Assignment 2

Section: 09

Course

BIO 101

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1. The molecular brakes that regulate the cell cycle and act as a tumor or cancer suppressor for preventing uncontrolled cell division are primarily associated with the G1 stage of cell cycle where proteins like p53 assess DNA integrity and cellular conditions before permitting progression to the next S phase. When a cell is mutated or dysfunctioned tumor suppressors lose their control over the cell cycle which results in cancer.

2. In the given figure, the first one represents the anaphase stage. This stage is characterized by the remarkable poleward movement of chromatids which is a process driven by the contraction and shortening of kinetochore microtubules. As a result of shortening, sister chromatids are pulled toward opposite poles of the cell to ensure the accurate and equal distribution of genetic material.

In the second figure, the telophase stage is portrayed. It marks the conclusion of chromatid migration to their respective poles. Here nuclear envelopes start to reform around the separated chromatids in preparation for the re-establishment of distinct nuclei in the daughter cells.

The third figure signifies the initiation of cytokinesis, a vital step following nuclear division. The visualization of the cell membrane pinching at the equator is indicative of cytokinesis onset. In animal cells, this pinching results in the formation of a cleft known as the cell furrow. Importantly, this furrow formation method is a characteristic feature of animal cell division, while in plant cells, cytokinesis involves the creation of a cell plate.

Finally, the fourth figure depicts the completion of cytokinesis, resulting in the formation of two fully separated daughter cells. This stage marks the end of the entire mitotic process with each daughter cell now possessing an identical and complete set of genetic material.

3. In the figure, negatively charged DNA is wrapped around positively charged histone molecules and forms a complex called a nucleosome. It illustrates the fundamental process of DNA packaging (DNA -> nucleosome -> chromatin -> chromatin fiber -> chromosome) in which the involved biomolecules are DNA, histone octamer, non-histone protein, linker protein etc.

From the figure, each nucleosome bead is separated from the next one by linker DNA. The linker DNA exclusively contains the H1 histone protein. DNA completes two full turns around a histone octamer, consisting of the H2A, H2B, H3, and H4 pairs, forming a structural unit known as a nucleosome.

Within each nucleosome, there are 200 base pairs of DNA. This nucleosomal arrangement is repeated, resulting in a sequence called chromatin, composed of both DNA and protein. The chromatin undergoes further condensation into chromatin fibers, facilitated by non-histone chromosomal proteins. Eventually, these chromatin fibers condense to form chromosomes, which contributes to the DNA packaging in the nucleus.

4. Mitotic cell division ensures genetic identity in daughter cells through some steps. Initially, each chromosome is duplicated by the process of DNA replication in order to create identical sister chromatids. After that chromosomal condensation occurs which leads to aligning chromosomes at the metaphase plate.

The next step is called anaphase in which event spindle fibers separate sister chromatids, ensuring each daughter cell receives an identical set of chromosomes. Finally Cytokinesis completes the division, yielding genetically identical daughter cells.