Is it possible to artificially prolong life?

곽서현, 정민

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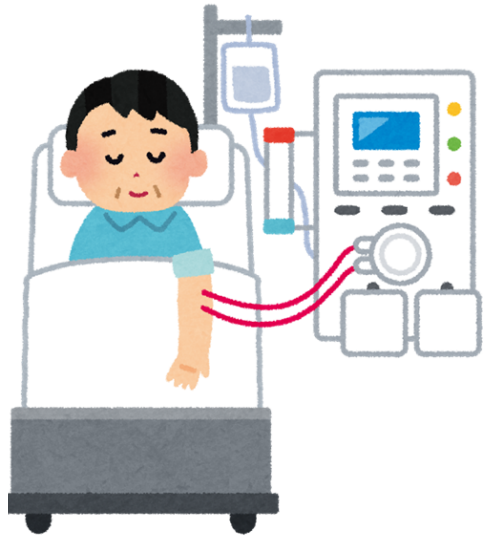
Medical technology

- surgery
- hemodialysis
- ventilator in ICU

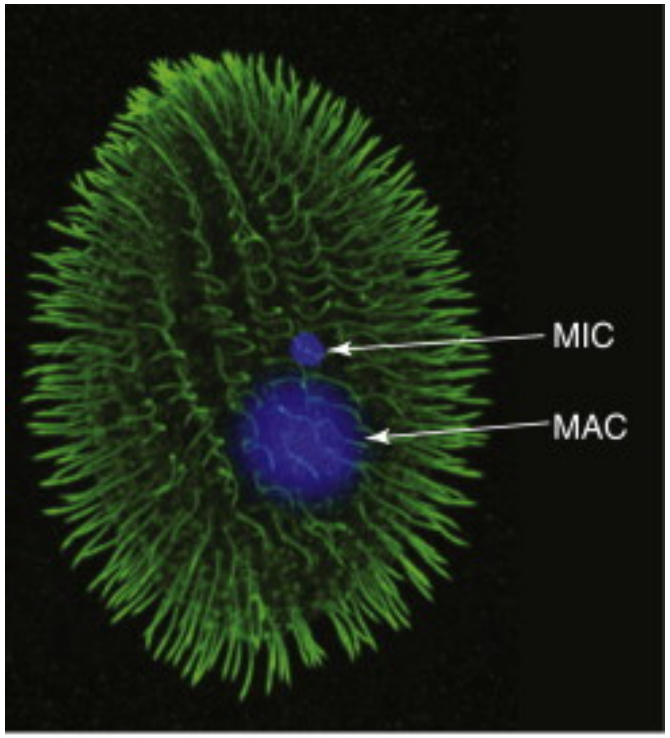


Scientific definition of living organisms

- inheritance & reproduction
- metabolism
- respond & adapt
- evolutions

Discovery of Telomere

- Leonard Hayflick: number of division limitation
- Elizabeth Blackburn: the reason is related to telomere
  - DNA of tetrahymena
  - MIC: store genetic information
  - MAC: make proteins



Current Biology

Discovery of Telomere

- In tetrahymena, (5'-CCCCAA-3’)

organism	Sequence (5’ to 3’)
Vertebrate(척추동물) Person Mice Rats Birds	TTAGGG
Red Bread Mold	TTAGGG
Arabidopsis	TTTAGGG
Chlamydomonas	TTTTAGGG
Silkworm Moth	TTAGG
Yeast	TTAC(A)(C)G(1-8)

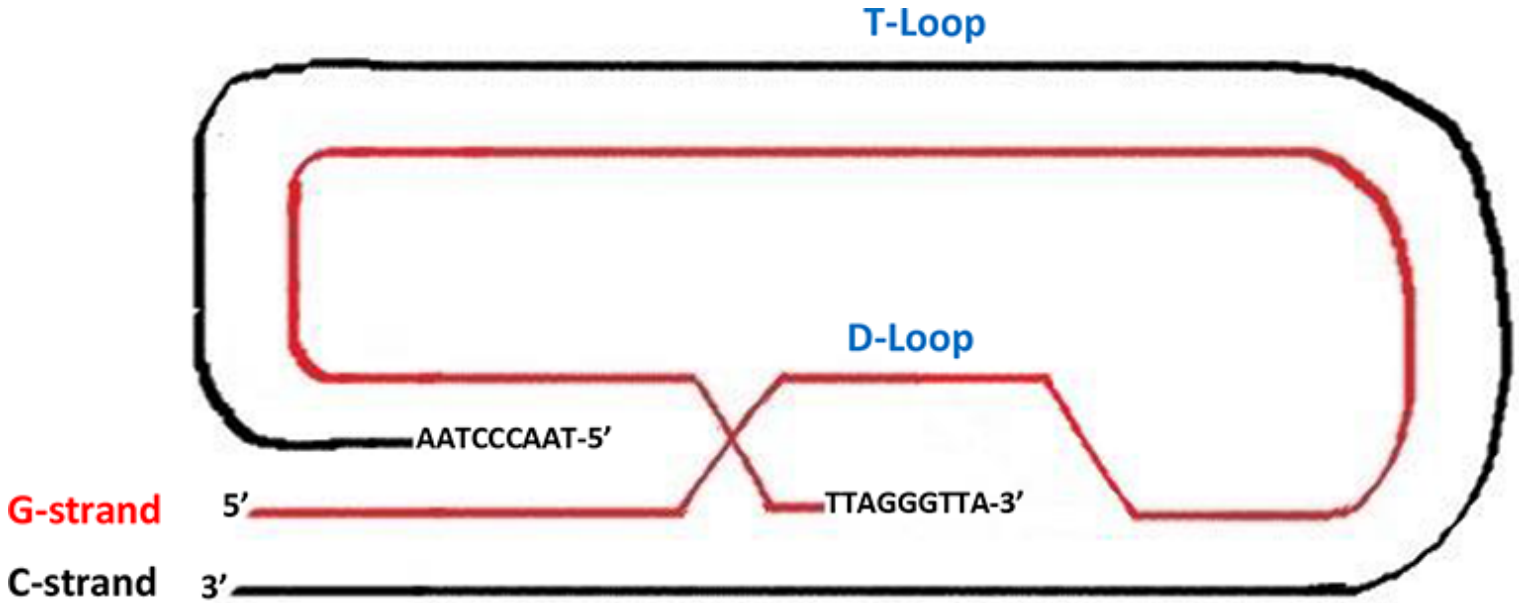
Functions of Telomere

1. chromosomes-end-protection

prevent ends from being recognized as DNA breaks

'end-capping' structure: 3` end forms a t-loop (stable)

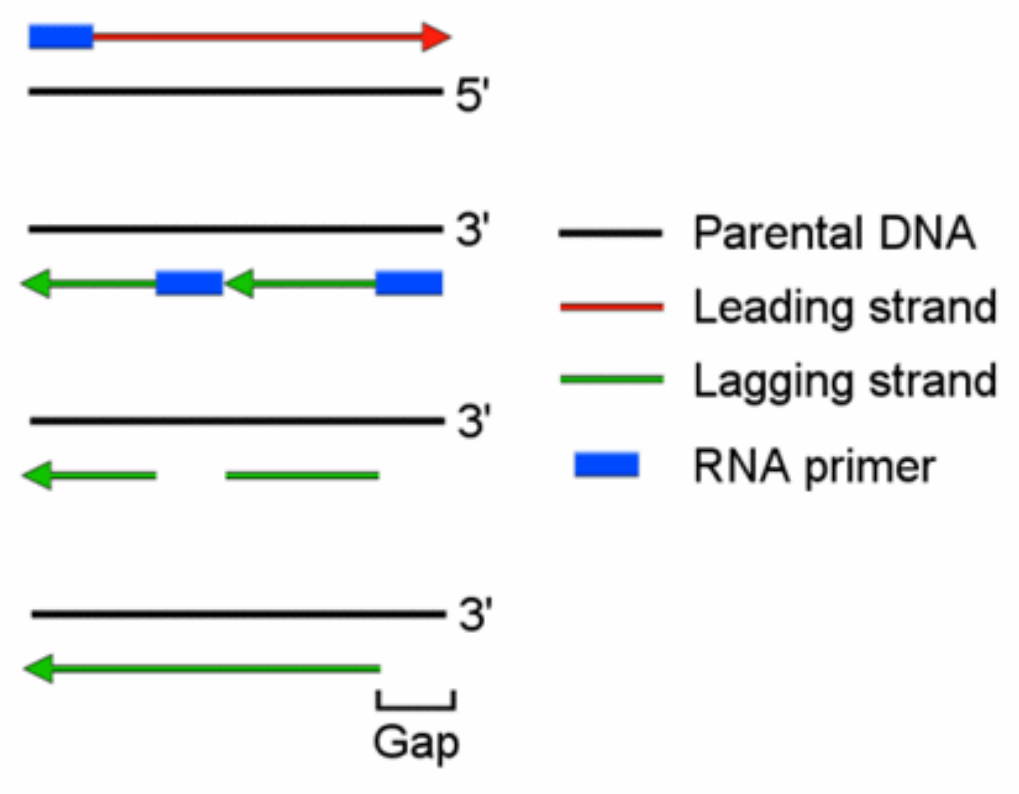
*t-loop(telomeric-loop)
*D-loop(displacement-loop)



Functions of Telomere

2. solve the end-replication problems

DNA polymerases can’t copy the extreme ends of chromosomes

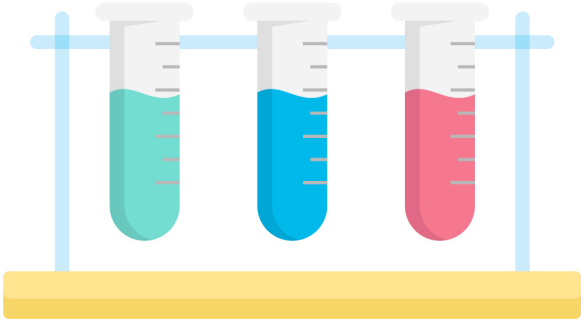


Discovery of Telomerase

Carol Greider:

add cell extracts to piece of telomeres DNA

-> telomeres were further synthesized

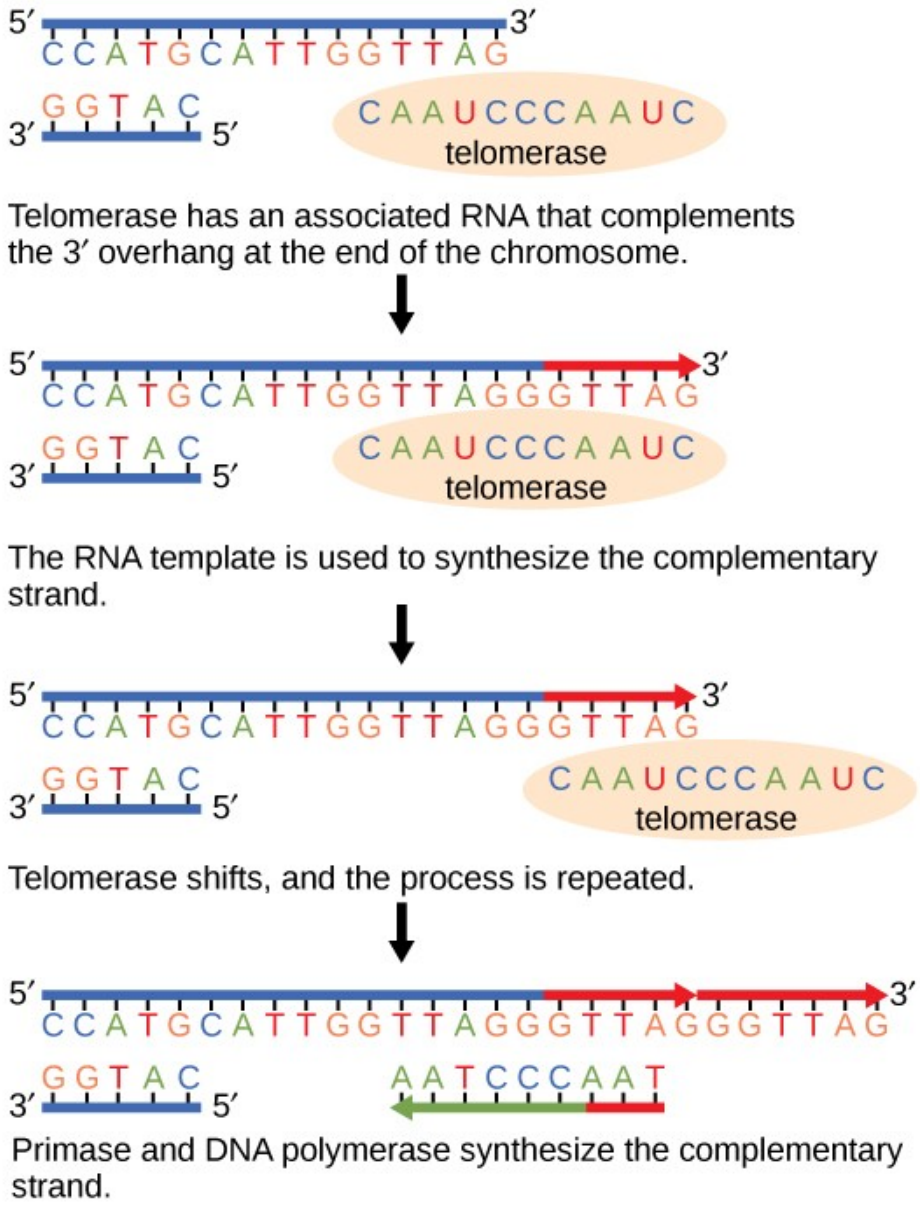


Finally, separate Telomerase from cell extracts

Functions of Telomerase

prevents shortening of telomeres

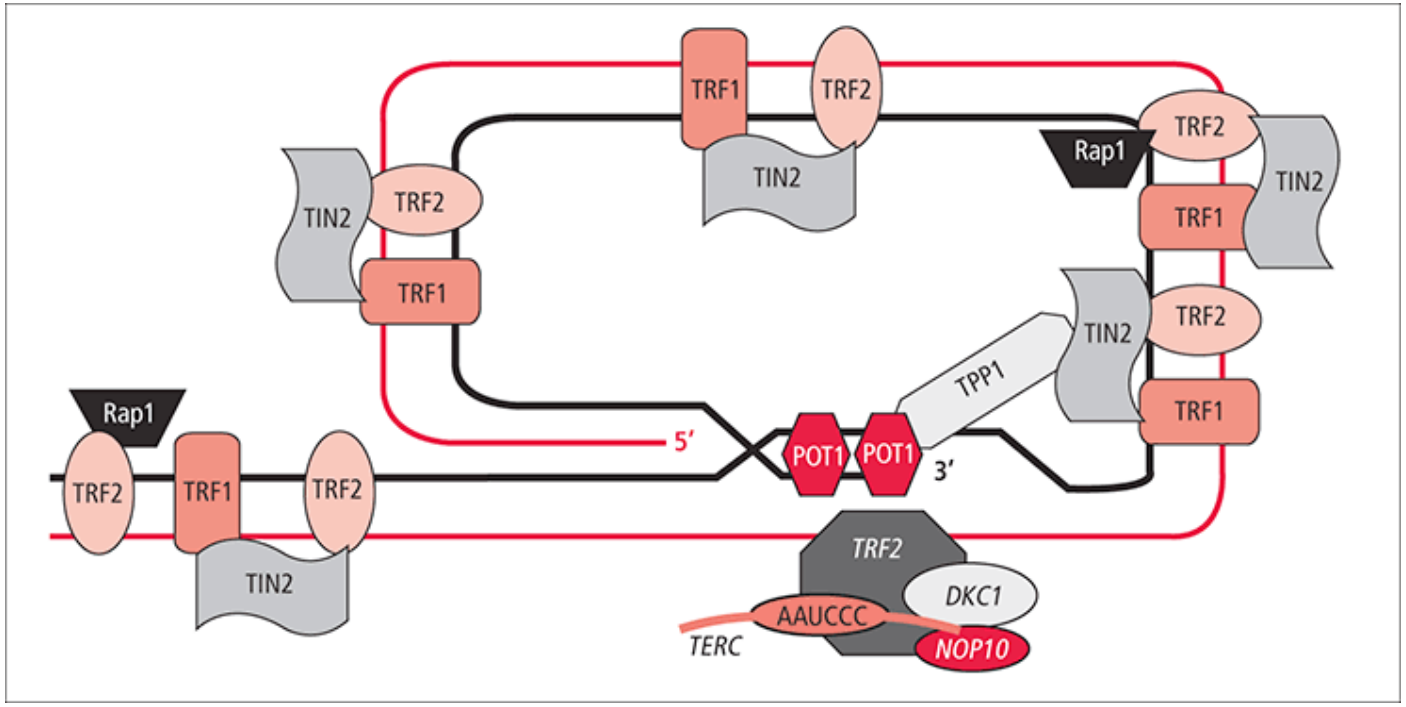
- can make telomeric DNA using its RNA template
- RNA template has a complementary sequence to telomere



Telomeric Proteins

help chromosomes end protection

1. Telomere-binding proteins
 -> directly bind to telomere



2. Shelterin complex
 -> cannot directly bind to telomere

functions: prevents telomerase from approaching telomeres

Relationship between Lifespan and Telomere

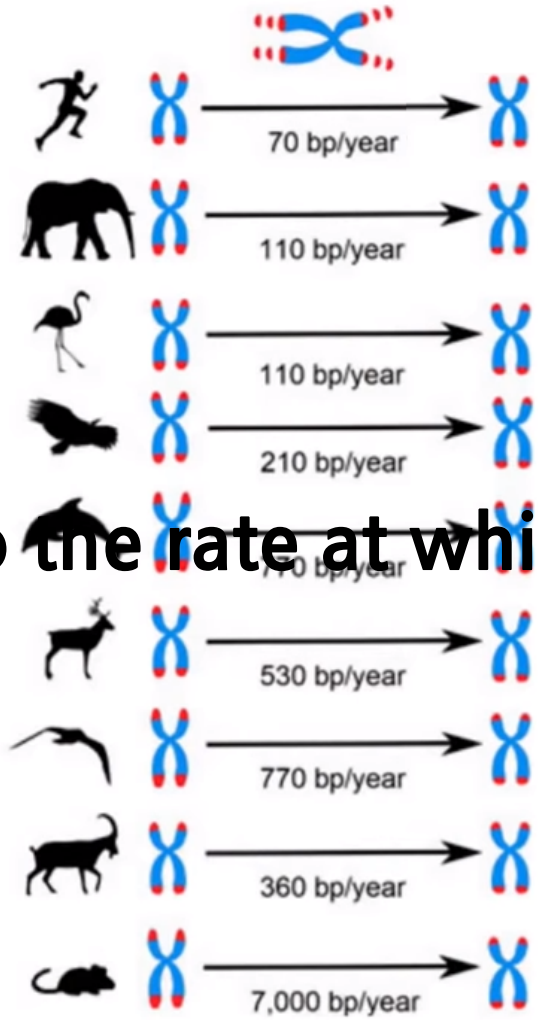
=

?

Relationship between Lifespan and Telomere

	length of telomere (kb)
Humans	5~15 kb
Mice	Up to 150 kb
Rats	20~100 kb
Birds	5~20 kb
Ants	9~13 kb

Relationship between Lifespan and Telomere



Lifespan is related to the rate at which telomeres are reduced.

we can use it as a measure of relative life span length.

Extending life by extending the actual telomere length

increase the length of the telomeres → extend the lifespan?

The length of the telomere can be increased by using mRNA to transmit genetic information of DNA to ribosomes to activate the 'telomerase'

Extending life by extending the actual telomere length

Article | Open Access | Published: 17 October 2019

Mice with hyper-long telomeres show less metabolic aging and longer lifespans

Miguel A. Muñoz-Lorente, Alba C. Cano-Martin & Maria A. Blasco

Nature Communications **10**, Article number: 4723 (2019) | Cite this article

1. cholesterol levels have been reduced
2. insulin, glucose tolerance has been increased
3. DNA damage has been reduced
4. Mitochondria has been improved.

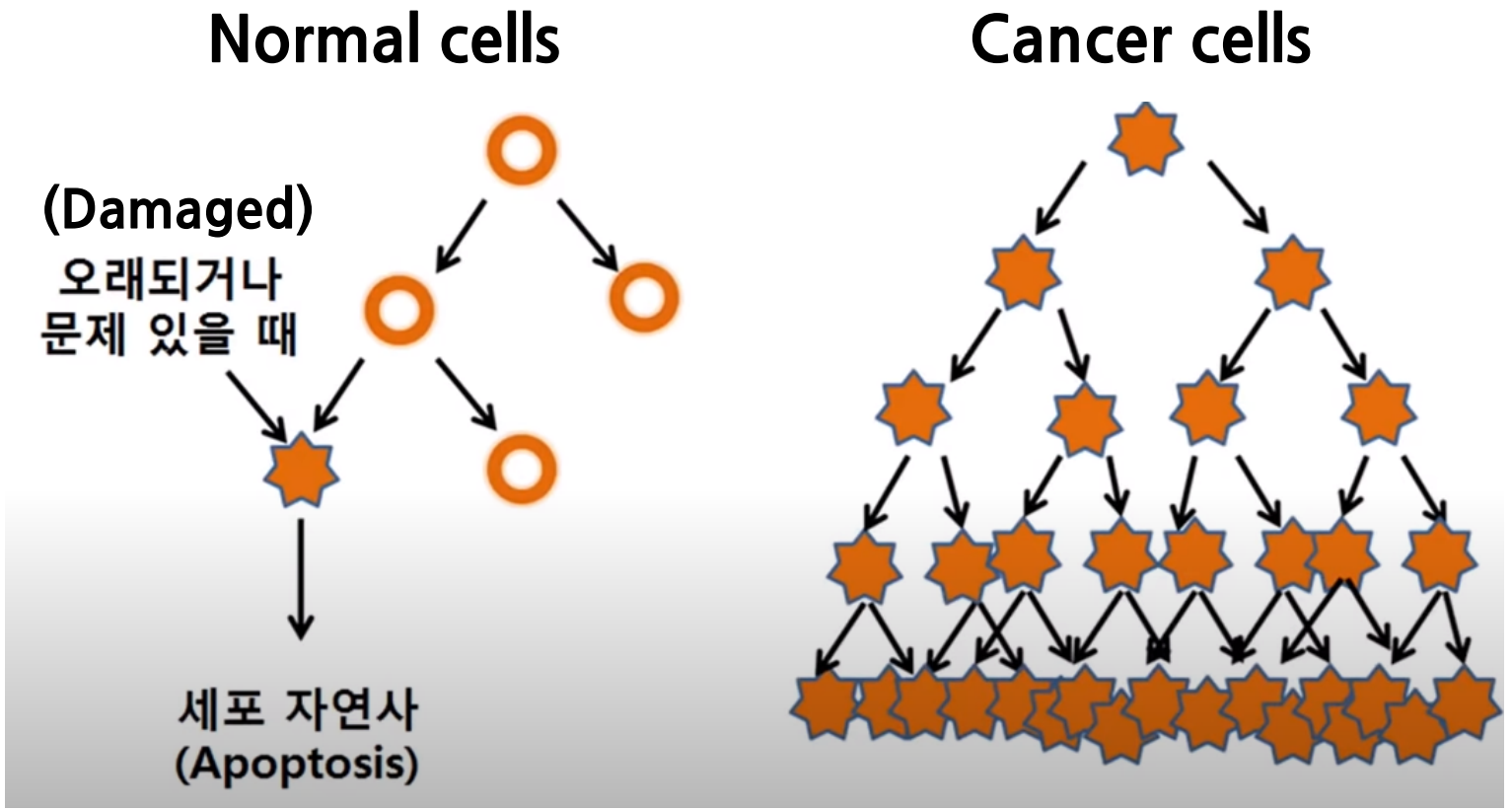
Extending life by extending the actual telomere length

people with shorter telomeres are more vulnerable to

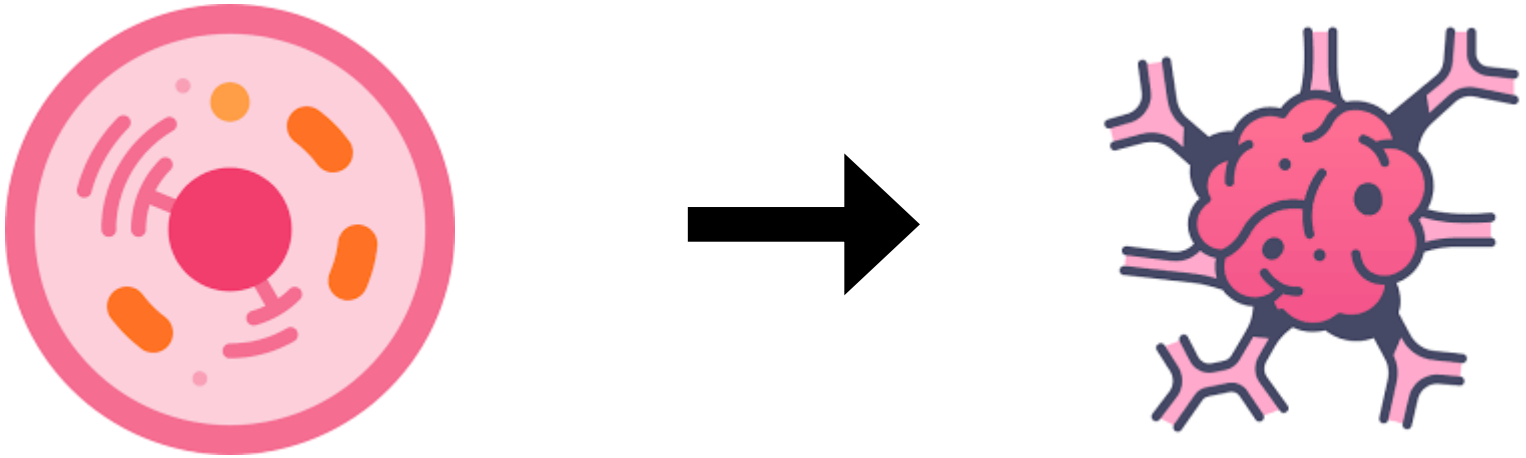
- viruses
- cancer
- obesity
- Hypertension (High blood pressure)

These indicate that telomere length extension can increase life span.

Extending life by extending the actual telomere length



Extending life by extending the actual telomere length

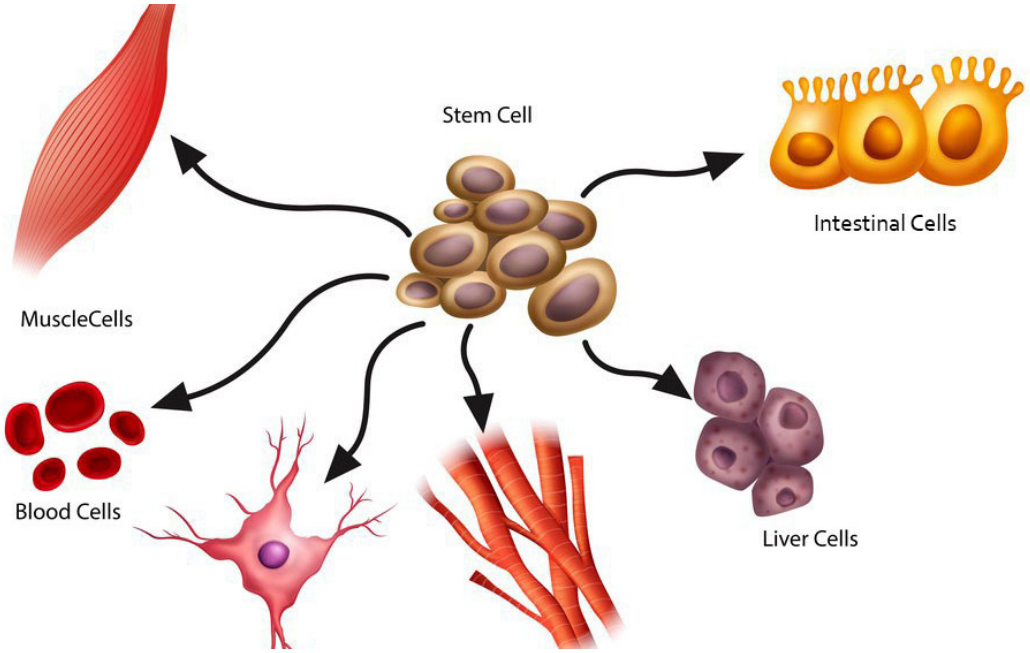


If the telomeres of cancer cells are prolonged, the adverse effects will occur.

Still need more research!

Different ways of extending lifespan

1. Using stem cell



Stem cells have the ability to differentiate into different types of body tissues

artificial organ cultivation
→ Replacing unhealthy organs with healthy ones
→ life expectancy extension

Different ways of extending lifespan

1. Using stem cell

Injection

Lifespan increased by more than 30%!

Stem cells penetrated into the brain damaged by aging and differentiated into nerve cells

Different ways of extending lifespan

2. Drug treatment

Lifespan increased by 48%!

1.Lithium(tranquilizer) 2.trametinib(anti-cancer drug) 3.rapamycine(immunomodulator)

These slow down the aging process and delays death through aging.

Different ways of extending lifespan

3. Genetic modification

2~3 weeks → 6 weeks

600 days → 800 days

From now, apply to a human!

Reference

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Thank you for your attention.