

What is Genetics?



Genetics is the study of heredity

- ✦ Heredity is the transmission of traits from **parent to offspring**.
- ✦ These factors determine individual characteristics: responsible for the resemblances between parents and offspring

Where did the interest in genetics come from?



- ✦ Agriculture and selective breeding
- ✦ Characteristics seen in parent/child

Examples of selective breeding







Types of Traits

- ✦ Trait – an inherited characteristic
- ✦ Dominant trait- shown in the outward appearance even if recessive trait is present
- ✦ Recessive trait - hidden trait that can be masked by a dominant trait

Lets look at your traits!



✦ Survey

The beginnings of Genetics

Gregor Mendel

When and where did he live?

What was his life like?

What did he do?

Describe his research

What did he discover?



Gregor Mendel



Mendel
1884

- ✦ **Austrian Monk**
- ✦ **Biologist**
- ✦ **Father of Genetics**
- ✦ worked with pea plants to determine patterns from one generation to the next
- ✦ Identified characteristics as traits



The life of Gregor Mendel

✦ He was a son of a peasant who learned much about **agriculture** who went to a monastery to study theology. After failing his **teacher** examination, he went to the University of Vienna to study **science** and **math**. There he learned how to study science through **experimentation** and how to use mathematics to explain natural phenomena.

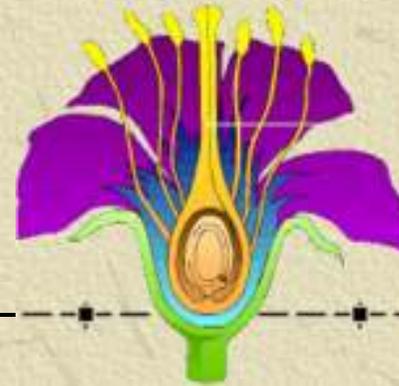
✦ After attending the University, Mendel returned to the monastery where he studied **pea plants**.





✦ While Mendel's research was with plants, the basic underlying principles of **heredity** that he discovered also apply to people and other animals because the mechanisms of **heredity** are essentially the same for all complex life **forms**.

Experiments



- ✦ Used pea plants because they grow and reproduce quickly- either self pollinate, or cross pollinate
- ✦ Used observations, crossed pea plants: short with short and tall with tall
- ✦ Led to the discovery of dominant and recessive traits





What did Mendel discover?

✦ Mendel discovered the basic rules that govern genetics

- ◆ Law of Dominance
- ◆ Law of Segregation
- ◆ Law of Independent Assortment

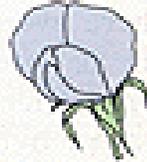
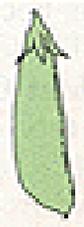


FLOWER COLOR	 Purple	 White
FLOWER POSITION	 Axial	 Terminal
SEED COLOR	 Yellow	 Green
SEED SHAPE	 Round	 Wrinkled
POD SHAPE	 Inflated	 Constricted
POD COLOR	 Green	 Yellow
STEM LENGTH	 Tall	 Dwarf



TABLE 10.1 Mendel's Results from Monohybrid Crosses

	P		F ₂			
	DOMINANT	× RECESSIVE	DOMINANT	RECESSIVE	TOTAL	RATIO
Spherical	×	Wrinkled seeds	5,474	1,850	7,324	2.96:1
Yellow	×	Green seeds	6,022	2,001	8,023	3.01:1
Purple	×	White flowers	705	224	929	3.15:1
Inflated	×	Constricted pods	882	299	1,181	2.95:1
Green	×	Yellow pods	428	152	580	2.82:1
Axial	×	Terminal flowers	651	207	858	3.14:1
Tall	×	Dwarf stems	787	277	1,064	2.84:1

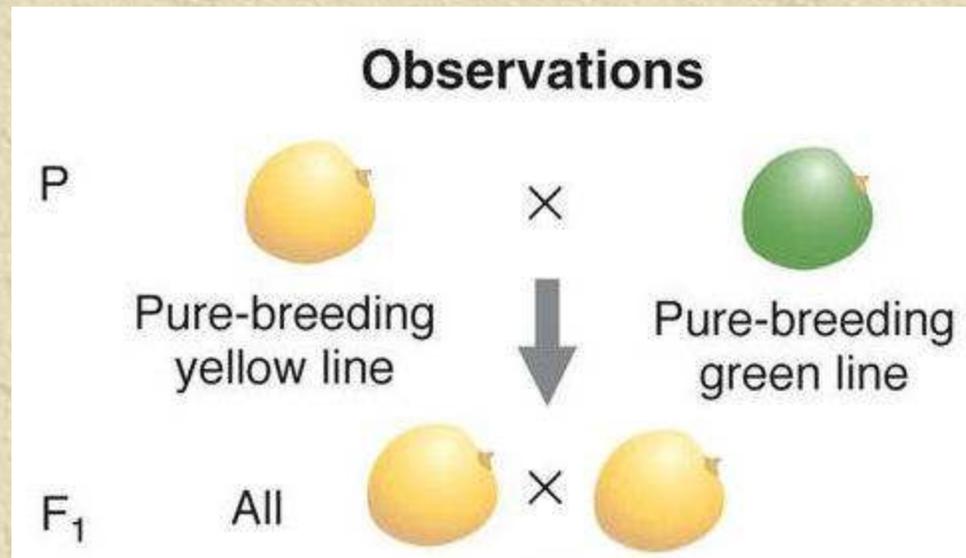
	Stem length	Flower color	Seed color	Seed shape	Pod color	Pod shape	Flower position
Dominant characteristic (dominant allele)	 Long	 Purple	 Yellow	 Round	 Green	 Round	 Axial (along stem)
Recessive characteristic (recessive allele)	 Short	 White	 Green	 Wrinkled	 Yellow	 Pinched	 Terminal (at tip)

What did Mendel discover?

- ✦ **Trait** – an inherited characteristic
- ✦ **Dominant trait**- shown in the outward appearance even if recessive trait is present
- ✦ **Recessive trait** - hidden trait that can be masked by a dominant trait

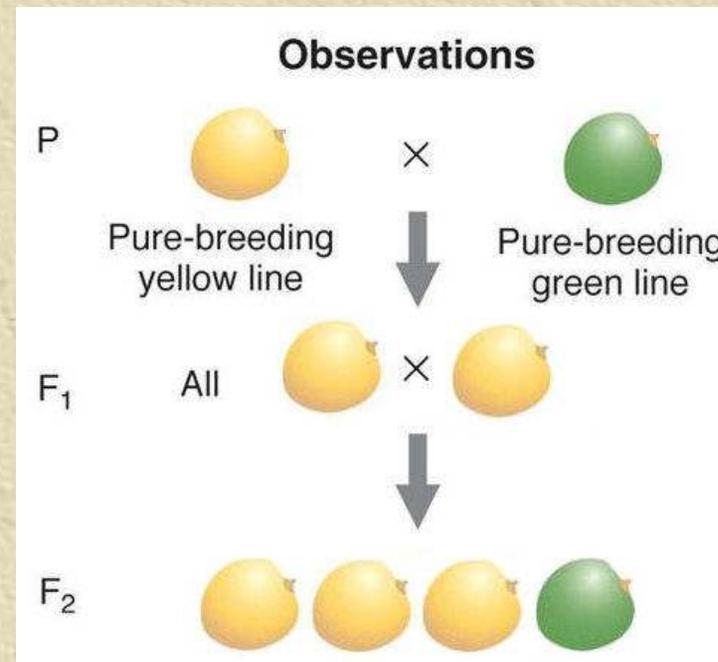
What did Mendel discover?

- ✦ Dominant and Recessive traits
- ✦ Crossed Green and Yellow-- Got all Yellow
- ✦ What would you do to see if the green trait was still there?



What did Mendel discover?

- ✦ He planted the Yellow and made them self fertilize.
- ✦ Results: 6022 Yellow and 2001 Green
- ✦ Ratio of 3:1



His conclusions: Mendel discovered alleles

- ✦ There must be 2 alleles
- ✦ **Allele:** alternative form of a single gene, different sequences of code
 - ◆ Ex: YY, Yy, yy
- ✦ Each parent gives you one allele
- ✦ **Dominant allele** - **Y** capital letter
- ✦ **Recessive allele** – **y** lower case letter

Vocabulary

✦ **Homozygous:** an organism with 2 of the same case alleles for a particular trait

- Homozygous dominant:
- Homozygous recessive:

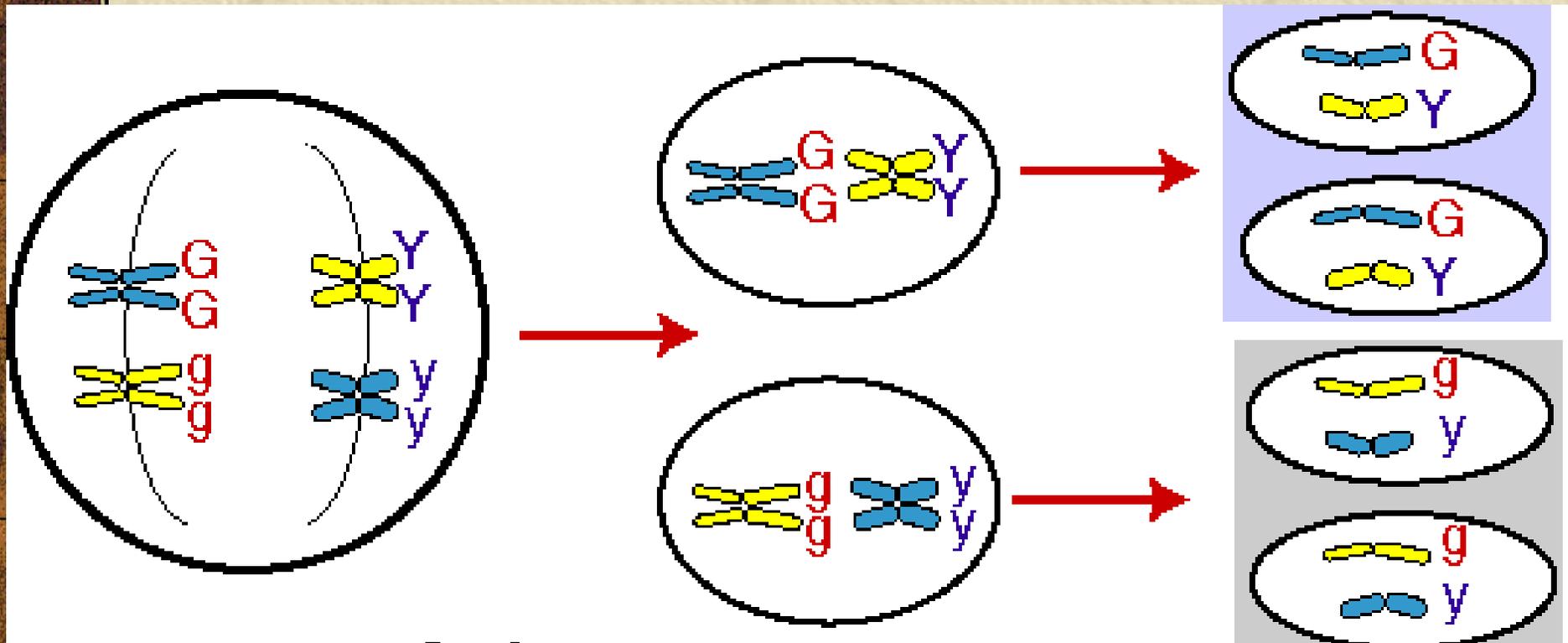
✦ **Heterozygous:** An organism with 2 different case alleles for a particular trait

- EX:

Mendel discovered the Law of Segregation

- ✦ **Law of Segregation:** During meiosis, the 2 copies of each gene separate because homologous chromosomes separate
 - ◆ Each gamete ends up with only one copy of each gene for each trait
 - ◆ Remember! Each organism has **two** copies of each gene for each trait; each one originally came from each parent

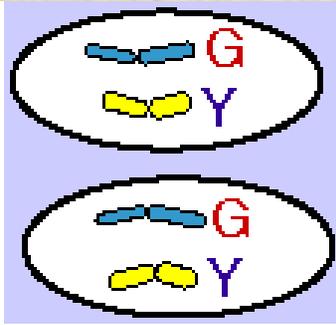
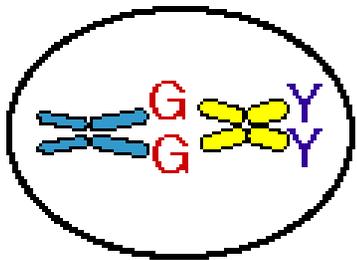
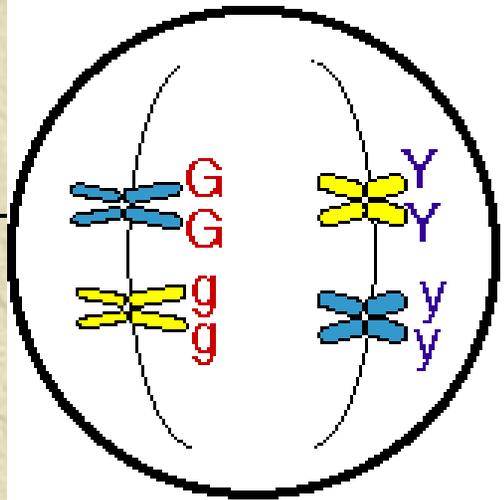
Segregation of alleles in the production of sex cells



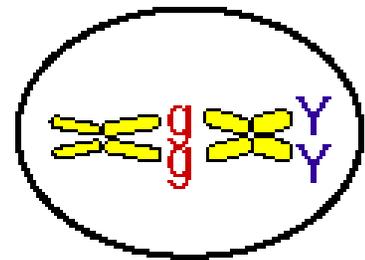
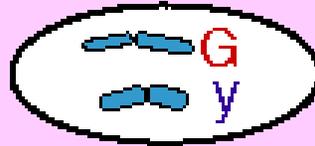
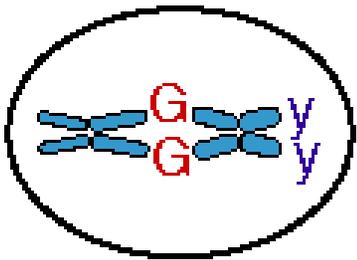
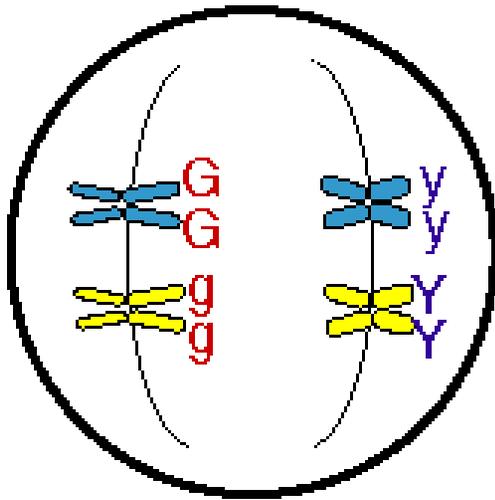
Mendel discovered the Law of Independent Assortment

✦ **Law of Independent Assortment:** During meiosis, the homologous chromosomes line up randomly before they separate.

- ◆ Each gamete gets only 1 gene for each trait but the trait it receives is random
- ◆ How is it random? The side which the chromosomes line up on up determines which cell they will end up in
 - Independent



or





Why can't one gene influence the chance of another gene?



- ✦ Genes are independently assorted
- ✦ Inheritance of one trait does not influence another trait because different traits are located on different chromosomes

So what do we know now?



✦ DNA codes for traits



Why do we study genetics?

- ✦ It's all about probability!
- ✦ Knowing genetics allows us to calculate probability of traits being passed down and expressed in offspring!

Probability Formula

$$★ P = n/N$$

P = probability

n= number of successful events

N= number of total events

Probability Lab

-
- ✦ If you have a coin, and you flip it, what is the chance it will be heads? Tails?
 - ✦ Flip one coin 50 times, and write down results.
 - ✦ If you flip two coins at once, determine the chance of getting two heads, one head one tail, two tails.
 - ✦ Flip two coins and write down results.
 - ✦ If you toss 5 coins, what are the odds of getting, 5heads, 4H1T, 3H2T, 2H3T, 1H4T, 5tails.
 - ✦ Toss 5 coins at once, 50 times, write down results

Probability Lab Questions

- ✦ Did your results match for each trial?
- ✦ How close were they?
- ✦ How could you get closer to the expected results?
- ✦ What does probability have to do with genetics?
- ✦ What is the chance of having a boy?
- ✦ What is the chance of having 3 in a row?

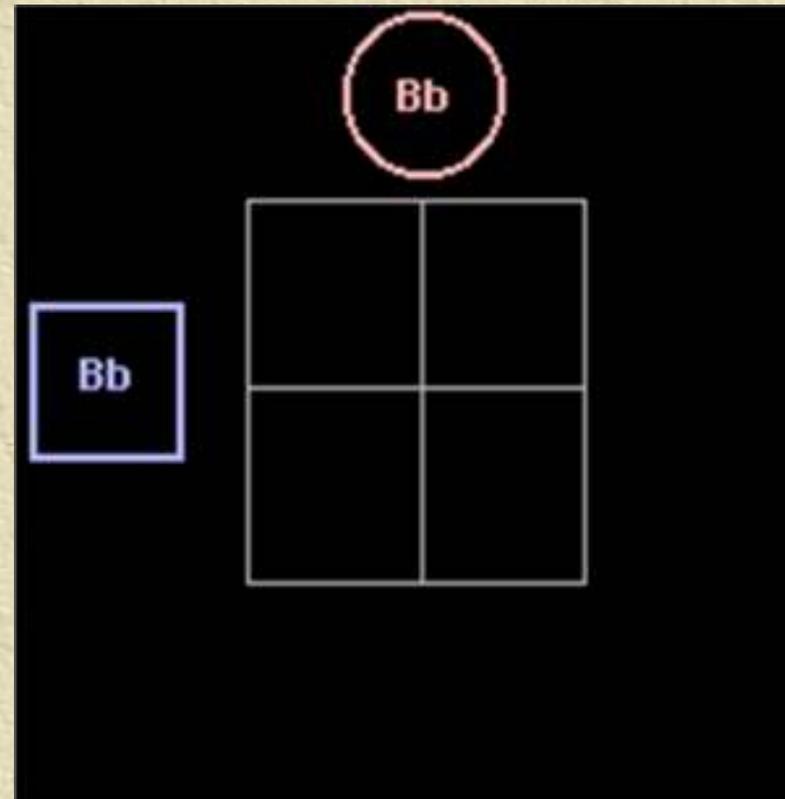
As a result of Mendel...



- ✦ Biologists began to use **probabilities** to determine how likely a specific event would occur. They would set up **punnett squares**.

Punnett squares - What are they good for?

- ✦ Punnett squares show all of the possible gene combinations from 2 parents for a specific trait

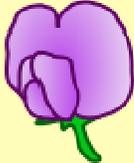
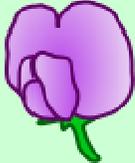
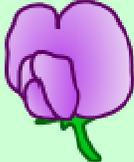
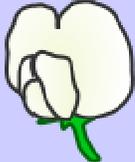


Punnett square basics

-
- ✦ The combinations that can be made by each parent gamete are shown on each side.
 - ✦ The possible combinations of each future offspring are shown in the boxes

Monohybrid Cross

- ✦ Cross for one trait
- ✦ EX: Flower color

		pollen ♂	
		B	b
pistil ♀	B	 BB	 Bb
	b	 Bb	 bb

Practice



	y	y
Y		
Y		

	Y	y
Y		
y		

Genotype

✦ True genetic
makeup of the
chromosome -
Allele set

Yy

Phenotype

- ✦ **Outward appearance**
- ✦ **Trait that is shown**



Dihybrid cross

✧ A cross between TWO traits

AaBb X AaBb



	AB	Ab	aB	ab	
AB	AABB 	AABb 	AaBB 	AaBb 	9 agouti
Ab	AABb 	AAbb 	AaBb 	Aabb 	
aB	AaBB 	AaBb 	aaBB 	aaBb 	4 albino
ab	AaBb 	Aabb 	aaBb 	aabb 	

AaBb

AB

Ab

aB

ab

AB

Ab

aB

ab

AaBb

	AB	Ab	aB	ab
AB				

F1 Generation

✦ **F1=**

Children

✦ **1st “filial”
generation**

Parents	B	b
B	BB	Bb
B	BB	Bb

F2 Generation

✧ 2nd Filial
Generation- **F2**

✧ Children of the
cross between
the children of
the F1

	B	B
b	Bb	Bb
b	Bb	Bb

	B	b
B	BB	Bb
b	Bb	bb

What can we do with Punnett squares?



✦ Genotype and phenotype ratio