Pre – AP Biology

Process of Meiosis (5.4)

Somatic vs. Germ
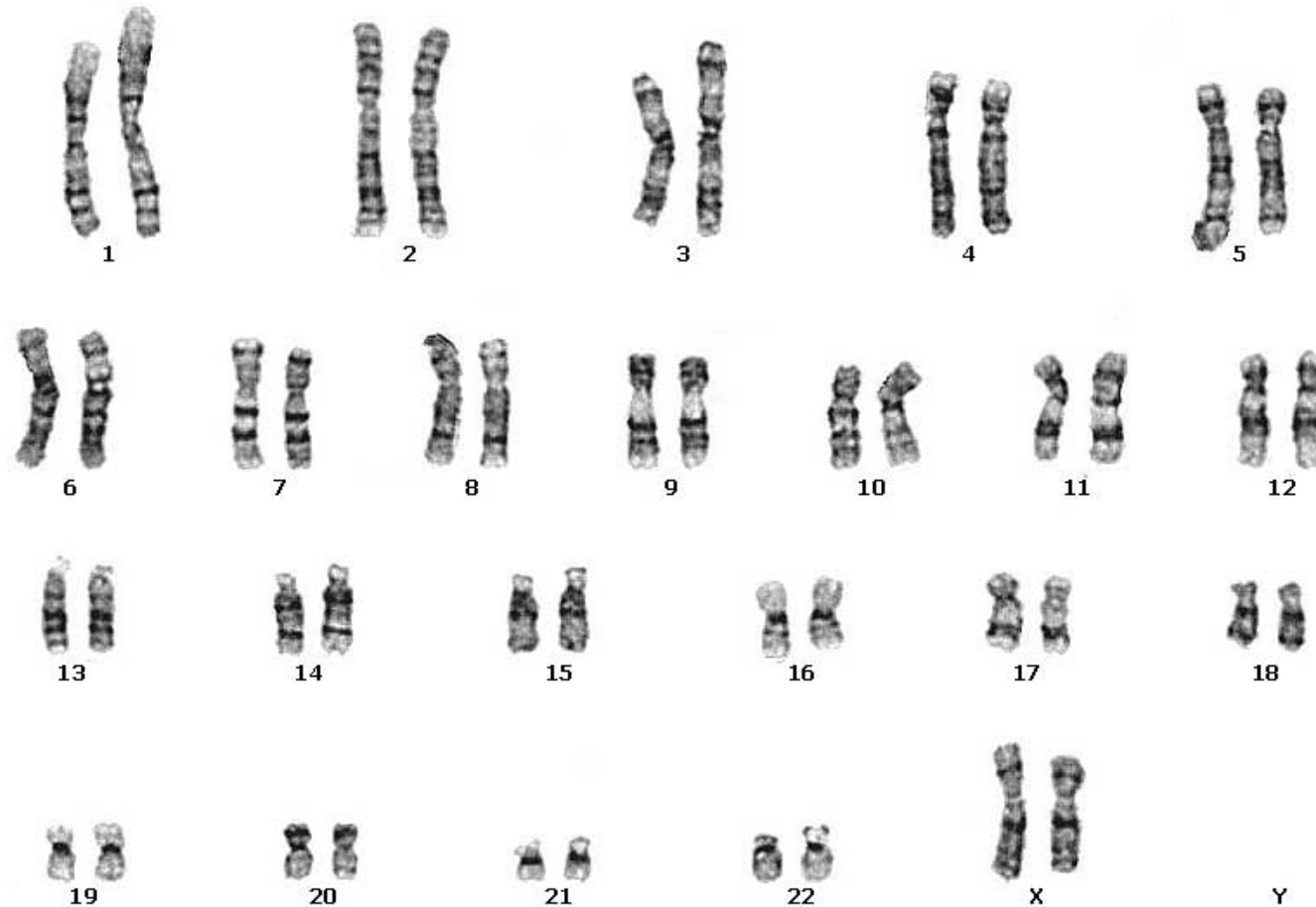

Gametes

Meiosis

Fertilization

Zygote 2n

2n

Diploid multicellular organism

Mitosis

(a) Animals
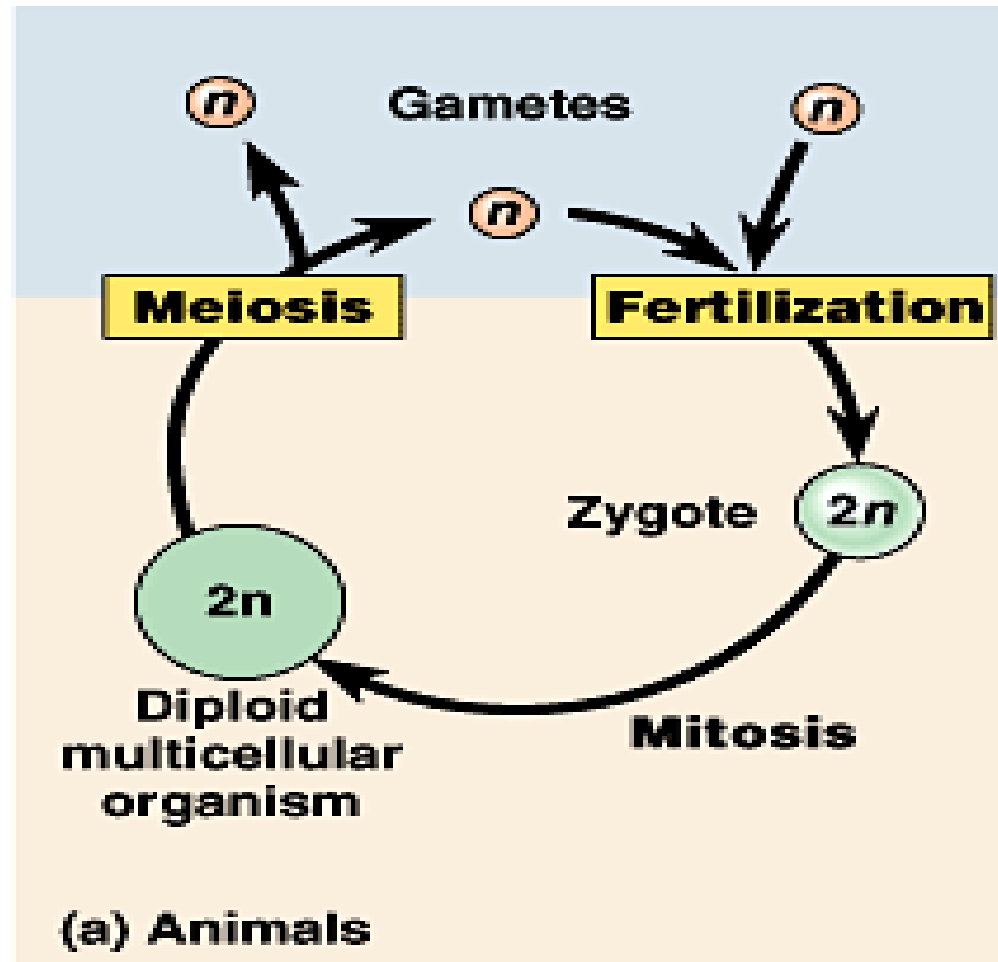
Female XX Karyotype
(Remember… "kary" means "nucleus")

Human Female G-bands

1   2   3   4   5

6   7   8   9   10   11   12

13   14   15   16   17   18

19   20   21   22   X   Y

Male XY Karyotype

Human male
G-bands

1 2 3 4 5

6 7 8 9 10 11 12

13 14 15 16 17 18

19 20 21 22 X Y
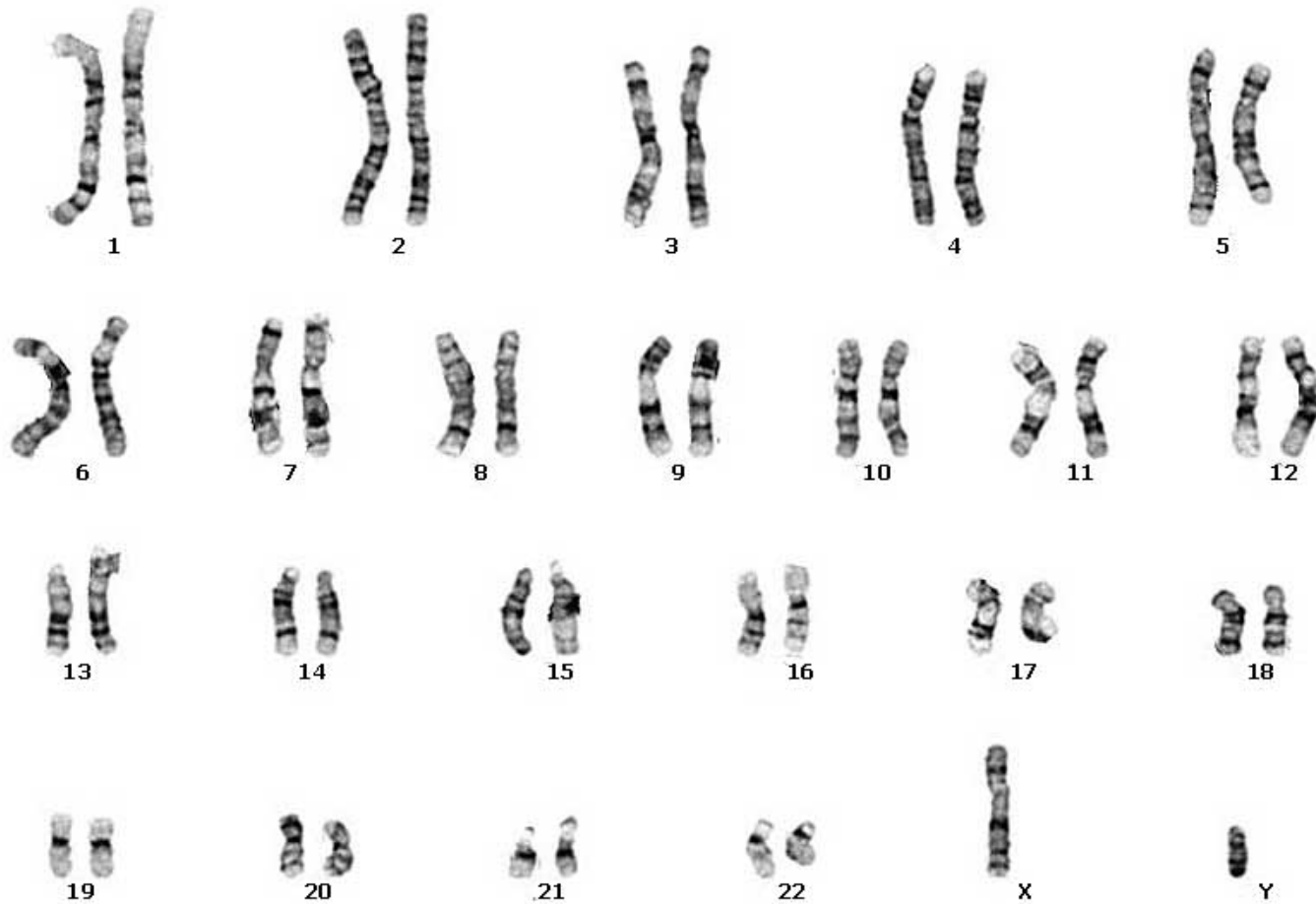
Germ cells
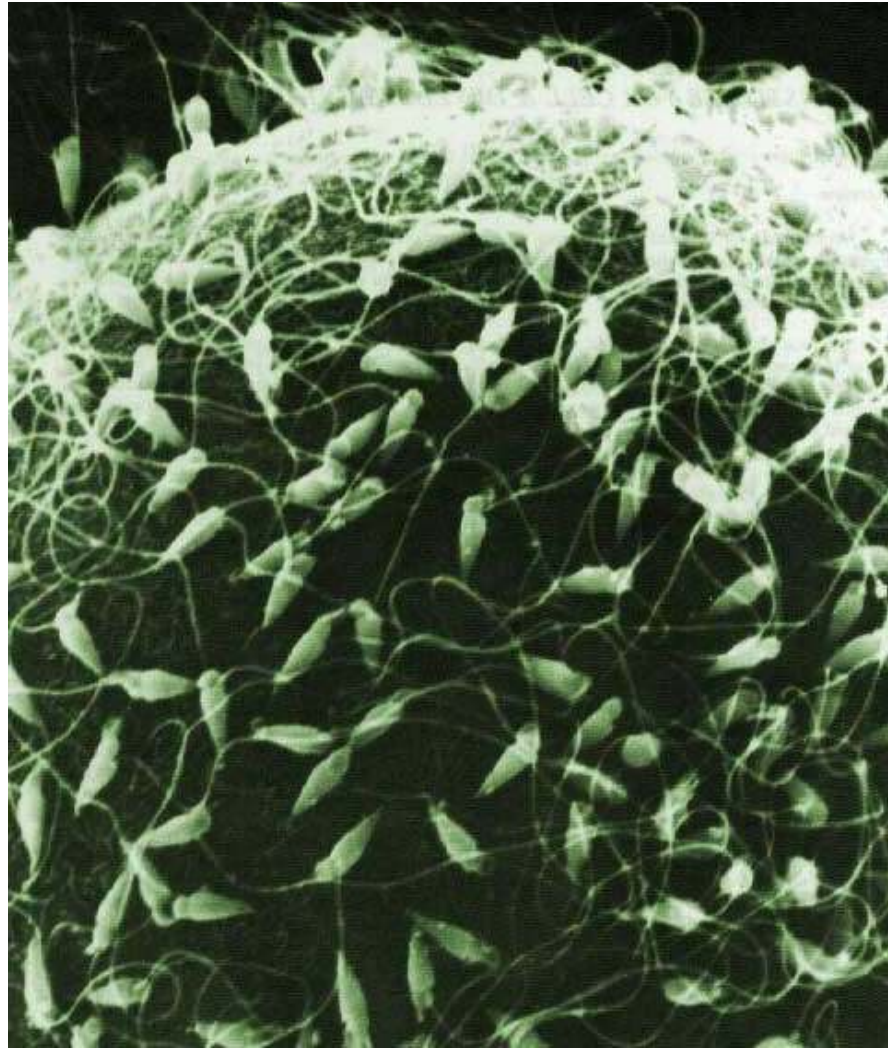
TWO Divisions of Meiosis

Interphase I of Meiosis

Homologous pair of chromosomes in diploid parent cell

Chromosomes replicate

Homologous pair of replicated chromosomes

Sister chromatids

Diploid cell with replicated chromosomes

Meiosis I

❶ Homologous chromosomes separate

Haploid cells with replicated chromosomes

Meiosis II

❷ Sister chromatids separate

Haploid cells with unreplicated chromosomes

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Meiosis I -First Division

MEIOSIS I:
Separates homologous chromosomes

INTERPHASE	PROPHASE I	METAPHASE I	ANAPHASE I

INTERPHASE

Centrosomes (with centriole pairs)

Nuclear envelope   Chromatin

Chromosomes duplicate

PROPHASE I

Chiasmata
Spindle

Sister chromatids   Tetrad

Homologous chromosomes pair and exchange segments

METAPHASE I

Microtubule attached to kinetochore   Metaphase plate

Centromere (with kinetochore)

Tetrads line up

ANAPHASE I

Sister chromatids remain attached

Homologous chromosomes separate

Pairs of homologous chromosomes split up

Meiosis II - Second Division

MEIOSIS II:
Separates sister chromatids

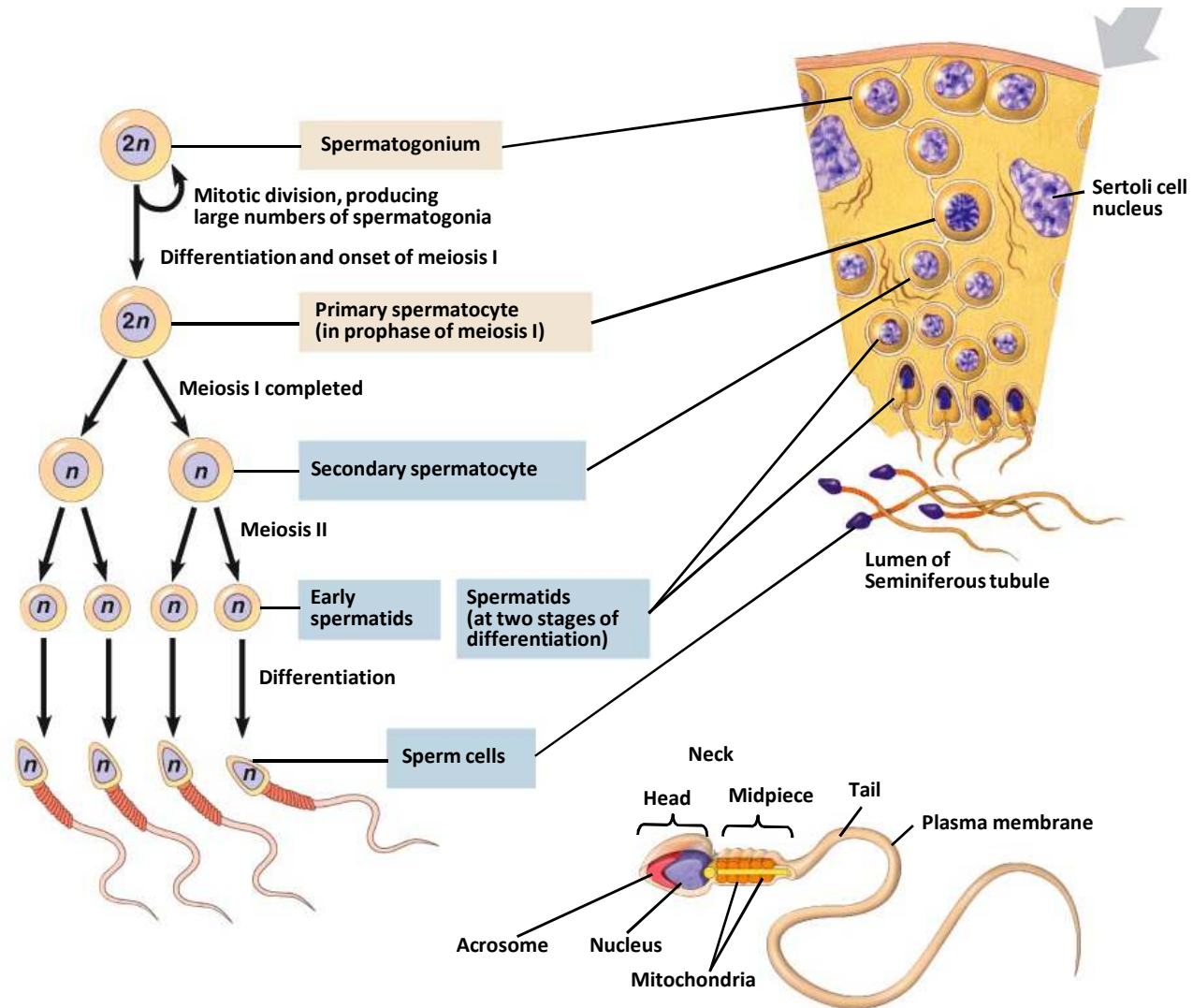| TELOPHASE I AND CYTOKINESIS | PROPHASE II | METAPHASE II | ANAPHASE II | TELOPHASE II AND CYTOKINESIS |

Cleavage furrow
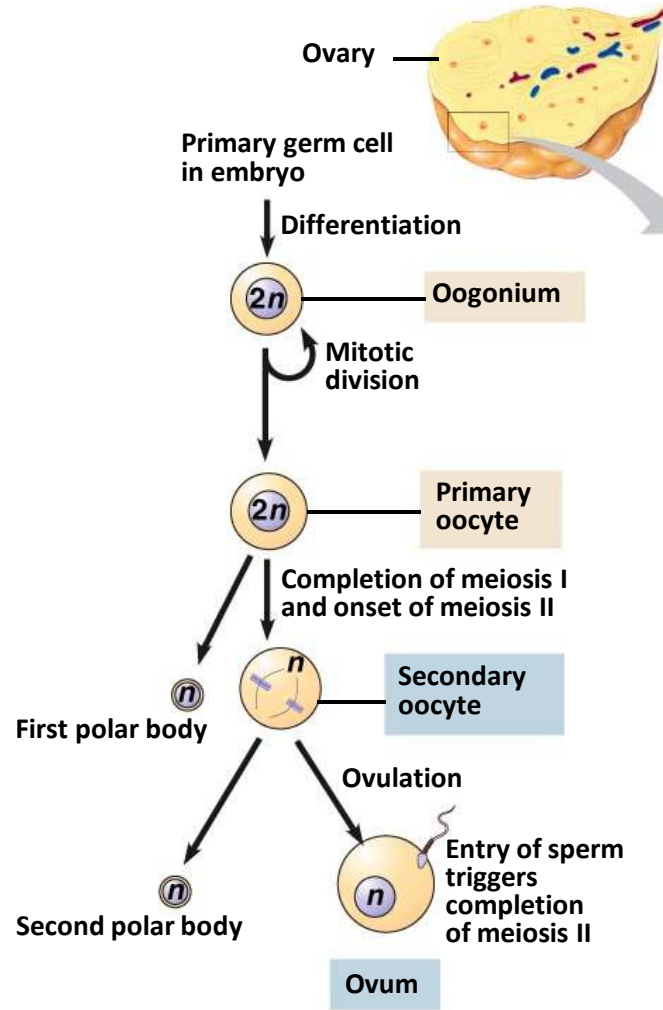
Sister chromatids separate

Haploid daughter cells forming
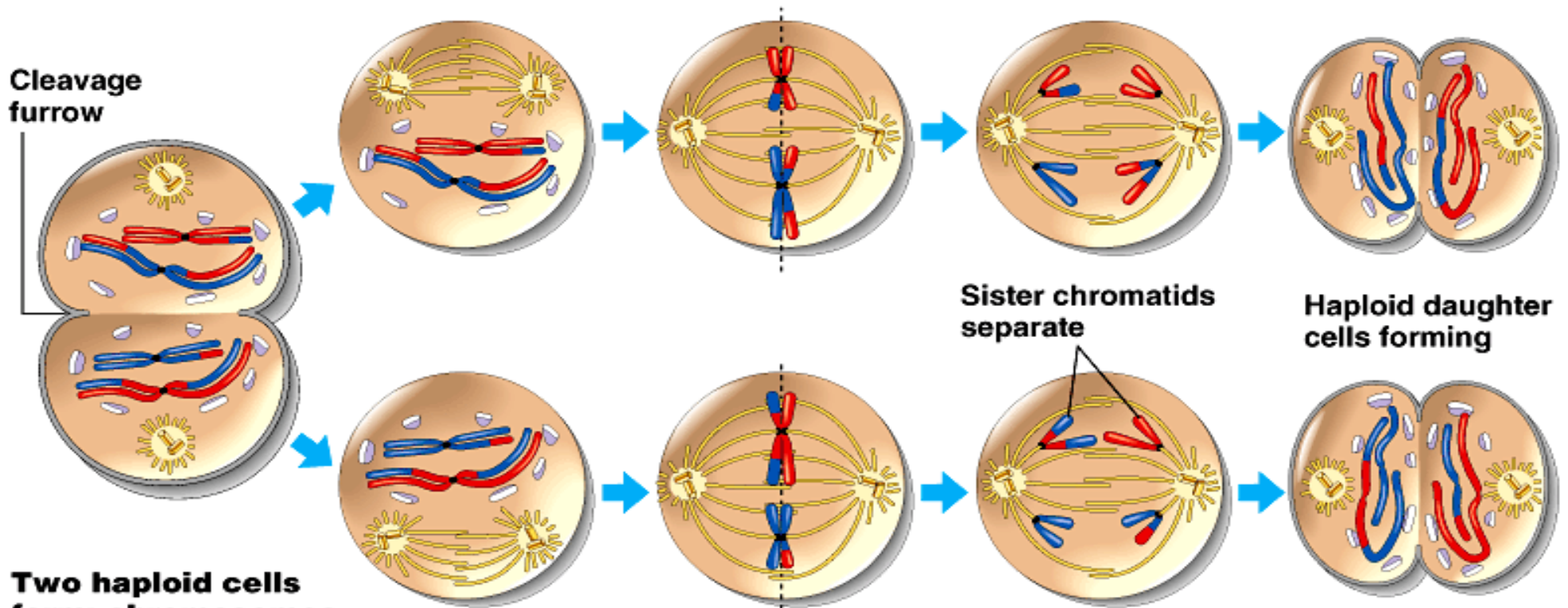
Two haploid cells form; chromosomes are still double

During another round of cell division, the sister chromatids finally separate; four haploid daughter cells result, containing single chromosomes

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Spermatogenesis

Spermatogonium

Mitotic division, producing large numbers of spermatogonia

Differentiation and onset of meiosis I

Primary spermatocyte (in prophase of meiosis I)

Meiosis I completed

Secondary spermatocyte

Meiosis II

Early spermatids

Spermatids (at two stages of differentiation)

Differentiation

Sperm cells

Sertoli cell nucleus

Lumen of Seminiferous tubule

Neck

Head   Midpiece   Tail

Plasma membrane

Acrosome   Nucleus

Mitochondria

Oogenesis in the ovaries

Ovary

Primary germ cell
in embryo

Differentiation

(2n) —— Oogonium

Mitotic
division

(2n) —— Primary
oocyte

Completion of meiosis I
and onset of meiosis II

(n) Secondary
oocyte

(n) First polar body

Ovulation

(n) Second polar body

(n) Entry of sperm
triggers
completion
of meiosis II

Ovum

Variation is the outcome desired

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.
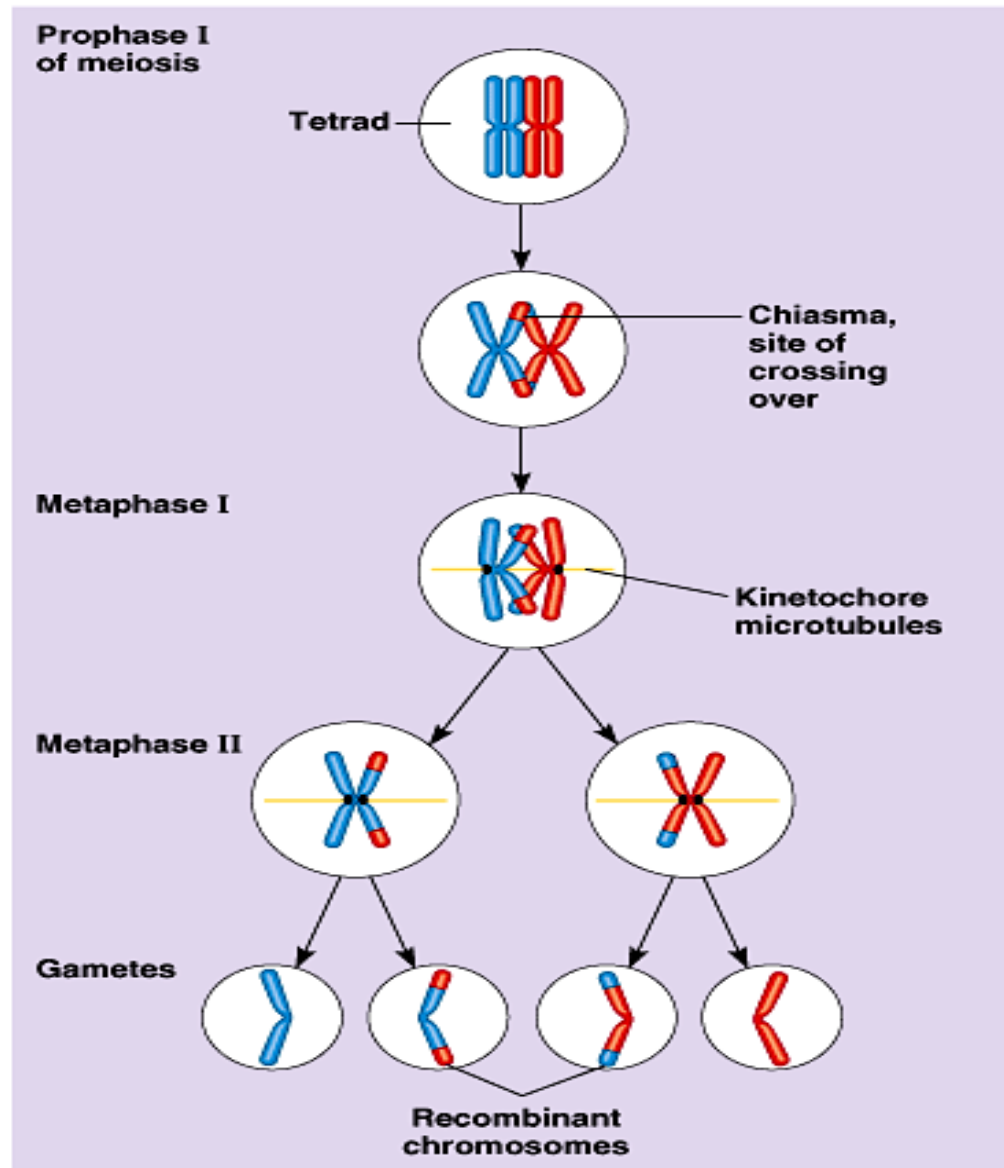
Mitosis vs. Meiosis

SUMMARY		
Event	**Mitosis**	**Meiosis**
DNA replication	Occurs during interphase before nuclear division begins	Occurs once, during the interphase before meiosis I begins
Number of divisions	One, including prophase, metaphase, anaphase, and telophase	Two, each including prophase, metaphase, anaphase, and telophase
Synapsis of homologous chromosomes	Does not occur	Synapsis is unique to meiosis: During prophase I, the homologous chromosomes join along their length, forming tetrads (groups of four chromatids); synapsis is associated with crossing over between nonsister chromatids
Number of daughter cells and genetic composition	Two, each diploid ($2n$) and genetically identical to the parent cell	Four, each haploid (n), containing half as many chromosomes as the parent cell; genetically nonidentical to the parent cell and to each other
Role in the animal body	Enables multicellular adult to arise from zygote; produces cells for growth and tissue repair	Produces gametes; reduces chromosome number by half and introduces genetic variability among the gametes