

TOPIC 1.6: CELL CYCLE REGULATION

Cell Cycle Checkpoints

A cell cycle contains numerous checkpoints that ensure the fidelity and viability of continued cell divisions

G₁ checkpoint

- Monitors potential growth conditions (nutrients, etc.)
- Assesses level of DNA damage (from UV, etc.)

G₂ checkpoint

- Monitors state of pre-mitotic cell (suitable size, etc.)
- Identifies and repairs any DNA replication errors

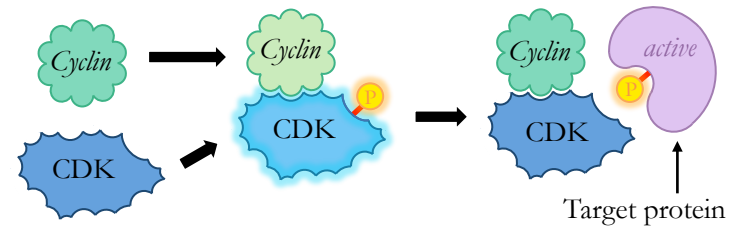
Metaphase checkpoint

- Ensures proper alignment (prevents aneuploidy)

Cyclins

Cyclins are proteins that control progression of the cell cycle

- Cyclins bind to cyclin dependent kinases (CDKs)
- The activated complex phosphorylates proteins involved in specific cell cycle events (e.g. centrosome duplication)
- After the event has occurred, the cyclin is degraded and the cyclin dependent kinase is rendered inactive



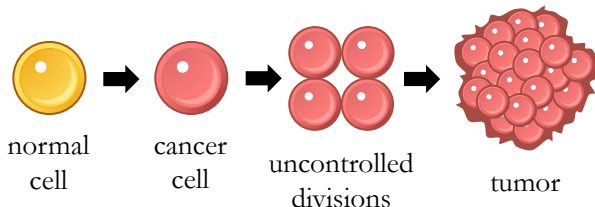
Cancer

Cancers are diseases caused by uncontrolled cell division

- The resulting abnormal cell growths are called tumors

Tumor cells may remain in their original location (benign) or spread and invade neighboring tissues (malignant)

Metastasis is the spread of cancer from an original site to a new body location (forming a secondary tumor)



Cancer Development

Cancers can be caused by many different factors:

Mutagens

Mutagens are agents that change the genetic material of cells

- These agents may be either physical (e.g. UV), chemical (e.g. arsenic) or biological in origin (e.g. certain viruses)
- Mutagens that cause cancer are classified as carcinogens

Genetics

Most cancers are caused by mutations to two classes of genes:

- Proto-oncogenes stimulate cell growth and proliferation
- Tumor suppressor genes repress cell cycle progression

Proto-oncogene mutations create cancer-causing oncogenes

Cell Death

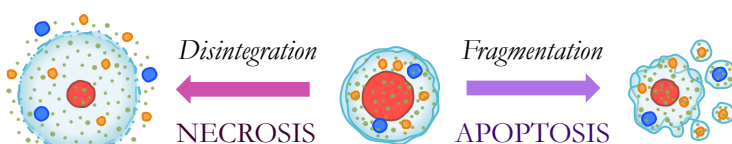
The death of a cell may occur by one of two mechanisms:

Necrosis (uncontrolled 'cell homicide')

- The cell loses functional control due to injury, toxins, etc.
- There is a destabilization of the membranes, leading to swelling
- The cell bursts and releases its contents (causing inflammation)

Apoptosis (programmed 'cell suicide')

- It is a controlled event triggered by mitochondrial proteins
- Cell contents are packaged in membranous protrusions (blebs)
- The cell fragments into apoptotic bodies which are recycled



Smoking

There is a strong positive correlation between the frequency of smoking and the incidence of cancer

- Cigarette smoke contains >60 known carcinogens

