

PUBLISHED BY THE CRYONICS INSTITUTE

ISSUE 01 | 2024

CRYONICS INSTITUTE MAGAZINE

Cryonics insights and
information for members
and friends of the
Cryonics Institute





Hello everyone,

CI marked a new milestone in 2024 with the suspension of our 250th patient, which is a testament to our steady growth and, most importantly, our stability. The Cryonics Institute has been operating without incident since 1976 and in just two short years we will be celebrating our 50th Anniversary.

We have a great legacy behind us and a bright future ahead, so if you're reading this but not currently a member of the Cryonics Institute, I invite you to join us. If you are a member thank you! Our leadership team is elected from the membership, so you are the glue that holds the organization together and keeps us strong.

However, as strong as we are, we could and, in my opinion, should be even stronger. One of the challenges cryonics has faced since its inception is gaining wider mainstream awareness among the general public. Ask your friends and family about cryonics and it's likely many of them have never even heard of the concept - much less know there are actually fully operational cryonics facilities offering suspension services.

If that is the case, we are missing out on a golden opportunity to help spread the word, increase our member base and further strengthen our long-term viability. For an organization that has to stay in business indefinitely (until potential revival), it's critical to keep growing our membership.

With that in mind, I would respectfully ask that if you have never brought up the subject with the people you know, please consider doing so. In most cases it wouldn't even be a "sales job," requiring you to justify cryonics as an option. In my experience, simply letting people know fully-operating cryonics organizations exist is usually enough to pique their curiosity. If they want to ask you questions about it, feel free to answer, or if you're not 100% comfortable discussing the pros and cons just direct them to cryonics.org and they can do their own research. All you really need to do is mention cryonics, even in an off-handed "did you know?" way and people are immediately interested and want to know more about it. That's a very simple thing all of us can do to help build awareness and interest which can only help our organization.

Keeping that in mind, one of our organizational goals for 2024 is to elevate our social media presence. We're planning to generate content that builds awareness, sparks interest in cryonics and CI and hopefully encourages shares and likes. We're actively working on this strategy now and I'm very excited to share it with you as it comes together. We welcome your ideas and suggestions for content or topics. If you also have the ability to produce professional social media content, we'd love to hear from you. If you're interested, contact us at social@cryonics.org.

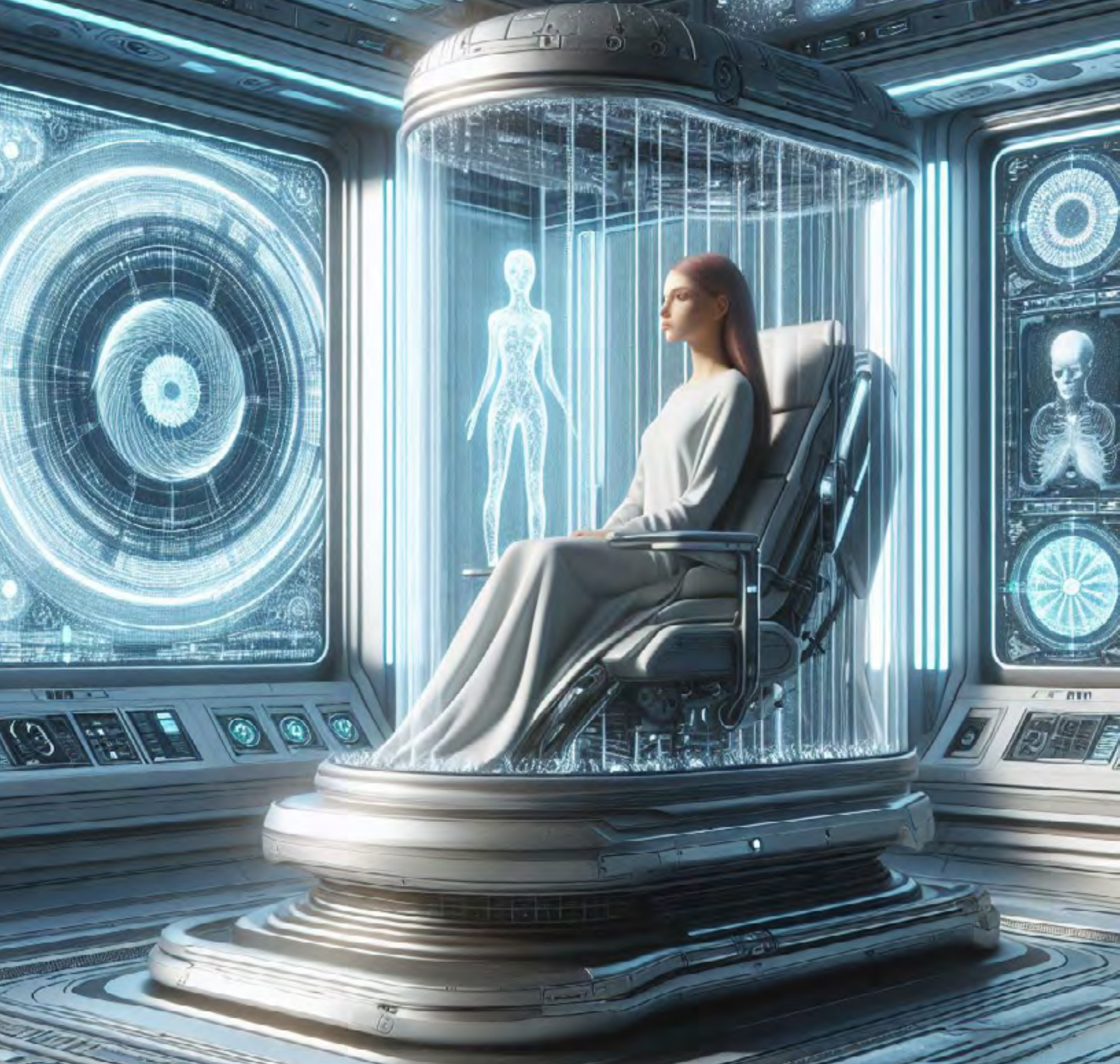
On to the topic of standby, I'm also pleased to report we are actively working on bringing the CI Check-In app to iOS. We are expecting to have development and testing completed sometime in the third quarter of the year, possibly coinciding with our 2024 AGM as a tentative launch date. Thanks again to Nikki Olsen for her help with the development.

The current Android version of CI Check-In App is free to download [here](#).

Sincerely

Dennis Kowalski

President - Cryonics Institute



CRYONICS INSTITUTE MAGAZINE

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ARTICLE SUBMISSIONS

Cryonics Institute or cryonics-related articles are welcome. Submissions: dg@cryonics.org

E-SUBSCRIPTIONS

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Or, go to LifeExtension.com/CI

Use code **AVX231A** to get these savings • Offer expires December 31, 2024



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Membership Benefits

Why join the Cryonics Institute?

The choice is clear: Irreversible physical death, dissolution and decay, or the possibility of a vibrant and joyful renewed life. Don't you want that chance for yourself, your spouse, parents and children?

1) **A Second Chance at Life**

Membership qualifies you to arrange and fund a vitrification (anti-crystallization) perfusion and cooling upon legal death, followed by long-term storage in liquid nitrogen. Instead of certain death, you and your loved ones could have a chance at rejuvenated, healthy physical revival through cryopreservation.

2) **Affordable Cryopreservation**

The Cryonics Institute (CI) offers full-body cryopreservation for as little as \$28,000.

3) **Affordable Membership**

Become a Lifetime Member for a one-time payment of only \$1,250, with no dues to pay. Or join as a Yearly Member with a \$75 initiation fee and dues of just \$120 per year, payable by check, credit card or PayPal.

4) **Lower Prices for Spouses and Children**

The cost of a Lifetime Membership for a spouse of a Lifetime Member is half-price and minor children of a Lifetime Member receive membership free of charge.

5) **Quality of Treatment**

CI employed a Ph.D level cryobiologist to develop CI-VM-1, CI's vitrification mixture which can help prevent crystalline formation at cryogenic temperatures.

6) **Standby Options and Assistance**

CI's use of Locally-Trained Funeral Directors means that our members can get knowledgeable, licensed care. Or members can arrange for professional cryonics standby and transport by subcontracting with [Suspended Animation, Inc](#) or [International Cryomedicine Experts](#) (I.C.E.) CI also offers Standby

Training Materials and Kits for members who choose to perform Local Standby.

7) **Affordable Funding Options**

Cryopreservation with CI can be funded through life insurance policies issued in the USA or other countries. Prepayment and other options for funding are also available to CI members.

8) **Cutting-Edge Cryonics Information**

Members receive a free e-subscription to the Cryonics Institute Newsletter, as well as access to our Facebook page, Twitter feed, YouTube channel and an official members-only forum.

9) **Helpful, Professional Support**

CI's professional staff is available to answer any questions and address any concerns you may have about CI, your membership or Cryopreservation.

10) **Additional Preservation Services**

CI offers a sampling kit, shipping and long-term liquid nitrogen storage of tissues and DNA from members, their families or pets for just \$98.

11) **Support Education and Research**

Membership fees help CI to fund important cryonics research and public outreach, education and information programs to advance the science of cryonics.

12) **Member Ownership and Control**

CI Members are the ultimate authority in the organization and own all CI assets. They elect the Board of Directors, from whom are chosen our officers. CI members also can change the Bylaws of the organization (except for corporate purposes).



To get started, contact us at:

(586) 791-5961 • email: info@cryonics.org

Visit us online at www.cryonics.org



MCRR Hosts Minnesota Standby Training Event



Aschwin de Wolf presents opening remarks

On September 24, 2023 Biostasis Technologies of New York, Resurgence Biomedical of Florida, and Minnesota Cryonics Rapid Response co-organized a local cryonics training at the Billman-Hunt Funeral Chapel in Minneapolis, Minnesota.

The emphasis of the training was basic cryonics first-response skills, with multiple physicians, nurses, paramedics, an EMT and three funeral directors in attendance.

Aschwin de Wolf of Biostasis Technologies led the effort. Trainers included Aschwin, Aaron Drake of International Cryomedicine Experts (I.C.E.), paramedic Vincent Burburan and nurse Christine Gaspar.

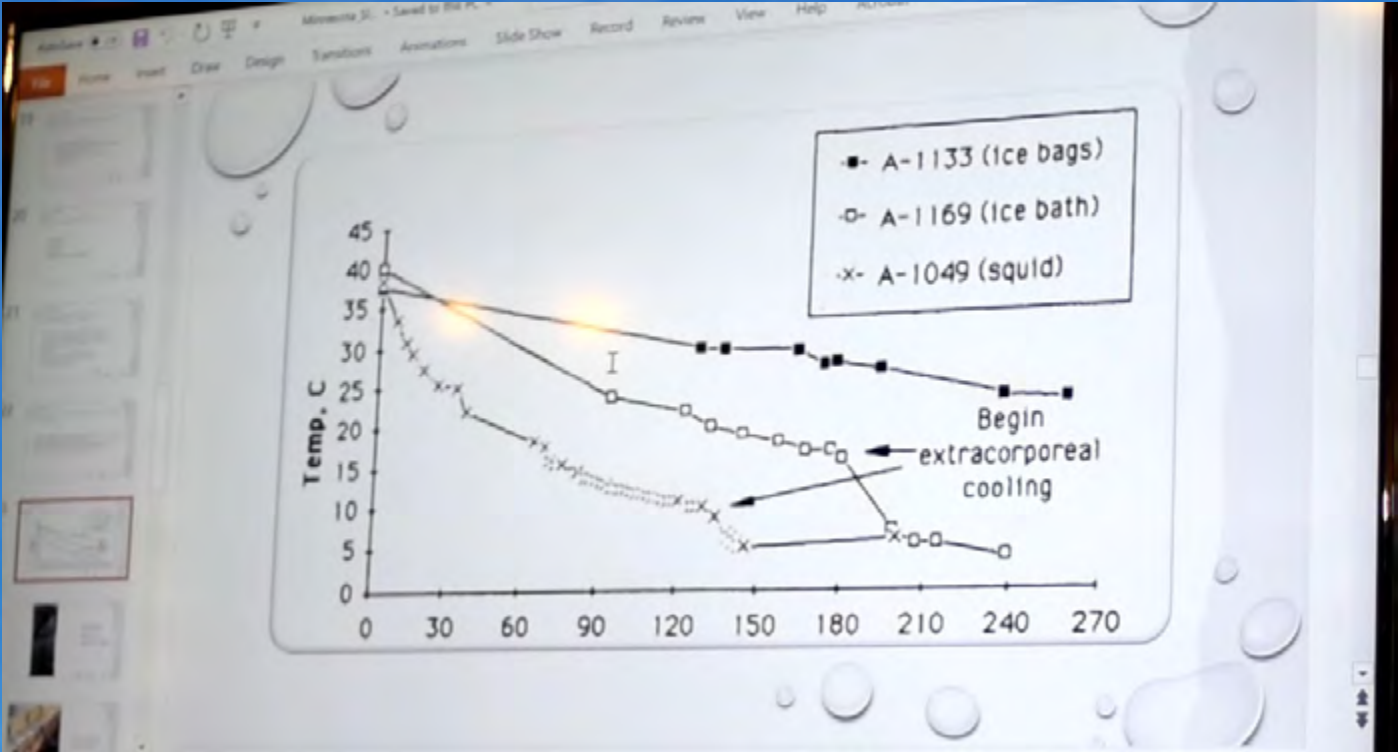
The meeting featured presentations and attendee-participation demonstrations on the critical importance of rapid cooling, medication administration, Lucas 1 chest compression techniques, portable ice bath usage and vehicle loading.

Thirty-four registered attendees represented cryonicists from Colorado, Kansas, Washington, D.C., Washington State, Wisconsin, Minnesota, New York, Florida, Tennessee, Canada and Mexico, including new Suspended Animation CEO, Houston Westfall, and former Cryonics Institute president, Ben Best.

A welcome dinner was held the night before.

** Special thanks to MCRR President Chuck Bartl for the article and photos*

Minnesota Standby Training Event



Aschwin de Wolf's Critical Cooling Chart



Ice from across the street.



Gene Shaver from MCRR shows Christine Gaspar his latest alert projects.

Minnesota Standby Training Event



Aaron Drake presents Standby fundamentals



Vincent Burburan demonstrates Lucas 1 chest compression system.



Ziegler shipper with pre-cut insulation, packing equipment and instructions.





Fourteenth Annual Young Cryonicists Gathering

**** Scholarships Available ****

Teens & Twenties 14 2023 & RAADfest 5 2023:

Thursday-Sunday, Sept 7-10, 2023

Hyatt Regency Orange County; Garden Grove CA

Host: Biomedical Research & Longevity Society - Director: Bill Faloon

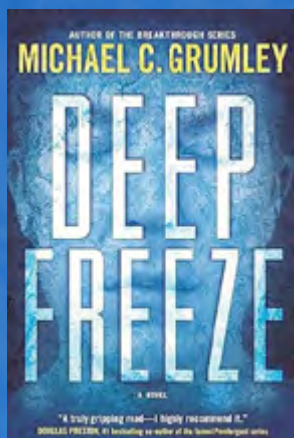
Young cryonicists aged 13-30 are eligible for full or partial scholarships to the 2023 Teens & Twenties / RAADfest event Sept. 7-10, 2023 in Garden Grove, CA. Applicants must be financially covered & contracted cryonicists. Additionally, T2 Alums, DAs and RITs may also apply to attend.

The scholarship covers admittance to RAADfest from Thursday (6-10 pm) -Sunday. The T2 14 2023 program runs Friday & Saturday, 9 am -noon, beginning with breakfast & all day Sunday 'till 10 pm. Breakfast, lunch & dinner will be provided on Sunday. Flight & lodging also covered.

Application deadline: July 30, 2023. 40 Scholarships available on a first-applied first-granted basis to all qualified applicants – so best apply early.

REGISTRATION PACKET & APPLICATION

From the CI Members-Only Discussion Board



Cryonics-Adjacent Sci-Fi Book

I wanted to note a new science fiction book, one of apparently an upcoming series - Deep Freeze by Michael C. Grumley. It's a reasonable thriller set in the near future, but I mention it because it looks like Grumley did some decent research into the hazards of freezing, cryoprotectants, and so on, and incorporated them into the plot. One reference to "Ettinger" as well. Here's the link if you have any interest:

<https://www.amazon.com/Deep-Freeze-Novel-Revival-Book-ebook/dp/B0C2MW16LK/>

Longevity Report Update

The new groups.io group NewLongevityReport is up and running. It replaces the former Longevity Report group. My group description is:

A continuation of the former Longevity Report group owned and hosted by the late John de Rivaz. Discussion of health and longevity of humans and other living things and related issues.

Group Email Addresses

To post (once you are a member): NewLongevityReport@groups.io

To subscribe: NewLongevityReport+subscribe@groups.io

To email the Group Owner (me): NewLongevityReport+owner@groups.io

Metro.co UK Story on the Cryonics Institute

This is a great & positive article of (January 24, 2024) from England about the Cryonics Institute.

Thanks to Dennis Kowalski, President of CI for this interview.

<https://metro.co.uk/2024/01/24/inside-deep-freeze-ambulance-brits-go-life-death-20164112/>



Member Readiness Checklist

*You've signed up for cryonics -
what are the next steps?*

Welcome Aboard! You have taken the first critical step in preparing for the future and possibly ensuring your own survival. Now what should you do? People often ask "What can I do to make sure I have an optimal suspension?" Here's a checklist of important steps to consider.

- ☐ Become a fully funded member through [life insurance](#) or easy pre-payments
Some members use term life and invest or pay off the difference at regular intervals. Some use whole life or just prepay the costs outright. You have to decide what is best for you, but it is best to act sooner rather than later as insurance prices tend to rise as you get older and some people become uninsurable because of unforeseen health issues. You may even consider making CI the owner of your life insurance policy.
- ☐ Keep CI informed on a regular basis about your health status or address changes. Make sure your CI paperwork and funding are always up to date. CI cannot help you if we do not know you need help.
- ☐ Keep your family and friends up to date on your wishes to be cryopreserved. Being reclusive about cryonics can be costly and cause catastrophic results.
- ☐ Keep your doctor, lawyer, and funeral director up to date on your wishes to be cryopreserved. The right approach to the right professionals can be an asset.
- ☐ Prepare and execute a Living Will and Power of Attorney for Health Care that reflects your cryonics-related wishes. Make sure that CI is updated at regular intervals as well.
- ☐ Review the [CI Standby Manual](#) and other materials designed to help you with you Standby Planning. Also, consider joining or forming a local standby group to support your cryonics wishes. This may be one of the most important decisions you can make after you are fully funded. As they say-"Failing to plan is planning to fail".
- ☐ Always wear your cryonics bracelet or necklace identifying your wishes should you become incapacitated. Keep a wallet card as well. If you aren't around people who support your wishes and you can't speak for yourself a medical bracelet can help save you.
- ☐ Get involved! If you can, donate time and money. Cryonics is not a turnkey operation. Pay attention and look for further tips and advice to make both your personal arrangements and cryonics as a whole a success. The stronger our organization is, the stronger your chances of success.
- ☐ Keep your records, contact information and contracts up to date. It is recommended you review your relevant information annually at a minimum. One way is to schedule time to review all your materials at the same time you submit your required Annual Proof of Funding to CI. Also, Be especially aware of easy to forget things like a new email, phone number or address. Remember, you can also contact us at any time to ask if you have any outstanding paperwork or other info that needs to be updated.

The online [CI Members' Information Form](#) is a great resource for updating your current information on file.



DNA and Tissue Sample Preservation Services

Lifetime and Annual Members of the Cryonics Institute can have DNA / Tissue Samples cryopreserved by CI. Annual Members must have fully paid for no less than one year, i.e. have paid \$120 yearly dues (plus the initial \$75 initiation fee if it is their first year) for a full year's Membership.

CI provides a DNA sampling kit for hair, skin, and/or inner cheek samples from living persons or pets. Tissue samples may be extracted from a deceased person or pet by a funeral director or veterinarian, respectively. A CI Member may store DNA/tissue for \$98 for four samples that will each fit into a 1.8ml sample vial. Some members choose to store larger samples, which cost more and that cost is calculated based on the size of the sample. The cost includes a DNA sampling kit which consists of four 1.8-milliliter nalgene vials, swabs, instructions, tissue storage contracts and labels that can be placed on the vials, along with a mailing envelope. Each nalgene vial can be individually labeled for content. Each full kit is labeled, identified by a tissue storage contract and stored in liquid nitrogen at the Cryonics Institute.

Tissue samples need not be sent to CI in the DNA sampling kit. Any small vial or container can be used, and CI will transfer samples to nalgene vials for storage in liquid nitrogen.

For more information on DNA and Tissue Storage Cryopreservation, please contact us at info@cryonics.org or visit cryonics.org:



Visiting Hours For Family Members of CI Patients

Monday:	2:00pm - 4:00pm
Tuesday	2:00om - 4:00pm
Wednesday	2:00pm - 4:00pm
Thursday	2:00pm - 4:00pm

We ask that visitors kindly give us at least **one month advance notice** to ensure there are no scheduling conflicts. We cannot guarantee that the facility will be accessible to visitors who have not scheduled their visit in advance.

**** These visiting hours ar subject to change without notice due to patient or pet emergencies. ****

These requirements have been established for multiple reasons, but most importantly for protecting our patients, members and facility.

Questions regarding visitation can be directed to Andy Zawacki, Facility Manager at info@cryonics.org or 1-586-791-5961.

Thank you!





Worldwide Cryonics Groups

AUSTRALIA: The Cryonics Association of Australasia offers support and information for Australia & nearby countries. caalist@prix.pricom.com.au. Their Public Relations Officer is Philip Rhoades. phil@pricom.com.au GPO Box 3411, Sydney, NSW 2001 Australia. Phone: +6128001 6204 (office) or +61 2 99226979 (home.)

BELGIUM: Cryonics Belgium is an organisation that exists to inform interested parties and, if desired, can assist with handling the paperwork for a cryonic suspension. The website can be found at www.cryonicsbelgium.com. To get in touch, please send an email to info@cryonicsbelgium.com.

BHUTAN: Can help Cryonics Institute Members who need help for the transport & hospital explanation about the cryonics procedure to the Dr and authorities in Thimphu & Paro. Contacts : Jamyang Palden & Tenzin Rabgay / Emails : palde002@umn.edu or jamgarnett@hotmail.co Phones : Jamyang / 975-2-32-66-50 & Tenzin / 975-2-77-21-01-87

CANADA: This is a very active group that participated in Toronto's first cryopreservation. President, Christine Gaspar; Vice President, Gary Tripp. Visit them at: <http://www.cryocdn.org/>. There is a subgroup called the Toronto Local Group. Meeting dates and other conversations are held via the Yahoo group. This is a closed group. To join write: csc5@cryocdn.org

BRITISH COLUMBIA: The Lifespan Society advocates for radical life extension. They also organize conferences and educational outreach events on life extension issues. Lifespan welcomes all Canadians as members, although voting in the society is open to BC residents. Contact Carrie Radomski, President at carrie@lifespanbc.ca Web site www.lifespansociety.com

QUEBEC: Contact: Stephan Beauregard, C.I. Director & Official Administrator of the Cryonics Institute Facebook Page. Information about Cryonics & perfusion services in Montreal for all cryonicists. Services available in French & English: stephan@cryonics.org

CHILE: Community oriented to provide reliable information on human cryopreservation, as far as technical scientific as well as other practical aspects. Dissemination, awareness and education on issues related to the extension of life in general and cryonics in particular. Contact José Luis Galdames via galdamesh.jl@gmail.com.

FINLAND: The Finnish Cryonics Society, (KRYOFIN) was established in 2008 and is an organization collaborating with all nearby groups and organizations. Contact them at: kryoniikka.fi Their President is Ville Salmensuu ville@salmensuu.fi

FRANCE: SOCIETE CRYONICS DE FRANCE is a non profit French organization working closely with European cryonics groups. For more information: J.Roland Missionnier: phone: 33 (0) 6 64 90 98 41 or email: cryonicsnews.inpi@gmail.com • **Facebook group**

<https://www.francecryonics.fr/a-propos/> Vivien Gruss, member of Cryonics Institute, has opened a web site for the information of persons interested in cryonic suspension.

GERMANY: DGAB There are a number of Cryonicists in Germany. Their Organization is called "Deutsche Gesellschaft für Angewandte Biostase e.V.", or short "DGAB". More information on their homepage at www.biostase.de. If there are further questions, contact their Board at vorstand@biostase.de

GERMANY: CRYONICS-GERMANY is an active group providing cryonics support, including a special 8-member Standby Response Team. Members from Germany or Internationally are welcome to join. at <http://cryonics-germany.org>. Direct inquiries to contact@cryonics-germany.org.

INDIA: Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr and authority in Bangalore & Vellore Area. Contacts : Br Sankeerth & Biooster Vignesh / Email : vicky23101994@gmail.com Phones : Biooster / 918148049058 & Br Sankeerth / 917795115939

ITALY: The Italian Cryonics Group (inside the Life Extension Research Group (LIFEXT Research Group)) www.lifext.org and relative forum: forum.lifext.org. Contact Giovanni Ranzo at: giovanni1410@gmail.com

Kriorus Italy: Representative Filippo Polistena, email: filippopolistena45@gmail.com. phone: +39 334 298 9378

JAPAN: Hikaru Midorikawa is President Japan Cryonics Association. Formed in 1998, our goals are to disseminate cryonics information in Japan, to provide cryonics services in Japan, and eventually, to allow cryonics to take root in the Japanese society. Contact mid_hikaru@yahoo.co.jp or <http://www.cryonics.jp/>

NEPAL: Can help Cryonics Institute Members who need help for the transport & hospital explanation about the cryonics procedure to the Dr and authorities in Kathmandu. Contact : Suresh K. Shrestha / Email : toursuresh@gmail.com Phone : 977-985-1071364 / PO Box 14480 Kathmandu.

THE NETHERLANDS: Dutch Cryonics Organization is the local support group since 2002 and able to provide advice, standby, perfusion and shipment 24/7, in case of need. We are an active group utilizing the latest equipment. New members from The Netherlands welcome.

E-mail: info@cryonisme.nl
website: <http://www.cryonisme.nl>

NORWAY : Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr, funeral home and authority at Sandvika. Contacts : Gunnar Hammersmark Sandvika Begegravelsesbyrå / Phones : 011-47-2279-7736

RUSSIA: KrioRus is a Russian cryonics organization operating in Russia, CIS and Eastern Europe that exists to help arrange cryopreservation and longterm suspension locally, or with CI or Alcor. Please contact kriorus@gmail.com for additional information or visit <http://www.kriorus.ru>. Phone: +7 962 947-50-79

SWEDEN: www.kryonik.se or Facebook: Svenska Kryonikföreningen. Initially, the society will focus on providing information and assistance to those who wish to sign up for cryonics. Eventually,

we also hope to provide practical assistance in cases, possibly in collaboration with other European groups.

SWITZERLAND: www.cryosuisse.ch

CRYOSUISSE The Swiss Society for Cryonics is an active group with over 30 members. To join, [email info@cryosuisse.ch](mailto:info@cryosuisse.ch)

UNITED STATES:

Minnesota: Minnesota Cryonics Rapid Response (MCRR) is a nonprofit standby, stabilization and transport group based in Minneapolis, Minnesota. We have a strong, longstanding working relationship with local funeral directors, and have successfully participated in significantly more-timely suspension efforts in Minnesota in cooperation with both Alcor and the Cryonics Institute. Contact: President, Chuck Bartl, chuckbartl@yahoo.com.

Washington DC Metro Region: Life Extension Society (LES) is a nonprofit organization of area cryonicists dedicated to enhancing local capabilities for standby, stabilization and transport. Members from both Alcor and Cryonics Institute are welcome. Contact: Mark Mugler, mugsim2@gmail.com.

UNITED KINGDOM: Cryonics UK is a nonprofit UK based standby group. www.cryonics-uk.org Cryonics UK can be contacted via the following people: Tim Gibson: phone: 07905 371495, email: tim.gibson@cryonics-uk.org. Victoria Stevens: phone: 01287 669201, email: vicstevens@hotmail.co.uk. Graham Hipkiss: phone: 0115 8492179 / 07752 251 564, email: ghipkiss@hotmail.com. Alan Sinclair: phone: 01273 587 660 / 07719 820715, email: cryoservices@yahoo.co.uk

Can help Cryonics Institute Members who need help, funeral home, transport at London. Contact : F.A. Albin & Sons / Arthur Stanley House Phone : 020-7237-3637

INTERNATIONAL: The Cryonics Society is a global cryonics advocacy organization. www.CryonicsSociety.org. They publish an e-newsletter *FutureNews*. Phone: 1-585-643-1167.

HELP US STAY UP-TO-DATE!

Please send any corrections or changes to the address below. If you know of, or are considering starting a support, standby or other cryonics-related group in your area, please send details to

dg@cryonics.org.



Please note, this list is provided as an information resource only. Inclusion on the list does not constitute an endorsement by the Cryonics Institute or our affiliated organizations. We urge our readers to use this list as a starting point to research groups that may meet their own individual needs. We further note that readers should always use their own informed judgment and a reasonable amount of caution in dealing with any organization and/or individual listed.


CI MEMBERSHIP

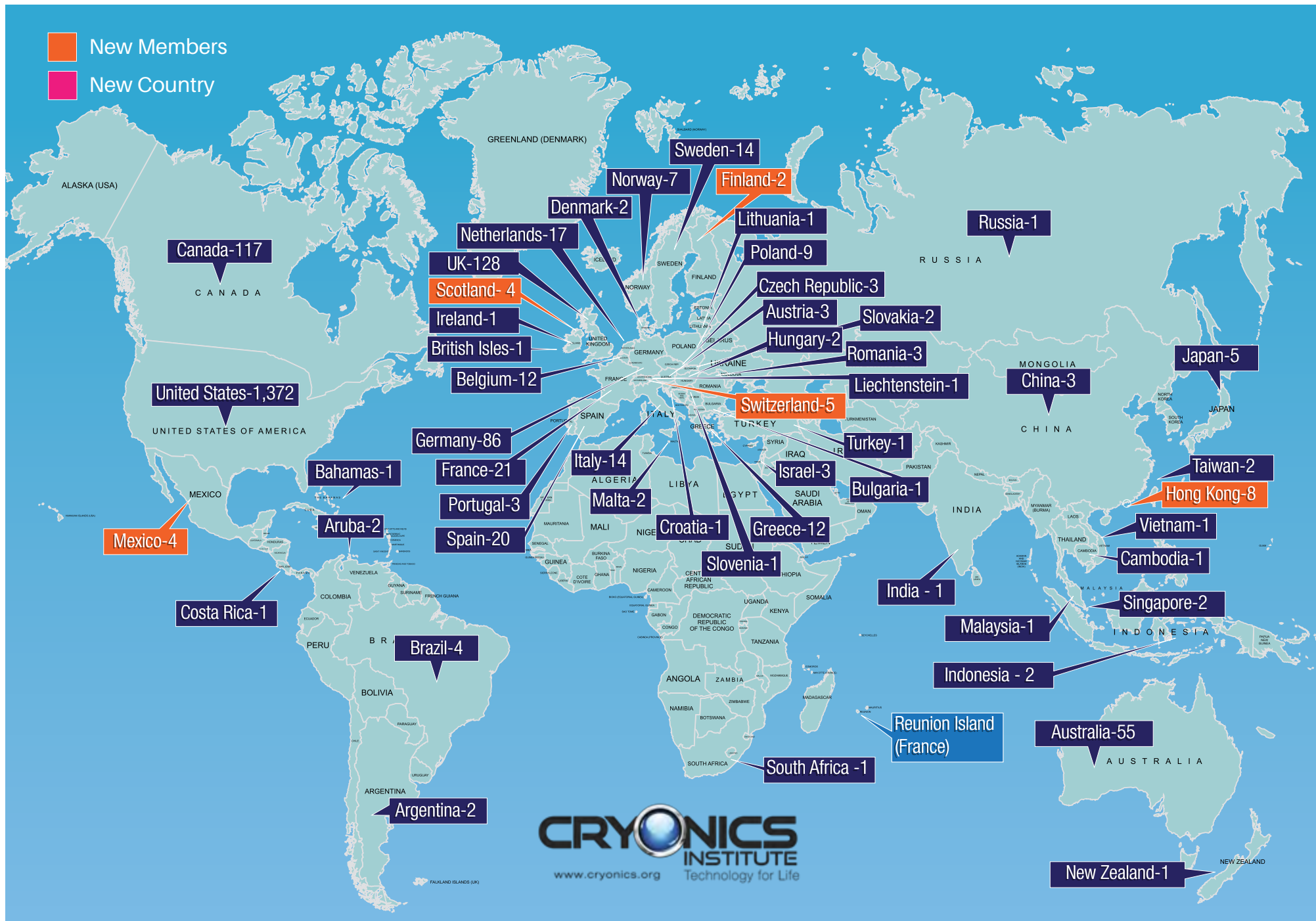
APRIL 2024

Members 1,966
Patients 254

Pets 257
DNA/Tissue 357
SA 334

TOTAL
2,220

 New Members
 New Country



Who will be there for YOU?



Don't wait to make your plans. Your life may depend on it.



Suspended Animation fields teams of specially trained cardio-thoracic surgeons, cardiac perfusionists and other medical professionals with state-of-the-art equipment to provide stabilization care for Cryonics Institute members in the continental U.S.

Cryonics Institute members can contract with Suspended Animation for comprehensive standby, stabilization and transport services using life insurance or other payment options.



Speak to a medical representative for more information.

..... **Call 1-949-482-2109**

or email info@suspendedanimationinc.com

Scientists can tell how fast you're aging. **Now, the trick is to slow it down**

JANUARY 29, 2024 - HEARD ON MORNING EDITION | Allison Aubrey



I used to flinch at the topic of aging. Is there anything we can do about the inevitable?

But recently I've been digging into a new wave of longevity research that is making it an exciting time to be an aging human — which is all of us.

It turns out, we all age at varying rates. Super-agers may have great genes, but research shows our habits and routines — everything from what we eat and how we move our bodies to who we spend our time with — matter a lot, when it comes to aging well.

Now, the next frontier is to target the basic biology of aging

and come up with new interventions to slow it down.

Many scientists are optimistic that we're on the cusp of breakthroughs. Not only to help us live longer, but — more importantly — to extend the number of years we live with good health.

This is the goal of researchers at the Human Longevity Lab at the Northwestern University Feinberg School of Medicine. They're recruiting study participants so they can test what kinds of interventions may slow the rate of aging. To that end, I decided to roll up my sleeve for science.

Welcome to aging: My visit to the longevity lab

When I arrived, the first step was a quick blood draw. The Potocsnak Longevity Institute is housed on the light-filled 21st floor of Northwestern Memorial Hospital, overlooking Lake Michigan. It felt more like a spa than a doctor's office. I didn't anticipate the vast range of data and insights scientists could glean from a battery of tests.

Over a four-hour period, they performed more than two dozen assessments. At first it felt a bit like an annual physical. They checked my blood pressure, weight, glucose and cholesterol.

But then, the tests got a lot more interesting. Inside a small exam room, a medical assistant opened the hinge of a BodPod, a capsule that looks like a submersible. The machine assessed my body composition, determining the ratio of fatty mass to lean mass, which includes muscle. Strength is a key marker of healthy aging, helping us fend off frailty and falls.

Next, I was asked to sniff and identify a range of distinct smells — from leather to chocolate — to test olfactory function. The loss of smell can be an early sign of disease and cognitive decline. They scanned my retina and took digital images of the inside of my eyes, which can also help detect disease. And I took a memory and cognitive function test, called MOCA. Thankfully, all was healthy.

Then I went through a slew of cardiovascular health tests. They measured my endothelial function, which keeps blood flowing smoothly through the body. They looked at my heart rate variability and pulse-wave velocity, which is an indicator of stiffness of the arteries. I had electrodes

placed onto my chest for an electrocardiogram.

Midway through I was feeling a bit nervous, and my mind raced to what ifs.

Of all the tests they performed, the most intriguing is the GrimAge test. This test predicts biological age. It's gauging whether your DNA age is younger, or older, than your actual age, known as chronological age. Conjure images of the Grim Reaper? Yep, that's the idea: The test can estimate how quickly, or slowly, you're aging.

To figure this out, researchers use a technique based on DNA methylation, which is a measure of modifications in our DNA. Basically, as we age, compounds called methyl groups attach to some of our DNA molecules, which can turn genes on or off. Researchers have shown that the higher the proportion of methylated DNA in certain locations, the more accelerated a person's biological age. Published research suggests this is a reliable way to predict life span and health span.

Can you change your biological age?

No one wants to find out they're aging faster than their peers, right? But here's the exciting part. Our biological age may be malleable. The hope is that we can slow down our rate of aging — by making changes to lifestyle. Down the line, there may be anti-aging pills or other interventions.

For researchers, the GrimAge test isn't just a way to estimate DNA age. It's a tool to study whether interventions can alter it.

"That's the big ray of optimism that comes through all of this — the possibility that we can slow down aging and extend the health span of people," says Dr. Douglas Vaughan, director of the Longevity Institute. Health span is the number of years we live with good health. "It can be changed very rapidly in experimental models and probably in people, too," he says.

For example, smoking has a very strong effect on methylation. "Tens of thousands of locations gain methylation when you smoke," explains researcher Steve Horvath, who developed the epigenetic clock used as part of the GrimAge test. People with obesity also exhibit higher methylation at certain locations. "Conversely, if you eat vegetables, if you are lean, if you exercise, that slows methylation age," he explains.

Now, of course, it's long been known that smoking and eating poorly are bad for you. But researchers can now test specific interventions to see if it's possible to move the needle.

Vaughan's deep interest in aging took off when he identified a distinct genetic variant in an Amish community in Indiana. People who have the variant are protected from



NPR's Allison Aubrey has her body composition measured inside a BodPod. Several other tests performed at the longevity lab — led by Dr. Douglas Vaughan — are used to estimate biological age.

Jane Greenhalgh/NPR

diabetes and have healthier cardiovascular systems compared to people who don't. In the laboratory, when Vaughan engineered mice to have only a 50% level of a protein associated with this mutation, their life spans increased by nearly fourfold. "This was a eureka moment," he says.

He tells his current medical students that in their careers they will prescribe interventions to slow down biological aging in their patients.

"I don't know exactly what that's going to be. It might be a drug. It might be a lifestyle intervention, for all I know it might be gene editing," Vaughan says. "But there are going to be ways that we are going to slow down this process and give people a longer health span."

Democratizing aging

People who live in the upscale Chicago neighborhood where the Human Longevity Lab is located can expect to live a much longer, healthier life compared to people who live just a few miles away. Vaughan wants to help close this gap.

"I'm worried about the poor soul in south Chicago who has a life expectancy of 55, compared to 92 in the neighborhood where we're standing right now," he says. A stunning difference of more than 30 years. (You can check out life expectancy in your ZIP code [here](#).)

A lot of factors play into this life expectancy gap including poverty, housing, stress and crime, which can all work against health span.

Vaughan and his collaborators are enrolling people from a wide range of ages, ethnic groups, neighborhoods and socioeconomic status to see what works to slow biological aging for everybody.

"There are lots of people who've been dealt a bad hand with regard to aging," Vaughan says. Their goal is to find affordable, evidence-based interventions that can benefit everyone, regardless of socioeconomic status.

For example, there's interest in studying stress, which Vaughan says could be "part of the reason for the discrepancy in the life expectancy in different neighborhoods of Chicago." To study this, he could measure people's biological age at baseline, have them try a stress-reduction program, and test again to see if their results changed.

Vaughan is also interested in studying people with chronic HIV, who tend to age at an accelerated rate. A charitable gift from a Chicago family with a shared interest helped launch the institute. Vaughan's team is considering a range of interventions to test whether they can slow down aging in this population.



Dr. Douglas Vaughan and Dr. John Wilkins of the Northwestern University Feinberg School of Medicine and the Potocsnak Longevity Institute. - Allison Aubrey/NPR

"It might be weight training, it might be intermittent fasting, it might be dietary manipulations, it might be drugs that are available now that might have anti-aging effects," Vaughan explains, citing the diabetes drug metformin.

Longevity and health span research is attracting lots of funding and attention, from places like the Hevolution Foundation, which provides grants and early stage investments, and Altos Labs, a biotechnology company, founded by Dr. Rick Klausner, which is investigating ways to reprogram or rejuvenate cells.

Dozens of groups have signaled their intent to compete in the \$101 million X-PRIZE global competition focused on treatments that support healthy longevity — everything from new drugs or supplements, to devices, to repurposing old drugs for new uses.

"Teams have to come to the starting line and we're going to set up the frameworks by which they prove their therapeutic works," says XPRIZE's Jamie Justice, who is also a researcher at Wake Forest University School of Medicine.

Embracing aging science

Fortunately, my GrimAge score came back younger than my actual age, though I did get some surprises. I learned that my body composition isn't optimal. Turns out, I need to build more lean muscle mass, which is pretty common as we age — especially for women.

With muscle mass, if you don't use it, you lose it. After the age of 30 to 35, muscle starts to slowly decline. And after age 65 or so, this loss accelerates. So it's never too soon to start building a reserve. My goal for this year is to build muscle through resistance training and an optimal diet. And also, to reduce stress.

My experience in the longevity study has motivated me to get started on a new project: How To Thrive As You Age. We'll have more stories on healthy aging interventions coming soon.

Unveiling Nature's Ultimate Survivors: Tardigrade Genomes Reveal the Secrets of Extreme Survival-

By SMBE JOURNALS

FEBRUARY 12, 2024

Recent research on tardigrades uncovers a complex genetic basis for their extreme resilience, challenging previous assumptions about their ecological adaptations and pointing to independent evolutionary events in their anhydrobiosis capability.



Tardigrades may be nature's ultimate survivors. While these tiny, nearly translucent animals are easily overlooked, they represent a diverse group that has successfully colonized freshwater, marine, and terrestrial environments on every continent, including Antarctica.

Commonly known as "water bears", these unusual creatures may be among the most resilient organisms on the planet thanks to their unparalleled ability to survive extreme conditions, with various species being resistant to drought, high doses of radiation, low oxygen environments, and both high and low temperatures and pressures.

While numerous genes have been suggested to contribute to this extremotolerance, a comprehensive understanding of the origins and history of these unique adaptations has remained elusive. In a new study published in *Genome Biology and Evolution*, scientists at Keio University Institute for Advanced Biosciences, the University of Oslo Natural

History Museum, and the University of Bristol reveal a surprisingly intricate network of gene duplications and losses associated with tardigrade extremotolerance, highlighting the complex genetic landscape that drives modern tardigrade ecology.

Understanding Tardigrade Gene Families

As one form of extremotolerance, tardigrades can survive almost complete desiccation by entering a dormant state called anhydrobiosis (i.e., life without water), which allows them to reversibly halt their metabolism. Multiple tardigrade-specific gene families were previously found to be associated with anhydrobiosis.

Three of these gene families are referred to as cytosolic, mitochondrial, and secretory abundant heat soluble proteins (CAHS, MAHS, and SAHS, respectively) based on the cellular location in which the proteins are expressed.



A photograph of the tardigrade *Ramazzottius varieornatus*, in the center of a phylogeny of CAHS, the largest of the six desiccation-related protein families analyzed in this study. Credit: Kazuharu Arakawa, Keio Institute of Advanced Biosciences

Some tardigrades appear to possess a variant pathway that involves two families of abundant heat-soluble proteins first identified in the tardigrade *Echiniscus testudo* and usually referred to as EtAHS alpha and beta.

Tardigrades also possess stress resistance genes that can be found in animals more broadly, such as the meiotic recombination 11 (MRE11) gene, which has been implicated in desiccation tolerance in other animals. Unfortunately, since the identification of these gene families, limited information has been available from most tardigrade lineages, making it difficult to draw conclusions on their origins, history, and ecological implications.

Investigating Tardigrade Evolution

To better shed light on the evolution of tardigrade extremotolerance, the authors of the new study—James Fleming, Davide Pisani, and Kazuharu Arakawa—identified sequences from these six gene families across 13 tardigrade genera, including representatives from both of the major tardigrade lineages, the Eutardigrades, and Heterotardigrades. Their analysis revealed 74 CAHS, 8 MAHS, 29 SAHS, 22 EtAHS alpha, 18 EtAHS beta, and 21 MRE11 sequences, allowing them to build the first tardigrade phylogenies for these gene families.

As resistance to desiccation is likely to have emerged as an adaptation to terrestrial environments, the authors assumed that they would find a link between gene duplications and losses in these gene families and habitat changes within tardigrades. “When we began the work, we expected to find that each clade would be clearly grouped around ancient duplications, with few independent losses. That would help us easily tie them to an understanding of modern habitats and ecology,” says the study’s lead author, James Fleming. “It’s an intuitive hypothesis,” he continues, “that the evolution of the duplications of these desiccation-related genes should, in theory, contain remnants of the

ecological history of these organisms, although, in reality, this turned out to be overly simplistic.”

Instead, the authors were surprised by the sheer number of independent duplications of heat-soluble genes, which painted a much more complex picture of anhydrobiosis-related gene evolution. Notably, however, there was no clear link between strongly anhydrobiotic species and the number of anhydrobiosis-related genes a species possessed. “What we found was far more exciting,” says Fleming, “a complex network of independent gains and losses that does not necessarily correlate to modern terrestrial species ecologies.”

Independent Adaptations in Tardigrade Lineages

Despite the lack of a relationship between gene duplications and tardigrade ecology, the study did provide crucial insight into the major transitions that led to the acquisition of anhydrobiosis. The distinct distributions of gene families across the two major groups of tardigrades—CAHS, MAHS, and SAHS in the Eutardigrades and EtAHS alpha and beta in the Heterotardigrades—suggest that two independent transitions from marine to limno-terrestrial environments occurred within tardigrades, once in the Eutardigrade ancestor and once within the Heterotardigrades.

This research marks a significant step forward in our understanding of the evolution of anhydrobiosis in tardigrades. It also provides a foundation for future studies into tardigrade extremotolerance, which will require the continued development of genomic resources from more diverse tardigrade lineages.

“We, unfortunately, have no representatives from several important families, such as the Isohypsibiidae, and this does limit how firmly we can stand by our conclusions,” notes Fleming. “With more freshwater and marine tardigrade samples, we will be better able to appreciate the adaptations of terrestrial members of the group.” Unfortunately, some tardigrades can be especially elusive, presenting a major obstacle to such studies. As an example, *Tanarctus bubulubus*, one of Fleming’s favorite tardigrades, is too small to see with the naked eye and is found only in sediment in the North Atlantic at depths of around 150 m. “Hopefully,” says Fleming, “large-scale sequencing initiatives through the Earth Biogenome Project will steadily bridge this gap in our understanding, and it’s an effort I’m excited to see continue.”

Reference: “The Evolution of Temperature and Desiccation-Related Protein Families in Tardigrada Reveals a Complex Acquisition of Extremotolerance” by James F Fleming, Davide Pisani and Kazuharu Arakawa, 29 November 2023, *Genome Biology and Evolution*.

DOI: 10.1093/gbe/evad217

Things we can do to help cope with traumatic loss

February 7, 2024 - Source: North Carolina State University

A new study finds there are simple activities that can help people improve their mood and emotional well-being on a day-to-day basis after the traumatic loss of a loved one.

"The untimely or traumatic death of close friends or family is emotionally taxing, and navigating grief can be difficult," says Caitlin Reynolds, co-author of the study and a Ph.D. student at North Carolina State University. "Our study suggests there are specific things people can do to bolster their emotional well-being following a traumatic loss."

"We were conducting a larger study that looked at how daily behaviors affect emotional well-being and day-to-day functioning, and we realized that a significant number of study participants were dealing with the traumatic loss of a loved one," says Shevaun Neupert, corresponding author of the study and a professor of psychology at NC State. "This gave us an opportunity to gain insights into how daily behaviors in the wake of a loss can influence our emotional well-being."

For the study, researchers worked with data from 440 U.S. adults between the ages of 50 and 85. 356 of the study participants reported the traumatic loss of a loved one. Study participants completed a daily diary survey for 14 consecutive days. The survey questions were designed to capture changes in each participant's day-to-day lived experiences and "affect" -- or mood.

"The survey questions also helped us capture information related to subjective age, or how old people report feeling each day," Neupert says. "Do they feel older than they actually are? Younger? And how does that correlate to their mood or emotional well-being?"

"One of the study's big findings is that activities we call 'uplifts' can have a significant impact," says Ali Early, co-author of the study and a former undergraduate at NC State.

Uplifts refer to a variety of activities that can improve our

mood, such as:

- Completing a task;
- Getting enough sleep;
- Dining out;
- Visiting, phoning or writing a friend; or
- Spending time with family.

"Uplifts were good for everyone, but there is some nuance in not only who is most impacted, but when the uplifts are most powerful," Neupert says. "For example, we found that the positive effect of uplifts was more pronounced for people who had experienced traumatic loss, and especially so on days when they reported feeling older."

The findings held true even when researchers accounted for the socioeconomic status of study participants, their age and the age at which they first experienced a traumatic loss.

"In other words, there are things we can do -- which are accessible for most people -- to improve our moods," Neupert says. "And those things can help us most on days when we most need it."

The paper, "Traumatic Losses Permeate Daily Emotional Experiences: Roles of Daily Uplifts and Subjective Age," is published open access in the journal *Applied Psychology: Health and Well-Being*.

Story Source: Materials provided by North Carolina State University. Original written by Matt Shipman. Note: Content may be edited for style and length.

Journal Reference: Alexandra S. Early, Caitlin M. Reynolds, Shevaun D. Neupert. Traumatic losses permeate daily emotional experiences: roles of daily uplifts and subjective age. Applied Psychology: Health and Well-Being, 2024; DOI: 10.1111/aphw.12530

Using cancer's strength to fight against it

New technique made human T cells 100 times more potent at killing cancer cells

Date: February 7, 2024 | Source: Northwestern University

Scientists at the UC San Francisco (UCSF) and Northwestern Medicine may have found a way around the limitations of engineered T cells by borrowing a few tricks from cancer itself.

"By studying mutations in malignant T cells that cause lymphoma, they zeroed in on one that imparted exceptional potency to engineered T cells. Inserting a gene encoding this unique mutation into normal human T cells made them more than 100 times more potent at killing cancer cells without any signs of becoming toxic.

While current immunotherapies work only against cancers of the blood and bone marrow, the T cells engineered by Northwestern and UCSF were able to kill tumors derived from skin, lung and stomach in mice. The team has already begun working toward testing this new approach in people.

"We used nature's roadmap to make better T cell therapies," said Dr. Jaehyuk Choi, an associate professor of dermatology and of biochemistry and molecular genetics at Northwestern University Feinberg School of Medicine. "The superpower that makes cancer cells so strong can be transferred into T cell therapies to make them powerful enough to eliminate what were once incurable cancers."

"Mutations underlying the resilience and adaptability of cancer cells can super-charge T cells to survive and thrive in the harsh conditions that tumors create," said Kole Roybal, associate professor of microbiology and immunology at UCSF, center director for the Parker Institute for Cancer Immunotherapy Center at UCSF, and a member of the Gladstone Institute of Genomic Immunology.

The study will appear in *Nature* Feb. 7.

A solution hiding in plain sight

Creating effective immunotherapies has proven difficult against most cancers because the tumor creates an environment focused on sustaining itself, redirecting resources like oxygen and nutrients for its own benefit. Often, tumors hijack the body's immune system, causing it to defend the cancer, instead of attacking it.

Not only does this impair the ability of regular T cells to target cancer cells, it undermines the effectiveness of the engineered T cells that are used in immunotherapies, which quickly tire against the tumor's defenses.

"For cell-based treatments to work under these conditions," Roybal said, "we need to give healthy T cells abilities that are

beyond what they can naturally achieve."

The Northwestern and UCSF teams screened 71 mutations found in patients with T cell lymphoma and identified which ones could enhance engineered T cell therapies in mouse tumor models. Eventually, they isolated one that proved both potent and non-toxic, subjecting it to a rigorous set of safety tests.

"Our discoveries empower T cells to kill multiple cancer types," said Choi, a member of the Robert H. Lurie Comprehensive Cancer Center of Northwestern University. "This approach performs better than anything we've seen before." Their discoveries can be incorporated into treatments for many types of cancer, the scientists said.

"T cells have the potential to offer cures to people who are heavily pretreated and have a poor prognosis," Choi said. "Cell therapies are living drugs, because they live and grow inside the patient and can provide long-term immunity against cancer."

In collaboration with the Parker Institute for Cancer Immunotherapy and Venrock, Roybal and Choi are building a new company, Moonlight Bio, to realize the potential of their groundbreaking approach. They are currently developing a cancer therapy that they hope to begin testing in people within the next few years.

"We see this as the starting point," Roybal said. "There's so much to learn from nature about how we can enhance these cells and tailor them to different types of diseases."

The research was supported by the Parker Institute for Cancer Immunotherapy, NIH grants (grants F30 CA265107, T32 CA009560, 1DP2AI136599-01 and DP2 CA239143), Cancer Moonshot grant U54 CA244438, the Mark Foundation for Cancer Research, the Bakewell Foundation, and UCSF Helen Diller Family Comprehensive Cancer Center.

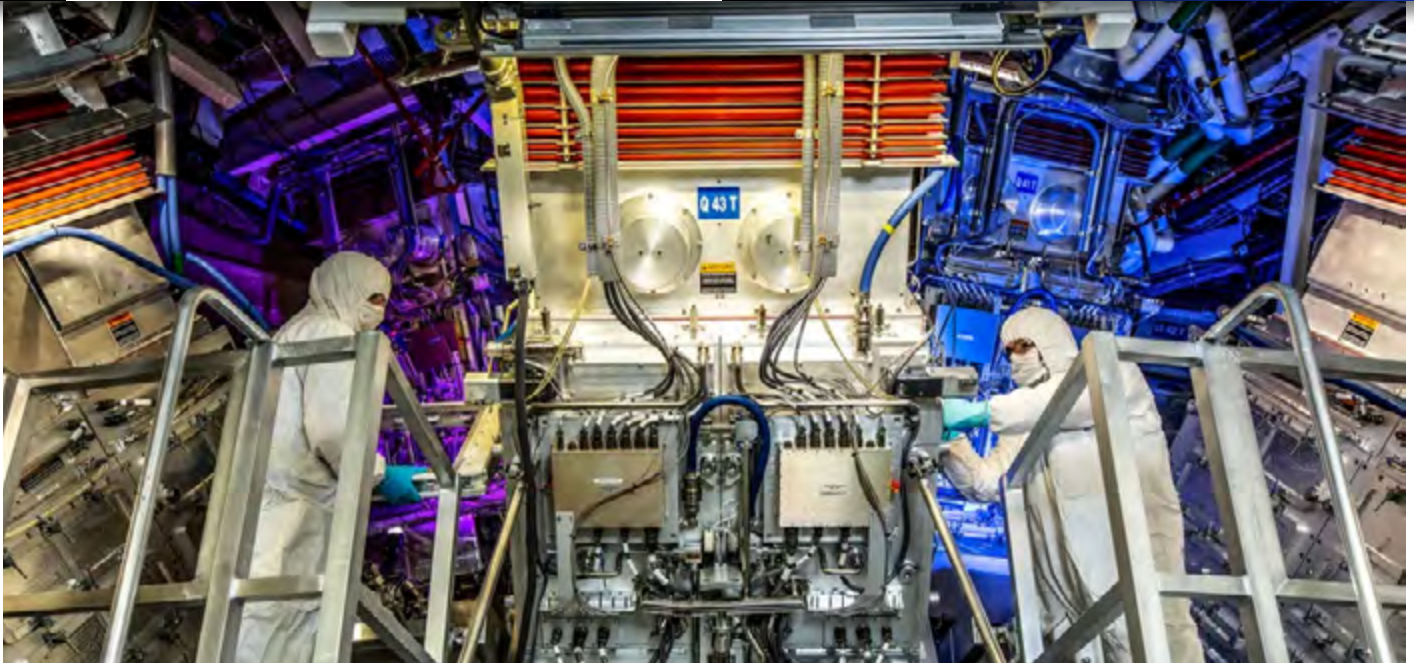
Roybal and Choi are inventors on patents related to these discoveries and are co-founders and equity holders in Moonlight Bio.

Story Source: Materials provided by Northwestern University. Note: Content may be edited for style and length.

*Journal Reference: Julie Garcia, Jay Daniels, Yujin Lee, Iowis Zhu, Kathleen Cheng, Qing Liu, Daniel Goodman, Cassandra Burnett, Calvin Law, Chloé Thienpont, Josef Alavi, Camillia Azimi, Garrett Montgomery, Kole T. Roybal, Jaehyuk Choi. Naturally occurring T cell mutations enhance engineered T cell therapies. *Nature*, 2024; DOI: 10.1038/s41586-024-07018-7*

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In December 2022, scientists at the National Ignition Facility (pictured) achieved nuclear fusion “ignition,” in which the energy produced by the fusing of atomic nuclei exceeds that needed to kick the fusion off. JASON LAUREA/LLNL

Here’s how scientists reached nuclear fusion ‘ignition’ for the first time

*The experiment, performed in 2022, also revealed a
never-before-seen phenomenon*

By Emily Conover FEBRUARY 16, 2024 AT 9:30 AM

One of nuclear fusion’s biggest advances wouldn’t have happened without some impeccable scientific artistry.

In December 2022, researchers at Lawrence Livermore National Laboratory in California created fusion reactions that produced an excess of energy — a first. In the experiment, 192 lasers blasted a small chamber, setting off fusion reactions — in which smaller atomic nuclei merge to form larger ones — that released more energy than initially kicked them off (SN: 12/12/22). It’s a milestone known as “ignition,” and it has been decades in the making.

Now, researchers have released details of that experiment

in five peer-reviewed papers published online February 5 in Physical Review Letters and Physical Review E. The feat demanded an extraordinary level of finesse, tweaking conditions just so to get more energy out of the lasers and create the ideal conditions for fusion.

The work is “exquisitely beautiful,” says physicist Peter Norreys of the University of Oxford. Norreys, who was not involved with the research, compares the achievement to conducting a world-class orchestra: Different elements of the experiment had to be meticulously coordinated and precisely timed.

Scientists also discovered a long-predicted heating effect that could expose the physics of other violent environments, such as exploding stars called supernovas. "People say [physics is] a dry subject," Norreys says. "But I always think that physics is at the very forefront of creativity,"

The road to nuclear fusion's big break

Fusion, the same process that takes place in the sun, is an appealing energy source. Fusion power plants wouldn't emit greenhouse gases. And unlike current nuclear fission power plants, which split atomic nuclei to produce energy, nuclear fusion plants wouldn't produce dangerous, long-lived radioactive waste. Ignition is the first step toward harnessing such power.

Generating fusion requires extreme pressures and temperatures. In the experiment, the lasers at LLNL's National Ignition Facility pelted the inside of a hollow cylinder, called a hohlraum, which is about the size of a pencil eraser. The blast heated the hohlraum to a sizzling 3 million degrees Celsius — so hot that it emitted X-rays. Inside this X-ray oven, a diamond capsule contained the fuel: two heavy varieties of hydrogen called deuterium and tritium. The radiation vaporized the capsule's diamond shell, triggering the fuel to implode at speeds of around 400 kilometers per second, forming the hot, dense conditions that spark fusion.

Previous experiments had gotten tantalizingly close to ignition (SN: 8/18/21). To push further, the researchers increased the energy of the laser pulse from 1.92 million joules to 2.05 million joules. This they accomplished by slightly lengthening the laser pulse, which blasts the target for just a few nanoseconds, extending it by a mere fraction of a nanosecond. (Increasing the laser power directly, rather than lengthening the pulse, risked damage to the facility.)

The team also thickened the capsule's diamond shell by about 7 percent — a difference of just a few micrometers — which slowed down the capsule's implosion, allowing the scientists to fully capitalize on the longer laser pulse. "That was a quite remarkable achievement," Norreys says.

But these tweaks altered the symmetry of the implosion, which meant other adjustments were needed. It's like trying to squeeze a basketball down to the size of a pea, says physicist Annie Kritcher of LLNL, "and we're trying to do that spherically symmetric to within 1 percent."

That's particularly challenging because of the mishmash of electrically charged particles, or plasma, that fills the hohlraum during the laser blast. This plasma can absorb the laser beams before they reach the walls of the hohlraum, messing with the implosion's symmetry.

To even things out, Kritcher and colleagues slightly altered the wavelengths of the laser beams in a way that allowed them to transfer energy from one beam to another. The fix

required tweaking the beams' wavelengths by mere angstroms — tenths of a billionth of a meter.

"Engineering-wise, that's amazing they could do that," says physicist Carolyn Kuranz of the University of Michigan in Ann Arbor, who was not involved with the work. What's more, "these tiny, tiny tweaks make such a phenomenal difference."

After all the adjustments, the ensuing fusion reactions yielded 3.15 million joules of energy — about 1.5 times the input energy, Kritcher and colleagues reported in *Physical Review E*. The total energy needed to power NIF's lasers is much larger, around 350 million joules. While NIF's lasers are not designed to be energy-efficient, this means that fusion is still far from a practical power source.

Another experiment in July 2023 used a higher-quality diamond capsule and obtained an even larger energy gain of 1.9, meaning it released nearly twice as much energy as went into the reactions (SN: 10/2/23). In the future, NIF researchers hope to be able to increase the laser's energy from around 2 million joules up to 3 million, which could kick off fusion reactions with a gain as large as 10.

What's next for fusion

The researchers also discovered a long-predicted phenomenon that could be useful for future experiments: After the lasers heated the hohlraum, it was heated further by effects of the fusion reactions, physicist Mordy Rosen and colleagues report in *Physical Review Letters*.

Following the implosion, the ignited fuel expanded outward, plowing into the remnants of the diamond shell. That heated the material, which then radiated its heat to the hohlraum. It's reminiscent of a supernova, in which the shock wave from an exploding star plows through debris the star expelled prior to its explosion (SN: 2/8/17).

"This is exactly the collision that's happening in this hohlraum," says Rosen, of LLNL, a coauthor of the study. In addition to explaining supernovas, the effect could help scientists study the physics of nuclear weapons and other extreme situations.

NIF is not the only fusion game in town. Other researchers aim to kick off fusion by confining plasma into a torus, or donut shape, using a device called a tokamak. In a new record, the Joint European Torus in Abingdon, England, generated 69 million joules, a record for total fusion energy production, researchers reported February 8.

After decades of slow progress on fusion, scientists are beginning to get their atomic orchestras in sync.

CI Reading Room

Serializing essential works on cryonics

R.C.W. Ettinger

YOUNIVERSE

**Toward a Self-Centered Philosophy
of Immortalism and Cryonics**

CHAPTER TEN

"A classic for anyone trying to understand what this universe is all about...and it has many little things that add to the fun of reading it."

—Professor Peter Gouras, M.D., Ph.D., Columbia University, about the first edition.

Chapter 9

Identity & Survival 2 - Silicon

AI & Computers—Let's Be Sensible:

Although much of my writing, past and current, has involved grand projections of technological progress, this chapter is mainly a whoa-Nellie, an antidote to widespread hyperbole and misunderstandings about computers and computer simulations. We'll need to touch on many aspects, but the main effect will be to debunk common notions—shared by many “experts”—about potentially living and superhuman computers. The radical coterie believe that thinking is information processing and information processing is thinkinff and “intelligence” is primarily quantitative. I say, balderdash.

Can Machines Think? Obviously this depends on the definitions of “machine” and “think”, and there is no consensus on either. One answer is that we are machines (mechanisms or physical systems obeying the laws of nature) and we think. But the question is whether clunkier and clankier machines, including digital computers, can do everything that human brains can do, and the answer is an unequivocal negative, as will gradually develop.

Many laymen still think that Deep Blue, the IBM chess program that beat world champion Garry Kasparov in 1997, was intelligent. In fact, it was mostly a brute-force algorithm, testing possible outcomes many moves ahead. It understood nothing, about chess or anything else, and didn't think at all in any proper sense. But large numbers of experts still have misunderstandings almost as egregious.

Artificial Intelligence (AI) has a long history of failed goals, beginning at least 40 years ago. This doesn't prove anything, but it ought to give pause to those who keep making apocalyptic predictions.

Mom on Brute-Force Computation: For reasons that remain mysterious to me, most of the AI people refuse to acknowledge the plain fact that a computer, in principle, could display just about any capability without the least hint of human intelligence. I have already mentioned Deep Blue now let's generalize a bit. Many AI people buy the Turing Test criterion of humanity—if its email messages cannot be distinguished from those of a normal adult human, the correspondent must be assumed human or human-equivalent. But I can, in principle, describe a computer program that will pass a Turing Test, yet lack LAWKI (life as we know it) as well as intelligence in anything like the human sense. All we need do is write a program that matches a humongous list of questions with a humongous list of answers, and either has humongous speed or has a humongous amount of time available. If humongous is sufficiently humongous, it is clear—or ought to be—that the program will almost always find a reasonable match in the answer list for anything in the question list. It will pass any Turing Test with a high grade. And yet it is just a crude machine, which is goal-directed but understands and feels nothing.

Disclaimer. I do *not* assert any theoretical limit on the future capabilities of computers in

the areas of description or prediction. In principle, as far as I know, an advanced computer could describe you down to your last atom and predict (and retrodict) your every thought and action. But this is vastly different from the assertion that "you" could be "uploaded" into a computer and "live" there.

Is Information Everything? Many scientists and mathematicians now seem to subscribe to the "information paradigm," with the aforementioned implication among other absurdities, that you could in principle, and perhaps before very long in practice, be "uploaded" "into" a computer and live there, far better than before, as a simulation or emulation. (An emulation is an exact simulation.)

All right, it does take a bit of crust for me to label "absurd" the conclusions of people who are mostly smarter than I am and better informed. But some of the most eminent scientists have disagreed sharply with each other in many areas over long stretches of time and still do, which proves that some of them (at least) must be wrong. (E.g., check out the various interpretations or ontologies of quantum theory.)

And some of the greatest, e.g. Newton, had weaknesses acknowledged from the very beginning, and were later shown to have been partly wrong.

In any event sciences not democratic, issues are not settled by vote, and while an alleged "consensus of experts" makes a good debating point, it is far from conclusive. So let's calmly assess the evidence.

Motivation for this discussion of course includes entertainment. There is also the continuing effort to form a consistent and useful worldview, including a balance of atten-

tion. Debunking of the information paradigm might save some lives by deemphasizing frivolous activities.

First some ground rules.

Digital computers, essentially similar to the one you are using, constitute the battleground. To be sure, some have argued that new types of computers will be far more powerful and offer far more possibilities than current ones, with qualitative differences. Allusions sometimes include parallel computing, analog computing, quantum computing and organic substrate computing.

For now let's note that there is pretty general agreement that digital computers are sufficient—in principle—for any task of computation, to an arbitrary degree of accuracy. In fact it has been proven, to the satisfaction of most experts, that there exists in principle a universal digital computer which could (eventually) do any job of computing imaginable. One embodiment of this is the Turing Tape.

The Turing Tape (described by Alan Turing around 70 years ago, although not actually built) is a simple but cunning mechanical device consisting of an arbitrarily long paper tape divided into squares or cells, each of which is either marked with an X or blank. There is also a mechanism for moving the tape, forward or backward, one square at a time, for reading the tape, and for making or erasing marks. Various sequences of squares can be interpreted as data caches or as a computer program or algorithm, i.e., series of instructions as to what happens next, or as a "state" of the computer. There are many variations of the Tape, but again, there seems to be general agreement that the Tape can potentially (eventually) do any job of computation whatever

and simulate any physical system.

Hence, whenever we ask could a digital computer do this or that we can equally well .1, could a Turing Tape or universal Turing computer do it.

Isomorphism & the Information Paradigm It isn't clear how many, but a considerable number of high-domes subscribe to the notion that information is everything, meaning relations between objects or even ideas or symbols. "Isomorphism" means roughly same-in-form. If I want to express the idea that $2 + 3 = 5$, this could be done by displaying two stones next to three stones, or two grunts followed by three grunts, with some suggestive punctuation.

We also note the difference between a number and a numeral, a numeral being the name of a number. Thus the numerals 5 and five and fünf and V are all names for the same number, the number itself perhaps existing in some Platonic seals of the abstract.

The most daring of those who choose the information paradigm would have us believe that everything in nature is symbolism and isomorphism including not only matter but even space and time. I see many problems here including lack of any clear and useful consequences.

In a more restricted sense, the information paradigm seems to tell us that any system closely analogous to a brain would for all intents and purposes be a brain, with thoughts and feelings, i.e., with life.

Viewed narrowly enough, this helps the cryonics thesis. If enough information is retrievable from your frozen or vitrified brain, you can potentially be repaired and restored to life. Viewed broadly, however, we have "infolife"

or "uploaders" or "upmorphists", those who think you could hive" as a simulation or emulation "in" a digital computer.

Thinking about a Thermostat Thinking:

Some "strong AI" proponents have gone to truly grotesque extremes which may convince some readers, with no further ado, of the absurdity of their claims.

John McCarthy was a pioneer of Artificial Intelligence, and may have coined the term. He has been quoted as saying that even a thermostat "thinks" and "feels", albeit not very much.

What does it feel? It's too cool in here, or it's too warm in here or it's just right in here. What does it think? I'll adjust for warmer, or I'll adjust for cooler, or I'll let it be.

One must admire McCarthy's position for boldness and courage of conviction, but I think not for clarity of thought.

The point is that the claim is essentially meaningless. It predicts nothing and explains nothing. One might as well say that every physical system, including every elementary particle, thinks and feels. After all, every physical interaction, every event, in some sense involves "perception" and calculation.

Consider two oxygen atoms coming into proximity. Will they combine to form an oxygen molecule? Each has to "know" the location and momentum of the other and "compute" future behavior. "There's a nice-looking atom—I think I'll reach out with my electric field and grab her." This is anthropomorphizing ad absurdum.

Of course not all uploaders take so radical a view as McCarthy's. Most have their focus on electronic digital computers with high speed

and large storage capacity as well as fancy programs, which they emphasize, is necessary for practical purposes. But the implication is that these factors are also sufficient for uploading, and this is just not the case. Let's look at what is swept under the rug.

What is Really Happening in a Digital Computer?

While many laymen learned, somewhere up the line, some of the basics of computers, they allow these facts to recede from awareness, and so do many of the experts.

The hardware of a digital computer is essentially a collection of gadgets, including mechanical aspects such as the keyboard, and electromagnetic aspects such as tiny magnetic domains capable of binary information storage—on or off, one or zero. There are also higher-level systems, such as "source code", readily readable and writable by human programmers, and intermediate compilers or interpreters to translate the source code into machine-readable binary code.

The point is that the computer in the end does nothing but manipulate symbols, using switches and gates. The symbols can be interpreted as numbers or logical operators, and these in turn can be interpreted as description of things or events.

Note carefully: *can be* interpreted. Possible interpretations are not unique. A number, or a set of numbers, describes something in the real world only by convention.

So—a particular state of a computer may be interpreted as a model or description of a state of a physical system, such as you. A sequence of such states may describe the trajectory (succession of states) of the system or your life. But

on top of the other shortcomings (more to be noted), there are multiple possible interpretations, which may or may not relate to a physical reality.

The Refinery Analogy: In refutation of my argument we are sometimes asked to think about an oil refinery and its governing program. The program "merely" manipulates symbols, yet the refinery, guided by the program, actually runs a huge and useful capital installation. (A similar but weaker analogy is sometimes proffered—that of the human brain, which uses symbolic signals to great effect)

The alleged refutation misses the point. Certainly it is often possible to exploit a certain interpretation of a set of symbols, or succession of sets. It is still true that the program itself was originally just a set of symbols, and that set could have been used in different ways, just as "V" could mean a capital letter in certain languages or could stand for the number five.

Can Symbols have a Unique Interpretation?

I am not aware of any symbol set that could not have alternate interpretations, but there have been efforts to devise a language which could be broadcast or beamed to extraterrestrials, and which to a reasonable and advanced intelligence, would admit of only one interpretation. This admittedly opens one small potential future hole in one aspect of my argument

Phase space is a concept that many readers already understand, but they too could perhaps benefit from the implications.

Phase space is a "space" of possible "points" corresponding to a mathematical description of the states of a system or a trajectory

of states. Let's start with something easy, a two-space of Cartesian coordinates of a single particle.

In this ultra-simple example, we will deal with only a single particle and its location in 2-space, say on a sheet of graph paper.



The horizontal or x axis is often used for the independent variable, and the vertical or y axis for the dependent variable. Specifying a pair of values (x,y) locates the point on the chart. The point where the axes cross is called the origin of coordinates and represented by (0,0). A line or curve connecting a succession of locations (x₁, y₁), (x₂, y₂) etc. would show a trajectory or path.

Notice that in the sketch above, “points” on the area are separated by gaps, deliberately, which is not ordinarily seen in books on analytic geometry, which assume we are dealing with the “real number” continuum. But digital computers do not deal with the continuum, rather with a finite number of intervals in any line segment. To be sure, there are speculations that nature itself is digital, but if so that would presumably be at the Planck scale,

many orders of magnitude smaller than anything now practicable.

More generally, we could associate successive sets of four variables x,y,w,t with the trajectory of a particle.

Further, we could drag in additional particles, and additional characteristics of particles, such as mass and charge or anything at all that can be symbolized and quantified. The grand result for a reasonably complex system, might be N different particles with M different characteristics to be quantified. Then a “point” in the corresponding phase space would be represented by a set of M x N “coordinates”, and a trajectory or history would be a succession of such sets.

So—the computer, or a subset of it can be thought of as *representing* a certain phase space, and that phase space is a *representation* of a physical system, potentially you. We have layers of representation or description, that’s all.

Is the Map the Territory? I sometimes use a hoary slogan against the information paradigm: *The map is not the territory*. A map of a city is not a city. An atlas of the human body is not a body. A photo of a thing, or a hologram of a thing, is not that thing.

Well the slogan is not quite bullet-proof. If I make an adequate copy of a map, the copy is just as good, and essentially the “same” as, the original map. That aside, a map or representation of a thing is just a description of the thing, and cannot in all respects be substituted for the thing. A computer-embedded description of you will not be you, but will differ in several important ways.

Simulations and the Laws of Nature: One

fatal flaw in computer simulations is one I have not seen mentioned in the literature, viz, any simulation, for the foreseeable future, will employ "physics" that is incorrect or incomplete.

Our current attempts to understand nature are just way stations, as no one denies. Everyone agrees that the "laws" of nature as currently proposed will be found wanting. An agreed Theory of Everything is not on the horizon. This means that, to a near certainty, any of the foreseeable future will not be a faithful representation of the simulated system, will not be a true emulation.

Whether the discrepancies in a biological system will be significant remains unknown. Conceivably, a middle-future simulation of you will be close enough for some purposes. But it will still be wrong. It won't be you.

Quantum Questions: Another partly redundant area of flaws in the information paradigm concerns quantum theory, which is seen as ruling the macroscopic world as well as the subnanoscopic, albeit seldom in obvious ways. Its relevance to computer simulation seems generally overlooked.

To begin with, a digital computer is a classical device. This does not preclude its handling quantum calculations; you could do quantum calculations on sufficiently simple systems with pencil and paper. But accurate calculations become intractable for all but the very simplest systems, such as a single atom. So again the simulated person will inevitably be at best an approximation to the reality, and whether the difference is important is unknown.

We might also mention the Bekenstein Bound, which tells us, among other things, that the

"points" in the quantum phase space of a brain are blurred to non-zero volume, so that there is an upper finite limit to the number of possible states of a human brain, if the size of the skull is limited. Thus the total possible number of experiences such a brain can have is limited. Ramifications of this I'll pass for now.

Zombies: A zombie here means an automaton that outwardly behaves exactly like a person—even a particular person—but has no inner life, no subjectivity, no consciousness, no qualia.

Uploaders generally hold that zombies do not and cannot exist or at least cannot be proven to exist. A system that is outwardly indistinguishable from a person must be assumed to be a person they insist. This is partly just a practical matter, since when or if we encounter aliens claiming to be people, we can't saw open their skulls to make sure, because that wouldn't be nice and they might object. But it is also frequently an article of faith, to be applied not only to visiting aliens but to our own creations, and really amounts to the implied postulate that feelings (qualia) are strictly emergent phenomena that just naturally and inevitably arise in any sufficiently large and complex information processor.

Zombies & Evolution Again: Those who argue that there are no zombies are sometimes, in effect, saying that there are only zombies, in the sense that subjective experience is an illusion.

How anyone can say with a straight face that our only direct experiences are illusory baffles me, but set that aside for now. What the no-zombie (or only-zombie) people are asking is, if a system behaves just like a human, what is the evolutionary reason for it to develop

inwardness or subjectivity? Don't survival and proliferation depend on your actions, and doesn't this mean there is no evolutionary advantage to a zombie in developing feelings? That is a fair question, and I think I have a fair answer.

First, although at least one writer thinks consciousness is young, than humanity, it seems obvious to me that all mammals and birds have it and perhaps lower forms as well, although probably not the lowest.

How could it arise, in a process of variation and selection? I suspect that consciousness has survival value, in part, because it saves reaction time. If, e.g., you can categorize stimuli as "smell good" or "smell bad", rather than having to sort through a whole lot of specific odors, you can make and act upon your decision more quickly.

In addition, there is the family or community connection. Evolution works on those levels as well. If you can categorize a situation as threatening to a relative, without going into sorting details, you are more efficient.

Further, there is a possible delay factor. Although I have said that consciousness may reduce some reaction time, it may also lengthen others, which could yield benefit. Some kinds of decisions tend to be better if pondered, at least a little, rather than flashed.

Now perhaps you have noticed an apparent flaw in my argument. On the one hand, I say there could be zombies, systems that behave just like humans but lack feelings. On the other hand, I have said that perhaps feelings improve survivability and proliferation through certain mechanisms. Isn't there a contradiction here?

Not really. An earlier generation of zombies might compete at a disadvantage with similar systems that feel or with a later generation of zombies that imitated the feeling systems. But the feeling systems might develop more readily than the improved zombies. The probabilities remain to be calculated.

In any case, once more, such speculation is just entertainment. That we have feelings, and that systems without feelings could nevertheless behave as we do are simply fact, observable or deducible.

Is Subjectivity Private? This little discussion is redundant but should probably be inserted here.

The no-zombie crowd, and the uploaders generally, tend to maintain that subjectivity—the capacity for subjective experience—is not a scientific question, because it cannot be objectively determined or even investigated. This is basically the solipsist argument that you can never know for sure whether another person is conscious.

But nobody is serious about solipsism. We all recognize that other people are mostly very similar to ourselves, and we know we are conscious, so beyond any reasonable doubt, most of them are too.

In slightly different terms, (some of) the uploaders say that feeling is private by definition, hence its existence is immune to falsification or verification.

Not so. By reasonable hypothesis, subjective experience (a quale) is a physical condition or event (a standing wave in the brain?) which is not yet amenable to direct study or objective characterization, but potentially can be and almost certainly will be. I see no reason

whatever to doubt that, sooner or later, it will become possible for an outside investigator to peer inside another person's or entity's skull, as it were, and determine whether processes are there which are similar to those known to constitute qualia.

It is true that qualia might (for all we know) take more than one form in different organisms, especially exotic ones, which could introduce elements of uncertainty in particular cases, at least temporarily. But nobody said it would be easy.

It won't necessarily be very hard either, at least as pertains to other humans. Maybe something as simple as radio-mediated mental telepathy will eventually allow direct sharing of feelings. It's much too early to rule anything in or out.

The Subsimulation Problem While some attention has been given to this, there seems to be considerable misunderstanding, so let's have a look.

An assumption of many uploaders is that sooner or later a person or people, together with a sufficient portion of the environment will be uploaded "into" a digital computer to "live" there in splendor at best or perhaps in a way parallel to that of the original, if the original were to remain in what we think of as reality.

I believe I have already shown that the simulation(s) could not be perfect, could not be emulations, although it is not clear how significant the variation would be. But there are other implications, if it could work at all. First of all, there would inevitably be a quick cascade of subsimulations. This follows because a good simulation of the environment would have to include imitations of a lot of other

people and their computers. Some of these people would inevitably create their own little in-computer worlds with virtual programs, and those in turn would do sub-sub-simulations, etc., probably resulting in a quick freeze or essential stall of the real-world hardware.

Some have speculated that since, in a scenario anywhere along these lines, the simulated worlds and people would vastly outnumber the "real" world and people, the Principle of Mediocrity suggests that, in all probability, WE are right now living in a simulation—but don't worry about it, because there is no way to tell and nothing to be done. As so often happens, I disagree.

How to Tell if You are in a Simulation, and How to Help Yourself: This isn't easy or guaranteed (what is?), but it might work. Being a simulation doesn't necessarily mean you are helpless against the program or programmer.

For one thing, unless or until the computer freezes up, you might be able to communicate with the programmer or operator. After all, if he is interested in you he may sometimes pay attention to what you are doing. So you address him with questions or requests. If you want a word for this, you can call it prayer. And if he felt like it, he could respond, in a suitable voice of thunder or with 20-point type in an email.

The programmer supposedly controls your world, including its "laws of nature", which he can alter. In other words, the programmer could also "pass miracles" in response to prayer.

Remember too that you, a simulation "in" the computer, might be living and thinking far faster than the programmer. You might soon outthink him in many ways.

You might control him by persuasion or trickery. In effect, then, you might become the God of your simulated world.

Hey, son or daughter, how do you know I'm not the Programmer or the power behind the Programmer?

Next Issue:

Chapter Eleven: The Singularity & Super-Meat

10 Worst Mistakes in Cryonics

Don't ruin your chance for a successful suspension

1) Not signing up ahead of time

Becoming a member, having contracts in place, and having paperwork in order should not be a last minute decision. Waiting until the last minute or after death results in an unnecessary delay of care or worse- No suspension at all! Don't wait. Sign up here and be prepared.

<https://www.cryonics.org/membership/>

2) Not providing proof of funding

Some people believe that they can worry about funding later or if they have funding, they have put off providing proof of funding to CI. This should be done annually. Failing to provide this can result in a delay of care while the funding clears, which can take weeks. Send your proof of funding to CI now to be prepared.

3) Not telling anyone your plans

Being reclusive or not telling family or friends your wishes is not recommended. You should not be afraid to tell those around you what your wishes are, especially your next of kin. Wearing a bracelet, necklace or having identification or other items in view can speak to your wishes. This is all you have when you can't speak for yourself. Disasters have resulted in the past from not sharing. Talk with your family, close friends and your estate attorney, so you can be prepared.

4) Not planning

Many think cryonics is a turnkey service where you can just sign up and let fate take over. No matter how much you pay for cryonics, you are the only one who can make sure that you will have the best chance by planning. CI has provided a lot of information on our website and in our standby manuals. Those who plan succeed those who don't fail.

For more information visit: <https://cryonics.org/category/members/standby/>

5) Not notifying CI of Emergencies

There is no way that your cryonics provider can help you if they do not know of your emergency. Your family, friends, standby group or next of kin must immediately contact CI when you are having health issues or worse. It is also important for CI to know if you have up and coming surgeries or procedures, including terminal illness. Patients with a diagnosed terminal illness could enter hospice care, which might help your cryonics situation vastly. Any delay in notifying us directly could result in a poor suspension. Those helping you must have simple and clear instructions.

6) Committing suicide

Anyone who commits suicide who is not terminally ill or breaks a local law in doing so is potentially putting both themselves and our organization at great risk. CI will not risk itself for people who engage in behavior that goes against our mission to preserve life. Such activity will likely lead to an autopsy and long delays, rendering the suspension process substandard or impossible to carry out.

Do not consider cryonics as a way out of your problems. You are likely to not get suspended under those circumstances. If you do not have a terminal illness and are considering suicide, you should seek mental health advice and treatment as soon as possible. <https://www.mentalhelp.net/articles/depression-hotline/>

7) Engaging in Risky or illegal activities

Risky behaviors or associations that lead to the patient dying around suspicious circumstances will also likely lead to mandated autopsies that will also stand in the way of your cryonics wishes. It is best to use common sense and not put yourself in harm's way. Not only could your life be ended, so too could your chances of cryonics suspension or future reanimation. Use common sense and stay safe.

10 Worst Mistakes in Cryonics

8) Providing financial or legal incentives that encourage your **not** being suspended.

Leaving all of your insurance or cryonics money to family if you are not suspended is certainly an option at CI, but ironically it does provide financial incentive for hostile family members to block your suspension. As often is the case, people will make sure you are not suspended to get a hold of your money.

One suggestion is to leave family and next of kin some separate money from cryonics funding while suggesting that Cryonics funding go to cryonics as a donation no matter if you are buried or suspended. In addition, family or next of kin can be further compelled to cooperate if they will actually lose the money that is allocated to them for not cooperating. It is also suggested that your family be made fully aware of your wishes and stipulations, so they know what the results of their actions will be. You want to make sure you put incentives and disincentives in the correct place, so that your wishes are honored. It is suggested that your will and cryonics documentation reflect this and get reviewed by an attorney. See <https://cryonics.org/members/protect-yourself-from-legal-threats/>

9) Not removing a hostile next of kin from rights to your remains and finances

In many states and areas you can legally remove a hostile family member or next of kin from your estate. You can reassign someone who is sympathetic to cryonics and who has the legal authority to disposition of your remains, as well as your assets. In some states and locations there are disposition of remains reassignment documents, as well as powers of attorney, both in regards to financial as well as medical decisions. The executor of your will or anyone involved with making decisions should

be sympathetic to your cryonics wishes. It is your responsibility to make your wishes very clear and to remove any doubt or potential legal resistance from family or next of kin.

We suggest seeking legal advice to help you in this regard. Some members have even made a video statement of their wishes and given it to both their cryonics organization as well as their attorneys. Not being careful could mean that you don't get suspended, despite your wishes. Many are surprised to learn that they lose their rights upon legal death. See an attorney and prepare.

10) Dying under less than favorable conditions

This seems harder to control than the other situations, but there are some things you can do to make your situation more favorable. You can diet, exercise and follow the latest official medical advice to stay healthy longer. The longer you are alive, the better the technology will probably be for suspending you and the closer we will be to a future that may be able to reverse your condition.

You can also avoid travel to remote or hostile places where such travel is risky. Some overseas travel can result in long delays both logistically and bureaucratically. In general, dying near your cryonics provider or cryonics standby group helps your chances. Living a healthy lifestyle and staying sociable, while surrounding yourself with people who will act on your behalf is paramount. Building solid, positive relationships with good people is probably one of the most important things you can do to have your wishes honored. Take care of yourself and maintain social connectivity.

