

Early Ideas

People realized that something was being passed from parents to offspring so that each generation in some way resembled the previous generations.

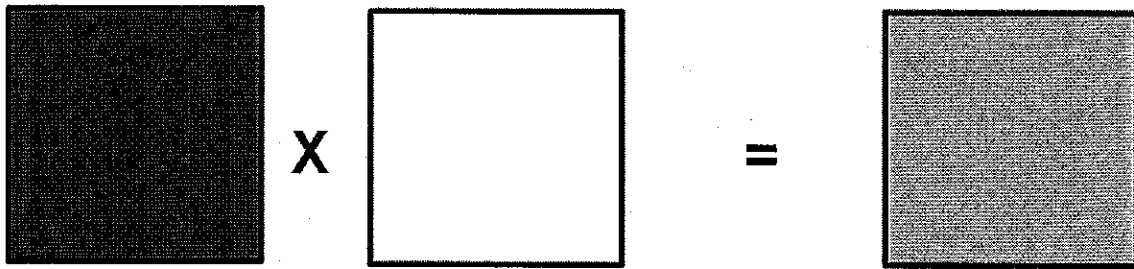
Farmers had performed breeding experiments with cattle and crops in an attempt to create larger and healthier plants and animals, but it was largely done through trial and error.

Blended Inheritance

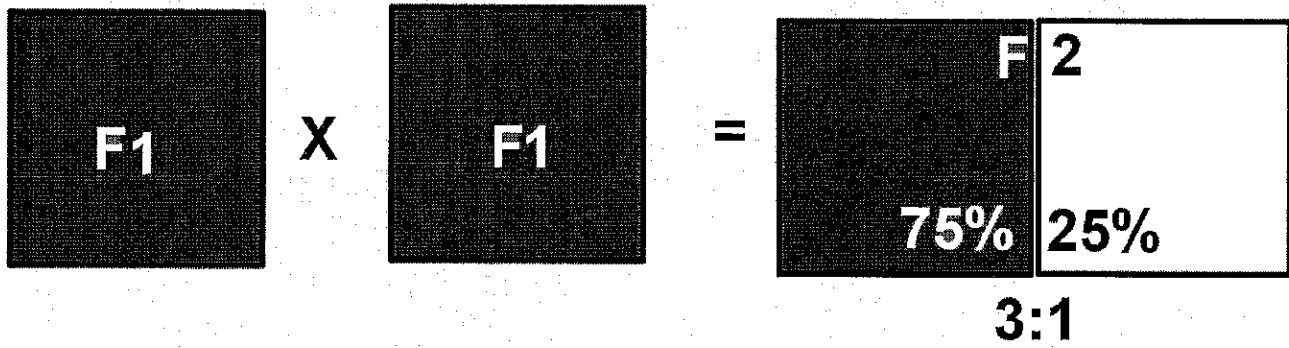
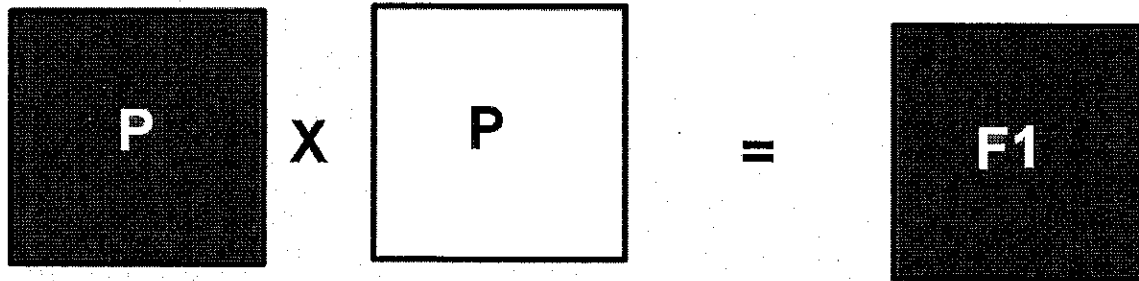
People believed in "blended inheritance."

They thought that whatever was being passed to the next generation somehow mixed like putting together two colors of paint.

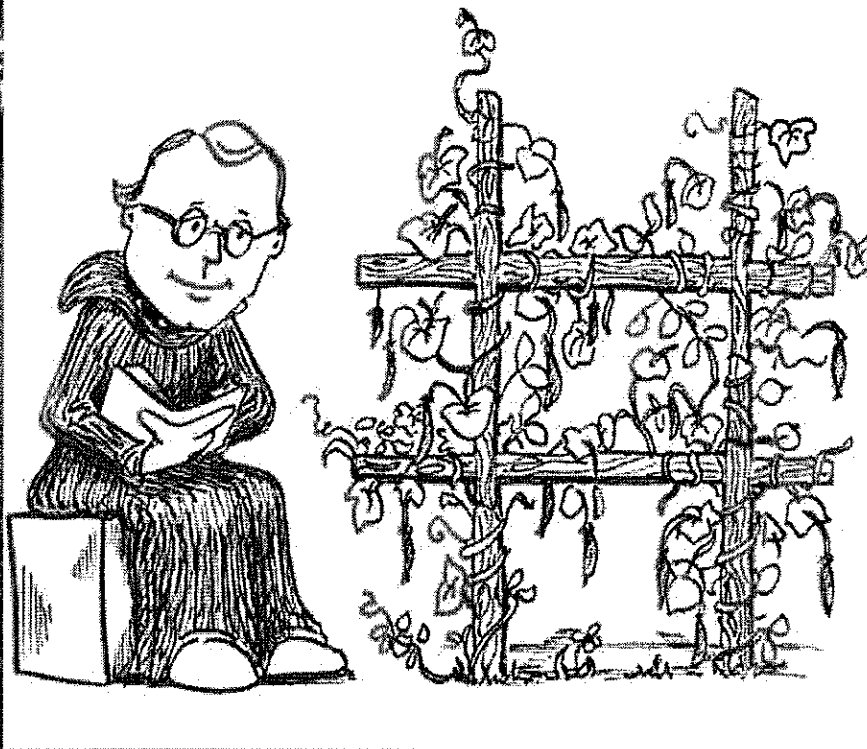
Blended Inheritance

















Gregor Mendel



Gregor Mendel studied the peas that he grew in the monastery garden by mathematically analyzing the results of various crosses.



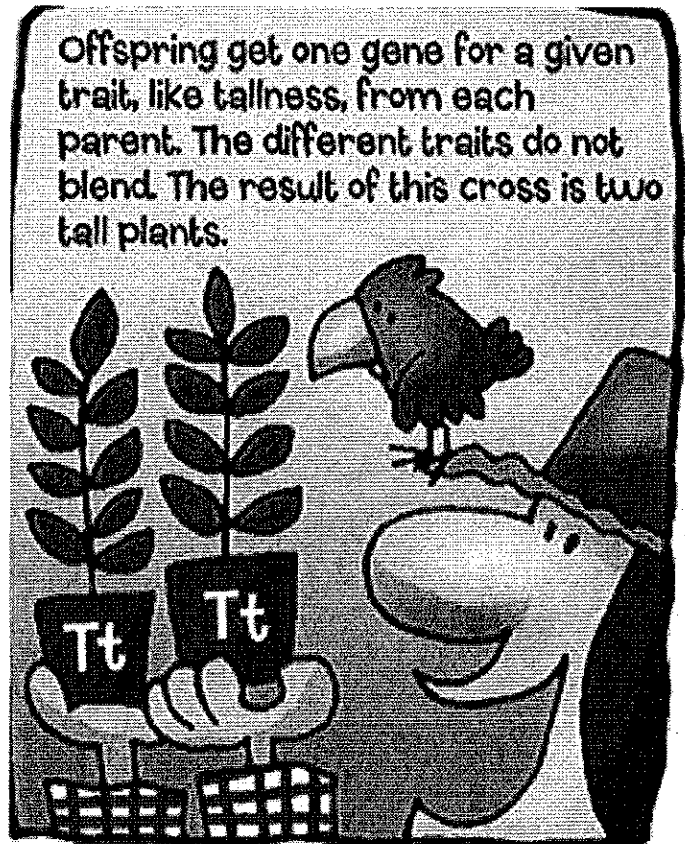
Mendel studied seven traits.

Character	Dominant trait	Recessive trait	Character	Dominant trait	Recessive trait	
Seed shape	 Spherical	 Wrinkled	Flower position	 Axial	 Terminal	
Seed color	 Yellow	 Green		Stem height	 Tall	 Dwarf
Flower color	 Purple	 White				
Pod shape	 Inflated	 Constricted				
Pod color	 Green	 Yellow				

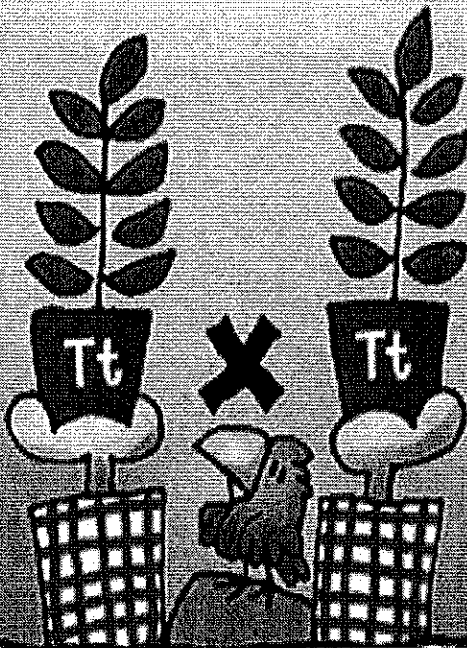
A tall pea plant (TT) is crossed with a short pea plant (tt).



Offspring get one gene for a given trait, like tallness, from each parent. The different traits do not blend. The result of this cross is two tall plants.

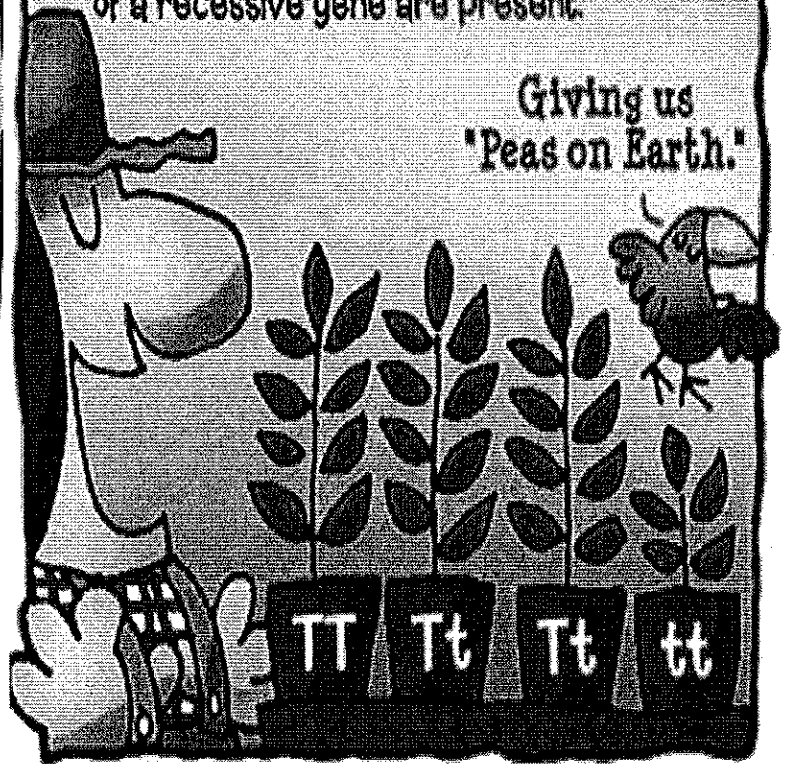


When these two tall plants are crossed, however...



... the result is three tall plants and one short plant because tall is a dominant trait and short is a recessive trait. But recessive traits can crop up in later generations if two copies of a recessive gene are present.

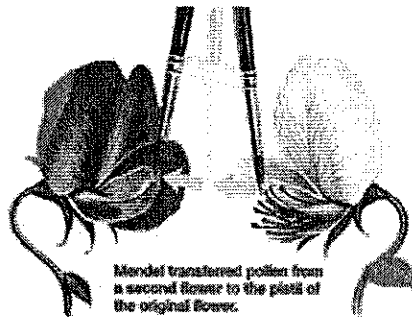
Giving us
"Peas on Earth."



Mendel learned in his study of peas that some traits occur more often than others.



When he crossed true-breeding purple-flowered plants with true-breeding white-flowered plants, the offspring (F1) were all purple.




Mendel transferred pollen from a second flower to the pistil of the original flower.



We call traits that appear, even if only one gene is present, "dominant".

Traits that only appear if both genes are the same are called "recessive."



Different forms of a gene that affect the same trait are called alleles.

For example, flower color in peas can be either purple or white.

The genes for purple flowers and white flowers are alleles for a gene.

The physical traits of an organism make up its phenotype.



"Purple flowers", "tall" and "yellow seeds" are all examples of phenotypes.



A phenotype can also be a trait that can be measured in some way.



For example, blood type, colorblindness, sickle cell anemia

The genetic make-up of an organism is known as its "genotype."

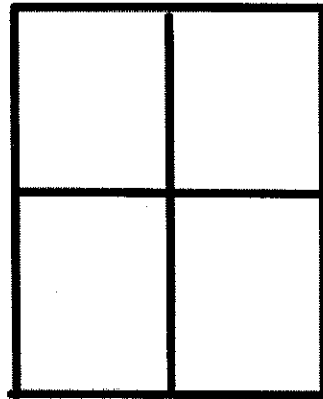


Organisms that have identical genes for a trait are said to be "homozygous."



Organisms that have two different genes for a trait are said to be "heterozygous."

To determine the possible offspring of a cross between two organisms, a device called a Punnett square can be used.



Use a capital letter to represent a dominant gene and a small case letter to represent a recessive gene.

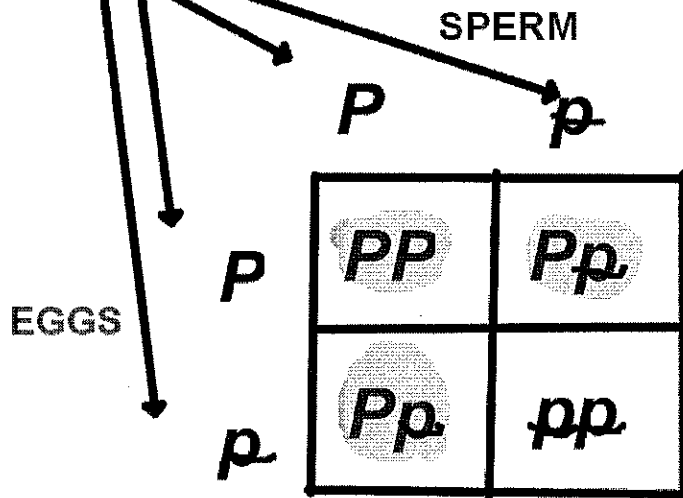
For example, P = purple and p = white.

Mendel's F1 cross would be written as:

Pp x Pp

To determine what might happen in this cross, write the genes for one parent on the top of the Punnett square and the genes for the second parent along the side of the Punnett square.

Use these letters to fill in the blocks.



This tells us that the F2 generation is likely to be 3/4 purple and 1/4 white.





This is the phenotype ratio (3/4:1/4).

	<i>P</i>	<i>p</i>
<i>P</i>	<i>PP</i>	<i>Pp</i>
<i>p</i>	<i>Pp</i>	<i>pp</i>

This also tells us that the F2 generation is likely to be 1/4 homozygous dominant, 2/4 heterozygous and 1/4 homozygous recessive.

This is the genotype ratio (1/4:2/4:1/4).

Review how to use a Punnett square

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

Brainwarmer

T= Tall Plants
t= short plants

Cross a heterozygous tall plant
with a short plant.

1. What are the chances that these plants will
produce short offspring?

Use a *fraction* as your answer.

2. What are the chances that these plants will produce
heterozygous tall offspring?

Use a *fraction* as your answer.

When two organisms that are both heterozygous for the same trait are mated, this is known as a monohybrid cross.

It looks like this:

Aa X Aa

	A	a
A	AA	Aa
a	Aa	aa

When two organisms that are both heterozygous for two traits are mated, it is known as a dihybrid cross.

It looks like this:

AaBb X AaBb

B = Brown

b = white

S = short tail

s = long tail

Cross two cats each of which is heterozygous for brown coat color and heterozygous for short tail.



The cross looks like this:

BbSs X BbSs

BbSs X BbSs

The next step is to determine what gene combinations each parent can give to its offspring.



Don't forget Mendel's laws of
***segregation and**
***independent assortment!**

Write all the possible combinations of genes that would be present in the egg cells and in the sperm cells.

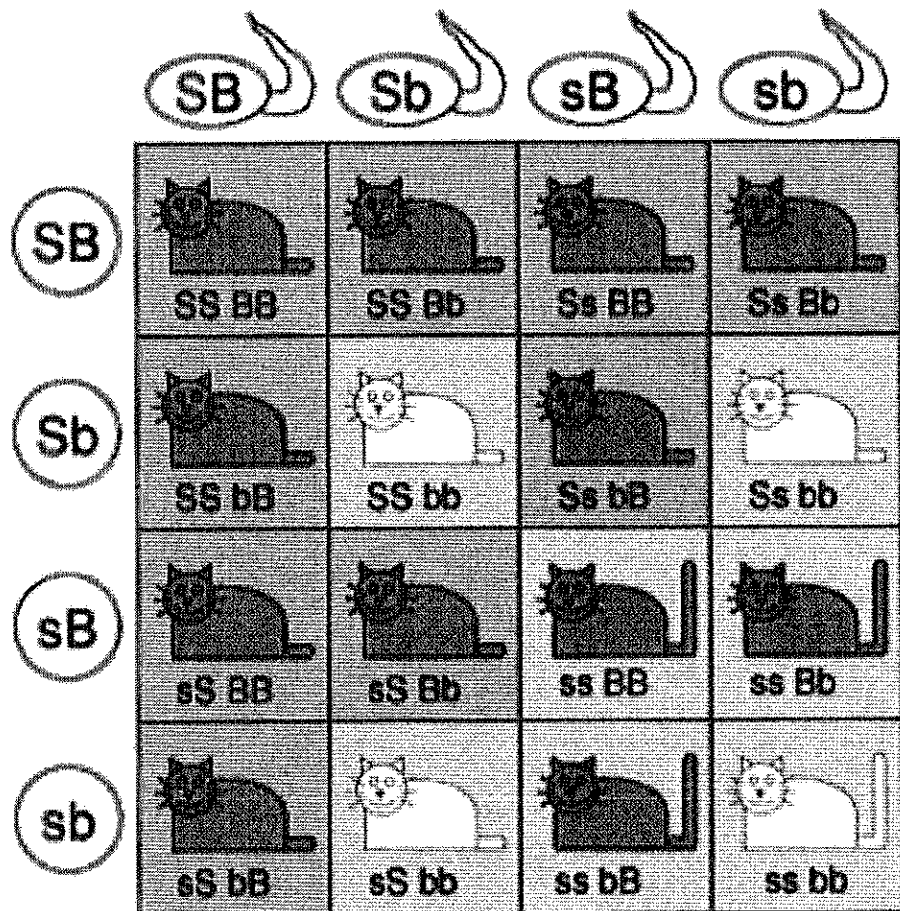
SB

















Sb

sB

sb

Now place them on a Punnett square.



SB	 SS BB	 SS Bb	 Ss BB	 Ss Bb
Sb	 SS bb	 SS bb	 Ss bb	 Ss bb
sB	 sS BB	 sS Bb	 ss BB	 ss Bb
sb	 sS bb	 sS bb	 ss bB	 ss bb

_____ Short tail and brown _____ Long tail and brown

_____ Short tail and white _____ Long tail and white

There's an easier way...

Separate the crosses:

Bb X Bb

Ss X Ss

3/4 Brown

3/4 Short tail

1/4 White

1/4 Long tail

To determine the probability of two separate events occurring at the same time, multiply their separate probabilities.

Chance of brown = $3/4$

Chance of short tail = $3/4$

**Chance of brown and short tail =
 $3/4 \times 3/4 = 9/16$**

Not all crosses involving two traits are dihybrid crosses, but they can all be done the same way.

Just determine the probabilities on separate Punnett squares and multiply them together.

Cross a heterozygous brown cat that has a long tail with a white cat that has a homozygous short tail.

What are the chances of these cats producing a kitten that is brown and has a long tail?

white with a short tail?

brown with a short tail?

white with a long tail?

What are the chances that the kittens will be heterozygous brown and homozygous for short tails?

What are the chances that the kittens will be white and be heterozygous for short tails?

Cross AaBbCc x AaBbCc

What kind of a cross is this?

What are the chances of producing:

AaBBcc?

AABBcc?