



# 端粒和端粒酶

## Telomere and Telomerase

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# 秦始皇寻仙求药



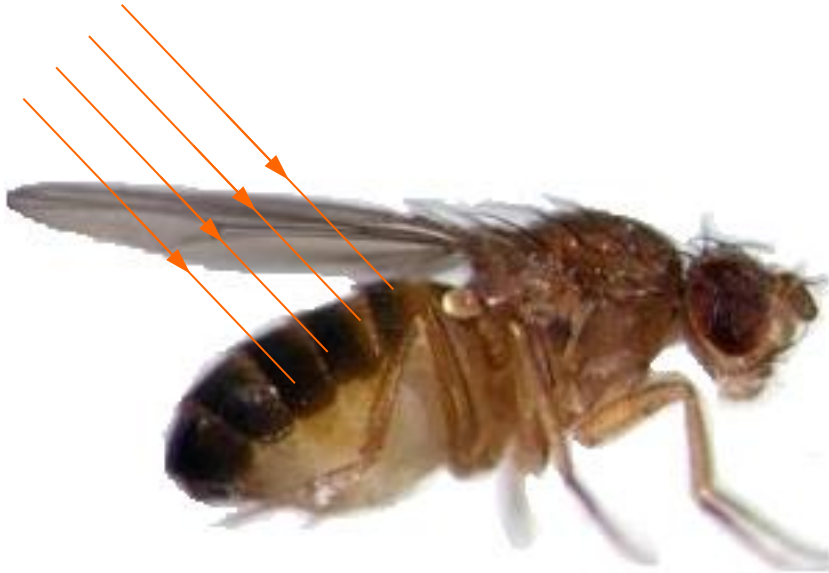
# The Mystery of Aging Revealed...



# 1. Telomere



1938, Hermann J. Müller



# 1.1 definition

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**Telomeres are the terminal DNA-protein complexes of linear eukaryotic chromosomes.**

# 1.2 components



## telomeric DNA

Species	Sequence
Tetrahymena (四膜虫)	$[-TTGGGG-]_n$
Arabidopsis (拟南芥)	$[-TTTAGGG-]_n$
mouse	$[-TTAGGG-]_n$
human	$[-TTAGGG-]_n$



# telomeric DNA

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Species	Length
yeast (酵母)	300~400 bp
oxytricha (纤毛虫)	20 bp
mouse	20~50 kb
human	5~15 kb

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# protein complexes



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**Shelterin**

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**function**

**TRF1**

**TRF2**

**Rap1**

**TPP1**

**POT1**

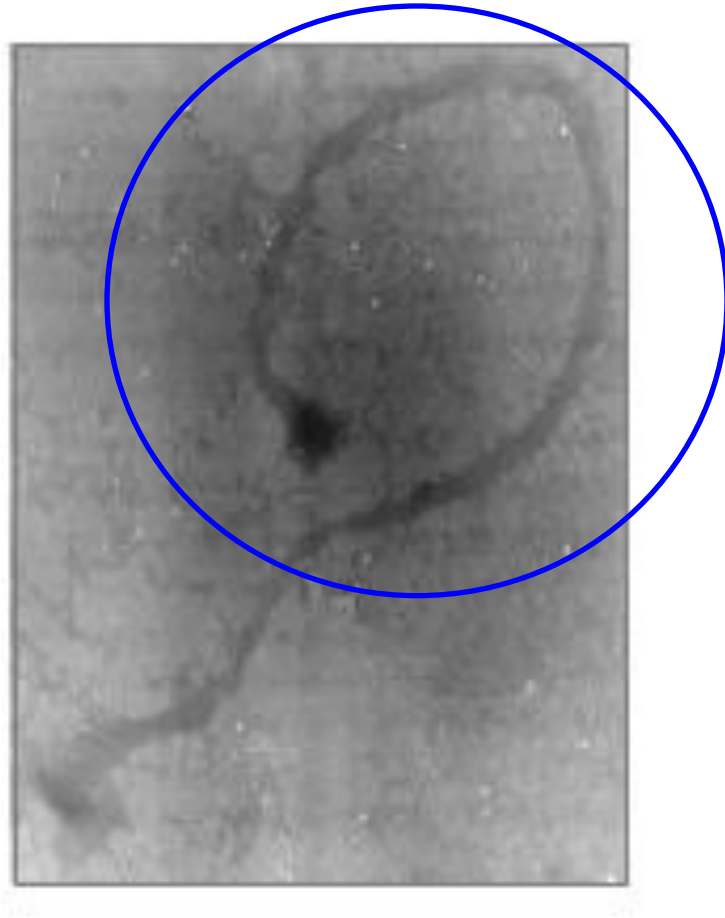
**TIN2**

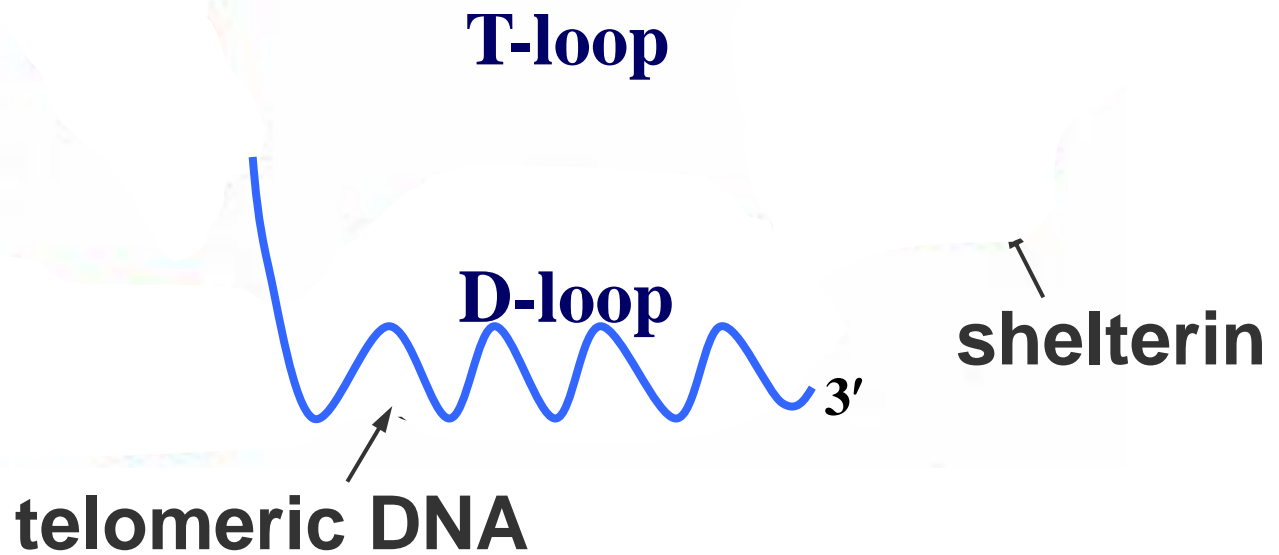
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**negatively  
regulate  
telomere length**



# 1.3 structure

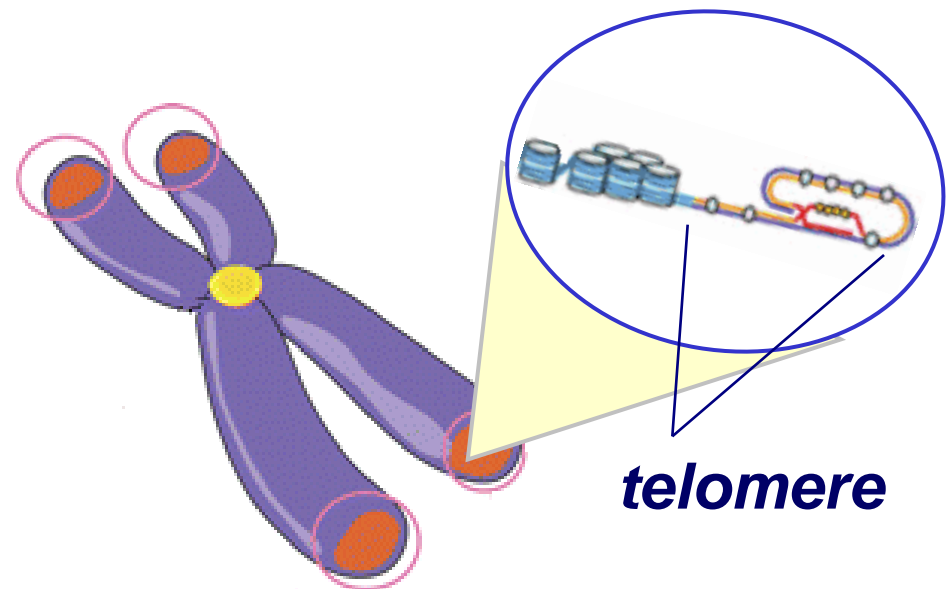




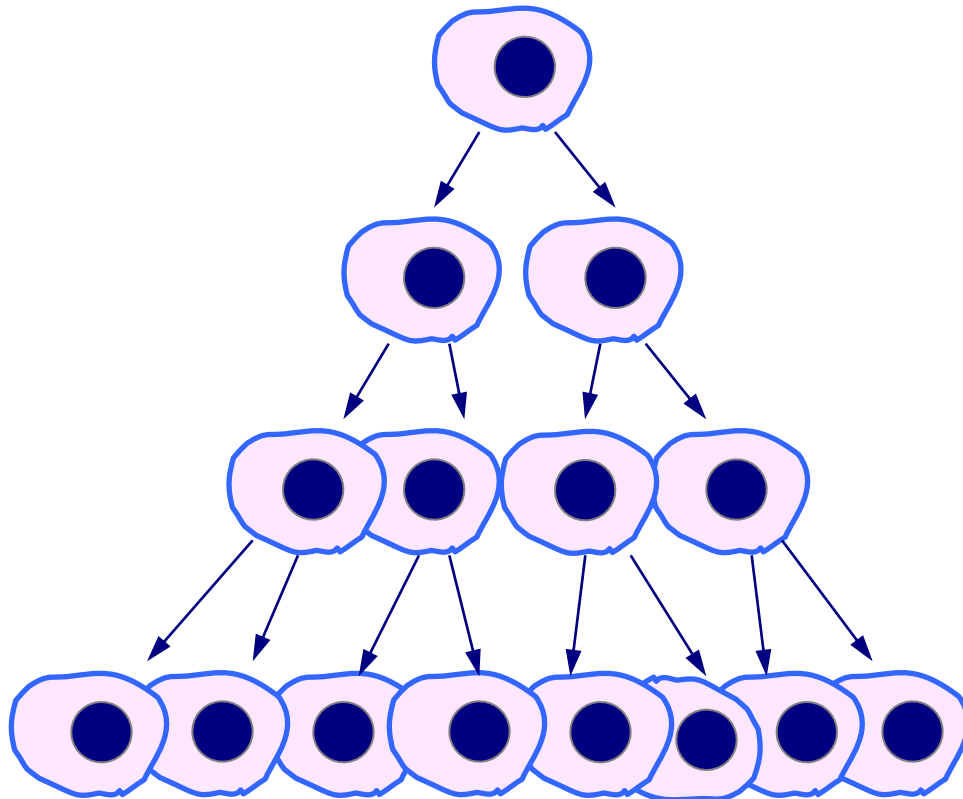
# 1.4 function



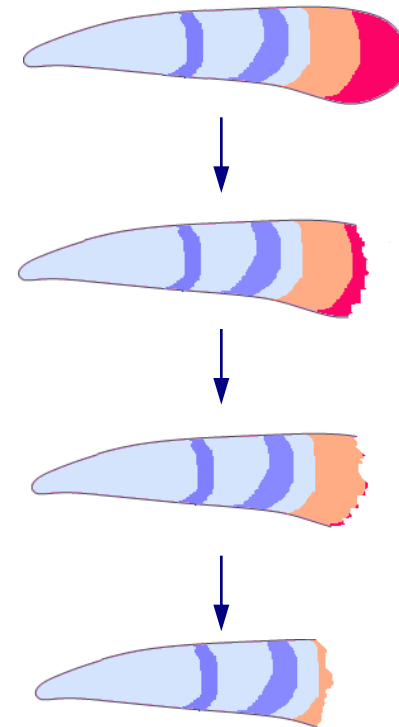
**Ensure chromosome integrity  
and stability.**



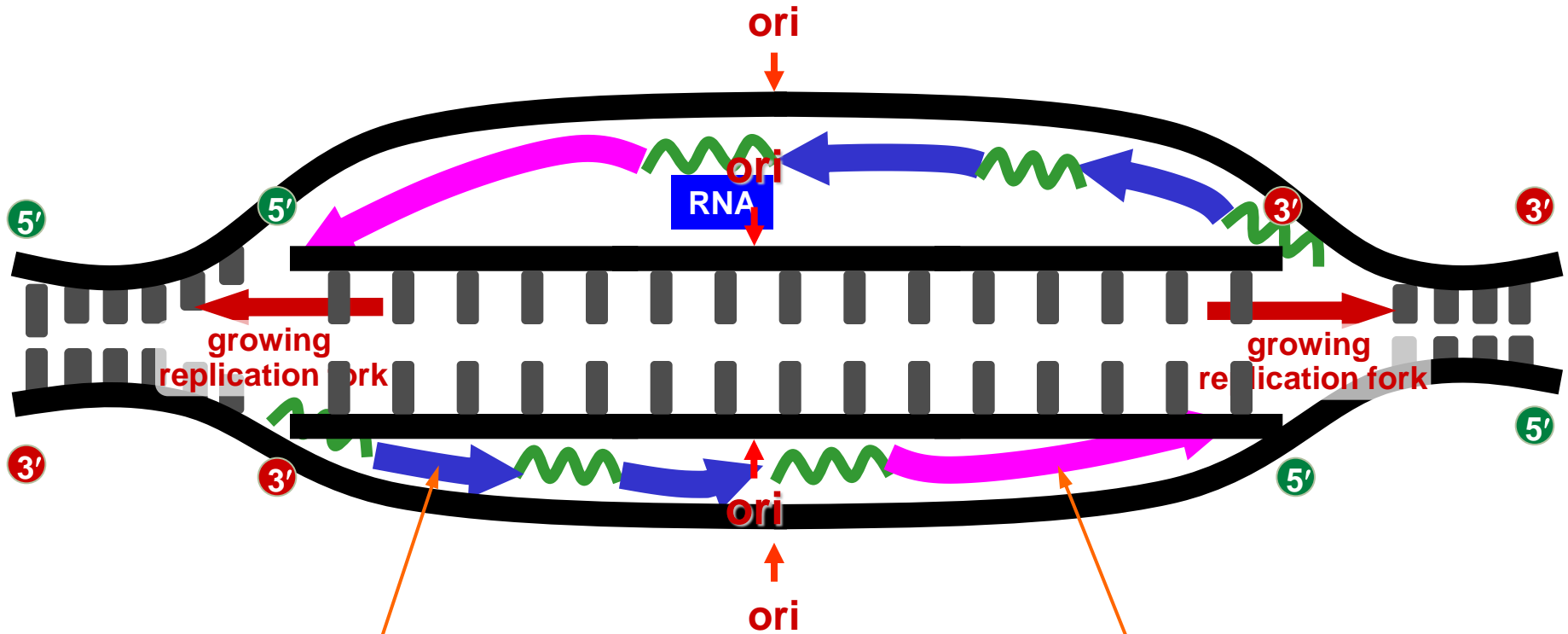
# Cell division



# Chromosome tips without telomerase



# semi-discontinuous replication

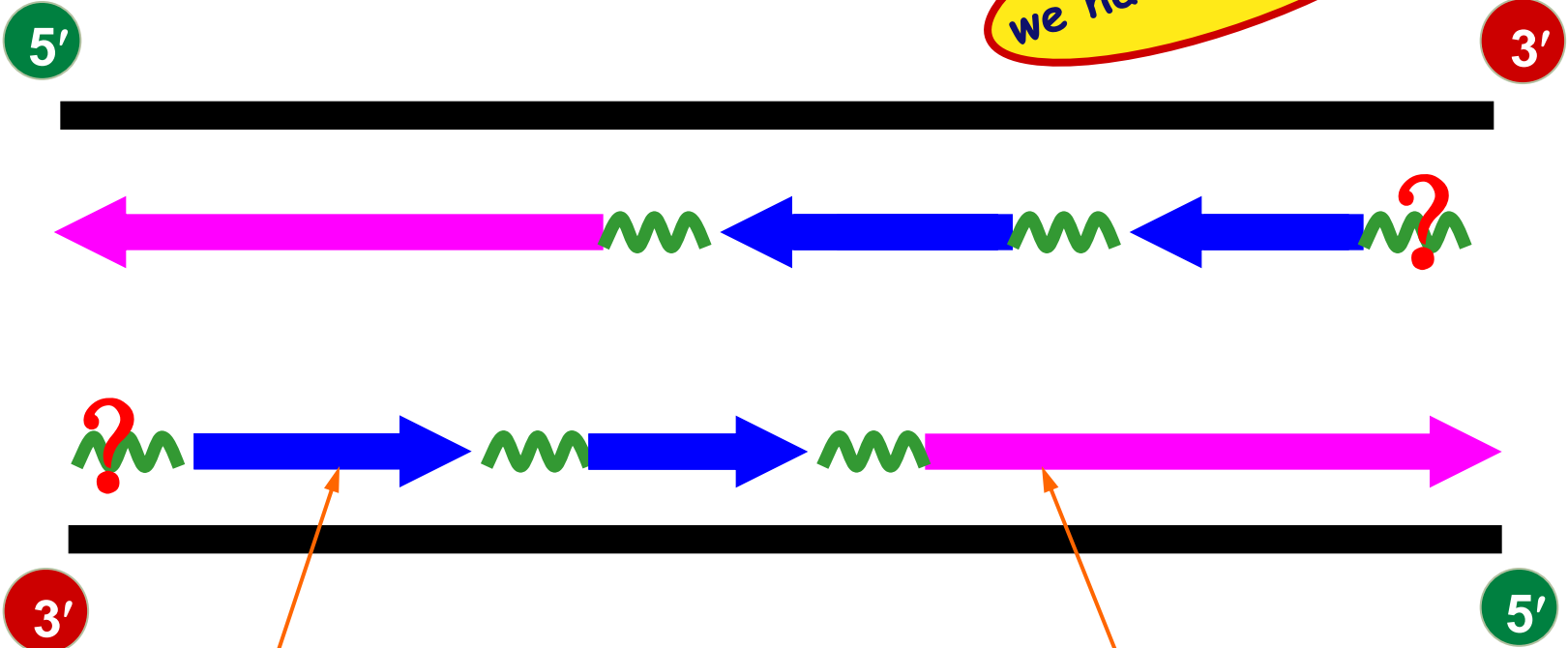
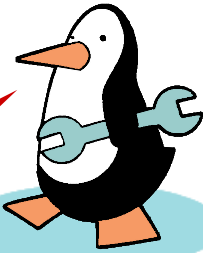


Lagging strand

Leading strand

# end-replication problem

we have a problem!



Lagging strand

Leading strand

# end-replication problem



# 2. Telomerase





# 2.1 definition

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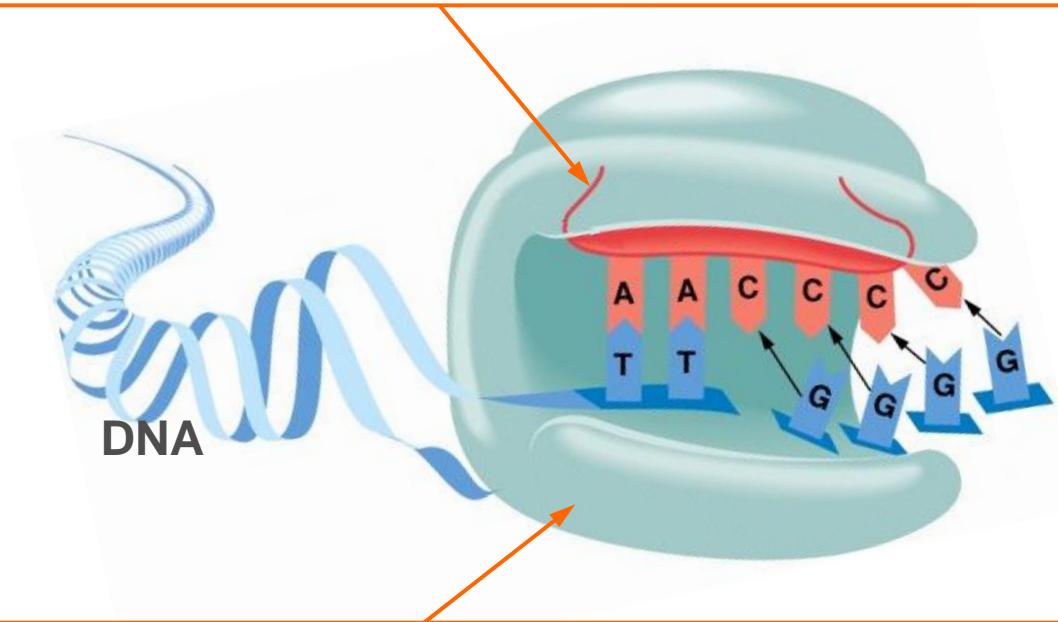


**Telomerase is an conserved reverse transcriptase that extends telomeric DNA using an integral RNA component as the template.**

# 2.2 components

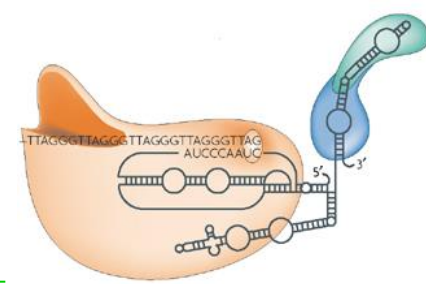


**TERC (telomerase RNA component)**



**TERT (telomerase reverse transcriptase)**

# Human telomerase



Nature Reviews | Cancer

**RNA**

**hTR**

(human telomerase RNA )

**5'-CUAACCCUAAC-3'**

**protein**

**hTERT**

(human telomerase catalytic subunit )

**TP1**

( telomerase associated protein 1)

# 2.3 function

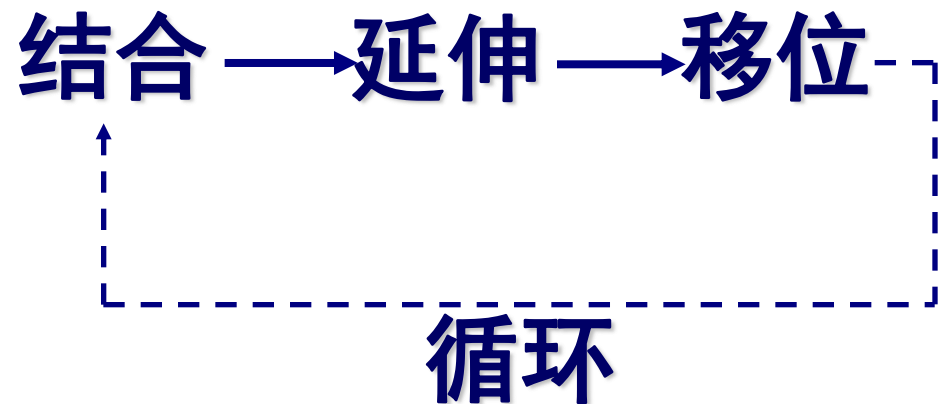


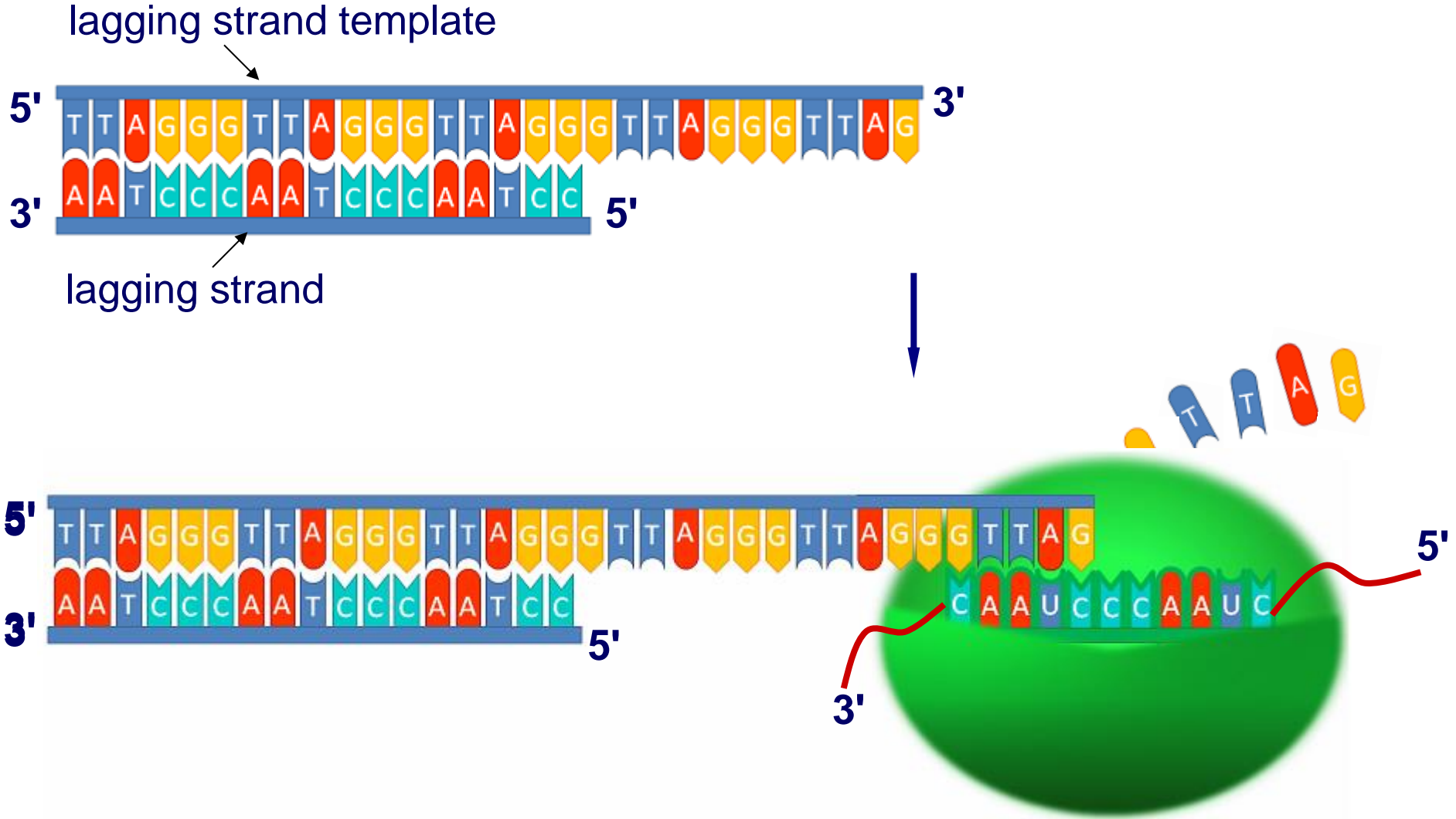
## extends telomeric DNA



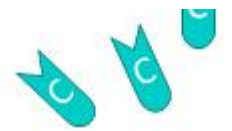
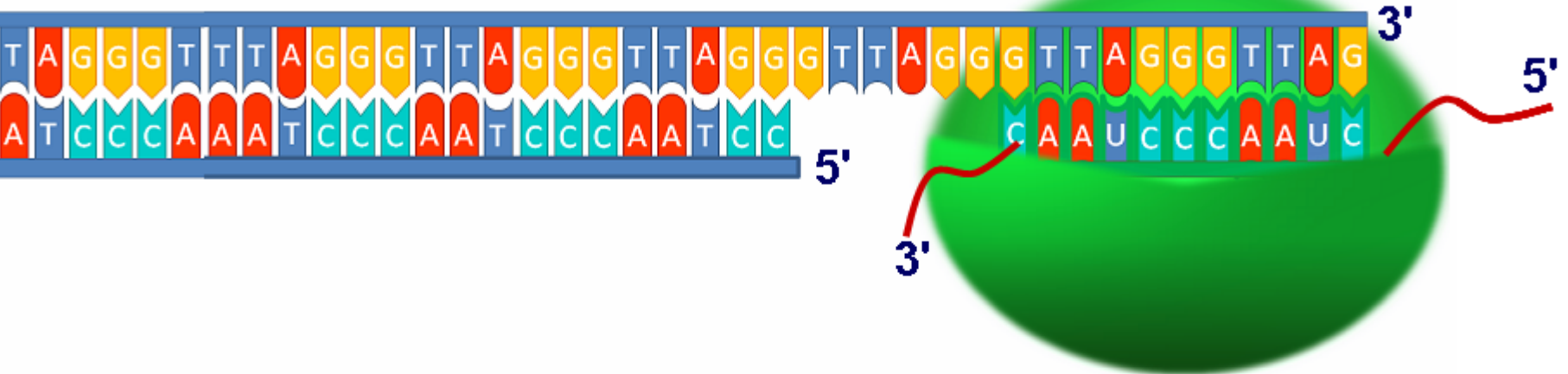
尺蠖 (inchworm)

**inchworm model**





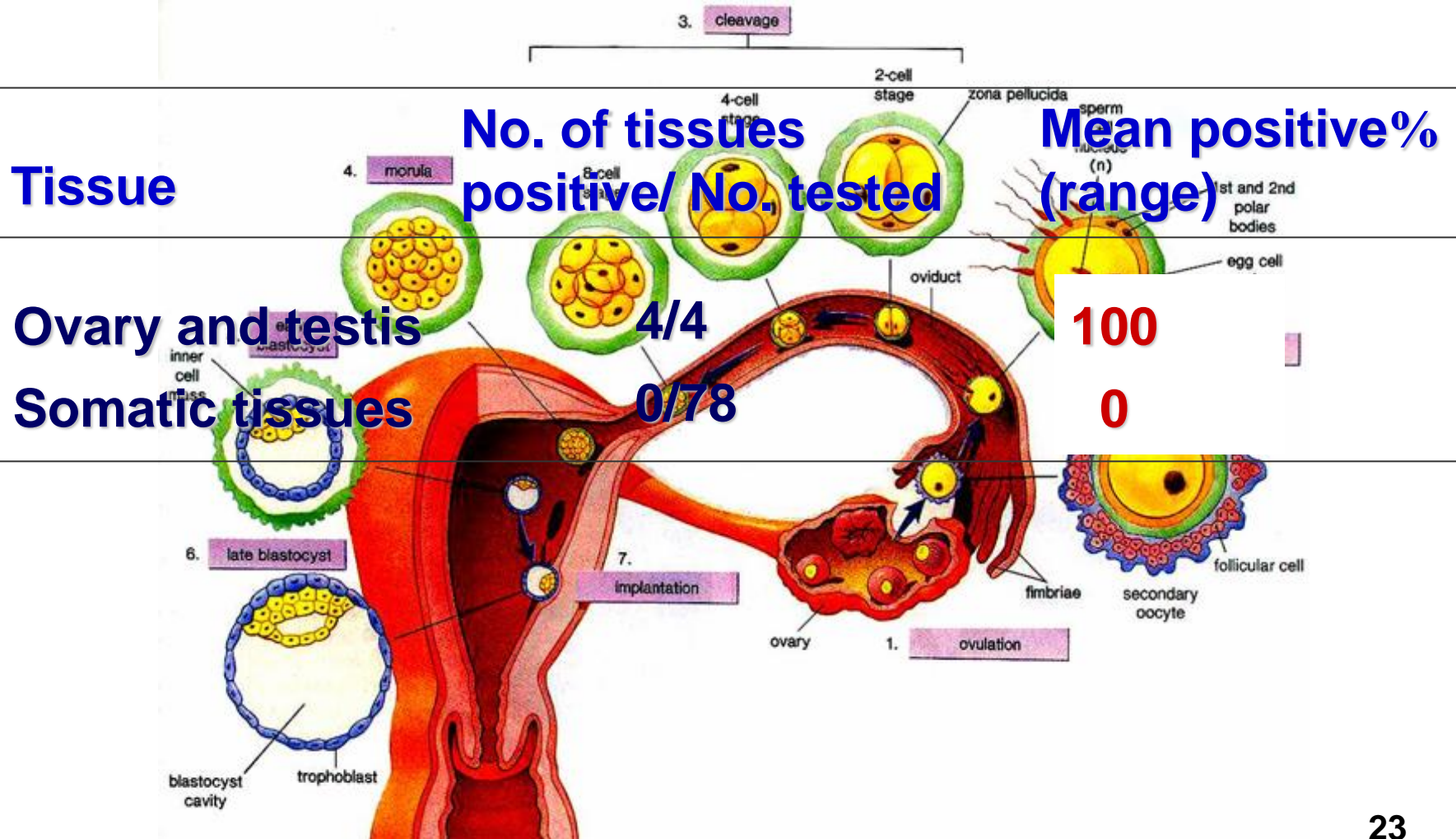
# 延伸 移位



3' end free to act as primer

ie

# 3. Telomere and aging



# 3. Telomere and aging



先天性角化不良

Dyskeratosis  
congenita

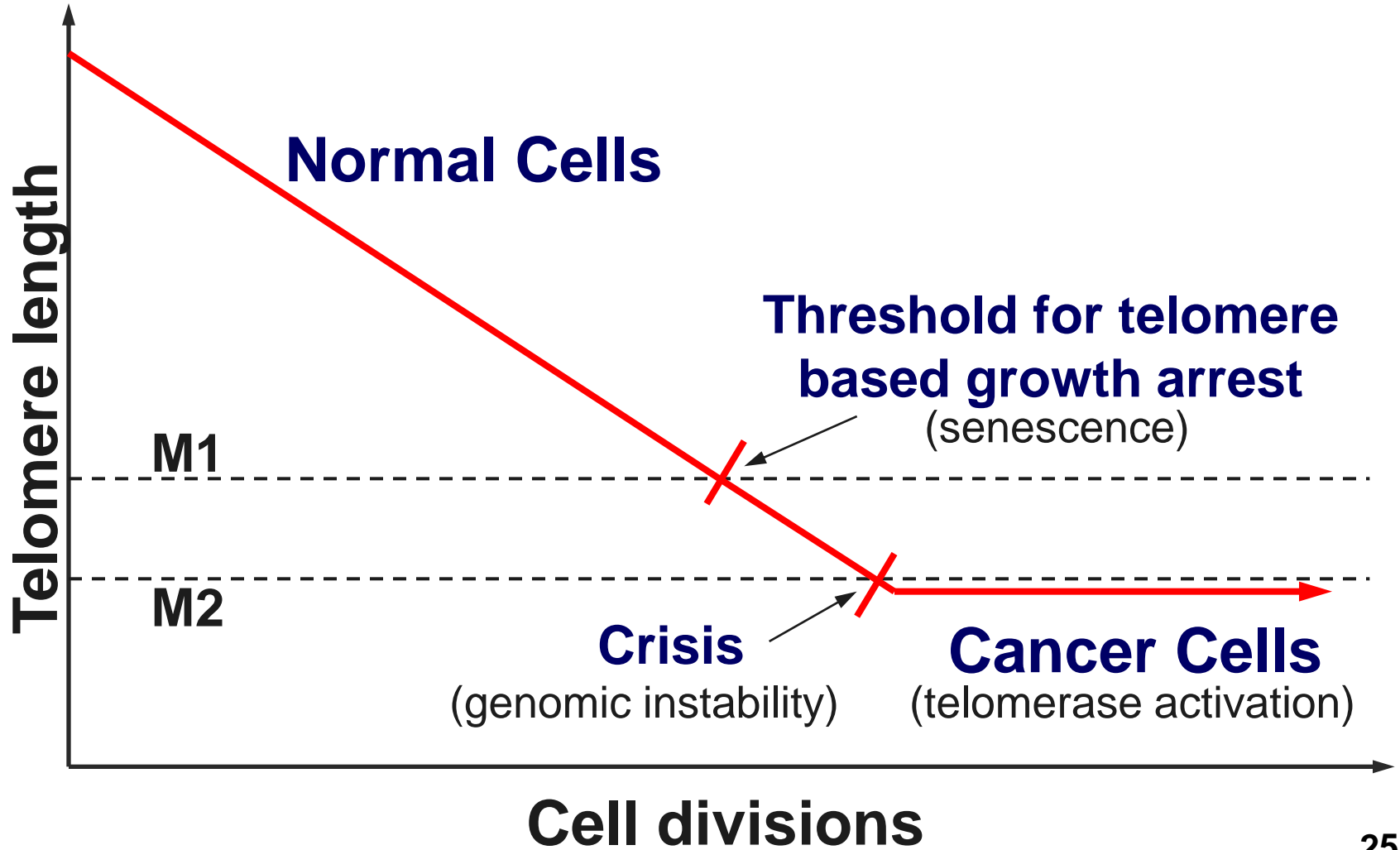


早衰綜合症

hutchinson-gilford  
progeria syndrome



# 4. Telomere and cancer



# unbalanced lifestyles

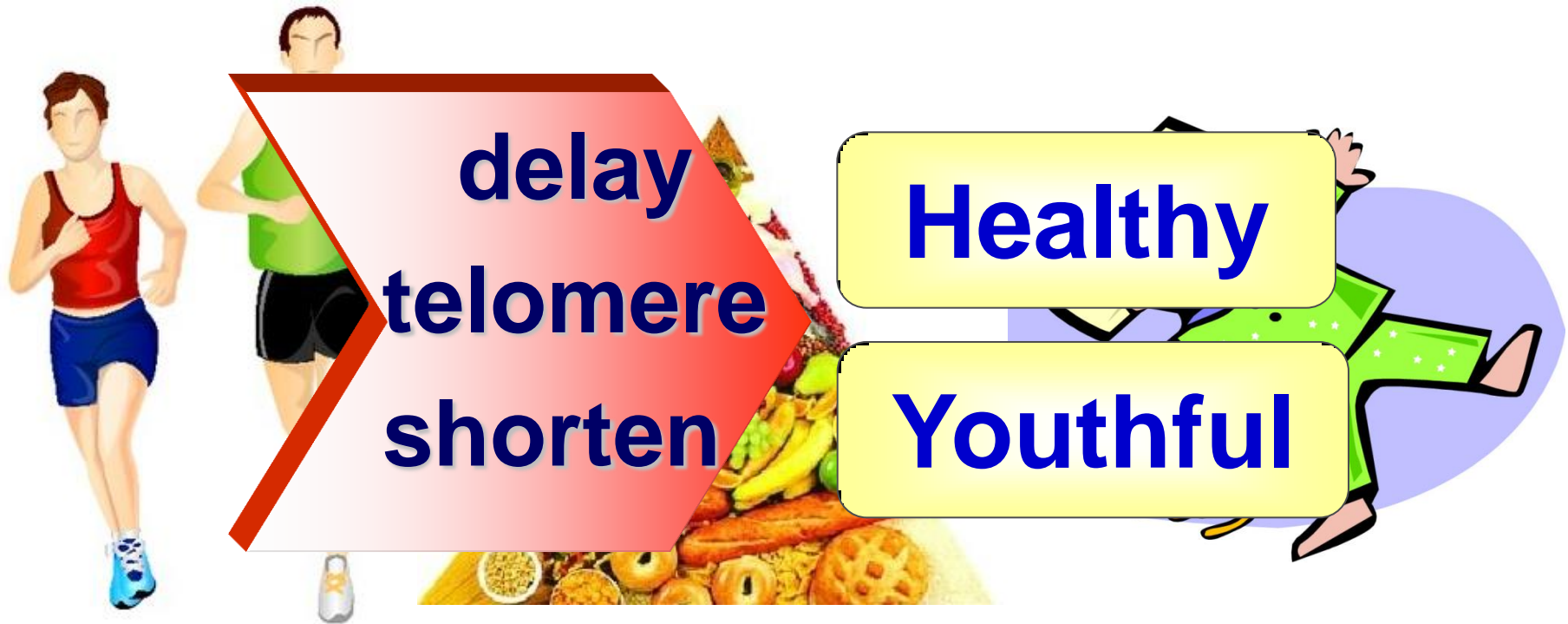


**shorten  
telomere**



**Aging**

# balanced lifestyles



**delay  
telomere  
shorten**

**Healthy**

**Youthful**

A close-up photograph of three vibrant red roses. The roses are arranged in a slightly overlapping manner, with the one in the foreground being the most prominent. Each rose is tied with a delicate white ribbon that forms a small bow at the top. The background is a soft, out-of-focus white, which makes the red of the roses stand out. The lighting is bright and even, highlighting the texture of the rose petals.

**Thank  
You!**