



Incomplete Dominance, Co-Dominance, and Sex-Linked Traits

It is a little more complicated than Mendel thought...

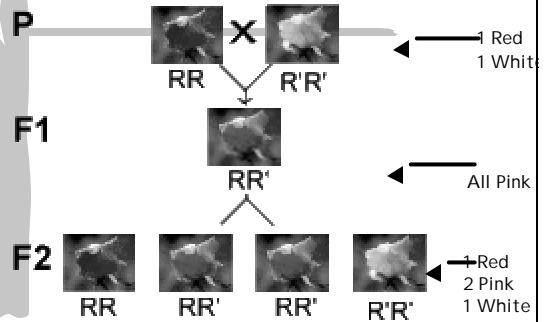
Remember:

- An allele is: a possible form of a gene.
- Normally, there are 2 alleles for a given gene (Dominant and Recessive.)
- Sometimes though, there are multiple alleles which allow 3,4,5 or more forms of a gene, but...
 - Though there are more forms of the gene, organisms still get just one from mom and one from dad...unless there is a mutation of course!
 - Populations can have more forms of the allele though.
 - Most known about is 100 alleles for a single trait.

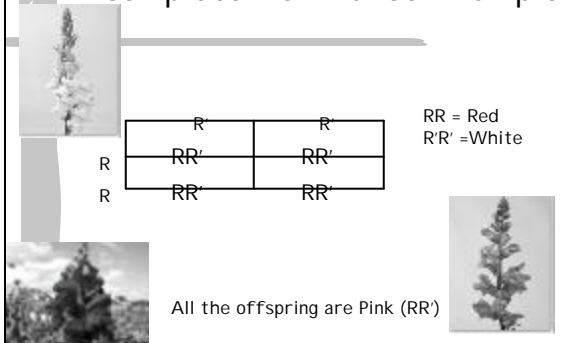
Incomplete Dominance:

- Blending of the homozygous phenotypes.
- Where the heterozygote shows an intermediate phenotype between the two homozygotes.
- Both alleles of the gene produce products which combine to give a new trait.
- Neither allele is more dominant than the other.
- Generally symbolized with the capital letter of the darker color and the same symbol prime for the other color (if colors.)

Incomplete Dominance:



Incomplete Dominance Example



Incomplete Dominance

- The alleles for curly hair and straight hair are examples of alleles for a trait that are incompletely dominant.
 - Individuals with curly hair are homozygous for curly hair alleles.
 - Individuals with straight hair are homozygous for straight hair alleles.
 - Individuals who are heterozygous, with one of each allele have wavy hair.

Co-Dominant:

- Where 2 types of alleles that are equally dominant.
- When an individual is heterozygous for such traits, both alleles for one trait in an individual are expressed equally.
- Phenotype of the heterozygote has both traits simultaneously.

Co-Dominance Horse Example



W W

W = White
B = Chestnut

B	BW	BW
B	BW	BW



All the offspring are Palomino (BW)

Co-Dominance Horse Example

	W	W
B	BW	BW
W	WW	WW

WW = White
BB = Chestnut
BW = Palomino

The offspring are 2 Palomino (BW) And 2 White (WW).

Co- Dominance

		RR	
		R	R
W	RW	RW	
W	RW	RW	

Sex-Linked Traits:

- Traits controlled by genes located on the sex chromosomes.
 - ie: Humans: 22 Homologous pairs of matching chromosomes (autosomes) and 1 pair of sex chromosomes (match if female only.)
 - There are genes found on (generally) the X chromosome that are not found on the Y chromosome.
 - Inheritance of phenotypic traits determined by these genes is therefore linked to the sex of the individual.
 - The Y chromosome is most important in determining the sex of an organism.
 - XX = Female; XY = Male

Sex-Linked Traits:



- Thomas Hunt Morgan was the first to discover sex-linkage in 1907.
 - Born: September 25, 1866
 - Died: December 4, 1945
 - American
 - He was working with *Drosophila* (Fruit Flies)
 - Notices eye color gene is on the X chromosome while performing test crosses in several generations.

Sex-Linked Traits

- When writing genotypes:
 - Put the trait gene as a superscript to the sex chromosome.
 - ie: $X^{R}X^{r}$ $X^{r}Y$

Sex-Linked Trait Example In Humans

- The X chromosome carries genes that are not associated with sex determination.
- One example is a gene that codes for a blood clotting protein. (The Y chromosome does not carry this gene.)
- Improper blood clotting is known as hemophilia.

Sex-Linked Hemophilia Example In Humans

- There are 3 types of possible chromosomal states:
 - X^H (X chromosome with normal blood clotting)
 - X^h (X chromosome with a mutant blood clotting gene)
 - Y^o (Y chromosome with no blood clotting gene)

Sex-Linked Hemophilia Example In Humans

- There are 5 types of possible genotypes:
 - $X^H X^H$ (female with normal blood clotting)
 - $X^H X^h$ (female with normal blood clotting but is a carrier of the trait)
 - $X^h X^h$ (female with hemophilia - rare condition)
 - $X^H Y^o$ (normal male)
 - $X^h Y^o$ (hemophiliac male)

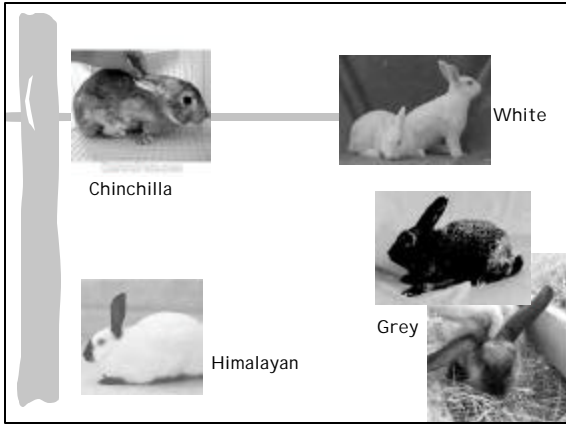
Sex-Linked Hemophilia Example

	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$
Y^o	$X^H Y^o$	$X^h Y^o$

The offspring are: 1 Normal Female
1 carrier Female
1 Normal Male
1 Hemphiliac Male

Multiple Alleles:

- When more than 2 alleles control a trait.
- Ie: 4 alleles for coat color in rabbits
 - C = dark grey
 - C^h = light grey (Chinchilla); dominant to c and c^h .
 - c = white
 - c^h = white with black points (Himalayan); dominant to c.



Example: Rabbit Fur

	c^{ch}	c^h
c^{ch}	$c^{ch} c^{ch}$	$c^{ch} c^h$
c^h	$c^h c^{ch}$	$c^h c^h$

The offspring are: all chinchillas