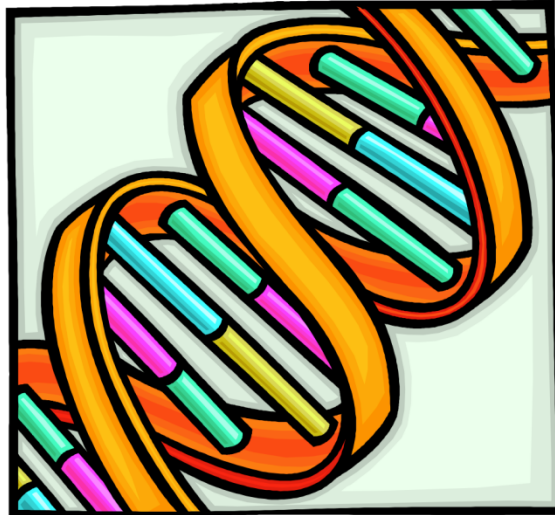


# Teacher Created Materials

---

P U B L I S H I N G

# Understanding Genetics Using Punnett Squares



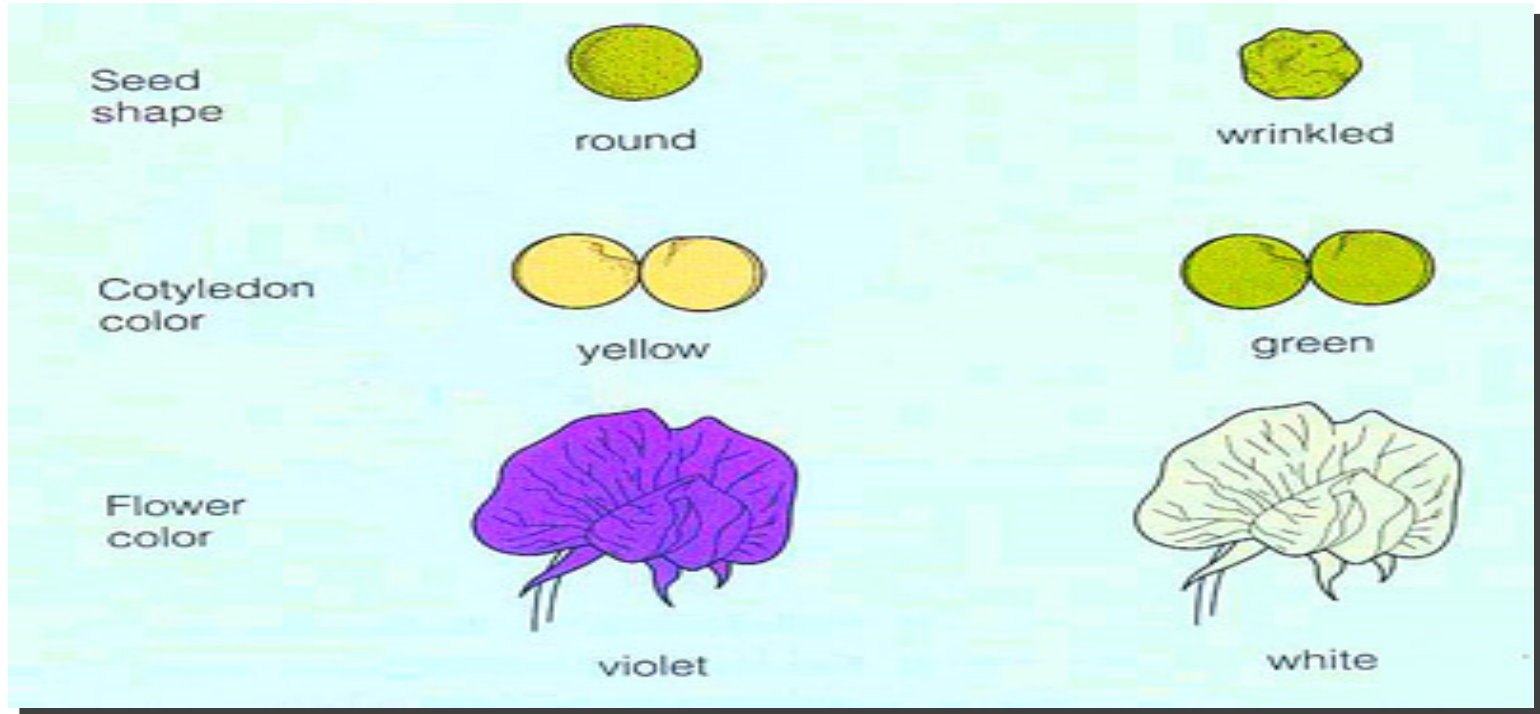
# Who is Gregor Mendel?

- Originated with observations by Gregor Mendel
- His observations led him to study pea plants, purple and white and how these heritable traits could be separated
- Mendel worked almost 150 years ago– (limited knowledge available about genes)
- Cultivated over 28,000 pea plants



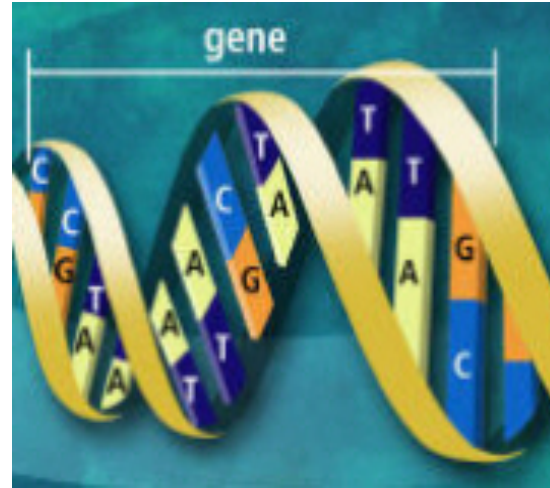
**Between 1856 and 1863 he cultivated and tested at least 28,000 pea plants.**

# What were the traits that Mendel observed?



# WHAT IS A GENE?

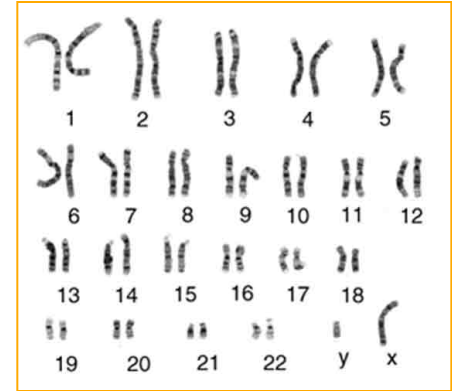
- A gene carries information that determines your traits.
- **Traits** are characteristics you inherit from your parents.
- Genes are located in chromosomes.
- Chromosomes come in pairs and there are thousands, of genes in one chromosome.



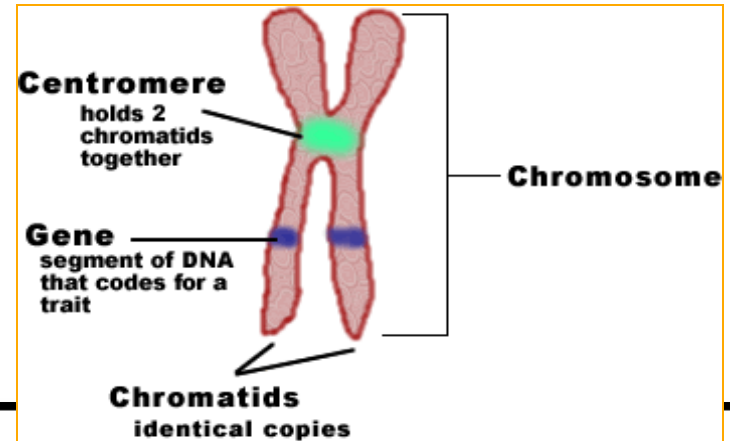
# What is a chromosome?

- In humans, a cell's nucleus contains 46 individual chromosomes or 23 pairs of chromosomes.
- Half of the chromosomes come from one parent and half come from the other parent.

Here is the detailed structure of a chromosome



This is a human karyotype representing the 23 pairs of chromosomes in a male



# What terms should I remember?

- Allele– discrete version of the same gene
- **Genotype**– the **g**enes of an organism for one specific trait
- **Phenotype**– the **p**hysical appearance of a trait in an organism

# What terms should I remember?

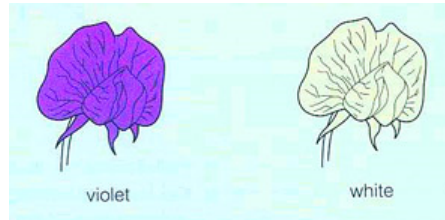
- **Dominant** trait refers to a genetic feature that “hides” the recessive trait in the phenotype of an individual.
- The term “**recessive**” describes a trait that is covered over (or dominated) by another form of that trait and seems to disappear.
- Homozygous= two alleles that are the same for a trait (Pure)
- Heterozygous= two different alleles for a trait (Hybrid)



# What is an example?

- We use two letters to represent the genotype.
- A capital letter represents the dominant form of a gene (allele) and a lowercase letter is the abbreviation for the recessive form of the gene (allele).
- Example below: P=dominant purple and p= recessive white

The phenotype for this flower is violet while its genotype (if homozygous) is PP.



The phenotype for this flower is white while its genotype is pp (to be white the flower must have two of the recessive copies of the allele).

# What is the Punnett Square?

- The Punnett square is the standard way of working out what the possible offspring of two parents will be.
  - It is a helpful tool to show allelic combinations and predict offspring ratios.

**Fig. 1** Punnett square

	B	b
B	BB	Bb
b	Bb	bb

# How do we set up a Punnett Square?

We begin by constructing a grid of two perpendicular lines.



# How do we set up a Punnett Square?

Next, put the genotype of one parent across the top and the other along the left side.

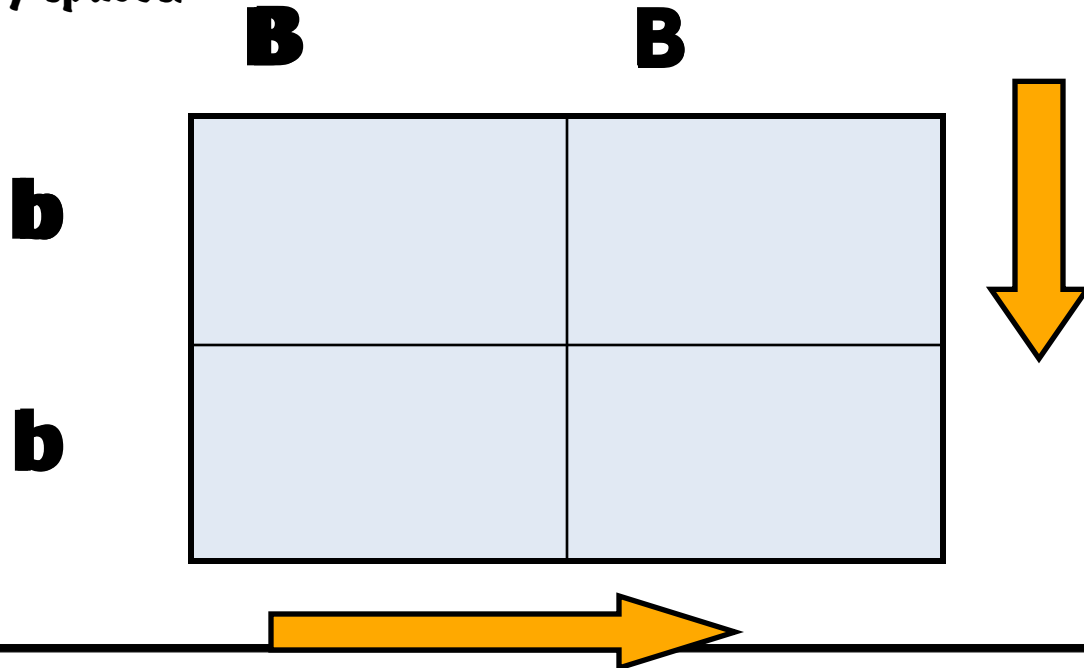
For this example let's consider a genotype of  $BB$  crossed with  $bb$ .

	<b>B</b>	<b>B</b>
<b>b</b>		
<b>b</b>		

- Notice only one letter goes above each box
- It does not matter which parent's genotype goes on either side.

# How do we set up a Punnett Square?

Next, fill in the boxes by copying the column and row head-letters **down** and **across** into the empty spaces.



# Punnett Squares

\*Now that we have learned the basics of genetics lets check for understanding with examples using Punnett Squares.

WHAT'S THE PROBABILITY...?



	<b>W</b>	<b>w</b>
<b>W</b>	<b>W W</b>	<b>W w</b>
<b>w</b>	<b>W w</b>	<b>w w</b>

Usually write the capital letter first

Lets say:

W - dominant **white**

w - recessive **violet**

Parents in this cross are **heterozygous (Ww)**.

**Note:** Be sure to make your letters distinctive!

What is the probability of the offspring will have violet flowers?

**ANSWER: 25% (homozygous recessive)**

Red hair (R) is dominant over blond hair (r). Make a cross between a heterozygous red head and a blond.

	R	r
r	Rr	rr
r	Rr	rr

What is the probability of the offspring will have red hair?

**50%**



# Let's try some more...



In pea plants, tall pea plants (T) are dominant over short pea plants (t). Construct a Punnett Square for a heterozygous tall pea plant and a short pea plant.

	T	t
t	Tt	tt
t	Tt	tt

What is the probability of phenotypes?

50% tall  
50% short

Black eyes (R) is dominant over red eyes (r)  
in rats. Make a cross between a homozygous rat with black  
eyes and a rat with red eyes.

	<b>R</b>	<b>R</b>
<b>r</b>	<b>Rr</b>	<b>Rr</b>
<b>r</b>	<b>Rr</b>	<b>Rr</b>

What is the probability of a red  
eye offspring?

0% ☹️

