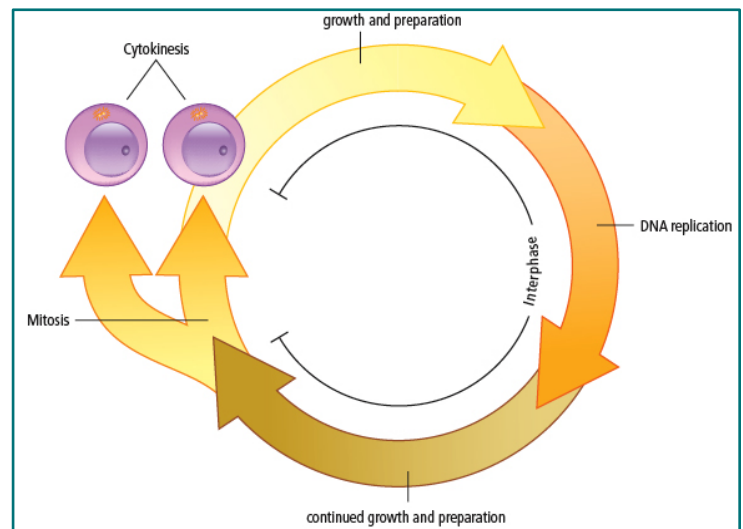


Chapter 5 - Mitosis is the basis of asexual reproduction.

5.1 The Cell Cycle and Mitosis

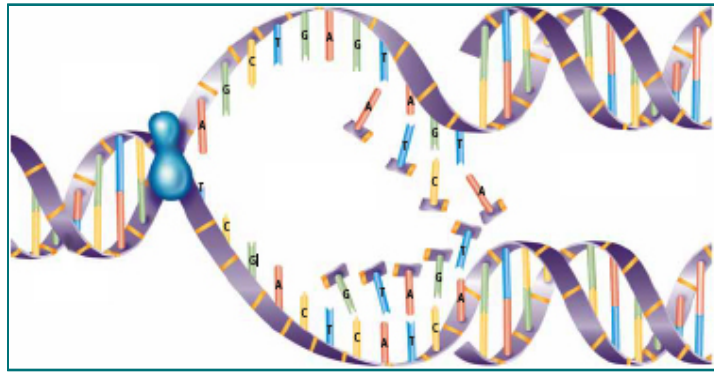
Stages of the Cell Cycle

- Due to the loss and death of cells, the body must replace them. A good example of this is human skin cells - each day millions are shed.
- The life of a cell is divided into three stages known as the cell cycle:
 - **Interphase:** cell carries out normal functions.
 - **Mitosis:** nucleus contents duplicated and divide into two equal parts.
 - **Cytokinesis:** separation of two nuclei and cell contents into two daughter cells.



Interphase

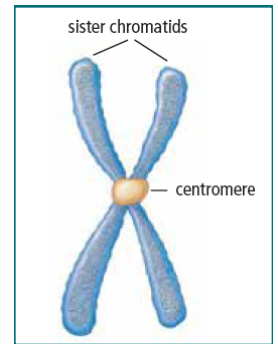
- Interphase, the longest cell cycle stage, is when a cell performs normal functions and grows. For example, an intestinal lining cell absorbing nutrients.
- In late interphase, DNA copies itself in the process of replication. Replication involves several steps:
 - The DNA molecule unwinds with the help of an enzyme.
 - New bases pair with the bases on the original DNA.
 - Two new identical DNA molecules are produced.



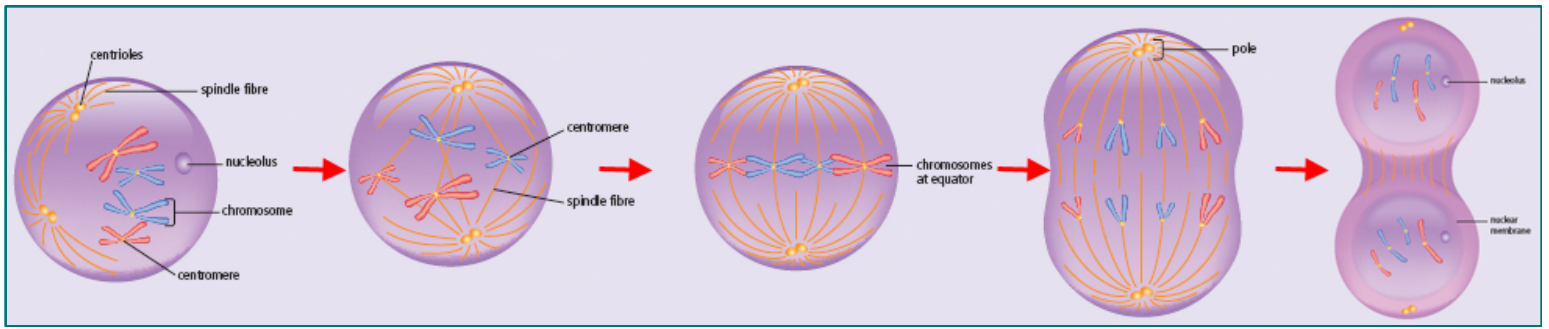
- At the end of interphase, the cell continues to grow and make proteins in preparation for mitosis and cytokinesis.

Mitosis

- Mitosis is the shortest stage of the cell cycle where the nuclear contents divide, and two daughter nuclei are formed. It occurs in 4 stages: Prophase, Metaphase, Anaphase and Telophase.
- As the nucleus prepares to divide, replicated DNA in interphase joins to form **sister chromatids**, joined by a **centromere**.



- **Early Prophase** - nucleolus disappears and spindle fibres form
- **Late Prophase (Prometaphase)** - spindle fibres attach to centromeres of chromosomes
- **Metaphase** - chromosomes align on equator of cell
- **Anaphase** - spindle fibres pull sister chromatids to opposite poles of cell
- **Telophase** - in this final stage, spindle fibres disappear and a nuclear membrane forms around each separated set of chromosomes.



Cytokinesis

- **Cytokinesis** is the separation of the nuclei into two daughter cells

Checkpoints in the Cell Cycle

- Checkpoints in the cell cycle will prevent division if:
 - If the cell is short of nutrients
 - If the DNA within the nucleus has not been replicated
 - If the DNA is damaged
- Mutations in genes involving checkpoints can result in an out-of-control cell cycle. The result can be uncontrolled cell division: **cancer**.
 - Cancer cells have large, abnormal nuclei
 - Cancer cells are not specialized, so they serve no function
 - Cancer cells attract blood vessels and grow into tumours.
 - Cells from tumours can break away to other areas of the body

5.2 Asexual Reproduction

- A **clone** is an identical genetic copy of its parent
- Many organisms naturally form clones via asexual reproduction
- Cloning is also used in agriculture and research to copy desired organisms, tissues and genes

Types of Asexual Reproduction

- **Binary fission:** single cell organisms splitting into identical copies
- **Budding:** areas of multicellular organisms undergo repeated mitosis to form an identical organism. Buds sometimes detach to form a separate organism
- **Fragmentation:** part of an organism breaks off due to injury, and the part grows into a clone of the parent
- **Vegetative reproduction:** special cells in plants that develop into structures that form new plants identical to the parent
- **Spore formation:** some bacteria, micro-organisms and fungi can form spores - single cells that can grow into a whole new organism

Advantages and Disadvantages of Asexual Reproduction

Advantages	Disadvantages
<ul style="list-style-type: none">• Large numbers of offspring are reproduced very quickly from only one parent when conditions are favourable.	<ul style="list-style-type: none">• Offspring are genetic clones. A negative mutation can make asexually produced organisms susceptible to disease and can destroy large numbers of offspring.
<ul style="list-style-type: none">• Large colonies can form that can out-compete other organisms for nutrients and water.	<ul style="list-style-type: none">• Some methods of asexual reproduction produce offspring that are close together and compete for food and space.
<ul style="list-style-type: none">• Large numbers of organisms mean that species may survive when conditions or the number of predators change.	<ul style="list-style-type: none">• Unfavourable conditions such as extreme temperatures can wipe out entire colonies.
<ul style="list-style-type: none">• Energy is not required to find a mate.	

Human-assisted Cloning

- Humans use all the asexual cloning methods in order to produce desired results with organisms. This is done in several ways:
- **Reproductive cloning:** purpose is to produce a genetic duplicate of an existing or dead organism. Steps involved:
 1. Remove nucleus from an egg cell
 2. A mammary gland cell is removed from an adult female
 3. Electricity fuses mammary and egg cell
 4. Fused cell begins dividing
 5. Dividing embryo is inserted into surrogate mother
- **Therapeutic cloning** - purpose is to correct health problems
 - Very important to therapeutic cloning are **stem cells** - cells that can become different types of cells
 - Stem cells can be used to replace cells damaged from injuries or disease
 - Diabetes, spinal injuries, Parkinson's disease are only a few that can benefit from stem cell therapy
 - Controversial because the best stem cells are from embryos which are destroyed when harvesting cells