THE NOBEL PRIZE

Illustrated Presentation

Nobel Poster from the Nobel Committee for Physiology or Medicine, web adapted by Nobel Web

Contents

Background Telomere DNA protects the chromosomes **Telomerase builds telomere DNA Telomerase and disease** Credits and references

The Nobel Assembly at Karolinska Institutet has awarded the Nobel Prize in Physiology or Medicine 2009 jointly to Elizabeth Blackburn, Carol Greider and Jack Szostak for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase.







Elizabeth H. Blackburn Born 1948 University of California, San Francisco, USA Carol W. Greider Born 1961 Johns Hopkins University School of Medicine, Baltimore, USA Jack W. Szostak Born 1952 Harvard Medical School, Boston, USA

The award recognizes the discovery of a fundamental mechanism that has added a new dimension to our understanding of the cell, shed light on disease mechanisms, and stimulated





Expected

Each time a cell divides, the chromosomes should be shortened. Finally the chromosomes should erode and be damaged.



Observed

The chromosomes are protected. Their length and integrity are maintained.

Telomere DNA protects the chromosomes

Elizabeth Blackburn studied the single-cell organism Tetrahymena thermophila and had found that the ends of chromosomes contain a short DNA sequence repeated many times.

Jack Szostak studied yeast cells and observed that linear artificial minichromosomes were rapidly degraded. Together they decided to test if telomere DNA from Tetrahymena could protect minichromosomes in yeast.



Telomerase builds telomere DNA

How are telomeres formed? Carol Greider and Elizabeth Blackburn asked if an enzyme might synthesize telomeres.



analyzed a cell extract from Tetrahymena for enzymatic activity. They mixed it with synthetic telomere DNA oligomers (as primers for an enzymatic reaction)

On Christmas Day 1984 the first positive

Telomerase had been discovered.



1. Assay for telomere elongation Different synthetic single-stranded telomere DNA oligomers were added to a Tetrahymena cell extract along with radioactively labeled nucleotides allowing visualization of the reaction product.

2. Telomerase synthesizes telomeres The experiment showed that an unknown enzyme extends telomere DNA. A ladder of bands was obtained when either Tetrahymena or yeast telomere oligomers were used as primers (lanes 5 and 6) but not when unrelated DNA sequences were used.

Telomerase and disease

The discovery of telomere function and telomerase has broad medical implications in many fields including cancer, ageing and certain inherited diseases.



Credits and references for the 2009 Nobel Poster for Physiology or Medicine

Scientific Advisors, Professors at Karolinska Institutet: Göran K. Hansson, Medicine. Secretary of the Nobel Assembly; Klas Kärre, Immunology. Chair of the Nobel Committee; Nils-Göran Larsson, Genetics; Thomas Perlmann, Developmental Biology; Rune Toftgård, Cancer Biology.

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