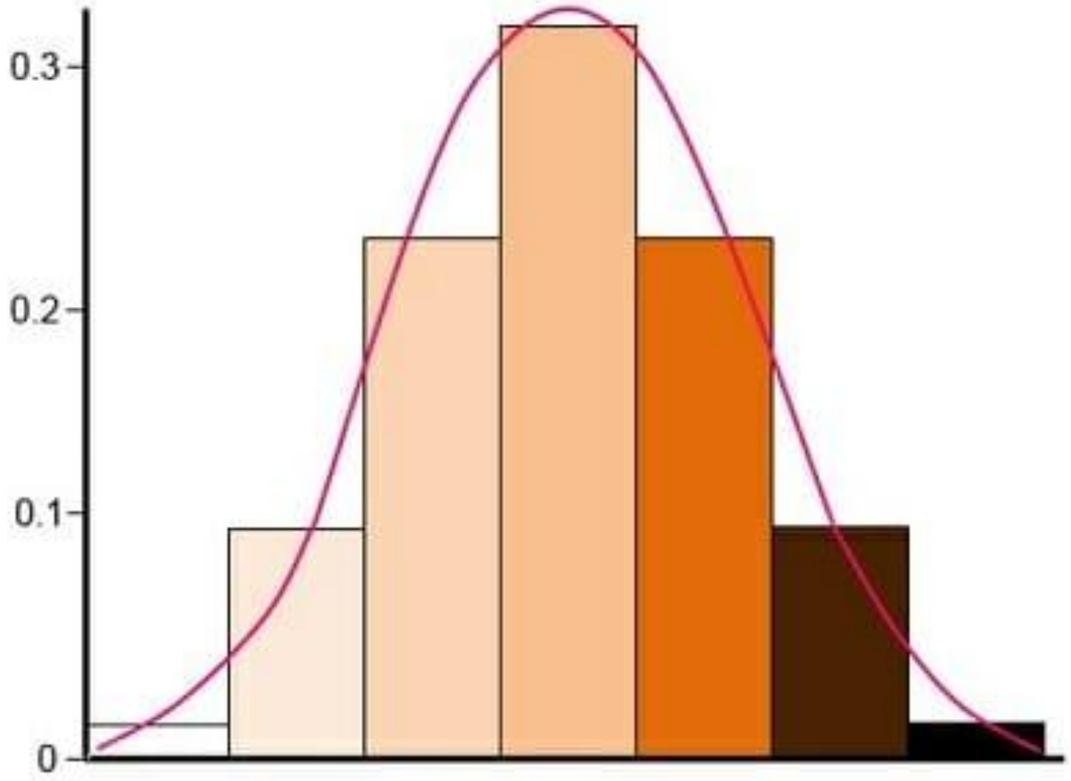
- 6 dominant – black - 1
- 5 dominant- very dark - 6
- 4 dominant – dark - 15
- 3 dominant – intermediate - 20
- 2 dominant- fair - 15
- 1 dominant – very fair -6
- 0 dominant - albino - 1


AaBbCc
×
AaBbCc
Each uppercase allele (A,B,C) contributes 1 unit of pigment
ABC AbC aBC ABc Abc abC aBc abc
ABC AABBCC AABbCC AaBBCC AABBCc AABbCc AaBbCC AaBBCc AaBbCc
AbC AABbCC AAbbCC AaBbCC AABbCc AAbbCc AabbCC AaBbCc AabbCc
aBC AaBBCC AaBbCC aaBBCC AaBBCc AaBbCc aaBbCC aaBBCc aaBbCc
ABc AABBCc AABbCc AaBBCc AABBcc AABbcc AaBbCc AaBBcc AaBbcc
Abc AABbCc AAbbCc AaBbCc AABbcc AAbbcc AabbCc AaBbcc Aabbcc
abC AaBbCC AabbCC aaBbCC AaBbCc AabbCc aabbCC aaBbCc aabbCc
aBc AaBBCc AaBbCc aaBBCc AaBBcc AaBbcc aaBbCc aaBBcc aaBbcc
abc AaBbCc AabbCc aaBbCc AaBbcc Aabbcc aabbCc aaBbcc aabbcc
1 : 6 : 15 : 20 : 15 : 6 : 1


Mother
Father
Genes in the egg cells
Genes in the sperms
B C
B C
b C
b C
B c
B c
b c
b c
B C B C
B b C C
B b C C
B B C c
b b C C
B B C c
B b C c
B b C c
B b C c
B b C c
b b C c
B B c c
b b C c
B b c c
B b c c
B = black coat (polygene)
b = brown coat (polygene)

Polygenic interaction

	ABC	*ABc*	*AbC*	*aBC*	*Abc*	*aBc*	*abC*	*abc*
ABC	6	5	5	5	4	4	4	3
ABc	5	4	4	4	3	3	3	2
AbC	5	4	4	4	3	3	3	2
aBC	5	4	4	4	3	3	3	2
Abc	4	3	3	3	2	2	2	1
aBc	4	3	3	3	2	2	2	1
abC	4	3	3	3	2	2	2	1
abc	3	2	2	2	1	1	1	0




THANK
YOU