6.6: DNA Replication and Aging

Telomeres cap off the ends of chromosomes, protecting the chromosomes from losing valuable coded regions of information during DNA replication. Telomeres have several functions:

- They help prevent chromosome ends from fusing to other chromosomes.
- They prevent DNA degradation from enzymes called nucleases.
- They assist DNA repair mechanisms in distinguishing DNA breaks from chromosomal ends.
- They play a role in determining the number of times that a cell can divide, and therefore may play a critical role in determining the lifespan of an organism.

**Role of Telomeres during Replication**

A telomeric sequence found at the ends of a chromosome, such as; 5'-TTAGGG - 3' and a complementary strand of 3'-AATCCC-5' may be repeated up to 2000 times. Since a portion of the chromosome is lost during each replication (100 bps), the telomeric sequence prevents any loss of genetic information.

The telomeres act like a biological clock, after many cell replications, a new cell may have lost its ability to function properly; grow, metabolize, or divide. The period of decline is called cell senescence. **Leonard Hayflick** determined that a cell had predetermined total number of time to divide, which became known as the Hayflick Limit. The predetermined limit is approximately 50 times before the telomeric sequence has been depleted. This limit is different for each species of organisms.

The germ cells (sex cells) are different since they must continue to divide to produce sex gametes with a full set of genetic information. An enzyme called telomerase is responsible for adding for base pairs to the shortening telomeric sequences.
Telomeres and Aging

Once a cell reaches its Hayflick Limit and senescence begins, the cells function begins to decline. As organisms age, the more senescence occurs, the less of healthy cells to function at optimal levels.

Telomeres and Cancer: When Cells Do Not Age

Evidence strongly links certain age-related diseases, such as; atherosclerosis, dementia, and macular degeneration, to senescence of specific cell groups in our bodies, but this has not been confirmed that these are caused by the length of a telomeric sequence.

Cancer cells do not degenerate their telomeric sequences through replication like normal healthy cells. Cancer cells produce telomerase continuously, therefore they are always adding to the telomeric sequence.

With the knowledge of the impact of telomerase on cancer cells, researchers will try to target the production of telomerase in cancer cells, giving them a life span. More research is required.

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