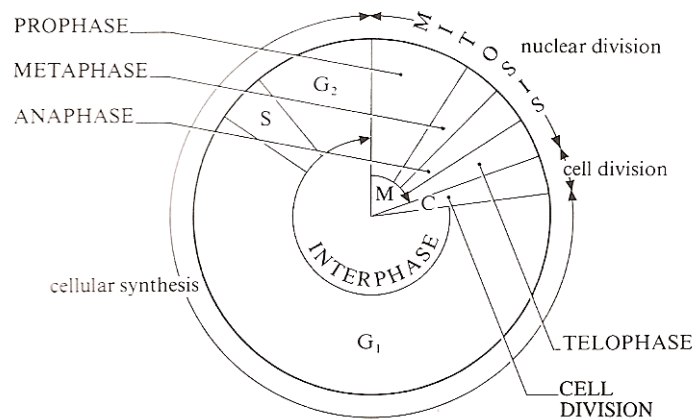


D2.1 Cell and nuclear division

New cells are produced by division of existing cells. Cell division involves:

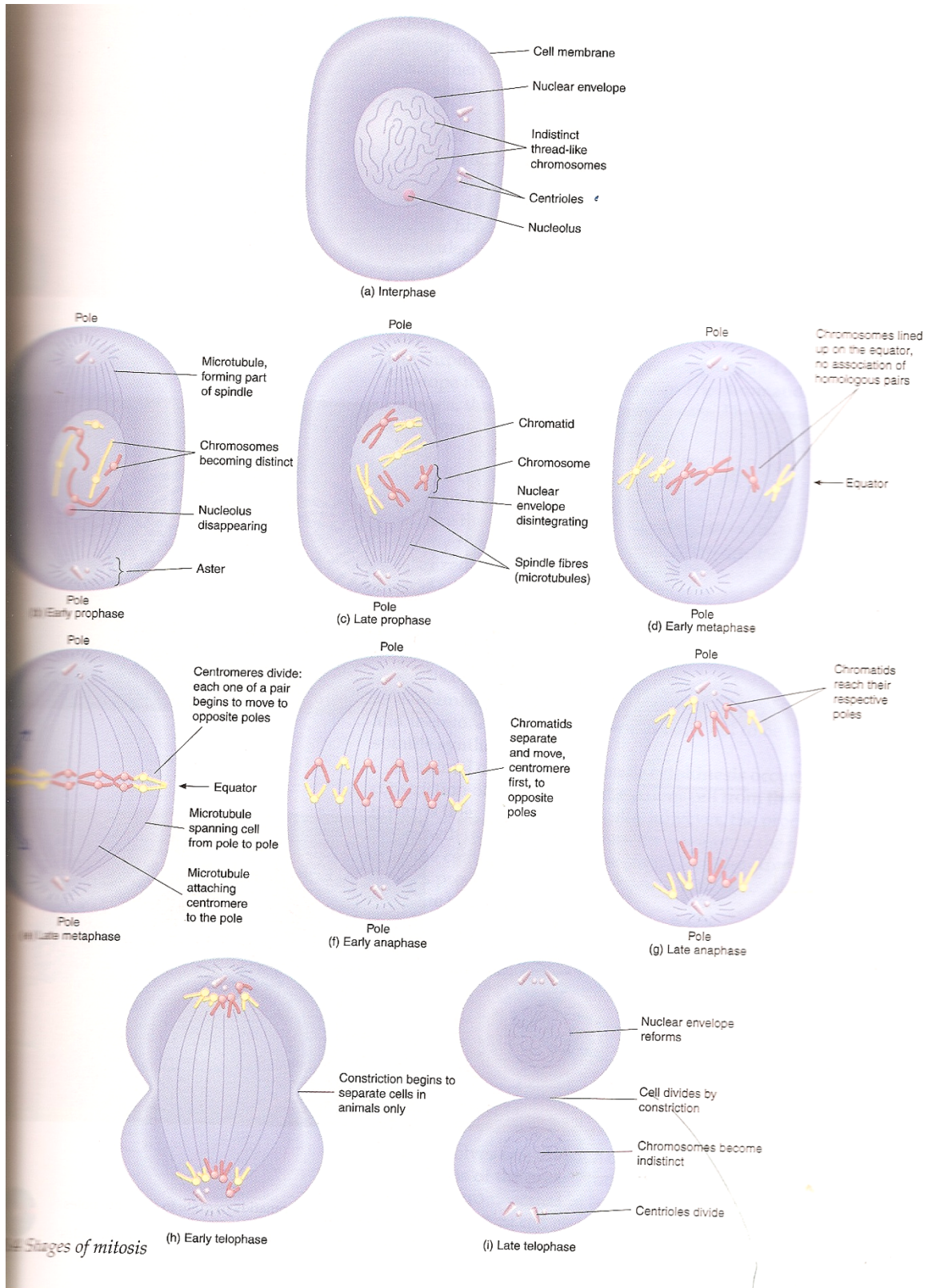
- Interphase
- Mitosis
- Cytokinesis (equal or unequal)



<i>Phase</i>	<i>Events within cell</i>
G ₁	Intensive cellular synthesis. Mitochondria, chloroplasts (in plants), ER, lysosomes, Golgi apparatus, vacuoles and vesicles produced. Nucleolus produces rRNA. mRNA and tRNA and ribosomes are synthesised. Cell produces structural and functional proteins. Cell metabolic rate high and controlled by enzymes. Cell growth occurs. Substances produced to inhibit or stimulate onset of next phase.
S	DNA replication occurs. Protein molecules called histones are synthesised and cover each DNA strand. Each chromosome has become two chromatids.
G ₂	Intensive cellular synthesis. Mitochondria and chloroplasts divide. Energy stores increase. Mitotic spindle begins to form.
M	Nuclear division occurs in four phases.
C	Equal distribution of organelles and cytoplasm into each daughter cell.

Interphase, the longest phase of the cycle, is an active period in the life of a cell when many metabolic reactions occur, including protein synthesis, DNA replication and transcription, cell growth and increase in mitochondria and/or chloroplasts.

Mitosis:



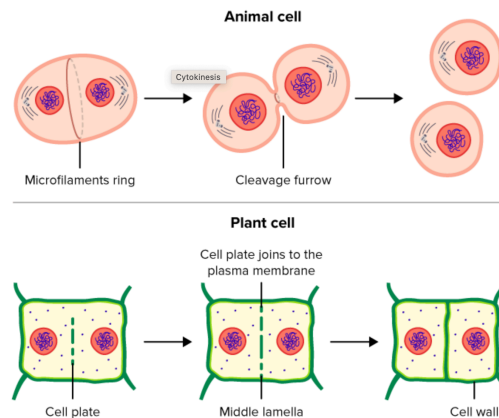
Microtubules

Structures (hollow cylinders) that chromosomes use in order to move

Kinetochores motor proteins

They assemble on the chromosome centromeres and link to the growing microtubules

Equal Cytokinesis (In plant and animal cells)



Unequal Cytokinesis:

The cytoplasm divides unequally in oogenesis during sexual reproduction and in yeast cells during asexual reproduction (budding).

Mitosis – cell division is needed for:

- Growth
- Embryonic development
- Tissue repair when damaged
- Asexual reproduction

→ **Mitosis** is nuclear division resulting in continuity of the chromosome number and genome.

→ **Meiosis** is nuclear division that results in reduction of the chromosome number and diversity between genomes.

Cause and consequence of anucleate cells:

These cells cannot synthesize proteins, nor grow or maintain themselves (eg erythrocytes)

Higher Level

Cell proliferation:

The rapid increase in the number of cells. In animals, growth plates near the end of bones are active in childhood, with cell divisions contributing to bone growth. Another example is tissue repair to replace damaged cells. In plants, cell proliferation is confined to regions called meristems found at the tips of stems and roots.

Cyclins:

They are proteins (accidentally discovered) involved in the control of the cell cycle. They ensure that tasks are performed at the correct time and that the cell only moves on to the next stage of the cycle when it is appropriate.

Tumour (cancer) formation:

Uncontrolled cell division causes tumours that can occur in any organ or tissue.

Mutagens:

→ **Chemicals**, Nitrosamines in tobacco, mustard gas used as a chemical weapon, the solvent benzene.

→ **High energy radiation**, X-rays, short or medium wave UV, gamma rays, and alpha particles from radioactive isotopes.

In the nuclear accident at Chernobyl (1986) and the nuclear bombing of Hiroshima (1945), radioactive isotopes were released, exposing people to dangerous levels of radiation.

Proto-oncogenes are a few genes that can become cancer – causing after mutating and are involved in the development of primary tumours (**benign**). **Metastasis** is the movement of cells from a primary tumour to set up secondary tumours in other parts of the body (**malignant**).

Tumor suppressor genes prevent cell proliferation and function as brakes at checkpoints in the cell cycle to correct possible errors during DNA replication.

The mitotic index:

The mitotic index is the ratio between the number of cells in mitosis in a tissue and the total number of observed cells. It can be calculated using this equation:

Mitotic index = number of cells in mitosis / total number of cells

It is an important prognostic tool for predicting the response of cancer cells to chemotherapy.