

## **BMS240 Topic One: Chromosomes and Cellular Reproduction and Basic Principles of Heredity**

### **Describe a basic cell type and basic chromosomal structure**

All organisms use the same genetic system: either DNA or RNA

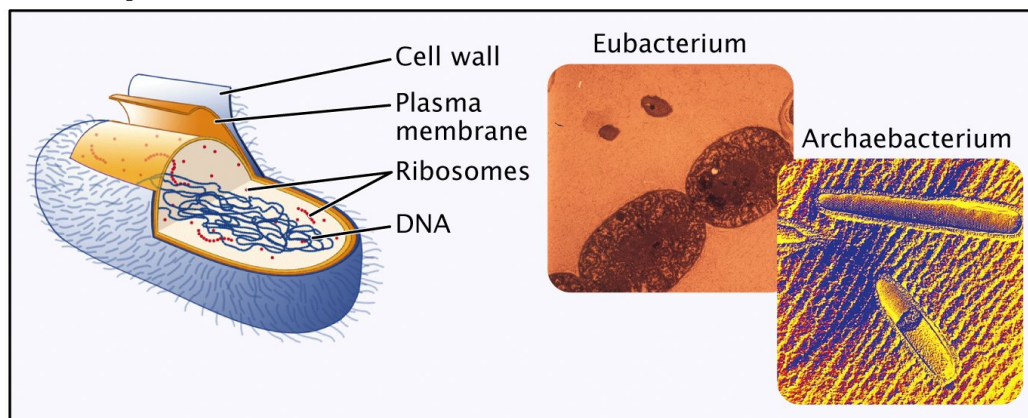
3 important steps in cell reproduction

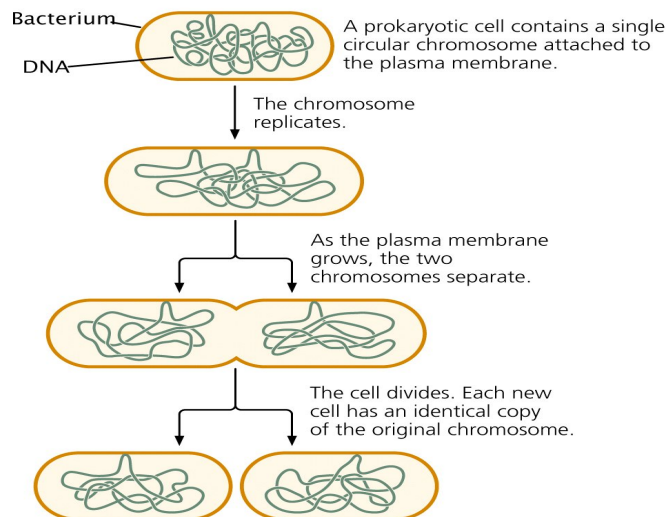
1. DNA Replication
2. Separation of the two copies of DNA
3. Division of the cytoplasm

Prokaryotic cells

- No nuclear membrane
- No membrane bound organelles
- Ribosomes present
- DNA is a single circular molecule (chromosome) with NO histones
- Chromosome replicates from the Origin of replication
- Cell divides by binary fission

### **Prokaryote**

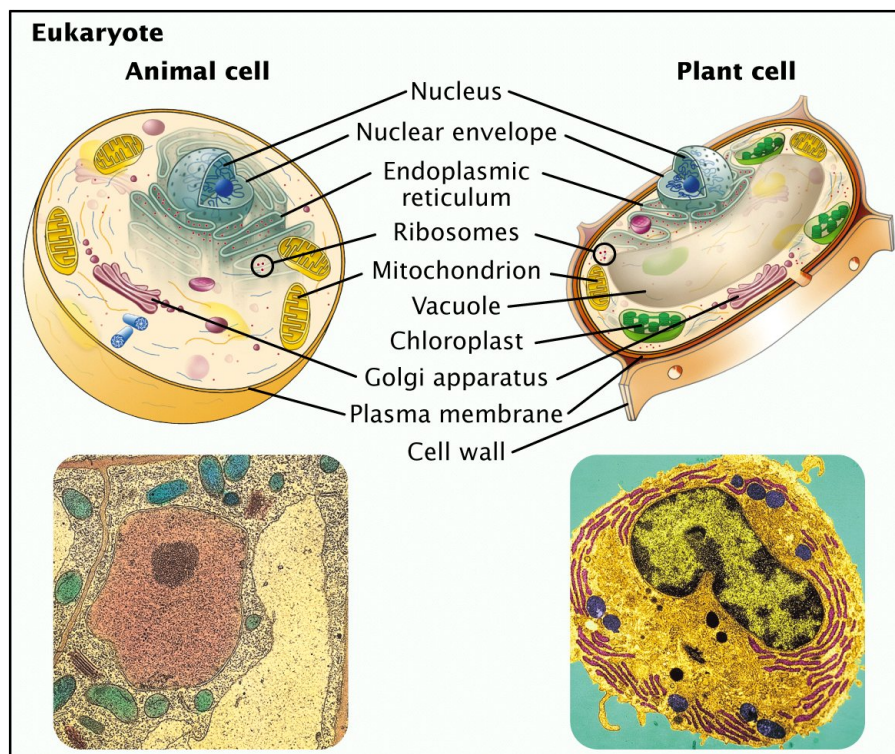




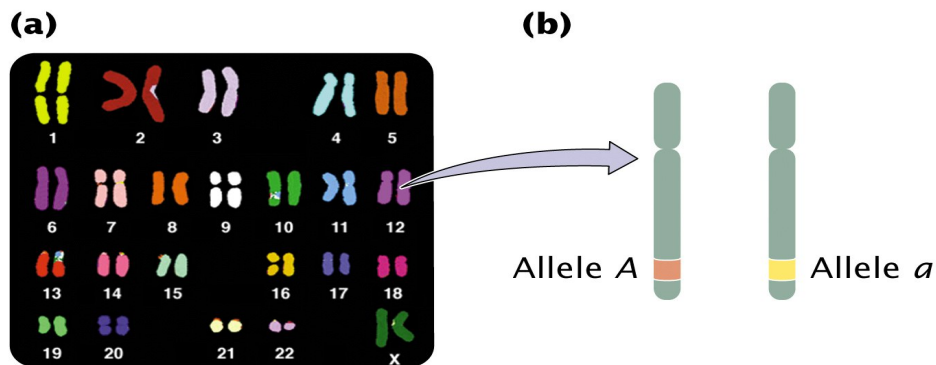
takes about 20 minutes

### Eukaryotic cells

- Nuclear membrane
- Membrane bound organelles
- Mitochondria (which also contain DNA)
- Multiple linear DNA molecules (chromosomes)
- Complexed with histones (which allows a large amount of DNA to be tightly packed).
- Chromosomes replicate and separate via mitosis. One copy of each chromosome to be passed onto new cell.
- Cells split via cytokinesis.



- There are two sets of chromosomes in humans (diploid)
- One set is from mum and one from dad.
- A pair of chromosomes is called a **HOMOLOGOUS PAIR**
- Each homologous chromosome carries **ALMOST** identical information in alleles.
- The homologous chromosomes are the same version of a chromosome but one is from maternal side and one is from paternal side.
- They will differ slightly at each locus, the alleles may differ but the loci code for the same thing. Eg. hair colour, eye colour etc.



Structure of Chromosomes:

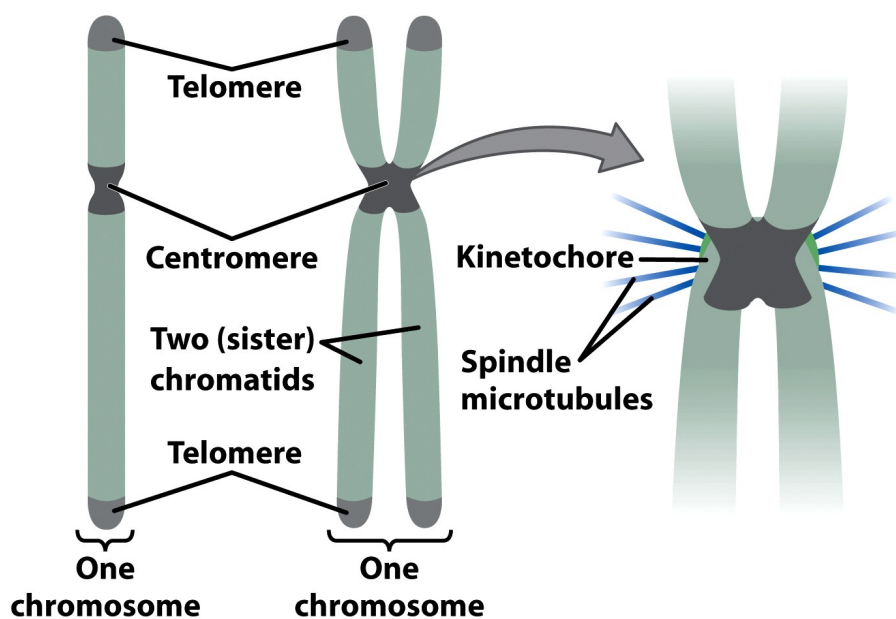
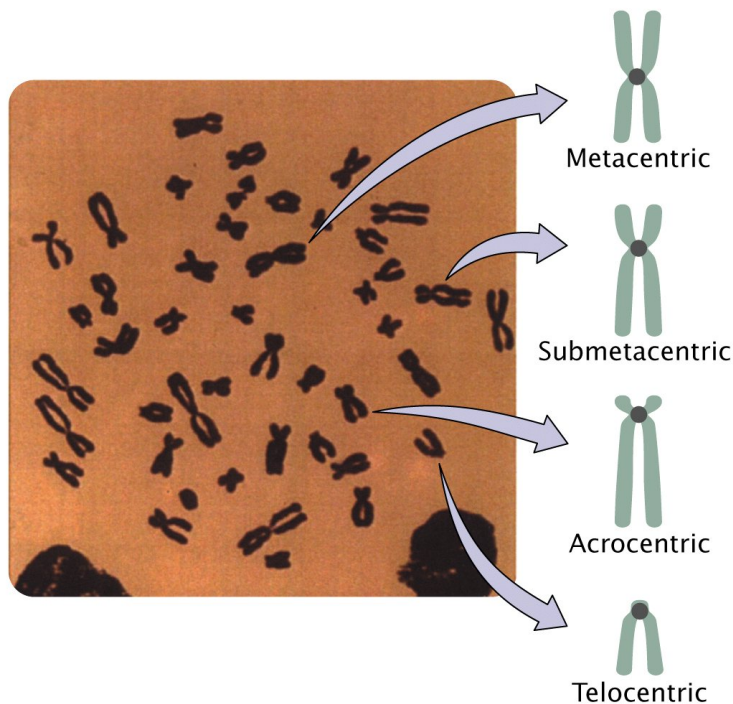


Figure 2-7  
Genetics: A Conceptual Approach, Third Edition  
© 2009 W. H. Freeman and Company

- Telomeres: ends, protect and stabilise the chromosome.
- Centromeres: connection point which interact with spindles
- Kinetochore: forms before division. Interact with spindle proteins and allow sister chromatids to be pulled apart. (sister chromatids are one chromosome and its replicate. Above the chromosome on the left has not replicated yet, the one on the right has)

- Chromosomes without a centromere would not be able to be pulled apart during mitosis.



## Describe the cell cycle

- The cell cycle is the life story of a cell, the stages that it passes through from one division to the next.
  - Through this process the genetic instructions for all characteristics are passed from parent to daughter cells.
  - Two phases
    - Interphase
      - G<sub>0</sub>, G<sub>1</sub>, S and G<sub>2</sub>
      - This is the period between cell divisions when the cell grows, develops and functions.
      - Critical events essential for cell division take place.
    - M-Phase
      - Mitosis and cytokinesis.
      - Period of active cell division.
- G<sub>1</sub> phase: cell grows, proteins necessary for cell division are synthesized. Longest amount of time spent here.
- G<sub>0</sub>: cells can exit the cell cycle and pass into this non-dividing phase. Fully differentiated cells and some cancer cells do this.
- G<sub>1</sub>/S checkpoint: This checkpoint holds the cell in G<sub>1</sub> until the cell has all the enzymes necessary for the replication of DNA. Once the cell passes this checkpoint it is committed to divide.

- S Phase: DNA synthesis. Each chromosome replicates. DNA synthesis must occur before mitosis. At the completion of S phase each chromosome is comprised of two sister chromatids.
- G<sub>2</sub> Phase: Several biochemical events necessary for cell division take place.
- G<sub>2</sub>/M checkpoint: at the end of G<sub>2</sub> the cell's DNA is checked to make sure it is completely replicated and undamaged. If everything is OK this checkpoint is passed and the cell is ready to divide and enters the M phase.
- M Phase: mitosis and cytokinesis take place.

