Lecture 7 Outline -

Old Business - DNA Packaging, Alleles, Loci, Mitosis and DNA content

New Business -

Chromosomes, Chromatids, Meiosis + Gametes

Mendelian Genetics - complex crosses, partial dominance, quantitative traits, one gene, one enzyme hypothesis

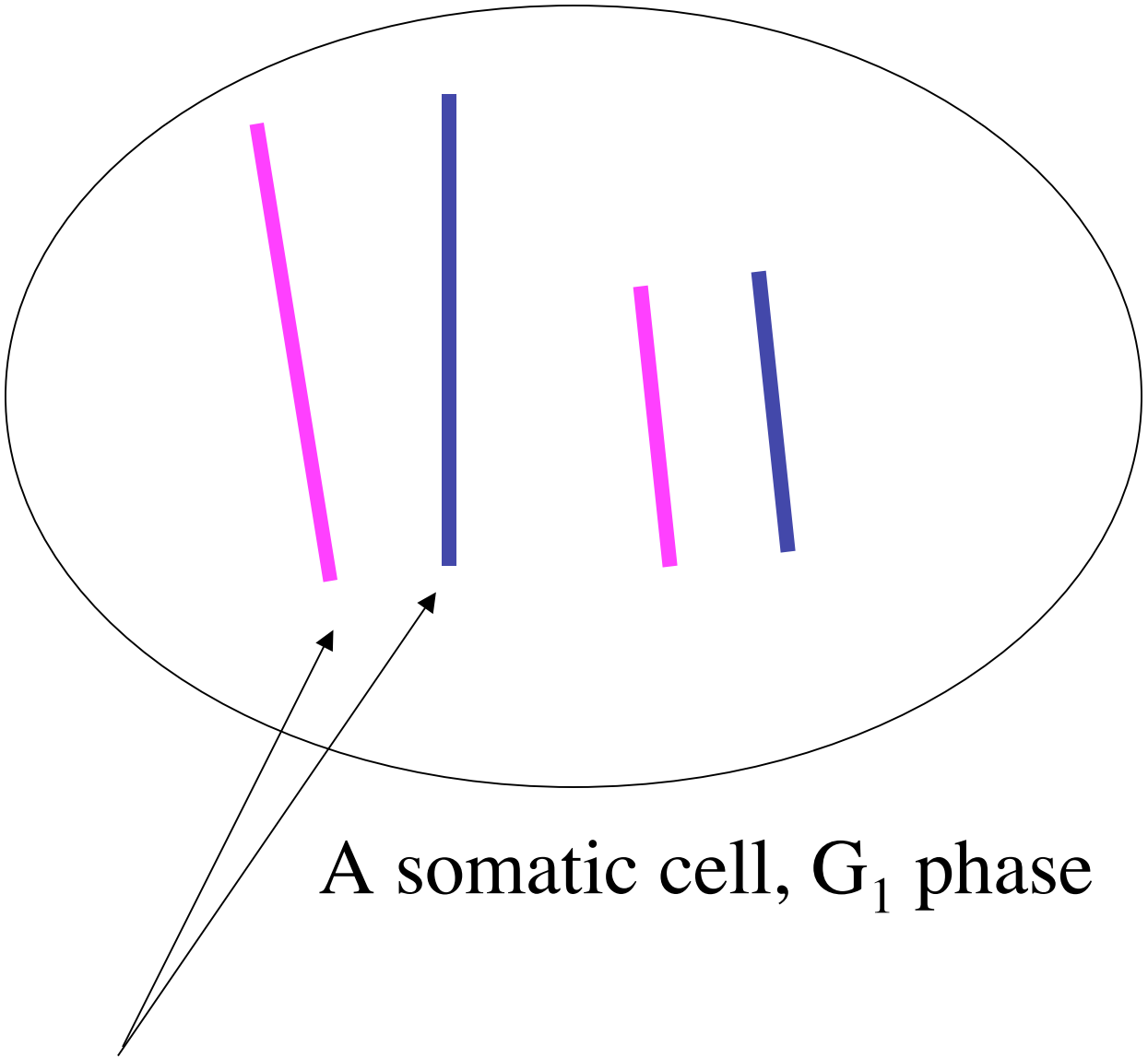
Surprise quiz

Chromosomes, Chromatids, ploidy and Mitosis

Humans normally have 23 unique types of chromosomes

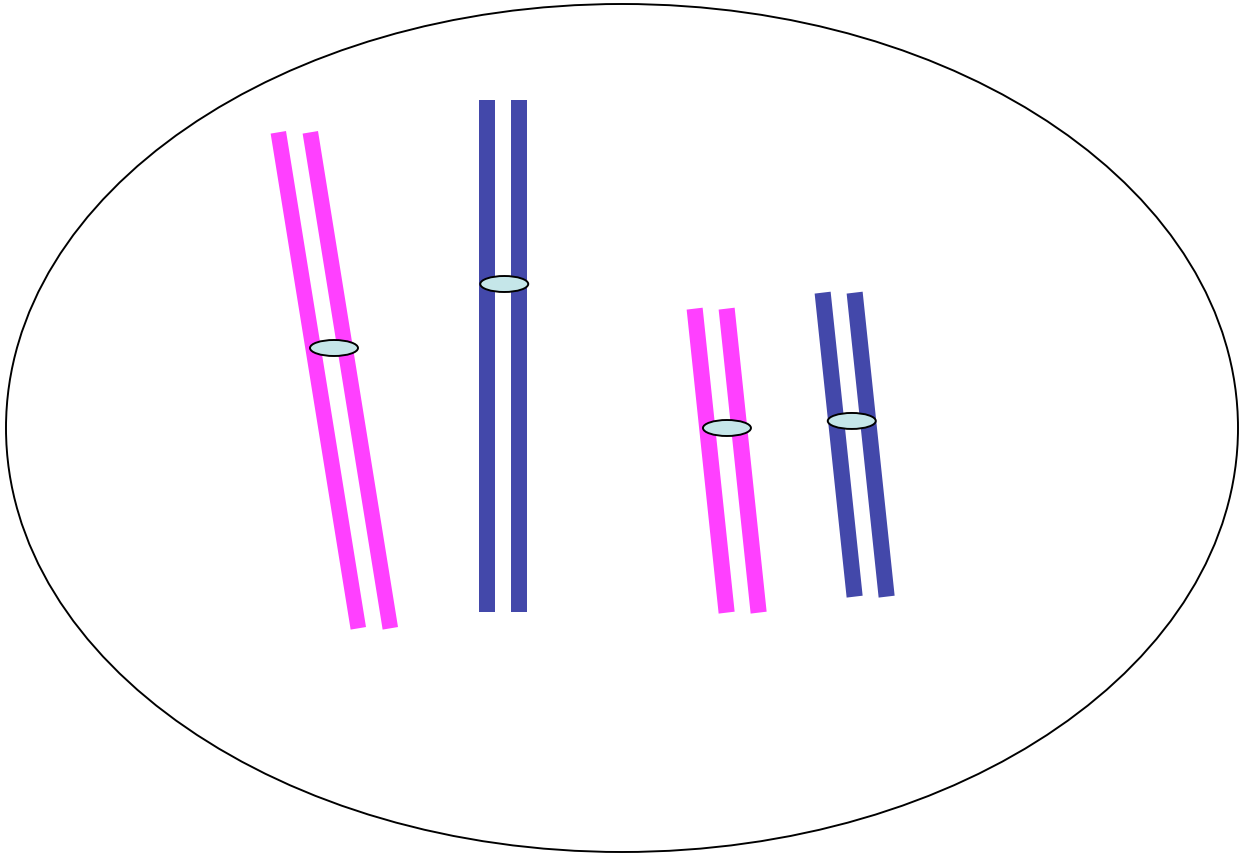
Each type is present in two copies in most cells during the G_1 (gap, growth) phase (46 chromosomes) (= Diploid)

After the S (synthesis) phase, each individual chromosome is duplicated (92 chromosomes, but still only 23 types)



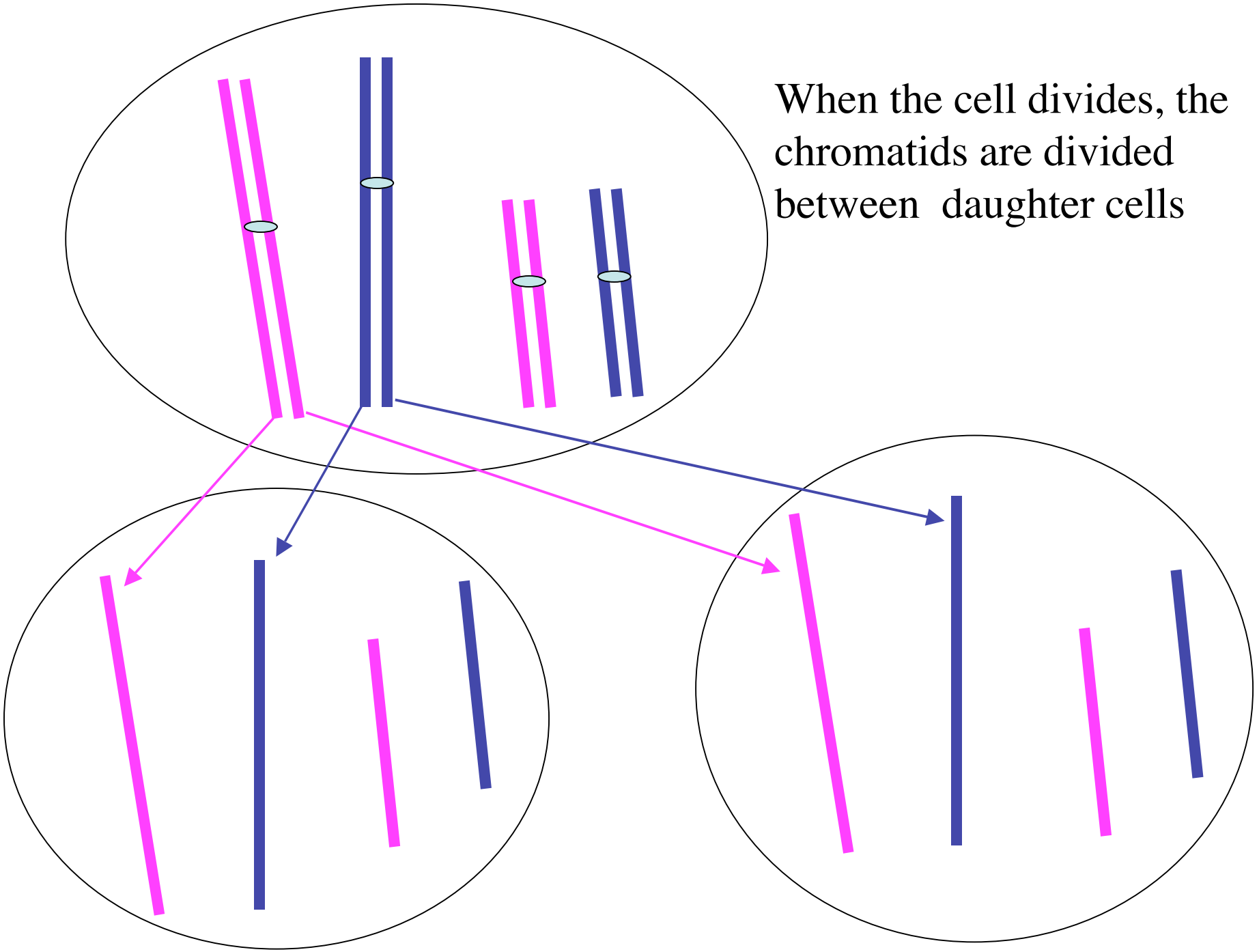
A somatic cell, G_1 phase

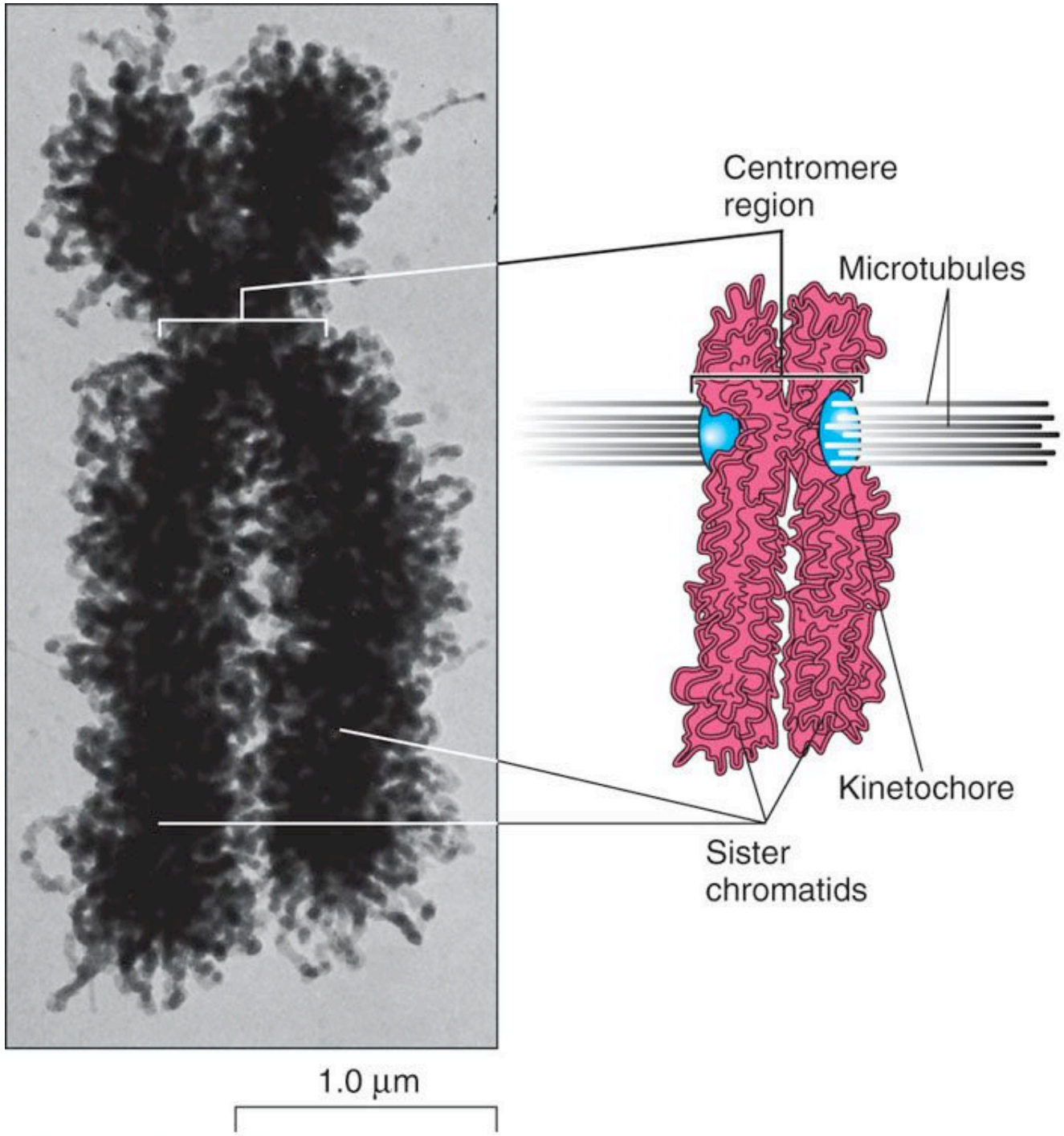
A pair of homologous chromosomes - the same set of loci, possibly different alleles



A somatic cell, At the end of S phase

When the cell divides, the chromatids are divided between daughter cells





Centriole

Problem: when organisms mate, the amount of DNA in gametes must be reduced by half, otherwise the amount of DNA in somatic cells would double every generation..

Solution: Meiosis - reduces the number of chromosome copies in gametes (= haploid)

Gametes - eggs, sperm - carry only one set of Chromosomes
(in humans, only 23 - no duplicates)

Meiosis is the mechanism used to decrease the number of copies

In humans (and other mammals), the overall process is oogenesis and spermatogenesis.

More detail at:
http://www.embryology.ch/genericpages/moduleembryoen.html

Basics of Meiosis

One round of DNA replication, but two rounds of cell division

Homologous chromosomes exchange genetic material - increases potential genetic variation

Homologous chromosososomes separate during Meiosis I, chromatids during Meiosis II

MEIOSIS

PROPHASE I

Synapsis of homologous chromosomes to form tetrads

ANAPHASE I

Homologous chromosomes move to opposite poles

PROPHASE II

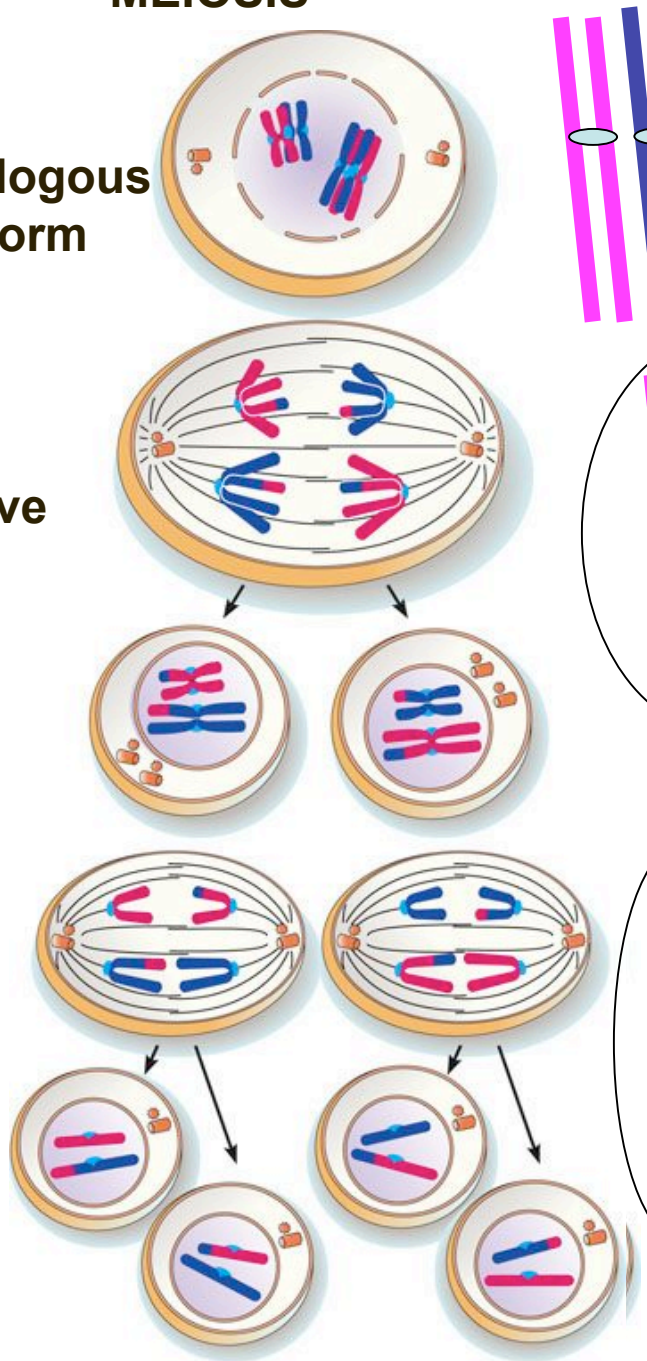
Two *n* cells with duplicated chromosomes

ANAPHASE II

Sister chromatids move to opposite poles

HAPLOID CELLS

Four *n* cells with unduplicated chromosomes



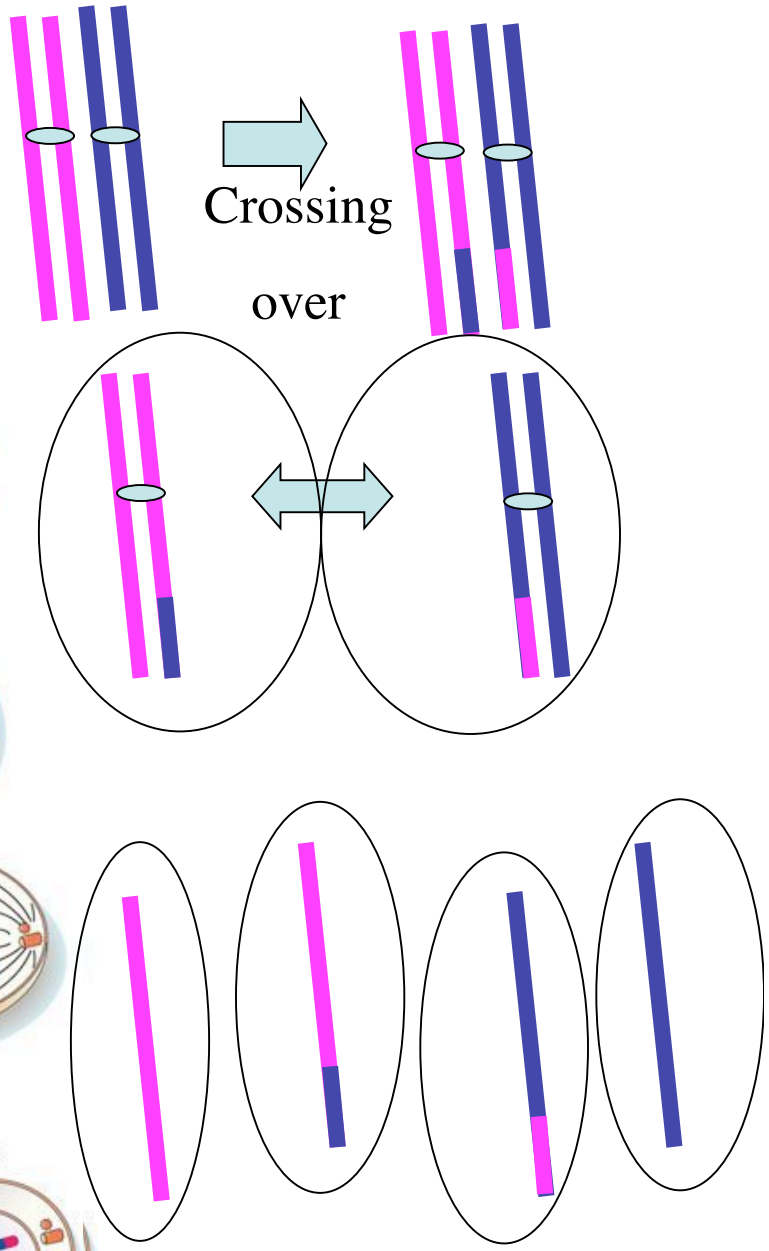


Fig. 10-16b, p. 229

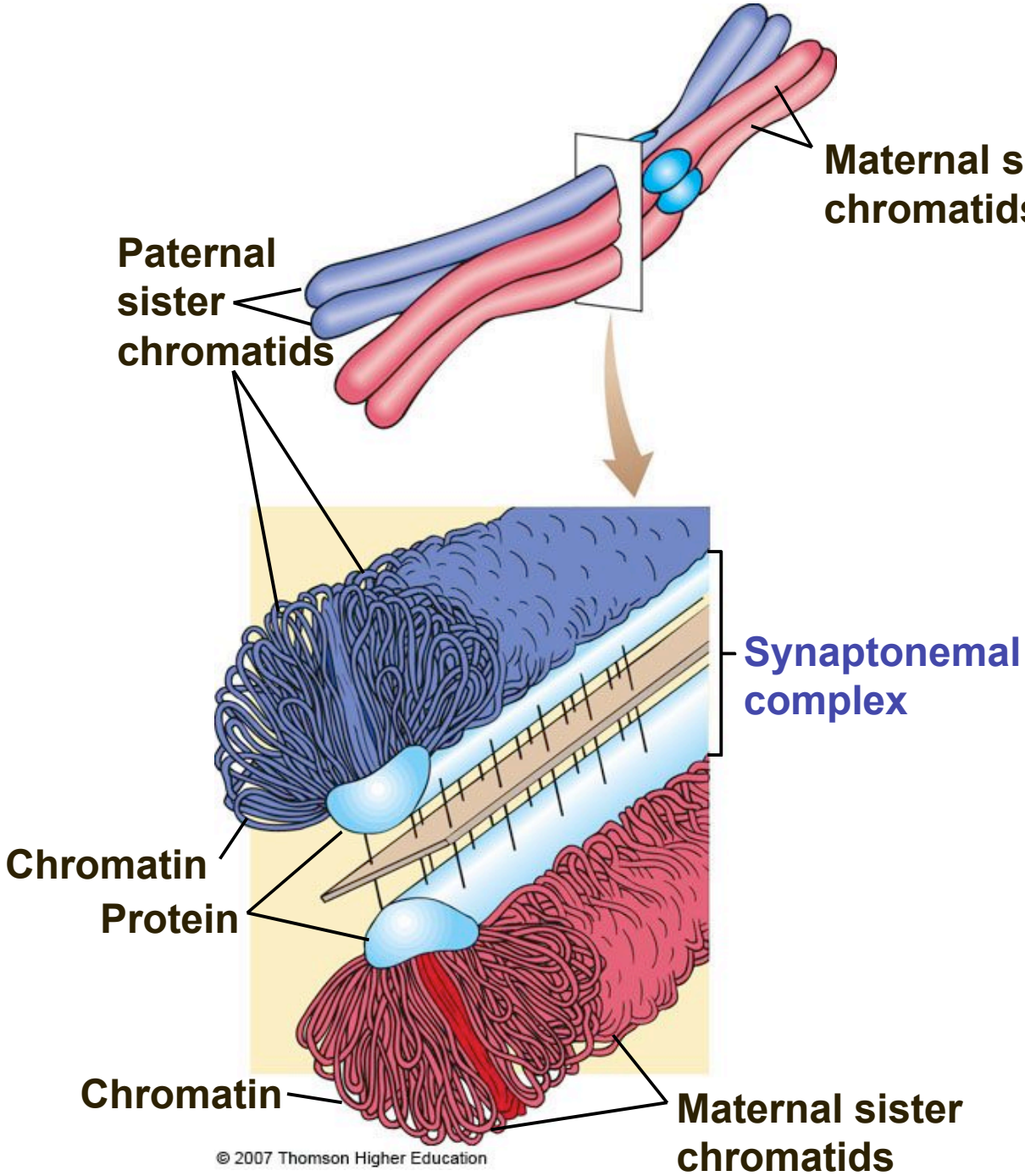


Fig. 10-14a, p. 228

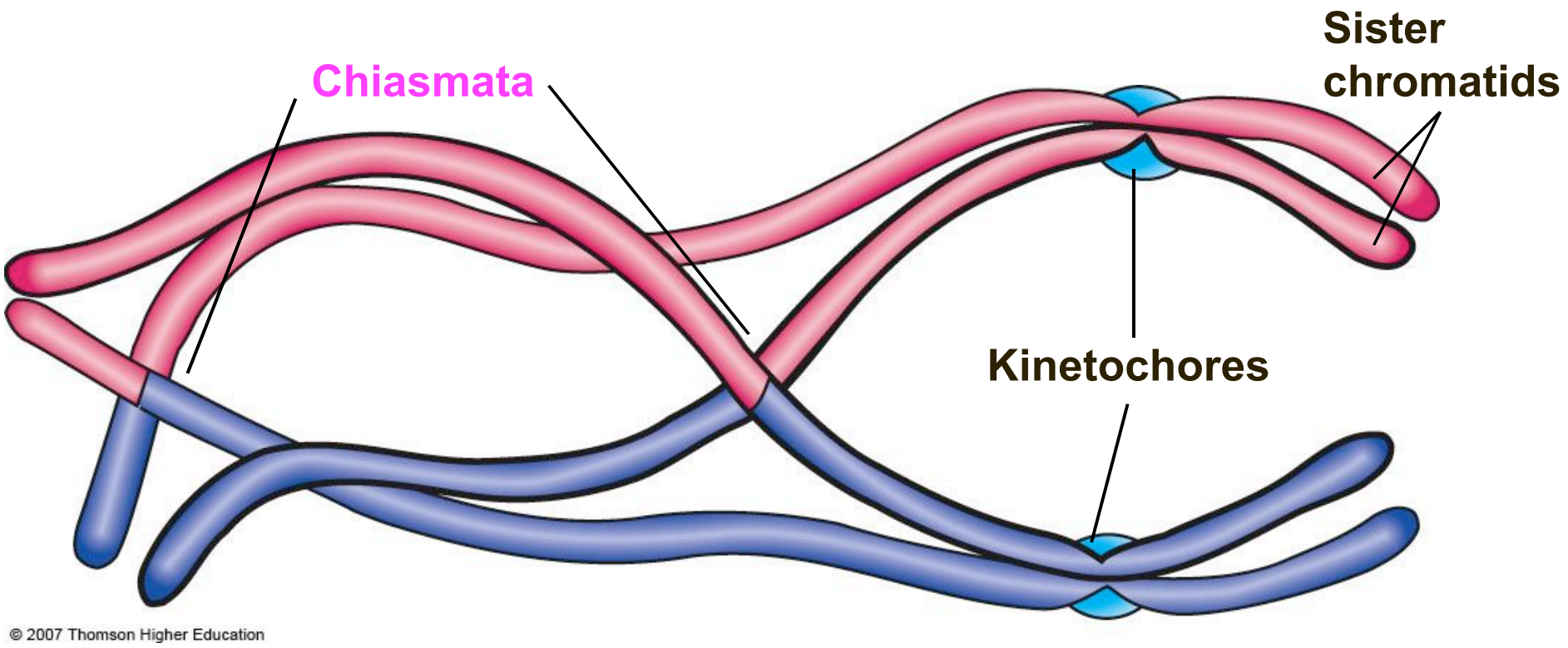


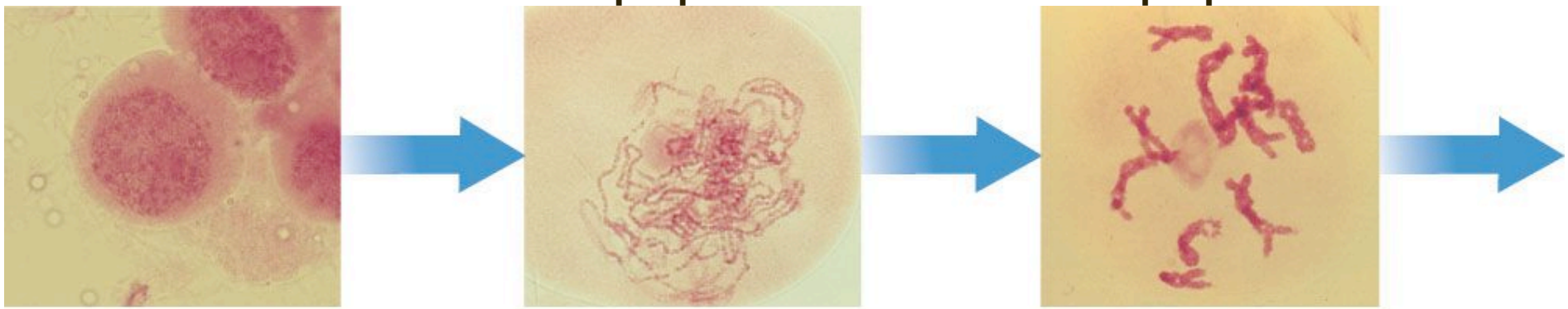
Fig. 10-15b, p. 228

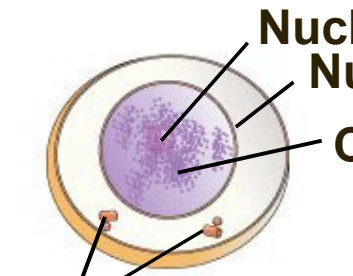
INTERPHASE

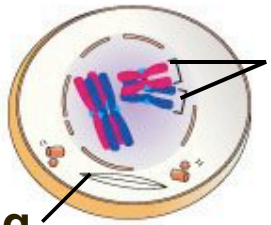
MEIOSIS I

Mid-prophase I

Late prophase I



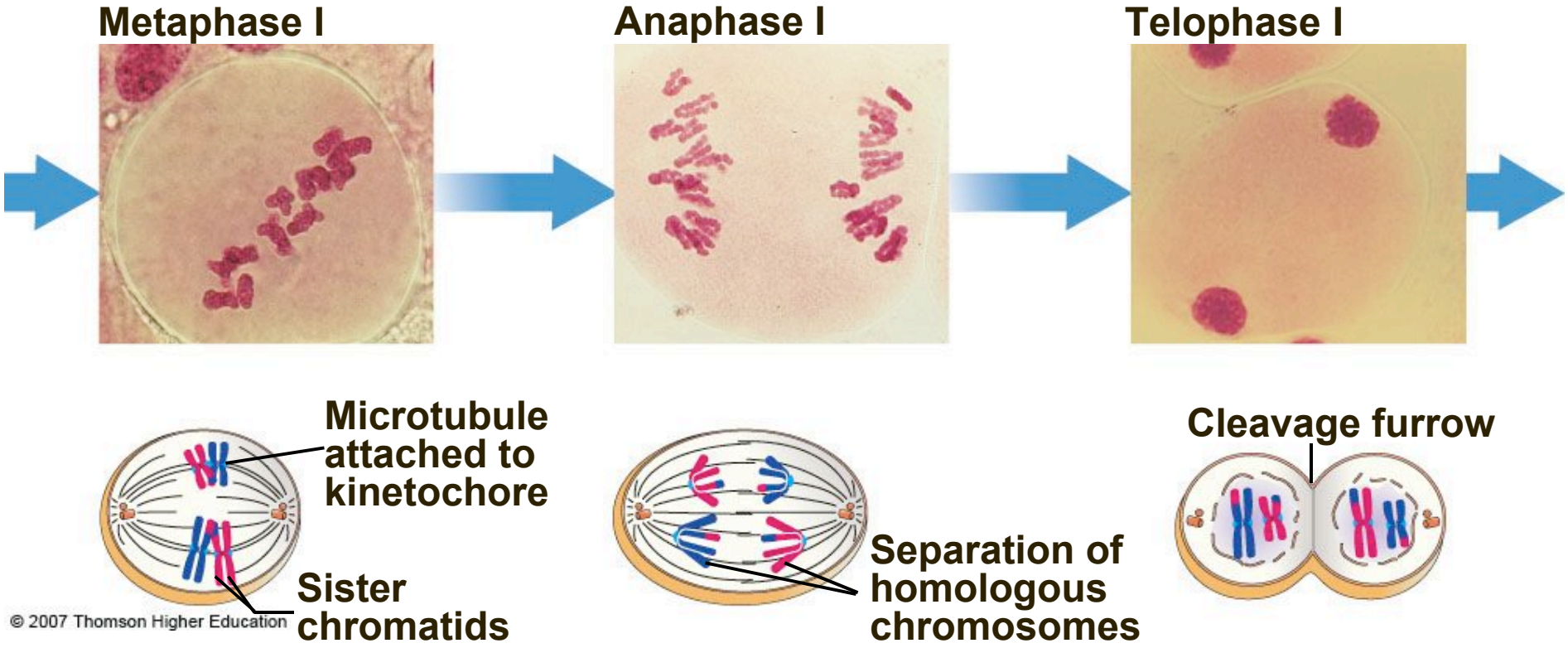




Interphase preceding meiosis; DNA replicates.

Homologous chromosomes synapse, forming tetrads; nuclear envelope breaks down.

Fig. 10-13a (1), p. 226



Tetrads line up on cell's midplane. Tetrads held together at chiasmata (sites of prior crossing-over).

Homologous chromosomes separate and move to opposite poles. Note that sister chromatids remain attached at their centromeres.

One of each pair of homologous chromosomes is at each pole. Cytokinesis occurs.

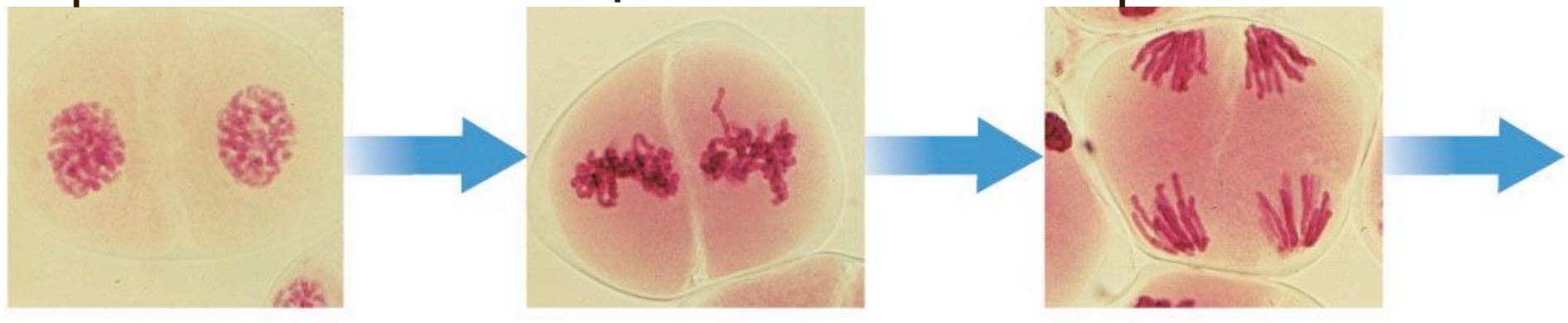
Fig. 10-13b (1), p. 227

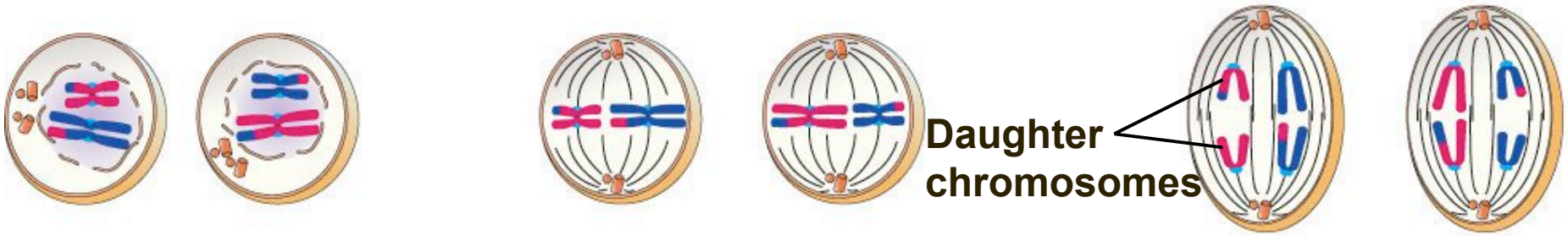
MEIOSIS II

Prophase II

Metaphase II

Anaphase II





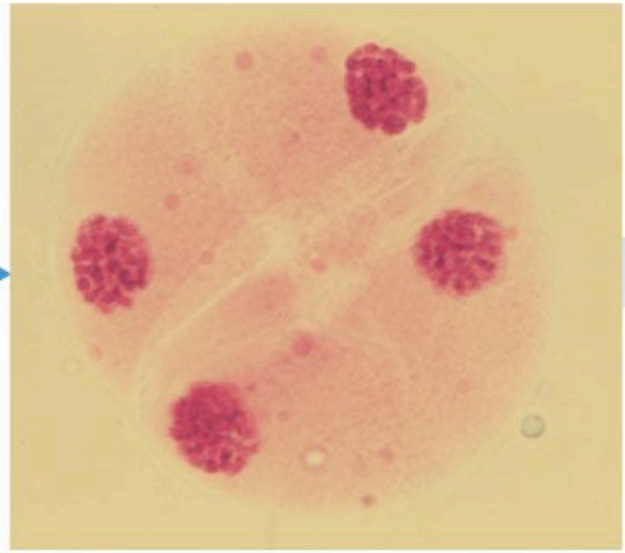
Chromosomes condense again following brief period of interkinesis. DNA does not replicate again.

Chromosomes line up along cell's midplane.

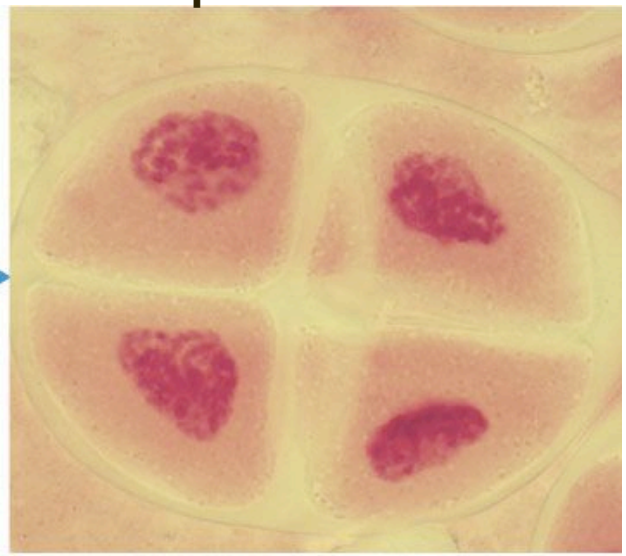
Sister chromatids separate, and chromosomes move to opposite poles.

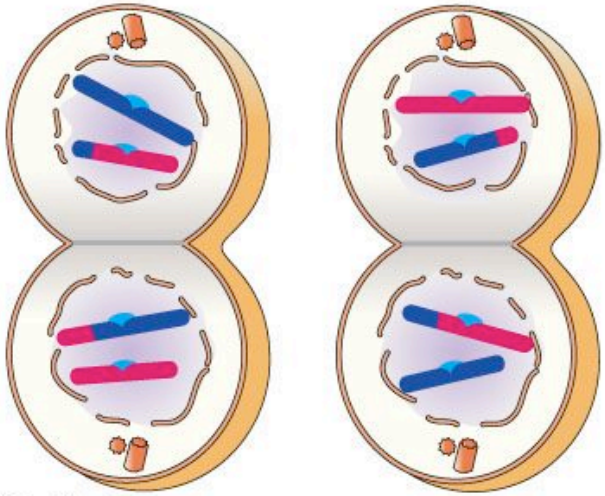
Fig. 10-13a (2), p. 226

Telophase II



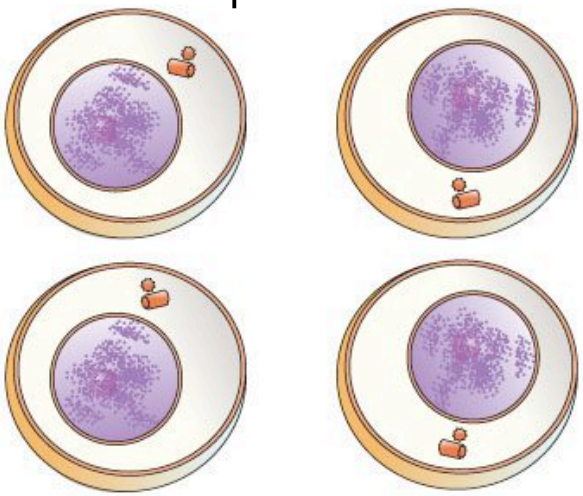
Four haploid cells





Nuclei form at opposite poles of each cell. Cytokinesis occurs.

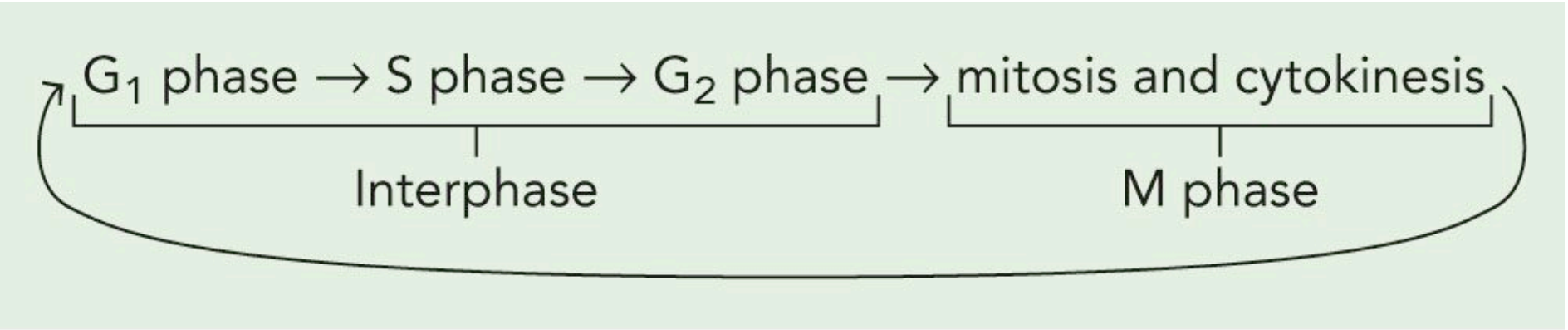
25 _m



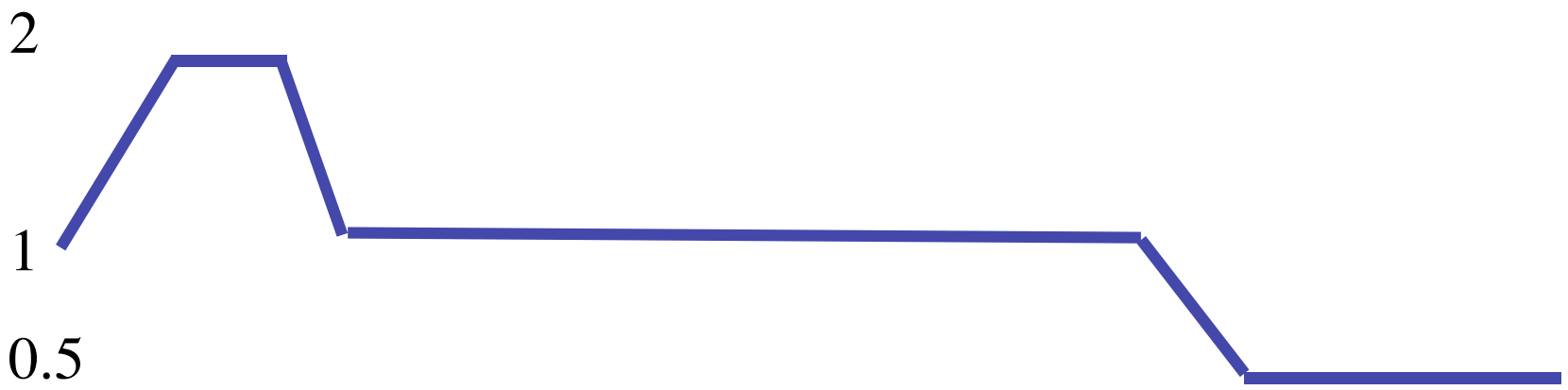
Four gametes (animal) or four spores (plant) are produced.

Fig. 10-13b (2), p. 227

D NA Content per cell in MITOSIS



DNA Content per Cell - MEIOSIS version



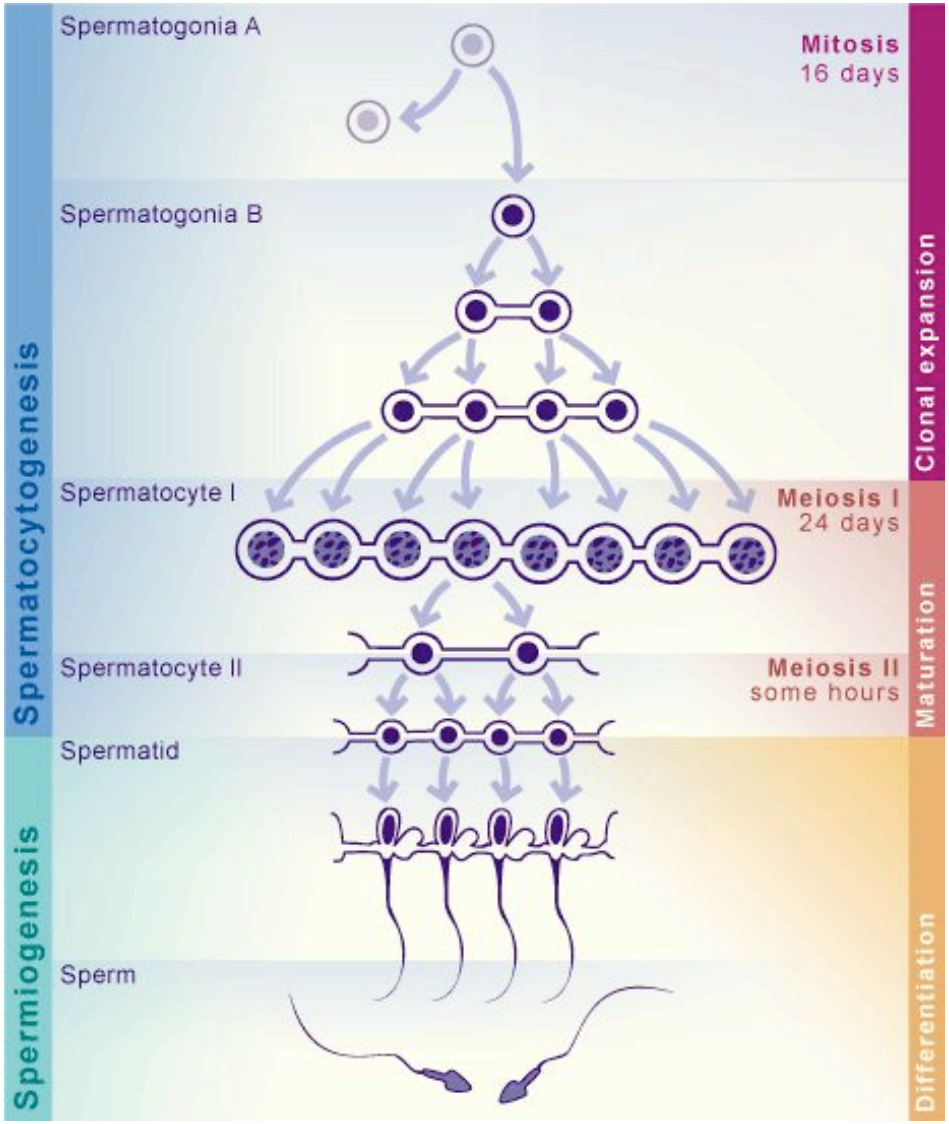
Meiosis I
Interphase
to S-phase

Meiosis I
Telophase I

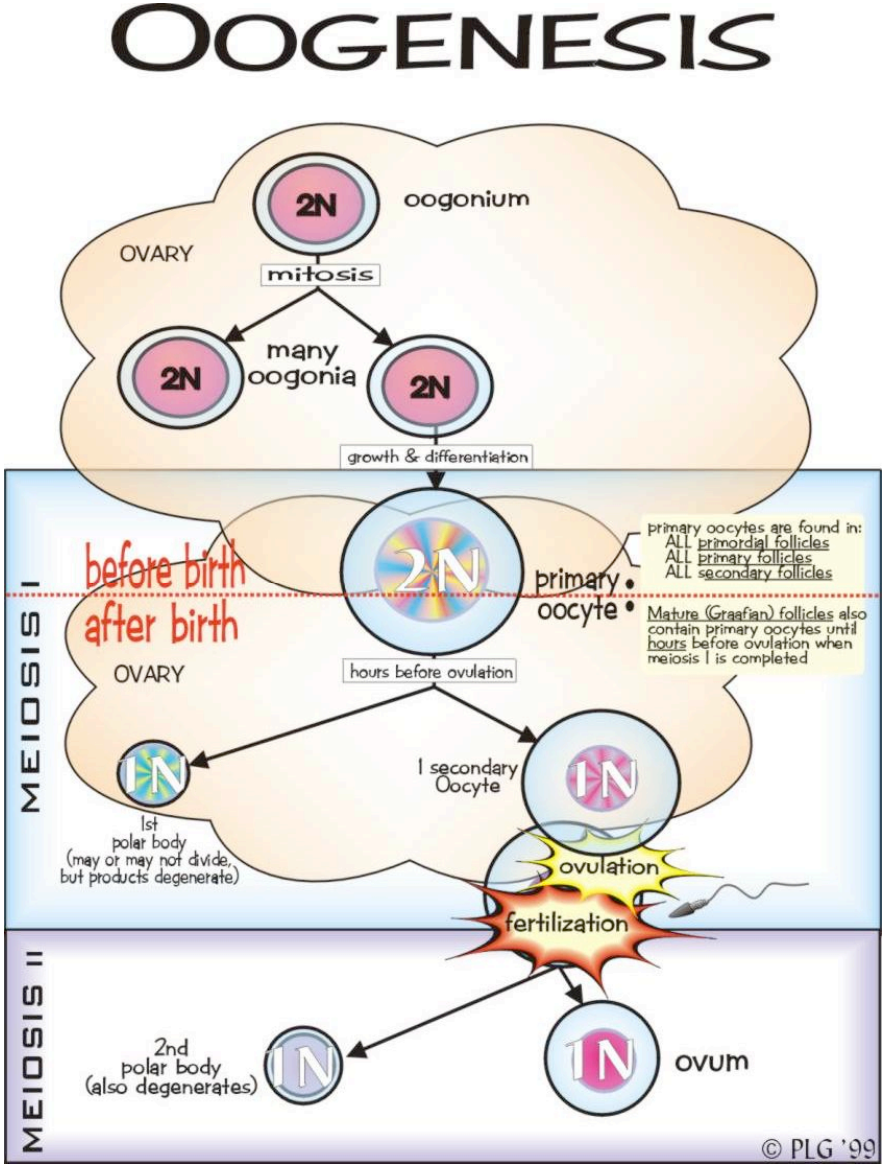
Meiosis II
Prophase II

Meiosis II
Telophase II

Spermatogenenesis



www.embryology.ch



science.tjc.edu/images/reproduction

Overview…

We always start by talking about simple Dominant and Recessive alleles and Independent Assortment, but that's not the whole story

Populations can contain more than two alleles.

Loci may be linked

Dominance may be incomplete

Sometimes one gene can influence many traits, and some traits are controlled by many loci

Sex chromosomes can cause odd patterns

Genotype the internally coded, inherited genetic information carried in all organisms. An organisms full hereditary information (even if it's not expressed)

Phenotype the observable traits of an organism - an organisms actual properties

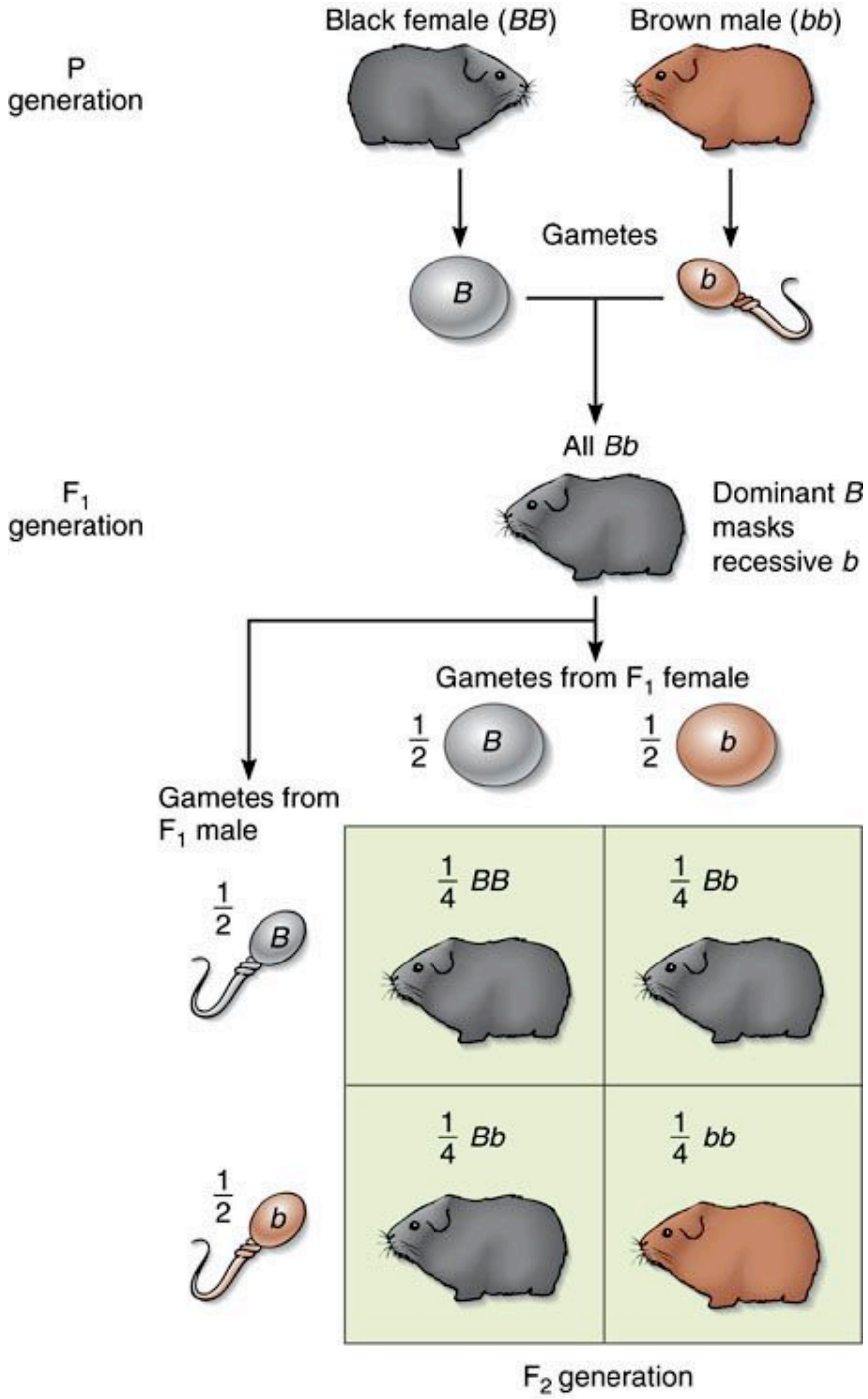


Fig. 11-6, p. 240

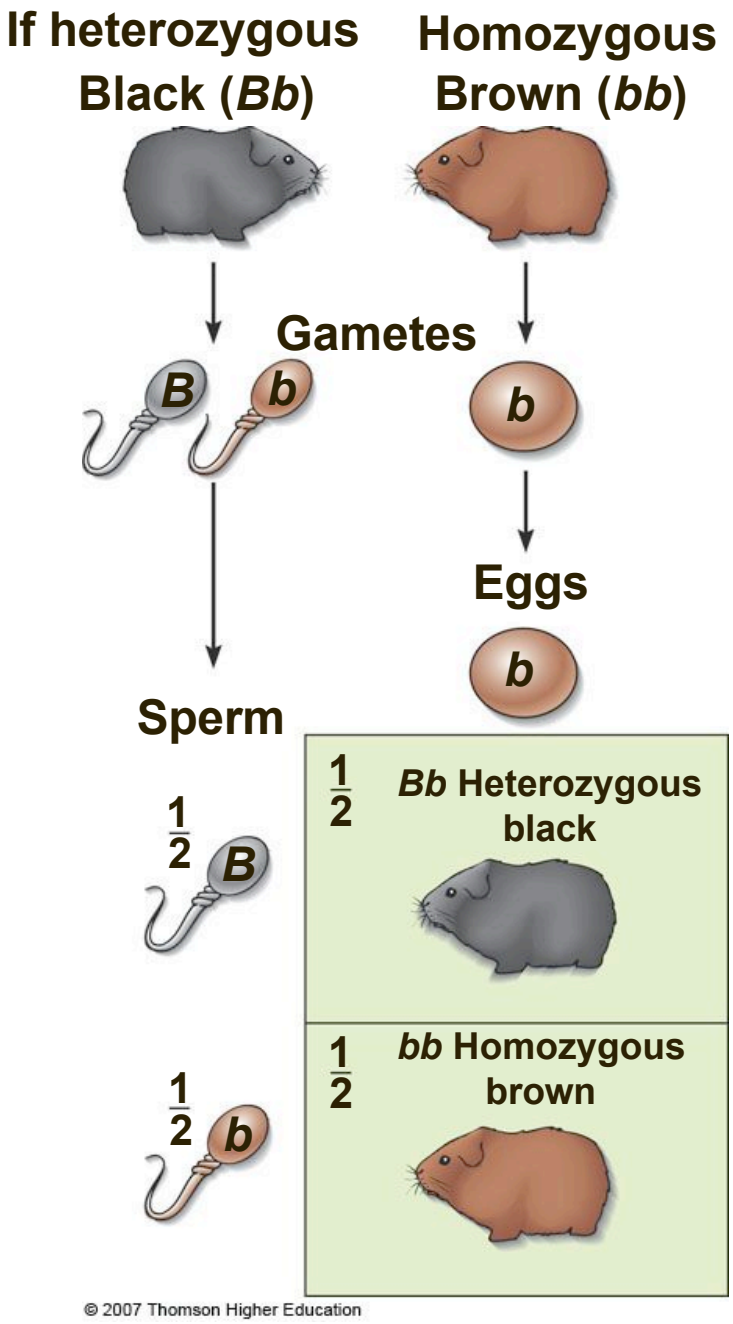
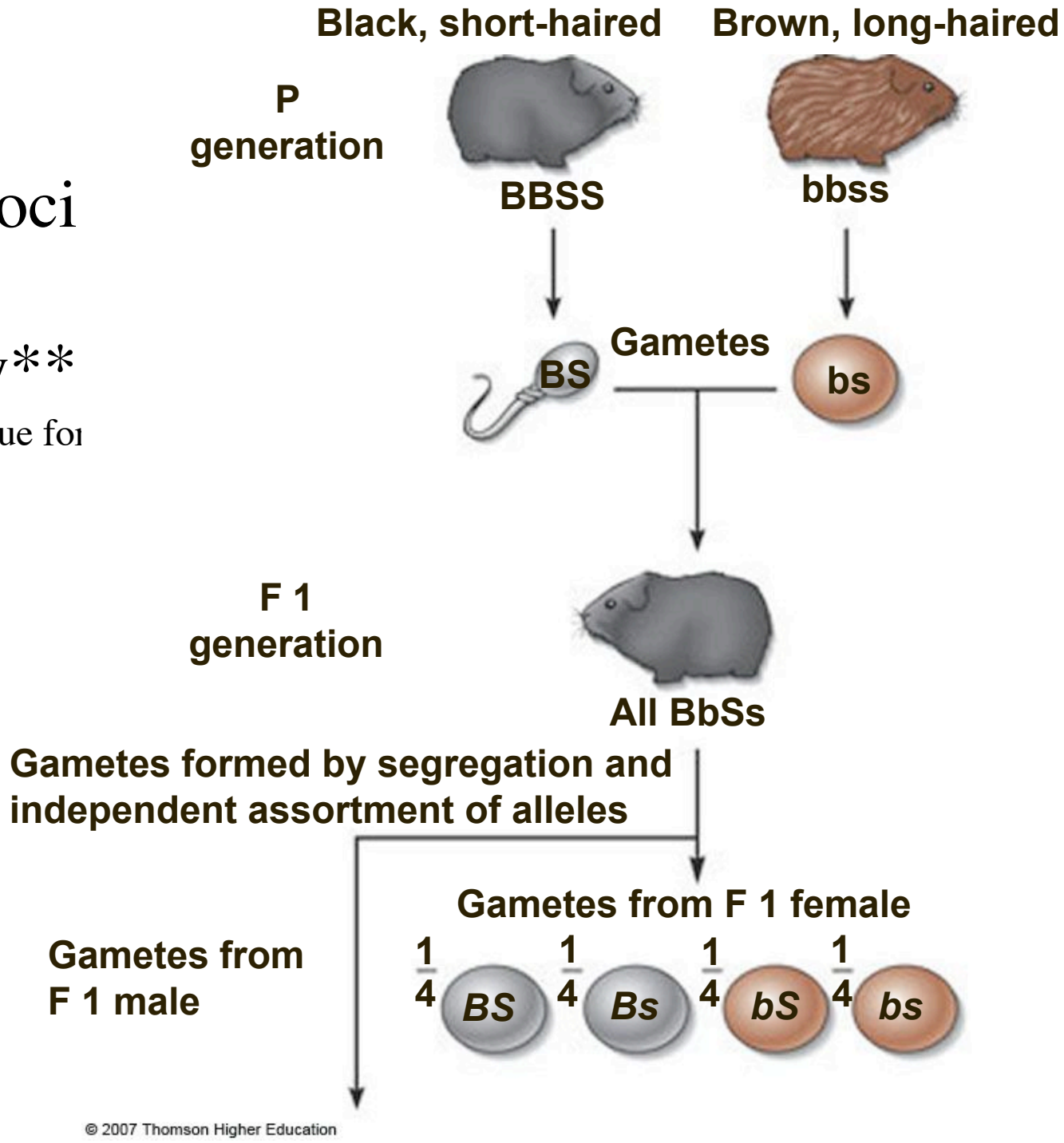


Fig. 11-7b, p. 241

Law of independent assortment - loci are inherited independently**

**not always true, but true for many traits



	BS	Bs	bS	bs
1/4 BS	*BBSS* Black, short	*BBSs* Black, short	*BbSS* Black, short	*BbSs* Black, short
1/4 Bs	*BBSs* Black, short	*BBss* Black, long	*BbSs* Black, short	*Bbss* Black, long
1/4 bS	*BbSS* Black, short	*BbSs* Black, short	*bbSS* Brown, short	*bbSs* Brown, short
1/4 bs	*BbSs* Black, short	*Bbss* Black, long	*bbSs* Brown, short	*bbss* Brown, long

F 2 generation

F_2 phenotypes

9/16 Black, short-haired

3/16 Black, long-haired

3/16 Brown, short-haired

1/16 Brown, long-haired

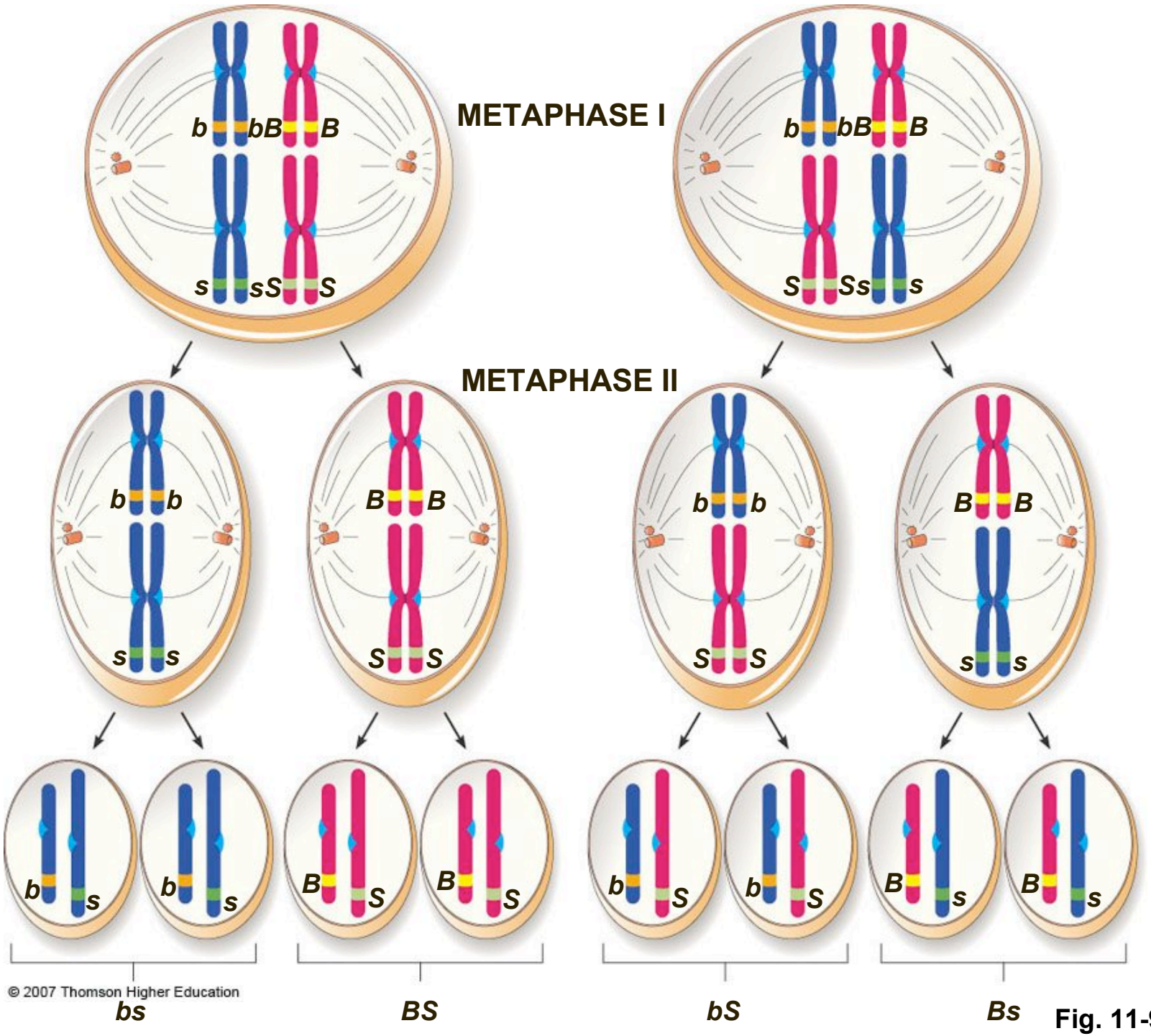


Fig. 11-9, p. 243

Linkage - an exception to independent assortment

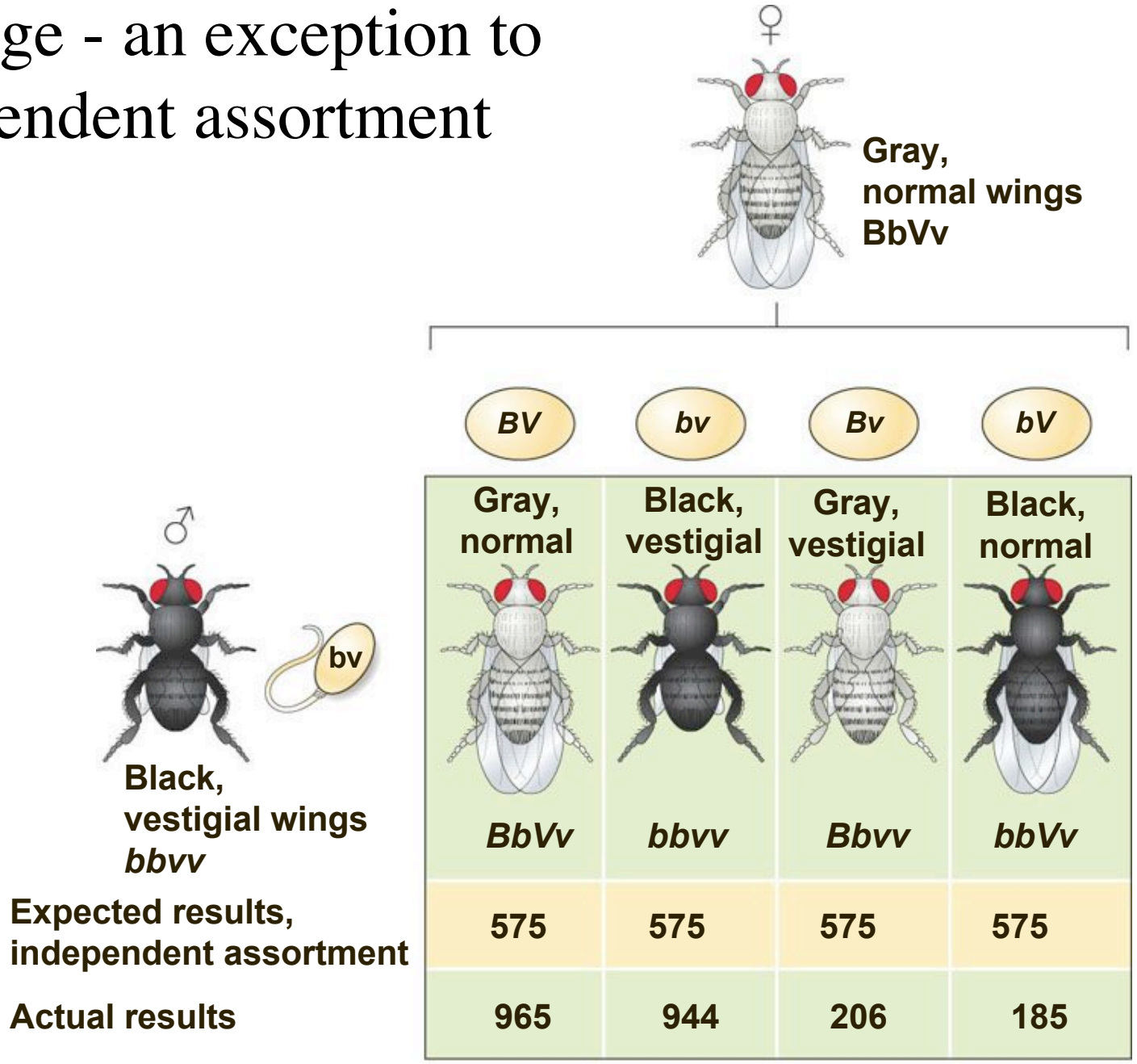


Fig. 11-11, p. 246

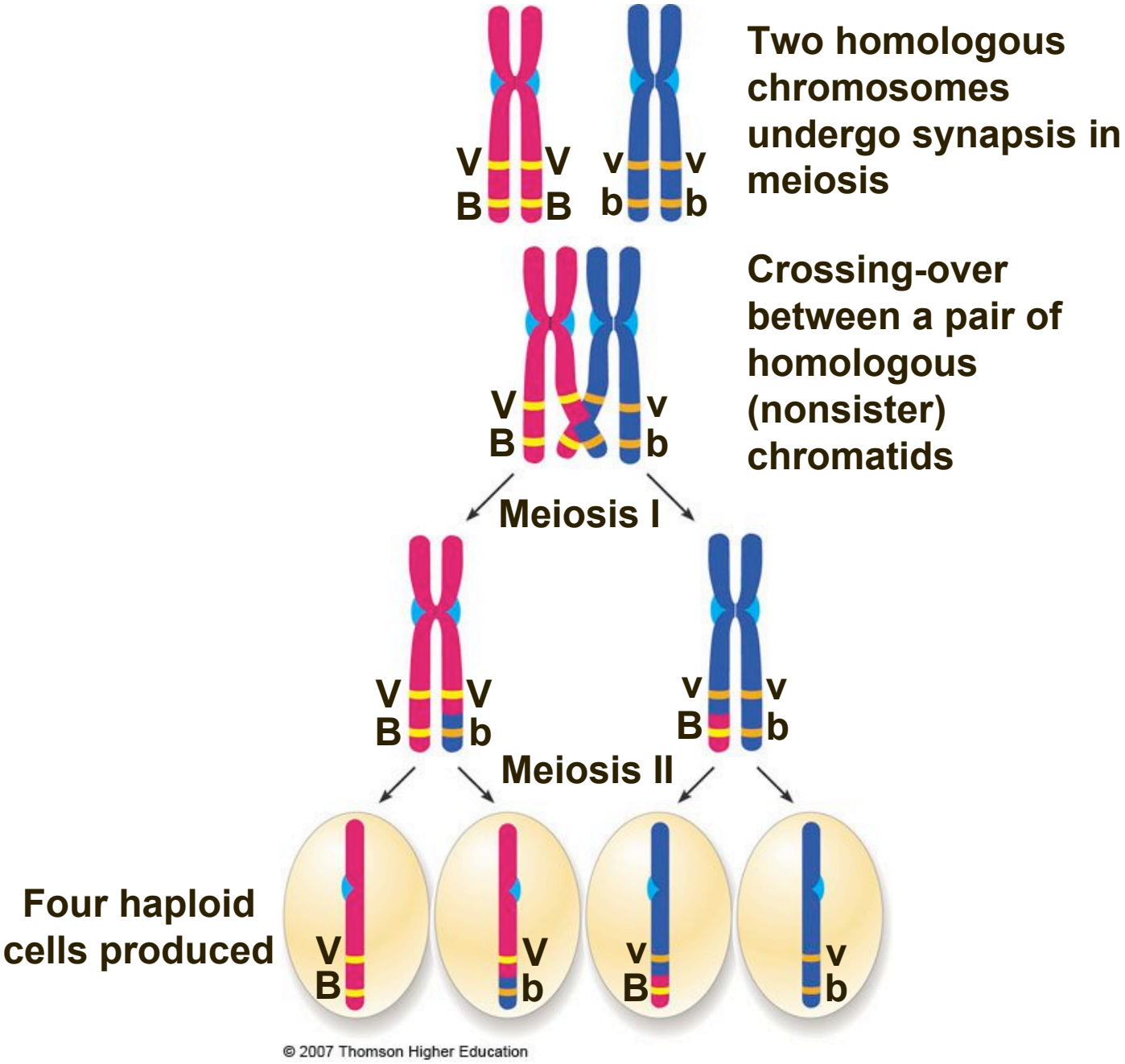
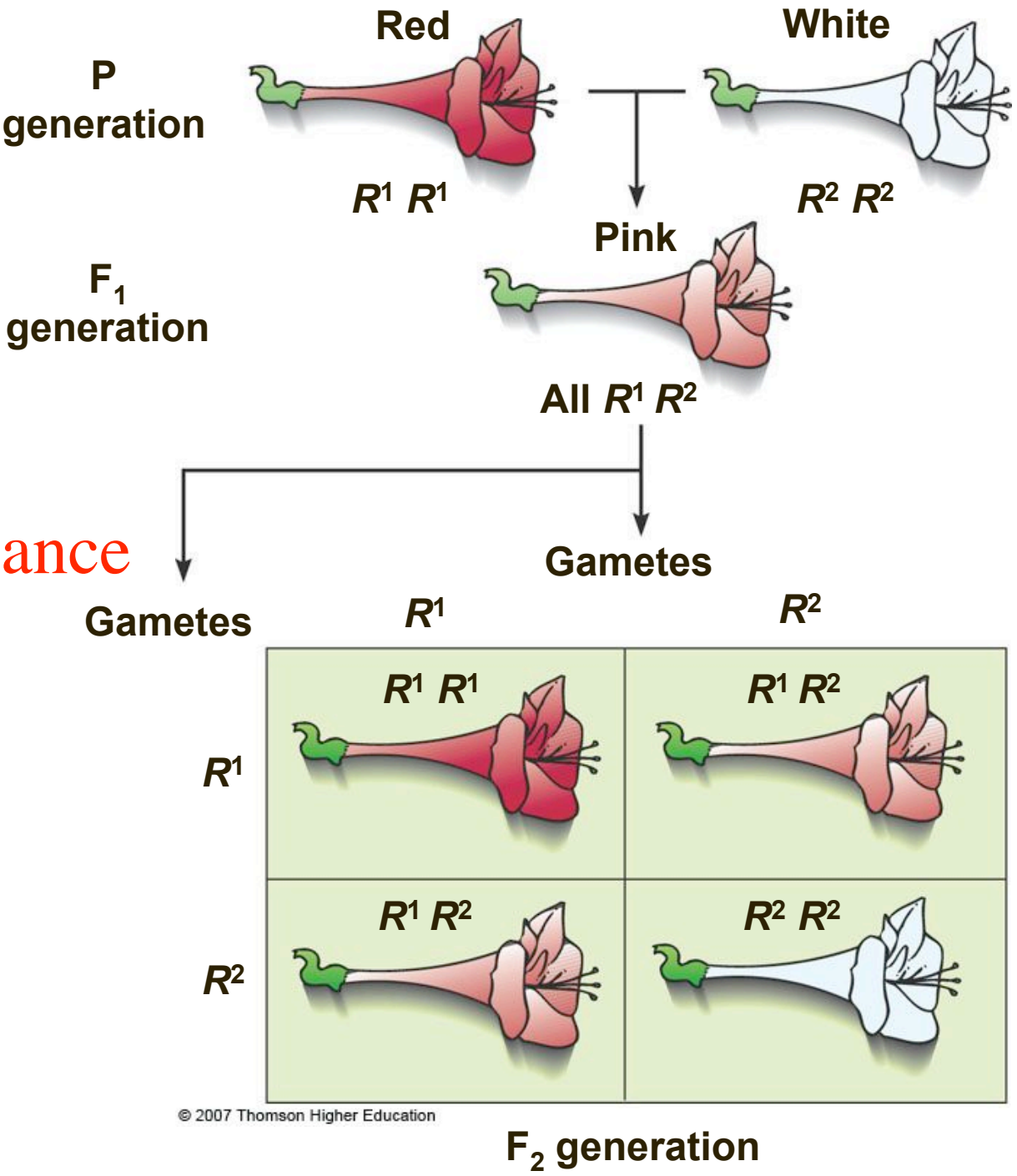


Fig. 11-12, p. 247

Not all alleles Are Dominant/ Recessive

Incomplete Dominance



Human blood groups, an example of multiple alleles in the population

TABLE 11-3

ABO Blood Types

Phenotype (blood type)	Genotypes	Antigen on RBC	Antibodies to A or B Antigens in Plasma
A	I^AI^A, I^Ai	A	Anti-B
B	I^BI^B, I^Bi	B	Anti-A
AB	I^AI^B	A, B	None
O	ii	None	Anti-A, anti-B

*This table and the discussion of the ABO system have been simplified somewhat. Note that the body produces antibodies against the antigens *lacking* on its own red blood cells (RBCs). Because of their specificity for the corresponding antigens, these antibodies are used in standard tests to determine blood types.

Polygenic Inheritance (Quantitative Traits)

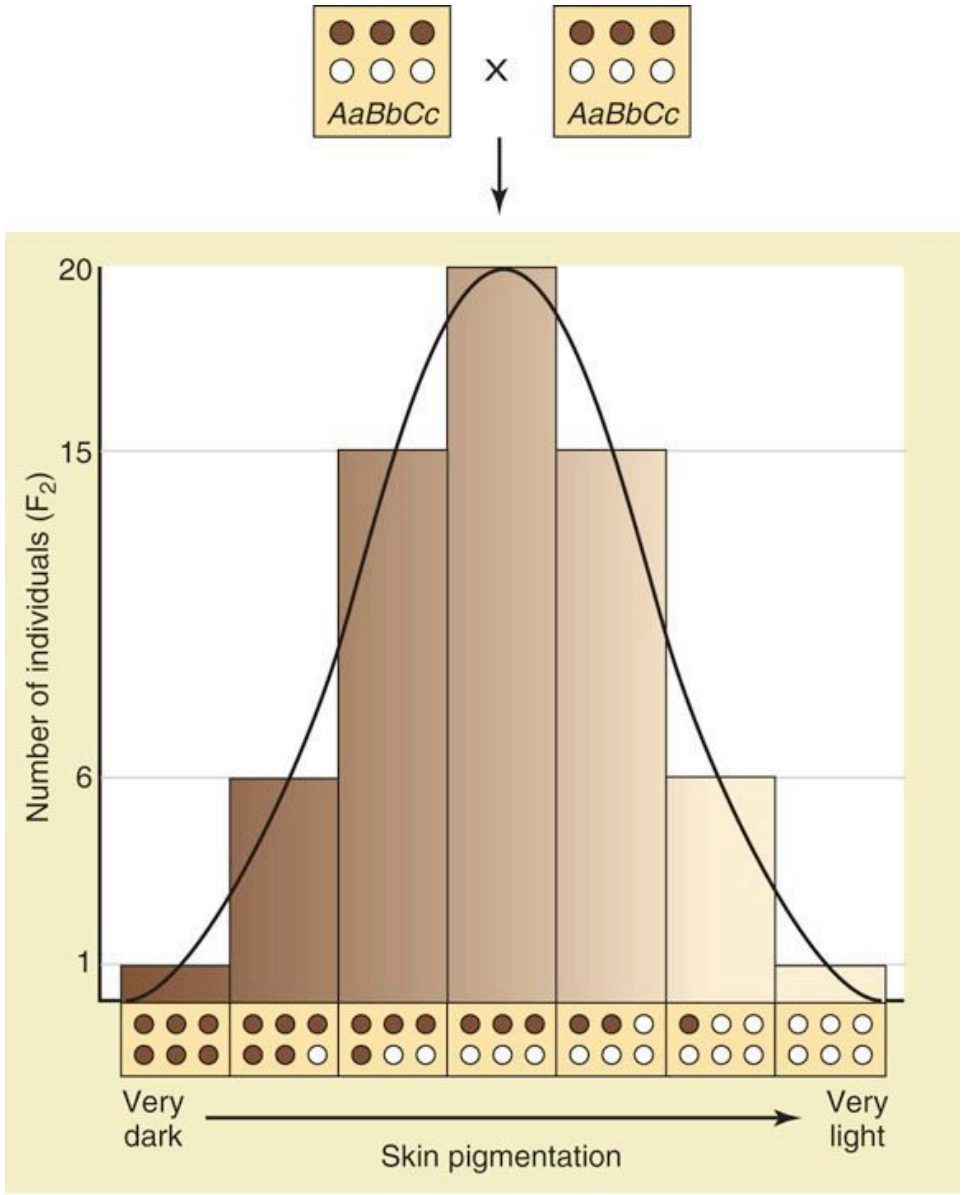


Fig. 11-22, p.

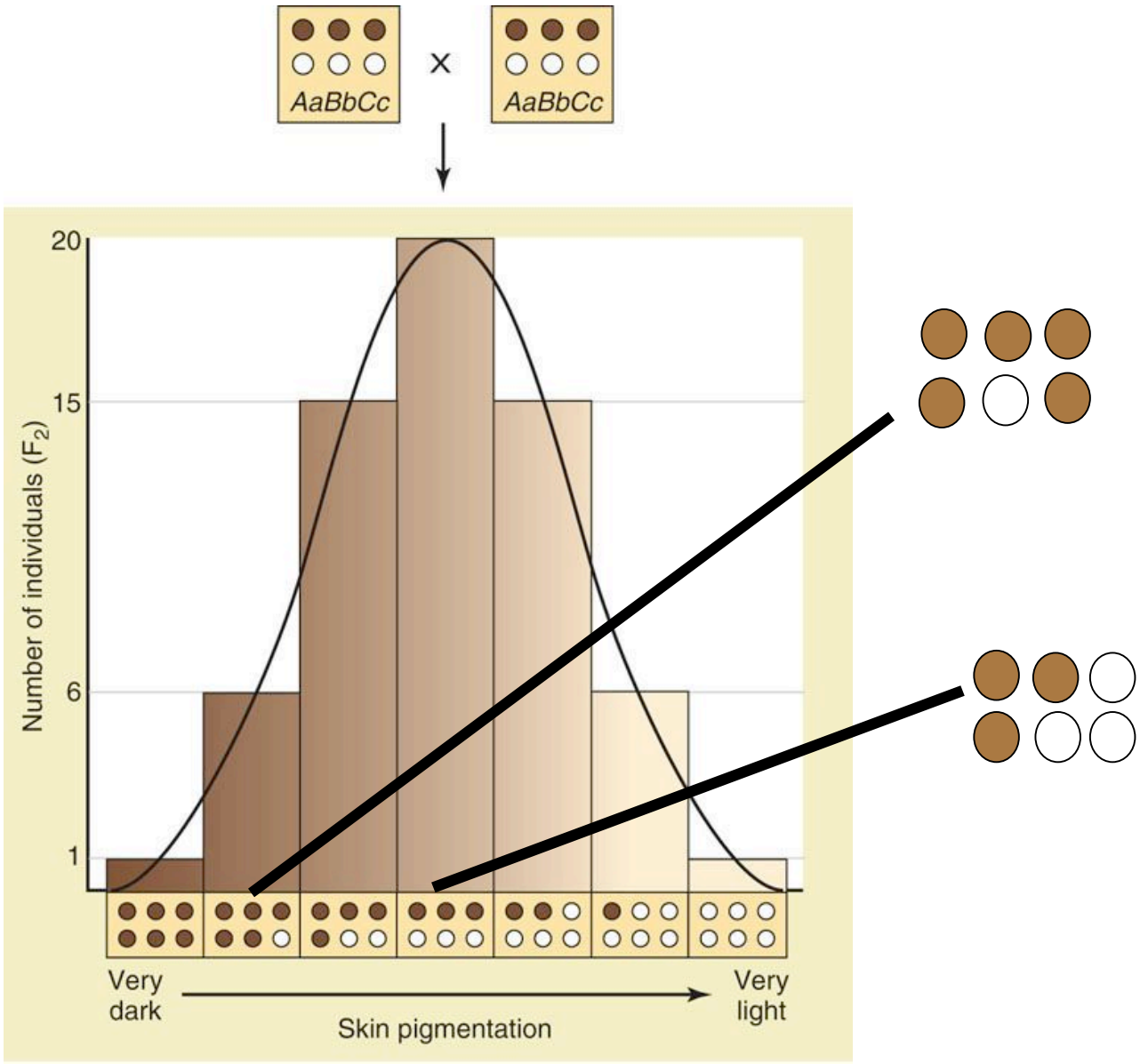


Fig. 11-22, p.

Epistasis alleles at different loci control a phenotype

Black	Yellow	Chocolate
BBEE, BbEE, BBEe* or *BbEe	***BBee, Bbee* or *bbee***	***bbEE* or *bbEe***

Pleitropy One locus influences many traits

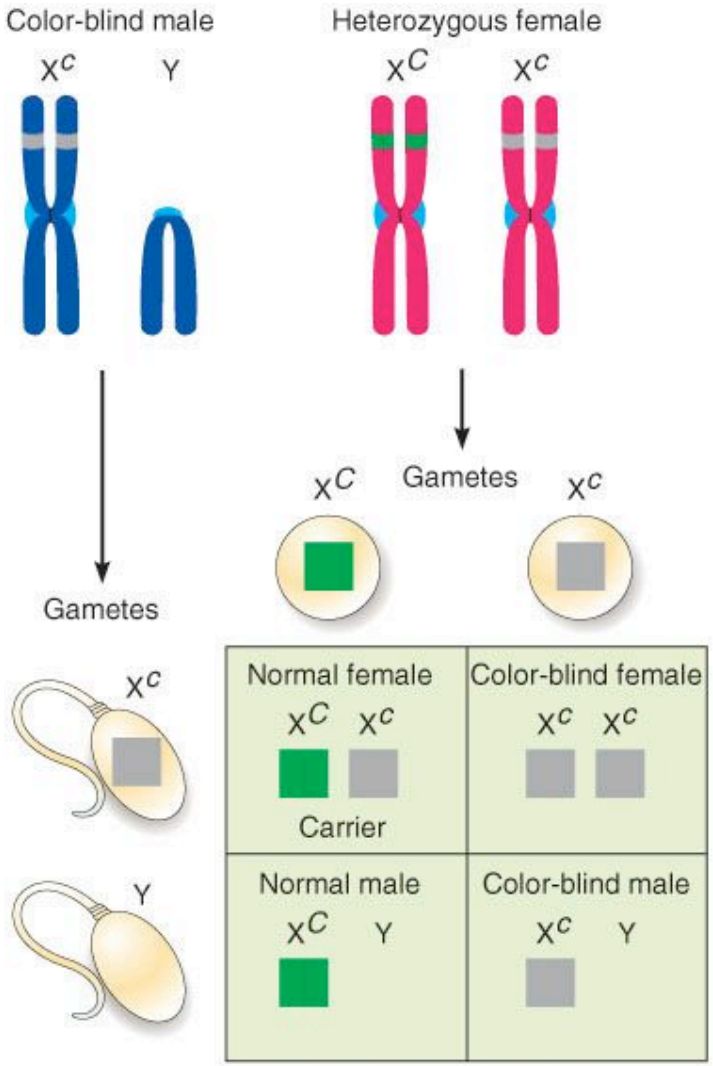
Sex Linkage

Mammals have two types of sex chromosomes,

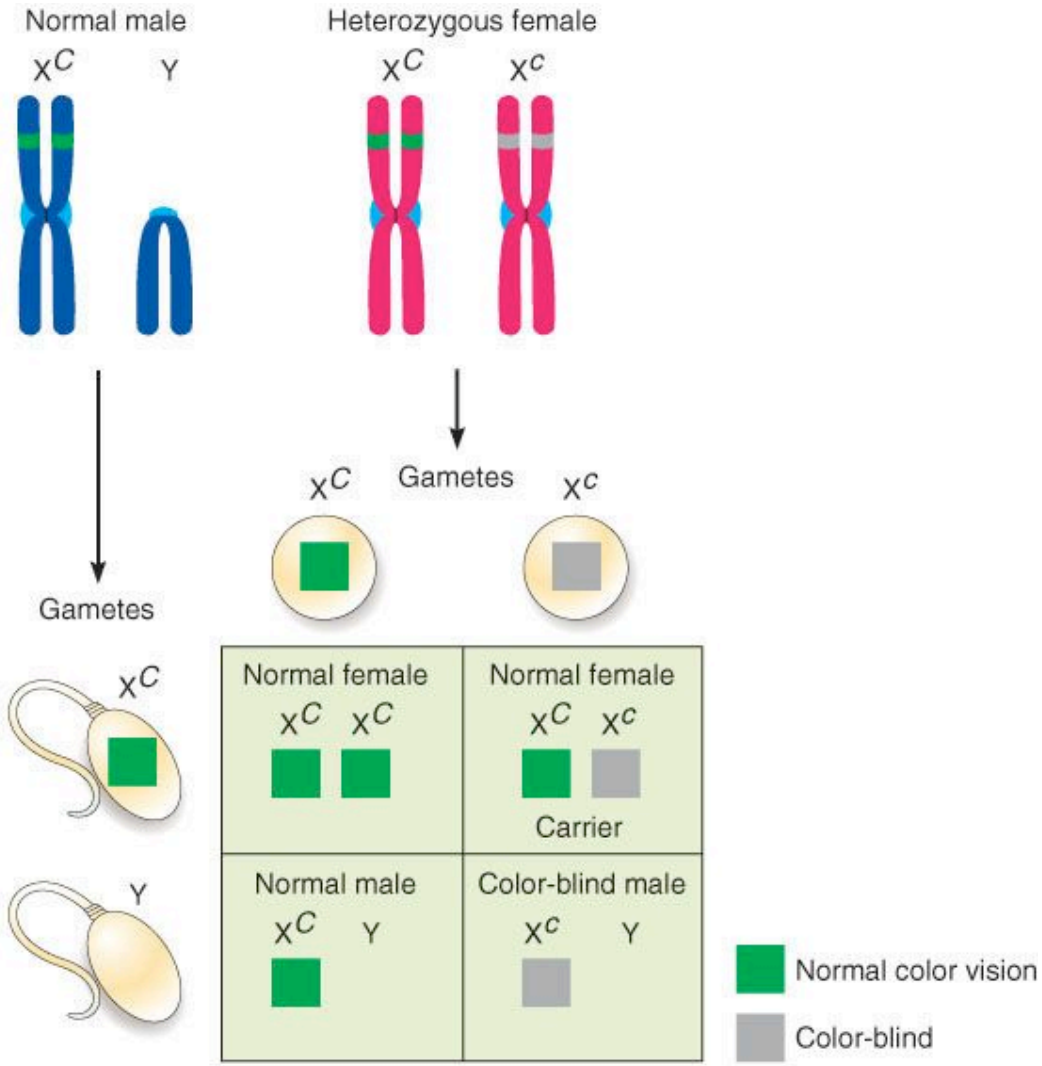
X and Y - females get two X's, males get an X and a Y

The X and Y aren't quite homologous, in fact the Y contains very few loci, but the X codes for many traits.

Non-sex chromosomes are called Autosomes



(a) To be color-blind, a female must inherit alleles for color blindness from both parents.



(b) If a normal male mates with a carrier (heterozygous) female, half of their sons would be expected to be color-blind and half of their daughters would be expected to be carriers.

Fig. 11-16, p. 250