

## SESSION 3: CELL DIVISION

### KEY CONCEPTS:

- What is cell division?
- Phases in Mitosis
- Role of mitosis
- Chromosome structure
- Cancer

### TERMINOLOGY

**Karyokinesis:** Division of the nucleus of cells to form new cells

**Cytokinesis:** Division of the cytoplasm of cells to form new cells

**Ploidy:** Refers to the number of sets of homologous chromosomes in a cell

**Diploid:** Refers to cells that have the full set of chromosomes. Somatic cells (ordinary body cells) receive one of each type of chromosome from female parent (maternal chromosomes) and one of each type of chromosome from male parent (paternal chromosomes)

**Haploid:** Refers to cells that have the half of chromosomes. Gametes (sex cells) must have half the number of chromosomes so that when fertilization occurs the resultant zygote has the full set of chromosomes.

### X-PLANATION

What are the two types of cell division that cells may be involved in?

**Mitosis** – ordinary cell division

**Meiosis** – special cell division for the production of gametes or sex cells

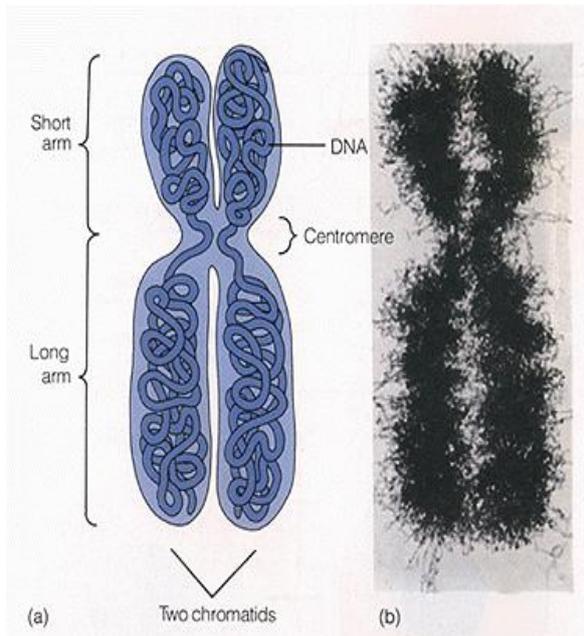
Why do cells divide? (During Mitosis)

- New cells are produced for:
- growth
- repair
- replace damaged or old cells
- asexual reproduction

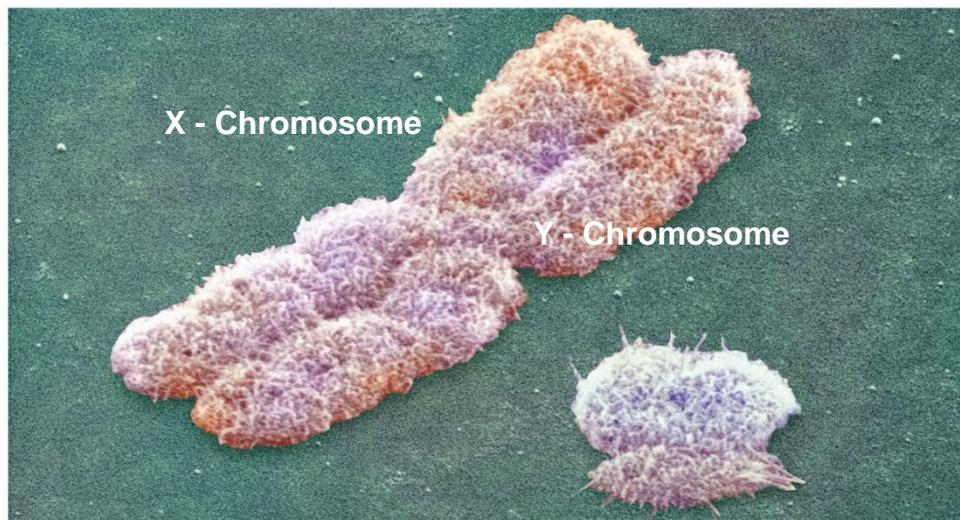
What are chromosomes?

Chromosomes are material found in the nucleus that:

- Are made of DNA
- Each chromosome consists of two strands, called chromatids held together by a centromere



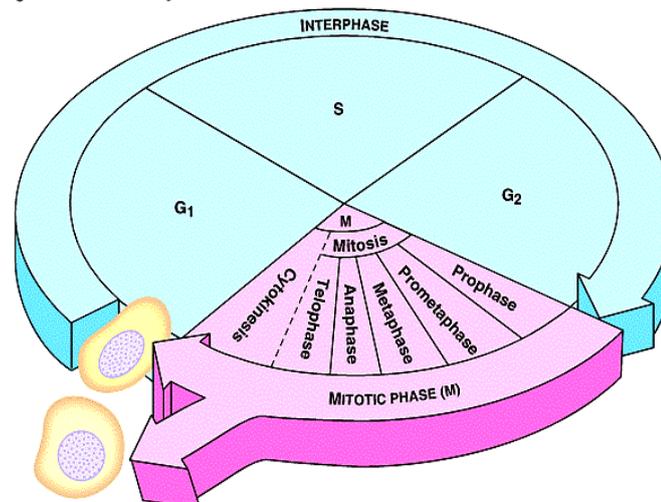
The following are the sex chromosomes:



**The cell cycle:**

- During the cell cycle, a cell grows, prepares for division, and divides to form 2 daughter cells, each with each of which then begins the cycle again.
- The cell cycle is divided into phases for easy understanding:
  - G - primary growth phase
  - S<sub>1</sub> – synthesis; DNA replicated
  - G - secondary growth phase
- M – mitosis – which is broken up into prophase, metaphase and telophase
- C – cytokinesis – which involves the splitting of the cytoplasm

*Collectively these 3 stages are called **interphase***

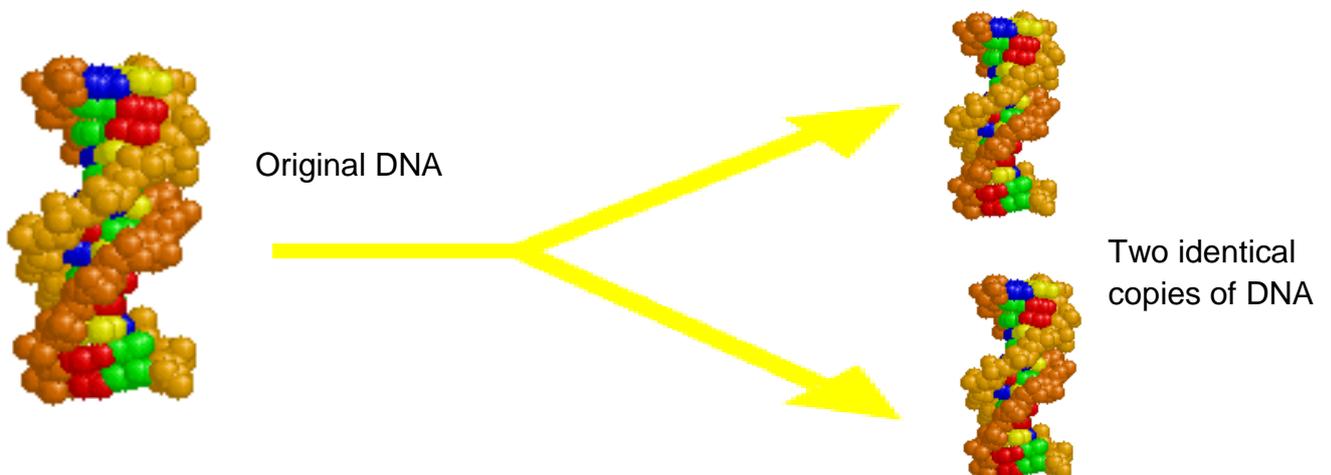


### Interphase – G<sub>1</sub>

- 1<sup>st</sup> growth stage after cell division
- Cells mature by making more cytoplasm & organelles
- Cell carries on its normal metabolic activities

### Synthesis stage

DNA is copied or replicated



### G<sub>2</sub> Stage

- 2<sup>nd</sup> Growth Stage
- Occurs after DNA has been copied
- All cell structures needed for division are made (e.g. centrioles)
- Both organelles & proteins are synthesized

### Mitosis

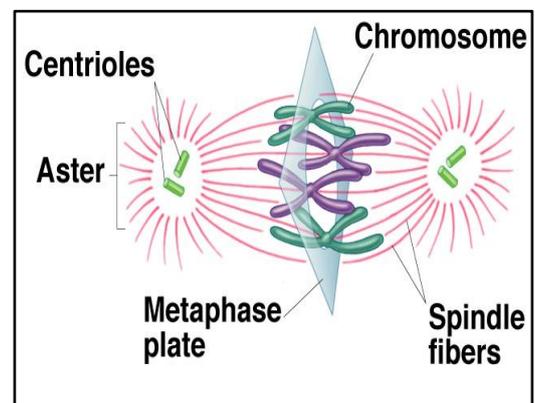
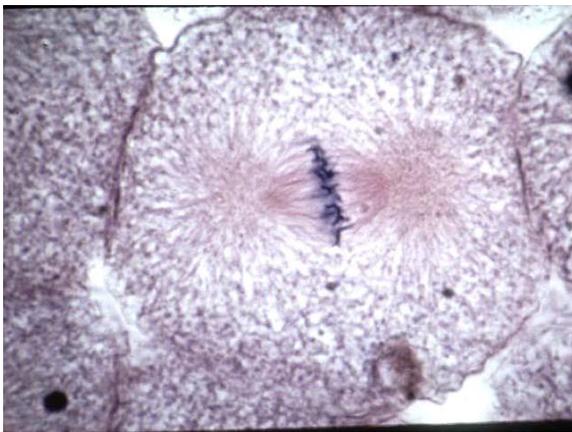
- Division of the nucleus
- Also called karyokinesis
- Only occurs in eukaryotes
- Has four stages
- Doesn't occur in some highly specialized cells such as brain cells

**Prophase:**

- Chromatin in nucleus condenses to form visible chromosomes
- Centrioles form spindle fibres in animal cells
- Nuclear membrane & nucleolus are broken down
- Chromosomes continue condensing & are clearly visible
- Chromosomes attached to spindle fibres

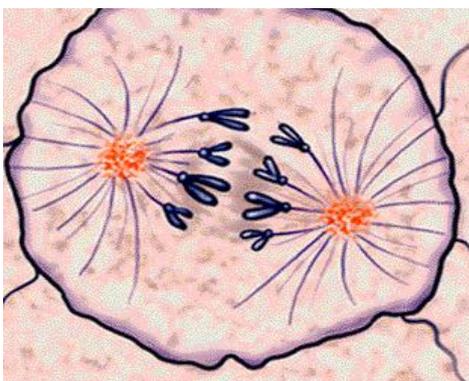
**Metaphase:**

- Chromosomes, attached to the spindle fibres,
- move to the center of the cell
- Chromosomes are now lined up at the equator

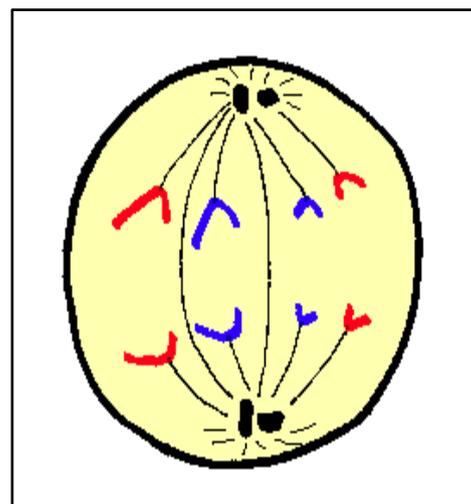


**Anaphase:**

- Occurs rapidly
- Sister chromatids are pulled apart to opposite poles of the cell by spindle fibres
- The (sister) chromatids separate and move apart to opposite ends of the cell.



**Anaphase**  
Centromeres divide in two.  
Spindle fibers pull sister chromatids to opposite poles of cell.  
Each pole (future daughter cell) now has an identical set of genes.

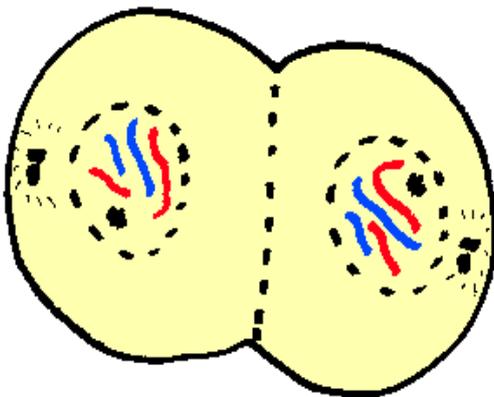


Chromosomes attached singly to spindle fibres and are at the equator of the cell



**Telophase:**

- Sister chromatids at opposite poles
- Spindle disassembles
- Nuclear membrane forms around each set of sister chromatids
- Nucleolus reappears
- CYTOKINESIS occurs
- Chromosomes reappear as chromatin



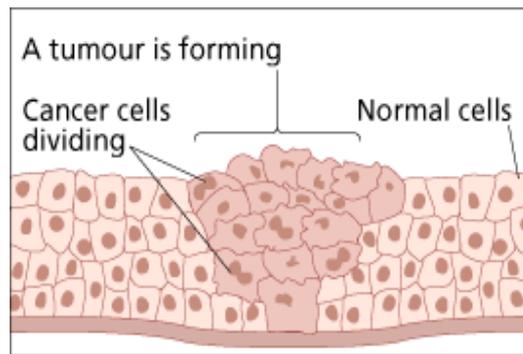
**Cytokinesis:**

- Means division of the cytoplasm
- Division of cell into two, identical halves called daughter cells
- In plant cells, cell plate forms at the equator to divide cell
- In animal cells, cleavage forms to split cell

**Cancer:**

**Uncontrolled Mitosis:**

- If mitosis is not controlled, unlimited cell division occurs causing cancerous tumors
- Cancer cells do not respond to the signals that regulate the growth of most cells.



- As a result, they form masses of cells called tumors that can damage surrounding tissues.

### Some tumors are:

- Benign tumors do not spread from their site of origin, but can crowd out (squash) surrounding cells e.g. brain tumour, warts.
- Malignant tumors can spread from the original site and cause secondary tumours. This is called metastasis. They interfere with neighbouring cells and can block blood vessels, the gut, glands, lungs etc.

### Causes:

- Cancer arises from the mutation of a normal gene.
- Mutated genes that cause cancer are called oncogenes.
- A factor which brings about a mutation is called a mutagen.
- A mutagen is mutagenic.
- Any agent that causes cancer is called a carcinogen and is described as carcinogenic.

### Carcinogens:

- Ionising radiation – X Rays, UV light
- Chemicals – tar from cigarettes
- Virus infection – *papilloma* virus can be responsible for cervical cancer.
- Hereditary predisposition – Some families are more susceptible to getting certain cancers. Remember you can't inherit cancer it's just that you maybe more susceptible to getting it.

### Treatment of Cancer:

- Surgery
  - Radiation
  - Chemotherapy
- Radiation and chemotherapy are aimed at killing actively dividing cells, but killing all dividing cells is lethal: you must make new blood cells, skin cells, etc. So treatment must be carefully balanced to avoid killing the patient.
  - Chemotherapy also has the problem of natural selection within the tumor. If any of the tumor cells are resistant to the chemical, they will survive and multiply. The cancer seems to have disappeared, but it comes back a few

years later in a form that is resistant to chemotherapy. Using multiple drugs can decrease the risk of relapse: it's hard for a cell to develop resistance to several drugs at the same time.

### X-AMPLE QUESTIONS

1. Describe the importance of mitosis
2. Name the phase depicted in the following diagrams:

