Topic 3 – Other patterns of Inheritance (heredity)
Pre-Class Reading Assignment

1. Read pgs 608-610

2. Define the following terms
    a. Wild type
    b. Mutant
    c. Incomplete dominance
    d. Codominance

Topic 3 – Other patterns of Inheritance (heredity)

Multiples Alleles

- Mendel only studied traits that had two possible alleles

- However, it is possible to have more than two alleles for one trait

- **wild type** - the most common allele of a gene with multiple alleles

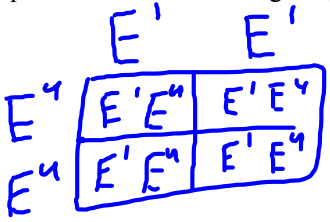
- **mutant** - any allele of a gene other than the wild type allele

- Geneticists who study fruit flies have noted the presence of many different eye colors
  - Red (wild-type) (E^1), apricot (E^2), honey (E^3), and white (E^4)
  - A fruit fly can only have only two different genes for eye color, but it can have many different combinations of alleles

Table 1 Dominance Hierarchy and Symbols for Eye Colour in *Drosophila*

Phenotype	Allele symbol	Possible genotype(s)	Dominant over
wild type	E^1	E^1E^1, E^1E^2, E^1E^3, E^1E^4	apricot, honey, white
apricot	E^2	E^2E^2, E^2E^3, E^2E^4	honey, white
honey	E^3	E^3E^3, E^3E^4	white
white	E^4	E^4E^4	

Example: A homozygous red eye fruit fly mates with a homozygous white eye fruit fly. Show the punnett square and determine the genotypic ratio and phenotypic ratio of the offspring.



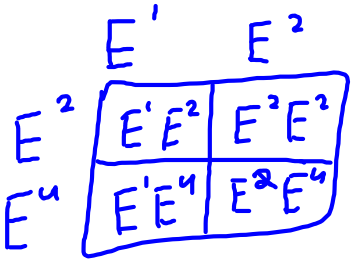
4:0:0:0

Example: A student working with *Drosophila* makes the following cross:

E^1E^2 (wild-type eye colour) x E^2E^4 (apricot eye colour)

What will be the phenotypic ratio of the offspring?

2:2:0:0



Incomplete Dominance

- the expression of both forms of an allele in a heterozygous individual in the cells of an organism

- **neither** the dominant or recessive phenotype is produced, instead, somewhere in the middle

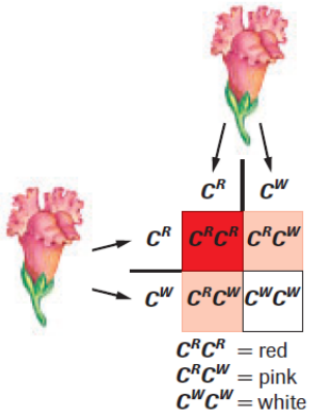


Figure 3
Colour in snapdragons is an example of incomplete dominance. When homozygous red-flowered snapdragons are crossed with homozygous white-flowered snapdragons, the F_1 generation all have pink flowers. When a cross is made between two F_1 individuals, the F_2 generation has a phenotypic ratio of one red to two pink to one white.

Codominance

- the expression of both forms of an allele in a heterozygous individual in different cells of the same organism

- results in both alleles being represented in the phenotype of the heterozygous individual

Example: Human blood type

- AB human blood type is an example of co-dominance since both A and B antigens are expressed
  - I^A the co-dominant A allele
  - I^B the co-dominant B allele
  - i or I^o is the recessive allele
  - Order of dominance: $I^A = I^B > I^o$

Genotype	Alternate way to write the genotype	Phenotype
$I^A I^A$	$I^A I^A$	A blood
$I^A i$	$I^A I^O$	A blood
$I^A I^B$	$I^A I^B$	AB blood
$I^B I^B$	$I^B I^B$	B blood
$I^B i$	$I^B I^O$	B blood
ii	$I^O I^O$	O blood

Effects of Environment

- Environmental conditions often affect the expression of genetic traits

- Some genes are influenced by temperature.

- Color pattern of Himalayan rabbits. Fur is pigmented on their feet, ears and face, the rest of the body is white

    - Genes that produce pigment only are active below a certain temperature

- Wings of fruit flies. Above a certain temperature wings that are formed are curly, not straight

Example:
Multiple alleles control the coat colour of rabbits. A grey colour is produced by the dominant allele *C*. The *Cch* allele produces a silver-grey colour, called chinchilla, when present in the homozygous condition, *CchCch*. When *Cch* is present with a recessive gene, a light silver-grey colour is produced. The allele *Ch* is recessive to both the full-colour allele and the chinchilla allele. The *Ch* allele produces a white colour with black extremities. This coloration pattern is called Himalayan. An allele *Ca* is recessive to all genes. The *Ca* allele results in a lack of pigment, called albino. The dominance hierarchy is *C* >*Cch* >*Ch* >*Ca*. Table 4 provides the possible genotypes and phenotypes for coat colour in rabbits. Notice that four genotypes are possible for full-colour but only one for albino.

(a) Indicate the genotypes and phenotypes of the F1 generation from the mating of a heterozygous Himalayan-coat rabbit with an albino-coat rabbit.

(b) The mating of a full-colour rabbit with a light-grey rabbit produces two full-colour offspring, one light-grey offspring, and one albino offspring. Indicate the genotypes of the parents.

(c) A chinchilla rabbit is mated with a light-grey rabbit. The breeder knows that the light-grey rabbit had an albino mother. Indicate the genotypes and phenotypes of the F1 generation from this mating.

(d) A test cross is performed with a light-grey rabbit, and the following offspring are noted: five Himalayan rabbits and five light-grey rabbits. Indicate the genotype of the light-grey rabbit.

Topic 3
Review Sheet

A horse that is homozygous for the allele *Cr* will have a chestnut, or reddish, coat. A horse that is homozygous for the allele *Cm* will have a very pale cream coat, called cremello. Palomino coat colour is determined by the interaction of both the chestnut and the cremello allele. Indicate the expected genotypic ratio and phenotypic ratio of the F1 progeny of a palomino horse with a cremello horse.

Several geneticists studied *M. jalapa* plants with deep crimson flowers and *M. jalapa* plants with yellow flowers. Cross-pollinating these plants produced plants with scarlet-red flowers (F_1 generation).

These F_1 plants were allowed to self-pollinate, and the resulting seeds produced *M. jalapa* plants with three different flower colours. Data similar to the following were collected for flower colour:

140 deep crimson
310 scarlet-red
160 yellow

—from *Engels, 1975*

With respect to the alleles for flower colour, these results indicate

A. X-linked inheritance
B. gene-linked inheritance
C. dominant-recessive inheritance
D. incomplete dominance inheritance

A different variety of homozygous *M. jalapa* produces flowers that are light crimson. Pure-breeding genotypes and phenotypes are:

R^PR^P – deep crimson
RR – light crimson
rr – yellow

When two pure-breeding P_1 plants are cross-pollinated, only scarlet-red-flowered offspring (R^Pr) are produced.

When another pair of pure-breeding P_1 plants are cross-pollinated, only orange-flowered offspring (Rr) are produced.

—from *Engels, 1975*

The likely genotypes of the P_1 plants for these two crosses is represented in row

Row	P_1 genotypes scarlet-red-flowered offspring	P_1 genotypes orange-flowered offspring
A	$R^PR \times rr$	$RR \times rr$
B	$R^PR^P \times rr$	$RR \times rr$
C	$R^Pr \times R^Pr$	$Rr \times Rr$
D	$R^PR^P \times RR$	$R^PR \times Rr$

Which of the following phenotypes is the predicted flower colour of *M. jalapa* with the genotype R^PR?

A. Yellow
B. Orange
C. Crimson
D. Scarlet-red