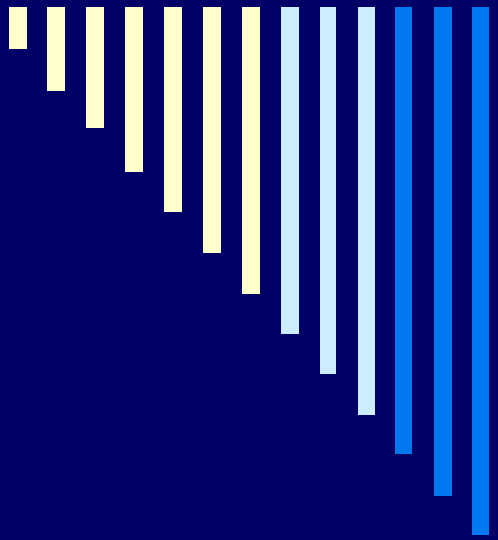


Chapter 10 Chromosomes and Cell Reproduction

Chromosomes

- Organisms grow by dividing of cells
- Binary Fission – form of asexual reproduction that produces identical offspring (Bacteria)
- Eukaryotes have two types of cell division, Mitosis and Meiosis

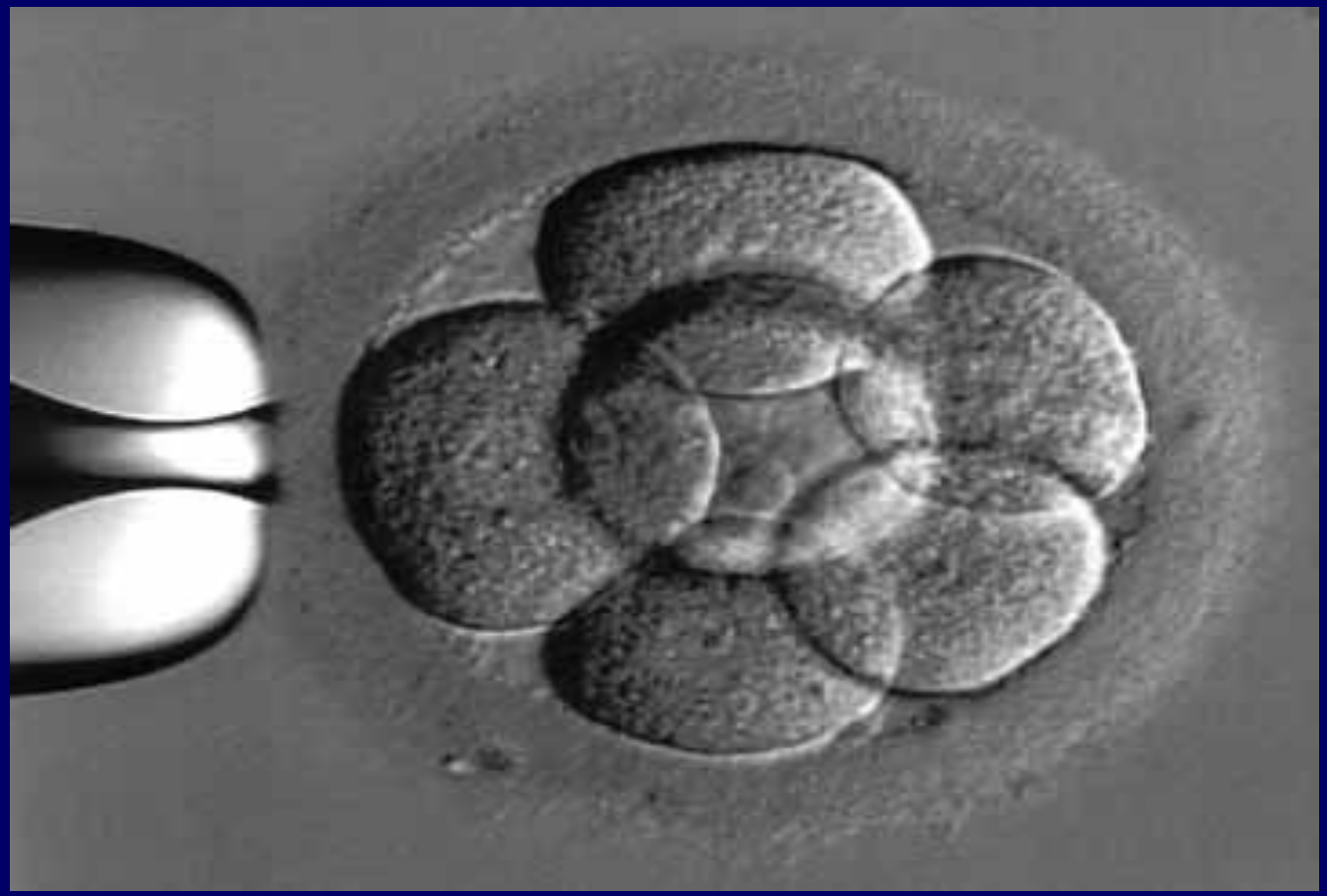
- Somatic Cell – a cell other than a sperm or egg cell (Mitosis)
- Gamete – a sperm or egg cell (Meiosis)

- Before a cell divides, chromosomes are made
- Chromosome – when the DNA and proteins associated with DNA coil
- Gene – segment of DNA that codes for a protein

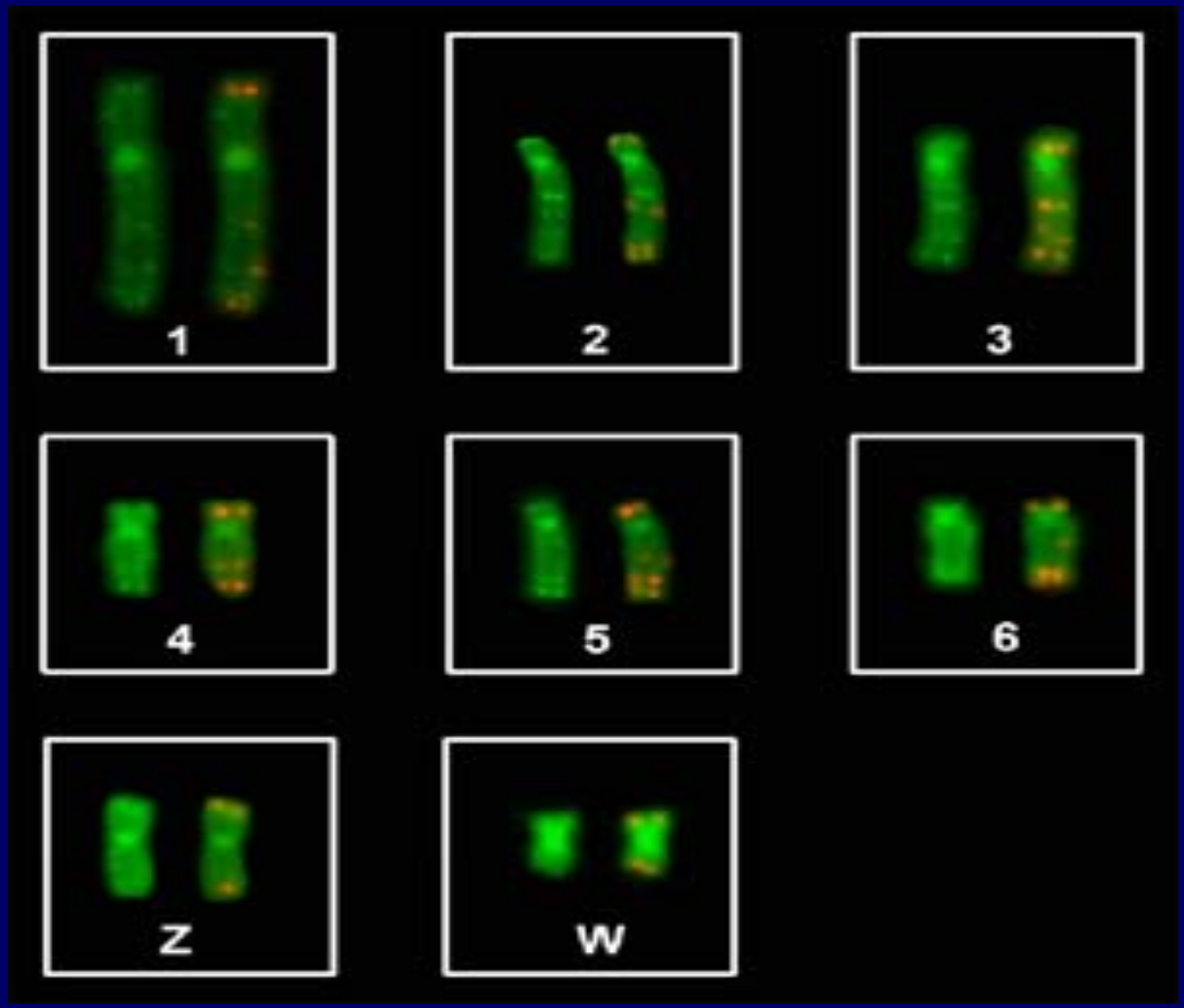
- Before chromosomes are created, DNA is copied
- The two exact copies are called chromatids
- Two chromatids are held together by a centromere

Chromosome

- Diploid – somatic cell contains two sets of chromosomes (2n)
- Haploid – when a gamete cell contains one set of chromosomes (n)
- Fusing two gametes creates a diploid zygote (fertilized egg cell)



- Homologous Chromosomes are like a pair of shoes
- You get one “shoe” from your mother and one “shoe” from your father
- n + n = 2n


1
2
3
4
5
6
Z
W

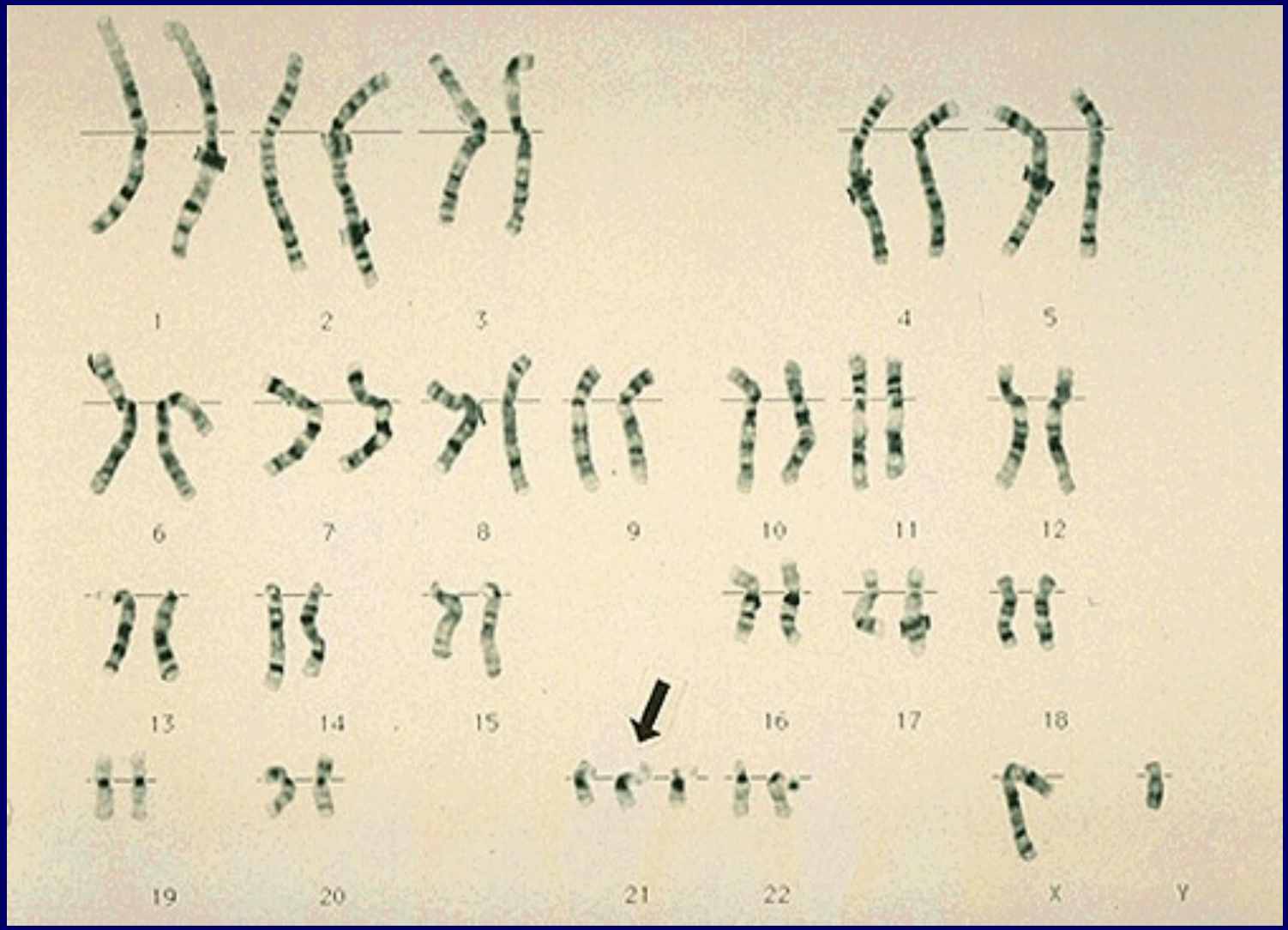
- Chromosomes determine the sex of offspring
- X and Y chromosomes are the sex chromosomes
- All others are called autosomes
- XX = Female (humans)
- XY = Male

- Some organisms have different types of sex chromosome combinations
- XX = Male Bird
- X = Female Bird

Changing Chromosome

- Each chromosome had thousands of genes
- Things go wrong if missing or having extra chromosomes
- Example is trisomy (three copies of a chromosme)

- Trisomy 21 causes Down syndrome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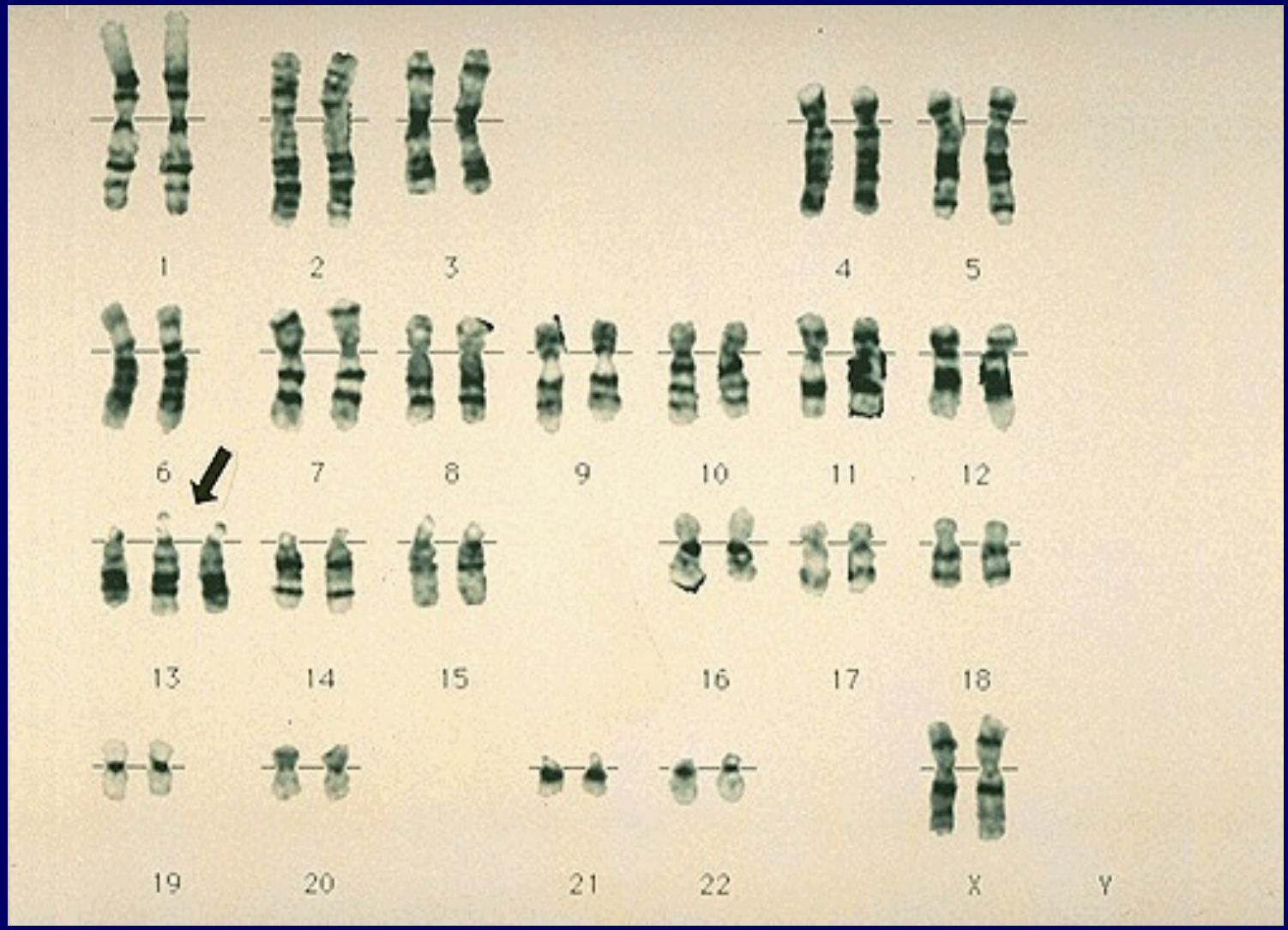
22
X
Y

- Trisomy 13 causes Patau Syndrome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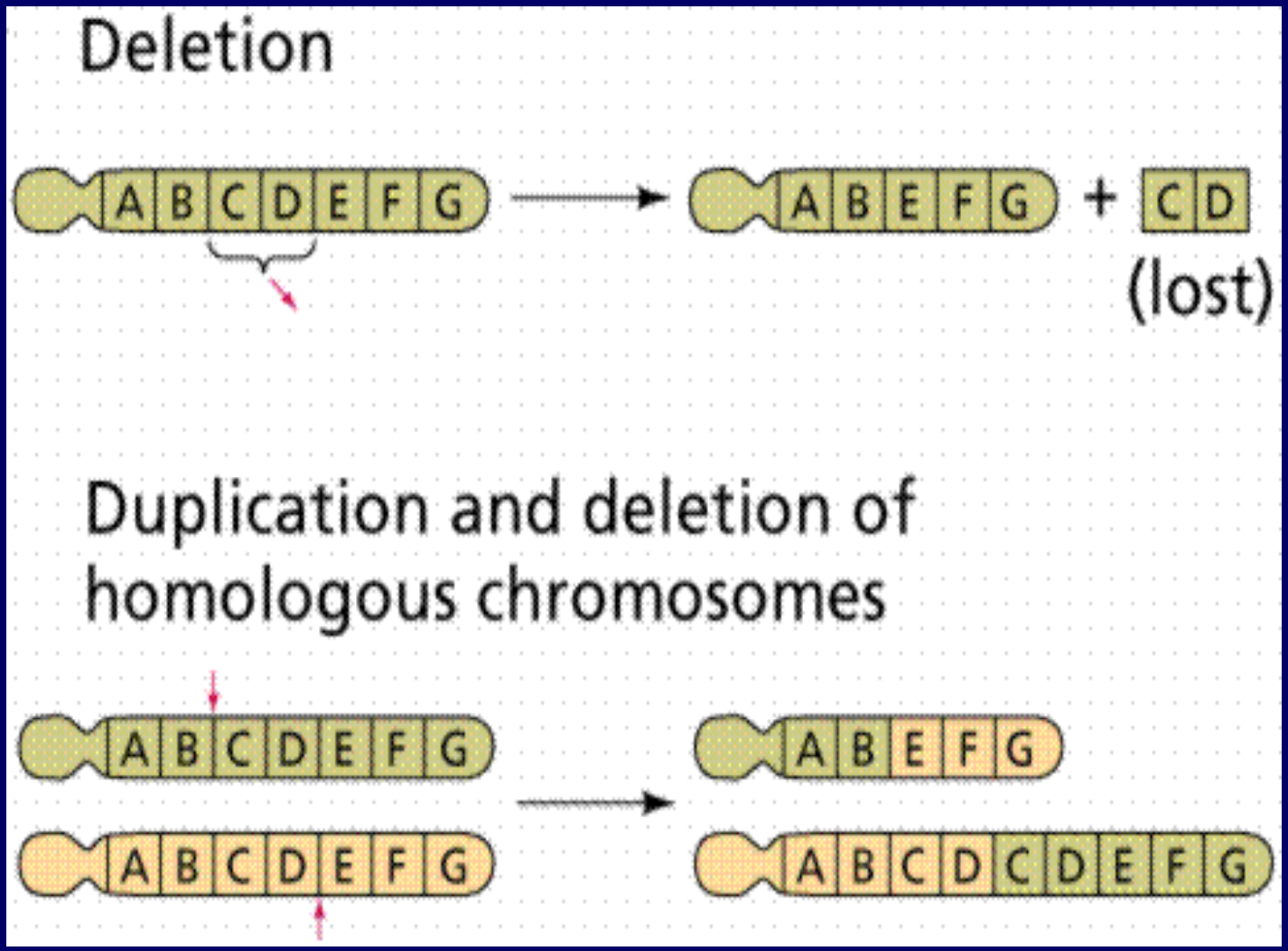
X
Y

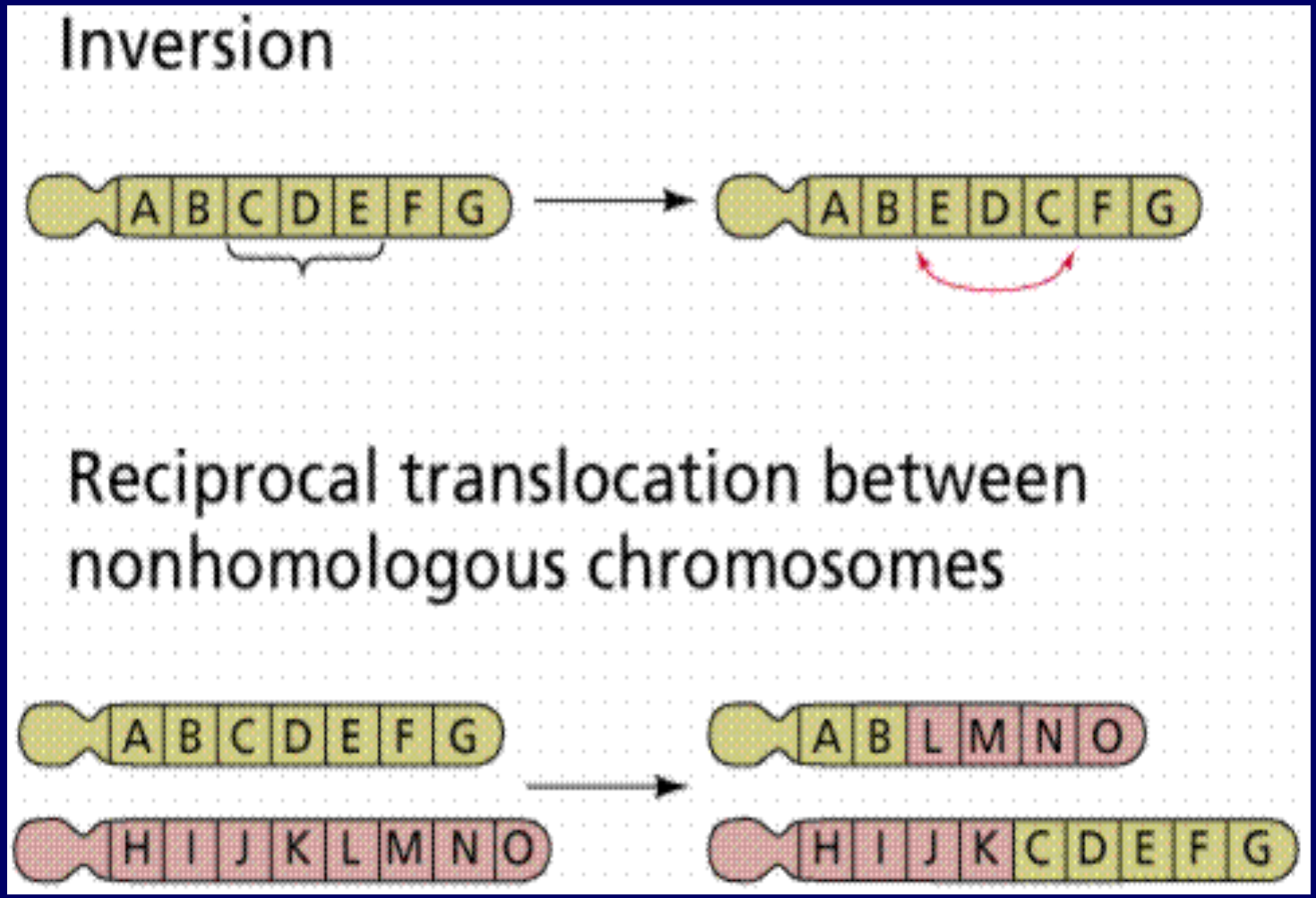
- A karyotype is a picture of the chromosome #
- Used to detect abnormalities in chromosome #

Change in Structure

- Mutation – change in chromosome structure
- Four types of mutations
- Deletion – Deletes information
- Duplication – Adds extra information

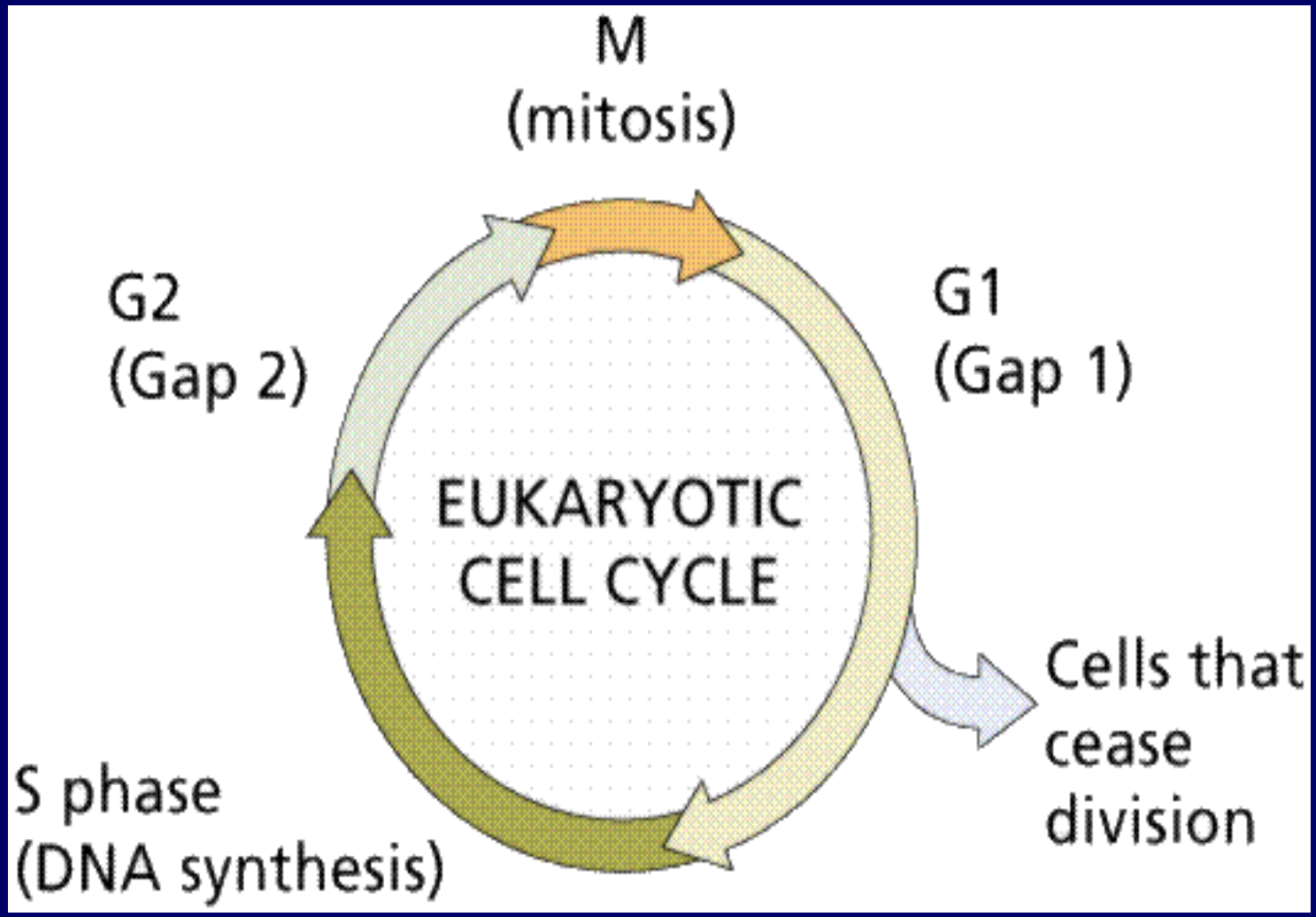
- Inversion – Changes order of information
- Translocation – moves information to a different chromosome


Deletion
A B C D E F G
A B E F G
+
C D
(lost)
Duplication and deletion of homologous chromosomes
A B C D E F G
A B C D E F G
A B E F G
A B C D C D E F G


Inversion
A B C D E F G
A B E D C F G
Reciprocal translocation between nonhomologous chromosomes
A B C D E F G
H I J K L M N O
A B L M N O
H I J K C D E F G

The Cell Cycle

- Is a repeating sequence of cellular growth and division during the life of an organism
- Broken down into 3 main phases: Interphase, Mitosis, Cytokinesis
- 90% of the time, a cell is in Interphase


M
(mitosis)
G2
(Gap 2)
G1
(Gap 1)
EUKARYOTIC
CELL CYCLE
Cells that
cease
division
S phase
(DNA synthesis)

Interphase

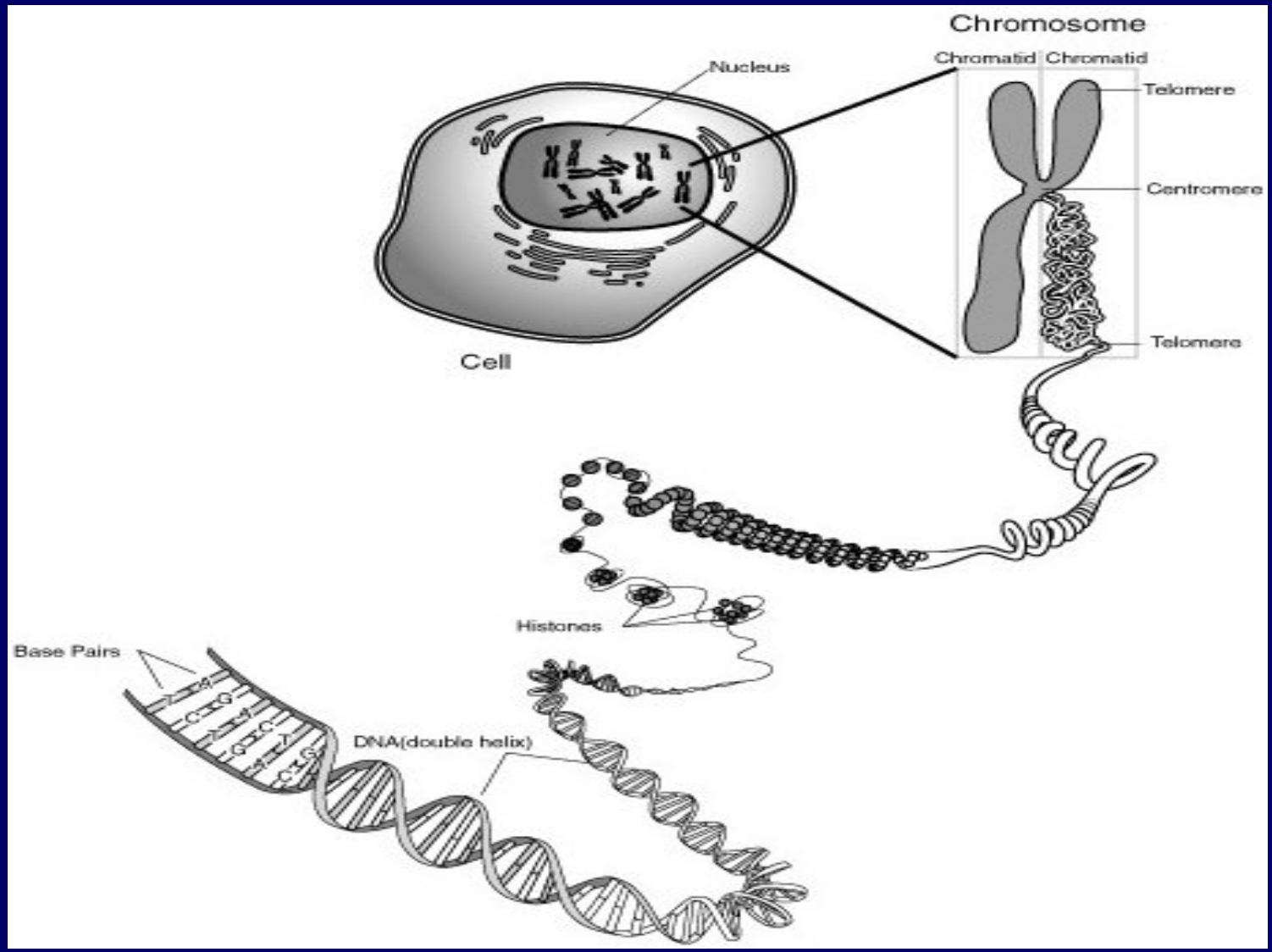
- Can be broken down into smaller phases: G1, S, G2

G1 Phase

- Cell grows rapidly and carries out routine functions
- Cell spends most of its life in this phase

S or Synthesis Phase

- A cell copies its DNA
- Each chromosome consists of two chromatids attached at a centromere at the end of S Phase


Chromosome
Chromatid
Chromatid
Nucleus
Telomere
Centromere
Telomere
Cell
Histones
Base Pairs
DNA(double helix)

G2 Phase

- Nucleus prepares to divide
- Proteins called microtubules form (used to move chromosomes during mitosis)

Mitosis

- The process of cell division in which the nucleus of a cell divides into two nuclei
- Produces exact copies

Cytokinesis

- The process during cell division when the cytoplasm divides

Controlling the Cell Cycle

- Controlled by many proteins
- Use checkpoints to regulate the cycle

G1 Checkpoint

- Decides whether a cell will divide
- If conditions are favorable, proteins will stimulate the cell into starting the S Phase
- Only when conditions are favorable

DNA Synthesis or G2 Checkpoint

- DNA replication is checked by DNA repair enzymes
- If checkpoint is passed, proteins help trigger mitosis

Mitosis Checkpoint

- Triggers the exit from mitosis
- Signals the beginning of the G1 Phase

- http://outreach.mcb.harvard.edu/animations_S03.htm

Cancer

- Certain genes contain the information for making checkpoint proteins
- If one of these genes gets mutated, the check points may not function
- Cancer is the uncontrolled growth of cells

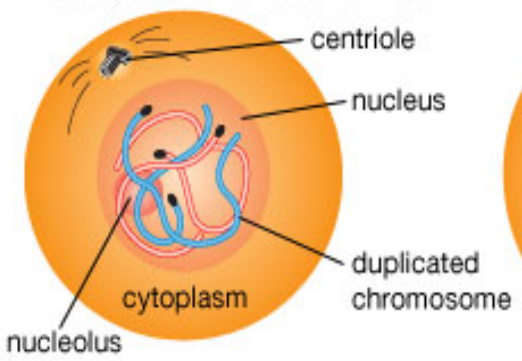
- Some mutations cause cells to grow to rapidly by overproducing growth molecules
- Some mutations cause inactivation of checkpoint proteins

- Some mutations occur spontaneously
- Others are caused by environmental influences

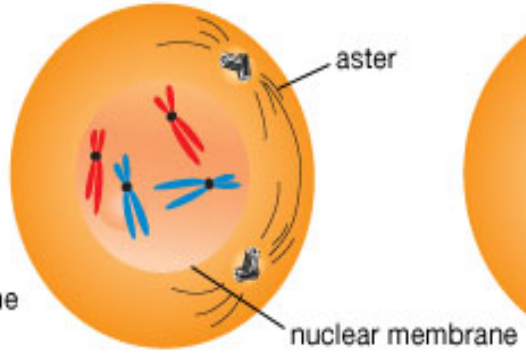
Mitosis

- Mitosis is the division of one nuclei into two
- Each contains a complete set of the cell's chromosomes

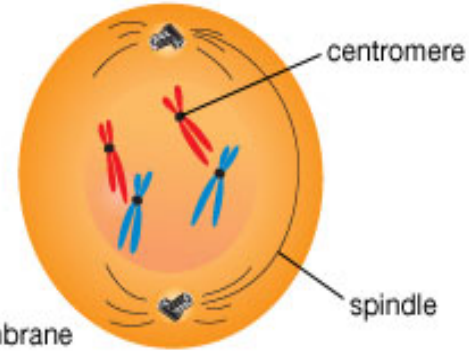
Mitosis, or somatic cell division



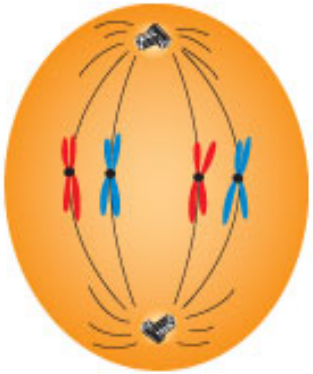
Prior to mitosis, thin strands of DNA in the cell nucleus thicken into chromosomes, which then duplicate themselves.



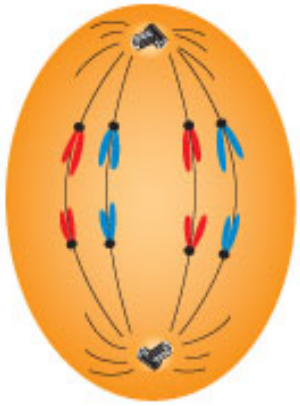
In early prophase, the centrioles divide and, with the asters, move apart. The nuclear membrane begins to disintergrate.



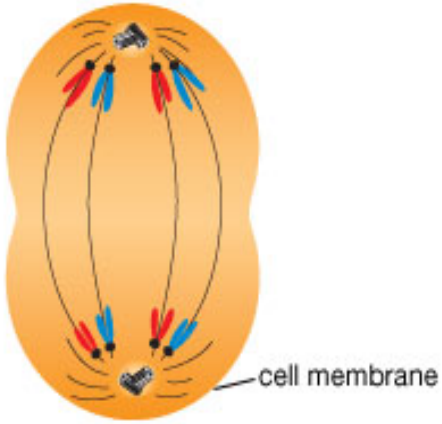
In late prophase, the centrioles and asters are at opposite poles. The nucleolus and nuclear membrane have almost disappeared.



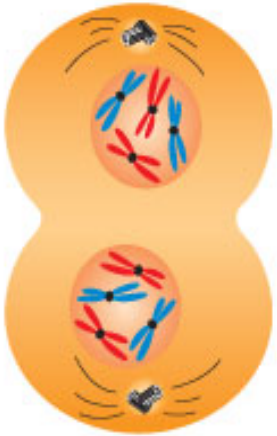
The doubled chromosomes—their centromeres attached to the spindle fibers—line up at mid-cell in the metaphase.



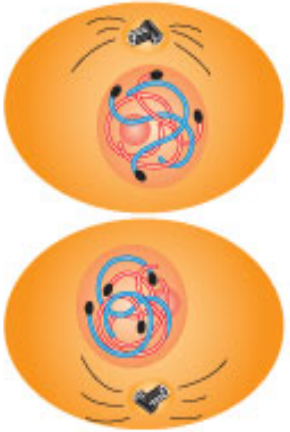
In early anaphase, the centromeres split. Half the chromosomes move to one pole, half to the other pole.



In late anaphase, the chromosomes have almost reached their respective poles. The cell membrane begins to pinch at the center.



The cell membrane completes constriction in telophase. Nuclear membranes form around the separated chromosomes.



Mitosis completed, there are two cells with the same structures and number of chromosomes as the parent cell.

- Structures called centrioles are replicated during G2 Phase in animal cells
- These centrioles migrate towards the poles during mitosis
- When they move, spindle fibers begin to form
- Spindle fibers are made of microtubules

- Spindle fibers are responsible for separating chromatids during mitosis

Prophase

- Chromosomes coil up and become visible
- The nuclear envelope dissolves and the spindle forms

Metaphase

- The chromosomes move to the middle of the cell and line up on the equator
- Spindle fibers link to the chromatids of each chromosome

Anaphase

- Centromeres divide
- Two chromatids move towards opposite poles
- These chromatids are now called chromosomes

Telophase

- A nuclear envelope forms around the chromosomes at each pole
- Chromosomes at each pole uncoil and the spindle dissolves
- Mitosis is now complete

Cytokinesis

- The cytoplasm of the cell divides in half
- Cell membrane grows to enclose each cell
- End result is two identical cells
- In animal cells, a belt of proteins threads pinches the cell in half
- Plant cells use a cell plate to split a cell into two

- http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter11/animations.html#