

## Chapter 11 Introduction to Genetics

## Section 1 The Work of Gregor Mendel

## Key Concepts

What is the principle of dominance?  
What happens during segregation?

Look at your table partner.

List similarities and differences between you and your partner.

If you have two brown rabbits, can they have a white offspring?

If you have two white rabbits, can they have a brown offspring?

This leads us to our first topic...

## Genetics

the study of heredity

## Gregor Mendel

Father of Genetics

studied peas...why?  
produce sexually  
short life cycles  
large number of offspring  
fertilization can be controlled  
quick growing

## fertilization

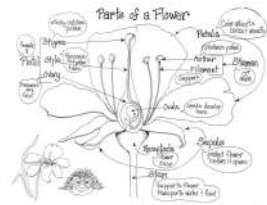
gametes (egg and sperm) join

male - pollen contains sperm

female - egg cells

self-pollination

sperm cells fertilize the egg cells of the same plant



## true-breeding

produce offspring identical to itself  
result of self-pollination

## cross-pollination

prevents self-pollination  
taking pollen from one plant and putting in the eggs  
of another plant

What was Mendel studying...

seven traits - page 264

Seed Shape, Seed Color, Seed Coat Color,  
Pod Shape, Pod Color, Flower Position, Plant Height

Trait	Parental Generation (P)	F <sub>1</sub> Generation	F <sub>2</sub> Generation
Seed Shape	Round (R) x Wrinkled (r)	Round (Rr)	Round (RR) and Wrinkled (rr)
Seed Color	Yellow (Y) x Green (y)	Yellow (Yy)	Yellow (YY) and Green (yy)
Seed Coat Color	Smooth (S) x Wrinkled (s)	Smooth (Ss)	Smooth (SS) and Wrinkled (ss)
Pod Shape	Full (F) x Constricted (f)	Full (Ff)	Full (FF) and Constricted (ff)
Pod Color	Green (G) x Yellow (g)	Green (Gg)	Green (GG) and Yellow (gg)
Flower Position	Terminal (T) x Axial (t)	Terminal (Tt)	Terminal (TT) and Axial (tt)
Plant Height	Tall (T) x Short (t)	Tall (Tt)	Tall (TT) and Short (tt)

Mendel drew two conclusions from this experiment.

1. Biological inheritance is determined by factors that are passed from generation to generation.

## Trait

specific characteristic  
eye color, height, seed color, flower color

Each original plant was the parent plant - P Generation

Offspring from the P Generation - F<sub>1</sub> or First Filial

Hybrids - offspring with two different traits

Genes - chemical factors that determine traits  
each of Mendel's traits that he studied was  
controlled by one gene with two  
different forms

Alleles = different forms of the gene

Trait = height  
Gene = chemical makeup for the trait  
Alleles = tall and short, always 2 forms

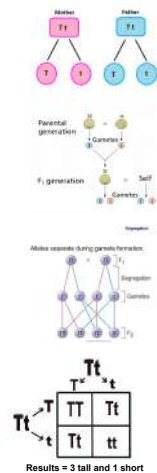
2. Principle of Dominance

states some alleles = dominant  
some alleles = recessive

dominant - always expressed, written with capital letters  
recessive - only expressed when dominant allele not present,  
written with lowercase letters

## Segregation

separation of alleles during formation of gametes  
each gamete carries a single copy of each gene



Results = 3 tall and 1 short

## Review

Why was Mendel surprised when the offspring had the characteristics of only one of the parents?

In Mendel's time, people thought that characteristics of the parents blended to form the offspring.

Look at 11-4 page 265.

Was the recessive allele for shortness lost in the F<sub>1</sub> generation?  
No it is masked by the dominant allele.

Are the F<sub>1</sub> plants true-breeding?  
No they did not produce offspring identical to themselves.

## 11-2 Probability and Punnett Squares

**Key Concepts**

How do geneticists use the principles of probability?  
How do geneticists use Punnett Squares

**Genetics and Probability****Probability**

how likely something will happen

flip a coin - two outcomes (heads or tails)  
50% for each side

Predict the probability of getting heads if you flip  
the coin 3 times.

$$1/2 \times 1/2 \times 1/2 = 1/8$$

Just like in genetics the alleles are random!

The **Principles of Probability** can be used to predict the  
outcomes of genetic crosses.

**Punnett Square**

illustrates the results of a cross between parents  
indicates the probability of the offspring  
shows genetic variation of a cross

Parental Genotypes		D	d
	D	DD	Dd
	d	Dd	dd

D = Dominant Allele  
d = Recessive Allele

**Monohybrid Cross**  
crossing one trait

**Homozygous/Purebred**

zygous = joined  
homo = same  
ous = having  
two same alleles  
DD, dd

**Heterozygous/Hybrid**

zygous = joined  
hetero = other  
ous = having  
two different alleles  
Dd

**Genotype**

genotype describes the actual set of genes carried by an individual  
genetic makeup  
BB or Bb

**Phenotype**

what the individual looks like. How the genes are expressed.  
physical characteristics  
brown eyes, black hair

**Dominant**

the allele that is expressed  
written in a capital letter

**Recessive**

hidden trait if with a dominant allele  
only expressed if paired with another recessive allele

**Ratio**

comparison of results  
3:1

Genotype	Phenotype
YY (homozygous)	Purple
Yy (heterozygous)	Purple
yy (homozygous)	Purple
yy (homozygous)	White
Ratio 3:1	

Using Punnett Squares: Probability Models

SELECTED TRAITS IN CATS			
Trait	Dominant allele	Recessive allele	
Coat length	Short hair (S)	Long hair (s)	
Body stripes	Tabby (T)	White (t)	
Coat color (independent of body stripes)	Black (B)	White (b)	

			Male's Alleles
Female's Alleles			





**Dihybrid Crosses**  
crossing two traits

Brown = B  
Blue = b  
Tall = T  
Short = t

**Find Genotypes, Phenotypes, Probabilities, Ratios**

**BBtt x bbTT**


**Bbtt x bbTT**


**BbTt x BBtt**


**Homework**

**Find Genotypes, Phenotypes, Probabilities, Ratios of the two crosses given:**

1. BbTt x BbTt
2. bbTt x BbTt


## Section 11-3 Exploring Mendelian Genetics

**Key Concepts**

What is the principle of independent assortment?  
What inheritance patterns exist aside from simple dominance?

**Independent Assortment**

state that genes for different traits can segregate independently during the formation of gametes

means they randomly sort and they do not stay with their paired allele when offspring is produced

**Summary of Mendel's Principles - page 272**

The inheritance of biological characteristics is determined by individual units known as genes. Genes are passed from parents to their offspring.

In cases in which two or more forms (alleles) of the gene for a single trait exist, some forms of the gene may be dominant and others may be recessive.

In most sexually reproducing organisms, each adult has two segregated from each other when gametes are formed. The alleles for different genes usually segregate independently of one another.

**Exceptions to Mendel's Principles**

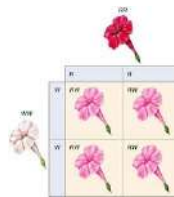
some alleles are neither dominant nor recessive  
many traits are controlled by multiple alleles or multiple genes

**Incomplete Dominance**

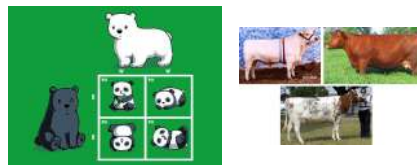
no dominant allele  
offspring a cross between dominant and recessive allele shows up in heterozygous offspring

**Flowers**

Red - (RR) x White - (WW) forms Pink (RW)

**Codominance**

both alleles are expressed in the heterozygous form

**Multiple Alleles**

when genes have more than two alleles  
coat color in rabbits has four colors



Alleles			
C	c <sup>h</sup>	c <sup>h</sup>	c
Genotype			
Cc <sup>h</sup>	Cc	c <sup>h</sup> c <sup>h</sup>	cc
Phenotype			
WILD TYPE (Brown)	CHINCHILLA (Dark grey)	HEMI-ALBINO (White with black patches)	ALBINO (White)

**Polygenic Traits**

traits controlled by two or more genes that interact with each other  
human skin color has more than 4 genes that control this trait

Table 1: the various shades of human skin colour

Phenotypes	Genotypes	Units of pigment
Extremely dark	AABBCC	6
Very dark	AaBBCC	5
Dark	AaBbCC	4
Intermediate	AaBbCc	3
Light	aabbCc	2
Very light	aabbcc	1
Extremely light	aabbcc	0

