Introducing Hayflick's Phenomenon

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Definition of Hayflick's

- Discovered by Leonard Hayflick in 1961.
- Normal somatic cells have a limited capacity to divide.
- This limit is known as the Hayflick Limit.

The Hayflick Limit in Detail

- Human fibroblasts divide 40–60 times before senescence.

- Influenced by cell type, species, and environmental conditions.

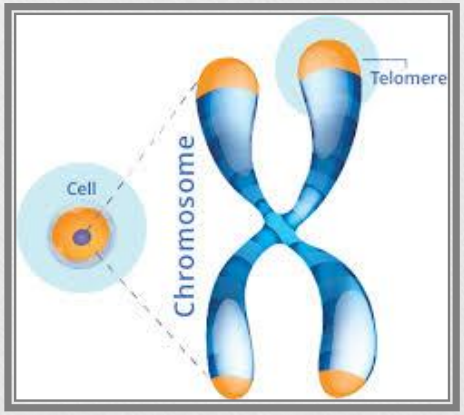
- Demonstrates that cellular aging is intrinsic, not due to culture failure.

Role of Telomeres

- **Telomeres** are repetitive DNA sequences at chromosome ends.

- Typically consist of **TTAGGG repeats** in humans.

- **Protect** chromosomes from degradation and fusion.

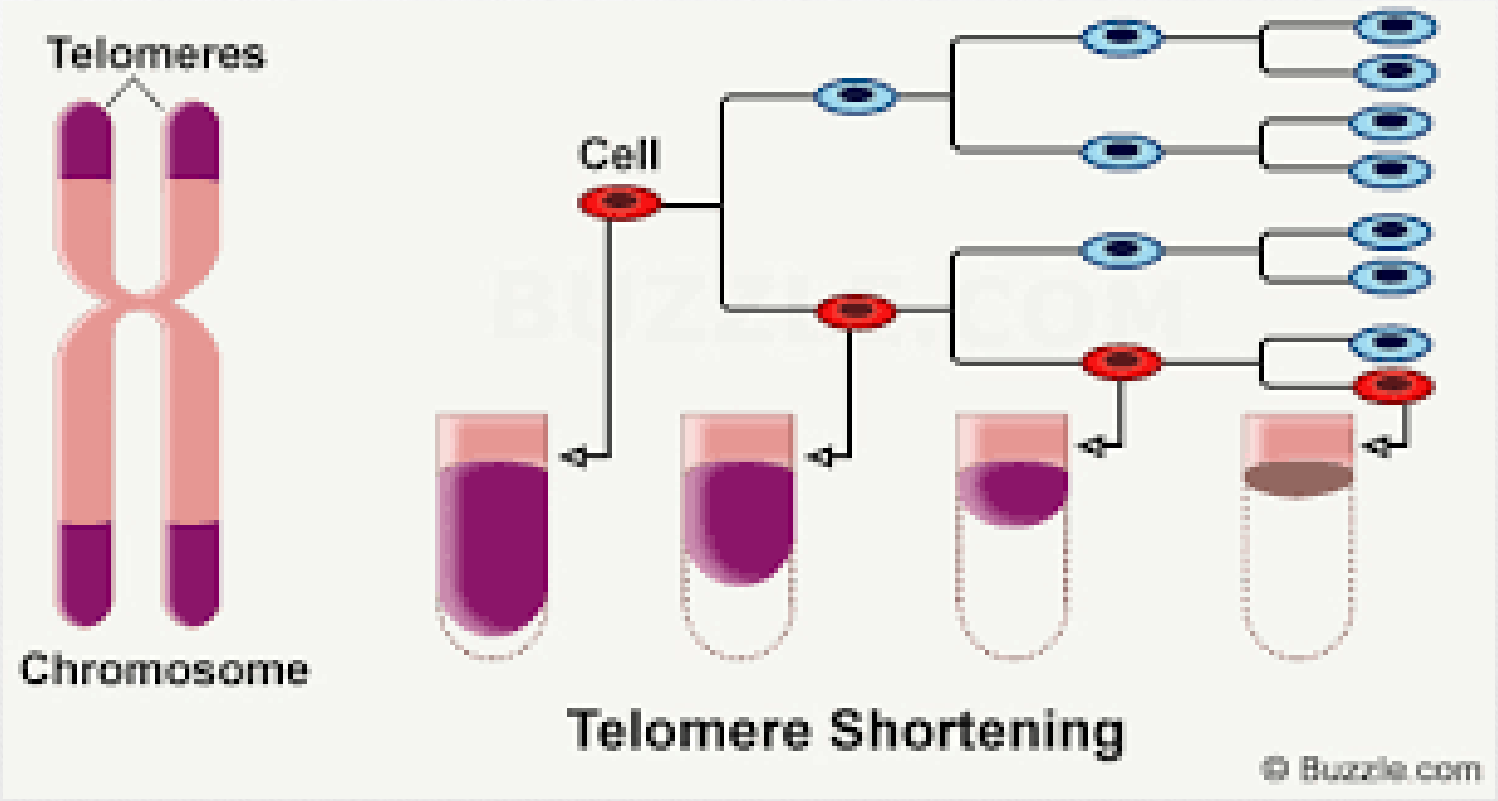


Telomere Shortening Mechanism

DNA polymerase cannot fully replicate chromosome ends.

- Each cell division results in telomere loss (50–200 bp).
- Critical telomere shortening activates DNA damage response.
- Triggers senescence or apoptosis.

Telomere Shortening Mechanism



Telomerase Enzyme

- **A reverse transcriptase** enzyme that elongates telomeres.
- Highly active in germ cells, embryonic stem cells, and cancer cells.
- Low or absent in normal somatic cells.
- Expression level strongly influences cell lifespan.

Senescence: Cellular Aging

- Senescence is a permanent cell cycle arrest.
- Triggered by telomere shortening or DNA damage.
- Senescent cells secrete inflammatory factors (SASP).

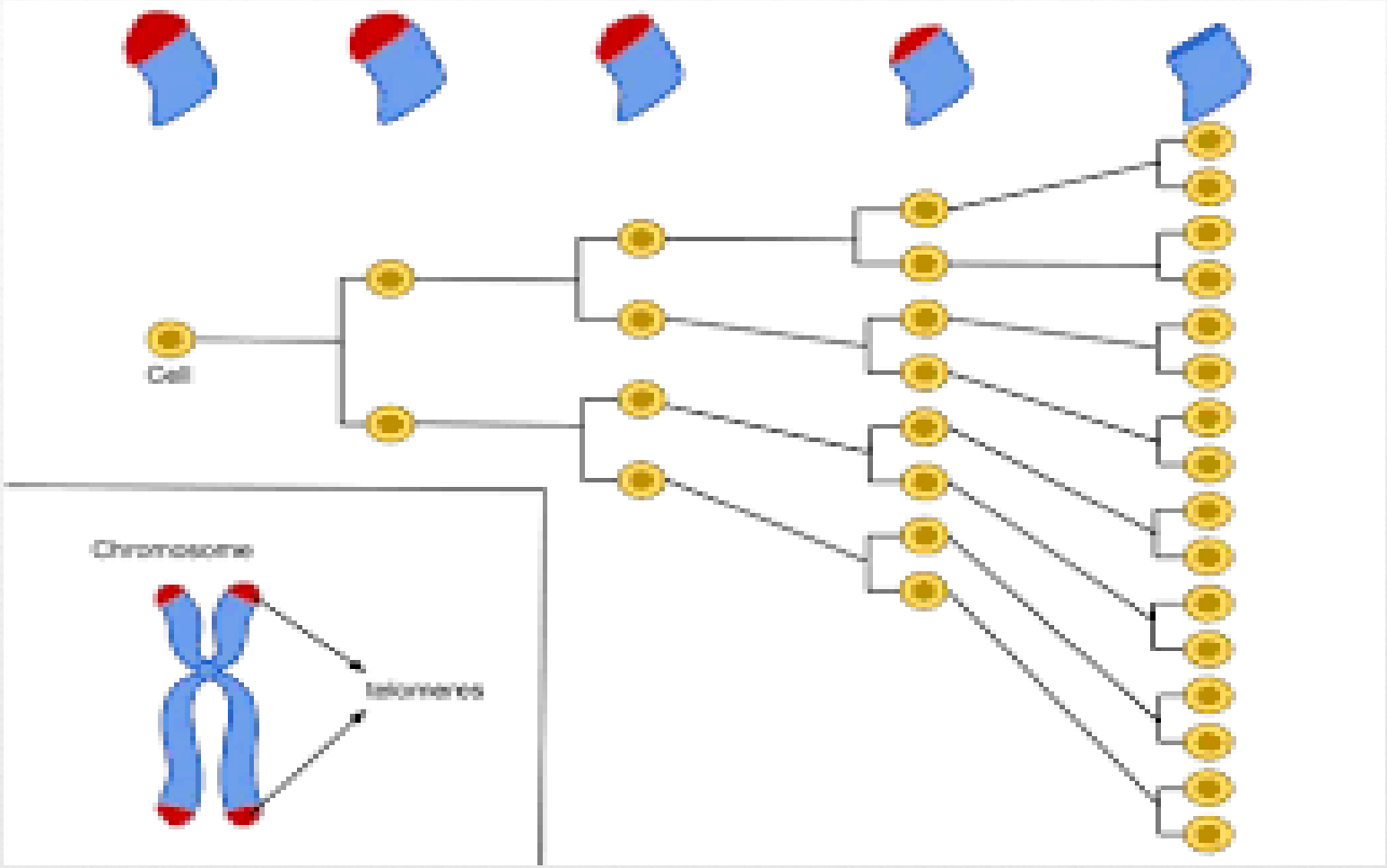
- Plays a role in aging, tissue dysfunction, and chronic diseases.

Apoptosis and Senescence

- Critically short telomeres can activate p53-mediated apoptosis.

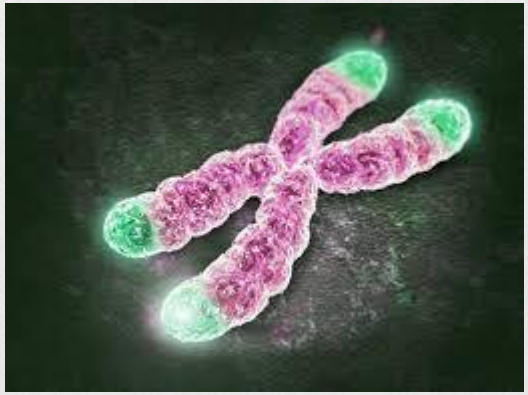
- Senescence preserves cell viability but halts proliferation.

- Balance between both pathways affects organismal aging.


Cell
Chromosome
telomeres

Hayflick Phenomenon and Cancer

- Cancer cells bypass the Hayflick limit.
- Achieved through telomerase reactivation or ALT pathway.
- Enables unlimited proliferation (cellular immortality).
- Targeting telomerase is a potential cancer therapy.



Environmental and Lifestyle Effects

Telomere shortening is accelerated by:

- Oxidative stress
- Chronic inflammation
- Smoking and poor diet

- Healthy lifestyle correlates with slower telomere attrition.