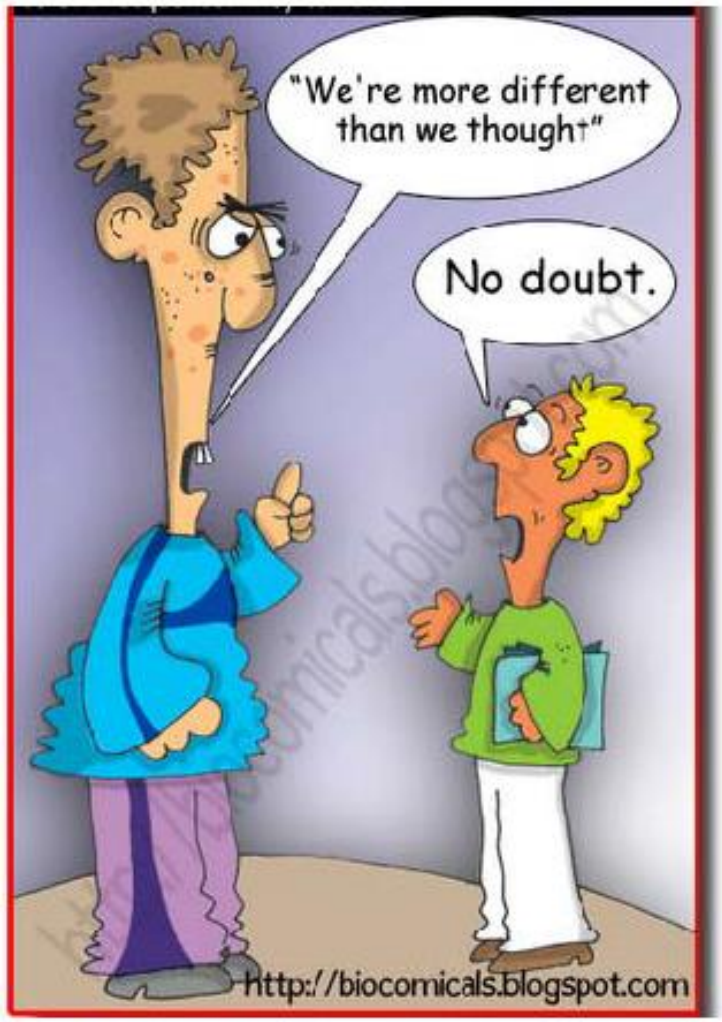
Section 6.1 – Beyond Mendel

SBI3U

MRS. FRANKLIN

Beyond Mendel

In the 20th century, with more developped technology, scientist were able to establish more complex patterns of inheritance.



Spectrum of Dominance

There are times when a gene for one trait does not have a completely dominant or recessive allele.

There are instances when one gene may have more than 2 alleles, or when a single gene produces multiple phenotypes.

Traits Involving Alleles for **1 GENE**

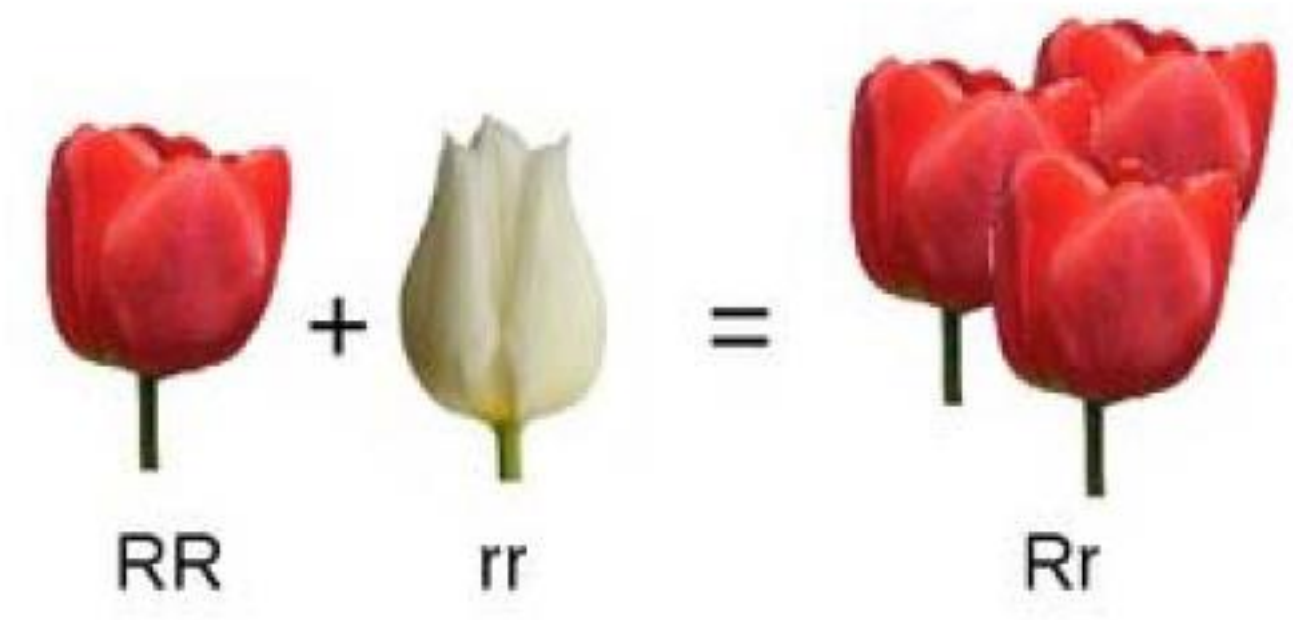
Spectrum of Dominance:

There are 6 forms of dominance:

1) Complete Dominance
2) Codominance
3) Incomplete Dominance
4) Multiple Alleles

1) Complete Dominance

The dominant allele always masks the recessive allele.



When representing the alleles an upper case letter is used to illustrate dominant and a lower case letter is used to illustrate recessive allele.

1) Complete Dominance

	R	R
r		
r		

Genotype:

Phenotype:

2) Codominance

Both alleles are fully expressed.The offspring contains spots which express either the dominant or recessive allele.

Roan cow, product of mating between a red cow and a white cow.

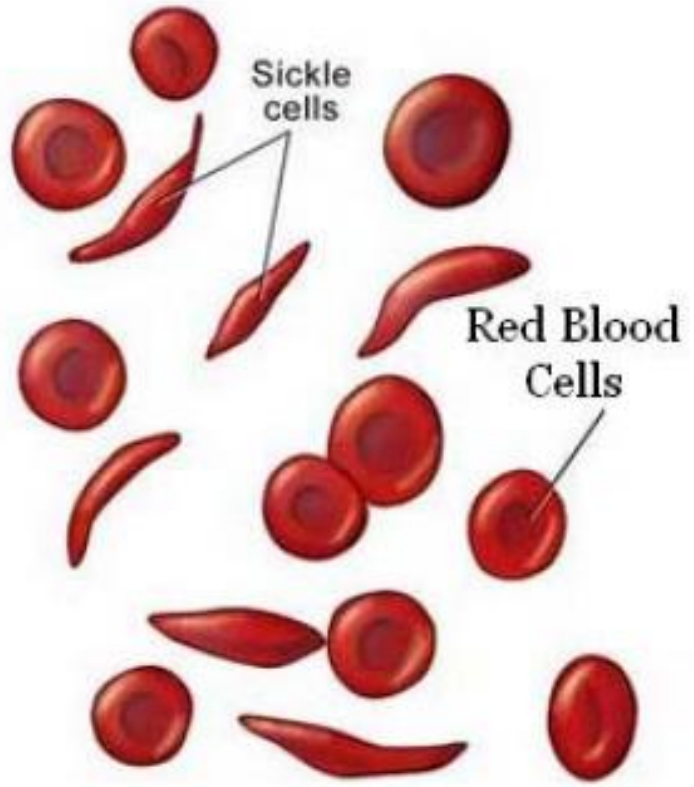
The red and white hairs can be found in patches are spread through the body.

Example of Codominance

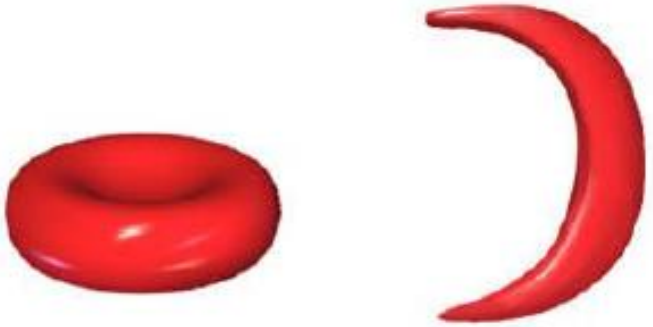
Hb^A = normal hemoglobin

Hb^S = sickle cell anemia

Considering that there isn't one allele that is more dominant over the other, you must use superscripts to represent the different forms of alleles.



2) Codominance



Normal red blood cell

Sickled red blood cell

	Hb^A	Hb^S
Hb^A		
Hb^S		

Homozygous (Hb^A Hb^A) = normal

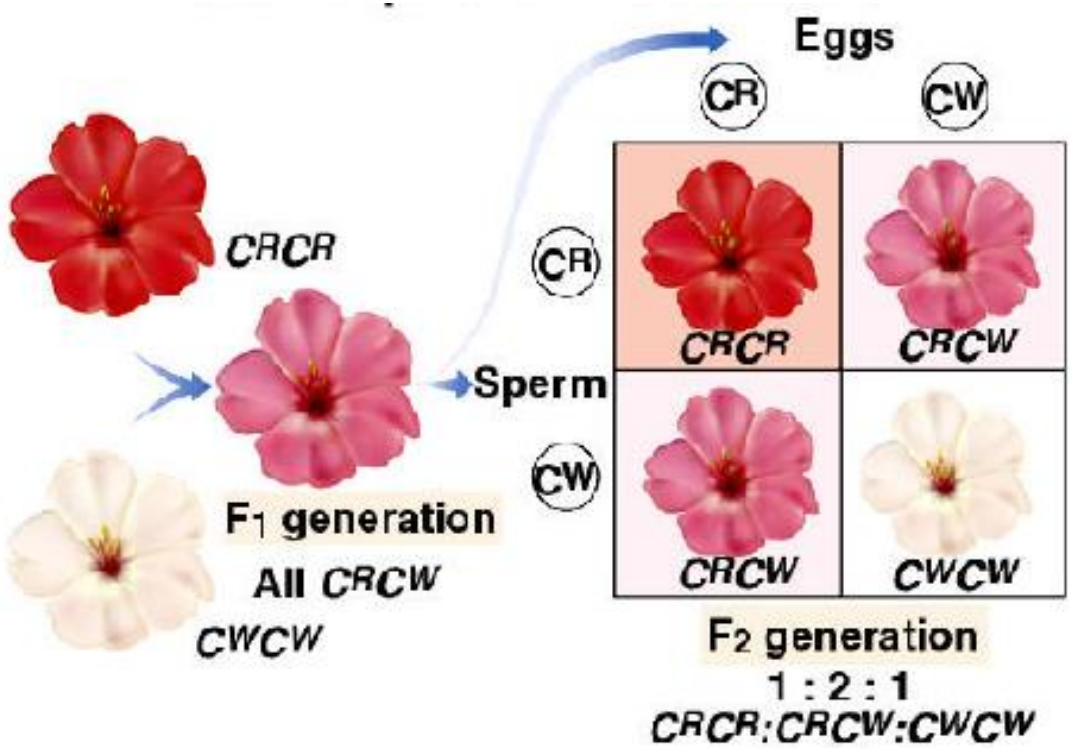
Homozygous (Hb^S Hb^S)= sickle cell

Heterozygous (Hb^A Hb^S)= normal red blood cell and some abnormal.

3) Incomplete Dominance

Neither one of the two alleles for the same gene can completely conceal in the presence of the other.

When an individual is a ***heterozygote***, its phenotype will be a ***blend*** of both parents.



When two heterozygous (pink) plants are hybridized scientists observed a 1:2:1 Ratio

Practice Problem 1 a)

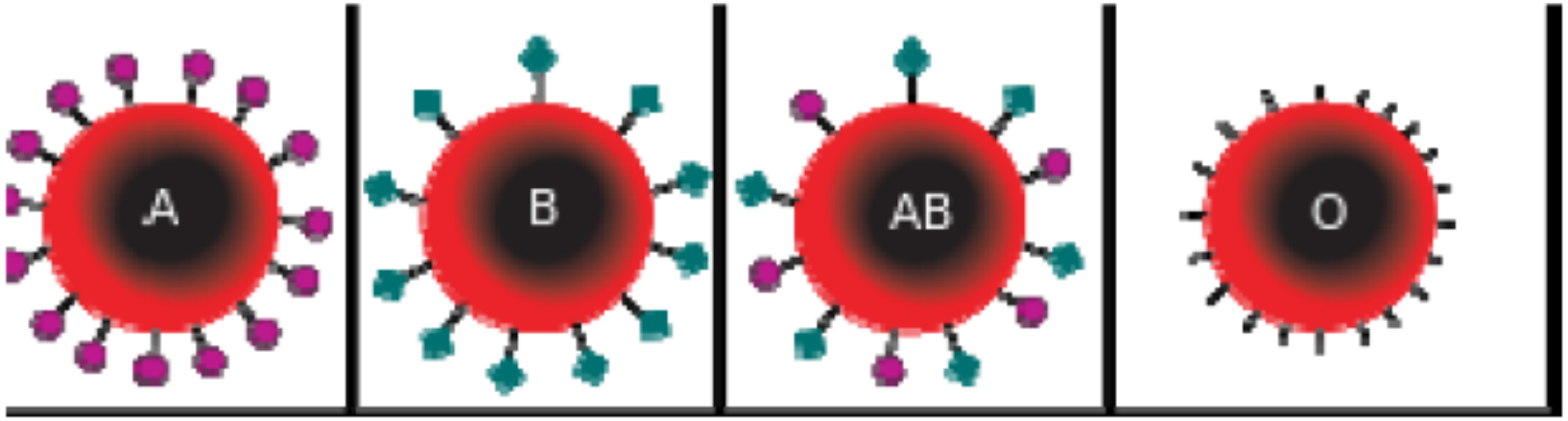
A plant that produces white flowers is crossed with a plant that produces purple flowers. If the pattern of inheritance is incomplete dominance what would the phenotype of the offpsring be?

Practice Problem 1 b)

Describe the phenotype of the offpsring if the inheritance pattern is codominant.

4) Multiple Alleles

There are many genes that exist in population in more than two allelic forms.



Blood type: A , AB, B, O

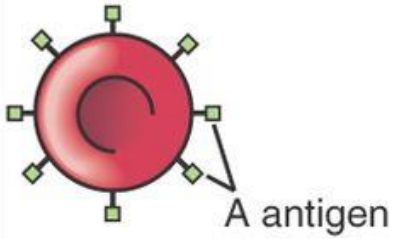
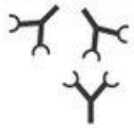
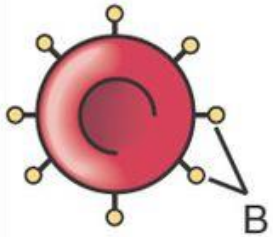
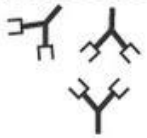
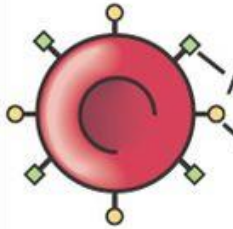
4) Multiple Alleles

The gene for blood type is designanted « I » with supercrispts.

3 different alleles: I^A (**blood type A**), I^B (**blood type B**), i (**blood type O**)

Phenotype and genotype:

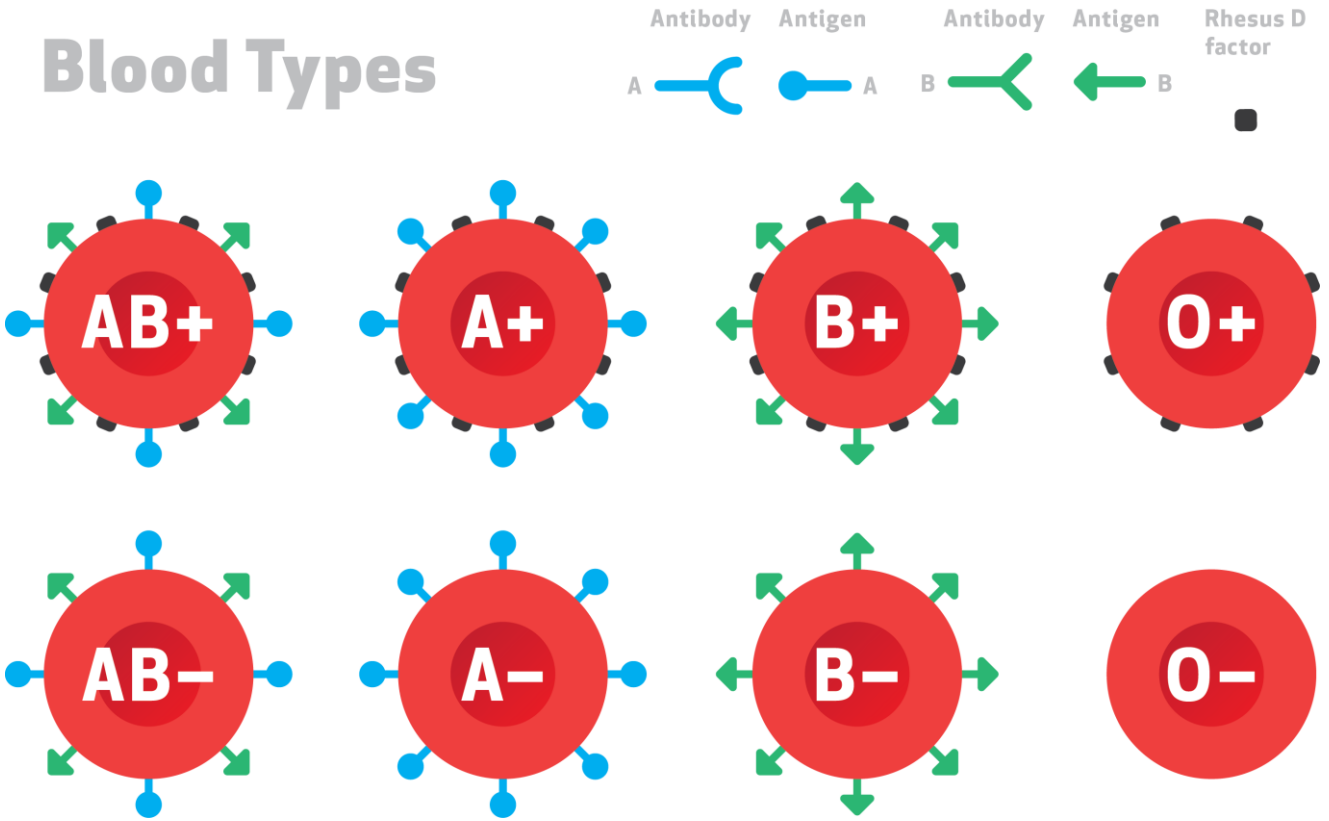
- type A ( )
- type B ( )
- type AB ( )
- type O ( )

Blood Type	Antigen (RBC membrane)	Antibody (plasma)	Can receive blood from	Can donate blood to
A (40%)	 A antigen	Anti-B antibodies 	A, O	A, AB
B (10%)	 B antigen	Anti-A antibodies 	B, O	B, AB
AB (4%)	 A antigen B antigen	No antibodies	A, B, AB, O	AB
O (46%)	 No antigen	Both Anti-A and Anti-B antibodies 	O	O, A, B, AB

Antigens: proteins on the surface of a cell that is able to trigger an immune response.

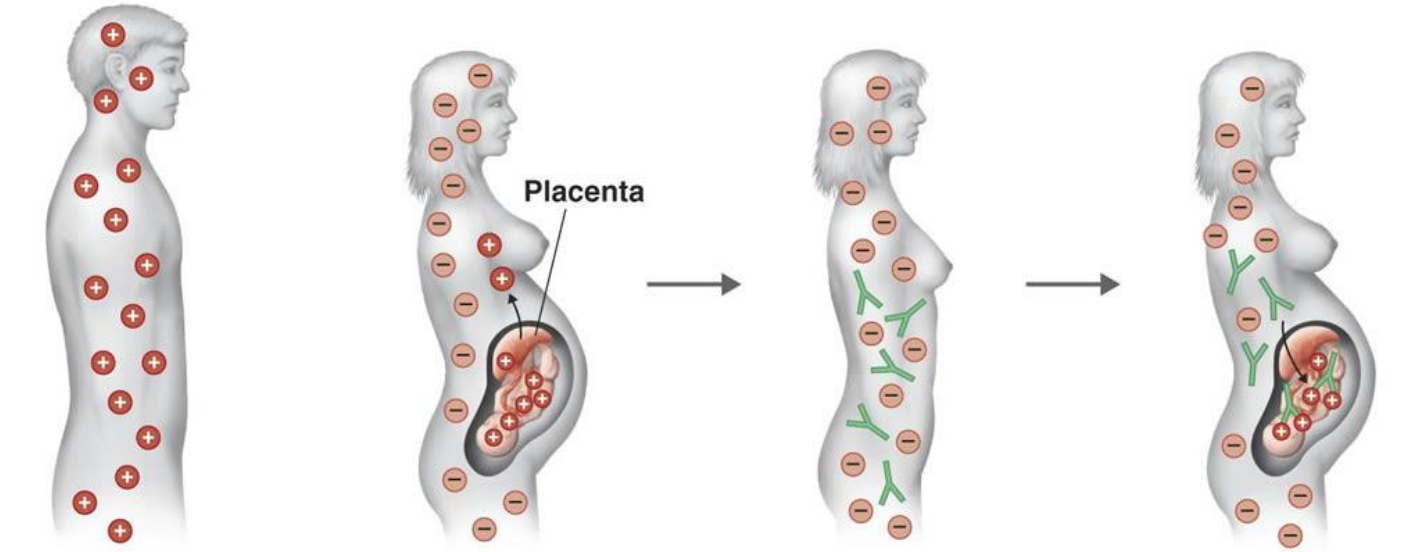
Antibody: Y-shaped proteins produced by the immune system that recognize and attack a specific antigen.

Rh Factor and Blood Types



The Rh factor is a type of protein (antigen) on the surface of red blood cells. Most people who have the Rh factor are known to be Rh-positive. Those who do not have it are Rh-negative.

Rh Factor and Blood Types



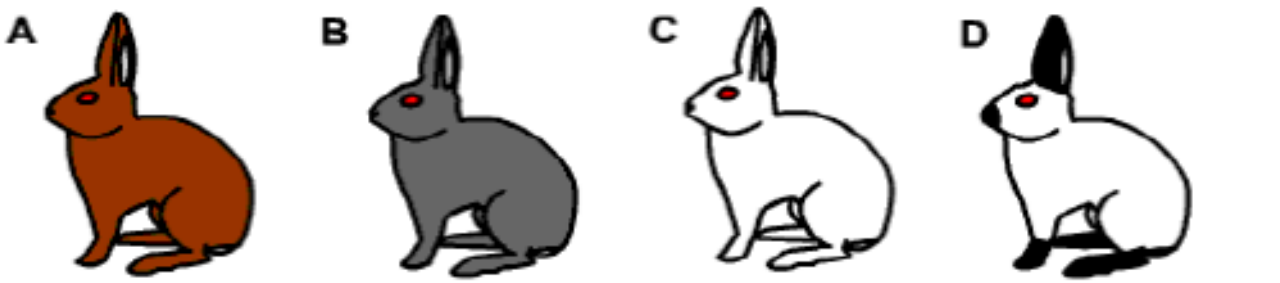
1. Rh^+ father.
2. Rh^- mother carrying her first Rh^+ fetus. Rh antigens from the developing fetus can enter the mother's blood during delivery.
3. In response to the fetal Rh antigens, the mother will produce anti-Rh antibodies.
4. If the woman becomes pregnant with another Rh^+ fetus, her anti-Rh antibodies will cross the placenta and damage fetal red blood cells.

4) Multiple Alleles

Rabbit Coat Colour:

There are 4 alleles that control the gene of coat colour.

Agouti (C) > chinchilla (c^{ch}) > Himalayan (c^{h}) > albino (c)



agouti (C) *chinchilla (c^{ch})* *albino (c)* *himalayan (c^{h})*

Practice Problem 2

a) *If a man has type O blood and a woman has type B blood what possible blood types could their children have?*

Practice Problem 3

If this couple has six children, all with type B blood, what would you infer about the woman's genotype?

Practice Problem 4

A chincilla rabbit with genotype c^{ch} c^{h} is crossed with a Himalayan rabbit with genotype c^{h} c. What is the expected ratio of phenotypes among the offspring?

Traits Involving Two or more **GENES**

There are two situations that involve the effect of multiple genes on one trait.

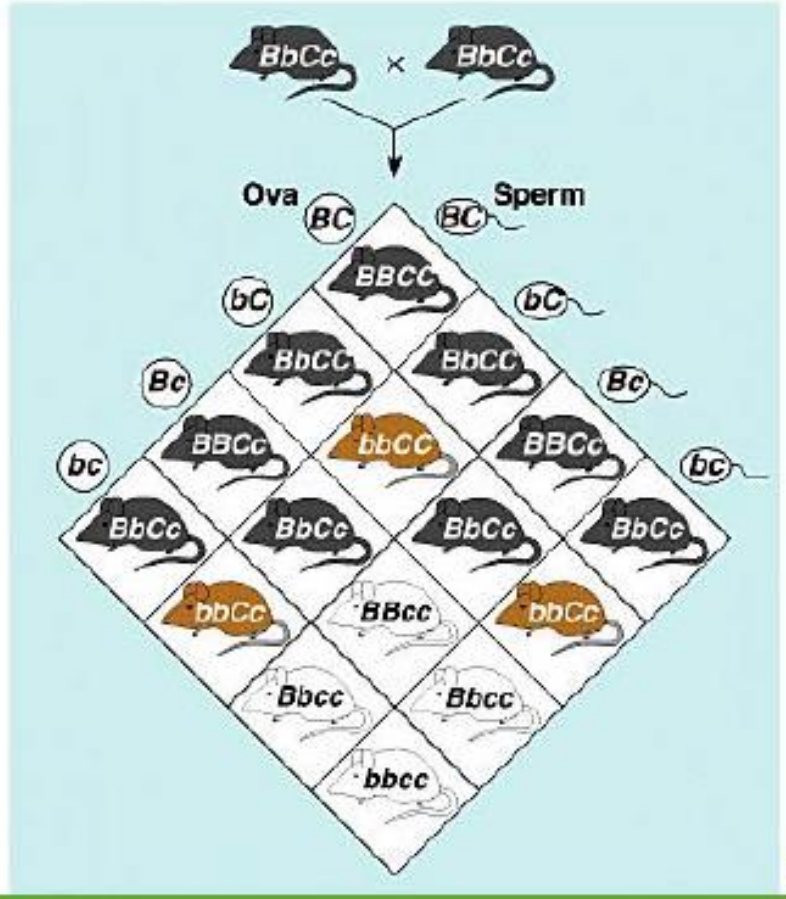
a) Epistasis
b) Polygenic Inheritance

a) Epistasis

Occurs when a gene at one locus alters the phenotypic expression of a gene on a second locus.

B = Black , b= brown
C = colour, c= no colour

These are two separate genes that can both influence the appearance of coat colour.



a) Epistasis

Black labrador (*B_E_*)

Chocolate labrador (*bbE_*)

Yellow labrador (*_ _ee*)

b) Polygenic Inheritance

Most human traits can vary along a continuum. Continuous variation leads to polygenic inheritance.

Continuous variation: a range of variation in one trait resulting from the activity of many genes.

b) Polygenic Inheritance

An additive effects of two or more genes on a single phenotypic character.

Skin colour in humans is controlled by at least three separately inherrited genes.

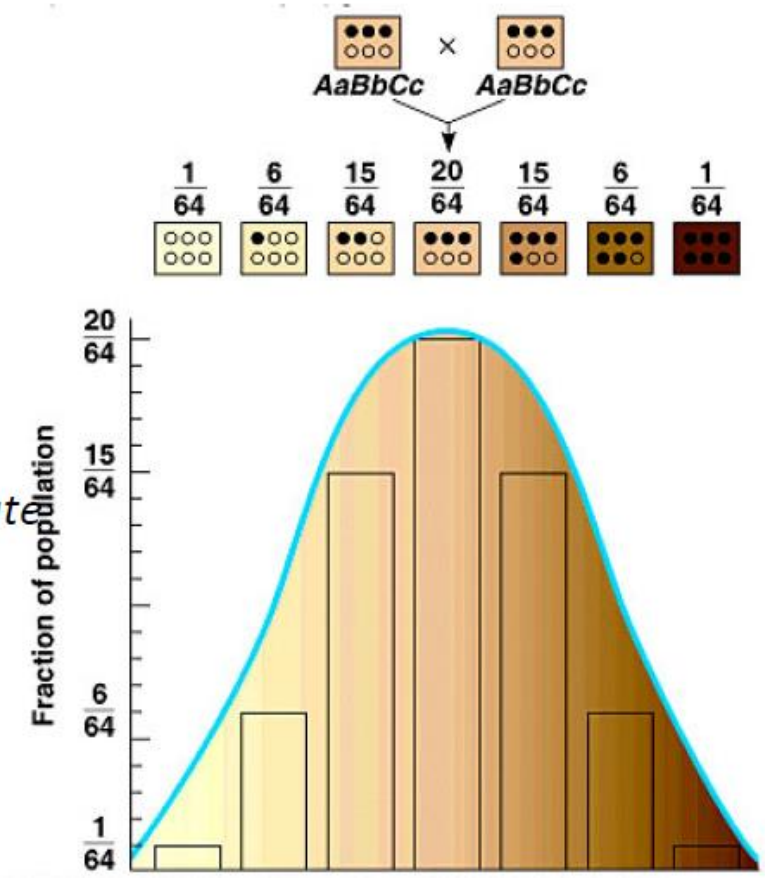
Each gene has its own seperate alleles dominant A, B, C and recessive a, b, c

b) Polygenic Inheritance

AABBCC – *person is very dark*

aabbcc – *person is very fair*

AaBbCc – *person has an intermediate shade*



Environmental Effects

Environmental affects can influence how the traits are expressed.

A genotype is not associated with defined phenotype, but with a range of phenotypic possibilities due to the environmental impact.

Thus, identical twins can accumulate phenotypic differences as a result of their unique experiences.

Checking for Understanding

The seed colour for a particular species of plant is inherited through incomplete dominance. If a true-breeding plant with blue seeds is crossed with a true-breeding plant with yellow seeds, what is the expected seed colour of the offspring?

A) yellow

B) Green

C) Blue

D) Yellow and Blue spots

E) You cannot predict seed colour from the information given

Checking for Understanding

Skin colour is humans ranges from very dark to very light. Which of the following most likely describes how skin colour is inherited?

A) principle of dominance

B) incomplete dominance

C) codominance

D) polygenic inheritance

E) environmental influence

Homework

Textbook: p. 250 # 1, 3, 4, 7 & 8