Contents

Cells

Mitosis

Interphase

G_1 Phase

- Increase in cytoplasm and cell size
- Mitochondria replicate
- Protein synthesis

G_0 Phase

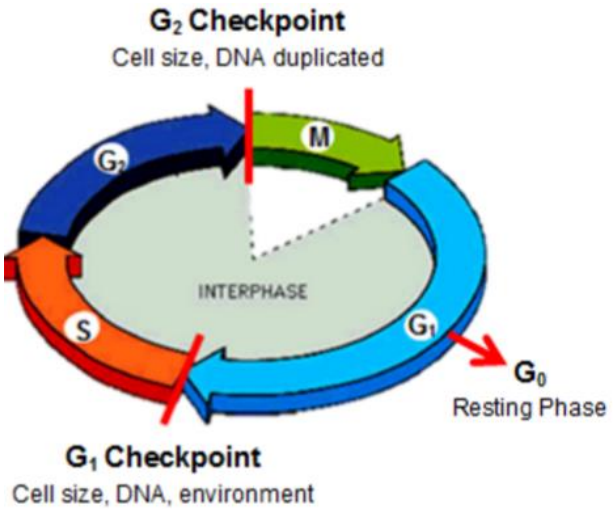
- 'Within' G_1 Phase
- Phase that allows the cell to exit the cycle permanently or temporarily

S Phase

DNA replicates- the cell goes from n to 2n

G_2 Phase

Increase in cytoplasm and cell size



M Phase

Prophase

- Chromosomes condense
- Kinetochores form at the centromere
- Spindle forms

Pro-Metaphase

- Nuclear envelope disappears
- Spindle microtubules attach to the kinetochores

Metaphase

Chromosomes align at the metaphase plate

Anaphase

- Centromere splits, and chromosomes are separated by microtubules
- Cell elongates

Telophase

- Nuclear envelope reforms
- Contractile ring, composed of actin and myosin filaments, forms

Cytokinesis

- Starts in anaphase
- Contractile ring pinches the cell in two
- Cellular components divide

Meiosis

Consists of Meiosis I and Meiosis II, which follow identical steps to mitosis except for…

Meiosis I

- **Prophase I**
  - ❖ Homologous chromosomes form bivalents – Synaptonemal Complex synapses them
  - ❖ Crossing over occurs
    - Exchange of genetic information
    - Produces variation among gametes
- **Metaphase I –** random alignment and assortment of homologous chromosomes
- **Anaphase I –** homologous chromosomes separate

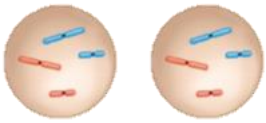
Meiosis II

- DNA doesn't duplicate (no S phase)
- **Metaphase II –** random alignment and assortment of sister chromatids
- **Anaphase II –** sister chromatids separate

Overall Differences

Mitosis

- 1 division
- Produces two diploid (2n), genetically identical daughter cells
- Role – growth and repair of tissues



Meiosis

- 2 divisions
- Produces four haploid (n), non-identical daughter cells
- Role – gamete produce

The Cell Cycle

Cyclin-Dependent Kinases (CDK's) – protein kinases that are active when bound to cyclical expressed cyclins

1) Interphase

- M-cyclin concentration increases
- M-cyclin binds to CDK's, forming M-CDK
- M-CDK activates proteins for mitosis

2) Mitosis

- M-CDK synthesis
- Extracellular signals must trigger G_1 cyclins (G_1–CDK's), or the cell will enter G_0

3) Termination

- M-CDK's activate APC, triggering cyclin proteolysis (degradation)
- M-cyclin concentration decreases
- M-cyclin no longer binds to CDK's

Cell Senescence

- **Cell Senescence –** the normal aging of cells
- Due to…
    - ❖ An accumulation of lipofuscin (waste)
    - ❖ Decreased homogeneity
    - ❖ Shorter telomeres

Apoptosis

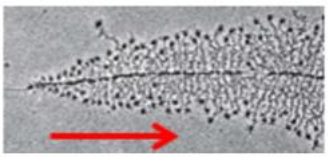
- **Apoptosis –** programmed cell death
- Steps
    1) Cell shrinks
    2) Cellular components disappear
    3) Cell surface alters to initiate phagocytosis (cell 'eating')
- Occurs…
    - ❖ During development
    - ❖ Due to a lack of survival factors

Basic Genetic Mechanisms

Transcription

Transcription – copying one DNA strand into mRNA by RNA Polymerase

Steps



1) **RNA Polymerase**
    - Binds upstream from the promotor
    - 'Unzips' DNA in a 5' to 3' direction
    - Inactive until…
        - ❖ Eukaryotes – transcription factors and / or regulatory proteins bind
        - ❖ Prokaryotes – the sigma subunit binds

2) Ribonucleotides (Adenosine, Uracil, Cytosine, Guanine) bind to form pre-mRNA

3) **Pre-mRNA Processing**
    - Capping – addition of methyl-guanosine to the 5' end of pre-mRNA to aid stability and bind to the cytoplasmic ribosome
    - Polyadenylation – addition of A ribonucleotides to the 3' end of pre-mRNA
    - Splicing – spliceosome (RNA + snRNPS) removes introns and leaves exons to form the final mRNA molecule

Types of RNA

- **mRNA –** involved in protein synthesis
- **MicroRNA**
- **Non-coding RNA –** thought to be involved in regulatory mechanisms
- **rRNA –** involved in protein synthesis
- **tRNA –** involved in protein synthesis