

# Genetics: The Science of Heredity

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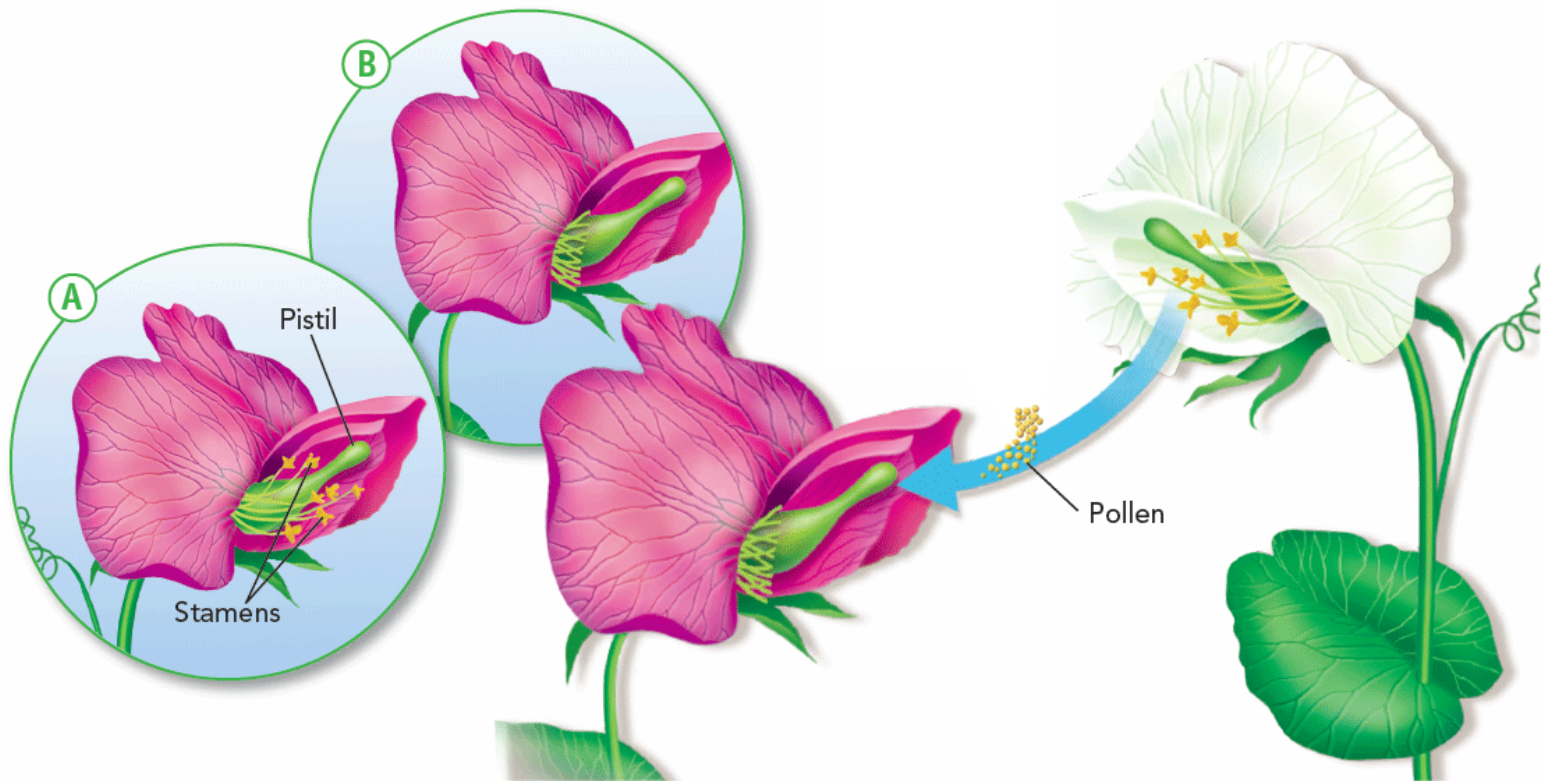
Patterns of Inheritance

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# What Is Heredity?

## Crossing Pea Plants

Mendel devised a way to cross-pollinate pea plants.

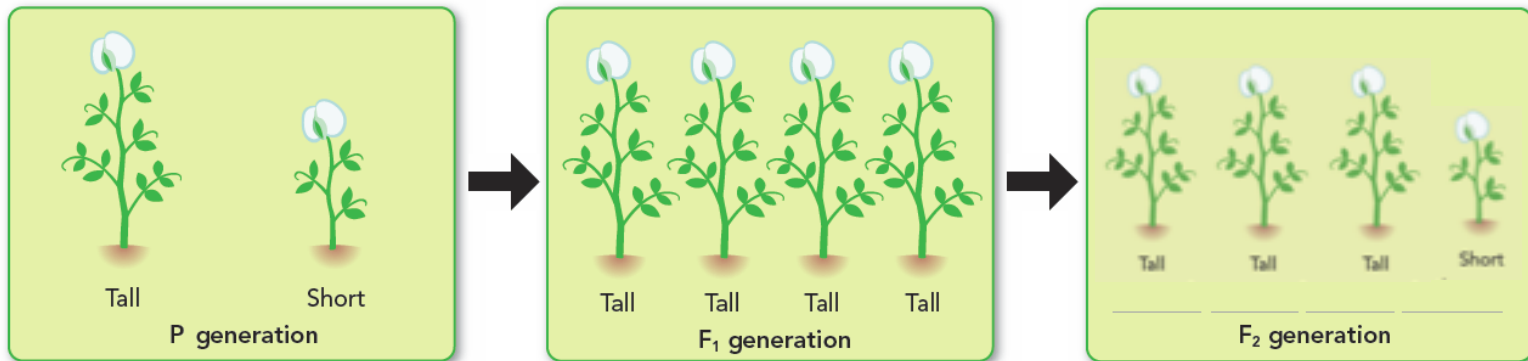


# What Is Heredity?

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## Results of a Cross

In Mendel's crosses, some forms of a trait were hidden in one generation but reappeared in the next. What was surprising about the offspring in the  $F_2$  generation?



# What Is Heredity?

**Genes** describe the factors that control a trait.




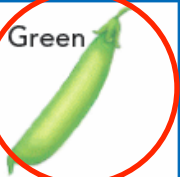





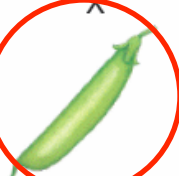











**Alleles** are the different forms of a gene.

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## Alleles in Pea Plants

Mendel studied the inheritance of seven different traits in pea plants.

**Circle the picture of each dominant form of the trait in the P generation.**

Inheritance of Pea Plants Studied by Mendel							
	Seed Shape	Seed Color	Pod Shape	Pod Color	Flower Color	Flower Position	Stem Height
P	Wrinkled 	Yellow 	Pinched 	Green 	Purple 	Tip of stem 	Tall 
	X Round 	X Green 	X Smooth 	X Yellow 	X White 	X Side of stem 	X Short 
F <sub>1</sub>	Round 	Yellow 	Smooth 	Green 	Purple 	Side of stem 	Tall 

# What Is Heredity?

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**Phenotype:** an organisms physical appearance. What genes are expressed.


**Genotype:** an organisms genetic makeup, or alleles.


## Dominant and Recessive Alleles

What are the symbols and descriptions of allele? Use the word bank to complete the statements.


**What are the two possible ways the F<sub>2</sub> offspring could look?**

**Word Bank**  
dominant  
recessive

**P**  Tall  
 $\underline{T} \quad \underline{T}$   
Purebred

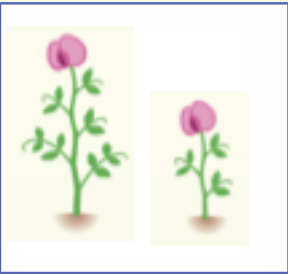
 Short  
 $\underline{t} \quad \underline{t}$   
Purebred

---

**F<sub>1</sub>**  Tall  
 $\underline{T} \quad \underline{t}$   
Hybrid

All plants inherit one dominant allele and one recessive allele. These plants are all tall.

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**F<sub>2</sub>** 

Plants may inherit two dominant alleles. These plants are tall.

Plants may inherit one dominant allele and one recessive allele. These plants are tall.

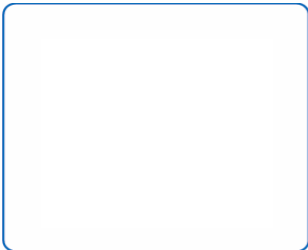
Plants may inherit two recessive alleles. These plants are short.

# 5.2 Probability and Heredity

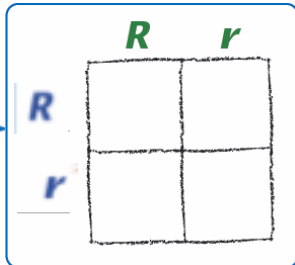
## How to Make a Punnett Square

What are the steps in using a Punnett Square to find the probabilities of a genetic cross?

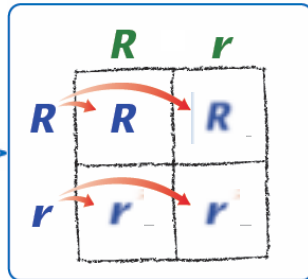
1 Start by drawing a box and dividing it into four squares.



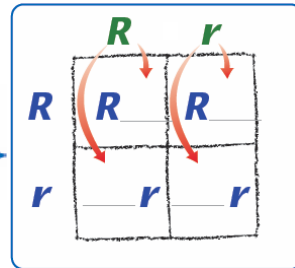
2 The male parent's alleles are written along the top of the square. Fill in the female parent's alleles along the left side.



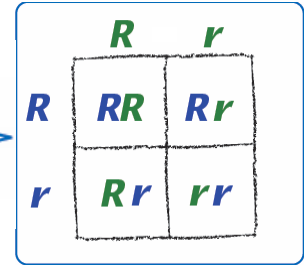
3 Copy the female parent's alleles into the boxes to their right. The first one is done for you.



4 Copy the male parent's alleles into the boxes beneath them.



5 The completed square shows all the possible allele combinations the offspring can have.



# Probability and Heredity

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## Describing Inheritance

An organism's phenotype is its physical appearance. Its genotype is its genetic makeup. Complete the missing information in the table.

**Homozygous:** an organism that has two identical alleles for a trait.

**Heterozygous:** an organism that has two different alleles for a trait.

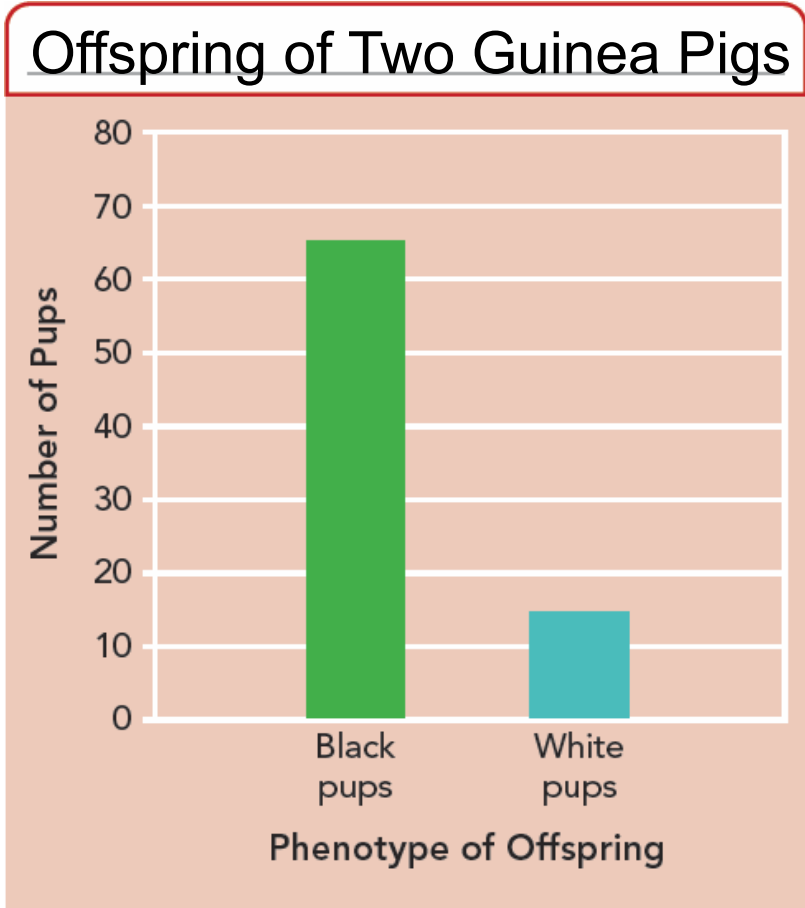
Smooth = S  
Pinched = s

Phenotypes and Genotypes		
Phenotype	Genotype	Homozygous or Heterozygous
Smooth pods	<u>SS</u>	<u>Homozygous</u>
Smooth pods	<u>Ss</u>	<u>Heterozygous</u>
Pinched pods	<u>ss</u>	<u>Homozygous</u>

# Probability and Heredity

**Probability:** a number that describes how likely it is that an event will occur.

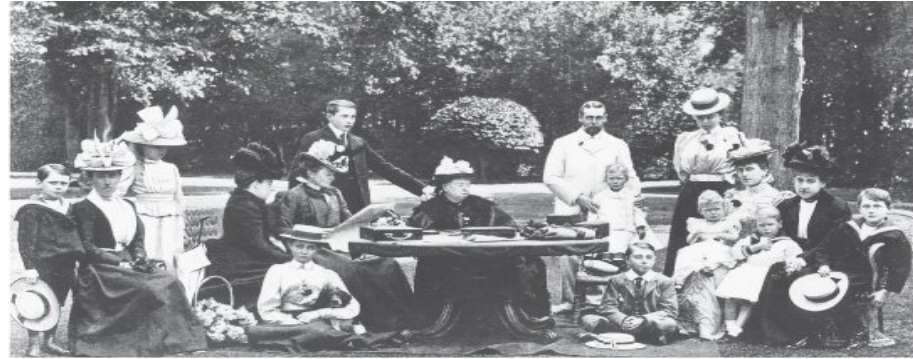
This graph shows the phenotypes of guinea pig pups. What would be a good title for the graph?



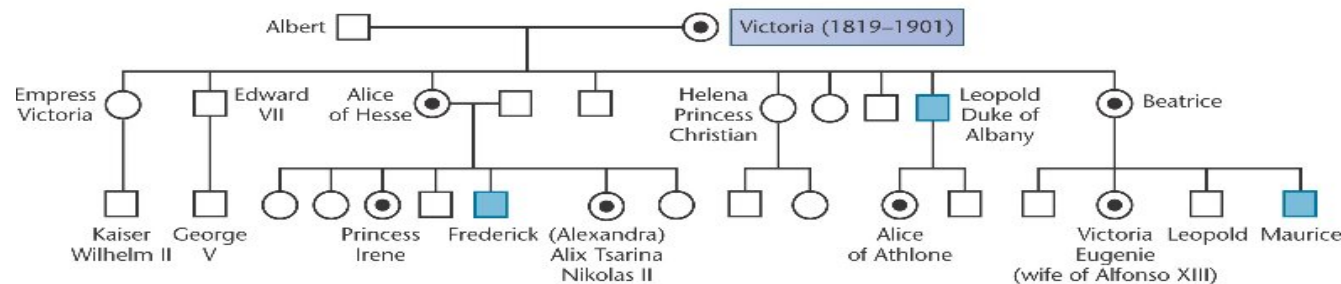


# Chromosomes and Inheritance

Genetics is the study of heredity.



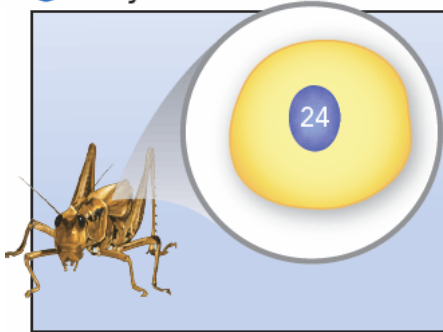
**Pedigree**



A pedigree is a chart or “family tree” that tracks members of a family that have a particular trait.

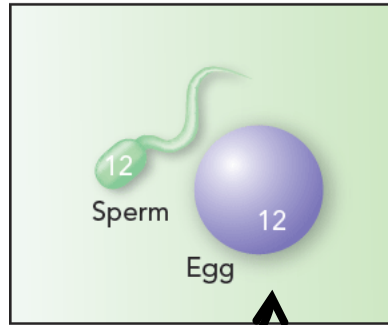
# Chromosomes and Inheritance

1 Body Cell



Each grasshopper body cell has 24 chromosomes.

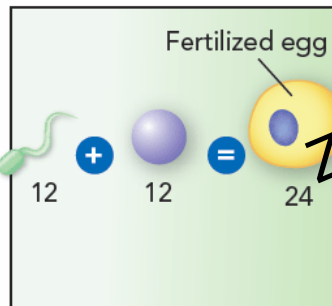
2 Sex Cells



Sutton found that grasshopper sex cells each have 12 chromosomes.

*1/2 the chromosomes of body cells*

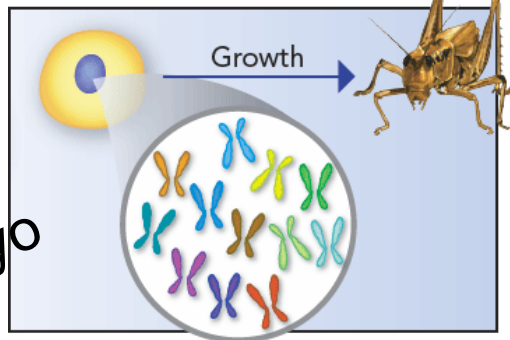
3 Fertilization



The fertilized egg cell has 24 chromosomes.

*Zygote to Embryo*

4 Grasshopper Offspring



The 24 chromosomes exist as 12 pairs.

**Fertilization:** A form of sexual reproduction when an egg and sperm cell join to form a new cell.

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## Paired Up

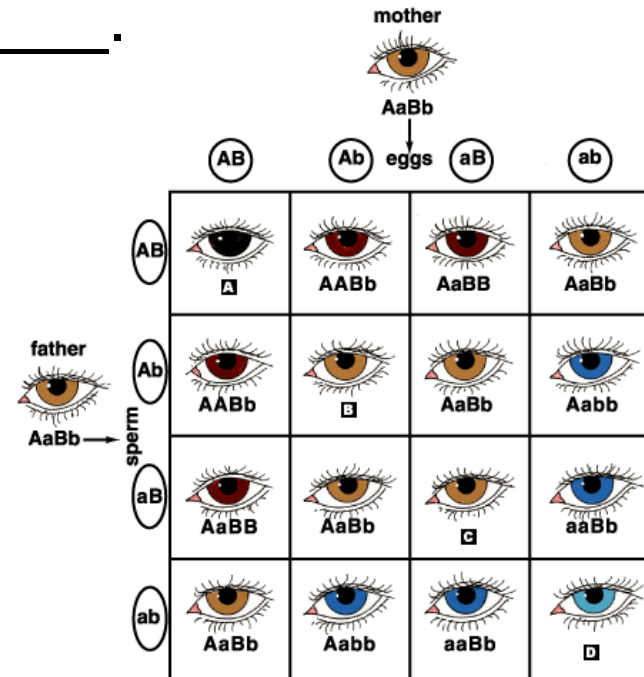
Sutton studied grasshopper cells through a microscope. He concluded that genes are carried on chromosomes.

# Are most traits a result of two-alleles?

# NO!!!!

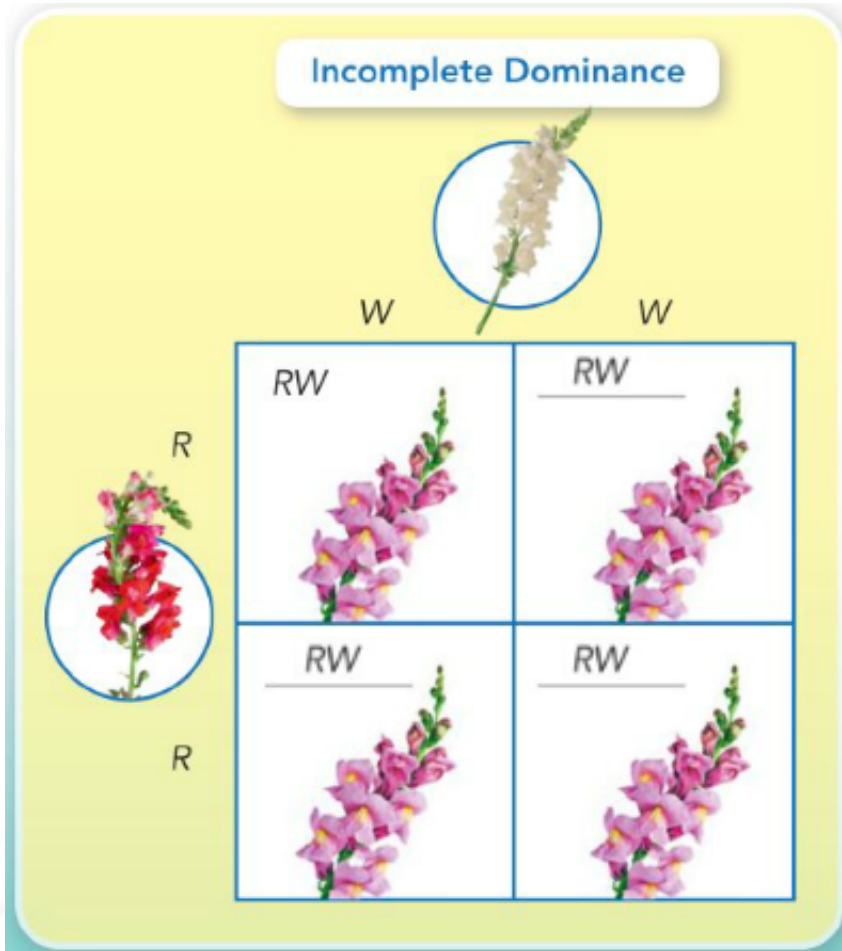
- Most traits are the result of complex patterns of inheritance.

	B/G	B/g	b/G	b/g
B/G	BB/GG	BB/Gg	Bb/GG	Bb/Gg
B/g	BB/Gg	BB/gg	Bb/Gg	Bb/gg
b/G	Bb/GG	Bb/Gg	bb/GG	bb/Gg
b/g	Bb/Gg	Bb/gg	bb/Gg	bb/gg



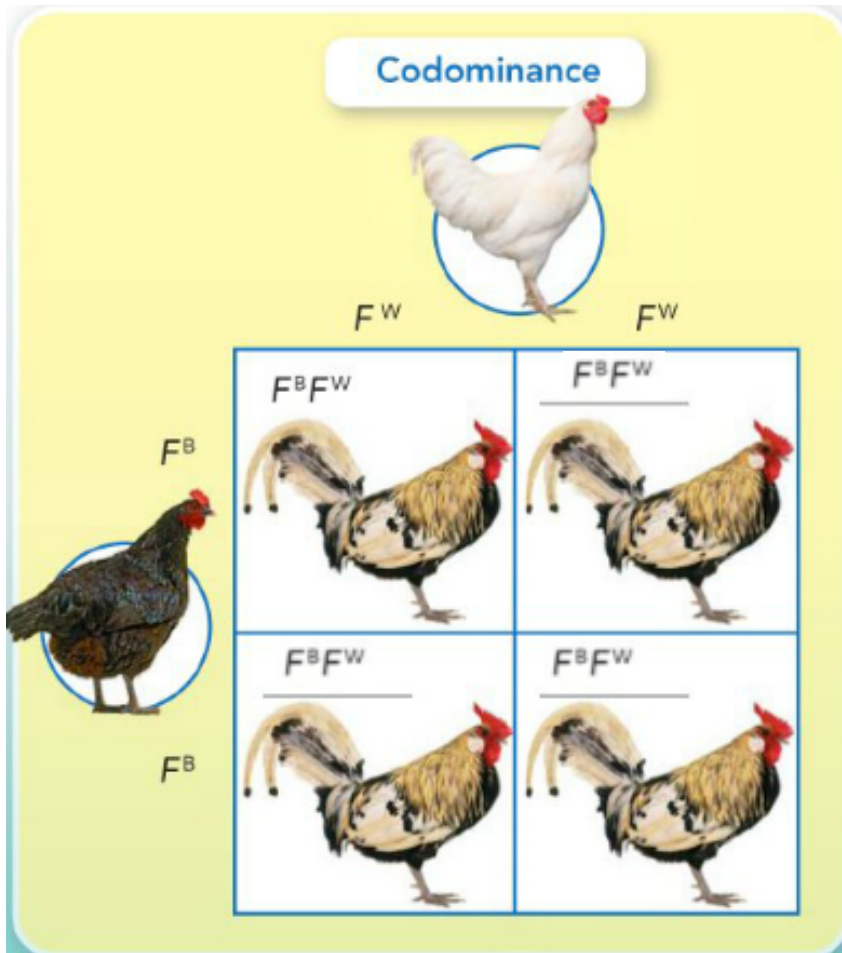
# Incomplete Dominance

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- When an allele is only partially dominant.
- For example: a red snapdragon and a white snapdragon produce pink offspring.

# Codominance



- When both allele for a trait are expressed equally
- For example: a black hen, and a white hen, will produce offspring with both feathers.

## Multiple Alleles:

when three or more alleles determine the trait.

EX: Blood types

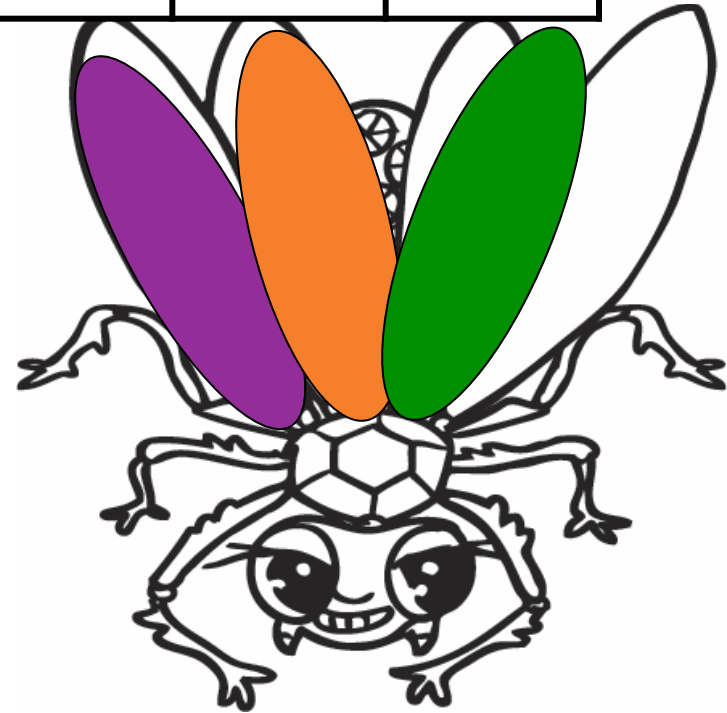
## Blingwings

An imaginary insect called the blingwing has three alleles for wing color: R (red), B (blue), and Y (yellow). What are the possible allele pairs for wing color in the blingwings?

RR      RB      RY  
BB      BY      YY

## Patterns of Inheritance

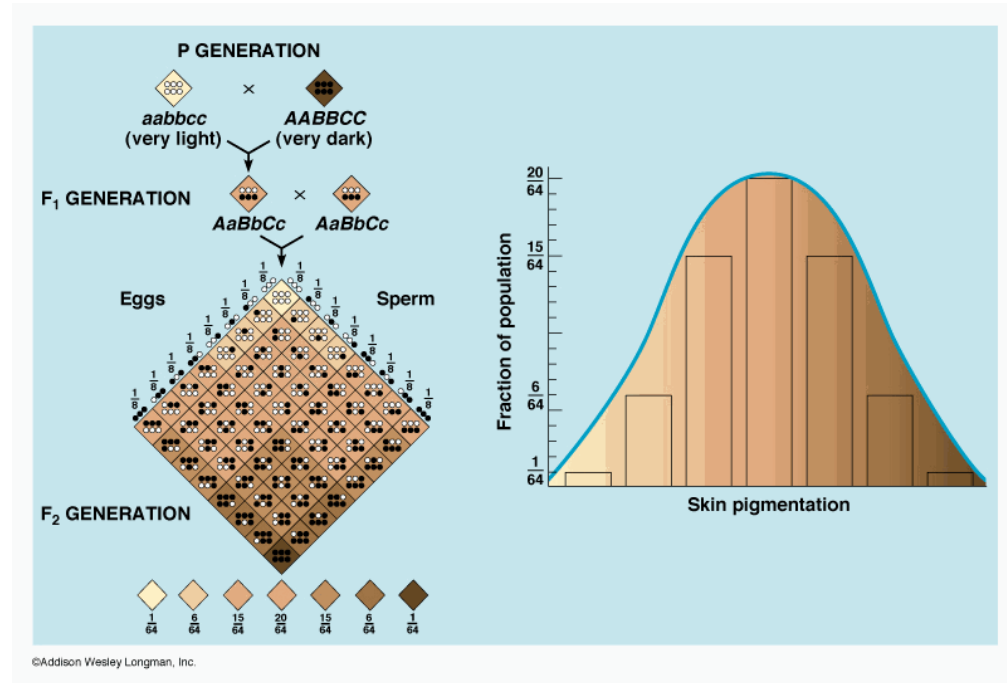
	R	B	Y
R	RR	RB	RY
B	RB	BB	BY
Y	RY	BY	YY



# Polygenic Inheritance

Inherited traits that are controlled by two or more **genes**

**EX: height, skin color, eye color, hair color . . .**



# Inherited vs Learned/Acquired Traits

## Inherited Traits

- Result of heredity
- Traits passed on from parent to offspring
- Determined by alleles
- Determined by genes
- EX: Hair, eye and skin color; height; blood type...

## Learned / Acquired Traits

- Influenced by environment
- Result of culture

**Can the environment also influence the way our genes are expressed?**

**Yes!**



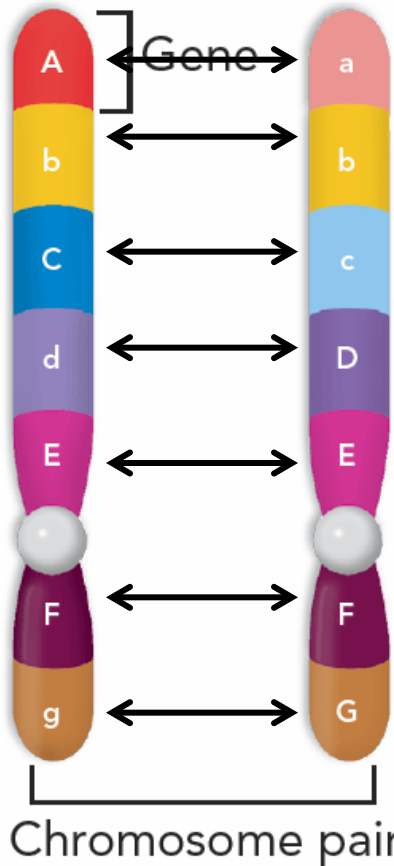


# Chromosomes and Inheritance

A human body cell has 46 chromosomes that form 23 pairs.

## A Pair of Chromosomes

Chromosomes in a pair may have different alleles for some genes and the same alleles for others. Is the organism homozygous or heterozygous?



Heterozygous

Homozygous

Heterozygous

Heterozygous

Homozygous

Homozygous

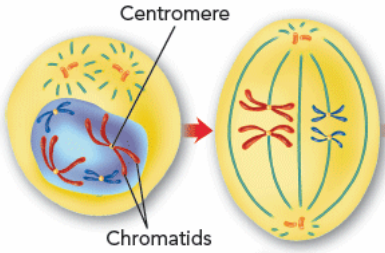
Heterozygous

# Chromosomes and Inheritance

**Meiosis:** During meiosis, a cell produces sex cells with half the number of chromosomes.

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**Before Meiosis**  
Every chromosome in the parent cell is copied. Centromeres hold the two chromatids together.



1 The chromosome pairs line up in the center of the cell.

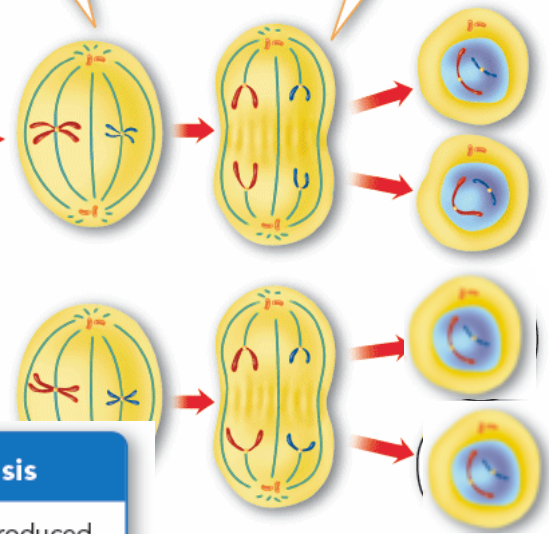
2 The pairs separate and move to opposite ends of the cell.

3 Two cells form. Each cell has half the original number of chromosomes. Each chromosome is still made of two chromatids.

4 In each cell, the **chromosomes** move to the center.

5 The centromeres split, and the **chromatids** separate. They become single chromosomes and move to opposite ends of the cell.

**After Meiosis**  
Four sex cells are produced. Each cell has half the number of chromosomes of the parent cell. Each sex cell has only one chromosome from an original pair.  
How many chromosomes are in each cell in Step 3? two



# Reproduction

## Sexual Reproduction

- Example: Meiosis
- Inherited genes from two parents
- Develop from a zygote to ... embryo to...(in fetal development)
- Offspring have a great degree of genetic variation

## Asexual Reproduction

- Ex: Mitosis, Binary Fission, and Budding-in yeast
- Are an exact copy of their parent cell
- Offspring have less genetic variation

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