Chapter 8: Cellular Reproduction and Inheritance Part II

Honors Biology
2012

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Homologous Pairs

- Somatic Cells - non-reproductive cells
  - have pairs of homologous chromosomes (one from each parent)
- Homologous chromosomes - match in length, centromere position, and gene locations
  - locus - position of a gene, where different versions of the same gene exist
- Sex chromosomes - often differ in size and genetic composition
- Autosomes - non-sex chromosomes

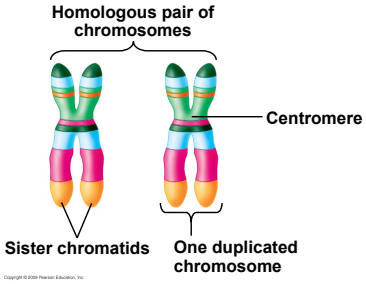

Fig. 8.12

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Meiosis

- Converts diploid nuclei into haploid nuclei
  - Diploid - have two homologous sets of chromosomes
  - Haploid - one set of chromosomes
- Meiosis occurs in sex organs producing gametes
  - Gametes - sex cells (egg and sperm)
- Fertilization - union of sperm and egg
  - Zygote - has a diploid number of chromosomes (one from each parent)

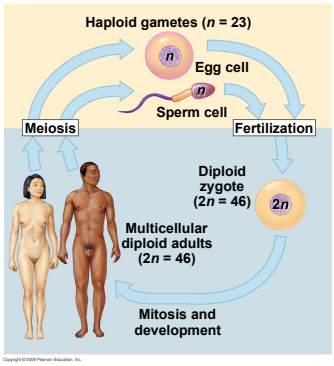

Fig. 8.13

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Meiosis

- Still follows interphase (G_1, S, G_2)
- Steps are similar to mitosis, but they happen twice
  - Meiosis I - homologous chromosomes separate
    - Chromosome number reduced in half (diploid to haploid)
  - Meiosis II - sister chromatids separate

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Meiosis I

- Prophase I
  - chromosomes coil and pair up
  - Each pair is called a tetrad
  - Crossing over can occur
- Metaphase I
  - Tetrads align
- Anaphase I
  - Homologous pairs separate
- Telophase I
  - Nuclear envelope forms
  - Each nucleus has a haploid number of chromosomes

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Meiosis II

- Happens after Meiosis I without chromosomes duplicating
- Prophase II
  - Chromosomes coil
- Metaphase II
  - Chromosomes line up at the equator
- Anaphase II
  - Sister chromatids separate
- Telophase II
  - Nuclear envelope reforms
- Cytokinesis happens to form a total of four haploid cells

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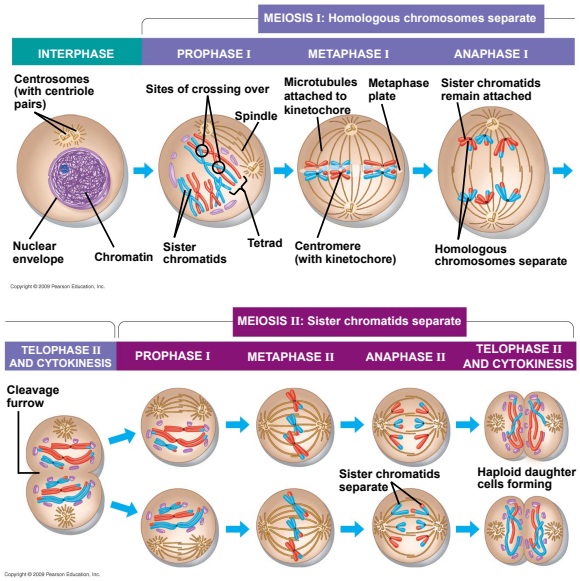

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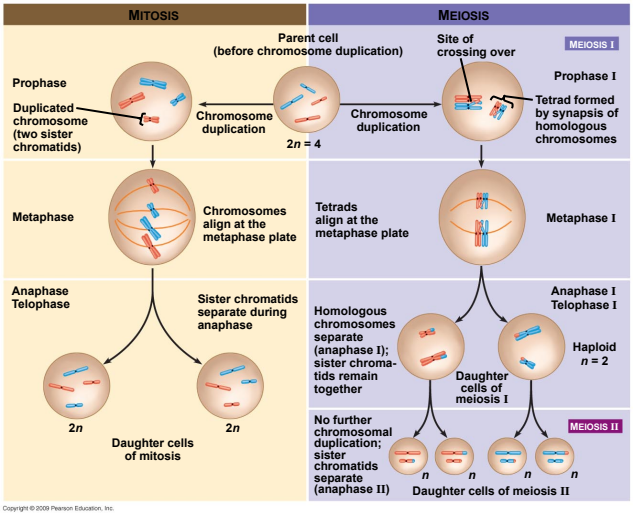
Comparing Mitosis and Meiosis



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Factors that Increase Genetic Diversity

- Independent Assortment - independent orientation of chromosomes at metaphase I
- Random Fertilization - unique combinations of each sperm and egg
- Crossing Over - genetic recombination
  - exchange of genetic material between homologous chromosomes

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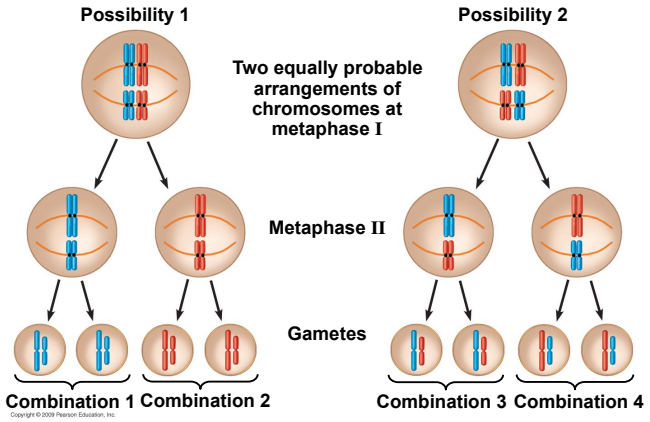
Independent Assortment

Fig. 8.16



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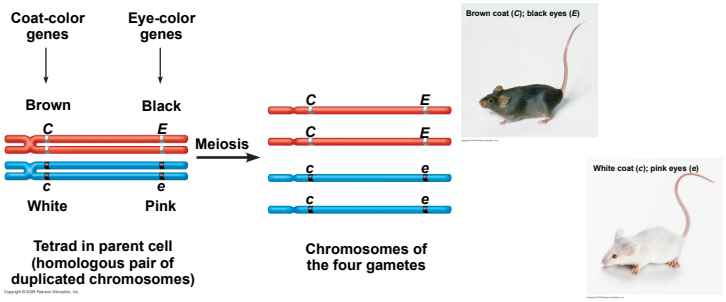
Homologous Chromosomes Carry Different Versions of Genes

- Homologous chromosomes may have different versions of a gene at the same locus
  - One is from a maternal parent and the other from a paternal parent



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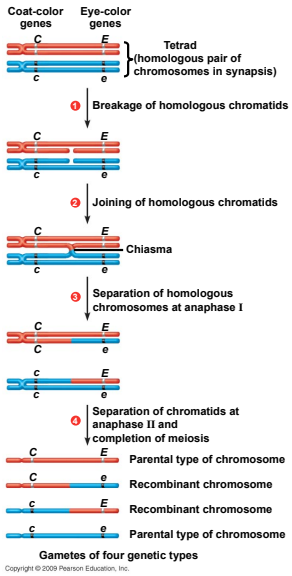
Crossing Over



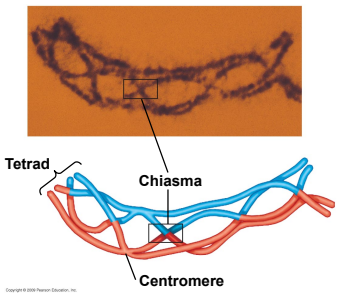


Fig. 8.18

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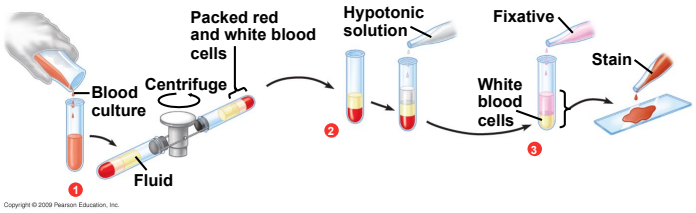
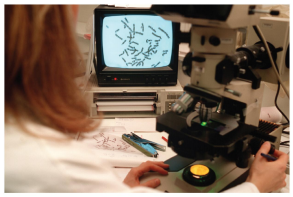
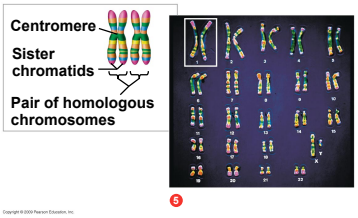
Karyotype

- Shows stained and magnified versions of chromosomes







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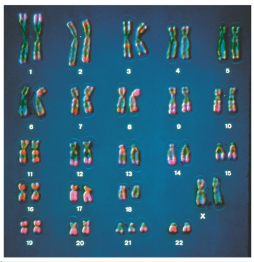
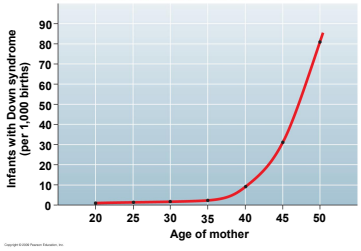
Chromosomal Disorders

- Down's Syndrome
  - Trisomy 21 - three copies of chromosome 21
  - Characterized by specific features
    - Characteristic facial features
    - Susceptibility to disease
    - Shortened life-span
    - Mental retardation
  - Incidence increases with age of mother





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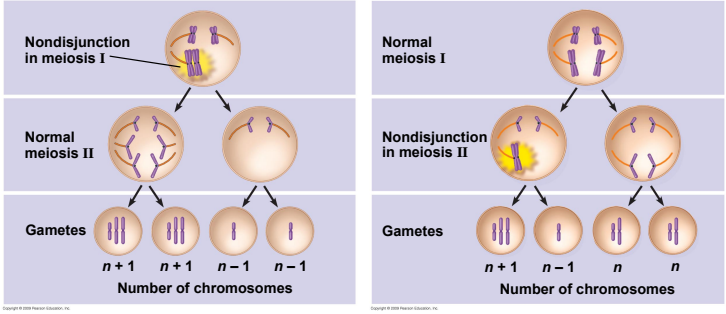
Chromosomal Disorders

- Many caused by nondisjunction (failure of chromosomes or chromatids to separate during meiosis)
- Can happen in Meiosis I or Meiosis II



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Chromosomal Disorders

- Can also occur with sex chromosomes
- Klinefelter Syndrome - produces males who are sterile and can express female secondary sex characteristics
- Turner Syndrome - produce females who are sterile and who have poor development of female secondary sex characteristics

TABLE 8.22 ABNORMALITIES OF SEX CHROMOSOME NUMBER IN HUMANS

Sex Chromosomes	Syndrome	Origin of Nondisjunction	Frequency in Population
XXY	Klinefelter syndrome (male)	Meiosis in egg or sperm formation	1/2,000
XYY	None (normal male)	Meiosis in sperm formation	1/2,000
XXX	None (normal female)	Meiosis in egg or sperm formation	1/1,000
XO	Turner syndrome (female)	Meiosis in egg or sperm formation	1/5,000

Changes in Chromosome Structure

- Can result from breakage and rejoining of chromosome segments
  - Deletion - loss of a segment
  - Duplication - repeat of a segment
  - Inversion - reversal of a segment
  - Translocation - attachment of a segment to a non-homologous chromosome