

PowerLecture:  
Chapter 11  
Observing Patterns in Inherited Traits  
Section 11.0: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 11.0: [Texas A&M Rose Breeding and Genetics Program](#)

Section 11.0: [American Floral Endowment—Floriculture Directory](#)

- Section 11.0: [Flower Trade. Vivienne Walt. \*National Geographic\*, April 2001.](#)
- Section 11.0: [Payday for US Plant Scientists: Supreme Court Upholds Patenting of Genetically Engineered Plants. Peg Brickley. \*The Scientist\*, Jan. 21, 2002.](#)

How Would You Vote?

The following is the question for this chapter. See national results below.

- [Is government spending on agricultural extension programs an appropriate use of resources?](#)

Impacts, Issues: In Pursuit of a Better Rose

- Roses have been around for at least 40 million years
- Researchers are working to create genetic maps for rose chromosomes

Impacts, Issues: In Pursuit of a Better Rose

- Knowing the location of desirable genes on chromosomes helps rose breeders mix the beauty of cultivated varieties with disease resistance of wild varieties

Section 11.1: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 11.1: [MendelWeb](#)

Section 11.1: [Mendel Museum of Genetics](#)

Section 11.1: [Mendelian Genetics Problem Sets & Tutorials](#)

➤ Section 11.1: Johann Gregor Mendel (A Life in Science). Nigel Collins. *Catalyst*, April 2002.

➤ Section 11.1: The Extent of Charles Darwin's Knowledge of Mendel. Andrew Sclater. *Georgia Journal of Science*, Fall 2003.

#### Earlobe Variation

- Whether a person has attached or detached earlobes depends on a single gene
- Attached earlobes: two copies of the recessive allele for this gene
- Detached earlobes: either one or two copies of the dominant allele

#### Early Ideas about Heredity

- People knew that sperm and eggs transmitted information about traits
- Blending theory
- Problem:
  - Would expect variation to disappear
  - Variation in traits persists

#### Gregor Mendel

- Strong background in plant breeding and mathematics
- Using pea plants, found indirect but observable evidence of how parents transmit genes to offspring

#### Gregor Mendel

- The founder of modern genetics

#### Genes

- Units of information about specific traits
- Passed from parents to offspring
- Each has a specific location (locus) on a chromosome

#### Alleles

- Different molecular forms of a gene
- Arise by mutation
- Dominant allele masks a recessive allele that is paired with it

#### Allele Combinations

- Homozygous
  - having two identical alleles at a locus
  - *AA* or *aa*
- Heterozygous
  - having two different alleles at a locus
  - *Aa*

#### Genetic Terms

## Genotype & Phenotype

- Genotype refers to particular genes an individual carries
- Phenotype refers to an individual's observable traits
- Cannot always determine genotype by observing phenotype  
Section 11.2: Weblinks and InfoTrac  
**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

➤ Section 11.2: The Test Cross and Logical Deduction

➤ Section 11.2: Odds Are against Your Breaking That Law of Averages (probability theory). James Trefil. *Smithsonian*, Sept. 1984.

### Tracking Generations

➤ Parental generation

$P$

mates to produce

➤ First-generation offspring

$F_1$

mate to produce

➤ Second-generation offspring

$F_2$

Monohybrid Crosses

Experimental intercross between  
two  $F_1$  heterozygotes

Mendel's

Monohybrid

Cross Results

### Probability

The chance that each outcome of a given event will occur is proportional to the number of ways that event can be reached

Monohybrid Cross

Illustrated

Mendel's Theory  
of Segregation

- An individual inherits a unit of information (allele) about a trait from each parent
- During gamete formation, the alleles segregate from each other

Test Cross

- Individual that shows dominant phenotype is crossed with individual with recessive phenotype
- Examining offspring allows you to determine the genotype of the dominant individual

### Section 11.3 Dihybrid Cross

Experimental cross between individuals that are homozygous for different versions of two traits

Dihybrid Cross:  $F_1$  Results  
Dihybrid Cross:  $F_2$  Results

#### Independent Assortment

- Mendel concluded that the two “units” for the first trait were to be assorted into gametes independently of the two “units” for the other trait
- Members of each pair of homologous chromosomes are sorted into gametes at random during meiosis

Independent Assortment

#### Tremendous Variation

Number of genotypes possible in offspring as a result of independent assortment and hybrid crossing is

$$3^n$$

( $n$  is the number of gene loci at which the parents differ)

#### Impact of Mendel’s Work

- Mendel presented his results in 1865
- Paper received little notice
- Mendel discontinued his experiments in 1871
- Paper rediscovered in 1900

#### Section 11.4: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 11.4: Blood Typing Game & Introduction

Section 11.4: Genes and Blood Types

Section 11.4: Horse Coat Color Genetics

- Section 11.4: Blood Type Puzzle. Janet Kelly. *Science Activities*, Winter 1997.
- Section 11.4: Understanding Marfan's Syndrome: Abraham Lincoln Revisited. Ian Young. *British Medical Journal*, Dec. 7, 1991.

Dominance Relations  
Complete dominance  
Incomplete dominance  
Codominance  
Incomplete Dominance

Codominance: ABO Blood Types

- Gene that controls ABO type codes for enzyme that dictates structure of a glycolipid on blood cells
- Two alleles ( $I^A$  and  $I^B$ ) are codominant when paired
- Third allele ( $i$ ) is recessive to others

ABO and Transfusions

- Recipient's immune system will attack blood cells that have an unfamiliar glycolipid on surface
- Type O is universal donor because it has neither type A nor type B glycolipid

Pleiotropy

- Alleles at a single locus may have effects on two or more traits
- Marfan syndrome - Mutation in gene for fibrillin affects skeleton, cardiovascular system, lungs, eyes, and skin

Epistasis

- Interaction between the products of gene pairs
- Common among genes for hair color in mammals

Epistasis  
Coat Color in  
Retrievers  
Comb Shape in Poultry

Section 11.5: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 11.5: Laboratory of Statistical Genetics—Linkage Analysis
- Section 11.5: Linkage Mapping
- Section 11.5: Linkage Analysis. David Pauls. *Journal of the American Academy of Child and Adolescent Psychiatry*, July 1999.

Crossing Over

Effect of Crossing Over

- After crossing over, each chromosome contains both maternal and paternal segments
- Creates new allele combinations in offspring

Linkage Groups

- Genes on one type of chromosome
- Fruit flies
  - 4 homologous chromosomes
  - 4 linkage groups
- Not all genes on chromosome are tightly linked

Full Linkage

Incomplete Linkage

Crossover Frequency

Linkage Mapping in Humans

- Linkage maps based on pedigree analysis through generations
- Color blindness and hemophilia are very closely linked on X chromosome

Section 11.6: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 11.6: The Importance of Context in Genetics: Genetic Effects Can Be Altered by Their Surroundings, and This Determines the Inheritance of Traits Such as Flower Color and the Likelihood of Cancer. H. F. Nijhout. *American Scientist*, Sept.–Oct. 2003.
- Section 11.6: The Interpretation of Genes. Jennie Dusheck. *Natural History*, Oct. 2002
  - Environmental Effects on Plant Phenotype
  - *Hydrangea macrophylla*
  - Action of gene responsible for floral color is influenced by soil acidity

- Flower color ranges from pink to blue

#### Temperature Effects on Phenotype

- Rabbit is homozygous for an allele that specifies a heat-sensitive version of an enzyme in melanin-producing pathway
- Melanin is produced in cooler areas of body

#### Section 11.7: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 11.7: Human Eye Color Heredity Calculator
- Section 11.7: Finding Genes that Underlie Complex Traits. Anne Glazier et al. *Science*, Dec. 20, 2002.
- Section 11.7: True Colours. Bill Harvey. *Optician*, Nov. 1, 2002.

#### Campodactyly: Unexpected Phenotypes

- Effect of allele varies:
  - Bent fingers on both hands
  - Bent fingers on one hand
  - No effect
- Many factors affect gene expression

#### Continuous Variation

- A more or less continuous range of small differences in a given trait among individuals
- The greater the number of genes and environmental factors that affect a trait, the more continuous the variation in versions of that trait

#### Human Variation

- Some human traits occur as a few discrete types
  - Attached or detached earlobes
  - Many genetic disorders
- Other traits show continuous variation
  - Height
  - Weight
  - Eye color

#### Describing Continuous Variation

