Cell cycle

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Tags	

Describe the interphase events and its importance

- Interphase occurs before cell and nuclear division
- During G1/G2 phases of the interphase there is an increase in cell size
- There is synthesis of cellular organelles such as mitochondria, chloroplast and centrioles to allow for equal division into the daughter cells
- There is synthesis of ATP in preparation for the energy consuming process during cell division
- During S phase of interphase, semi conservative DNA replication occurs
- Each parental DNA strand serves as a template to form daughter DNA molecule made up of 1 parental strand and 1 newly synthesised strand/daughter strand
- The amount of DNA content doubles
- G1 and G2 checkpoints checks to ensure no error in DNA so G1 checkpoints checks for DNA damage,cell size and whether nutrients are sufficient while G2 assesses if DNA is correctly replicated
- Progression of cell cycle is delayed as damaged cells are arrested preventing initiation of next phase if problems are detected
- If there is irreparable damage to DNA at either G1 or G2, cell death induced and apoptosis occurs to prevent accumulation of mutations on a single cell lineage and ensuring that incorrectly replicated DNA is not passed down to

daughter cells such as cancer-critical genes which may lead to development of cancer and uncontrolled cell division

Describe checks made at cell cycle checkpoints

- Has 3 regulatory checkpoints to ensure cell cycle events occured normally which are G1, G2 and M checkpoints
- During G1 checkpoints, sufficient nutrients/growth factors are checked for and whether there is adequate cell size/ duplication of all organelles/ no DNA damage before the cell proceeds to S phase
- At the G2 checkpoint DNA replication is assessed for completion and that there is no DNA damage and cell size is adequate
- At the M checkpoint, proper attachment of all chromosomes to kinectochore microtubules Is checked for and all chromosomes are properly aligned at the metaphase plate before dividing cell is allowed to enter anaphase
- Cell cycle checkpoints allow cell cycle to proceed only when internal and external conditions are favourable and also provide time for errors or malfunctioning cellular machinery to he repaired that may result if the cell cycle progressed prematurely to the next stage

Role of centrioles

- There is a pair of centrioles at each pile of the cell, determining the polarity of cells
- Centrioles organise the synthesis of the spindle fibres which leads to the equal separation of the sister chromatids so that resulting cells are genetically identical

Describe structure of homologous chromosomes

- Consists of 2 homologues one of paternal and one of maternal origin
- Have the same size, shape centromere position and staining pattern

- They have same genes at corresponding loci
- Are non-identical due to presence of different alleles which are alternative versions of corresponding genes
- Each homologue compromise of 2 sister chromatids held together by a centromere
- Pair up to form bivalents/tetrads
- Each chromatid consists of a molecule negatively charged DNA coiled around 8 positively charged proteins called histones and they from nucleosomes and come together to form a solenoid which coils to form looped domains which further super coils to form a short and thick structure called chromatid

Describe meiosis and mitosis

Interphase (both):

- Semi-conservative DNA replication occurs where both strands of DNA is used as a template for replication to synthesise a complementary daughter strand, consisting of one original strand and one newly synthesised strand
- G1,G2, and S checkpoints arrest cells that have DNA replication errors cause by the limited DNA proofreading abilities, giving time to repair errors in DNA to ensure DNA is replicated correctly and avoid accumulation of mutations

Stage (meiosis)	Description
Prophase I	1.Chromatin coils, shortens and thickens into condensed chromosome 2.homologous chromosomes pair up via synapsis to form bivalents 3. Crossing over occurs to form the chiasmata where exchange of equivalent portion of genetic material or alleles occur between non-sister chromatids of homologous chromosomes 4. Nuclear envelope disintegrates so that spindle fibres can attach to centromere and chromosomes can be pulled to opposite poles (role of nuclear envelope)
Metaphase I	Homologous chromosomes arranged as pairs at metaphase plate
Anaphase I	1.Each homologue is pulled by a shortening kinectochore microtubule by depolymorisation towards opposite poles
Telophase I	

Stage (meiosis)	Description
Anaphase II	1.Centromeres divide and sister chromatids separate to form daughter chromosomes and are pulled by a shortening kinectochore microtubules towards opposite poles by depolymerisation 2. Cohesin proteins are cleaved to allow sister chains to separate and move towards opposite poles of the cell 3. Kinectochore proteins interface for sister chromatids remain tightly bound to spindle microtubules as the spindle microtubules shorten
Telophase II	1.Chromosomes reach the poles of the spindle where they decondense and become diffuse 2. Nuclear envelope reforms around the chromosomes to form the nucleus (role of nuclear envelope)

Stage (mitosis)	Description

Significance of regulating mitotic cycle

- Cell cycle is regulated for normal growth and development
- Cell cycle is regulated at checkpoints at G1,G2 and M which determines if the cell cycle can proceed
- Dysregulation of checkpoints cause the cell to escape cell cycle control mechanism leading to uncontrolled division of cells amd cancer

Compare meiosis and mitosis

Meiosis	Mitosis
Produce 4 genetically different daughter cells	Produce 2 genetically identical cells
Daughter cells will have half the number of chromosomes as parent cell	Daughter cells have the same number of chromosomes as parent cell
2 nuclear divisons	1 nuclear division

Meiosis	Mitosis
Pairing of homologous chromosmes, chiasmata formation amd crossing over at prophase I	None
Centromeres do not divide at anaphase I	Centromeres divide at anaphase

What leads to genetic variation in meiosis

- Independent assortment of homologous chromosomes at metaphase plate during metaphase I And separation of chromosomes at anaphase I results in different combinations of parental chromosomes ingameres
- Crossing over of non-sister chromatids between homologous chemises during Prophase I at chiasmata, where equivalent portions of chromatids break and rejoin, resulting in exchange of alleles, new combinations of alleles on chromosomes
    - These non identical sister chromatids align randomly along metaphase plate during metaphase II and separate drying anaphase II into different gamtes
- Random fusion of genetically different gamete’s result in even greater genotype variation in zygote