



Nanyang  
Technological  
University  
Singapore

CC0007 Science and Technology for Humanity

# Our Genetics Endowment

Prof Oliver Dreesen, A\*STAR

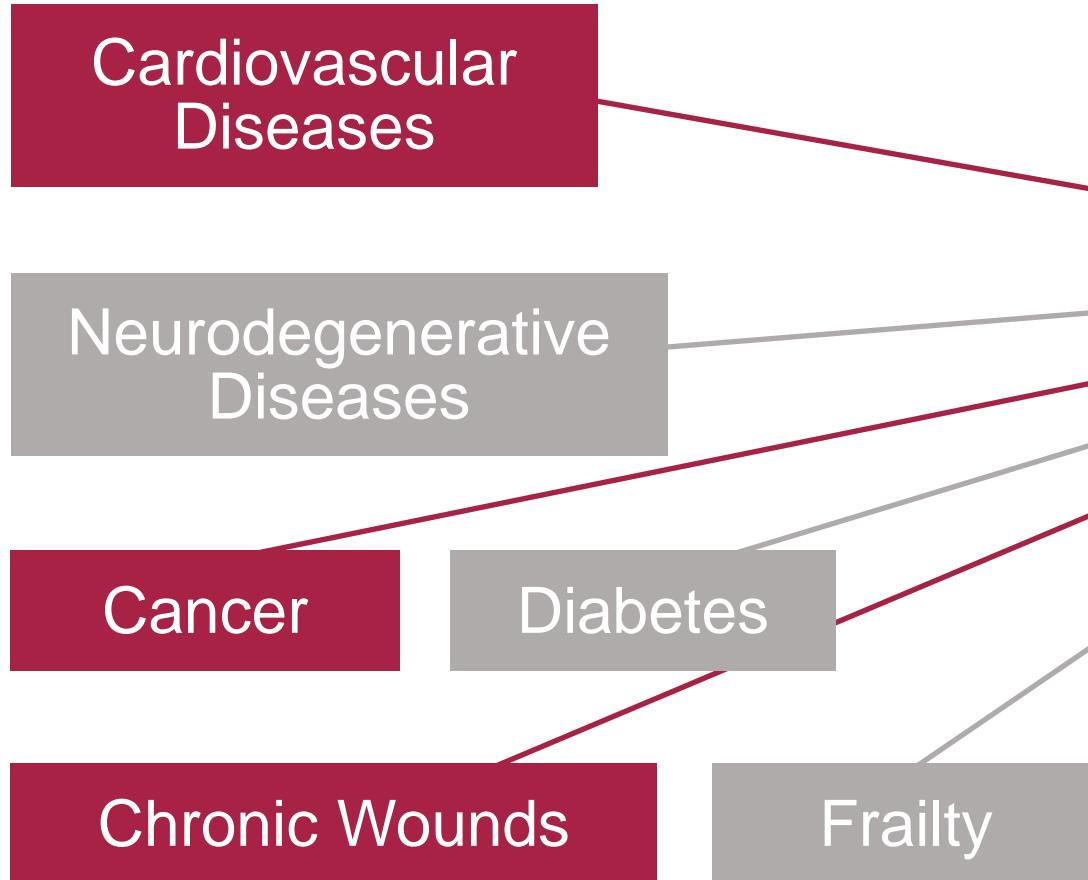


# By 2050

- 1/5 of human population will be over 60
- This trend is exacerbated in developed countries
- Increased health care costs
- Result in significant demographic challenges



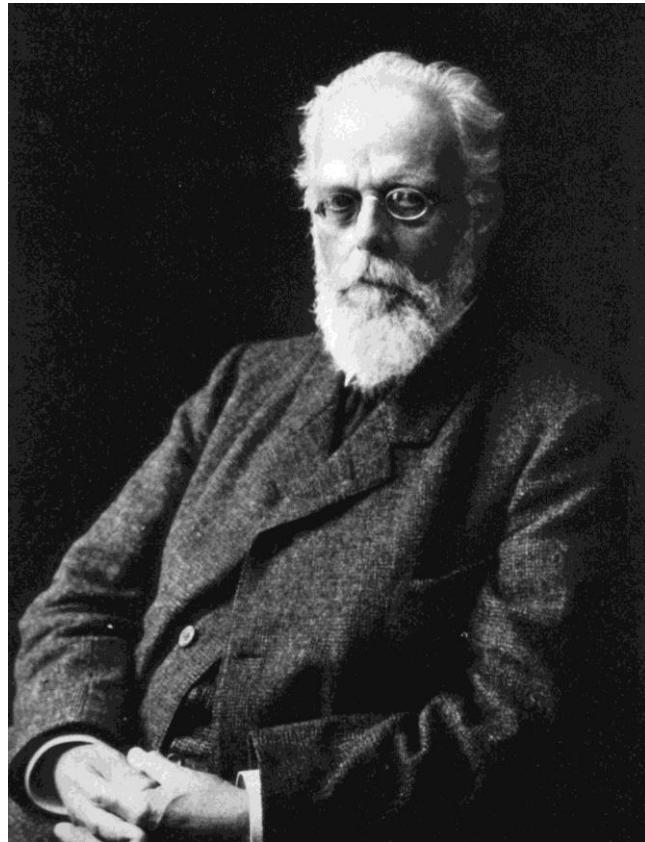
# Age-Related Illnesses



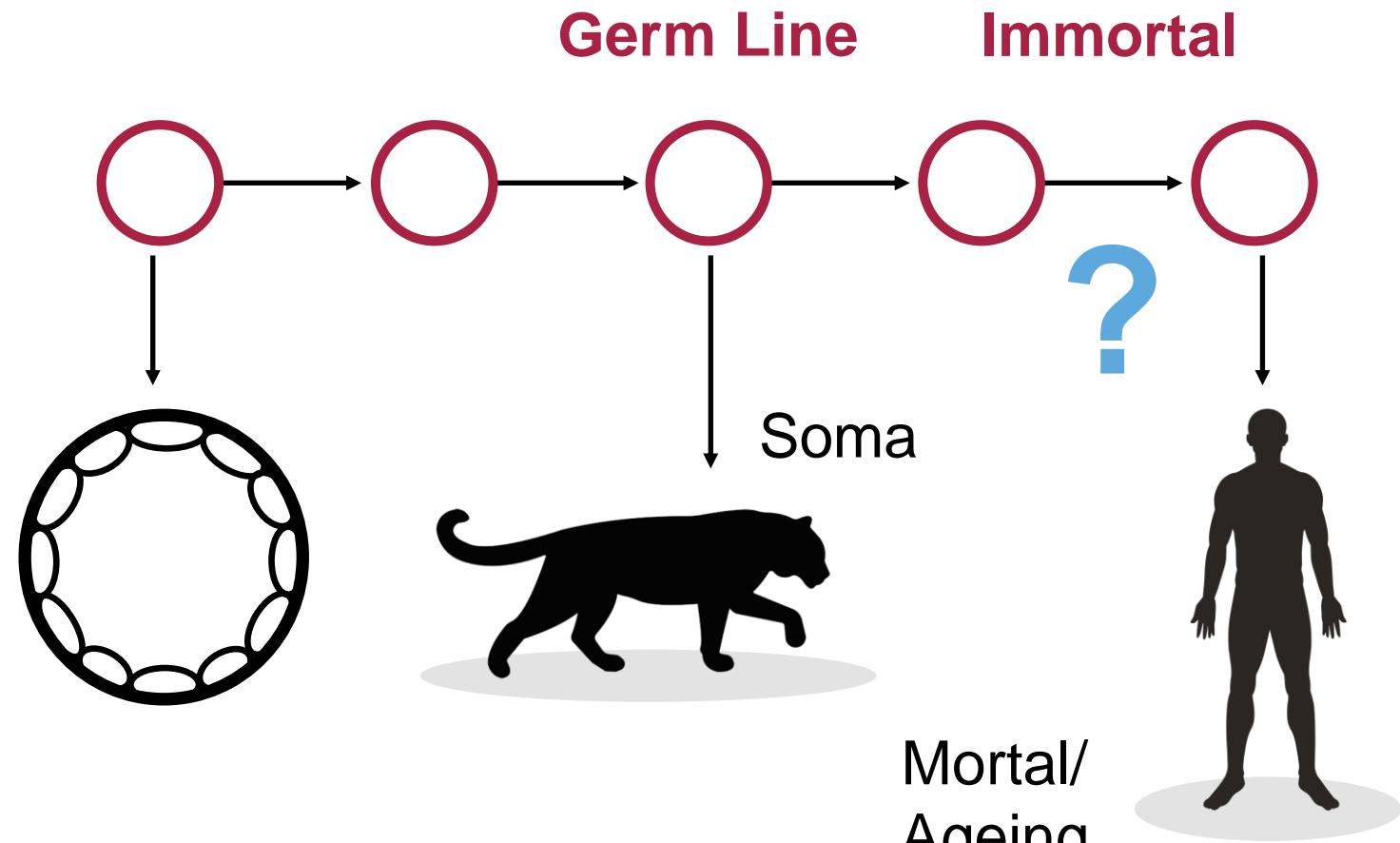
**Age is the Major Risk Factor for Developing Chronic Illnesses**

# The Germ Plasm Theory

Our body made of somatic  
cells



**August Weismann**  
1834–1914 “immortality”



- Growing up different type of epithelial cells from lung & skin

In the 60s...

Ageing on a Cellular Level

- use the cell for Vaccine

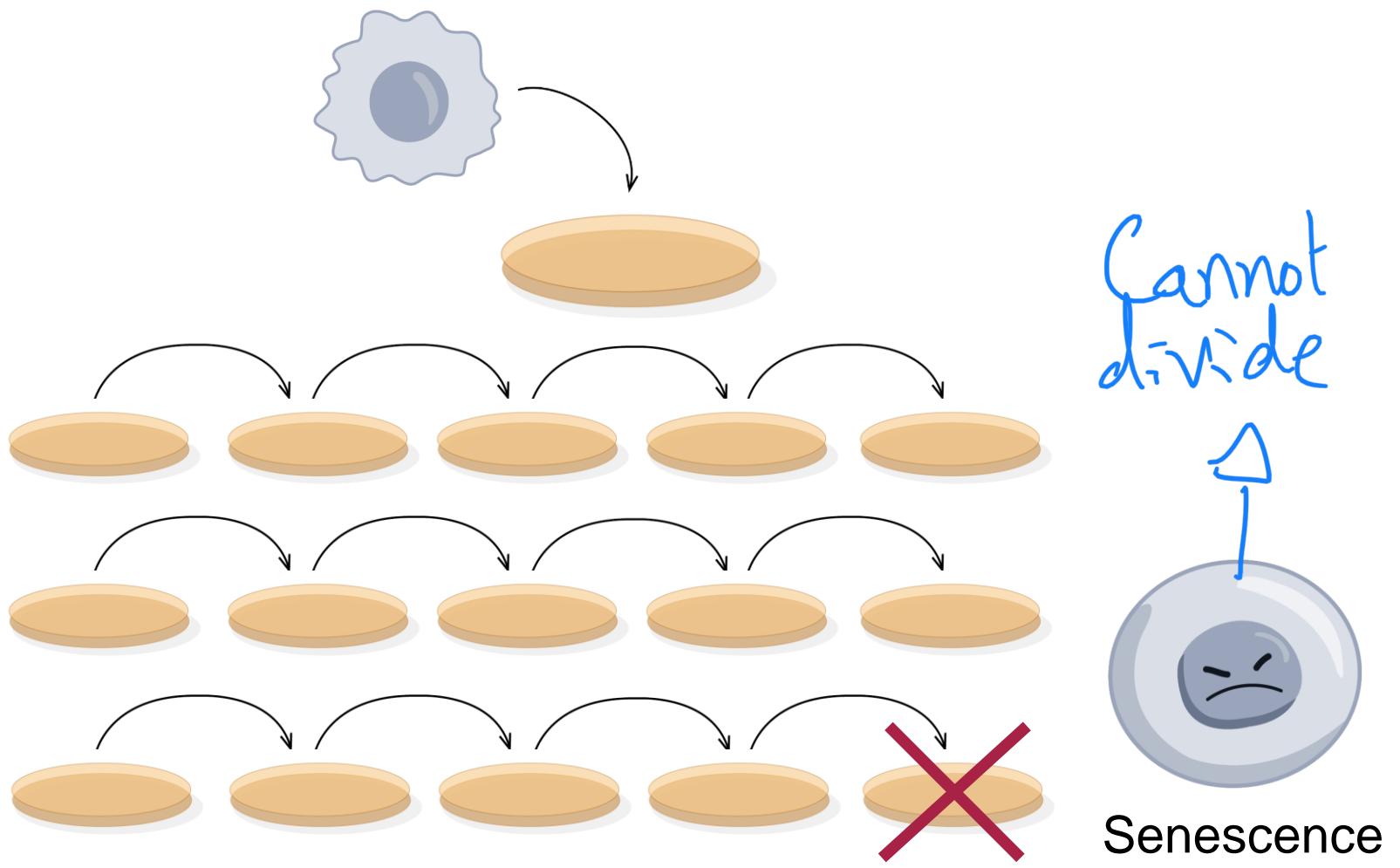
Leonard Hayflick



# Aged Cells Become Senescent



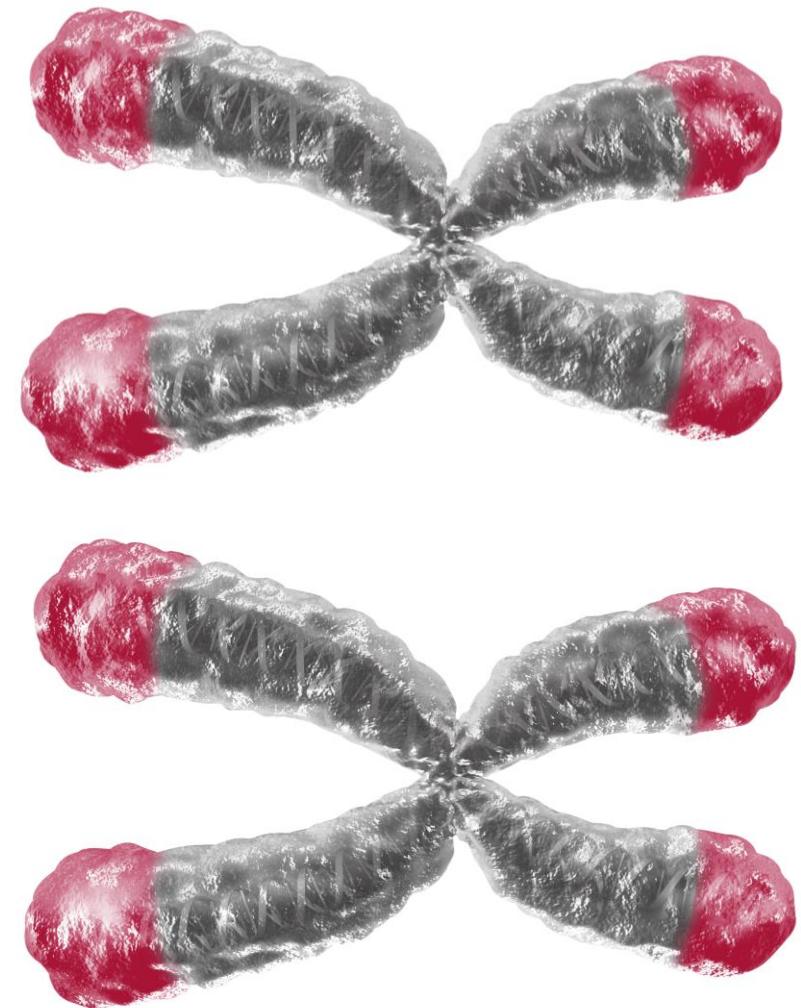
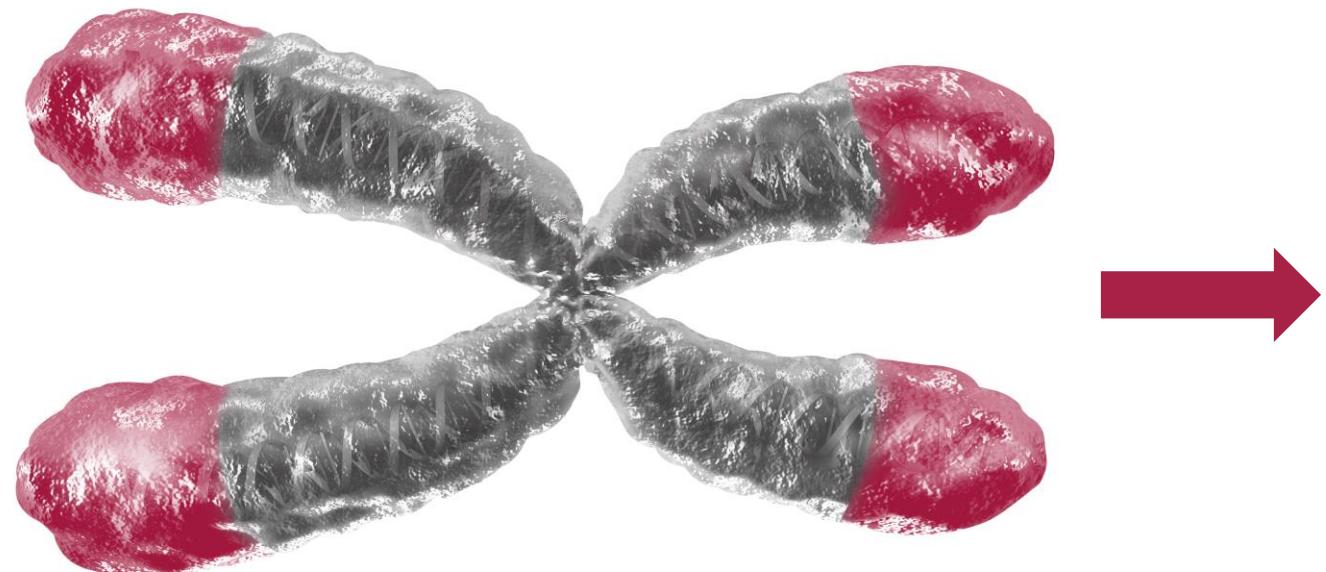
**Leonard Hayflick**



# The End Replication Problem:

Chromosome ends shorten during genome duplication

James Watson &  
Alexei Olovnikov





In the 80s...

# Nobel Prize 2009



Elizabeth Blackburn



Carol Greider



Jack Szostak

# Telomeres

Greek word “**telos**” = the end

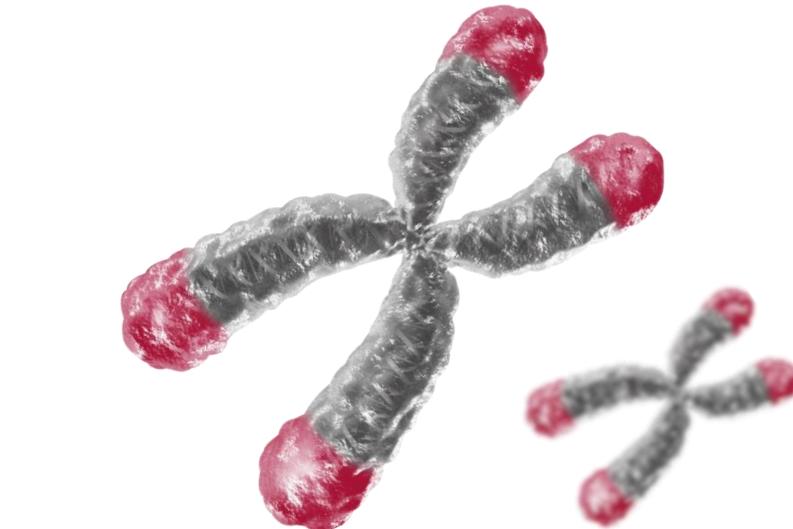
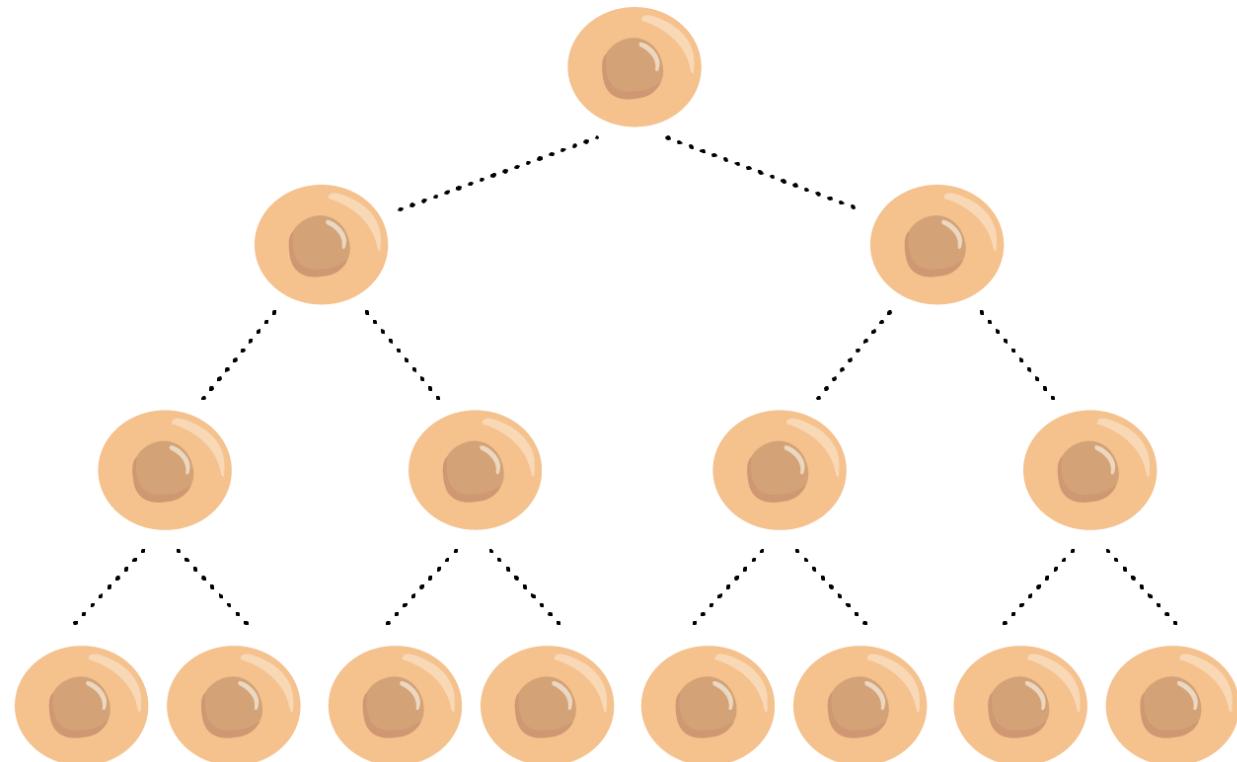
- Consist of repetitive DNA sequences
- Protect chromosome ends
- Limit cell proliferation





In the 90s...

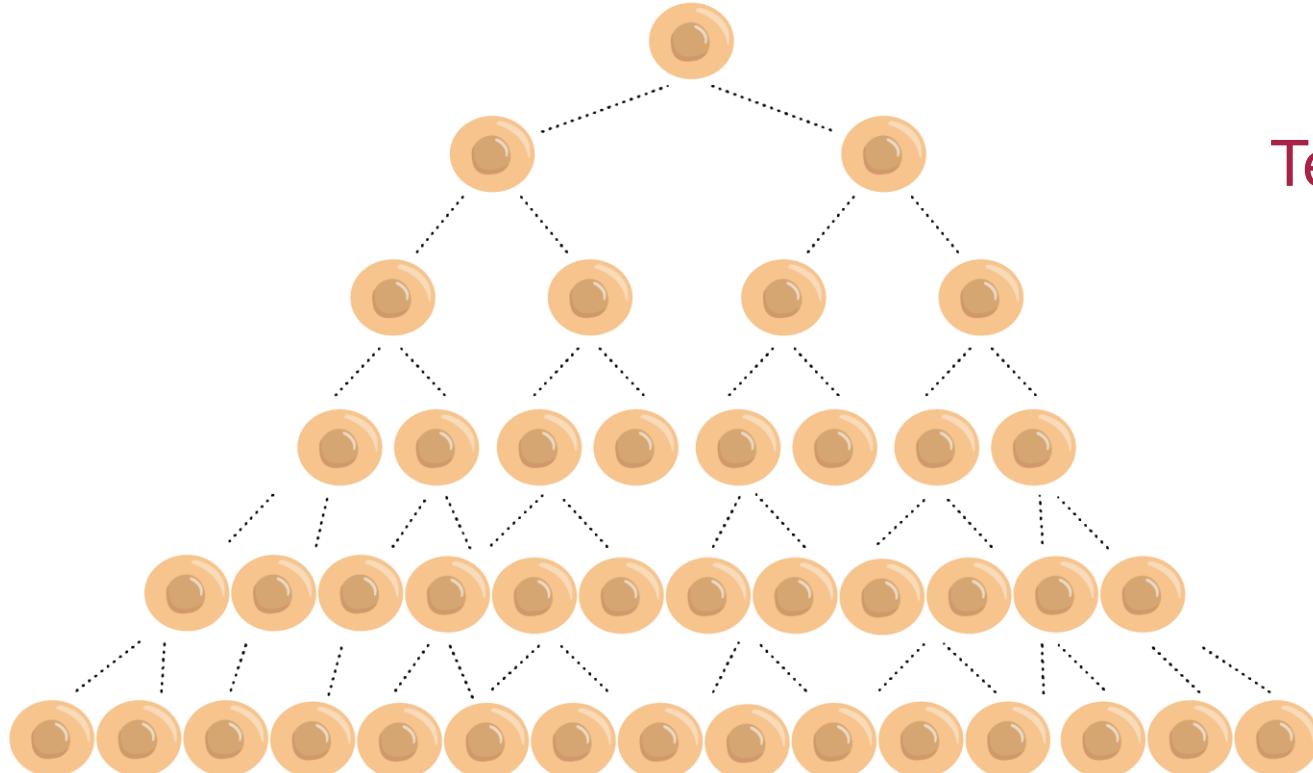
# Telomeres Become Shorter Every Time a Cell Divides



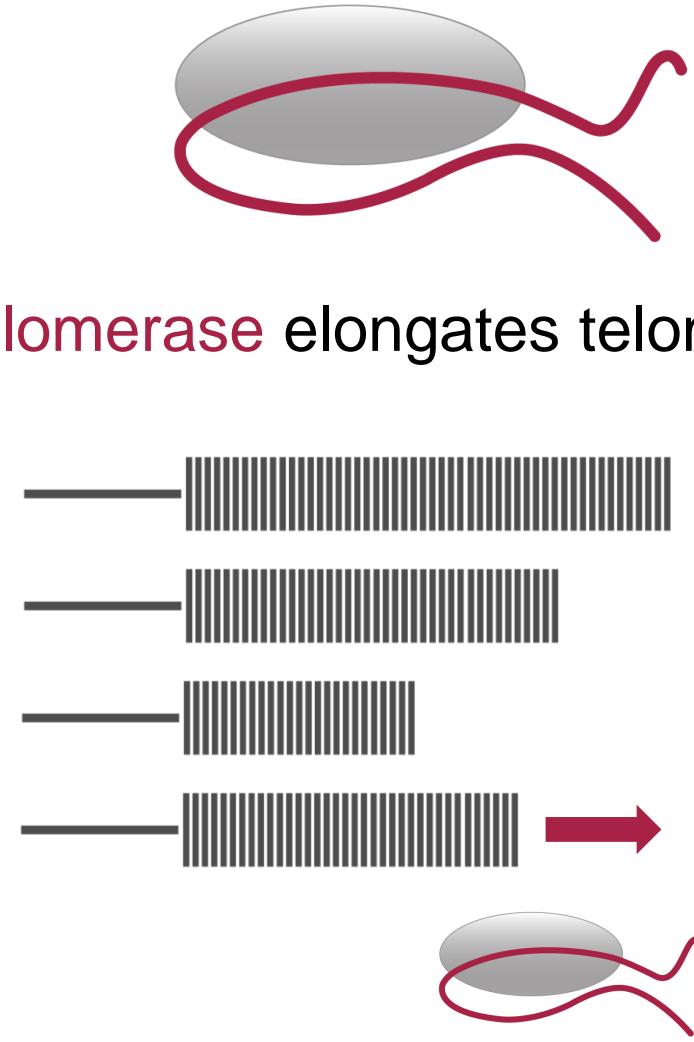
**! DNA DAMAGE !**  
Irreversible arrest  
**senescence/**  
**apoptosis**

→ Prime up of Chromosome end n<sup>telomeres</sup> make it longer

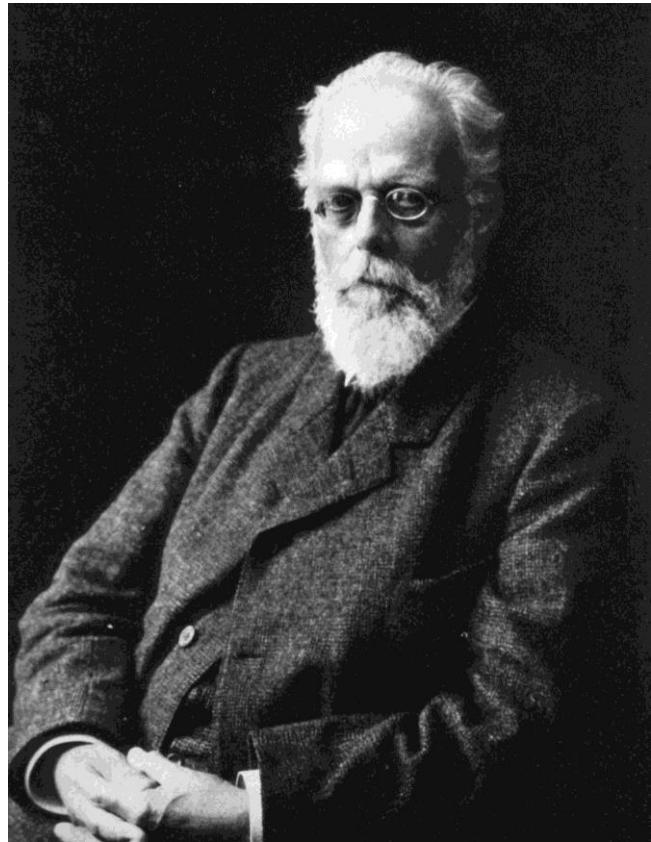
# Telomerase Elongate Telomeres + Immortalises Cells



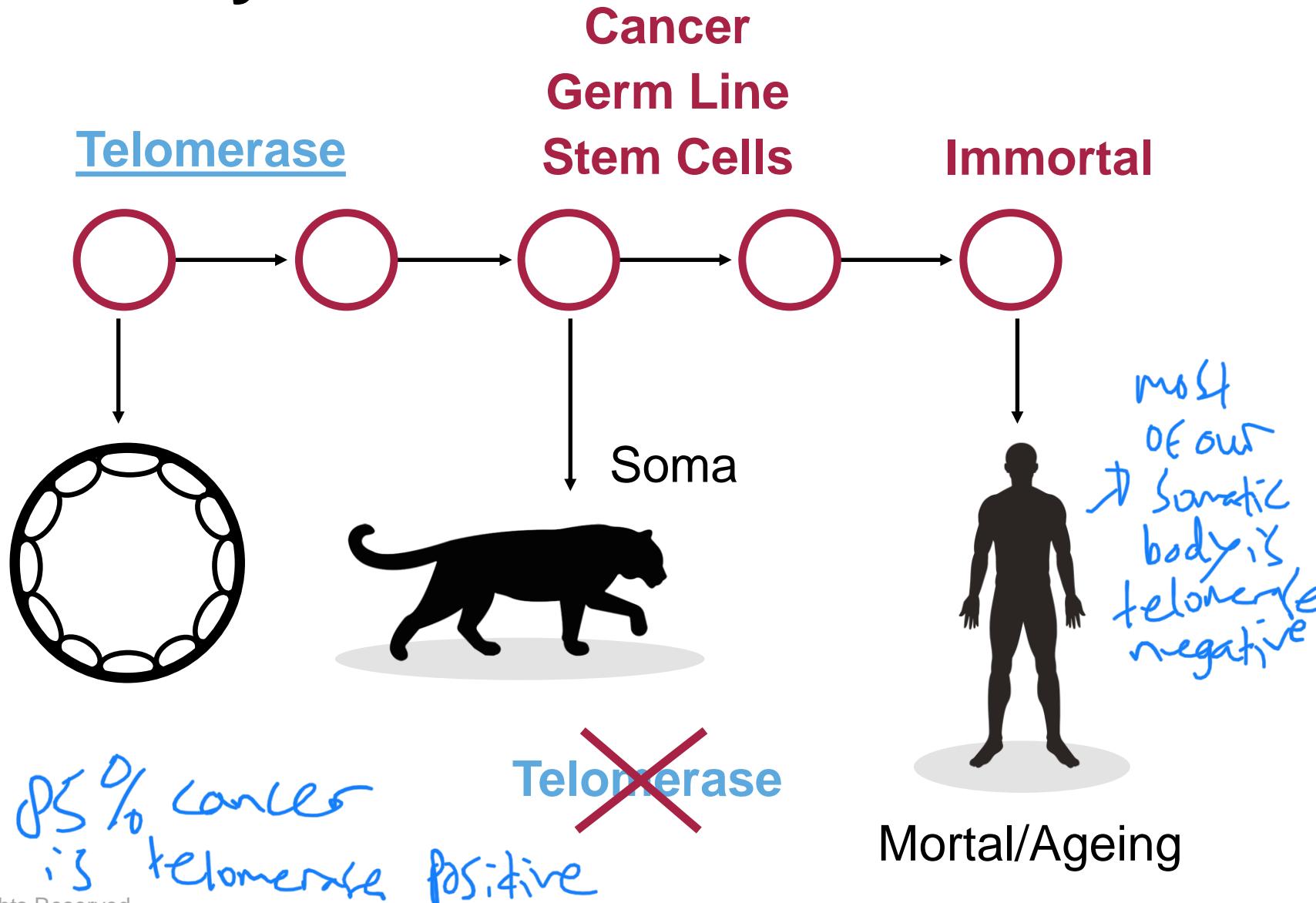
Telomerase elongates telomeres



# The Germ Plasm Theory



August Weismann  
1834–1914 “immortality”



# Telomere Dysfunction Causes Human Diseases/Ageing

- Genetic mutations
- Premature ageing syndromes
- Genetics / Lifestyle / Stress / Smoking / Obesity

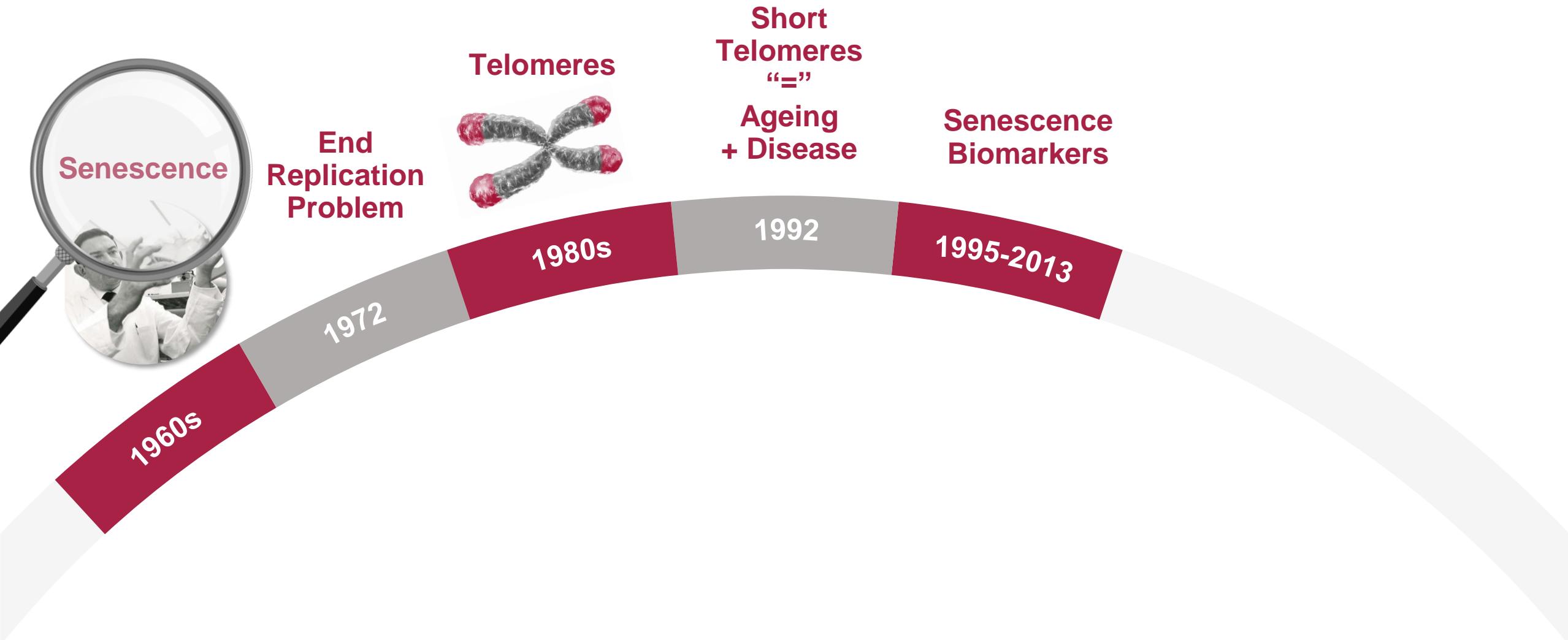
↳ Pollution can result in telomere Shortening  
↳ alcohol

Progeria



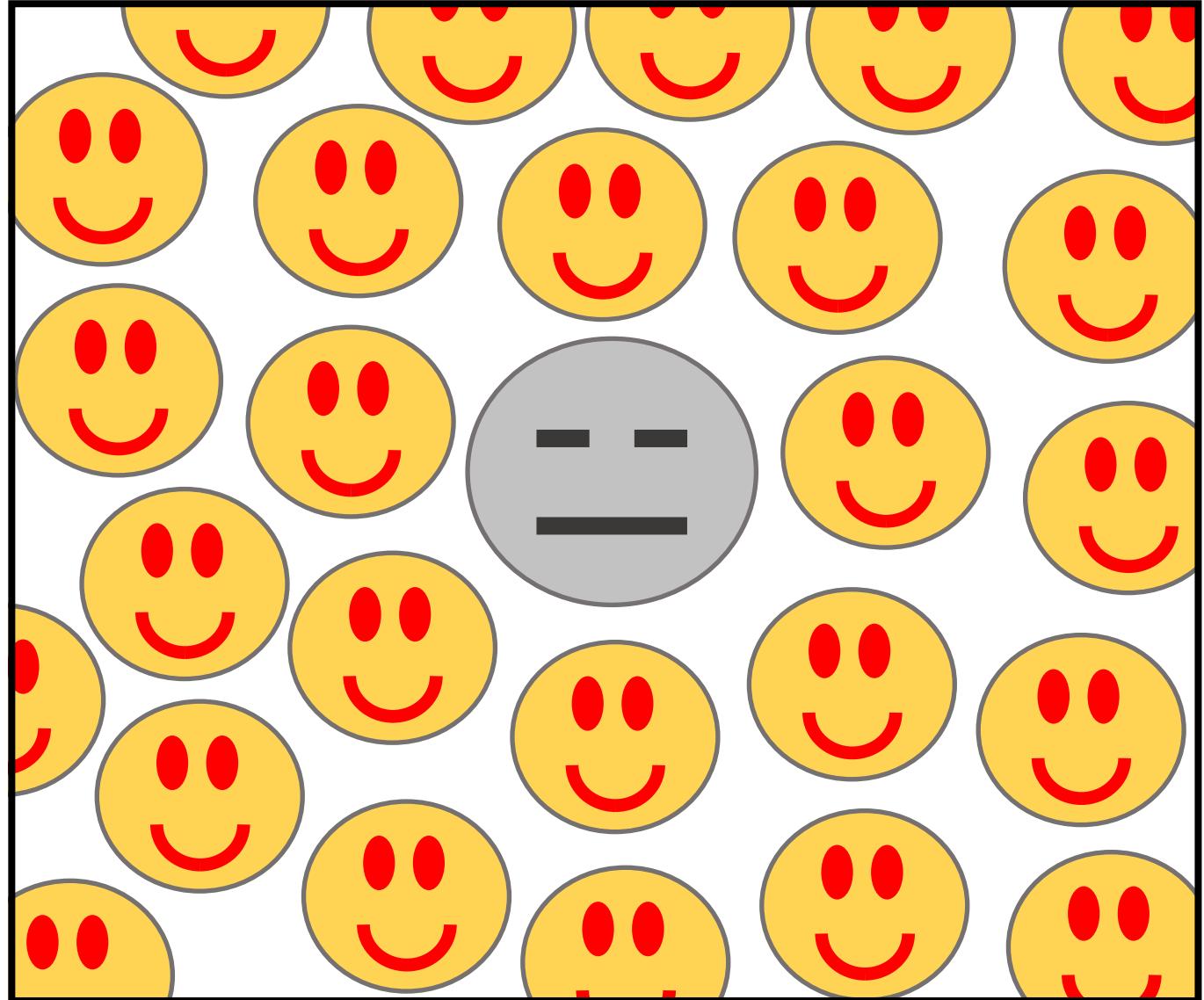
Sam Berns, TEDx talk

# Summary



# Summary

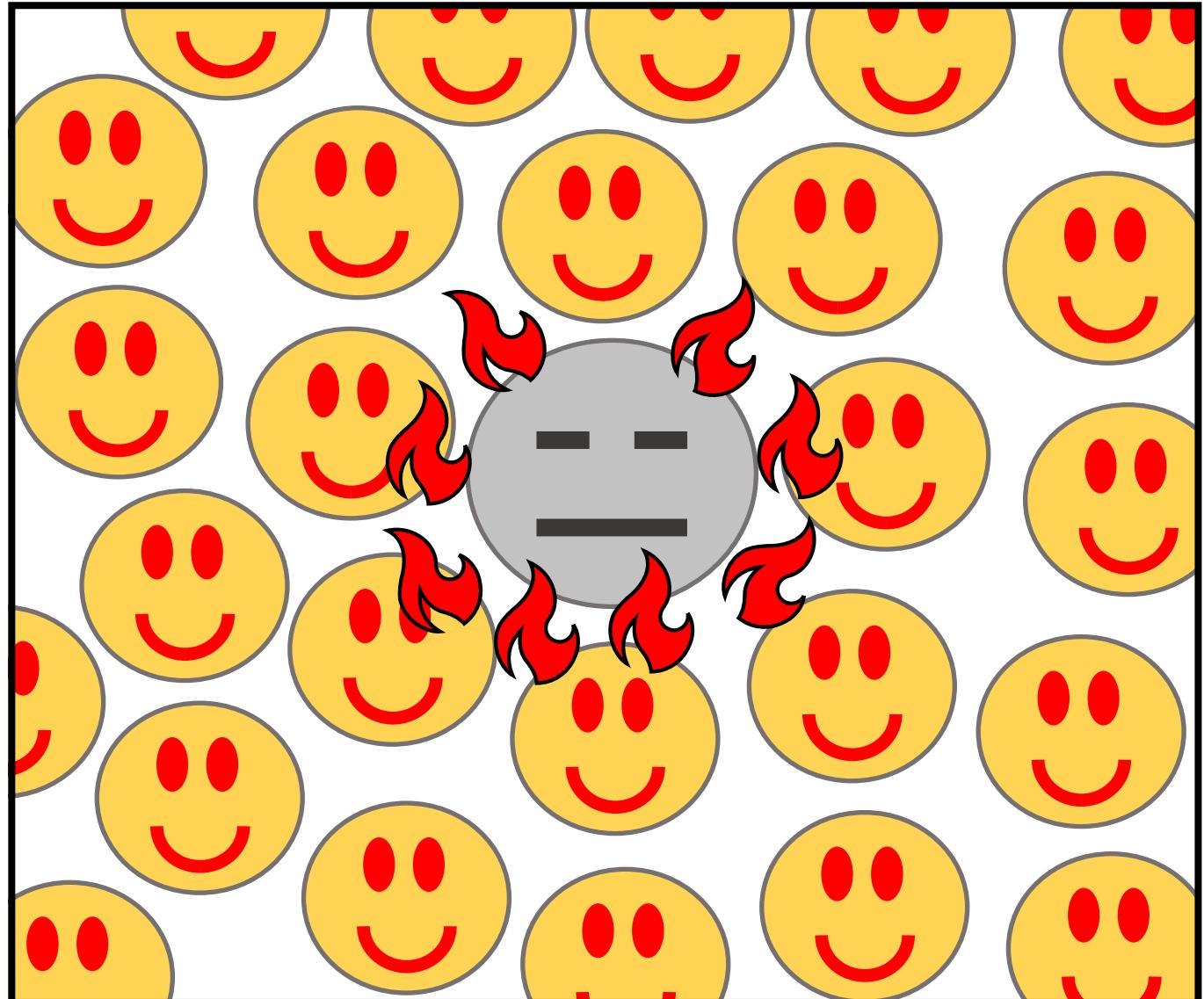
Senescent cells are bad neighbours



# Summary

Senescent cells are bad neighbours

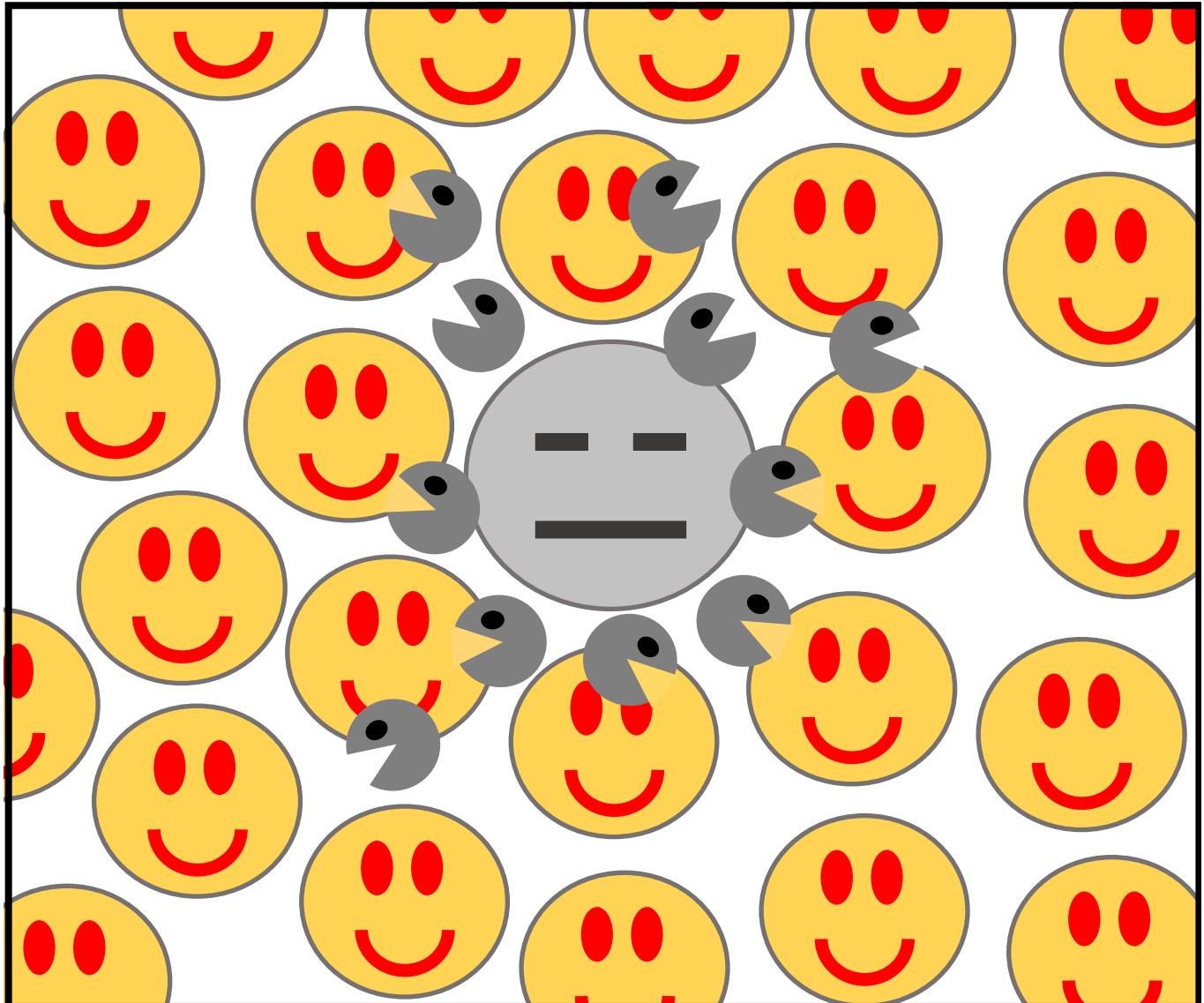
- Inflammation



# Summary

Senescent cells are bad neighbours

- Inflammation
- Tissue degeneration

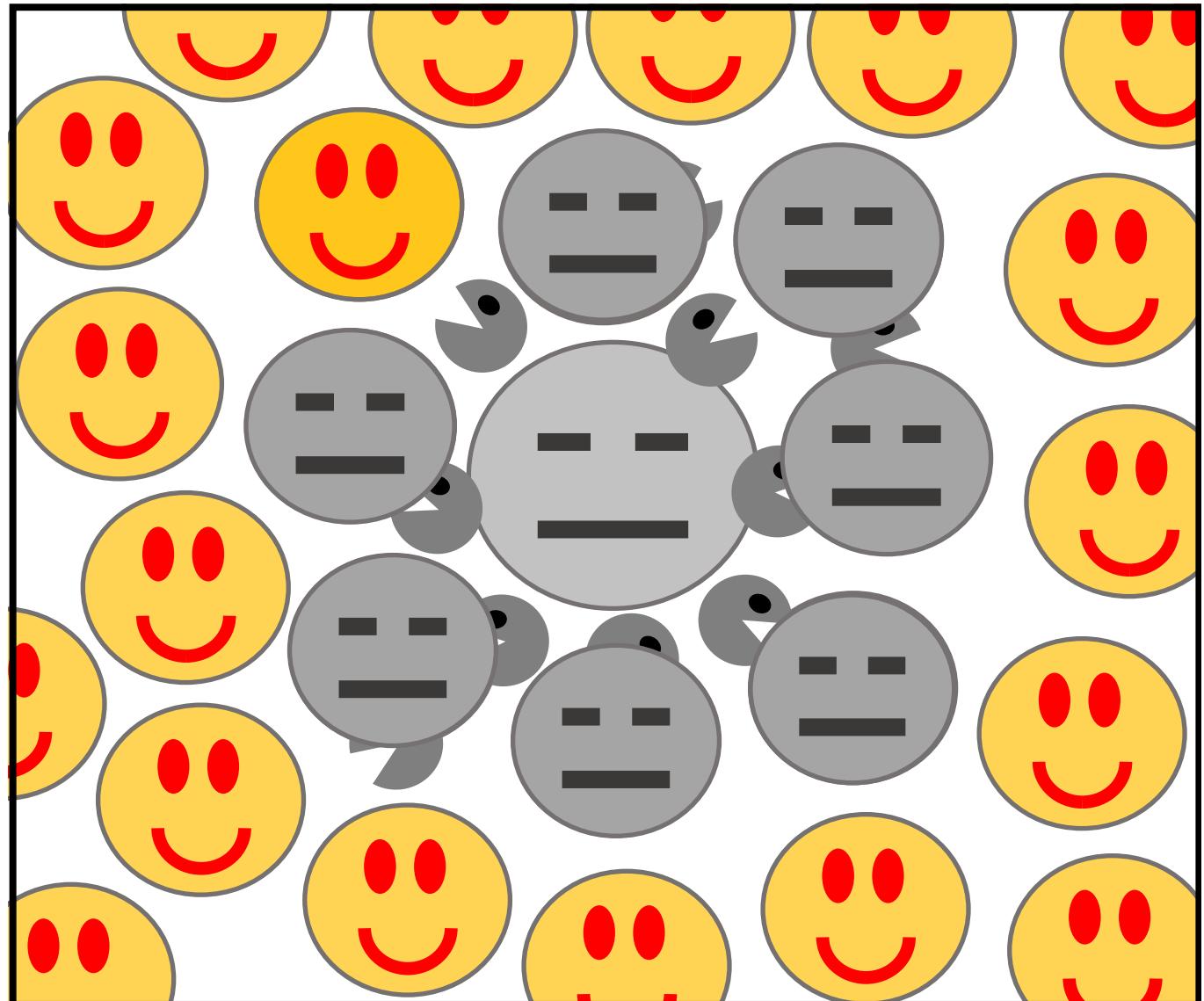


# Summary

Senescent cells are bad neighbours

- Inflammation
- Tissue degeneration

(Secretes  
metalloproteinases)

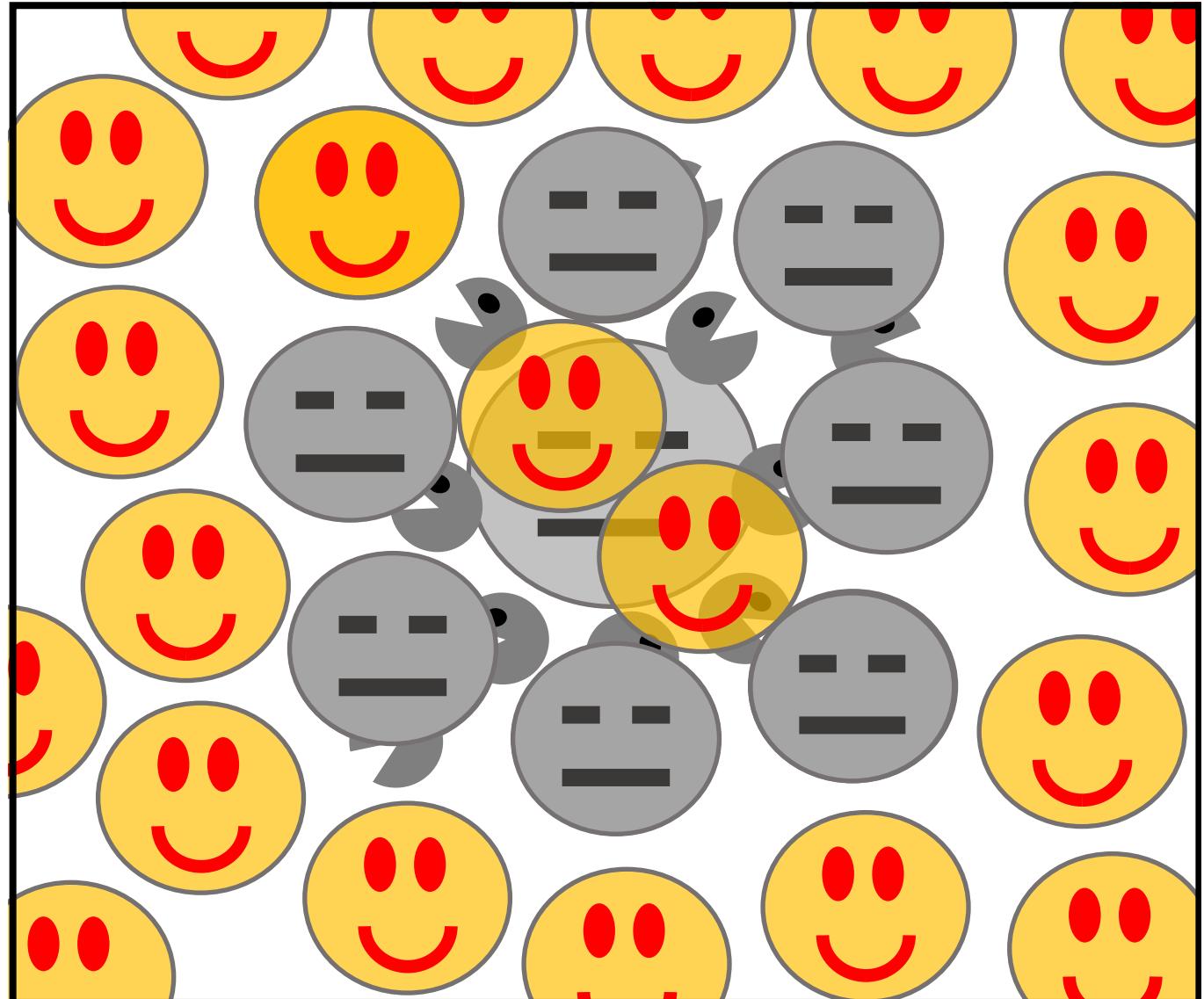


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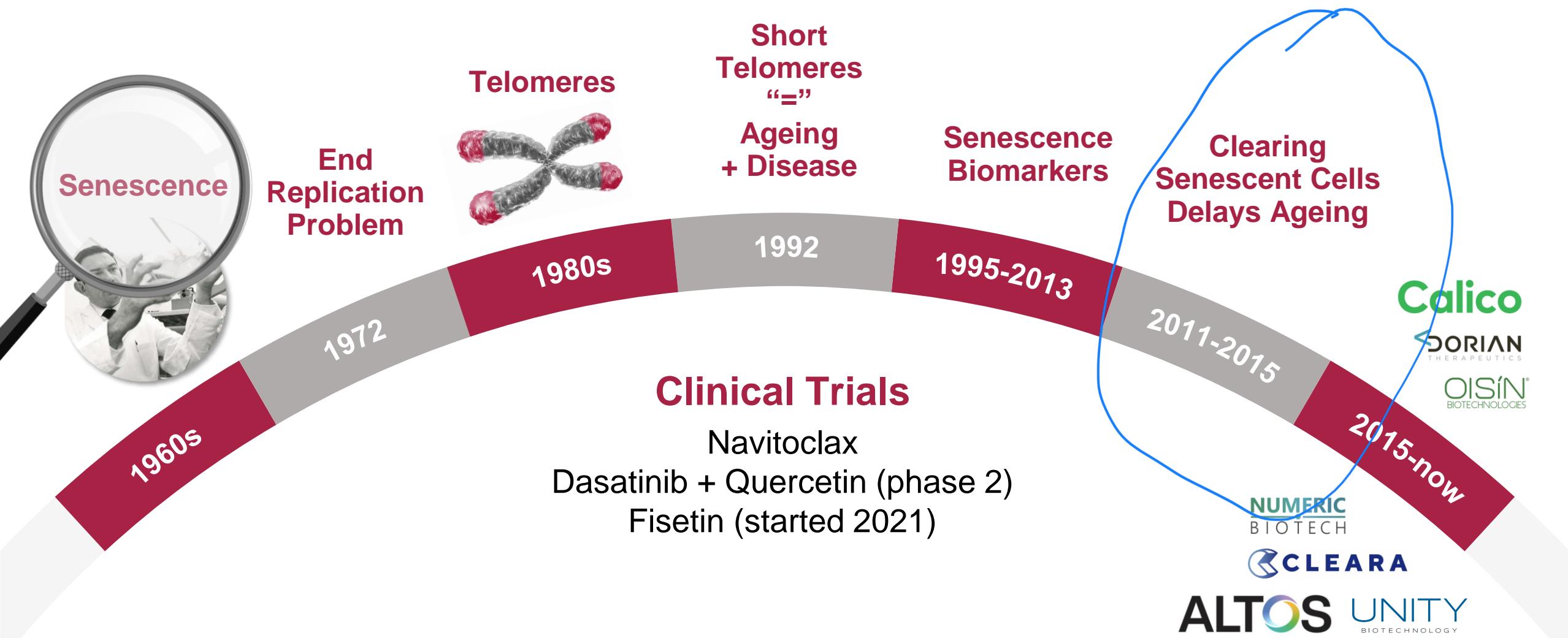
Senescent cells are bad neighbours

- Inflammation
- Tissue degeneration
- Senolytics

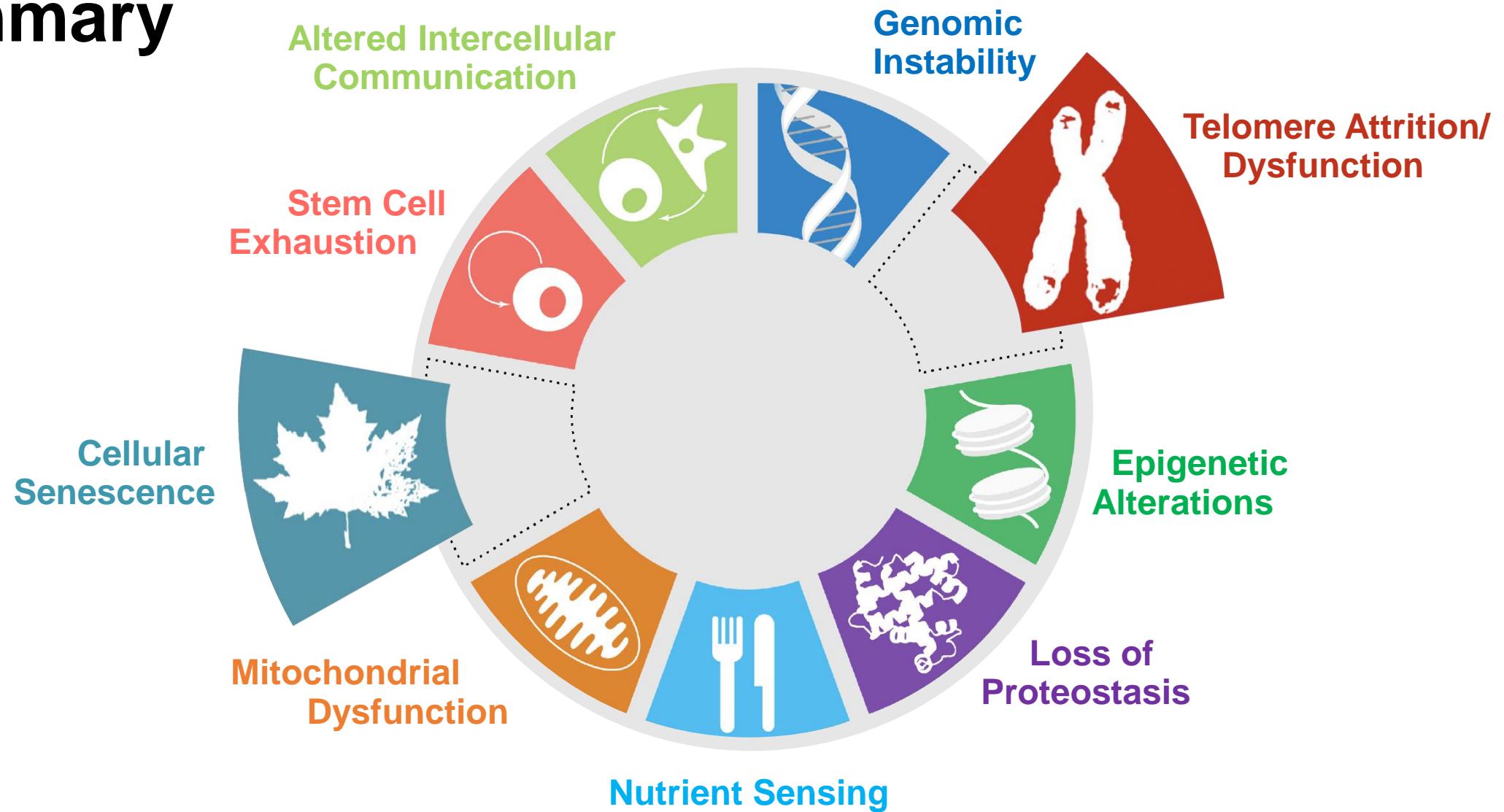
(doing that kill  
Senescent Cells)



# Summary

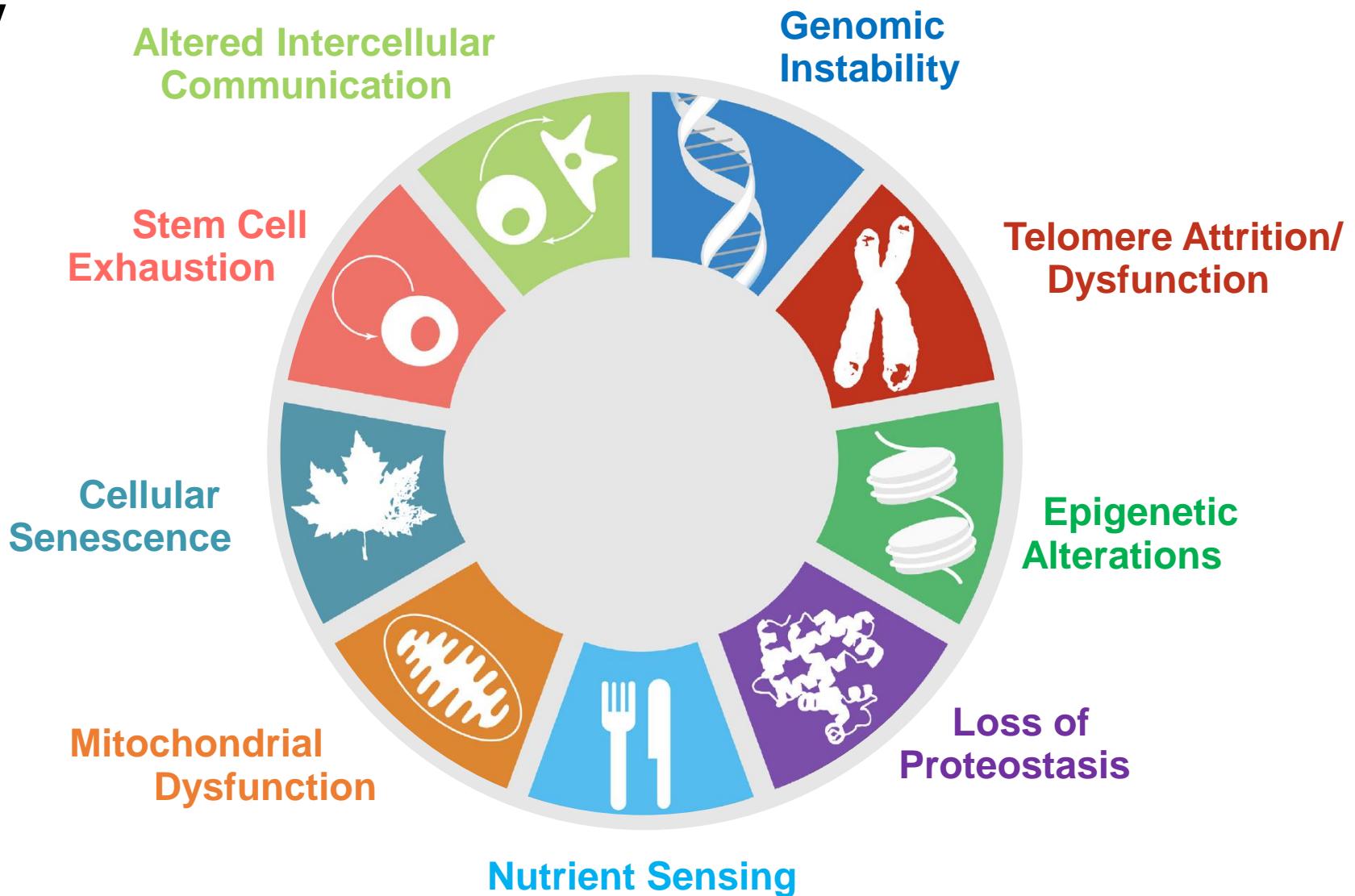


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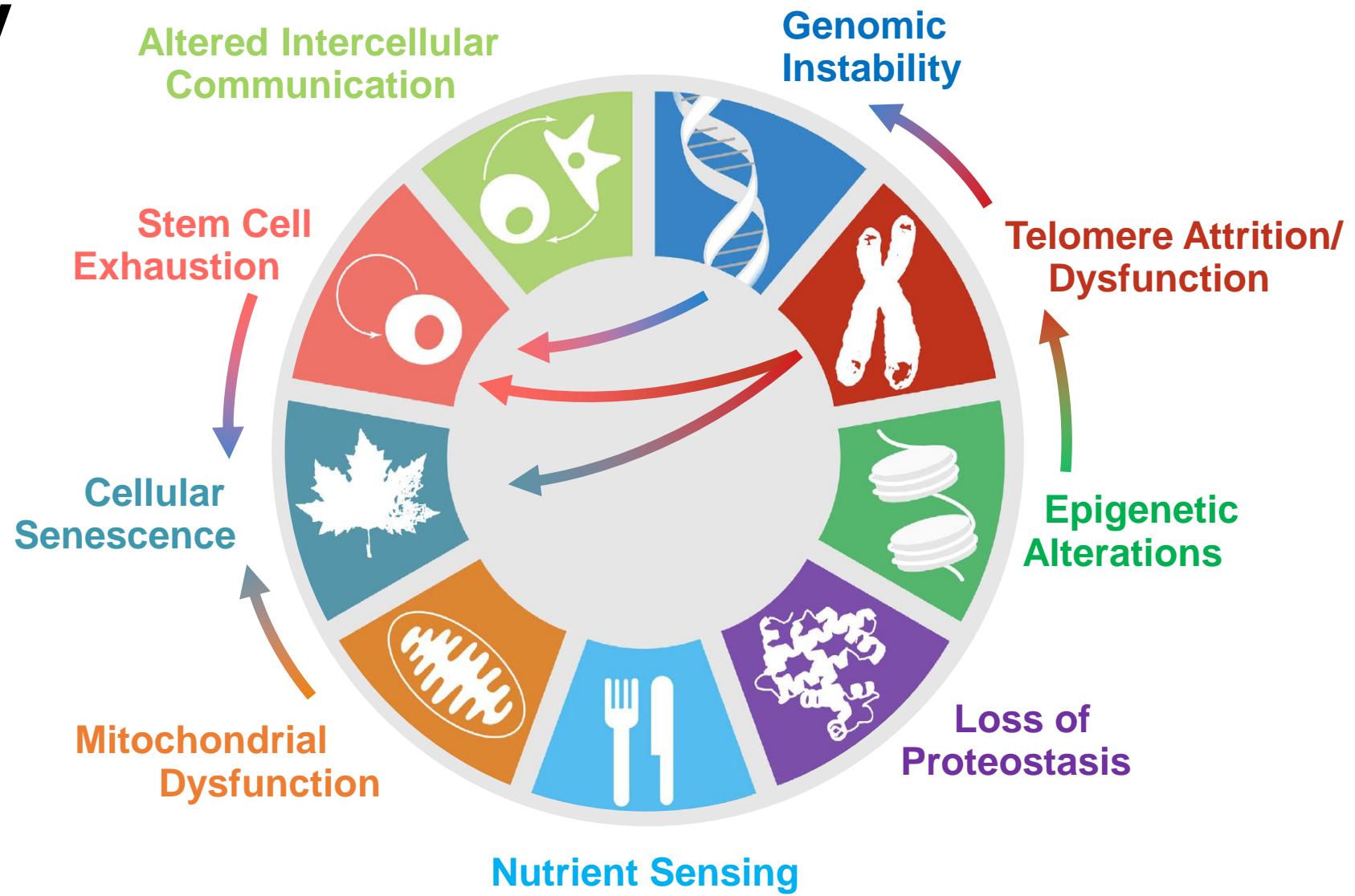
López-Otín, C., Blasco, M. A., Partridge, L., Serrano, M. & Kroemer, G. (2013). The hallmarks of aging. *Cell*, 153, 1194-1217. <https://doi.org/10.1016/j.cell.2013.05.039>

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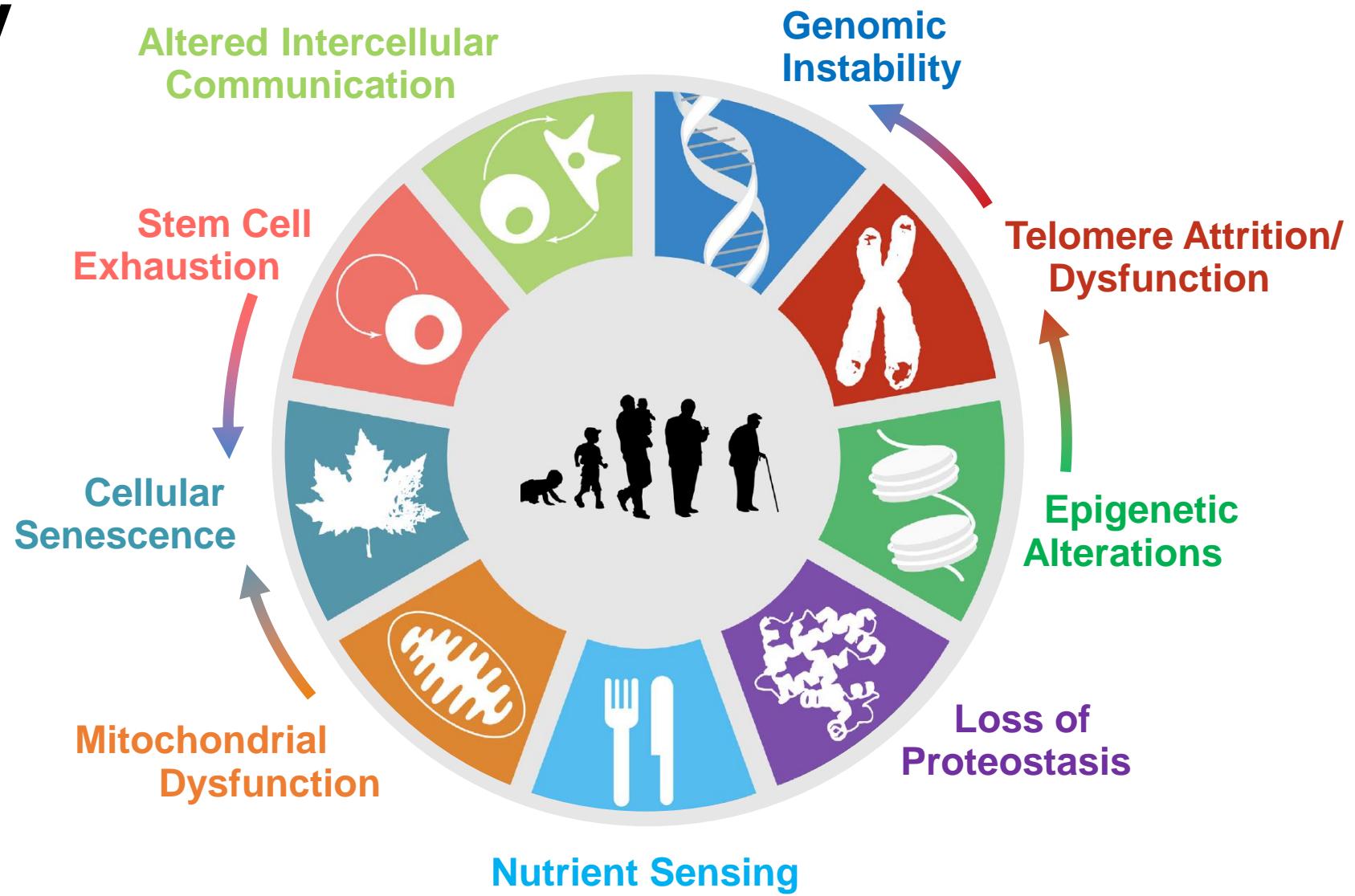
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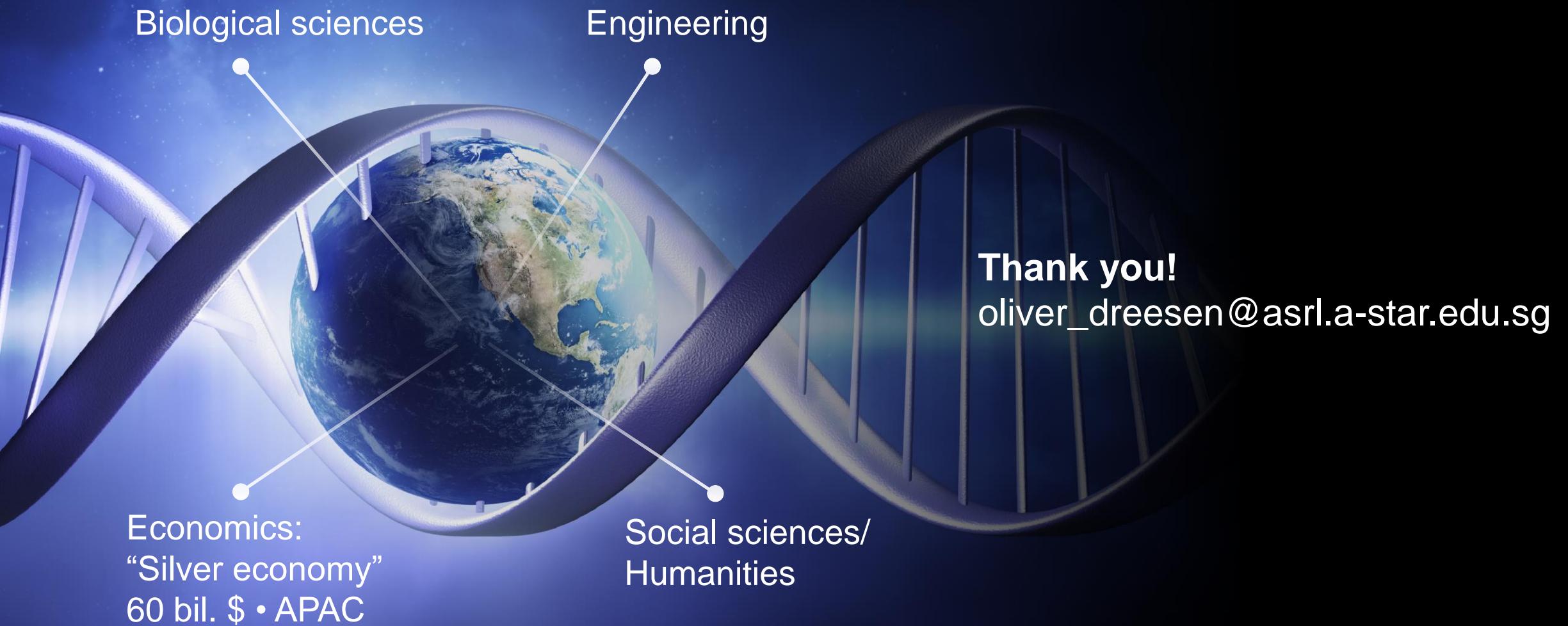
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# Summary



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