

CHAPTER 9

Patterns of Inheritance

BIOLOGY AND SOCIETY: TESTING YOUR BABY

- Genetic testing
 - Allows expectant parents to test for possibilities in their unborn child
 - Includes amniocentesis and CVS
 - Has risks associated with it.



Figure 9.1

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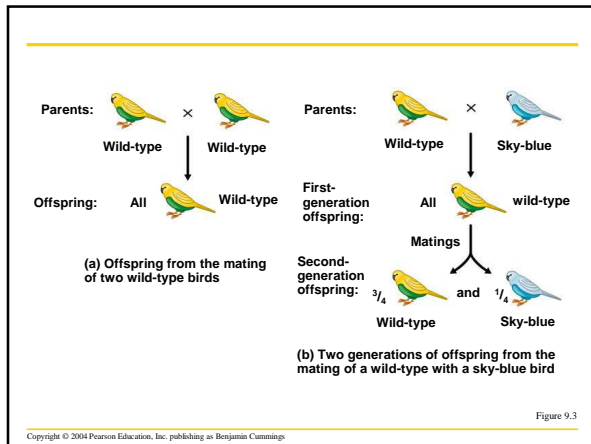
HERITABLE VARIATION AND PATTERNS OF INHERITANCE

- Wild type traits are traits most commonly found in nature.



Figure 9.2

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- Gregor Mendel
 - Was the first person to analyze patterns of inheritance
 - Deduced the fundamental principles of genetics.




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In an Abbey Garden

- Mendel studied garden peas
 - These plants are easily manipulated
 - These plants can self-fertilize.

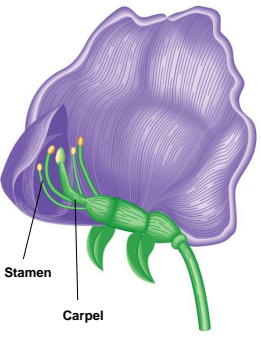


Figure 9.5
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- Mendel carried out some cross-fertilization
- P, F₁, F₂, p.145

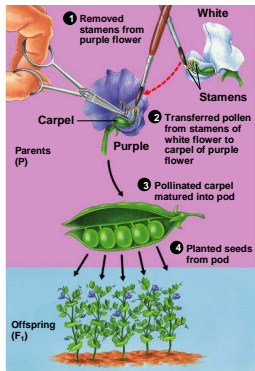


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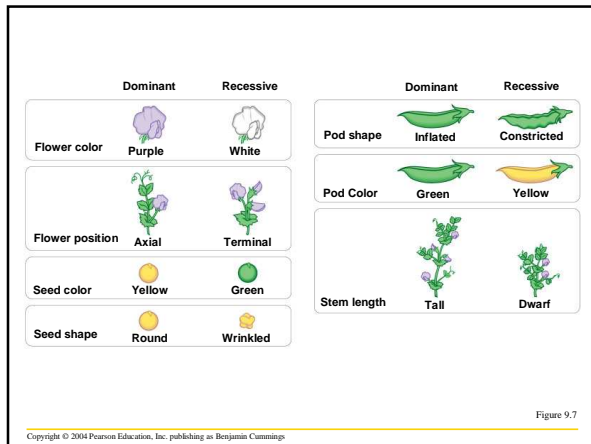
- He also created true-breeding varieties of plants (self-fertilization produced offspring all identical to the parent)
- Mendel then crossed two different true-breeding varieties, creating hybrids.

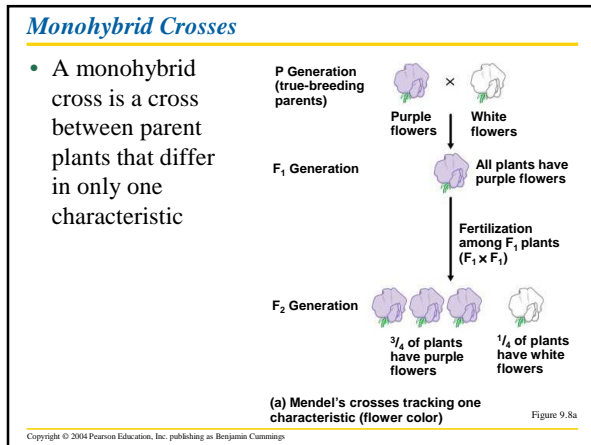
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Mendel's Principles of Segregation

- Mendel performed many experiments
 - He tracked several characteristics in pea plants from which he formulated several hypotheses.
- During the production of gametes each ovum or sperm receives only one from each pair of chromosomes.

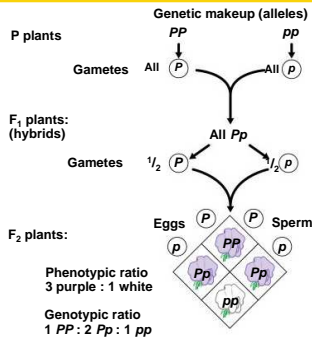
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- Mendel developed four hypotheses from the monohybrid cross
 - There are alternative forms of genes, now called alleles
 - For each characteristic, each organism has two genes
 - Gametes carry only one allele for each inherited characteristic
 - Alleles can be dominant or recessive.
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- An explanation of Mendel's results, including a Punnett square.



(b) Explanation of the results in part (a)

Figure 9.8b

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- Phenotype
 - An organism's physical traits ex. tall, short, green, etc.
- Genotype
 - An organism's genetic makeup ex. TT, Tt, tt

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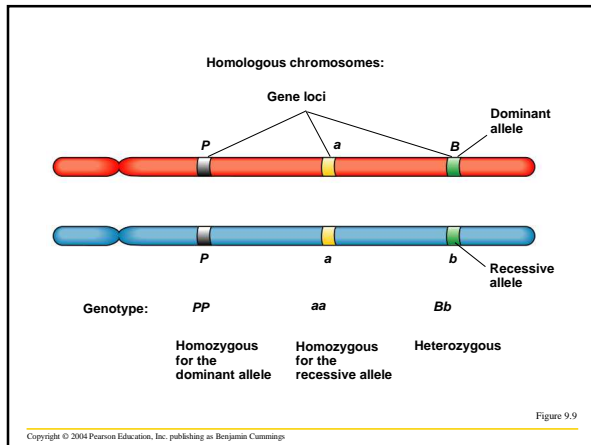
- Mendel's principle of segregation
 - Pairs of alleles segregate (separate) during gamete formation; the fusion of gametes at fertilization creates allele pairs again.

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Genetic Alleles and Homologous Chromosomes

- Homologous chromosomes
 - Have genes at specific loci
 - Have alleles of a gene at the same locus.

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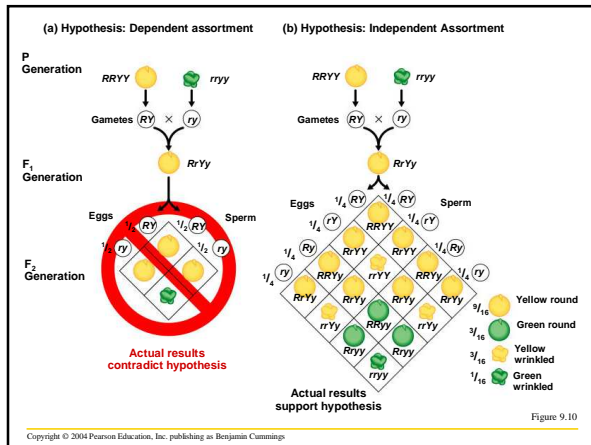
- Homozygous
 - When an organism has identical alleles for a gene
- Heterozygous
 - When an organism has different alleles for a gene.

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Mendel's Principle of Independent Assortment

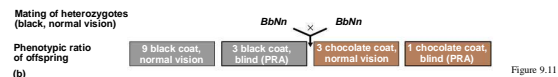
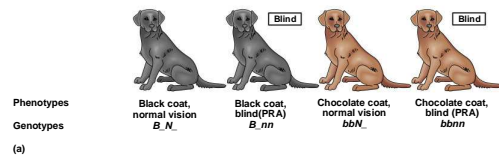
- Two hypotheses for gene assortment in a dihybrid cross
 - Dependent assortment
 - Independent assortment.

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Mendel's principle of independent assortment

- Each pair of alleles segregates independently of the other pairs during gamete formation



A dihybrid cross with two parents heterozygous for both genes gives nine genotypes and a 9:3:3:1 ratio of phenotypes.

See Fig. 9.8 p.149

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Using a Testcross to Determine an Unknown Genotype

- A testcross is a mating between
 - An individual of unknown genotype and
 - A homozygous recessive individual

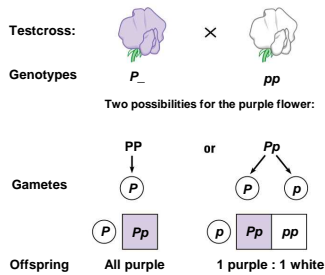


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The Rules of Probability

- The rule of multiplication
 - The probability of a compound event is the product of the separate probabilities of the independent events.

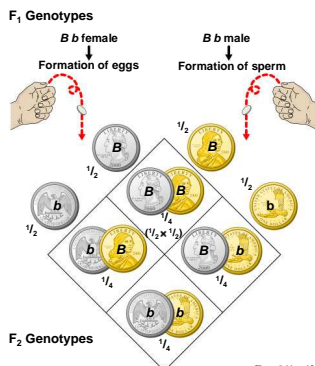


Figure 9.11, p. 151

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Family Pedigrees

- Mendel's principles apply to the inheritance of many human traits.



Figure 9.14

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- A family pedigree

- Shows the history of a trait in a family
- Allows researchers to analyze human traits.

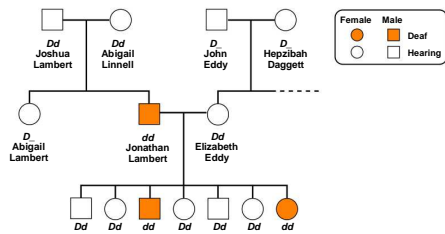


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Human Disorders Controlled by a Single Gene

- Many human traits
 - Show simple inheritance patterns
 - Are controlled by genes on autosomes.

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Disorder	Major Symptoms	Incidence
Recessive disorders		
Albinism	Lack of pigment in skin, hair, and eyes	1/37,000
Cystic fibrosis	Excess mucus in lungs, digestive tract, liver; increased susceptibility to infections; death in infancy unless treated	1/3,500 European Americans
Galactosemia	Accumulation of galactose in tissues; mental retardation; eye and liver damage	1/100,000
Phenylketonuria (PKU)	Accumulation of phenylalanine in blood; lack of normal skin pigment; mental retardation unless treated	1/10,000 in U.S. and Europe
Sickle-cell disease (homozygous)	Sickled red blood cells; damage to many tissues	1/400 African Americans
Tay-Sachs disease	Lipid accumulation in brain cells; mental deficiency; blindness; death in childhood	1/3,000 Ashkenazi Jews
Dominant disorders		
Achondroplasia	Dwarfism	1/10,000
Alzheimer's disease (one type)	Mental deterioration; usually strikes late in life	Not known
Huntington's disease	Mental deterioration and uncontrollable movements; strikes in middle age	1/10,000
Hypercholesterolemia	Excess cholesterol in blood; heart disease	1/250 in heterozygous

Table 9.1

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Recessive Disorders

- Most human genetic disorders are recessive
 - Individuals can be carriers of these diseases.

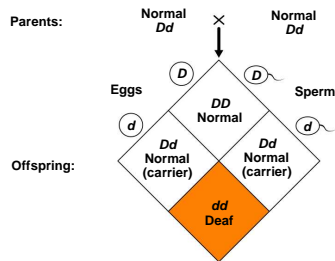


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Dominant Disorders

- Some human genetic disorders are dominant
 - Achondroplasia is a form of dwarfism.



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BEYOND MENDEL

- Some patterns of genetic inheritance are not explained by Mendel's principles.

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Incomplete Dominance in Plants and People

- In incomplete dominance, F_1 hybrids have an appearance in between the phenotypes of the two parents.

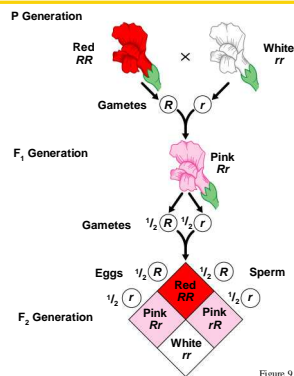


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Hypercholesterolemia

- Is a human trait that is incompletely dominant.

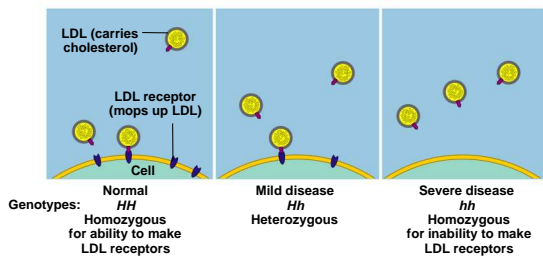


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Multiple Alleles and Blood Type

- The ABO blood groups in humans are examples of multiple alleles.

Blood Group (Phenotype)	Genotypes	Antibodies Present in Blood	Reaction When Blood from Groups Below Is Mixed with Antibodies from Groups at Left			
			O	A	B	AB
O	ii	Anti-A Anti-B				
A	$I^A I^A$ or $I^A i$	Anti-B				
B	$I^B I^B$ or $I^B i$	Anti-A				
AB	$I^A I^B$	—				

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- Two of the human blood type alleles exhibit codominance

- Both alleles are expressed in the phenotype.

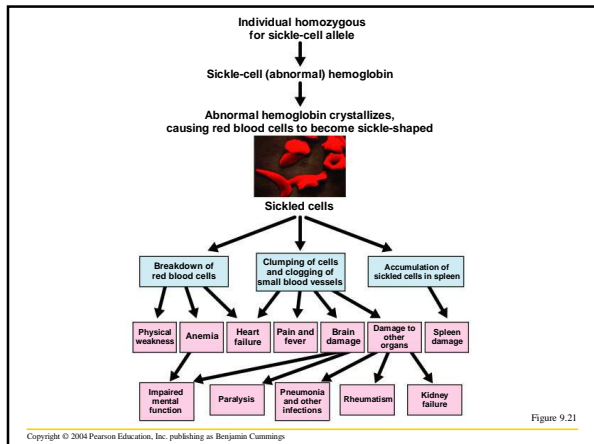
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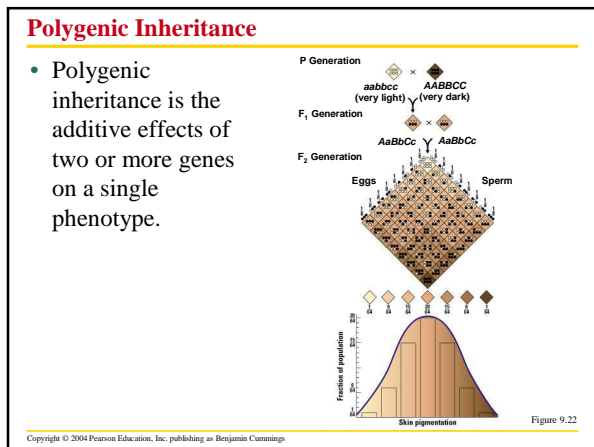
Pleiotropy and Sickle-Cell Disease

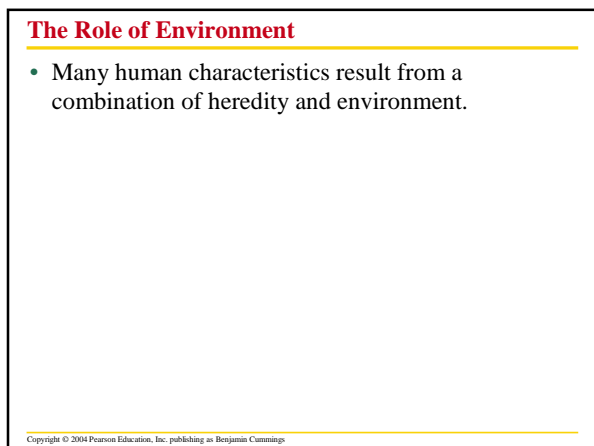
- Pleiotropy is the impact of a single gene on more than one characteristic

- Sickle-cell disease is an example.

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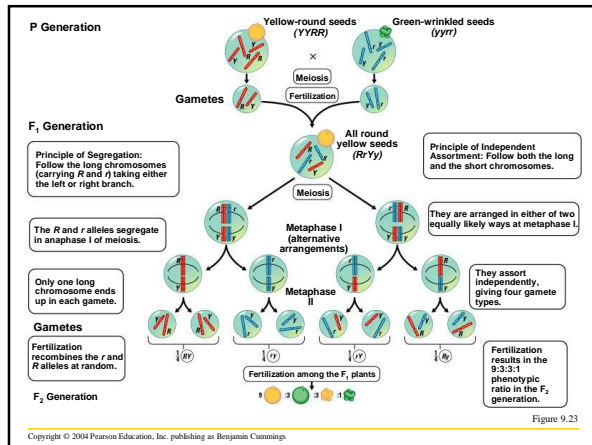




THE CHROMOSOMAL BASIS OF INHERITANCE

- The chromosome theory of inheritance states that
 - Genes are located on chromosomes
 - The behavior of chromosomes during meiosis and fertilization accounts for inheritance patterns.

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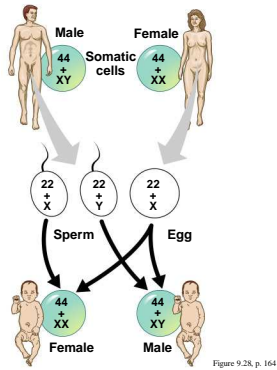
SEX CHROMOSOMES AND SEX-LINKED GENES

- Sex chromosomes
 - Influence the inheritance of certain traits.

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Sex Determination in Human and Fruit Flies

- Sex chromosomes
 - Are designated X and Y
 - Determine an individual's sex.



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Sex-Linked Genes

- Sex-linked genes
 - Are any genes located on a sex chromosome
 - Were discovered during studies on fruit flies.

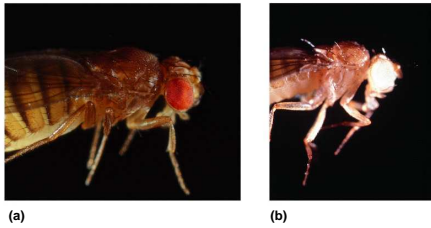
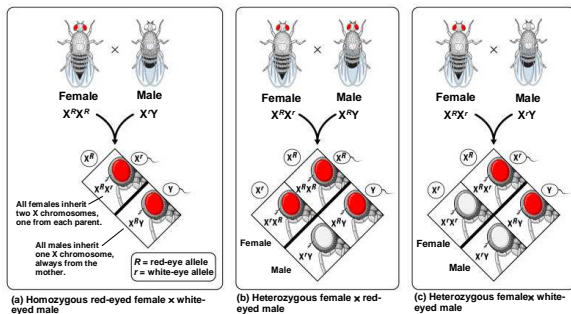


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- Inheritance patterns of a sex-linked gene



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- Red-green color blindness

- Is characterized by a malfunction of light-sensitive cells in the eyes.

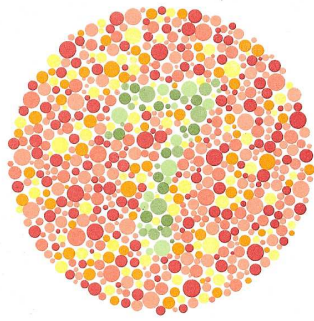


Figure 9.30

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- Hemophilia

- Is a blood-clotting disease.

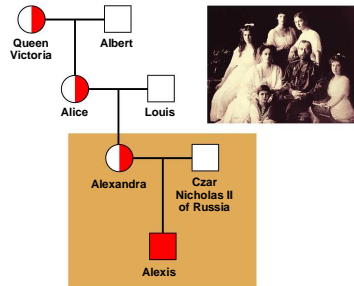


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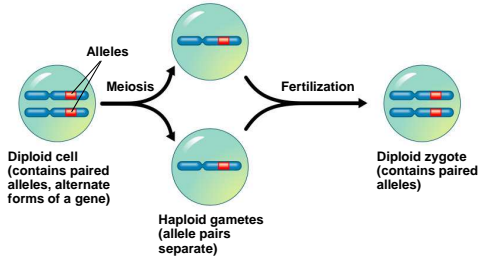
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- The Y chromosome of human males is only about one-third the size of the X chromosome
- Scientists believe that X and Y were once a fully homologous pair
- Major episodes of change have rearranged pieces of the Y chromosome.

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SUMMARY OF KEY CONCEPTS

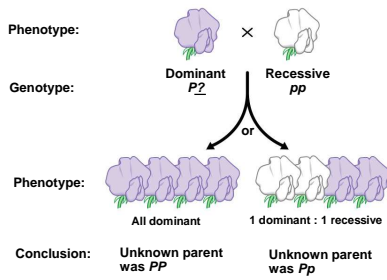
- Mendel's Principle of Segregation.



Visual Summary 9.1

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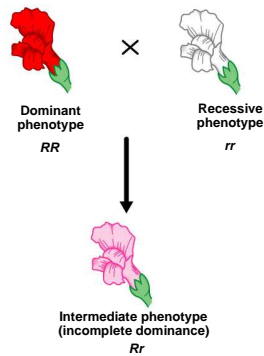
- Using a Testcross to Determine an Unknown Genotype.



Visual Summary 9.2

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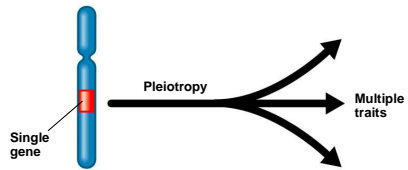
- Incomplete Dominance in Plants and People.



Visual Summary 9.3

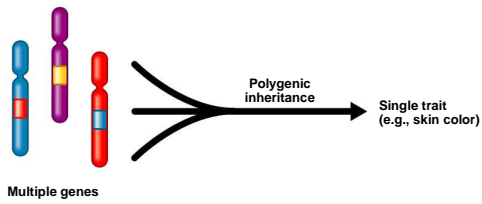
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• Pleiotropy and Sickle-Cell Disease.



Visual Summary 9.4

• Polygenic Inheritance.



Visual Summary 9.5
