WOODS HOLE — As I headed to Cape Cod this summer to attend a new course about the latest science on aging, my sister texted: “If they say anything positive about getting older, I’d love to hear it. So far it seems pretty sucky.”

Good news first, then: The very existence of the advanced research course I audited at the august Marine Biological Laboratory in Woods Hole bodes well for those of us rooting for science to find ways to slow our decline.

Its launch fits into a recent burst of research energy directed at the fundamental drivers of how organisms age, from yeast to humans.

“In the last 10 years, there’s been an explosion of interest and research on longevity and health span, so a niche area of biology has grown into a real field,” said course co-director Jennifer Garrison from the Buck Institute for Research on Aging, based in Novato, Calif.

“Health span” refers to how long we stay healthy as we age — and goodness knows we’d better stay healthy longer or we silver-tsunami types are going to sink the health care system. The average “healthy life expectancy” before major chronic conditions strike is 66 years, according to the American Heart Association, while Americans live on average to 76.

Financial enthusiasm for aging research has been rising too, particularly among no-longer-young billionaires. Investors have poured $3 billion into the anti-aging startup Allos, earning it the label of the best-funded biotech startup ever, and a Saudi foundation has pledged $1 billion a year for research to “make aging healthier.”

Against that backdrop, the Woods Hole course aims to nurture a new generation of scientific leaders, Garrison said. The attendees were all PhD students or postdoctoral trainees armed with 21st-century tools like CRISPR and portable DNA sequencers and big-data power.
Their endeavor goes by a name that’s not brand new but is still unfamiliar to many: geroscience.

“I think we’re about to enter a golden age for geroscience,” predicted crypto entrepreneur James Fickel, the donor who funded the course. He cited “new powerful tools” that are “maturing and being brought to bear on some of humanity’s most difficult engineering problems.”

(The “ger” in “geroscience” has a soft “g,” as in “geriatric.” It’s also used in terms like “geroprotective,” meaning a drug or other intervention that protects against aging. My personal suggestion for a new compound word would be “gero-obsessive,” for people consumed by the desire not to age.)

Age is the biggest risk factor for most top killers, including cancer, heart disease, and dementia, but traditionally, science has tackled each of these “aging-related diseases” individually. The essence of the geroscience approach is that “age is a risk factor that we can vary,” said course co-director William Mair from the Harvard Chan School of Public Health. Experiments have found that every organism has mechanisms that can change its rate of aging, Mair said. The goal of geroscience is to understand them and develop treatments that ward off multiple diseases of aging at once.

We are not there yet, he hastened to add, and he routinely disappoints people who ask what his longevity research — which focuses on worms — means for what they should eat to live longer. “Can I tell you what to eat? No,” he said. “Unless you’re a worm.”
What, no supplements?

Contrast Mair’s cautious approach with the many hyped and unproven claims over the years that have tainted aging research with a reputation for fringe science and overpromised regimens to “hack” life span. Frequenters of conferences on longevity and aging describe an atmosphere in which it’s common for researchers, even serious scientists, to tout the supplements, diets, and off-label drugs they use.

Not at this course.

“This is the opposite of biohackers,” Garrison said.

In four weeks of auditing lectures, I heard not a single recommendation for a fasting plan or pill regime. Mair even — gasp! — brought popovers and other pastries when it was his turn to lecture.

Instead, faculty members spent hours expounding upon topics ranging from metabolism to mitochondria, from the microbiome to limb regeneration. Scientists have found multiple ways to make animals live longer and stay healthier — cutting their calories, tweaking their genes, lowering their temperature — but a fundamental challenge in geroscience is that what works in fish or flies will not necessarily work in humans.

I’m sorry — I wish I’d come away with a quick and easy fix I could share, instead of the conviction that for now and the foreseeable future the best geroprotection we humans have is exercise, which is neither quick nor easy.

Still, I did head home with fresh hope for a healthier old age — not just from hearing over and over that “aging is malleable” and “aging is plastic,” but from actually seeing it in the research presented, a zoo’s worth of tantalizing clues.
Among these clues were clams far more memorable than the usual fried Cape Cod treat. These were members of a species that can live for more than 500 years off the coast of Iceland, according to the countable growth rings that clams have, much like tree rings.

Compare that impressive life span with that of the same species in the warmer, brackish waters of the Baltic Sea: They live to only about 35.

Harvard Medical School and Boston Children’s Hospital professor Matthew Harris and postdoc Stephen Treaster, who have also researched exceptionally long-lived rockfish, analyzed the Icelandic clams’ DNA and worked with students to explore what makes the clams unique. They homed in on a common enzyme that the long-lived clams regulate differently.

Student Silvia Vicenzi, from the University of California, San Diego, tried injecting the enzyme from the long-lived clams into zebrafish, small fish widely used in genetic research. Normally, zebrafish flinch at the lightest touch, but the ones that had received these enzyme injections reacted sluggishly, as if in slow motion. “Shocking, right?” Vicenzi said of the dramatic effect she had captured on video.

It was, but what does it mean? Too early to say, but I couldn’t help conjuring a gero-fantasy about a sci-fi drug that would let you live hundreds of years — but only in slow motion and constant cold. Would you do it?
Also among the inspiring menagerie were planaria, those long-known miraculous flatworms that can regenerate fully after being cut into pieces — so fully, in fact, that even just one one-hundredth of a worm can regrow the whole thing. As Cornell’s Carrie Adler explained, it’s now understood that planaria are “chock full of stem cells,” and it’s the activity of those stem cells that gives planaria such amazing powers. Uniquely among animals, they can even regenerate reproductive organs from chunks that had none.

Ants offer lessons for longevity as well, said Ingrid Fetter Pruneda from the National Autonomous University of Mexico. In some ant species, when the queen of a colony dies, a worker ant with just months to live can shift roles to become queen, and then live four or five times longer. So “social context is important for life span,” she said.

Scientists have studied zebrafish, flatworms, and ants for decades, but gerosciences are also making progress with a new animal model: a short-lived type of fish called killifish. In just months, they age enough to parallel multiple aspects of human aging — brittle bones, cancers, gut inflammation. They even get constipated.

One faculty member, Dario Riccardo Valenzano from the Leibniz Institute on Aging, led a splashy 2017 killifish study that the journal Nature headlined “Young Poo Makes Aged Fish Live Longer.” Now, he said, along with killifish, his team will be exploring the microbes in intestines from Greenland sharks known to live hundreds of years.

**Sex matters**

At a level closer to humans, Princeton’s Sarah Mitchell illuminated the importance of sex differences in mouse experiments that test ways to slow aging.

When a specific strain of male mice are fed 40 percent fewer calories, she said, they live longer, but females of the same strain given the same diet die earlier.

The relevance for humans: Whether “caloric restriction” of 20 percent or more may prolong human longevity remains an open question, but it looks likely to differ by sex and genetics, and possibly work less well for females. (Thanks, I think I will have that popover, Dr. Mair.)

What’s indisputable is that drugs and other anti-aging interventions must be tested with both sexes. And yet in some cases, geroprotectors have been tested only in males, Mitchell said.

I confess, part of my motivation for attending the course was personal: Entering old age feels like entering adolescence in the sense that momentous bodily changes are underway and fuel a hunger to understand “What the hell is happening to me?”

Somewhere along the way, though, I lost the selfish desire to understand my own impending decline and got caught up in the great scientific mystery of it all. How do those 500-year-old clams do it? Why can planaria regrow a pharynx in five days? What can we learn from the fact that ovaries age twice as fast as the rest of the body?

Broad outlines have been emerging in recent years: lists of “hallmarks of aging” and mounting evidence that epigenetics — how genes are turned on and off — is key and that metabolism is central. “Everything that we’ve found modifies aging at all has been connected to metabolism and growth,” Mair said.

Efforts in academia and at companies are underway to “reprogram” cells into younger states, to clear failing “senescent” cells that accumulate with age, and to develop epigenetic “clocks” that can assess how well geroprotective measures work. There are ongoing studies to test drugs that may have anti-aging effects, including a promising but risky medication called rapamycin and the common diabetes drug metformin.
Yet Nicholas Stroustrup, from the Centre for Genomic Regulation in Barcelona, argues that geroscience remains a “field with no central result” — that is, he said, “The basic molecular biology that drives aging” remains “a big open question.”

It’s also a field alive with controversies. The students in the course debated two of them: whether aging is “programmed,” a built-in process, or merely results from accumulated random damage, and whether humans can theoretically fend off death indefinitely.

The stated goal of geroscience is not to live forever, though. It’s more like what course student Janell Smith imagines: “I’d hope we can increase health span up until we croak.”

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