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GENETICS ESSENTIALS Concepts and Connections

THIRD EDITION

CHAPTER 1
Introduction to Genetics

Chapter 1: Introduction to Genetics

- The importance of genetics
- The history of genetics
- The fundamental terms and principles of genetics

Genetics Is Important to Individuals, to Society, and to the Study of Biology

- Genes influence our lives
- Genes contribute to personality
- Genes are fundamental to who and what we are

Genetics Is Important to Individuals, to Society, and to the Study of Biology

- Genes affect our susceptibility to many diseases and disorders

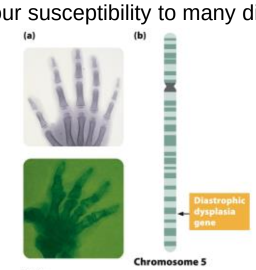

Figure 1.2
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Genetics Is Important to Individuals, to Society, and to the Study of Biology

- Genes are important in agriculture

Figure 1.3a
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Figure 1.3b
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Genetics Is Important to Individuals, to Society, and to the Study of Biology

- Genes are important in biotechnology and medicine

Figure 1.4
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Genetics Is Important to Individuals, to Society, and to the Study of Biology

- Genes are important in development

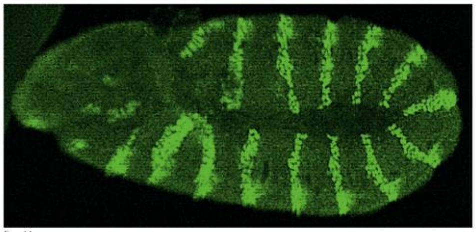

Figure 1.5
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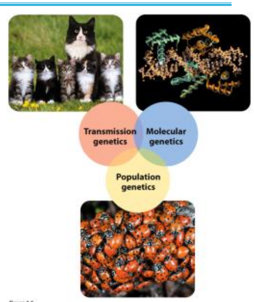
Steven Paddock

Genome

- A **genome** is a complete set of genetic instructions for any organism.
- Either RNA or DNA
- Coding system for genomic information very similar among organisms

Division of Genetics

- Transmission genetics
- Molecular genetics
- Population genetics



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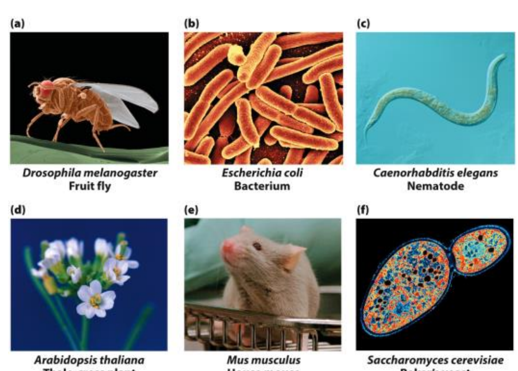
Model Genetic Organisms

- **Model genetic organisms** are organisms with characteristics that make them useful for genetic analysis.
- Six have been the most intensively studied genetically.

Common Characteristics of Model Organisms

- Short generation time
- Production of numerous progeny
- The ability to be reared in a laboratory environment



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We Have Been Using Genetics for Thousands of Years

1. 10,000–12,000 years ago: domestication of plants and animals
2. Ancient Jewish writing: understanding of genetics of hemophilia
3. Ancient Greeks: theories of inheritance

Human Reproduction

- Early Thoughts:
  - Preformationist (the homunculus)
  - Pangenesis
    - Info travels to sperm/egg from other parts of body

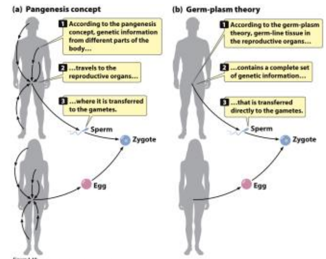

Figure 1.10
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Germ-plasm theory
- Reproductive cells carry genetic information
- Passed to egg/sperm

TABLE 1.1 Early concepts of heredity

Concept	Proposed	Correct or incorrect
Pangenesis	Genetic information travels from different parts of the body to reproductive organs.	Incorrect
Inheritance of acquired characteristics	Acquired traits become incorporated into hereditary information.	Incorrect
Preformationism	Miniature organism resides in sex cells; thus all traits are inherited from one parent.	Incorrect
Blending inheritance	Genes blend and mix.	Incorrect
Germ-plasm theory	All cells contain a complete set of genetic information.	Correct
Cell theory	All life is composed of and cells arise only from cells.	Correct
Mendelian inheritance	Traits are inherited according to specific principles proposed by Mendel.	Correct

Table 1.1
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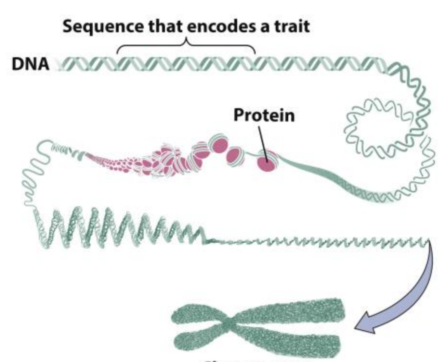
The Rise of the Science of Genetics

- Gregor Mendel: Principles of heredity
- Schleiden and Schwann: Cell theory
- Flemming: Chromosomes
- Darwin: Evolution
- Weismann: Germ-plasm theory
- Sutton: Genes are located on chromosomes
- Other modern geneticists

The Father of Genetics – Gregor Johann Mendel
- Principles of heredity - mid 1800s

- 1900ish - Mendel 'Rediscovered'
- 1902 - Sutton: Genes on chromosomes
- 1910–1930: Morgan - mutant genes, fruit flies
- 1903 ish: Chromosome - Linear arranged genes
- 1928 – Griffith: Genetic material passed btwn bacteria
- 1930's: Population genetics – (Wright/Fisher)
- 1944: DNA is the transforming principle (Avery, Macleod, McCarty)
- 1953: DNA structure– Watson/Crick/Wilkins/Franklin
- 1958: Genes code for enzymes (proteins) – Tatum/Beadle
- 1966: Genetic code cracked
- 1972: First gene sequenced (Sanger, Insulin)
- 1973: Recombinant DNA experiments
- 1983: PCR
- 1990: Human Genome Project begins
- 2001: Human Genome Project first draft



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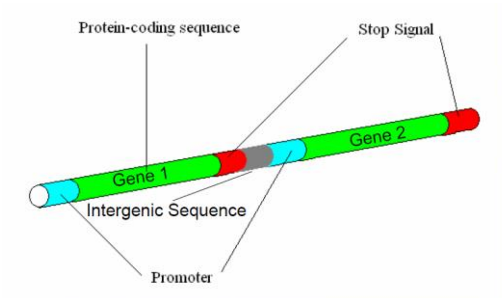
Modern but basic idea of a gene



Fundamental Concepts

- Eukaryotic vs. prokaryotic
- Genes are the fundamental unit of heredity
- Genes come in multiple forms called alleles
- Genes confer phenotypes
- Genetic information is carried in DNA and RNA
- Genes are located on chromosomes

Fundamental Concepts

- Chromosomes separate through mitosis and meiosis
- DNA to RNA to protein
- Mutations can cause permanent changes
- Some traits are affected by multiple factors
- Evolution is genetic change

Human Genome sequenced:
First Draft: 2001
More complete sequence: 2003
Still not actually complete – some inactive regions not done.
•Now the real work begins

So much data has been coming in that it has produce a new field: **Bioinformatics** - combines Molecular biology and computer science

Human Genome Project

Discoveries

- ~ 23,000 genes
- Alternative processing mean some genes code for more than one protein
- Avg gene -1400 bp
  23,000 x 1400 = 32,200,000 bp
- Humans have genes not found in other vertebrates

Why sequence the genome?

- Reference sample
- SNPs
- ?
- Genetic testing/ Genetic Diseases

Next?

- Continue Gene search
- Human Proteome
  - All genes that code for proteins

Freely Available

- Online database -GenBank

Homework #-1

Go find a sequence

- GenBank
- Find one of these
- For humans: Homo sapiens
- Nucleotide sequence
  - prolactin
  - Growth Hormone
  - Dopamine receptor
  - Immunoglobulin G

Print the Nucleotide Sequence

- Copy into Word - just the nucleotide sequence from the list
- Title - which gene sequence
- Print – *should be able to fit on one page*

Basic Concepts – and terminology

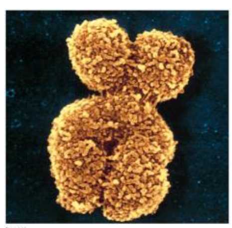
- Cells
  - Prokaryotic
    - No nuclear membrane
    - No membrane bound organelles
  - Eukaryotic
    - Nucleus/membrane bound organelles
- Gene
  - Unit of heredity
  - Definition more complex…
  - Segment of DNA that produces polypeptide / characteristic
- Allele
  - Form of genes
  - Gene = hair color
  - Allele = brown hair

Basic Concepts – and terminology

- Genes ~ phenotypes/traits
  - Environment influences expression
- DNA and RNA
  - Carry the genetic information
  - Code is the bases
    - DNA (C, T, A, G)
    - RNA (C, U, A, G)
  - Code for Proteins, which in turn run the cell
- Genes located on chromosomes
  - Diploid species have two of each chromosome thus two of each gene
- Chromosome separate via mitosis and meiosis

Basic Concepts – and terminology

- Information Flow
  - DNA makes RNA makes Protein
- Mutations are changes in genetic information
- Traits are influenced by many factors
  - Multiple genes
  - Environment
- Evolution…
  - Is genetic change
  1. Variation +
  2. Changes in frequency



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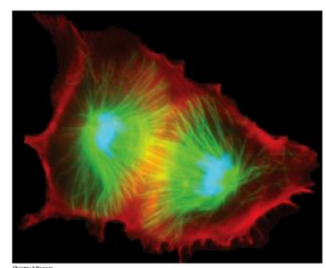
CHAPTER 2
Chromosomes and Cellular Reproduction



Chapter 2 Opener
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Chromosomes and Cellular Reproduction

- Prokaryote and Eukaryote
- Cell Reproduction
- Sexual Reproduction

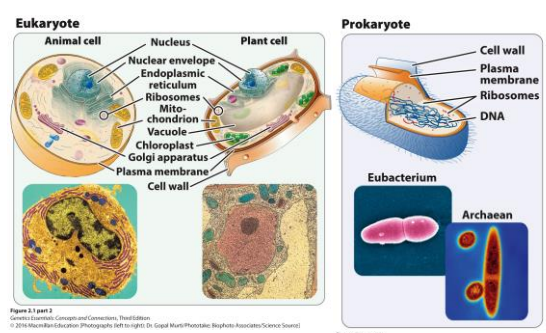

Figure 2.1 part 2
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Figure 2.1 part 1
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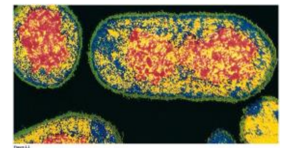
Prokaryotic and Eukaryotic organisms

- Eukaryotic
  - nuclear envelope
  - DNA packaged with histones
  - DNA in many linear strands
  - DNA also in mitochondria and chloroplast
    - Small circular molecule
- Prokaryotic
  - Usually single circular DNA molecule
  - Sometimes 'extra' DNA – plasmids (small circular)
  - Eubacteria
    - No histones
  - Archaea
    - Have histones
- Though similar in basic structure DNA evidence suggests that archaea and eubacteria are not very similar

	Prokaryotic cells	Eukaryotic cells
Nucleus	Absent	Present
Cell diameter	Relatively small, from 1 to 10 μm	Relatively large, from 10 to 100 μm
Genome	Usually one circular DNA molecule	Multiple linear DNA molecules
DNA	Not complexed with histones in eubacteria; some histones in archaea	Complexed with histones
Amount of DNA	Relatively small	Relatively large
Membrane-bounded organelles	Absent	Present

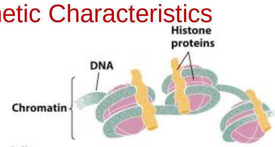
Prokaryotic and Eukaryotic Cells Differ in a Number of Genetic Characteristics

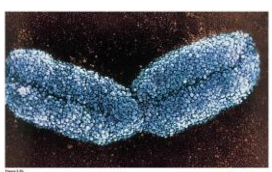
- Prokaryote
  - Unicellular, no membrane bound organelles.
  - Prokaryotic DNA does not exist in the highly ordered and packed arrangement.
  - Made up of eubacteria and archaea.



Prokaryotic and Eukaryotic Cells Differ in a Number of Genetic Characteristics

- Eukaryote
  - Both unicellular and multicellular with membrane-bound organelles.
  - Genetic material is surrounded in a nuclear envelope to form a nucleus.
  - DNA is closely associated with histones to form tightly packed chromosomes.



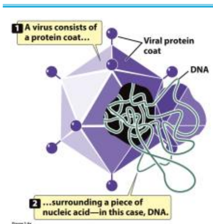


Concept Check

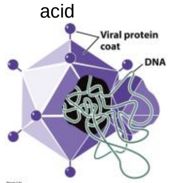
List several characteristics that eubacteria and archaea have in common and that distinguish them from eukaryotes.

Eubacteria and archaea are prokaryotes.
- They differ from eukaryotes in possessing no nucleus
- Genome usually single circular chromosome,
- Small amount of DNA.

Viruses



- Viruses
  - Neither prokaryotic nor eukaryotic
  - Outer protein coat surrounding nucleic acid



Cell Reproduction Requires the Copying of the Genetic Material, Separation of the Copies, and Cell Division

- Prokaryotic Cell Reproduction
  - Origin of replication
  - High rate of replication
- Eukaryotic Cell Reproduction
  - Eukaryotic chromosomes:
    - Homologous pair
    - Chromosome structure
    - The cell cycle
    - Genetic consequences of the cell cycle

Cell Reproduction Requires the Copying of the Genetic Material, Separation of the Copies, and Cell Division

- Homologous Pair
- Diploid cells carry two sets of genetic information.
- Haploid cells carry one set of genetic information.

- Symbols: n = number of different types of chromosomes. Haploid = 1n, diploid = 2n

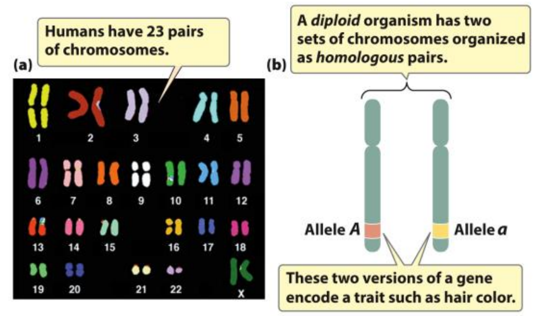


Figure 2.5
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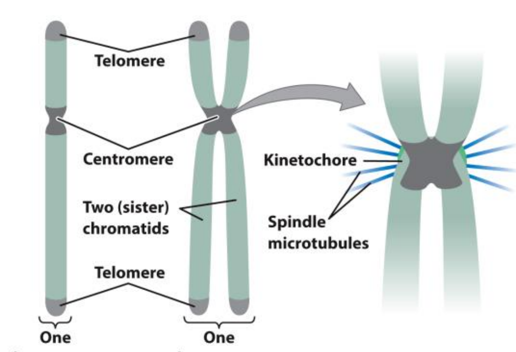
Concept Check

Diploid cells have

a. Two chromosomes.
b. Two sets of chromosomes.
c. One set of chromosomes.
d. Two pairs of homologous chromosomes.

Cell Reproduction - Chromosomes

- Chromosome Structure
  - Centromere: attachment point for spindle microtubules
  - Telomeres: tips of a linear chromosome
  - Origins of replication: where the DNA synthesis begins



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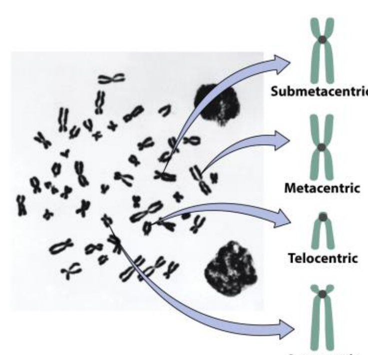

Humans do not have any telocentric chromosomes; 13, 14, 15, 21, 22, & Y are considered acrocentric

Figure 2.7
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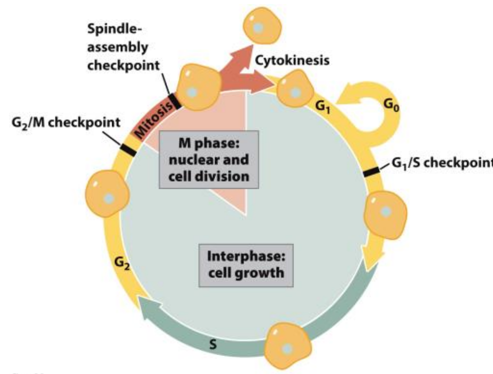
Cell Reproduction – Cell Cycle

- **The Cell Cycle and Mitosis**
  - **Life cycle of the cell**
  - **Interphase:** an extended period between cell divisions, DNA synthesis, and chromosome replication phase
  - **M phase:** mitotic phase
  - Phase check points: key transition points



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Cell Reproduction: Interphase

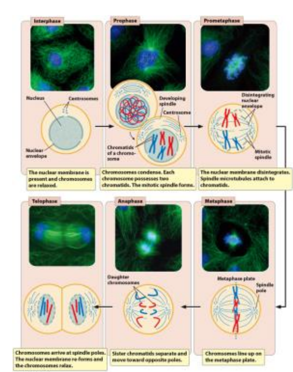
- Interphase
  - G_1, S, G_2
  - G_1: Growth; proteins necessary for cell division synthesized
  - G_1/S checkpoint: regulated decision point
  - S: DNA synthesis
  - G_2: biochemical preparation for cell division
  - G_2/M checkpoint: only passed if DNA completely replicated and undamaged

Cell Reproduction: Mitosis

- **M Phase**
  - **Mitosis:** separation of sister chromatids
- **Cytokinesis:** separation of cytoplasm

Cell Reproduction: Mitosis

- Prophase
- Prometaphase
- Metaphase
- Anaphase
- Telophase



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Cell Reproduction Requires the Copying of the Genetic Material, Separation of the Copies, and Cell Division

- Genetic Consequences of the Cell Cycle
  - Producing two cells that are genetically identical to each other and with the cell that gave rise to them.
  - Newly formed cells contain a full complement of chromosomes.
  - Each newly formed cell contains approximately half the cytoplasm and organelle content of the original parental cell.

TABLE 2.1 Features of the cell cycle

Stage	Major features
G_0 phase	Stable, nondividing period of variable length.
Interphase	
G_1 phase	Growth and development of the cell; G_1/S checkpoint.
S phase	Synthesis of DNA.
G_2 phase	Preparation for division; G_2/M checkpoint.
M phase	
Prophase	Chromosomes condense and mitotic spindle forms.
Prometaphase	Nuclear envelope disintegrates, and spindle microtubules anchor to kinetochores.
Metaphase	Chromosomes align on the metaphase plate; spindle-assembly checkpoint.
Anaphase	Sister chromatids separate, becoming individual chromosomes that migrate toward spindle poles.
Telophase	Chromosomes arrive at spindle poles, the nuclear envelope re-forms, and the condensed chromosomes relax.
Cytokinesis	Cytoplasm divides; cell wall forms in plant cells.

Table 2.1
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Concept Check

Which is the correct order of stages in the cell cycle?

a. G1, S, prophase, metaphase, anaphase
b. S, G1, prophase, metaphase, anaphase
c. prophase, S, G1, metaphase, anaphase
d. S, G1, anaphase, prophase, metaphase

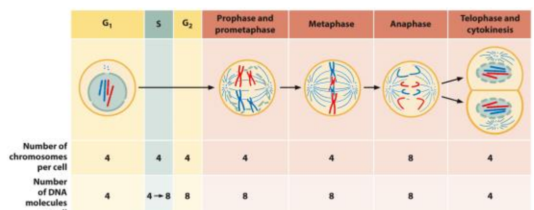

Figure 2.10
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Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- **Meiosis:** the production of haploid gametes
- **Fertilization:** the fusion of haploid gametes
- **Genetic variation:** consequences of meiosis

Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- **Meiosis**
  - **Interphase:** DNA synthesis and chromosome replication phase
  - **Meiosis I:** separation of homologous chromosome pairs, and reduction of the chromosome number by half
  - **Meiosis II:** separation of sister chromatids, also known as equational division

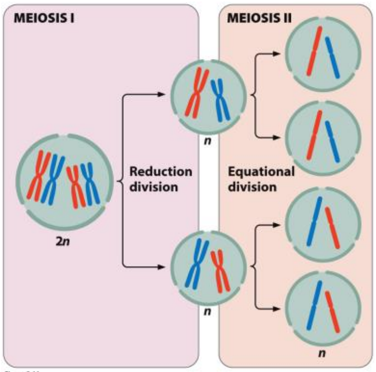

Figure 2.11
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Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- **Meiosis I**
  - **Prophase I**
    - **Synapsis:** close pairing of homologous chromosome
    - **Tetrad:** closely associated four-sister chromatids of two homologous chromosomes
    - **Crossing over:** crossing over of chromosome segments from the sister chromatid of one chromosome to the sister chromatid of the other synapsed chromsome—*exchange of genetic information, the first mechanism of generating genetic variation in newly formed gametes*

Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- **Meiosis I**
  - **Metaphase I:** random alignment of homologous pairs of chromosomes along the metaphase plate
  - **Anaphase I:** separation of homologous chromosome pairs, and the random distribution of chromosomes into two newly divided cells—*second mechanism of generating genetics variation in the newly formed gametes*
  - **Telophase I:** the chromosomes arrive at the spindle poles and the cytoplasm divides.

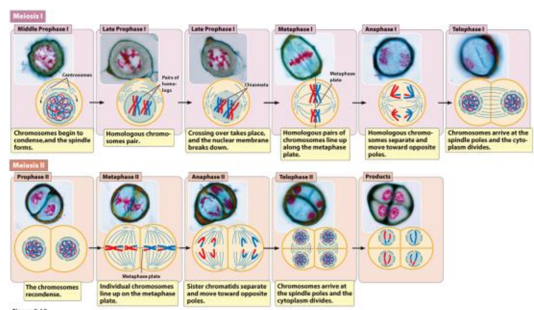

Figure 2.12
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TABLE 2.2 Major events in each stage of meiosis

Stage	Major events
Meiosis I	
Prophase I	Chromosomes condense, homologous chromosomes synapse, crossing over takes place, nuclear envelope breaks down, and mitotic spindle forms.
Metaphase I	Homologous pairs of chromosomes line up on the metaphase plate.
Anaphase I	The two chromosomes (each with two chromatids) of each homologous pair separate and move toward opposite poles.
Telophase I	Chromosomes arrive at the spindle poles.
Cytokinesis	The cytoplasm divides to produce two cells, each having half the original number of chromosomes.
Interkinesis	In some types of cells, the spindle breaks down, chromosomes relax, and a nuclear envelope re-forms, but no DNA synthesis takes place.
Meiosis II	
Prophase II*	Chromosomes condense, the spindle forms, and the nuclear envelope disintegrates.
Metaphase II	Individual chromosomes line up on the metaphase plate.
Anaphase II	Sister chromatids separate and move as individual chromosomes toward the spindle poles.
Telophase II	Chromosomes arrive at the spindle poles; the spindle breaks down and a nuclear envelope re-forms.
Cytokinesis	The cytoplasm divides.

*Only in cells in which the spindle has broken down, chromosomes have relaxed, and the nuclear envelope has re-formed in telophase I. Other types of cells proceed directly to metaphase II after cytokinesis.

Table 2.2
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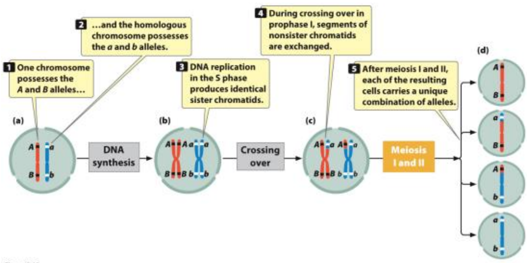
Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- Sources of Genetic Variation in Meiosis
  - Four cells are produced from each original cell.
  - Chromosome number in each new cell is reduced by half. The new cells are haploid.
  - Newly formed cells from meiosis are genetically different from one another and from the parental cell.



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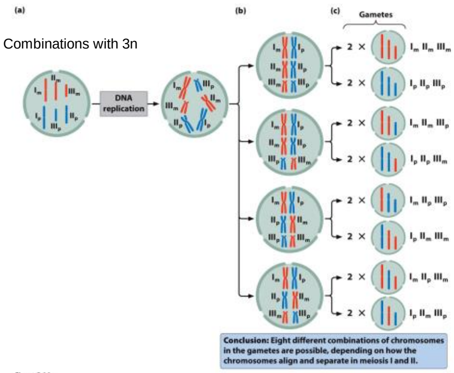
Combinations with 3n



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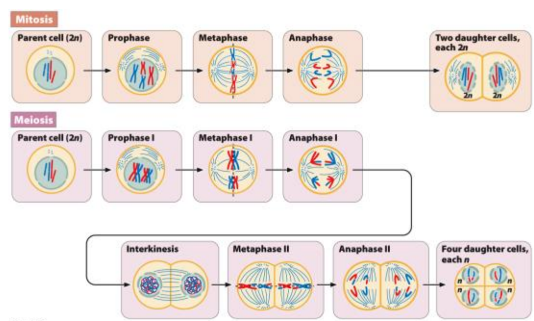
Concept Check

Which of the following events takes place in metaphase I?

a. Crossing over occurs.
b. The chromosomes condense.
c. Homologous pairs of chromosomes line up on the metaphase plate.
d. Individual chromosomes line up on the metaphase plate.



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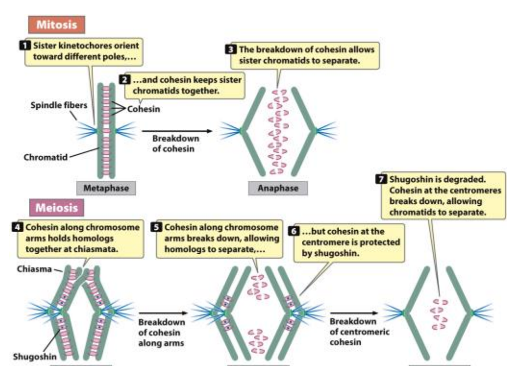
Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- **Separation of Sister Chromatids and Homologous Chromosomes**
  - **Cohesin:** a protein that holds the chromatids together and is key to the behavior of chromosomes in mitosis and meiosis



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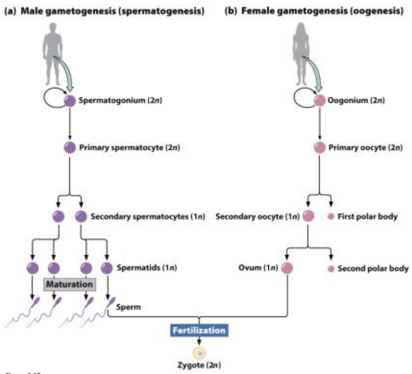

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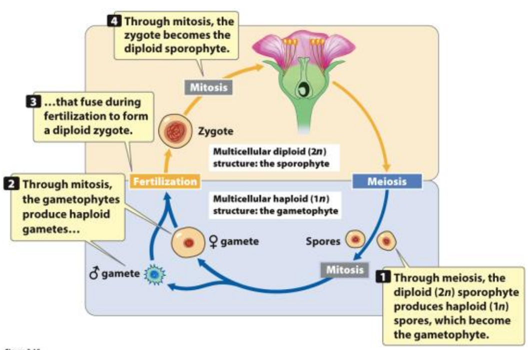
Sexual Reproduction Produces Genetic Variation Through the Process of Meiosis

- Meiosis in the Life Cycle of Animals and Plants
  - Meiosis in animals
    - **Spermatogenesis:** male gamete production
    - **Oogenesis:** female gamete production
  - Meiosis in plants



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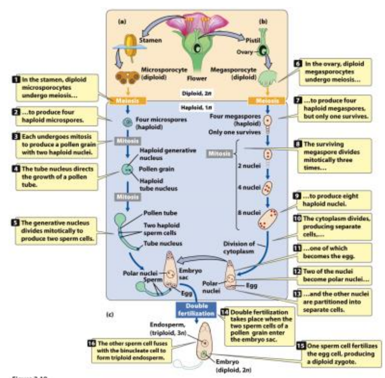

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Bio Tutoring

- Tuesday 3:30-5:30
- Biology Lab room (117)

GENERAL TUTORING BY APPOINTMENT

Please email tutor to make appointment. Type "tutoring" in subject line, and suggest times that work for you. If you do not hear back from tutor within 24 hours, call 402-437-2627.

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Anatomy	Michael Mellon	mmellon@southeast.edu
ASL	Summer Theis	summertheis@gmail.com
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Critical & Creative Thinking	Martine Hansen	martinehansen@ymail.com
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Food Service	Jazzi Alley	ja530494@southeast.edu
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Benjamin A. Pierce

GENETICS ESSENTIALS
Concepts and Connections
THIRD EDITION

CHAPTER 3
Basic Principles of Heredity

Gregor Mendel Discovered the Basic Principles of Heredity

- Gregor Mendel and his success in genetics
  - Good experimental model
  - Used an experimental approach and analyzed results mathematically
  - Studied easily differentiated characteristics

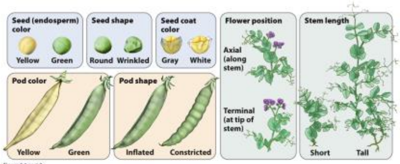

Figure 3.1 part 2
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TABLE 3.1 Summary of important genetic terms

Term	Definition
Gene	An inherited factor (region of DNA) that helps determine a characteristic
Allele	One of two or more alternative forms of a gene
Locus	Specific place on a chromosome occupied by an allele
Genotype	Set of alleles possessed by an individual organism
Heterozygote	An individual organism possessing two different alleles at a locus
Homozygote	An individual organism possessing two of the same alleles at a locus
Phenotype or trait	The appearance or manifestation of a characteristic
Characteristic or character	An attribute or feature possessed by an organism

Table 3.1
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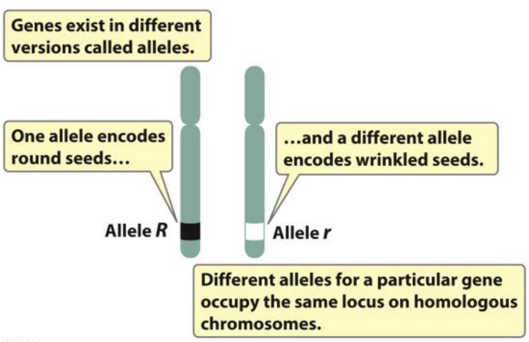

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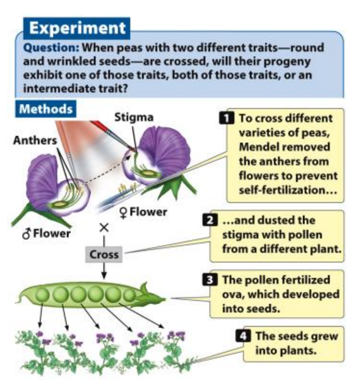
Concept Check 2

What is the difference between a locus and an allele? What is the difference between genotype and phenotype?

A locus is a place on a chromosome where genetic information encoding a characteristic is located. An allele is a version of a gene that encodes a specific trait.
A genotype is the set of alleles possessed by an individual organism, and a phenotype is the manifestation or appearance of a characteristic.

Monohybrid Crosses Segregation and the Concept of Dominance

- Monohybrid cross: cross between two parents that differ in a single characteristic.
  - Conclusion 1: one character is encoded by two genetic factors.
  - Conclusion 2: two genetic factors (alleles) separate when gametes are formed.
  - Conclusion 3: The concept of dominant and recessive traits.
  - Conclusion 4: Two alleles separate with equal probability into the gametes.



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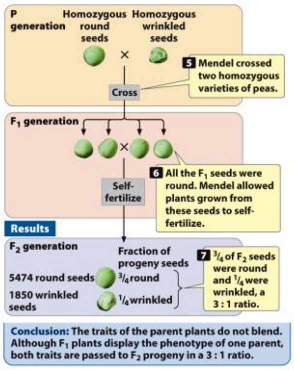

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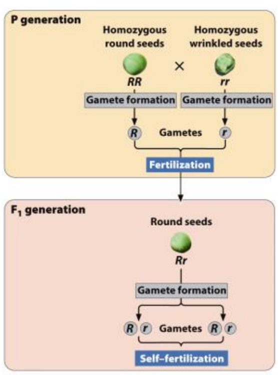
Monohybrid Crosses
Segregation and the Concept of Dominance

- Principle of segregation: (Mendel's first law)
  Each individual diploid organism possesses two alleles for any particular characteristic. These two alleles segregate when gametes are formed, and one allele goes into each gamete.

- The concept of dominance: when two different alleles are present in a genotype, only the trait encoded by one of them—the "dominant" allele—is observed in the phenotype.



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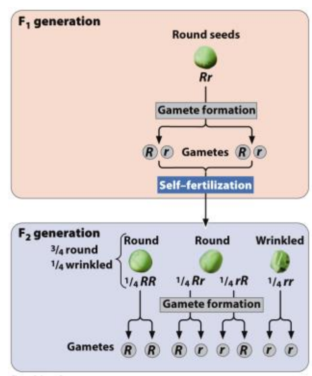

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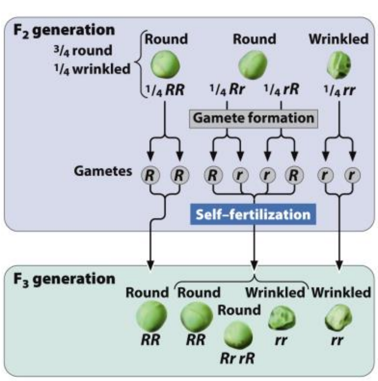

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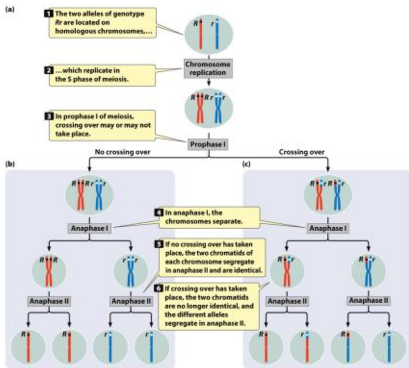
Monohybrid Crosses
Segregation and the Concept of Dominance

- Monohybrid crosses explained by the principle of segregation
- The symbols in genetic crosses correspond to alleles on chromosomes
- Sutton: Chromosomal Theory of Heredity



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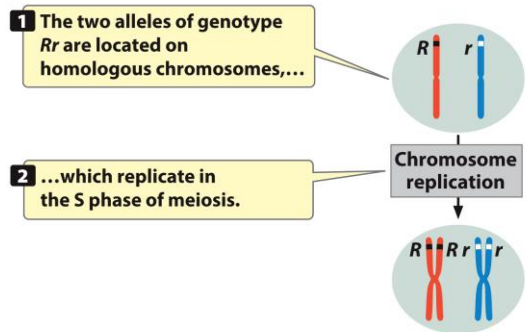

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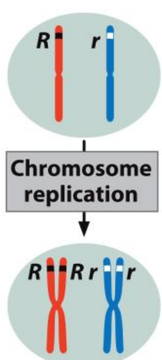

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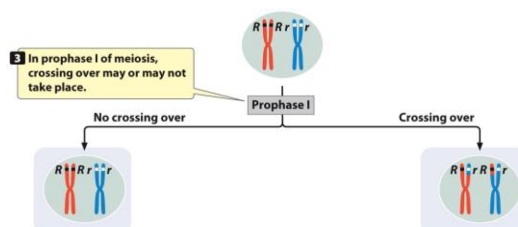

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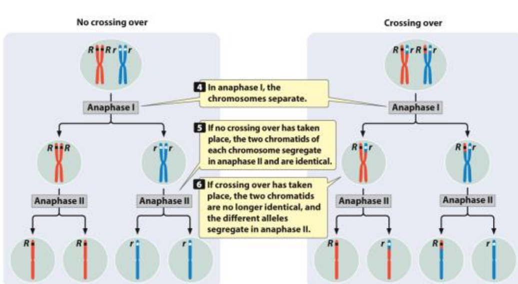

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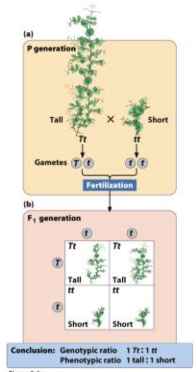
Monohybrid Crosses

- Test the theory of inheritance of dominant traits using backcrosses
- Predicting the outcomes of genetics crosses
  - The Punnett square



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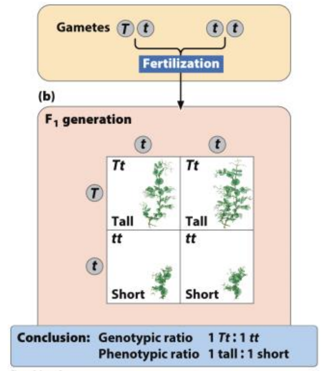

Figure 3.6 part 2
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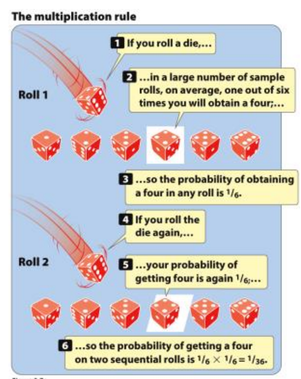
Probability

- Probability: the likelihood of the occurrence of a particular event
- Used in genetics to predict the outcome of a genetic cross
- Multiplication rule
- Addition rule



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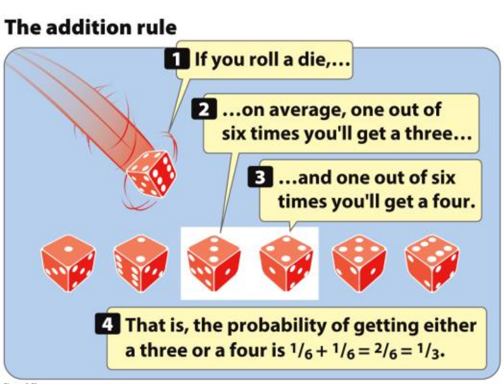

Figure 3.7b
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Concept Check

If the probability of being blood-type A is 1/8 and the probability of blood-type O is ½, what is the probability of being either blood-type A or O?

a. 5/8
b. ½
c. 1/8
d. 1/16

Monohybrid Crosses

- The Testcross
- Ratios in Simple Crosses

What is the probability of getting tall plants?

Tt X *Tt*

Tall: *TT*, *Tt* & *tT*
Short: *tt*

$\frac{1}{4}+\frac{1}{4}+\frac{1}{4}=\frac{3}{4}$

How do you know if an individual is homozygous dominant or heterozygous?

T? or *T_*

Do a testcross!

Unknown genotype X homozygous recessive
or
*T_* x *tt*

Testcross

*T_* x *tt*

TT x *tt* → *Tt* 100%

Tt x *tt* → *Tt* 50%, *tt* 50%

TABLE 3.2 **Phenotypic ratios for simple genetic crosses (crosses for a single locus)**

Phenotypic ratio	Genotypes of parents	Genotypes of progeny
3:1	*Aa* × *Aa*	$\frac{3}{4}$ *A_*:$\frac{1}{4}$ *aa*
1:1	*Aa* × *aa*	$\frac{1}{2}$ *Aa*:$\frac{1}{2}$ *aa*
Uniform progeny	*AA* × *AA*	All *AA*
	aa × *aa*	All *aa*
	AA × *aa*	All *Aa*
	AA × *Aa*	All *A_*

Table 3.2
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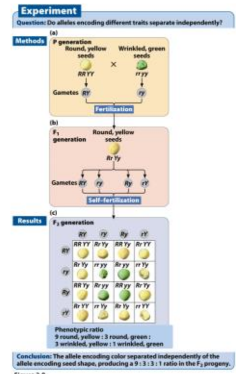
Some

Crossing Problems

Dihybrid Crosses Reveal the Principle of Independent Assortment

Dihybrid Crosses
- Examine two traits at a time
- The principle of independent assortment



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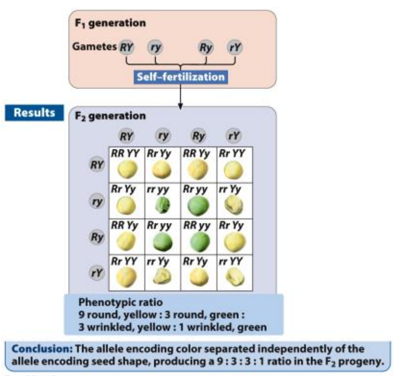

Figure 3.8 part 3
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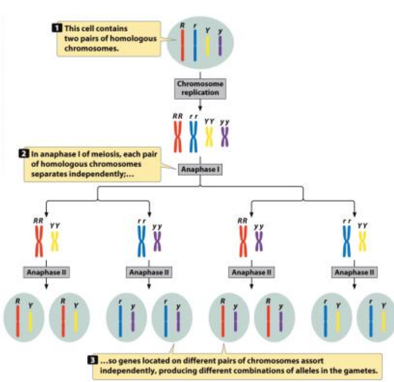
Dihybrid Crosses Reveal the Principle of Independent Assortment

Dihybrid Crosses
- Relate the principle of independent assortment to meiosis
- Gametes located on different chromosomes will sort independently



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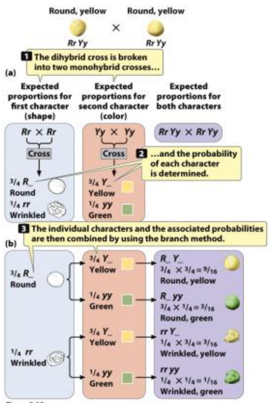
Dihybrid Crosses Reveal the Principle of Independent Assortment

Dihybrid Crosses
- Applying probability and the branch diagram to dihybrid crosses



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Observed Ratios of Progeny May Deviate from Expected Ratios by Chance

- Chi-Square Goodness of Fit
- Indicates the probability that the difference between the observed and expected values is due to chance

TABLE 3.4 Critical values of the χ_2 distribution

	P								
df	0.995	0.975	0.9	0.5	0.1	0.05*	0.025	0.01	0.005
1	0.000	0.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.812	18.548
7	0.989	1.690	2.833	6.346	12.017	14.067	16.013	18.475	20.278
8	1.344	2.180	3.490	7.344	13.362	15.507	17.535	20.090	21.955
9	1.735	2.700	4.168	8.343	14.684	16.919	19.023	21.666	23.589
10	2.156	3.247	4.865	9.342	15.987	18.307	20.483	23.209	25.188
11	2.603	3.816	5.578	10.341	17.275	19.675	21.920	24.725	26.757
12	3.074	4.404	6.304	11.340	18.549	21.026	23.337	26.217	28.300
13	3.565	5.009	7.042	12.340	19.812	22.362	24.736	27.688	29.819
14	4.075	5.629	7.790	13.339	21.064	23.685	26.119	29.141	31.319
15	4.601	6.262	8.547	14.339	22.307	24.996	27.488	30.578	32.801

P, probability; df, degrees of freedom.
*Most scientists assume that when $P < 0.05$, a significant difference exists between the observed and expected values in a chi-square test.

Table 3.4
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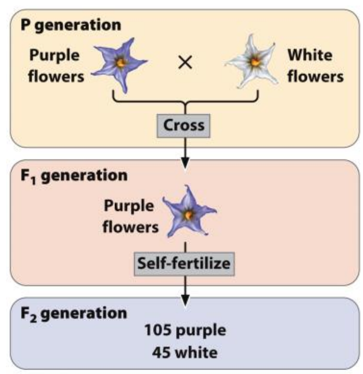

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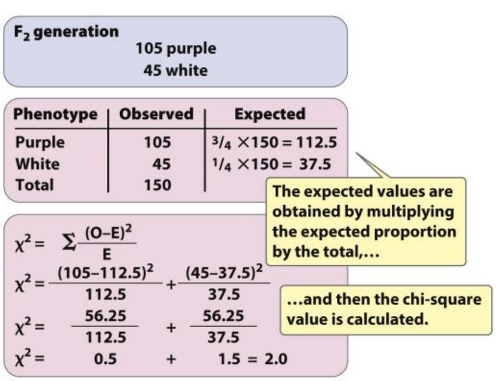

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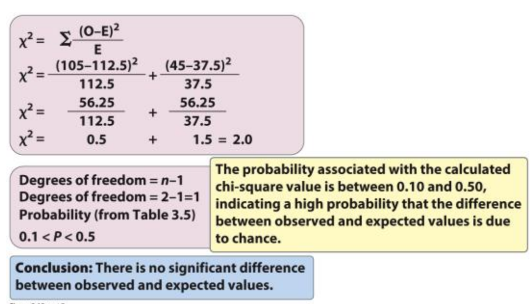

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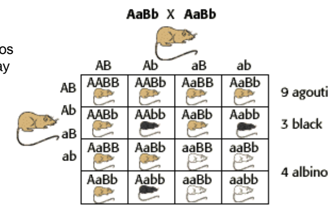
Concept Check

A chi-square test comparing observed and expected numbers of progeny is carried out, and the probability associated with the calculated chi-square value is 0.72. What does this probability represent?

a. Probability that the correct results were obtained
b. Probability of obtaining the observed numbers
c. Probability that the difference between observed and expected numbers is significant
d. Probability that the difference between observed and expected numbers is due to chance

Don't assume gene combos will always turn out the way they did for Mendel

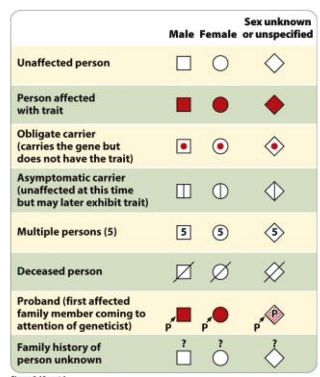


What will the phenotypic ratio be if all offspring with at least one upper case B are blue and all others are red.

	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	Aabb	AaBb	Aabb
aB	AaBb	AaBb	AaBB	aaBb
ab	AaBb	Aabb	aabB	aabb

Geneticists Use Pedigrees to Study the Inheritance of Characteristics in Humans

- Pedigree: pictorial representation of a family history, a family tree that outlines the inheritance of one or more characteristics
- Proband: the person from whom the pedigree is initiated



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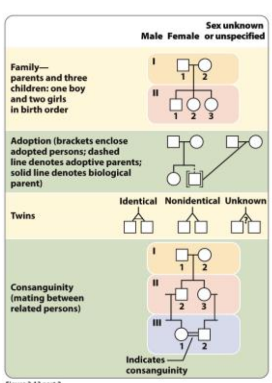

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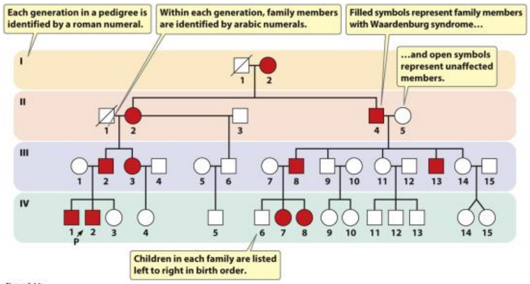
Geneticists Often Use Pedigrees to Study the Inheritance of Characteristics in Humans

- Autosomal recessive traits
- Autosomal dominant traits
- X-linked dominant traits
- Y-inked traits



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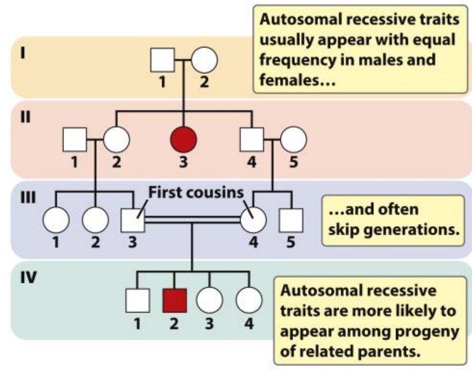

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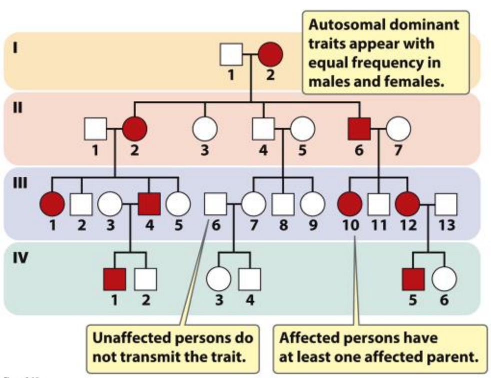

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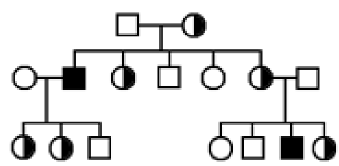

X-linked Recessive