

Each Mouse Click will present information

# Gregor Mendel Genetics Punnett Square

Demos of  
Single Trait,  
Double Trait  
Incomplete Dominance  
Codominance  
& Sex Linked Crosses  
Other Genetic Traits

# Single Trait Cross

Parent Generation P1

pure Tall plant (TT) x pure short plant (tt)

Tall (T) is **dominant** short (t) is **recessive**

Both parents **Genotypes** are **homozygous** 1 TT & 1 tt

The parents **Phenotypes** are 1 Tall 1 short 1:1

$$F1 = TT \times tt$$

T	T
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+	+ T TALL	+ T TALL
+	+ T TALL	+ T TALL

Genotype all 4 heterozygous

Phenotype 4 Tall 0 short

$$F2 = Tt \times Tt$$

T	t
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T	+ T TALL	+ t TALL
t	+ T TALL	+ t short

Genotype 2 homozygous 2 heterozygous

Phenotype 3 Tall to 1 short 3:1

# Double Trait Cross

Parent Generation P1

Tall Red flowered (TtRr) x Tall Red flowered (TtRr)

Tall (T) & Red (R) are **dominant** to short (t) & white (r)

Both parents **Genotypes** are **heterozygous**

Both parents **Phenotypes** are Tall Red flowered

F1 = TtRr x TtRr

TtRr

Phenotype Ratio

9 Tall & Red

3 Tall & white

3 short & Red

1 short & white

Genotype Ratio

14 heterozygous

2 homozygous

	TR	Tr	tR	tr
TR	TTRR TallRed	TTRr TallRed	TtRR TallRed	TtRr TallRed
Tr	TTrR TallRed	Ttrr TallWhite	TtRr TallRed	Ttrr TallWhite
tR	tTRR TallRed	tTrR TallRed	ttRR shortRed	ttRr shortRed
tr	tTrR TallRed	ttrr TallWhite	ttRr shortRed	ttrr shortwhite

# Incomplete Dominance

Parent Generation P1

white plant (ww) x red plant (rr)  
Phenotype

NO traits are dominant

ww=white      rr=red      rw=pink

Genotype = Homozygous

Genotype = Heterozygous

F1 = WW X rr

W                      w

r	r W pink	r w pink
r	r W pink	r w pink

Genotype all are Heterozygous

Phenotype all will look pink 4:0

F2 = rW X rW

r                      w

r	r r red	r w pink
w	w r pink	w w white

Genotype 2heterozygous 2 homozygous

Phenotype 1 white    2 pink    1 red    1:2:1

Male  
XY

Female  
XX

# Sex Linked Cross

The trait for colorblindness is carried ONLY on the X chromosome

C = Normal Color Vision      c = Color Blind Vision

Male possibilities       $X_C Y$  or  $X_c Y$

Female possibilities       $X_C X_C$  or  $X_C X_c$  or  $X_c X_C$

Cross colorblind male  $X_c Y$  with normal vision carrier female  $X_C X_c$

2 Females

1 color blind

1 normal vision  
but carrier for  
color blindness



2 Males

1 color blind

1 normal

$X_C X_c$ female colorblind	$X_c Y$ male colorblind
$X_C X_C$ female normal but carrier	$X_C Y$ male normal

Genotype Ratio  
= 1:1:1:1

# Codominance (Blood Types)

- Blood type (A, B, AB, or O) is caused by genes which code for the production of special protein/sugar (glycoprotein) molecules on the cell membrane of blood cells.
- Each blood type causes the production of a different kind of glycoprotein.
- Patients with Type O blood must receive Type O blood
- Type O blood is the universal blood type and is the only blood type that can be transfused to patients with other blood types
- That means that one gene doesn't necessarily mask the presence or actions of another.
- "A" is a dominant gene and causes the production of one type of blood glycoprotein.
- "B" is also dominant (codominant) and causes the production of another type of blood glycoprotein.
- "o" gene is recessive and is masked by either "A" or "B".
- Blood type A could be either "AA" or "Ao" (since "o" is recessive)
- Blood type B could be either "BB" or "Bo" (since "o" is recessive).
- Blood type o must be "oo".
- Blood type AB doesn't have either type A blood or type B blood.
  - Instead, they have type AB blood because both genes are dominant.

# Codominance (Blood Types)

A married couple wants to know what the possible blood types their children may have

Mom is **Ao** x Dad is **AB**

**A**      **o**

<b>A</b>	<b>A</b>	<b>Ao</b>
<b>B</b>	<b>B</b>	<b>Bo</b>

Blood Phenotypes

2 A types

1 AB type

1 B type

Blood Genotypes

1 AA

1 Ao

1 AB

1 Bo

# Epistasis

occurs when a single gene influences multiple phenotypic traits.

**Gene 1 - production of pigment**

**BB - Black**

**Bb - black**

**bb - chocolate**

**Gene 2 - pigment deposition**

**EE or Ee - pigment deposited**

**ee - no pigment deposited**

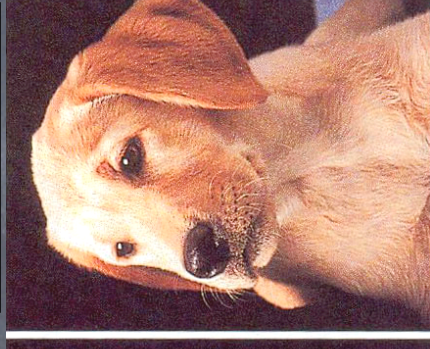
What phenotype ratio's a male black lab BbEe crossed with a female bbEe?

- 6 will be Black
- 6 will be Chocolate
- 4 will be Golden

Black Lab



Golden Lab



Chocolate Lab



BBEE  
BBEe  
BbEE  
BbEe

**BBee**  
**Bbee**  
**bbee**

bbEE  
bbEe

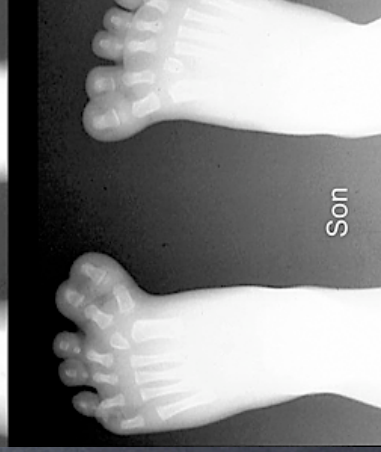
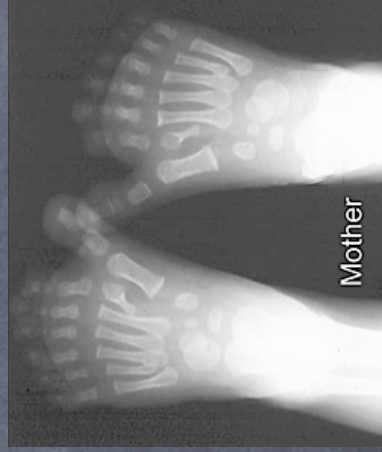
BE                      Be                      be

	BbEE	BbEe	bbEE	bbEe
bE	BbEE	BbEe	bbEE	bbEe
be	BbEe	<b>Bbee</b>	bbEe	<b>bbee</b>
bE	BbEE	BbEe	bbEE	bbEe
be	BbEe	<b>Bbee</b>	bbEe	<b>bbee</b>



# Polydactyly

Maine Coon Cats



Alfredo Alfonseca  
"The Six Shooter"  
former Chicago Cubs relief pitcher  
Six fingers and toes on each hand  
& foot  
all functional!

# Lethal Alleles

Manx Cat

Tail-less  $Mm$

Tail  $mm$

Lethal  $MM$



What happens if you breed two tailless Manx kitties?

What is the chance of you getting a kitten with a tail?

What is the chance of a kitten getting a lethal allele?

$M$

$m$



$M$



$Mm$



$Mm$

$m$

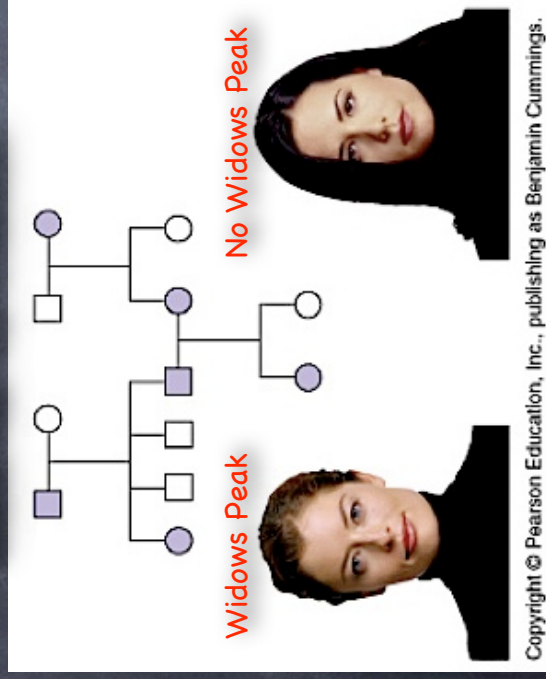


$mm$

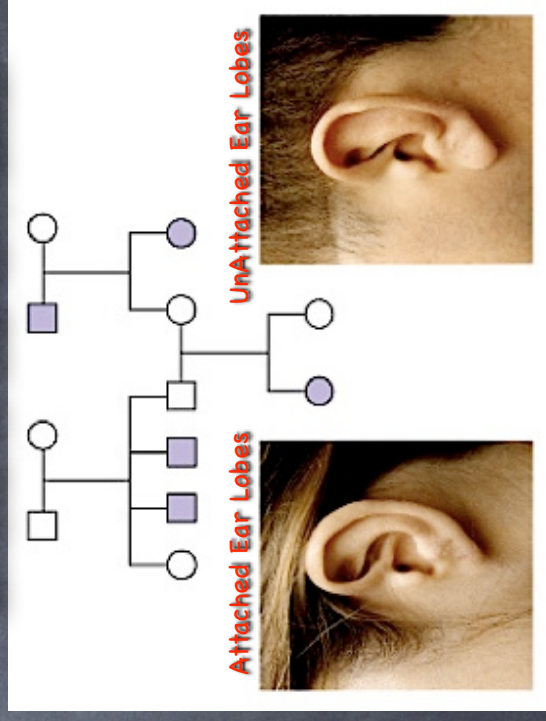
# Pedigree Analysis

- Pedigree analysis shows Mendelian patterns in human inheritance.
- A family pedigree can be assembled into a family tree that shows the relationships of parents and children across the generations.
- In the family trees below, squares symbolize males and circles represent females.
- The horizontal line connecting a male and a female indicates a mating.
- Offspring are listed below in order of birth from left to right.
- Shaded symbols stand for individuals with the trait being expressed.

Widows Peak trait is Dominant



UnAttached Ear Lobes trait is Dominant



What pair of trait alleles would indicate the genotype for the each family member in the two family trees above