What's Telling About Telomeres (and the Aging Process)

Is aging a natural process that we simply have to accept as a fact of life?

A philosopher would say yes. Many doctors would also agree: that our cells eventually reach a point where they can no longer divide and either die or reach senescence, a retirement phase. Many scientists believe in the "Hayflick limit" — that no one can live past about 120 years old. These people might also say that aging — and dying — is a good thing; that the world is already overcrowded, that we already cannot handle our aging populations, that life must be finite to appreciate it, that all good things must come to an end.

But there's a growing group of people — including gerontologists, biologists, engineers, and futurists—who believe that aging is a disease in itself, a disease that can be cured. That aging is not an immutable process, an inevitable "dying of the light," to quote poet Dylan Thomas, but one we can "rage against" — through science, drugs, and lifestyle changes.

Many "Cures" for Aging

Since 1900 the average life expectancy has risen from 47.3 years to 78 years in the United States — that's about 60 percent. It is likely that scientists will be able to prolong life even more — that is, healthy living. Gerontologists and others in the field are not concerned with prolonging end-of-life stages, when we are at our weakest, unhealthiest point of life. Today's search for a longer and healthier life is about turning back our biological clocks to be younger for longer.

They believe in the "longevity dividend," which, as proposed in an article in *The Scientist*, means the economic benefits of extending healthy life, including savings on health care and entitlements, and an increase in contributions to society.

But the first question about extending healthy life should not be philosophical — Is it a good thing? — but practical: How do we do it?

In today's popular scientific literature, many claim to have cures for aging or ways to retard aging. Some believe in a calorie-restrictive diet to prolong our lives. Oxford biogerontologist Aubrey de Grey — the leader of the anti-aging movement — believes we can rejuvenate the body by repairing cellular and molecular damage the way you could fix a car's broken parts. De Grey believes that a person has already been born who will live to the age of 1,000. In his book "Fantastic Voyage: Live Long Enough to Live Forever," futurist Ray Kurzweil writes about the science behind radical life extension, investigating everything from diet and exercise to hormone and gene therapy.

Some of these people are considered on the edge of accepted science. Kurzweil, for example, takes more than 250 supplements a day, while de Grey has arranged to have his head cryopreserved after his death. On the other hand, scientists in Scotland recently used a 3-D printer to replicate embryonic human stem cells … so who is to say what is outrageous?

The "Cure" Within

One of the most promising avenues of anti-aging research comes from inside our own bodies: the telomere.

Derived from the Greek nouns *telos* ("end") and *meros* ("part"), these end-parts are at the ends of our chromosomes, serving as protective caps for preserving genetic information — think of them as plastic sheaths on the ends of shoelaces to prevent the laces from fraying. Telomeres are disposable buffers blocking the ends of chromosomes; without them, genomes would lose information after cell division. A cell's age can be measured by the length of its telomere.

Telomeres also protect cells' chromosomes from fusing with each other or rearranging — abnormalities which can lead to cancer. When cells divide, telomeres shorten. When telomeres reach their shortest point, cells stop dividing or die. These senescent cells, some believe, cause age-related diseases, make us wrinkle, weaken our immune and other systems.

In 2009, the Nobel Prize in Physiology and Medicine was awarded jointly to Elizabeth Blackburn, Carol Greider, and Jack Szostak for their 1984 discovery "of how chromosomes are protected by telomeres and the enzyme telomerase." Telomerase is the ribonucleoprotein that stabilizes telomeres when they get worn, or causes them

to lengthen, and aids cell division. Three months after the prize was awarded, a genetics team at The Longevity Genes Project at the Institute for Aging Research at New York's Albert Einstein College of Medicine, discovered a correlation between living to the age of 100 and inheriting a mutant gene that makes their subjects' telomerase-making systems extra-active and able to maintain telomere length more effectively. For the most part, these people were spared age-related diseases, such as cardiovascular disease and diabetes, which cause most deaths among elderly people.