

11.3 Exceptions to Mendel's rules

- Incomplete Dominance
- Codominance
- Multiple Alleles
- Polygenic Traits

Incomplete Dominance

- **Incomplete dominance** = one allele is not completely dominant over another
 - Phenotype is a combination of the two alleles
- EXAMPLE: Four o'clock flowers

R = Red

W = White

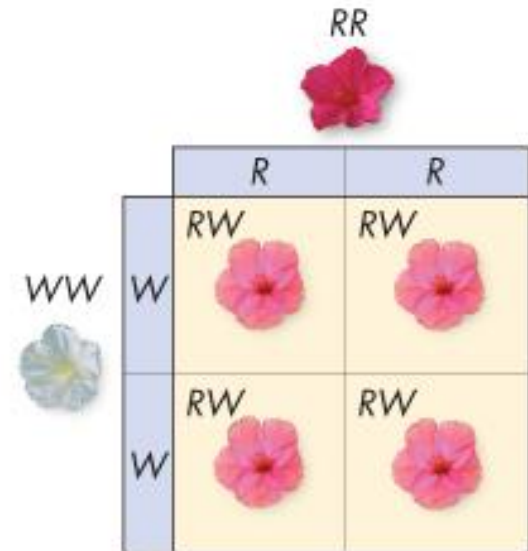
What are the genotypes of the following?

Red RR White WW Pink RW

What are the phenotypes of the following

RR Red RW Pink WW White

Cross a white flower with a red flower



Codominance



- **Codominance** = both alleles are seen in phenotype

– The phenotype shows each allele

Example – Some varieties of chickens

W = White

B = Black



WW = White BB = Black BW = Black AND White

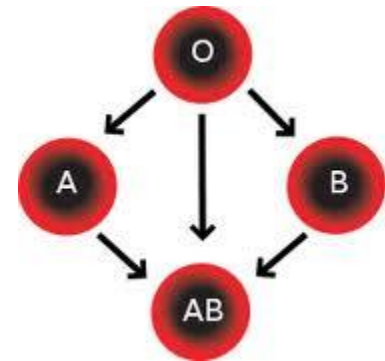
What is the phenotypic ratio when you cross two heterozygous chickens????

1 Black : 2 Black and White : 1 White

	B	W
B	BB	BW
W	BW	WW

Multiple Alleles

- **Multiple alleles** = there are more than 2 alleles for a trait
 - Example – rabbit's fur color, human blood types



Disorders caused by individual genes – codominant and multiple alleles

- ABO Blood Types
 - A (I^A) and B (I^B) are codominant
 - O (i) is recessive

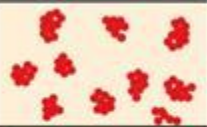


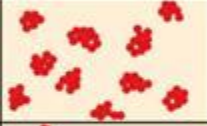




father	mother		
	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

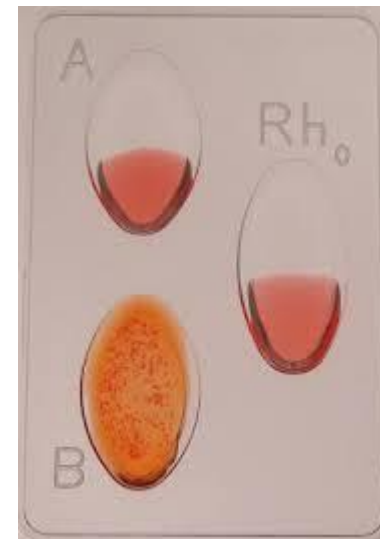
alleles blood type

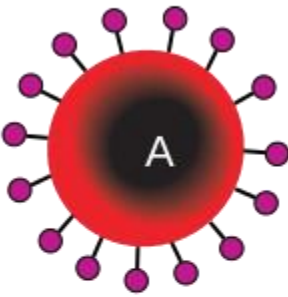
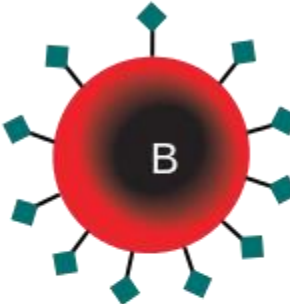
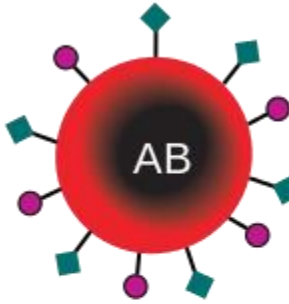
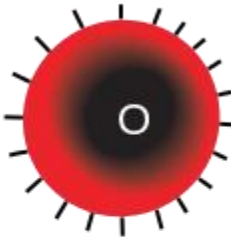
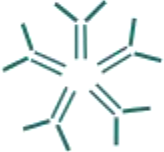

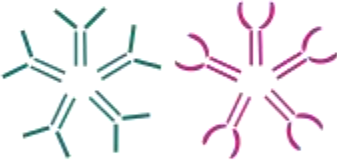



A+A = A
 A+O = A
 A+B = AB
 B+B = B
 B+O = B
 O+O = O

Blood Groups				
Phenotype (Blood Type)	Genotype	Antigen on Red Blood Cell	Safe Transfusions	
			To	From
A	$I^A I^A$ or $I^A i$	A	A, AB	A, O
B	$I^B I^B$ or $I^B i$	B	B, AB	B, O
AB	$I^A I^B$	A and B	AB	A, B, AB,
O	ii	None	A, B, AB,	O

Blood Typing

Blood type of cells	Genotype	Antibodies made by body	Reaction to added antibodies	
			Anti-A	Anti-B
A	$I^A I^A$ or $I^A i^O$	Anti-B		
B	$I^B I^B$ or $I^B i^O$	Anti-A		
AB	$I^A I^B$	Neither anti-A nor anti-B		
O	$i^O i^O$	Both anti-A and anti-B		



	Group A	Group B	Group AB	Group O
Red blood cell type	 <p>A</p>	 <p>B</p>	 <p>AB</p>	 <p>O</p>
Antibodies in Plasma	 <p>Anti-B</p>	 <p>Anti-A</p>	<p>None</p>	 <p>Anti-A and Anti-B</p>
Antigens in Red Blood Cell	 <p>A antigen</p>	 <p>B antigen</p>	 <p>A and B antigens</p>	<p>None</p>

Polygenic Traits

- **Polygenic trait** = traits produced by more than one gene
 - Examples – human skin color and height

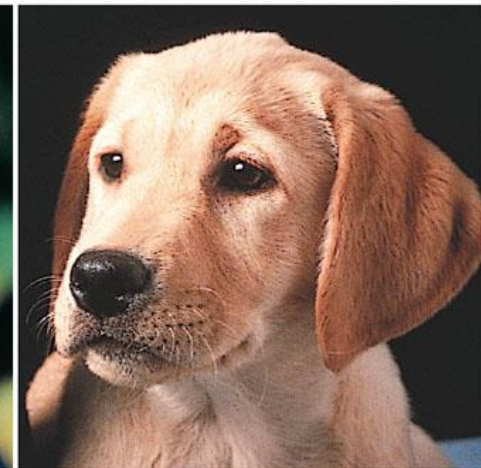
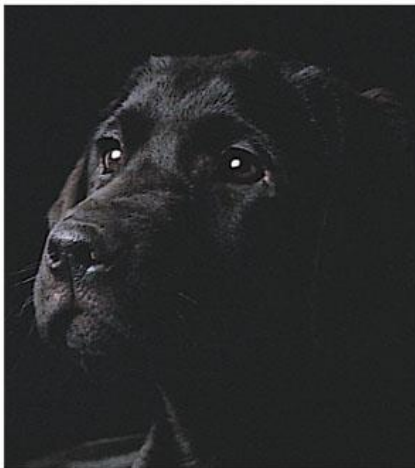


Epistasis

- **Epistasis**
 - Two or more gene products influence a trait
 - Typically, one gene product suppresses the effect of another
- *Example:* Coat color in dogs
 - Alleles *B* and *b* designate colors (black or brown)
 - Two recessive alleles *ee* suppress color

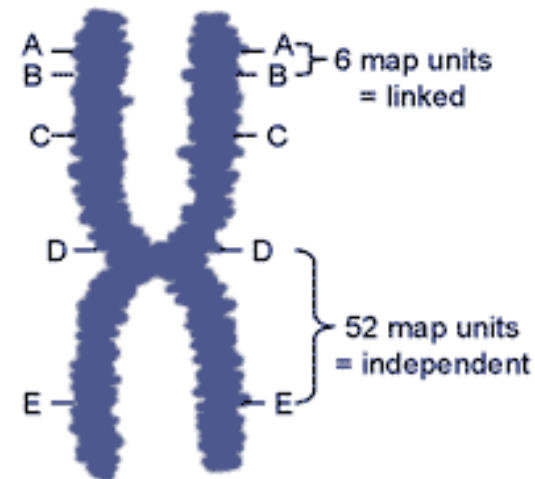
Epistasis in Coat Colors

	EB	Eb	eB	eb
EB	$EEBB$ black	$EEBb$ black	$EeBB$ black	$EeBb$ black
Eb	$EEBb$ black	$EEbb$ chocolate	$EeBb$ black	$Eebb$ chocolate
eB	$EeBB$ black	$EeBb$ black	$eeBB$ yellow	$eeBb$ yellow
eb	$EeBb$ black	$Eebb$ chocolate	$eeBb$ yellow	$eebb$ yellow

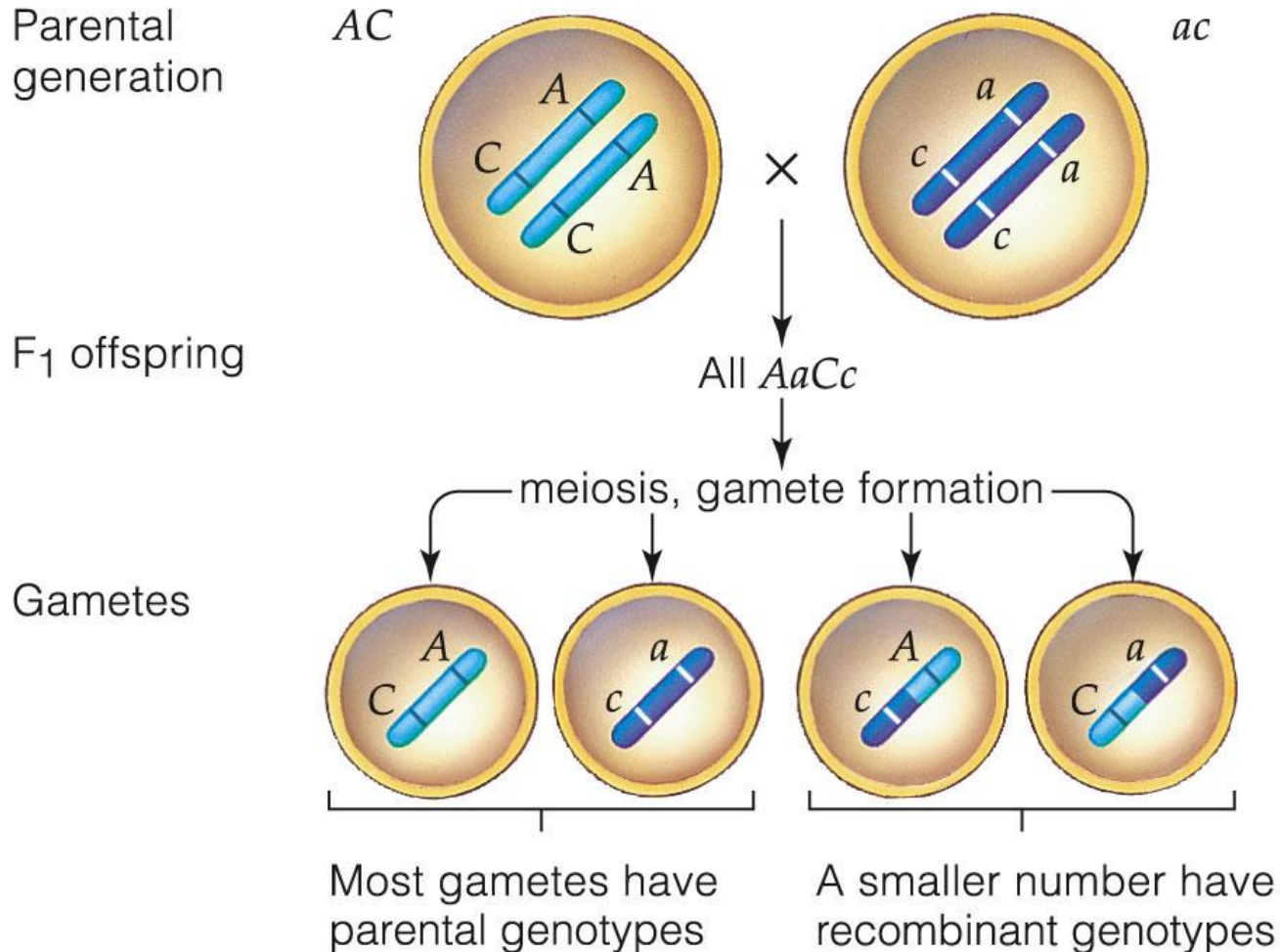


11.5 Linkage Groups

- The farther apart two genes are on a chromosome, the more often crossing over occurs between them
- **Linkage group**
 - All genes on one chromosome
 - **Linked** genes are very close together; crossing over rarely occurs between them

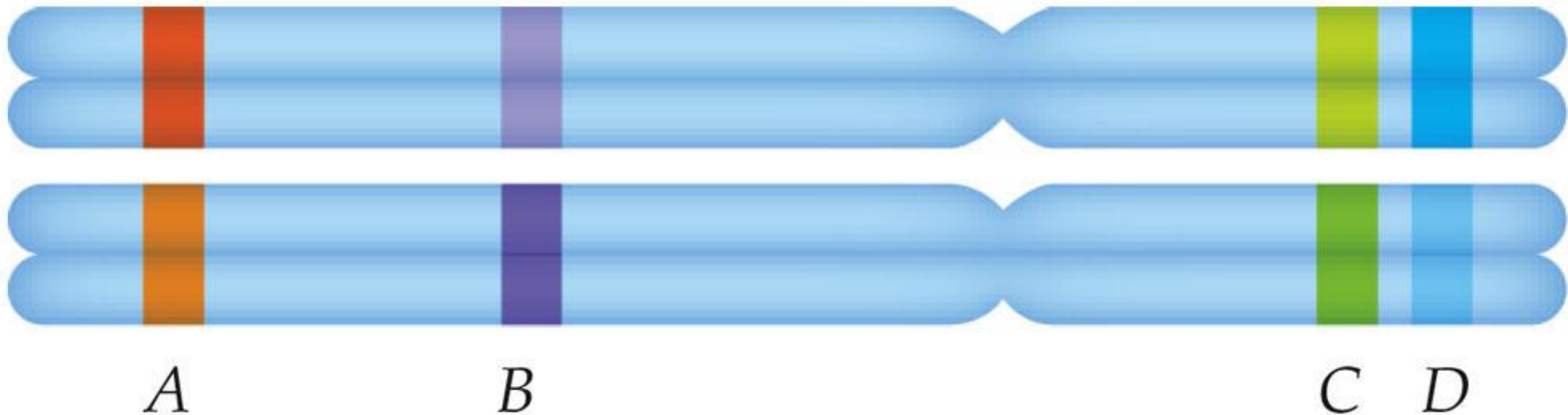


Linkage and Crossing Over



The Distance Between Genes

- The probability that a crossover event will separate alleles of two genes is proportional to the distance between those genes



Genes and the Environment

- Genes provide a plan for development, but environment also plays a role in phenotype

