Cell Division

Syllabus -- Objectives (OL)

- Explain the terms: cell continuity & chromosomes.
- Define the terms: haploid & diploid number.
- Describe the cell activities in he state of non-division: Interphase and Division (mitosis).
- Define the term: mitosis.
- Explain the process in simple terms with some diagrams.
- Define cancer and state causes.
- State the primary function of mitosis for single-celled vs multi-cell. Organisms.
- Define the term: meiosis.
- State the functions of meiosis.

Cell Continuity

- Def: Cell continuity means that all cells develop from pre-existing cells

  - 3 steps to form a new cell

    1. Produce materials it will need
    2. Grow larger
    3. Reproduce to form a new cell

Chromosomes

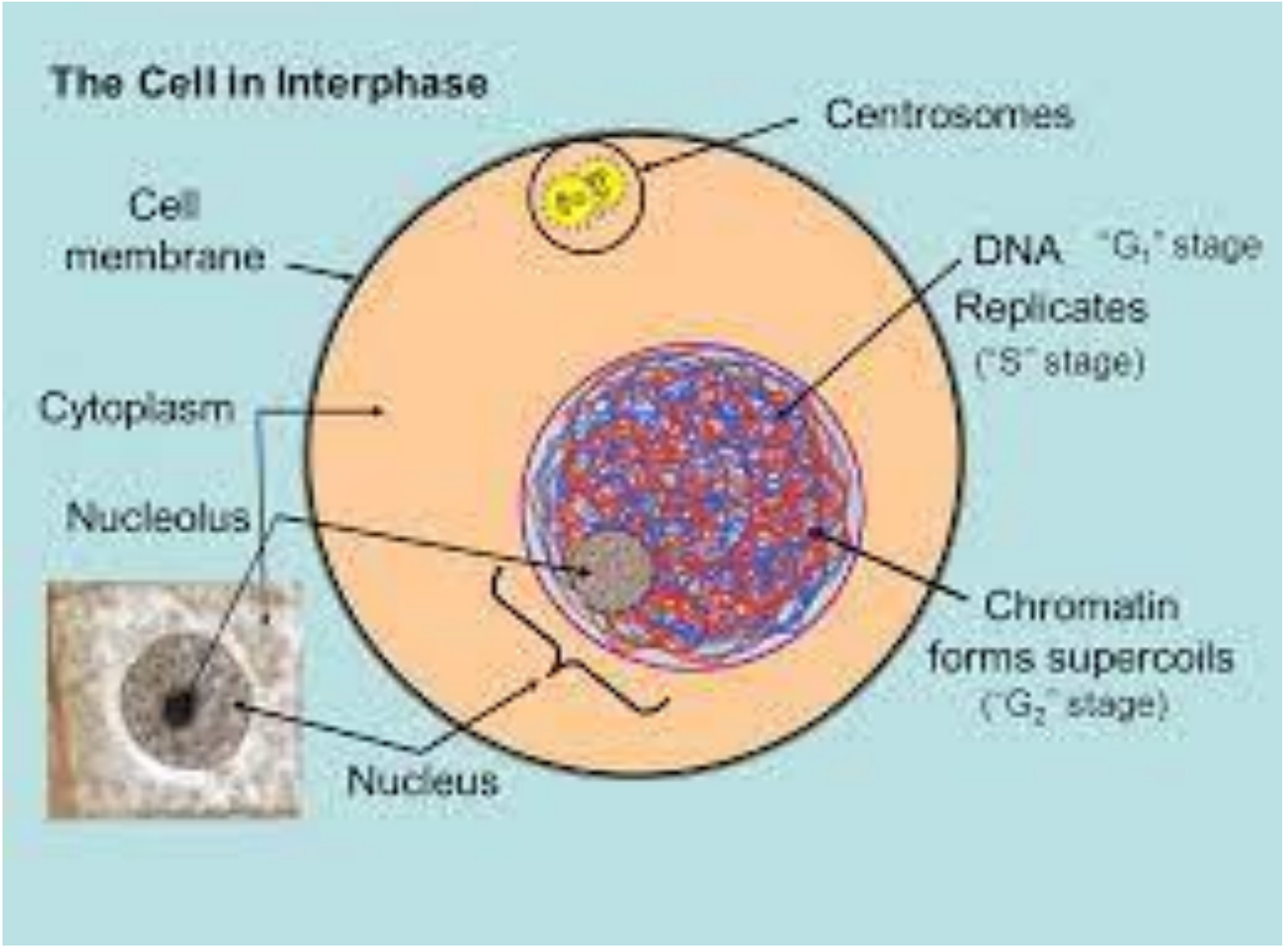
- Def: Chromosomes are structures in the Nucleus, made of DNA & Protein

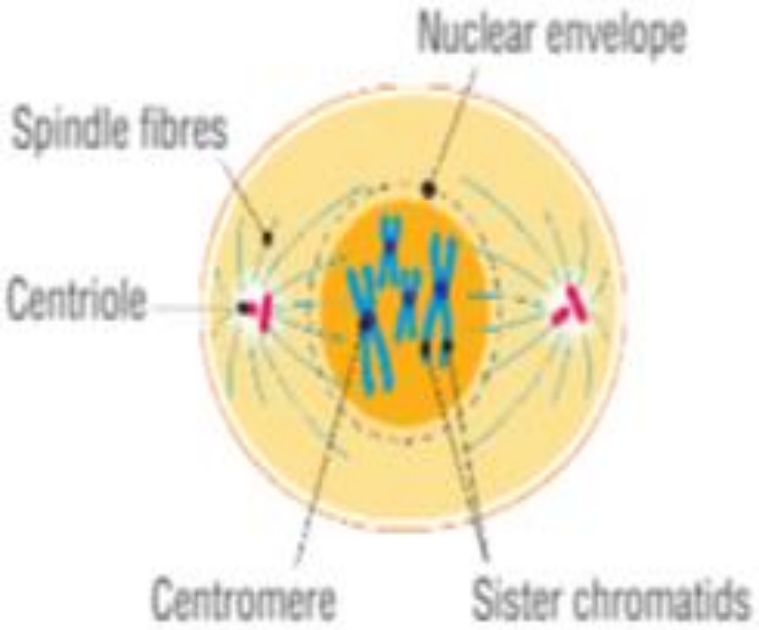
- Not dividing = Chromatin (long thin threads)

- When dividing = Chromatin forms a numbers of clearly distinguishable Chromosomes

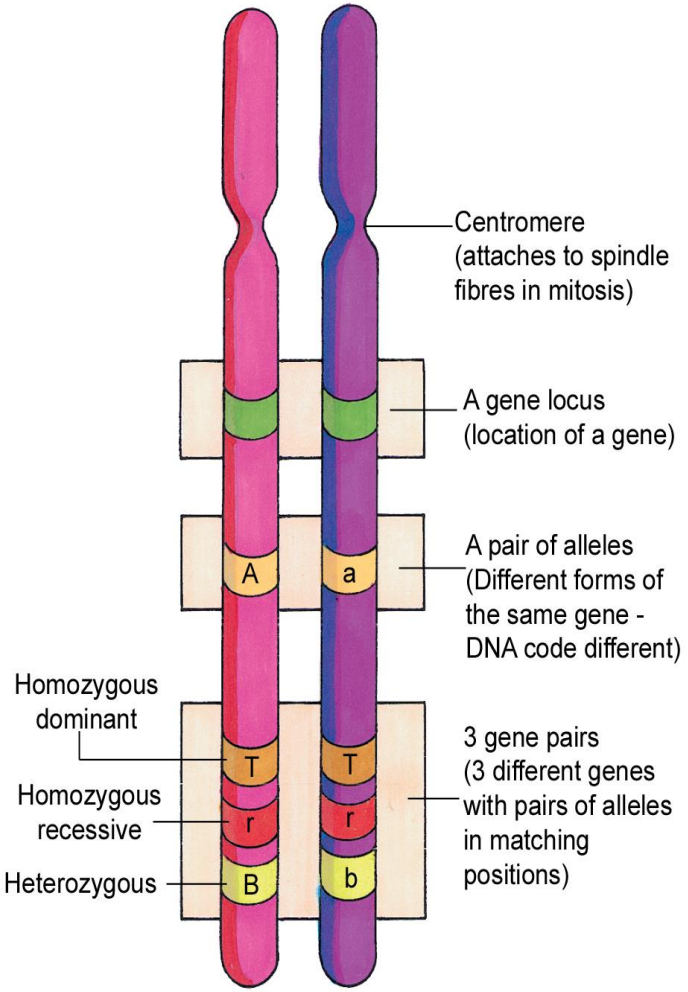
- Each species has a definite no. of Chromosomes, Humans= 46 chromosomes

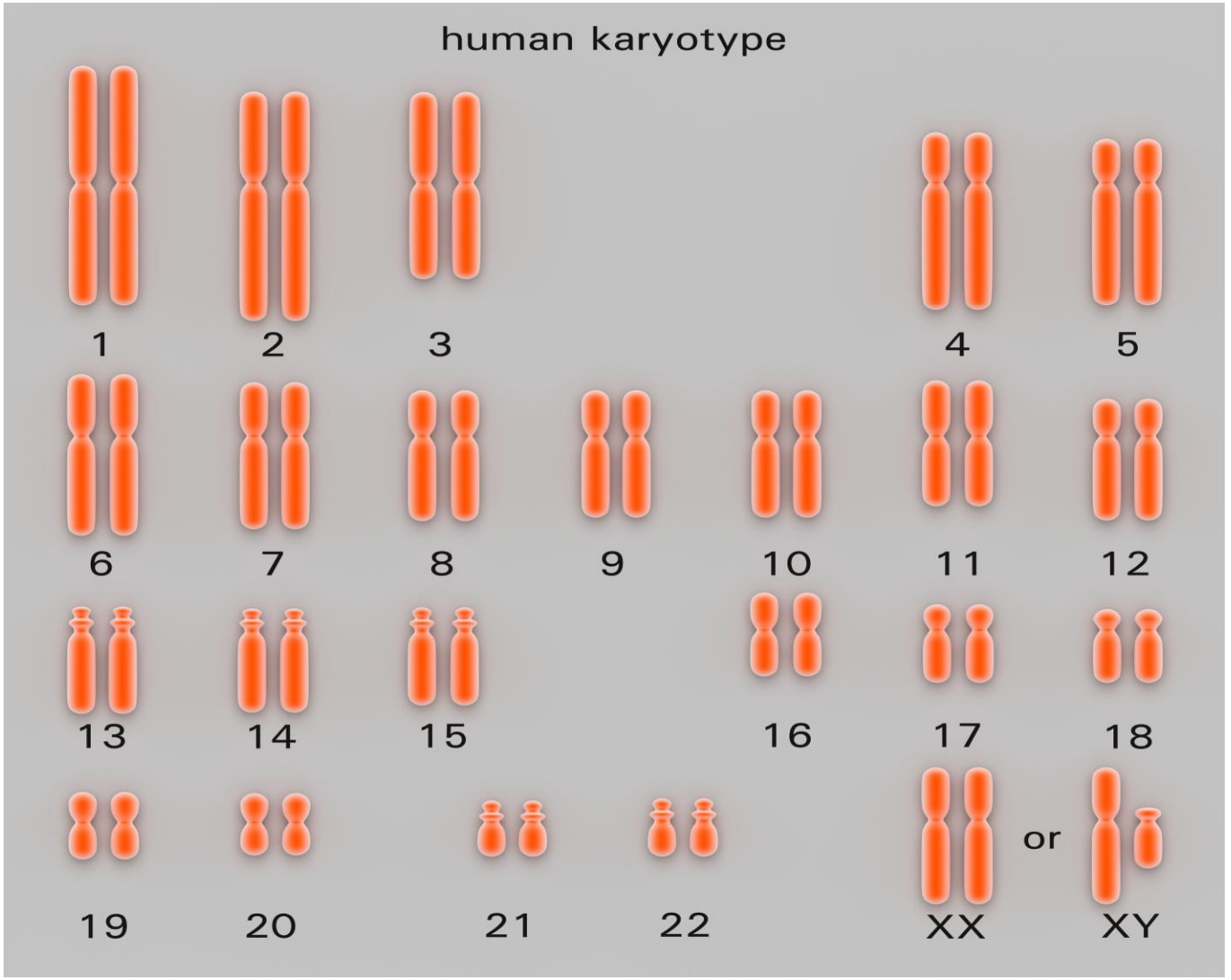
- Each Chromosome has 1000s of genes (Check out human genome project) Each cell in the human body contains about 25,000 to 35,000 genes.


The Cell in Interphase
Centrosomes
Cell membrane
DNA Replicates ("S" stage)
"G1" stage
Cytoplasm
Nucleolus
Chromatin forms supercoils ("G2" stage)
Nucleus



A PAIR OF HOMOLOGOUS CHROMOSOMES




human karyotype
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
XX
or
XY

Learning Check

- What does cell continuity mean?
- What 3 stages are involved in cell continuity?
- What is a chromosome?
- When chromosomes are not dividing what are they known as?
- How many chromosomes are found in a typical human cell?

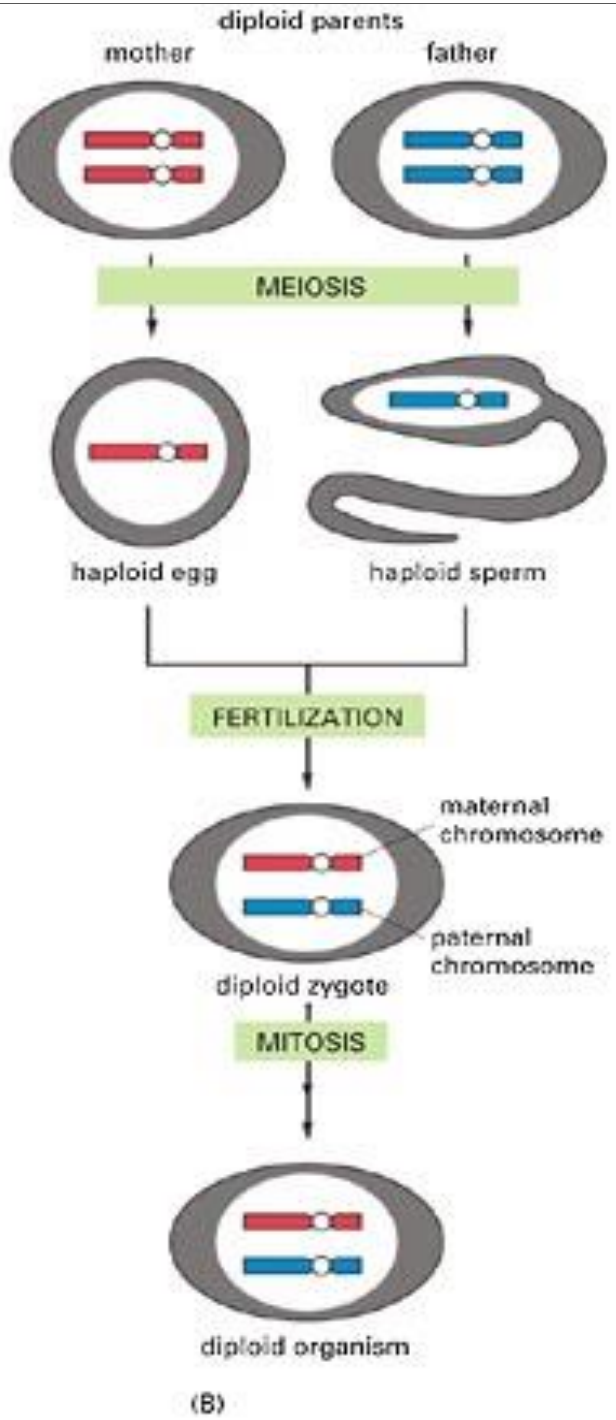
Haploid

Def: A Haploid cell has only one of each type of chromosomes, ie has only one set of each type of chromosomes in the nucleus.

Haploid is symbolised by letter 'n' and number of chromosomes in the cell is given as n=23

In humans, eggs and sperm are haploid n=23


diploid parents
MEIOSIS
haploid egg
haploid sperm
FERTILIZATION
diploid zygote
MITOSIS
diploid organism
(A)


diploid parents
mother
father
MEIOSIS
haploid egg
haploid sperm
FERTILIZATION
maternal chromosome
paternal chromosome
diploid zygote
MITOSIS
diploid organism
(B)

Diploid

Def: A diploid cell has two of each type of chromosome in the nucleus (two sets of each type of chromosomes

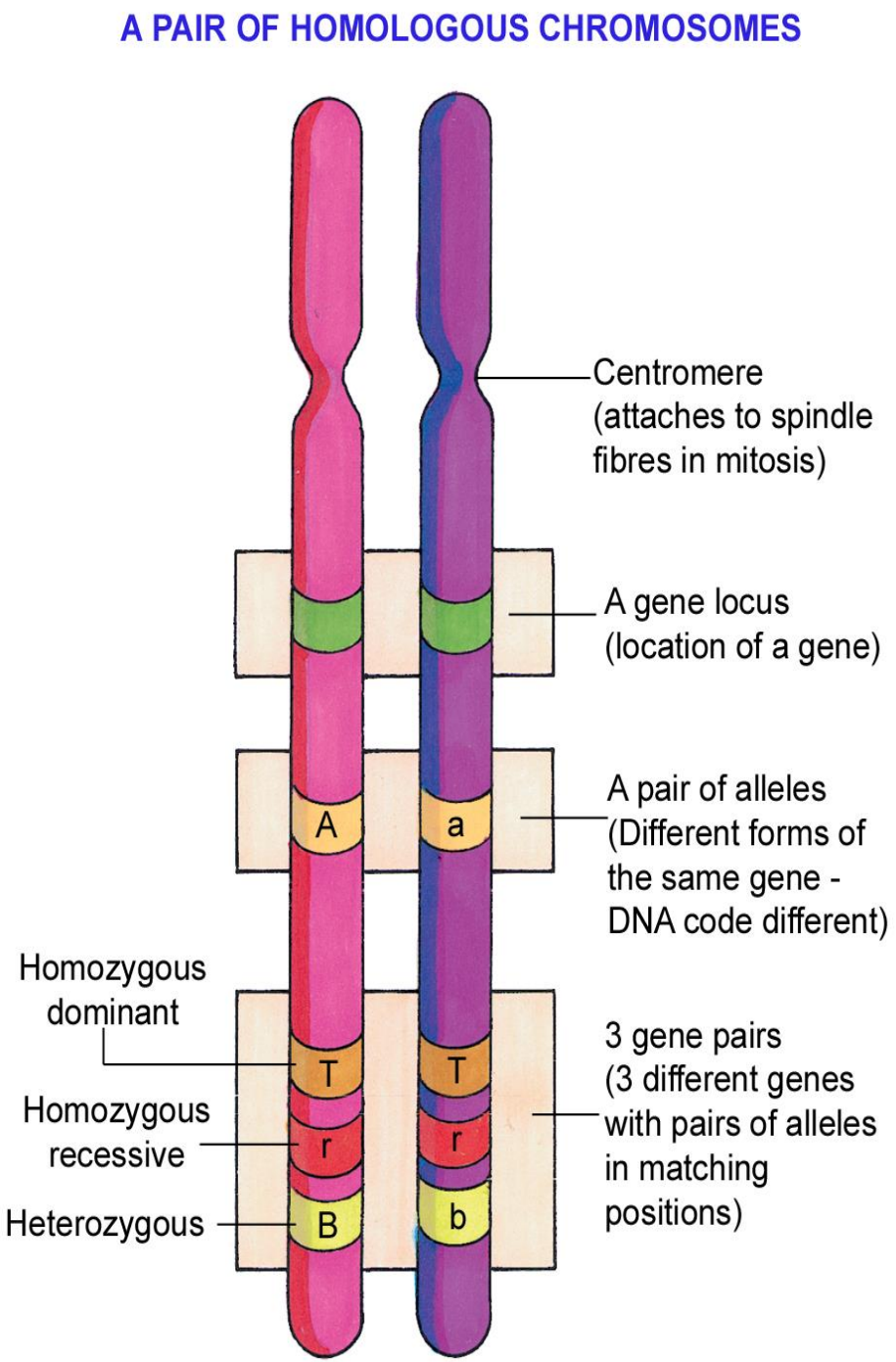
- Chromosomes are in pairs in diploid cell, called homologous pairs.

- Diploid is symbolised as '2n' and total no. of chromosomes in cell is given as 2n=46. This means there are 23 pairs of chromosomes

Somatic Cells

- Somatic cells are normal body cells of an adavanced organism and contain two sets of chromosomes (not sex cells)

- **In diploid cells, 1 chromosome from the homologous pair comes from the mother and the other comes from the father.**



Learning Check

- What is meant by haploid?
- What is meant by diploid?
- How many chromosomes does a haploid human cell have?
- What is the correct way to write this?
- How many chromosomes does a human diploid cell have?
- What is the correct way of writing this?
- If a cell has a diploid number 2n=6 what is its haploid number?

Cell Cycle

- Describes the life of a cell. It includes the period between division when the cell is not dividing, called Interphase

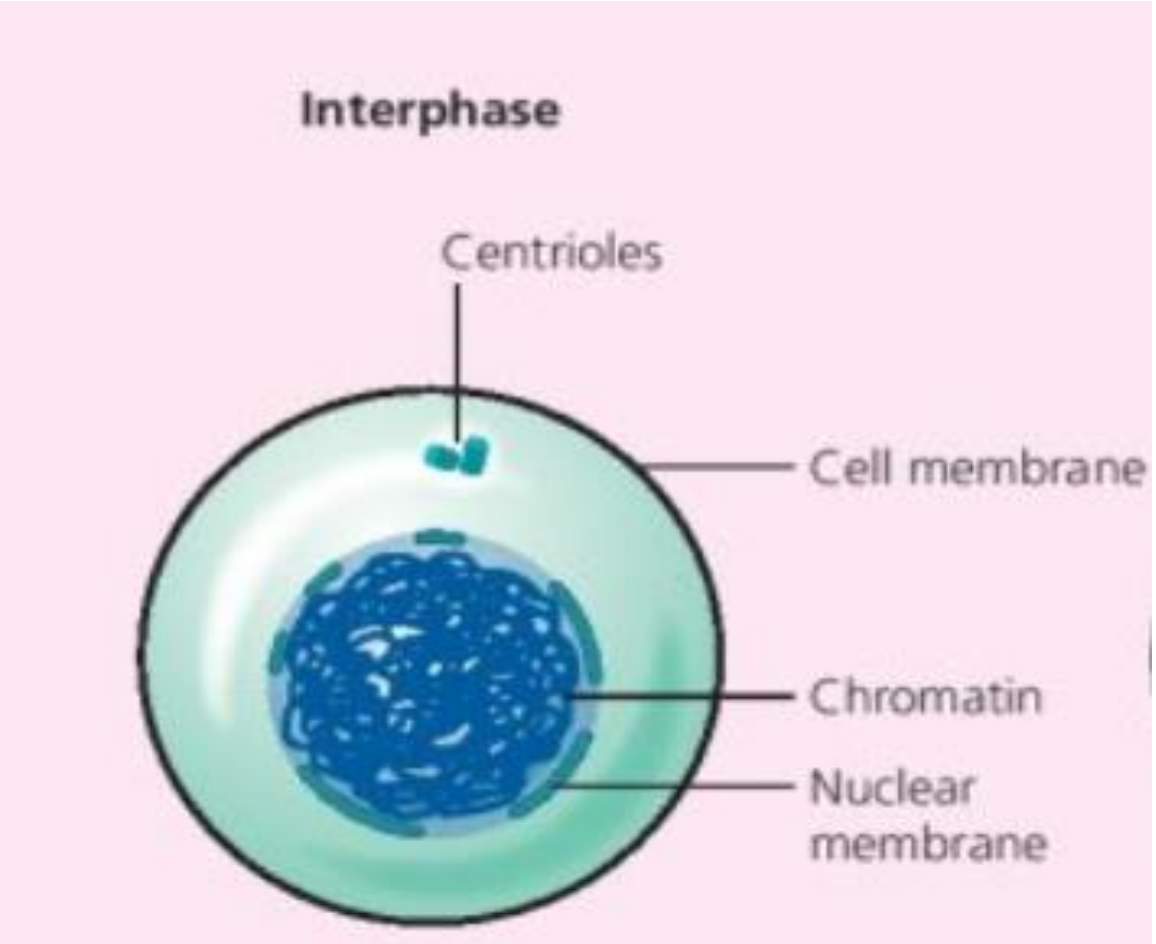
- Period when a cell divides = Mitosis

11.3 The cell cycle

Interphase

- Longest phase in cell cycle = 90% of a cells life is in interphase
- Chromosomes elongated = chromatin
- Cell very active in Interphase, produces new mitochondria, chloroplasts etc. and chemicals needed for growth.

Copy Diagram of Interphase from pg 121 of textbook



Mitosis

- **Def: Mitosis is a form of nuclear division in which one nucleus divides to form two nuclei, each containing identical sets of chromosomes.**

- Two new cells called daughter cells and they are IDENTICAL to each other.

Learning Check

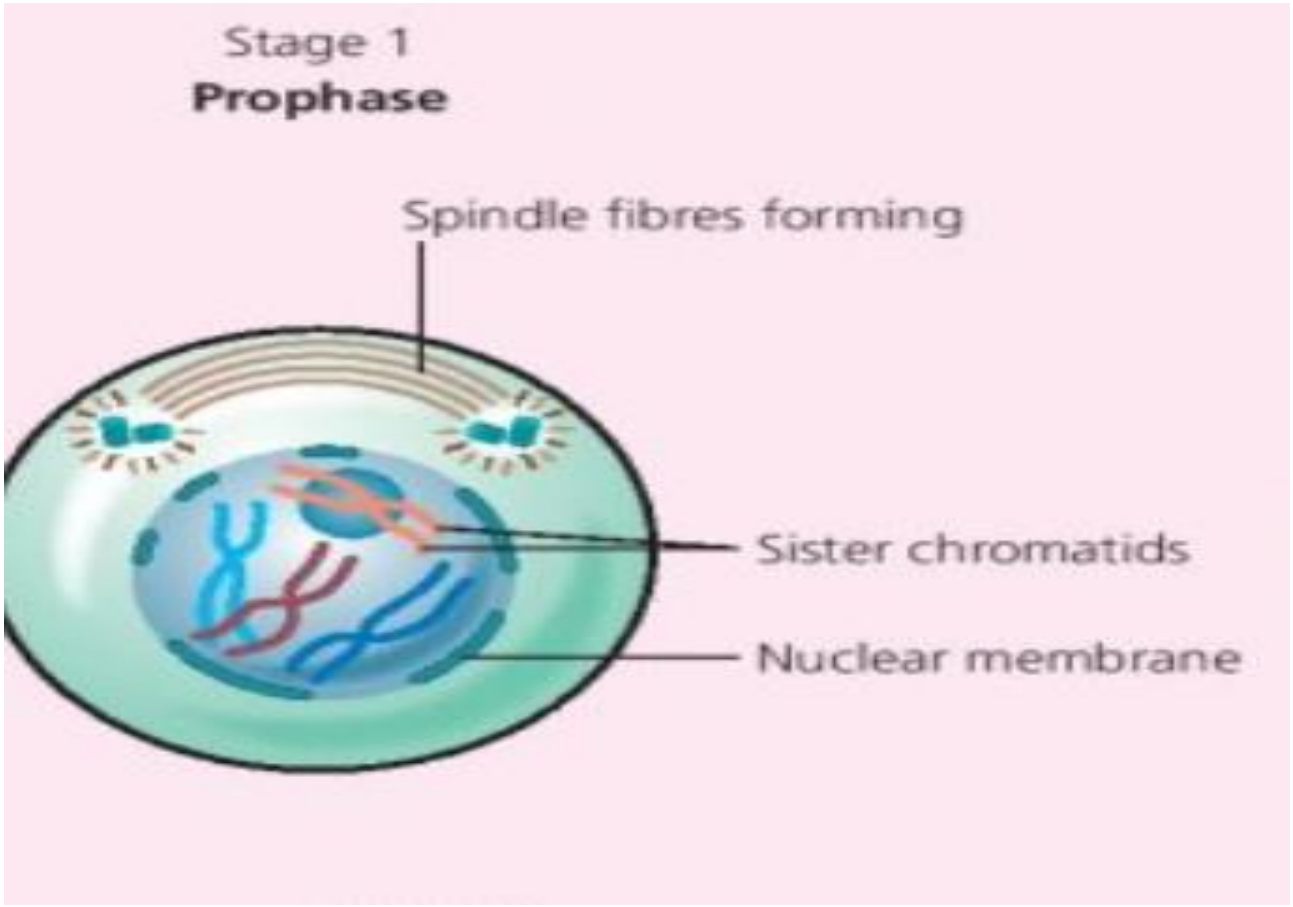
- How many stages are there in the cell cycle?
- What part of the cell cycle does the cell spend most of its time in?
- What happens in this stage?
- What is the stage when the cell is actually dividing called?
- What kind of cells are produced by mitosis?

Stages of Mitosis (4 in total)

Stage 1 Prophase (HL)

- At end of Interphase, Chromosomes contract and become visible.
- Each chromosome appears as a duplicated strand.
- Fibres appear in cytoplasm
- Nuclear membrane starts to break down.

Copy Diagram of Prophase (Stage 1)from pg 121 of textbook

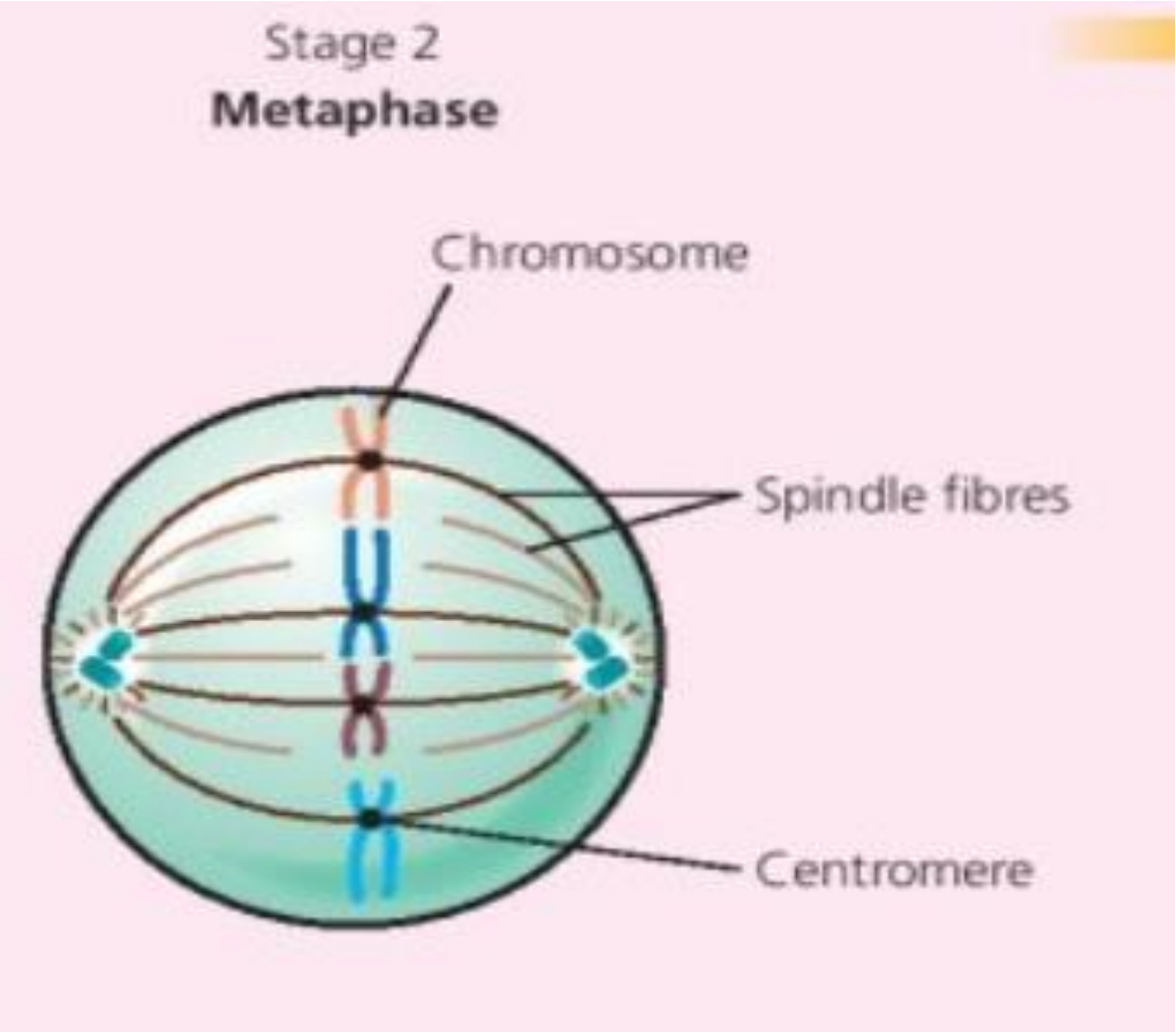


Stages of Mitosis

Stage 2 Metaphase (HL)

- Nuclear membrane broken down
- Chromosomes thicken even more
- Chromosomes line up across the centre of cell along equatorial plate
- Fibres produced by centrioles attach to chromosomes
- Each chromosome has 2 fibres attached, 1 from each side of the cell.

Copy Diagram of Metaphase (Stage 2) from pg 121 of textbook

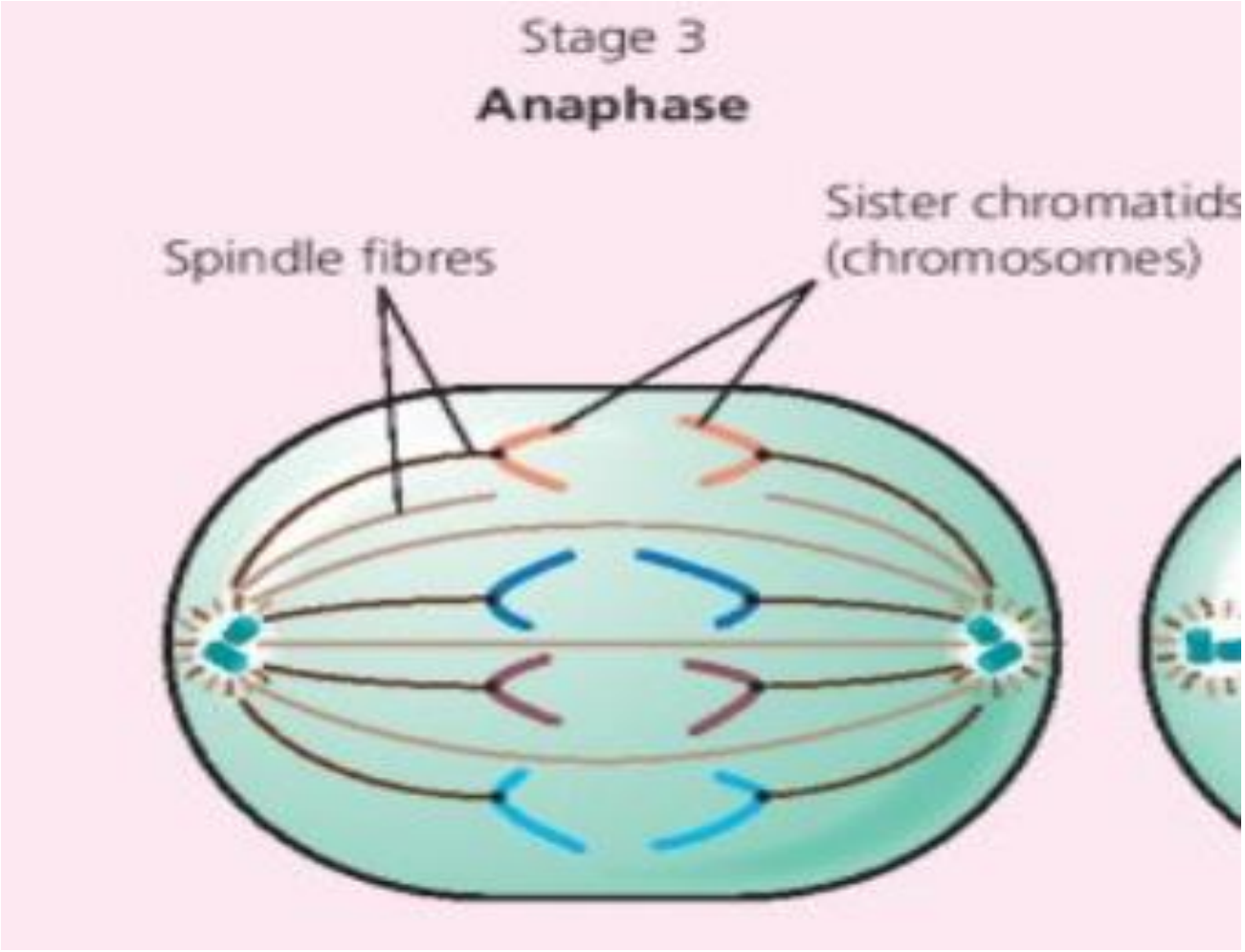


Stages of Mitosis

Stage 3 Anaphase (HL)

- Fibres contract, chromosomes pulled apart
- Each strand of chromosome is pulled to opposite end of cell .
- Hence, identical set of genes pulled to each end of the cell.
- (Look for V shape to recognize this stage)

Copy Diagram of Anaphase (Stage 3) from pg 121 of textbook



Stages of Mitosis

Stage 4 Telophase (HL)

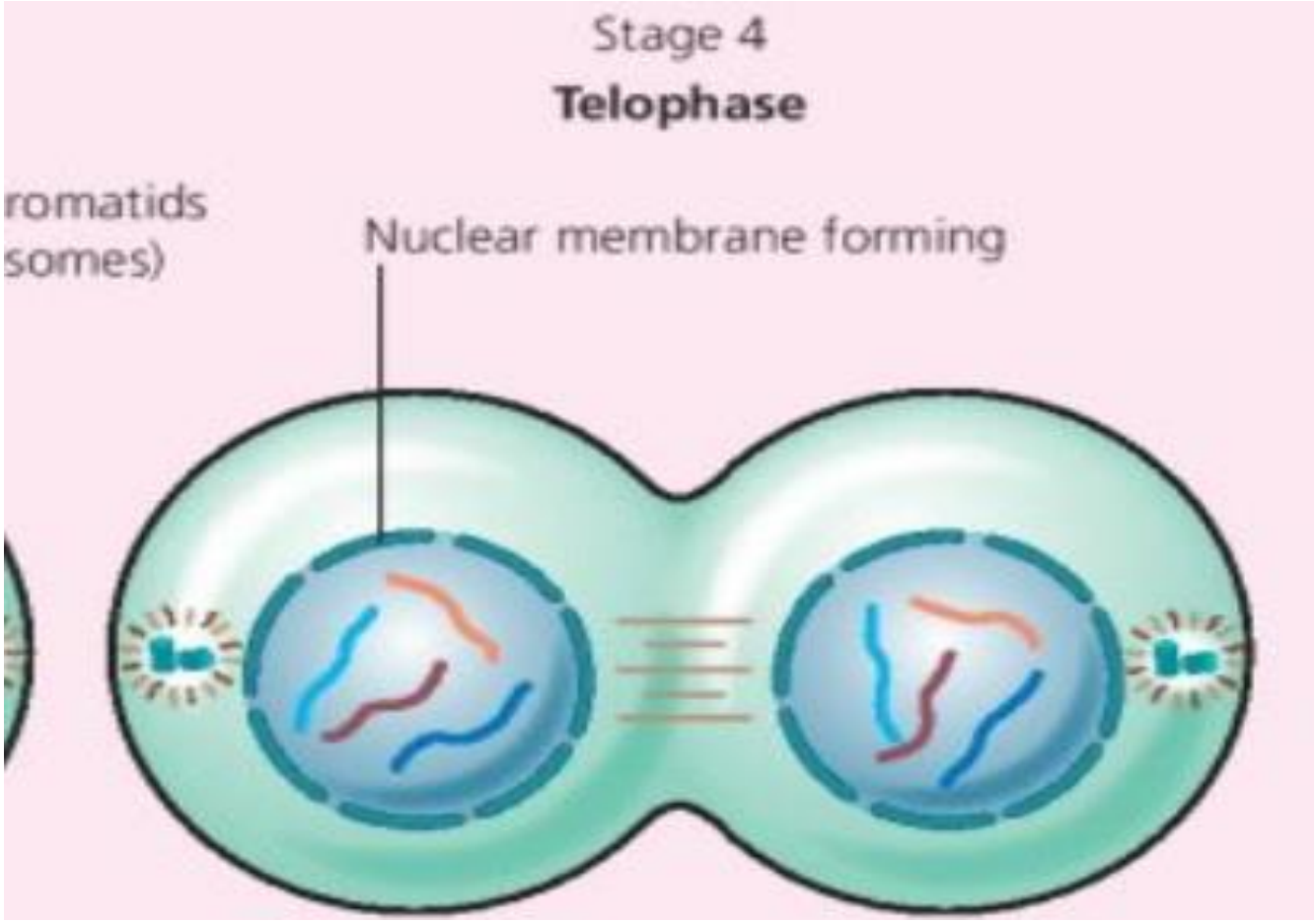
- Nuclear membrane forms around each of the 2 sets of chromosomes
- Chromosomes elongate within each nucleus

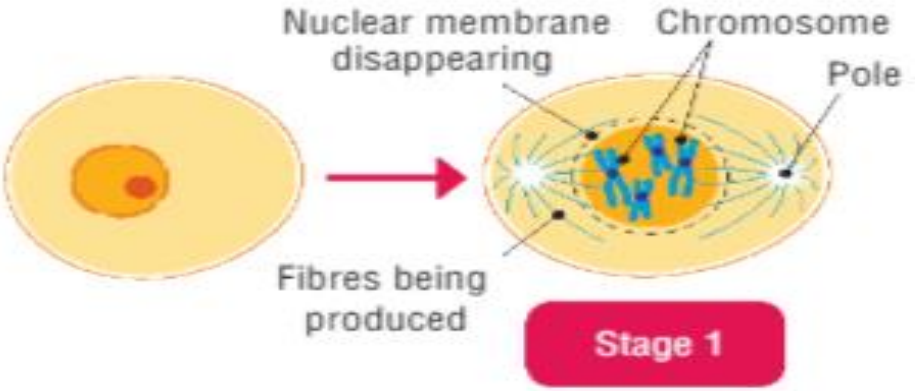
Mitosis is complete

Once complete, original cell divides to form 2 cells

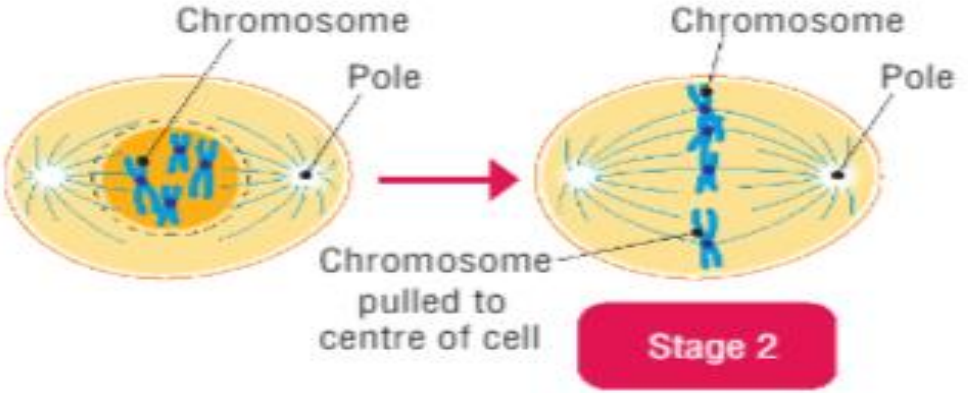
In reality there are 5 stages –see Pg 123 Cytokinesis

Copy Diagram of Telophase (Stage 3)from pg 121 of textbook

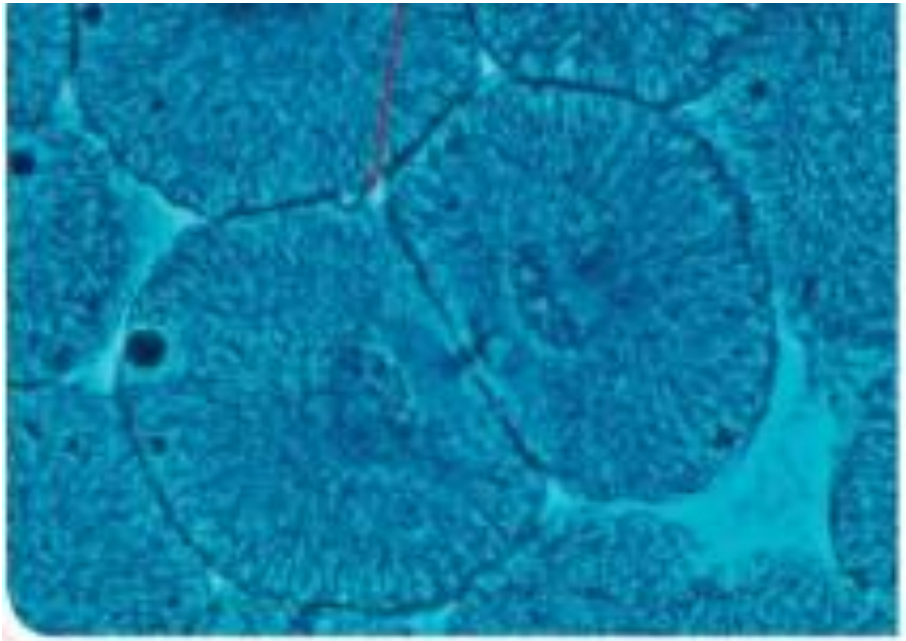




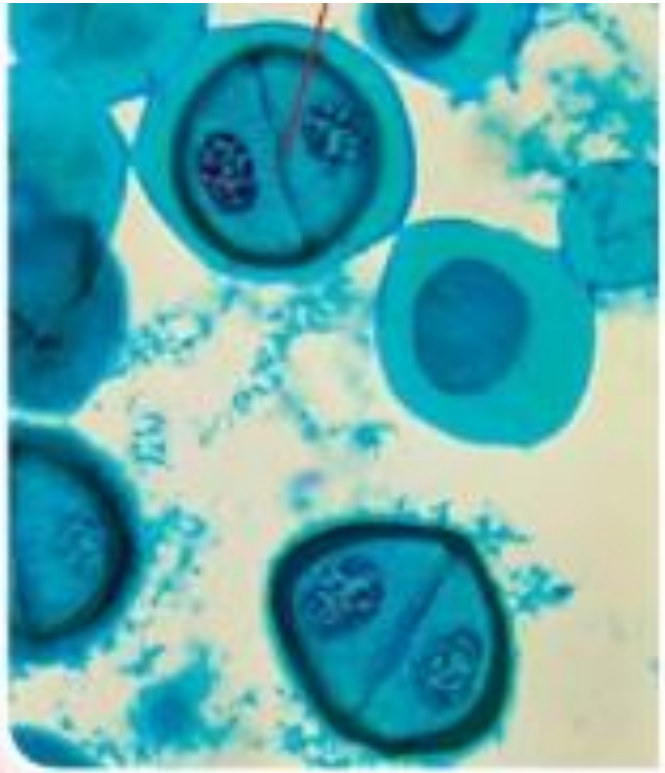
11.5 Stage 1 of mitosis



11.6 Stage 2 of mitosis

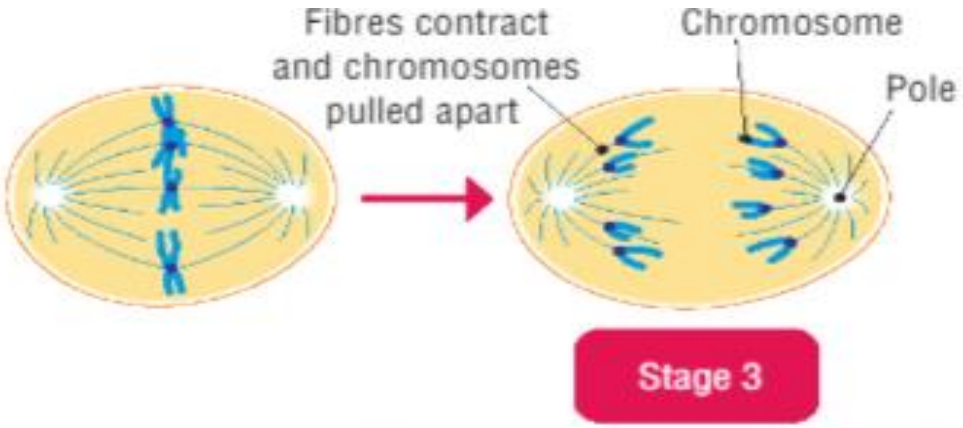


11.10 *Animal cell: whitefish cells in cytokinesis, showing cleavage furrow*



11.11 *Plant cell: lily cells showing cell plate*

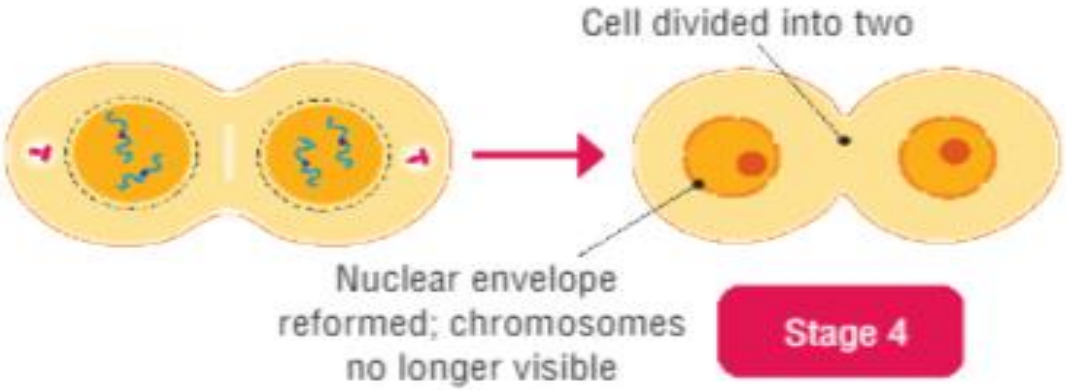
s produced by Golgi apparatus and containing
ne and form a **cell plate** between two nuclei.



of

11.7 Stage 3 of mitosis

l



11.8 Stage 4 of mitosis

Learning check

- How many stages are there in mitosis?
- What happens in each stage 1?
- What happens in each stage 2?
- What happens in each stage 3?
- What happens in each stage 4?

Functions of Mitosis

In Unicellular Organisms

- Method of reproduction for *Amoeba* Reproduction that does not involve the joining of 2 cells is called Asexual reproduction.

In Multicellular Organisms

- Produces new cells, not new individuals
- Responsible for growth & renewal and repair of cells

Learning Check

- What is the function of mitosis in multicellular organisms?
- What is the function of mitosis in unicellular organisms?

Cancer

- Rate of cell division (mitosis) is carefully controlled.
- Sometimes a cell or group of cells lose the ability to control the rate of cell division.
- They form a mass of cells called a tumour which can be benign or malignant.

Cancer

Benign tumours

- Benign means kind, they are not life threatening and do not invade other tissues. Eg warts, skin tags.
- Cells stop dividing after some time

Def: Cancer occurs when certain cells lose their ability to control the rate of mitosis

Cancer

Malignant tumours

- Uncontrolled multiplication of abnormal cells
- Malignant tumours (cancers) invade other cells and move around the body
- Movement of these cells called Metastasis.
- Cancer cells divide indefinitely.

Causes of Cancer

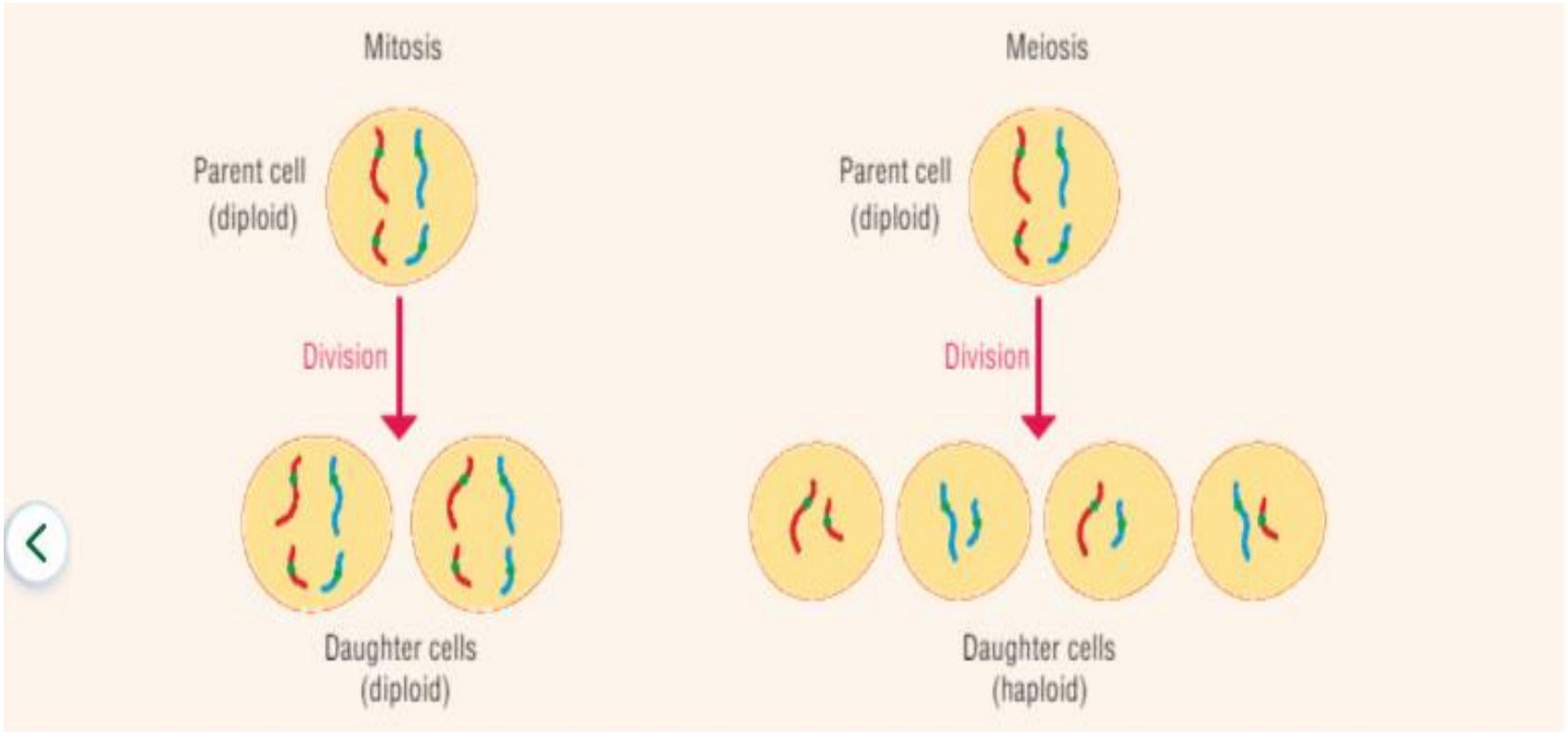
Caused when normal genes are altered to form cancer-causing genes called oncogenes

Brought about by cancer causing agents called carcinogens
eg 1.cigarette smoke,2.asbestos fibres 3. ultraviolet radiation and some viruses

- Most cancers can be cured with Radiation (burn out cancer), Chemotherapy (Chemicals slow down mitosis) and surgery

Learning Check

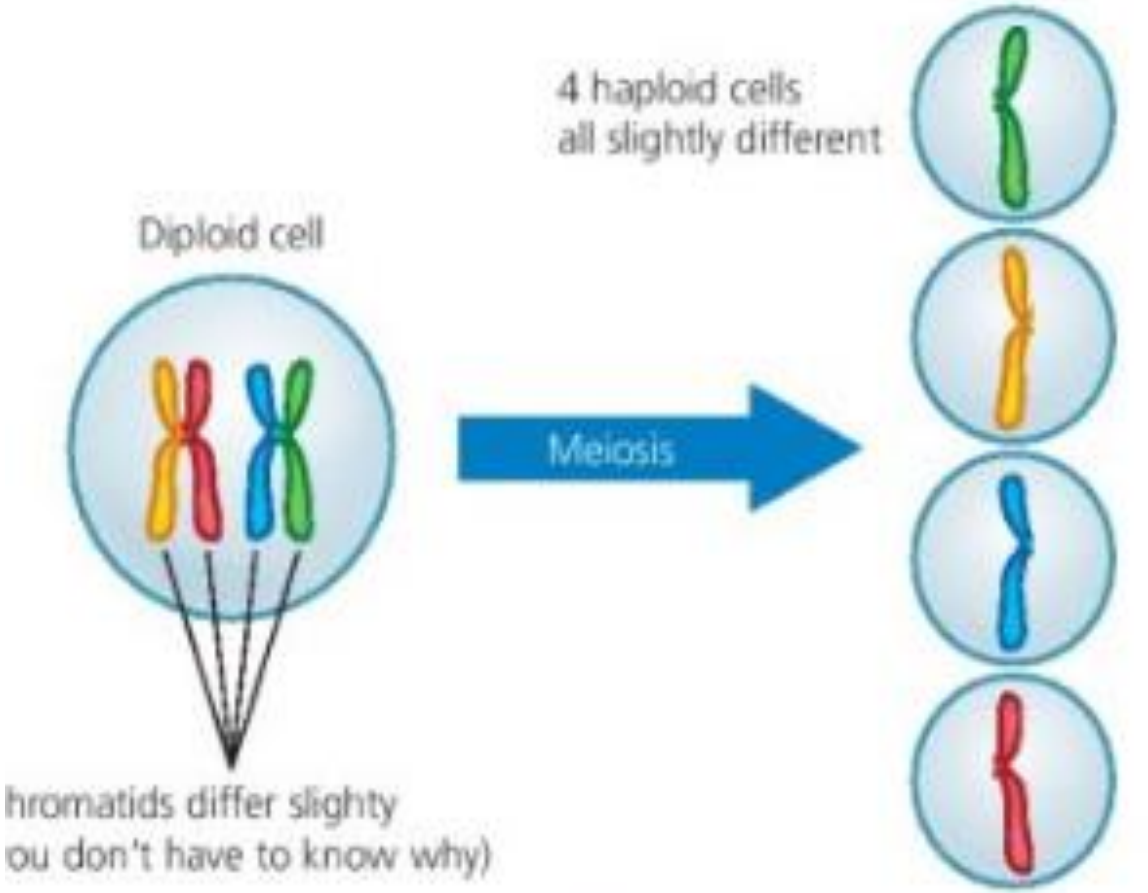
- How do tumours form?
- What is the difference between benign and malignant tumours?
- When cancer cells spread it is called m……?
- Can you name 3 possible causes of cancer?



11.4 The different types of cells produced by meiosis and mitosis

Meiosis

- Def –Meiosis- Is a form of nuclear division in which the daughter nuclei contain half the chromosome number of the parent nucleus.



11.12 *End results of meiosis*

ey fuse to form a

Meiosis

- Human cells have 46 chromosomes

- Meiosis occurs in the ovaries and testes to produce **gametes** called eggs and sperm so there are 23 chromosomes in each egg and sperm

Functions of Meiosis

2 functions in Multicellular Organisms

- Allows sexual reproduction without increasing the number of chromosomes in the offspring

- Allows new combinations of genes

Learning Check

- What is meiosis?
- How does meiosis differ to mitosis?
- What is the function of meiosis?
- What parts of a human would you expect meiosis to occur in?

Mitosis	Meiosis
Produces two daughter cells	Produces four cells
The daughter cells have the same number of chromosomes as the parent	The daughter cells have half the number of chromosomes as the parent
The daughter cells are genetically identical	The daughter cells are genetically different

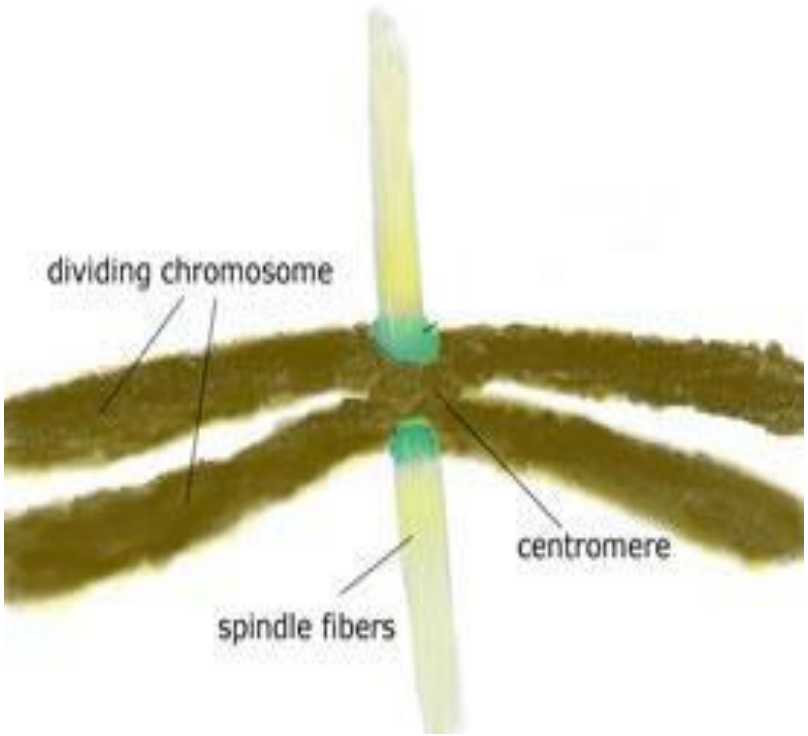
Table 11.1 Differences between mitosis and meiosis

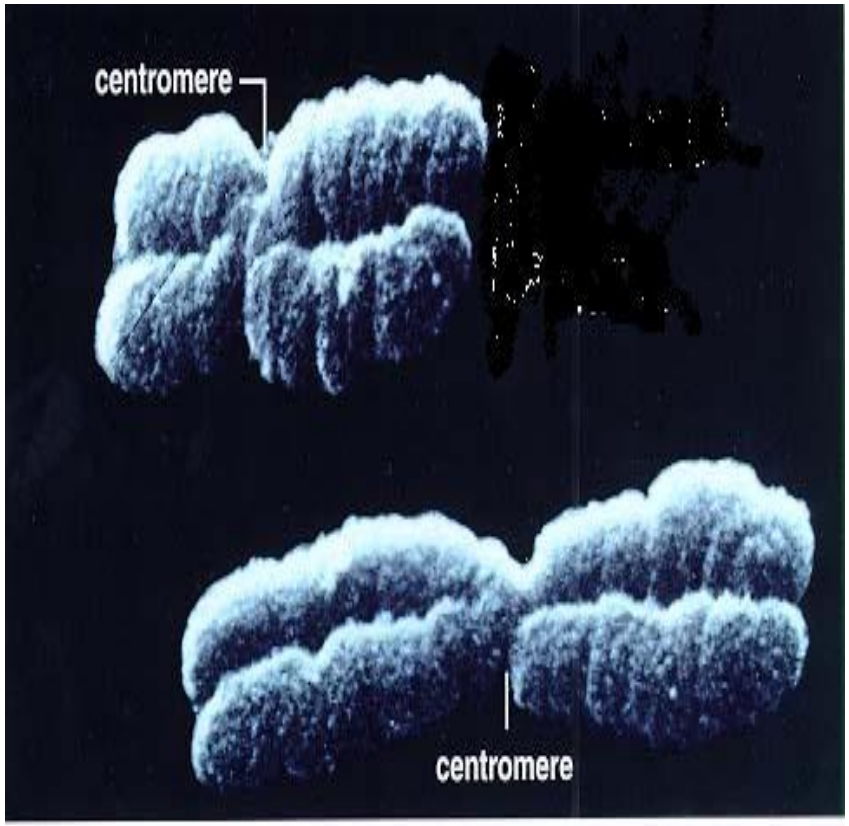
Higher Level

A sentence to help you remember the 4 stages of mitosis (HL)

- **I Party Monday And Tuesday**

Parts of the chromosome involved in mitosis





Learning Check

- What are the 4 stages of mitosis called
- Can you illustrate with diagrams what happens at each stage?
- To what part of the chromosome do spindle fibres attach?