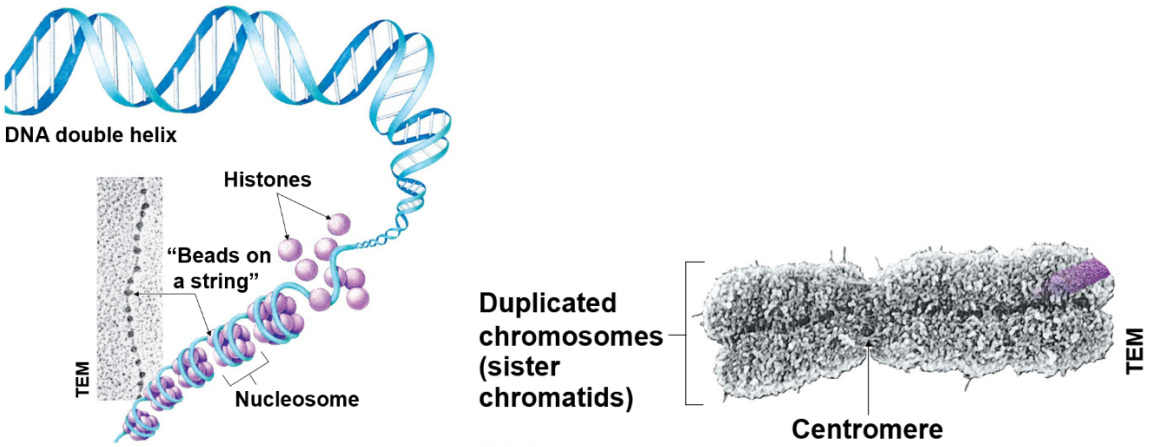
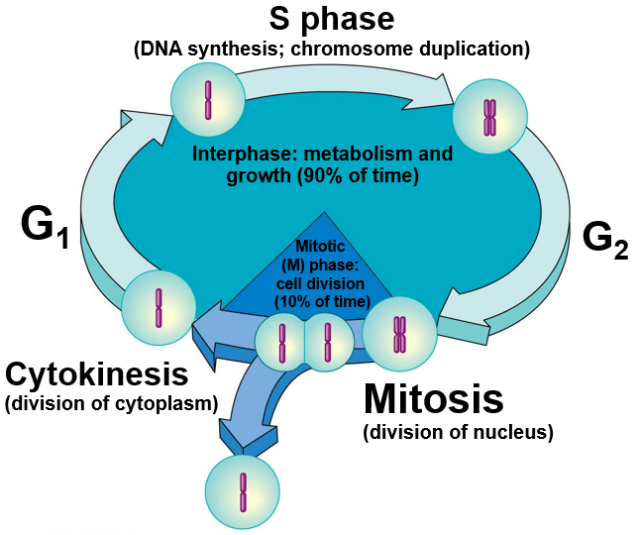
Review

Chapter 8. Cellular Reproduction: cells from cells

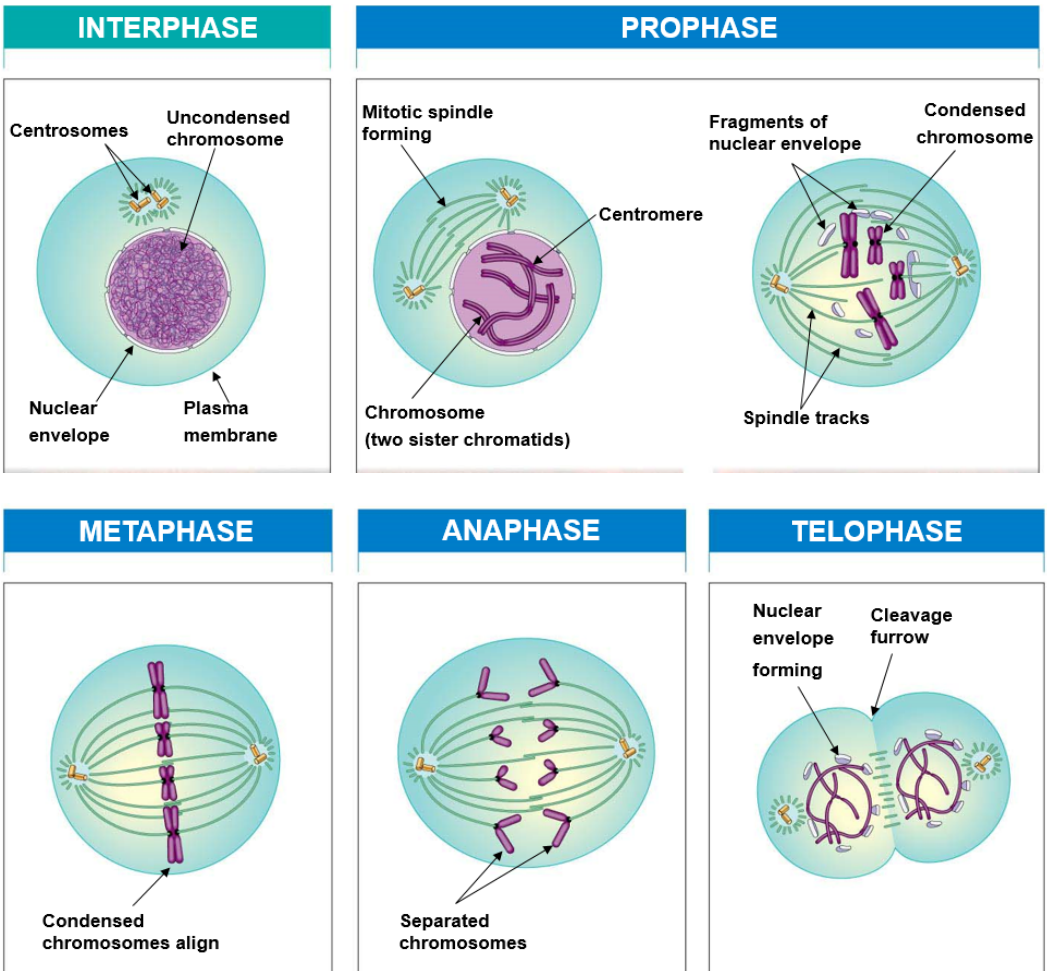
- **Cell division:** The two "daughter" cells that result are genetically identical to each other and to the original "parent" cell.
- **Functions of cell division:**
  1) Cell replacement
  2) Growth
  3) Reproduction
  - ✧ **Asexual reproduction → mitosis (有丝分裂) → growth and maintenance**
  - ✧ **Sexual reproduction → meiosis (减数分裂) → gametes (配子) → reproduction**
- **Chromosome (染色体):** The structure that contain most of the cell's DNA.
- **Chromatin (染色质):** Fibers composed of roughly equal amounts of DNA and protein molecules. The protein molecules help organize the chromatin and help control the activity of its genes.
- **Histones (组蛋白)→Nucleosome (核小体):** Consists of DNA wound around several histone molecules. **→Sister chromatids (姐妹染色单体) →Centromere (着丝点)**



- **Cell cycle:** The ordered sequence of events that extends from the time a cell is first formed from a dividing parent cell until its own division into two cells.



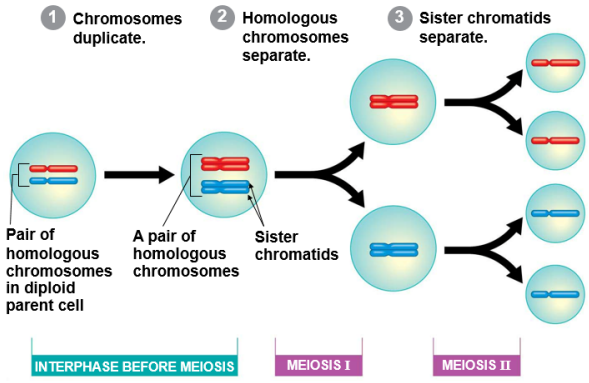
- **Interphase (间期):** A time when a cell goes about its usual business, performing its normal functions within the organism. Interphase lasts for at least 90% of the cell cycle.
  - ✧ G_1 phase:
  - ✧ S phase:
  - ✧ G_2 phase:
- **Four main stages of mitosis (有丝分裂):**
  prophase (前期); metaphase (中期); anaphase (后期); telophase (末期)
  At the start of mitosis, the chromosomes coil up and the nuclear envelope breaks down (prophase). Next, a mitotic spindle made of microtubule tracks moves the chromosomes to the middle of the cell (metaphase). The sister chromatids then separate and are moved to opposite poles of the cell (anaphase), where two new nuclei form (telophase). Cytokinesis overlaps the end of mitosis. In animals, cytokinesis occurs by cleavage, which pinches the cell in two. In plants, a membranous cell plate divides the cell in two. Mitosis and cytokinesis produce genetically identical cells.
- **Mitotic spindle (有丝分裂纺锤体):** A football-shaped structure of microtubule tracks that guides the separation of the two sets of daughter chromosomes.



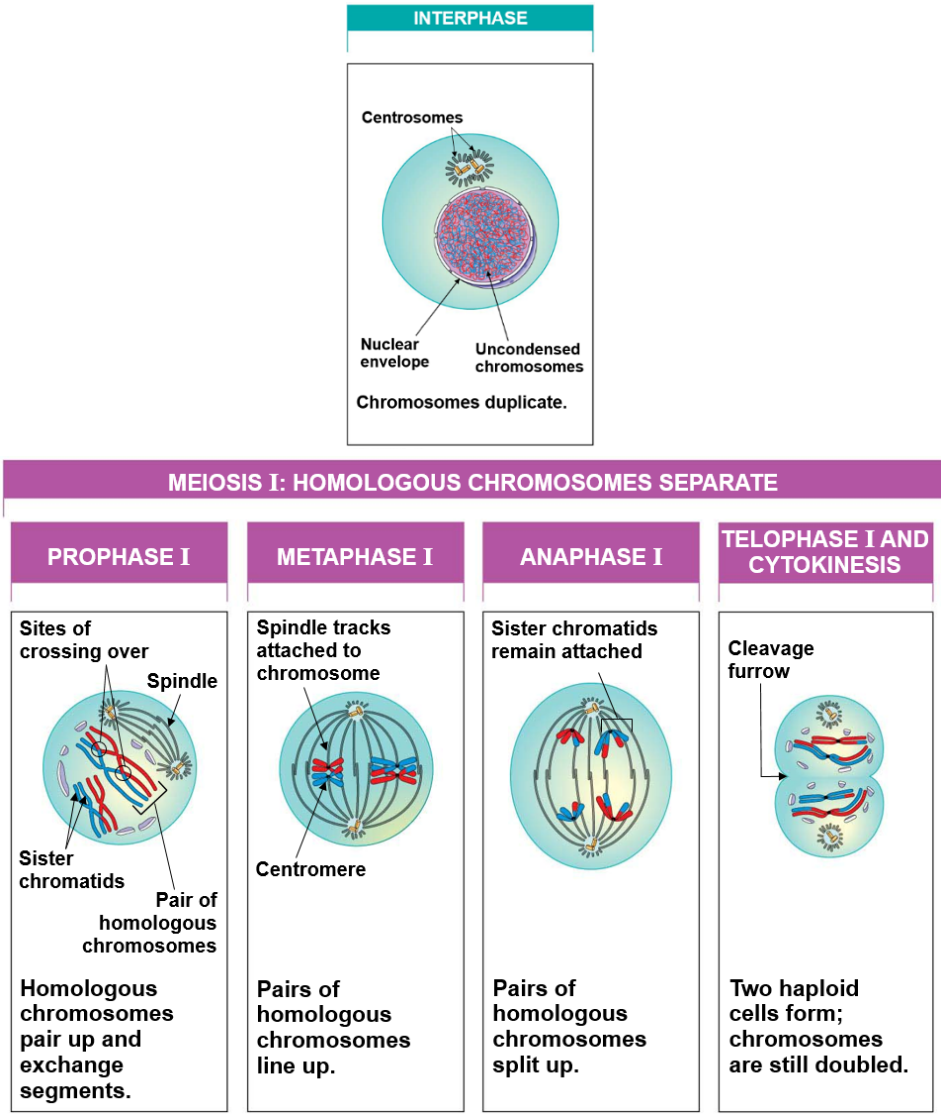
- **Cytokinesis (胞质分裂):** The division of the cytoplasm into two cells, usually begins during telophase, overlapping the end of mitosis.
  - ✧ **Animal cell:** Cleavage

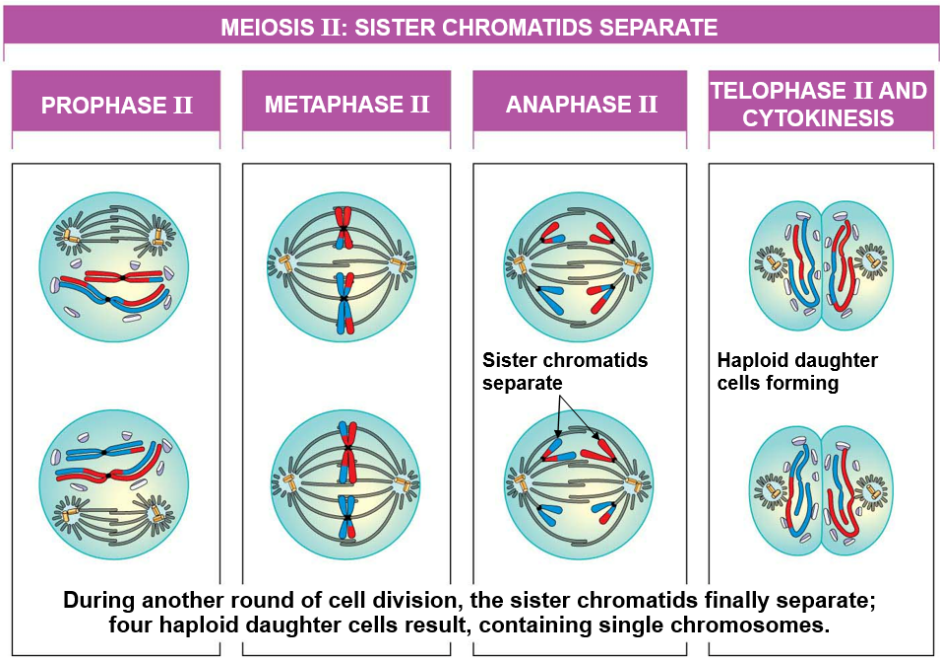
- ✧ **Plant cell:** Vesicles containing cell wall material collect at the middle of the cell. The vesicles fuse, forming a membranous disk called the **cell plate (细胞板)**. The cell plate grows outward, accumulating more cell wall material as more vesicles join it. Eventually, the membrane of the cell plate fuses with the plasma membrane, and the cell plate's contents join the parental cell wall.

- **Cell cycle control system:** Consists of specialized proteins within the cell. These proteins integrate information from the environment and from other body cells and send "stop" and "ho ahead" signals at certain key points during the cell cycle.
- **Tumor:** An abnormally growing mass of body cells.
  - ✧ **Benign tumor (良性肿瘤):** The abnormal cells remain at the original site.
  - ✧ **Malignant tumor (恶性肿瘤):** One that has the potential to spread into neighboring tissues and other parts of the body, forming new tumors.
- **Metastasis (转移):** The spread of cancer cells beyond their original site.
- **Cancer treatment:**
  - ✧ **Surgery:** The first step to remove a tumor, usually for many benign tumors.
  - ✧ **Radiation therapy:** Usually for malignant tumors that have not yet spread.
  - ✧ **Chemotherapy:** The use of drugs to disrupt cell division, is used to treat widespread or metastatic tumors.
- **Somatic cell (体细胞):** body cell
- **Karyotype (核型):** arrangement of the chromosomes in matching pairs by size
- **Homologous chromosomes (同源染色体):** Carry genes controlling the same inherited characteristics.
  - ✧ **Sex chromosomes (性染色体):** Determine a person's sex (male versus female). Males have one X chromosome and one Y chromosome; females have two X chromosomes.
  - ✧ **Autosomes (常染色体):** The chromosomes except sex chromosomes that found in both males and females.
- **Life cycle (multicellular organism):** The sequence of stages leading from the adults of one generation to the adults of the next.
- **Diploid organisms (二倍体):** All body cells contain pairs of homologous chromosomes.
- **Haploid cell (单倍体):** It has only one member of each pair of homologous chromosomes.
- **Fertilization (受精):** In the human life cycle, a haploid sperm fuses with a haploid egg.
- **Zygote (受精卵):** The resulting fertilized egg.
- **How meiosis halves chromosome number:**

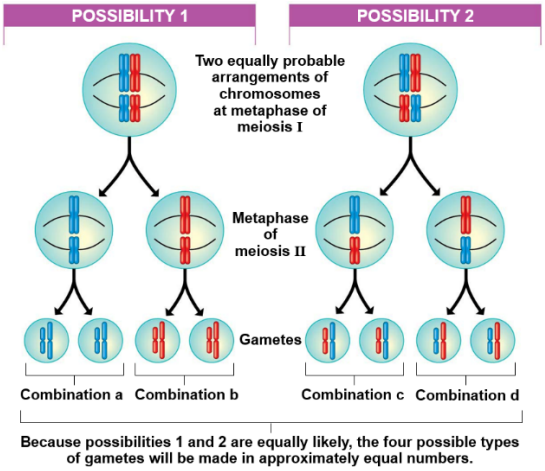


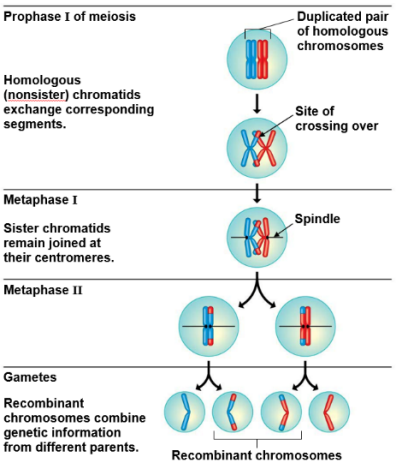
- **Meiosis:** The process of cell division that produces haploid gametes in diploid organisms.
- Meiosis, like mitosis, is preceded by chromosome duplication. But in meiosis, the cell divides twice to form four daughter cells. The first division, meiosis I, starts with the pairing of homologous chromosomes. In crossing over, homologous chromosomes exchange corresponding segments. Meiosis I separates the members of the homologous pairs and produces two daughter cells, each with one set of (duplicated) chromosomes. Meiosis II is essentially the same as mitosis; in each of the cells, the sister chromatids of each chromosome separate.



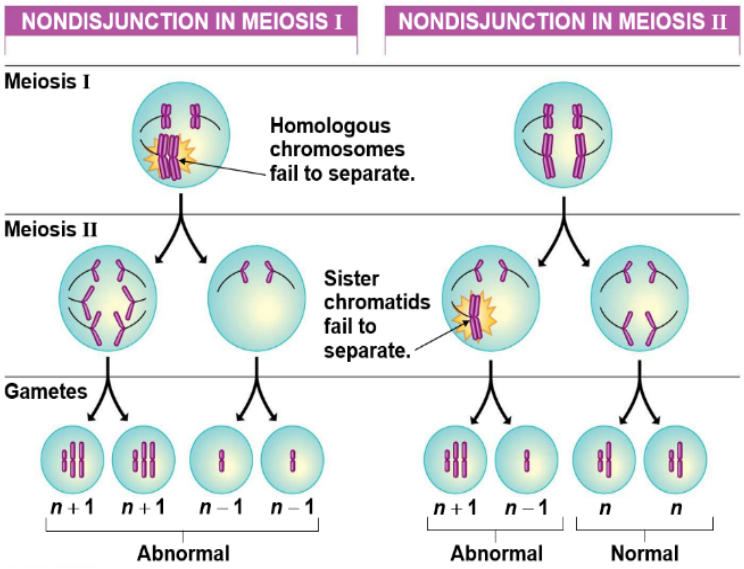


- **The difference between meiosis and mitosis:**
  1. During meiosis, the number of chromosomes is cut in half. A cell that duplicated its chromosomes undergoes two consecutive divisions, called meiosis Ⅰ and meiosis Ⅱ.
  2. **Crossing over**: the exchange of corresponding segments between nonsister chromatids of homologous chromosomes, which occurs during *prophase I* of meiosis.
- **The total number of chromosome combinations (in gamete):** 2^n, n represents the haploid number.
- **Genetic variation (遗传变异):**
  - ✧ Independent assortment of chromosomes;
  - ✧ Crossing over.





- **When Meiosis goes awry:**
  - ✧ **Nondisjunction:** The members of a chromosome pair fail to separate at anaphase. Nondisjunction can occur during meiosis Ⅰ or Ⅱ.



✧ Down syndrome (唐氏综合症): trisomy 21 (21 三体综合症), an autosomal nondisjunction.

✧ The most common human sex chromosome abnormalities:

Table 8.1 Abnormalities of Sex Chromosome Number in Humans

Sex Chromosomes	Syndrome	Origins of Nondisjunction	Frequency in Population
XXY	Klinefelter syndrome (male)	Meiosis in egg or sperm formation	$\frac{1}{2,000}$
XYY	None (normal male)	Meiosis in sperm formation	$\frac{1}{2,000}$
XXX	None (normal female)	Meiosis in egg or sperm formation	$\frac{1}{1,000}$
XO	Turner syndrome (female)	Meiosis in egg or sperm formation	$\frac{1}{5,000}$