Adam and Eve lost it, alchemists tried to brew it and, if you believe the legends, Spanish conquistador Juan Ponce de Leon was searching for it when he discovered Florida.

To live forever while preserving health and retaining the semblance and vigor of youth is one of humanity's oldest and most elusive goals.

Now, after countless false starts and disappointments, some scientists say we could finally be close to achieving lifetimes that are, if not endless, at least several decades longer. This modern miracle, they say, will come not from drinking revitalizing waters or from transmuted substances, but from a scientific understanding of how aging affects our bodies at the cellular and molecular levels.

Whether through genetic tinkering or technology that mimics the effects of caloric restriction—strategies that have successfully extended the lives of flies, worms and mice—a growing number of scientists now think that humans could one day routinely live to 140 years of age or more.

Extreme optimists such as Aubrey de Gray think the maximum human lifespan could be extended indefinitely, but such visions of immortality are dismissed by most scientists as little more than science fiction.

While scientists go back and forth on the feasibility of slowing, halting or even reversing the aging process, ethicists and policymakers have quietly been engaged in a separate debate about whether it is wise to actually do so.

**A doubled lifespan**

If scientists could create a pill that let you live twice as long while remaining free of infirmities, would you take it?

If one considers only the personal benefits that longer life would bring, the answer might seem like a no-brainer: People could spend more quality time with loved ones; watch future generations grow up; learn new languages; master new musical instruments; try different careers or travel the world.

But what about society as a whole? Would it be better off if life spans were doubled? The question is one of growing relevance, and serious debate about it goes back at least a few years to the Kronos Conference on Longevity Health Sciences in Arizona.

Gregory Stock, director of the Program on Medicine, Technology, and Society at UCLA’s School of Public Health, answered the question with an emphatic "Yes."

A doubled lifespan, Stock said, would "give us a chance to recover from our mistakes, lead us towards longer-term thinking and reduce healthcare costs by delaying the onset of expensive diseases of aging. It would also raise productivity by adding to our prime years."

Bioethicist Daniel Callahan, a cofounder of the Hastings Center in New York, didn't share Stock's enthusiasm. Callahan's objections were practical ones. For one thing, he said, doubling life spans won't solve any of our current social problems.

"We have war, poverty, all sorts of issues around, and I don't think any of them would be at all helped by having people live longer," Callahan
said in a recent telephone interview. "The question is, 'What will we get as a society?' I suspect it won't be a better society."

Others point out that a doubling of the human lifespan will affect society at every level. Notions about marriage, family and work will change in fundamental ways, they say, as will attitudes toward the young and the old.

**Marriage and family**

Richard Kalish, a psychologist who considered the social effects of life extension technologies, thinks a longer lifespan will radically change how we view marriage.

In today's world, for example, a couple in their 60s who are stuck in a loveless but tolerable marriage might decide to stay together for the remaining 15 to 20 years of their lives out of inertia or familiarity. But if that same couple knew they might have to suffer each other's company for another 60 or 80 years, their choice might be different.

Kalish predicted that as life spans increase, there will be a shift in emphasis from marriage as a lifelong union to marriage as a long-term commitment. Multiple, brief marriages could become common.

A doubled lifespan will reshape notions of family life in other ways, too, says Chris Hackler, head of the Division of Medical Humanities at the University of Arkansas.

If multiple marriages become the norm as Kalish predicts, and each marriage produces children, then half-siblings will become more common, Hackler points out. And if couples continue the current trend of having children beginning in their 20s and 30s, then eight or even 10 generations might be alive simultaneously, Hackler said.

Furthermore, if life extension also increases a woman's period of fertility, siblings could be born 40 or 50 years apart. Such a large age difference would radically change the way siblings or parents and their children interact with one other.

"If we were 100 years younger than our parents or 60 years apart from our siblings, that would certainly create a different set of social relationships," Hackler told *LiveScience*.

**The workplace**

For most people, living longer will inevitably mean more time spent working. Careers will necessarily become longer, and the retirement age will have to be pushed back, not only so individuals can support themselves, but to avoid overtaxing a nation's social security system.

Advocates of anti-aging research say that working longer might not be such a bad thing. With skilled workers remaining in the workforce longer, economic productivity would go up. And if people got bored with their jobs, they could switch careers.

But such changes would carry their own set of dangers, critics say.

Competition for jobs would become fiercer as "mid-life re-trainees" beginning new careers vie with young workers for a limited number of entry-level positions.
Especially worrisome is the problem of workplace mobility, Callahan said.

"If you have people staying in their jobs for 100 years, that is going to make it really tough for young people to move in and get ahead," Callahan explained. "If people like the idea of delayed gratification, this is going to be a wonderful chance to experience it."

Callahan also worries that corporations and universities could become dominated by a few individuals if executives, managers and tenured professors refuse to give up their posts. Without a constant infusion of youthful talent and ideas, these institutions could stagnate.

Hackler points out that the same problem could apply to politics. Many elected officials have term limits that prevent them from amassing too much power. But what about federal judges, who are appointed for life?

"Justices sitting on the bench for a hundred years would have a powerful influence on the shape of social institutions," Hackler writes.

Time to act

A 2003 staff working paper drawn up by the U.S. President's Council of Bioethics—then headed by Leon Kass, a longtime critic of attempts to significantly extend the human lifespan—stated that anti-aging advances would redefine social attitudes toward the young and the old, and not in good ways.

"The nation might commit less of its intellectual energy and social resources to the cause of initiating the young, and more to the cause of accommodating the old," the paper stated. Also, quality of life might suffer. "A world that truly belonged to the living would be very different, and perhaps a much diminished, world, focused too narrowly on maintaining life and not sufficiently broadly on building the good life."

While opinions differ wildly about what the ramifications for society will be if the human lifespan is extended, most ethicists agree that the issue should be discussed now, since it might be impossible to stop or control the technology once it's developed.

"If this could ever happen, then we'd better ask what kind of society we want to get," Callahan said. "We had better not go anywhere near it until we have figured those problems out."
Recent experiments on everything from roundworms to mice are giving some scientists hope that our maximum life spans are not set in stone but can be extended far beyond what nature intended.

In many ways, tremendous progress has already been made in extending human life. From lowering infant mortality rates (the biggest factor) to creating effective vaccines and reducing deaths related to heart problems, science has helped increase the average person's life span by nearly three decades over the past century.

But getting the average person from 80 to 120 and beyond requires research into the very cellular mechanisms that cause gray hair and wrinkles, that make our bones creak and our minds go weak, and what generally make all creatures shrivel, shrink and waste away.

The big question: Can cell aging be halted or reversed?

Eat less

The first hint of the possibilities came in the 1930's, when studies by Cornell University researchers discovered that rats fed severely reduced calories tended to live up to 40 percent longer than their fully fed littermates.

Scientists still aren't sure how caloric restriction, or CR, works. One early hypothesis, that CR regimens extended life span by preventing animals from reaching full body size, was debunked when experiments showed that even fully grown adults can benefit from CR.

For about 50 years, CR was the only proven method to extend an organism's maximum life span in a healthy way.

Then in 1996, scientists discovered a type of mutant dwarf mouse that lived up to 70 percent longer than its non-mutated peers. The rodents' stunted growth was due to a change at the genetic level that reduced production of hormones related to growth.

Genetic tinkering

In the years since, genetic tinkering has also produced more enduring yeasts, roundworms and fruit flies.

Much of the anti-aging research is still done on rodents, whose biological systems are similar to humans in many ways. In fact, a leading proponent of human anti-aging research has organized a hefty prize for breakthroughs that extend the lives of mice.

Scientists have also discovered other factors that affect life span in research that might eventually be applied to humans. A study out of Cambridge University in England found that what a mother eats during pregnancy and while nursing can greatly affect her children's life spans.

Using mice, the researchers found that mothers fed protein-rich diets during pregnancy, but low-protein diets while breast-feeding, had pups that lived up to 50 percent longer than those for whom this feeding pattern was reversed. If a similar approach could work for humans, this translates into a difference between reaching 50 and living to be 75 years old, the researchers said.

Get married

If the thought of eating only enough to survive or having your genes mucked with doesn't sound very appealing, scientists say there is another and perhaps more pleasurable way to live longer: fall in love.
A study earlier this year led by Linda Waite, a sociologist at the University of Chicago, showed that happily married couples tend to live longer than unwed individuals. Married men were found to live, on average, 10 years longer than non-married men, and married women lived about four years longer than non-married woman.

The researchers speculated that married men live longer because they adopt healthier lifestyles and take fewer risks. Married woman, on the other hand, probably live longer because of the improved financial well-being that comes with marriage.

Potentially Harmful 'Undead Cells' Collect with Age

By Bjorn Carey
LiveScience Staff Writer
posted: 02 February 2006
02:00 pm ET

As you age, so do your cells. A new study reveals that old cells make up a much larger portion of skin cells than previously thought.

Over the years, cells lose the ability to divide and they enter a state called senescence. They're not dead, but they're not quite functioning correctly either. These undead cells may delay wound healing, weaken immune responses, and help cause wrinkles.

"Senescence is not cell death, and that's really the problem with it," said John Sedivy of Brown University.

'Scary number'

Earlier studies suggested that senescent cells made up only a few tenths of a percent of living organisms. This study, performed on baboons, indicates that the amount could be as much as 20 percent in the elderly. Baboons and humans are very similar on a cellular level, so these findings likely hold true for us as well, the scientists figure.

"Twenty percent is a scary number in aged skin," Sedivy told LiveScience. "It means that 20 percent of your skin cells are nonfunctional and could be harmful."

Senescent cells have been extensively studied in tissue culture dishes, but this study, published online today by the journal Science, is the first to show that they're present in substantial amounts in living organisms.

To count the number of senescent skin cells at different life stages, researchers took small skin samples from the forearms of baboons living on a research preserve. The primates ranged from 5 to 30 years, roughly equivalent to ages 15 to 90 in humans.

Sedivy and his team tested the sample cells for certain biomarkers that indicate cellular aging. They found that the number of senescent cells increased exponentially with age. In 5-year-olds they made up only 4 percent of the sample cells; in 30-year-olds the figure increased to 20 percent.
Hanging around

For some reason, the body doesn't actively remove these cells and they accumulate over the course of an organism's life.

"They basically hang around and don't do anything, and that in itself could be deleterious," Sedivy said. "If they're not functioning normally, and just sitting there taking up space, that could damage surrounding cells."

Other evidence, Sedivy said, suggests that they might actively secrete chemicals that harm surrounding tissue.

The body removes other types of old, broken down cells. So why not these?

Most likely it's because most advantageous traits, crafted from thousands of years of evolution, are meant for healthy, reproductive individuals. Once that stage of life has passed, the body doesn't care what happens and damaging, cancerous cells are allowed to run amok, the researchers figure.

In the case of wild baboons, these cells never get the chance to hang around so long. Once a baboon passes the reproductive age, it is usually killed by a younger, more virile animal.

The Odds of Dying

By Robert Roy Britt
LiveScience Senior Writer
posted: 06 January, 2005
7:00 a.m. ET

There are significant caveats to consider before you contemplate the table below.

Risk varies with age. Infants face different threats than teens, whose risks are wildly different from senior citizens. Among people age one through 44, injuries are by far the leading cause of death in the United States. But heart disease is the hands-down No. 1 killer for those over 65. Since average life expectancy is about 77 years in the United States, simple logic reveals the leading killer of Americans.

The numbers get murkier the closer you look. Statistics are typically given for a person born in the year the numbers are crunched, but by the time that person grows up, the outlook will have changed because of medical advances, diet shifts, changes to the environment, and so on.

The list below is not complete. Rather it includes life-ending scenarios that carry some of the highest odds for U.S. residents, along with the chances of checking out in more bizarre fashion.

Health-related statistics and categories with high-odds (like heart disease at 1-in-5) are among the most statistically significant, sort of. All odds fluctuate from year-to-year. Toss in a flu pandemic -- some 50 million died in 1918 -- and all bets are off. The World Health Organization recently warned that the next such bout could kill 7 million people "in a best case scenario." That's not in the odds below.

The more specific figures are based on 2001, the most recent year for which complete data are available. Other odds, indicated with an asterisk (*) are based on long-term data.
All figures below are for U.S. residents.

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Lifetime Odds</th>
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<tbody>
<tr>
<td>Heart Disease</td>
<td>1-in-5</td>
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<tr>
<td>Cancer</td>
<td>1-in-7</td>
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<tr>
<td>Stroke</td>
<td>1-in-23</td>
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<tr>
<td>Accidental Injury</td>
<td>1-in-36</td>
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<tr>
<td>Motor Vehicle Accident*</td>
<td>1-in-100</td>
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<tr>
<td>Intentional Self-harm (suicide)</td>
<td>1-in-121</td>
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<tr>
<td>Falling Down</td>
<td>1-in-246</td>
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<tr>
<td>Assault by Firearm</td>
<td>1-in-325</td>
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<tr>
<td>Fire or Smoke</td>
<td>1-in-1,116</td>
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<td>Natural Forces (heat, cold, storms, quakes, etc.)</td>
<td>1-in-3,357</td>
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<tr>
<td>Electrocution*</td>
<td>1-in-5,000</td>
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<td>Drowning</td>
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<td>Air Travel Accident*</td>
<td>1-in-20,000</td>
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<tr>
<td>Flood* (included also in Natural Forces above)</td>
<td>1-in-30,000</td>
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<tr>
<td>Legal Execution</td>
<td>1-in-58,618</td>
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<td>Tornado* (included also in Natural Forces above)</td>
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<td>Lightning Strike (included also in Natural Forces above)</td>
<td>1-in-83,930</td>
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<tr>
<td>Snake, Bee or other Venomous Bite or Sting*</td>
<td>1-in-100,000</td>
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<tr>
<td>Earthquake (included also in Natural Forces above)</td>
<td>1-in-131,890</td>
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<td>Dog Attack</td>
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<tr>
<td>Asteroid Impact*</td>
<td>1-in-200,000**</td>
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<td>Tsunami*</td>
<td>1-in-500,000</td>
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<tr>
<td>Fireworks Discharge</td>
<td>1-in-615,488</td>
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</table>

** Perhaps 1-in-500,000

SOURCES: National Center for Health Statistics, CDC; American Cancer Society; National Safety Council; International Federation of Red Cross and Red Crescent Societies; World Health Organization; USGS; Clark Chapman, SwRI; David Morrison, NASA; Michael Paine, Planetary Society Australian Volunteers

(Update, Jan. 20, 2005
A new report finds that cancer became the leading killer of Americans under 85, based on 2002 data. That report is not reflected in this article).