RCDS Science News

A student-run scientific magazine focusing on scientific breakthroughs and decreasing the spread of misinformation.

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What made you interested in science?

Documentaries. When I was a kid, and by kid, I mean less than 10, the thing that I used to watch the most on TV were documentaries about nature and a lot of that. I could spend hours glued, literally glued to the TV to watch BBC documentaries or Italian documentaries. The speakers of the documentaries were mesmerizing to me. That’s how I got into science. I didn’t know what science was; it was just something that was very interesting to me. Then as I grew up, I got to understand better what it meant and how it worked. And even when I did not know, I was curious, and I kept on reading as much as I could. Keep in mind that this was not a time when the internet was available. So reading meant you had to go somewhere, find things to read, actually read them, and then return them.

And the village where I grew up didn’t have a library, so I went to school. I could only read during school; I couldn’t take the books out. So whatever came out at school, that’s what I liked.

That’s really cool. Do you have any advice for high school students who feel like chemistry or physics, for example, is difficult or they have trouble with it?

Stick to it. Don’t give up. Nothing is easy. If you are really interested, it’s easier to stick to it. I understand that it’s harder when you know that the passion is not there. So for those kids, I would recommend exploring more. Try it out in many different contexts because there might still be an interest at heart. It doesn’t need to be full-blown “scientist mode.” It can be a passion for understanding that you didn’t realize you had or that was repressed because you didn’t like the way you were interacting with your teacher. And I’m not blaming anyone; it’s just life. You interact with human beings—sometimes it goes well, sometimes it doesn’t. So, I would say just don’t give up. Stick to it.

So now that w**e know what got you into science when you were a kid, could you elaborate on what got you into physics in particular?**

Yeah, I can tell you. I have very vivid memories of when I figured out that physics was what I wanted to do. It was in middle school. I think I was in seventh or eighth grade, something like that. We were studying a little bit of physical science, and suddenly there was this section about atoms in the science book we had. I could not put the book down. I just wanted to know more and more. It was so cool—it made so much sense. I didn't know it was physics yet; I didn't even know it was chemistry. At the time, those words didn't even appear in the textbook, or maybe they did, but I overlooked them. But for me, those were the things I really wanted to know. And I knew I was good at math—very good at math—so I wanted to do something that involved both. Eventually, physics was the thing that provided me with that.

Just to elaborate more on physics and maybe the actual in-person experience of teaching—do you have a favorite lab experiment or maybe some experiments you think are pretty cool?

Hundreds. Do you mean something related to the teaching I'm doing right now or just in general?

Maybe just in general. It could be any lecture you've ever done or anything like that—it doesn't have to be current.

I think the best thing I have ever seen in an experimental context, and the one I enjoyed the most, is the polarization of light. You know, you have sunglasses called polarized sunglasses. Sorry, this is a Young's double slit problem. In the past, no, no, no—that wasn't part of Young's double slit problem at the time. So polarization is pretty much—it's an electromagnetic wave. And understanding how polarization works involves these things called polarizing glasses. If you hold them one way, light goes through like nothing has happened. But if you change the orientation—and orientation means you literally turn the lens around—you can filter out a large amount of light. So yeah, that's one of the experiments where the first time I encountered it, I was like, "Whoa, how does this work?" Then finding the explanation, forming hypotheses, and trying to figure things out—that's one of the most interesting things to do.

That's amazing. So could you describe your path since you discovered you were interested in physics as a middle schooler, to where you are now, teaching physics?

I like to describe it as random work with some directionality. Random work is a process that's completely random—you just don't know where you'll end up. There's a lot of probability in life. When you do things, you don't quite know how it will end up, and that's where probability comes into play. But you do settle on a general direction, saying, "Okay, I want to try going there." That's literally how I got to where I am.

I did some tutoring of my friends at school. I would help them with math and science. That allowed me to make friends and, at the same time, to practice things that mattered most to me and understand them better. So

yeah, I knew I wanted to continue on that path. That path has involved a lot of sideways, backward, and forward motion. I landed on the teaching path because I remembered that when I was teaching my friends and later on in college, I actually enjoyed it. It's challenging. It's a never-ending problem in the sense that even though you teach the same material, what changes is the "prime matter," which is the students. Teaching Jaymin isn't the same as teaching someone else, and there will never be another Jaymin. The challenge is figuring out how to make the new Jaymin understand what I'm talking about and, hopefully, to be passionate about it. Because ultimately, the aspiration of a teacher is to convince some students that what you are teaching is worth studying for the rest of their lives. That's the idea.

Yeah, that's really inspirational. So would you say that's your favorite part of teaching?

Yes, it is. Helping students develop what they want to do and have a clear understanding of what they want—not necessarily how to do it, but what they want to do—is one of the greatest challenges. It's one thing to be in a lab and try to understand nature, which has a set of rules that are defined but unknown to you. You have to figure out how to solve the riddle. But it's another thing to try to understand a human being—what they can do, how they can do it, and supporting them as they figure out what they want to do in life. It's a very different set of problems. It requires not just knowledge of the subject but also a human touch. That, to me, is very important.

You have a PhD—how would you describe the process of going from undergrad to getting a PhD in physics?

Well, you have to want it. You have to want to become a scientist, and in order to do that, you have to know what it takes to be a scientist. You really only learn that in grad school, not in undergrad. In undergrad, yeah, you can do some research and get a feel for it. Some undergrads are so capable that they can do amazing things and even publish before they get to grad school, which is incredible. That shows they have the potential to be a scientist. But you still have to go through grad school, because that's where you train yourself to think in a certain way. To be a scientist, you need to develop that way of thinking. It's not the only way, but it's 80% the same for most scientists. The other 20% is up to you—to give your own contribution.

Editor's Notes:
(1) On behalf of myself and the other writers and editors, we thank Dr. Bove for this amazing interview!!
(2) Dr. Bove is currently a physics teacher and YPT coach at Rye Country Day School.
(3) The text in bold was said by the interviewer (Jaymin Ding or Aarush Dey), and the regular text was said by the interviewee (Dr. Bove).

Interview with Mr. Burt

Shawn Wei ’26 and Juliette Moore ’27 - 12/31/24

What inspired you to pursue a career in chemistry?

There’s a long answer to that one and a short one. I’ve always been interested in the sciences since before I can remember. But I got the chance to start working in a lab at a college near where I grew up. The summer after I finished eighth grade, I enjoyed working in the lab there. Really enjoyed the complexities of chemistry and kept on with it since. So, working in a lab, essentially.

Do you still remember what you were working in a lab?

I was working on synthesizing monomers for organometallic polymers. So, the idea was to take metals to try and increase the conductivity of carbon-based central plastic substitutes. So, trying to create a carbon-based plastic that was always conductive. The goal of that was to ideally create conductive plastics that you can use as flexible wiring or for flexible electronic applications. Some of the stuff going on now, like folding phones, is an example of people looking at how we can make flexible conductive materials. So, we were looking at that back and forth. A long time ago. But not the ones that are currently in folding phones.

That’s really cool. Did you do anything between graduating from college and coming to teach?

Yeah, I went to chemistry grad school. So, after undergrad, I went to California for grad school. I did research for about a year and a half, just part of that, and then got my first teaching job after this.

Could you please elaborate on what led you to become a teacher?

Yeah, so that was really interesting. In grad school, we did a mix of research, classwork, and TA work. I was thinking about both. A lot of my friends went to work in pharmaceuticals. That’s really what my degree was more oriented towards. It was chemical applications and chemistry research. But I realized when I was there that I was pretty much excited every day about going into TA. I was excited most of

the time going into research, but I was enjoying the teaching side more than the research side at that point. So, when I got offers from both pharmaceutical companies and the school, I picked the school.

What are some real-world applications of chemistry that you find most exciting?

I think that's interesting. It's changed over time for me. So, the area of chemistry that I studied, in particular, is really focused on the synthesis of complex molecules. So, that's really targeted at drugs and therapies to help people. But you can also use it to better understand proteins and biological systems. The thing that I think I found more interesting since then is trying to find interesting ways to tie the more fundamental chemistry at the high school level to applications. So, thinking about how heat transfers show up in everyday life? Just talked about thermochemistry in class earlier. However, creating problems that feel more applied and thinking about where we have become is more interesting in some ways. Because that's more relevant to my everyday life, but it shows everywhere.

What do you think about chemistry as a field?

Chemistry as a field? Could you narrow the question a little bit? That's a super broad question.

Yes, I'll give an example. How about computational chemistry?

I think computational chemistry is great. I mean, right, if you think about where chemistry was 40 or 50 years ago, where to understand a molecule, people have to make it every single time. That takes an incredible amount of work and a critical amount of material. There's a lot of waste that goes along with producing things, especially in the initial processes where you haven't optimized the route. So it's pretty environmentally damaging at times. And then you think about it: instead of doing that, you have a computer that's getting more and more accurate as we learn more. Being able to model that in a couple of hours instead of having to spend weeks building that molecule. That's huge in terms of time and environmental savings. It's really fantastic what's going on with being able to model chemicals more accurately.

In terms of where chemistry is going, I think there will be more and more computational aspects. More machine learning, using algorithms that are using chemical understanding to better understand how systems are going to act. Yeah, I think it's generally those kinds of simulations that are really for the good. It'll be interesting to see what happens and how chemists' roles shift. Because if you don't have to spend weeks building a molecule and you can instead predict what's going on with it, do you shift more towards a computer science realm, or are those chemists being reassigned to only build the best candidates? Which is what I think is going on now. And yeah, it's heading in cool directions. Also, something really cool is biochem. Now, biologists are working with chemists to make greener

chemistry methods. It's a really cool area that's emerged in the last decade or so.

What are some career paths for students who are interested in chemistry?

It's pretty broad. So you can go down a peer research path. But anything related to food, right? Some chemists go work at companies that produce various foods, or they assess what's in a food. There are chemists working to produce everything that's plastic in synthetic material around you. You need chemists who are working to produce metals effectively, right? If you need efficiency, you'll need chemists and engineers understand the processes. You also need chemists, obviously, for drugs and pharmaceuticals. That's one of the big ones that I mentioned because that's sort of the subfield that I was headed toward for a long time. You also can go towards medicine yourself. If you're a nurse in chemistry and you find that sort of thinking of patterns and systems and working with a complicated system to figure out what's going on inside it, making medicines a good fit. There are a ton more of them. You can go in a lot of directions again.

I have a friend who has worked at a shampoo company for a long time. For five years and six years, he was doing quality control, making sure the formulation was right, and shifting the formulation just a little bit to make a more effective cleaning product or something like that. Then we can go into that. There's a lot of little fields that people don't think of. Another friend of mine went to work for a TV company. They are working on creating a more effective and efficient screen using quantum dot technology or OLEDs. That's all based on newly accountable methods. Yeah, there are a lot of areas in chemistry that kind of pop up the room and expect it necessary.

It's really flexible. Do you have a favorite element or molecule?

As someone who is trained as an organic chemist, I feel like a kind of suit should say carbon. At the same time, my grad school work was often focused on rodeo and cobalt. I'm always a little torn on that. I think that the other one that I always find interesting is when you can take something and make it more efficient, more green.

I'm curious to see what happens with things around lithium and sodium in the next couple of years, looking at batteries you're often familiar with. I see at least three lithium ion power devices in front of me. Can we switch out sodium to make it a little more sustainable? I'm being wishy-washy. I'm going to go with carbon because that is my training. But I think there's lots of interesting stuff around swapping elements.

What is one about carbon that you think is very special and interesting?

So carbon can bond to itself into lots of other molecules very easily while having a really strong bond. And it can bond to itself, essentially, infinitely while having strong bonds. So it's really the only molecule that we have that's able to do that effectively. Or the only element that can assemble into molecules that way. Silicon would be the most analogous element, but its bond

strength is significant in the ether. So the reason you're both carbon-based life, I'm carbon-based life, is because of that flexibility along the strength at the same time. You can do, essentially, infinite things of carbon.

Do you have a favorite chemistry lab or experiment?

I think that depends. But I'm trying to not just give you a wishy-washy answer on this. I think one of my favorites in terms of student excitement is the ability to delve deeper. I'll give you two.

One of them is the methane bubble fire demo slash lab where students can tie in,

and I'm just going to get thermochemistry, stoichiometry, reaction rates, kinetics, and molecular forces. You can tie in a lot of the units of the honors chem class, and also people get to hold the fireball. So it usually is like, there's a lot of fun tie-ins, and also people get the excitement part of like, I have a fire going in my hands right now. So that usually gets at least half the class excited.

I also really like the iodine clock reaction, which we don't do usually except maybe at the AP level. But it's a really counterintuitive simulation where it changes colors back and forth. And so it doesn't look like it settles out at one product. It instead looks like it's shifting back and forth between two different products, which you don't usually see. Usually reactions go one way, and then they stop at a certain position. So it's really confusing and counterintuitive, but you can figure it out once you work at it for a while.

Is that an equilibrium?

It's an equilibrium, but it's a complex equilibrium based on kinetics where it doesn't settle out at an equilibrium position for a long time. And instead it shifts between two different equilibrium positions as a situation of one thing builds up. It speeds up a reaction to a different thing. And so you see this shift back and forth between two different reactants before it settles out at the final product. And if you time it right spatially, you can even get it where colors radiate through like a column or a cross a surface. And that's also cool. So as they build up in one place, they react to change color. And then as they build up in the next place, they react to change color.It's really cool. If you don't do an AP, you can watch some videos of it on YouTube and stuff. It's really good.

Do you have any general advice to students pursuing chemistry or a related field?

I think the big ones, the big couple pieces of advice that I have are to be patient with yourself as you take on tougher and tougher problems. Chemistry problems go from being very small to very big, very quickly when I often have many parts to them. Being patient as you try to chew through it, not getting frustrated and seeking out as needed can be really helpful. Because the problems can get really big and intimidating, but if you break them into little chunks, you can get there.

The other thing that I would say with it is to try and look for patterns, particularly as you switch between sort of the macro of what you're seeing in the lab. And thinking about models and atomic structures. It's often difficult to connect those two, but if you think about patterns of behavior, most of chemistry is really pattern based. So look for the commonalities between things and you can figure out the connections that are of yourself problems.

How do you think that AI will affect chemistry?

I was kind of going down my road a little bit before. I think there's some cool stuff that will go on with protein folding problems or understanding of interactions between molecules and predicting them effectively. And again, helping people to be much more efficient, right? So in the past, one of the things that happened with Pharma, for example, is they would hire tons of people with bachelor's degrees just to go run experiments that other people were going to do. And just kind of to act as labor that knew what was like the basics of working in a chemistry lab, but didn't have expertise.

And then I think as they get better and better at modeling, they'll shift to having chemists with more expertise going after really like, okay, our AI model has predicted that this is going to be a really good candidate for what we want to do. And, let's go after just the really important stuff with humans. Because then you're being both more efficient and effective and cost effective and environmentally friendly. And maybe you're getting, if each chemist is doing more work in less time with less effort, then maybe you're going to get a bunch of new drugs on the market.

I think that's all the questions we have today. Thank you so much for your time today.

Editor's Note:
Thank you so much to Mr. Burt for this wonderful interview!

iPhone 16 & Apple AI unveiled at Apple ‘Glowtime’ Event

Sejal Mackey ’27 - 10/12/24

Apple proves itself to create a more impressive phone each year – this year not being different at all. With new features including built-in Apple Intelligence, easier camera controlling features, the A18 chip, all being created while being environmentally friendly, Apple boasts the iPhone 16 (plus, pro, and pro max) for good reason.

With AI becoming increasingly popular, Apple created its own version called Apple Intelligence. It has many different capabilities that affect almost every aspect of the new iPhone. It’s built right into the phone, so by using on-device processing, it doesn’t need to collect personal information. It also draws on bigger server-based models, which run on Apple silicon, meaning it can handle more complex requests while still protecting privacy. It upgrades Siri with a new design that allows it to have better language understanding and a more natural feel. Siri can also use personal context to take action in apps or respond to different questions. In writing apps, it has enhanced language capabilities that can summarize messages or text from the notes app. Also in the notes app – by using the new Image Wand, AI will be able to turn sketches into full pictures and images. A popular and exciting feature is Genmoji – introducing the ability to create custom emojis that go straight into texts like normal.

The amount of cameras has actually cut down from 3 on the iPhone 15 to just 2 on the iPhone 16. However, the new camera capabilities make it feel as if you have 4 separate camera lenses just on your phone. A new ultra wide camera called Macro preserves detail while still creating wide angle photos. A feature called Spatial Capture can also take photos and videos in 3D which you can rewatch on Apple Vision Pro to relieve any moment. New audio mixing features help enhance based on the task: in-frame allows for the focus to be on voices of people on camera, studio records professional-like sound, and cinematic pulls all the voices from around the video and puts them in front of the screen.

The satellite features lets users still connect – even without service. Messages via satellite lets you send and receive messages so that you can text over iMessage. Emergency services over satellite, which include SOS, crash detection, and a live feed with 911 responders, are supported by satellite features. Roadside assistance via satellite lets your iPhone connect you with a roadside assistance provider – who can

dispatch help to your exact location even when off the grid.
The new Ceramic Shield material on the iPhone 16 is 2 times tougher than any smartphone glass. The internal design also dissipates heat more efficiently, improving overall phone performance. A key accessibility feature is the iPhone Taptic Engine, which helps people who are hard of hearing feel music rhythms from Apple Music. The bonds with other Apple products become even stronger: with iPhone mirroring on Mac that you can control without touching the phone. An Apple Watch can help find a phone by approximate distance and direction if it's lost. The action button on the side of the phone, with one press, can do whatever function you set it to – including shortcuts. This includes voice memos, song recognition, or simply turning on silent mode.
All this is made possible with the new chip: the A18. This chip has Apple Intelligence built in, and a 60% faster 6-core CPU and up to a 2x faster 5-core GPU. The battery life is up to 22 hours video playback on iPhone 16 and 27 hours on iPhone 16 Pro Max.
Simplicity is key on this new iPhone: with the iPhone 16 using more recycled metals than ever, including a 95% recycled lithium battery. Even the packaging is environmentally conscious, with 100% fiber based packaging and a thinner case to reduce the carbon impact with shipment.

Sources:

It's Glowtime. – Latest News – Apple Developer (Cover Image) https://developer.apple.com/news/?id=zvdnvggt

Newly identified biomarkers could reveal the cause of Sudden Infant Death Syndrome (SIDS)

Daphne Panie ’27 - 10/12/24

In the United States, more than 1,300 children die from Sudden Infant Death Syndrome per year (prevalence rate of 0.35 deaths per 1,000 live birth). Sudden Infant Death Syndrome, also commonly called SIDS, is the sudden death of a baby under 1, and, in more than 90 percent of the cases, SIDS occurs when a baby is under 6 months old, with a peak from 1 to 4 months. It seems to threaten any baby and is a source of anxiety for any parent. Indeed, until a couple of months ago, the cause of SIDS remained unknown even after an autopsy, even though factors such as smoking during pregnancy, low weight at birth and air pollution had been identified as increasing the risk of SIDS. On September 9, 2024, an article was published in JAMA Pediatrics, announcing that they might have identified biomarkers highly correlated to higher SIDS risk. Scientists decided to examine biological factors, especially how the body stores and processes energy, that could play a role in SIDS and, if detected at birth, could allow for increased vigilance or preventive treatment. The study collected metabolic data from newborn screening, a combination of tests systematically done at birth, out of 2.7 million Californian born babies between 2005 and 2011. Scientists then compared these data between children who died from SIDS and children who survived. They discovered that among 354 children who died from Sudden Infant Death Syndrome, some biomarkers seemed to increase the risks of contracting the syndrome. They found that lower levels of C-3, a protein part of the human’s immune system, and higher levels of C-14 OH, fatty acids, could be one of the causes of SIDS. Some other biomarkers have been discovered and seem to lower the risk of SIDS in children. Although this is a major step in the understanding of SIDS, there is still a long way to go. The team of scientists plan to conduct more genetic testing to be able to identify more factors and with an ultimate goal of being able to perform SDIS screening. The leader of the research team, Scot Ottman declared in an interview: “These patterns could help identify children at higher risk, potentially saving lives in the future. This study is a critical step toward integrating metabolic markers with potential genetic markers and other risk factors to better assess the risk of SIDS in infants”, showing the importance of pursuing research to hope for a better future in this domain.

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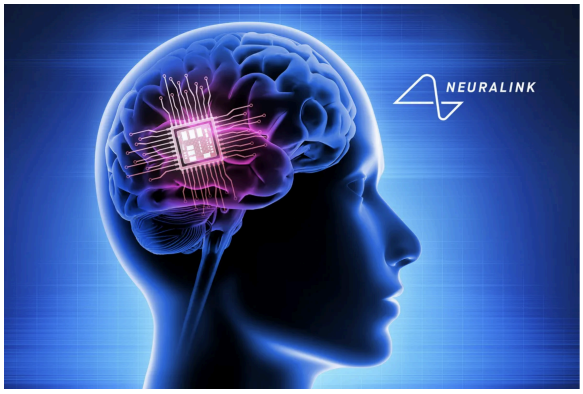
Neuralink successfully carries out second human trial

Shawn Wei ’26 - 10/12/24



The history of brain-computer interfaces (BCI) dates back to 1929, when German psychiatrist Hans Berger discovered brain waves, giving rise to speculation that these waves could be used for communication and control. The expression brain-computer interface was first introduced by Jacques Vidal in his paper titled: “Toward Direct Brain-Computer Communications” in 1973. This marked the official beginning of BCI research. In the 21st century, BCI research has drawn increasing attention, and many research institutes and companies have begun to develop and innovate in this field, with Elon Musk’s Neuralink being one prominent example. Neuralink’s first product, Telepathy, is an implantable device that allows people to control their mobile phones or computers directly through their thoughts.

How does this work? Neuralink has designed extremely thin electrode wires, known as threads, that can be surgically implanted into specific brain areas. These threads collect neural activity data, which are the electrical signals of neurons, and transmit it through a small device installed on the skull. These electrical signals are then decoded to understand the meaning of neuronal activity using machine learning algorithms and subsequently converted into commands controlling external devices like computer programs and prosthetic limbs.

Neuralink conducted its first human trial on January 28, 2024. The participant, Noland Arbaugh, is a 29-year-old man who had been paralyzed from the shoulders down for eight years after a diving accident. At the time, he could only tap on a tablet with a mouth-held stick. However, after receiving the implant, Arbaugh could move the cursor, surf the Internet, play games, and post messages simply by thinking.

Following this success, Neuralink launched a second human trial. The participant, Alex, was able to play the game Webgrid using only his mind within five minutes of implantation. On the same day, he broke mission records, achieving speed and accuracy beyond any other assistive technology and setting a new world record for brain-computer interface cursor control. While Noland initially played simpler games like chess and Mario Kart, Alex was able to play more complex games like CSGO. Before the implant, Alex used a

mouth-operated device called QuadStick, which allowed only one joystick input, limiting simultaneous actions like moving and aiming. Now, thanks to the BCI implant, Alex can aim and move simultaneously, significantly improving his gaming experience and allowing him to perform complex actions such as packing, unpacking, and reloading.

In addition to gaming, Alex has used Neuralink to develop 3D designs with CAD software. Before his injury, Alex was an automotive technician, repairing various vehicles and large machinery. He had always wanted to use computer-aided design (CAD) software to design 3D objects, but the technical limitations of his assistive tools made it impossible. However, with the help of Neuralink, his dream has become a reality. Alex used Fusion 360 CAD software to create a custom mount for the Neuralink charger.

Despite these successes, technical challenges remain significant. Connecting the brain directly to a computer is extremely complex and delicate, and any small mistake has serious consequences. About 85% of the threads connected to Noland retracted a few weeks after the first patient's surgery, resulting in decreased BCI performance. In response, Neuralink developed several solutions, including reducing the formation of air pockets in the skull during surgery and implanting the device deeper into brain tissue. Fortunately, Alex's implant has not experienced any thread retraction.

Looking forward, Neuralink plans to continue expanding the available controls to enhance participants' experience with digital devices. They are working on decoding multiple clicks and simultaneous movement intents to provide full mouse and video game controller functionality. Additionally, they are developing algorithms to recognize handwriting intent for faster text entry. Musk made a bold statement: "If all goes well, there will be hundreds of people with Neuralinks within a few years, possibly tens of thousands in five years, and millions in ten years."

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Scientists figure out culprit of Porbeagle Shark murder

Josie Choi ’26 - 10/12/24

Sharks are known as the kings of the sea as well as objects of fear due to their razor-sharp teeth and strong jaws. But off the coast of the UK, something quite contrasting has been found. A dead, pregnant porbeagle shark was discovered, weighing about 450 pounds, along with some evidence of it having been attacked by a much larger predator. Indeed, this has left scientists scratching their heads: what could kill such a powerful creature?

Porbeagle sharks are of the same family as great whites and are wired for speed and strength, reaching up to 20 mph. They usually feed on smaller fish, like mackerel and squid, making them quite fearsome hunters in the ocean. Although they are not aggressive towards humans, porbeagles are powerful enough to deter threats in the ocean. Thus, the finding of this pregnant shark in her condition was perplexing.

The shark had been tracked for almost a year by scientists at the Ocean Tracking Network via a satellite tag. On August 17, 2024, the tag transmitted a signal suggesting the shark wasn’t moving anymore. Investigation showed a badly damaged set of remains, which said that the shark was preyed upon by something much bigger and much stronger. It was, of course, slower and more vulnerable because it was carrying a dozen pups; that pointed towards an extraordinary predator who overpowered such a huge animal.

A few have speculated that a huge great white shark might have been responsible, as great whites do reach up to 20 feet and are known for an aggressive hunting style, but great whites seldom lurk in UK waters during the summer. Others believed a type of orca that is known to target sharks may have been the culprit. Highly intelligent orcas are group hunters, found off the UK coast, and have been known to take down big quarry, including sharks. An alternative theory is the Greenland shark—a large species from the North Atlantic that is slow and lacks aggression in hunting. However, given its lack of speed and hunting aggression, it’s a less likely candidate.

This has led to questions about who’s at the top of the ocean’s hierarchy. This is a case of being at the top of the food chain. While there are sharks like the porbeagle, there is

always something bigger or stronger. Scientists are now calling for more research and monitoring of sharks and other large marine animals to better understand how they interact. The ocean is both extensive and unpredictable, and as we go on discovering more, no doubt many discoveries will be unraveled, showing us how much more there is to know about the strong, mystic world beneath the waves.

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SpaceX launches first all-civilian crew

Tia Agarwal ’26 - 10/12/24

On September 10, 2024, at 5:24 am ET, Elon Musk’s SpaceX launched a capsule carrying four civilians that took off from NASA’s launch complex in Florida. This mission, dubbed Polaris Dawn, is the first time civilians have ever been to space and the highest humans have been in space since Apollo 17 in 1972. The spacecraft is aiming for the Van Allen radiation belt, made up of thousands of high-energy particles with radiation that is more powerful than the X-ray rays in medical devices. The first flight to ever get through the belts was NASA’s Apollo 8 in 1968, which was crucial in the passage to the moon. The belts have potentially dangerous effects if too much time is spent in them, which makes this mission what CNN calls “a daring excursion” (Wattles).

The complete civilian crew consists of billionaire Jared Isaacman, founder of Shift4 and the main source of funding for the project since its inception in 2021; Scott Poteet, a retired Air Force Lt. Col; and two crew members: Sarah Gills and Anna Menon. The capsule is on top of a Falcon 9 rocket designed by SpaceX. These rockets are used for SpaceX’s larger Starlink project, which aims to provide data coverage around the world. Upon its take-off, the firing lasted 2 ½ minutes, which spent most of its fuel. It entered Earth’s orbit by firing 17,000 mph, also called “orbital velocity.” Polaris Dawn also marks the first civilian spacewalk. Isaacman and Gillis were to be attached to tether, but unlike traditional crafts, this spacecraft doesn’t have a pressurized airlock. A pressurized airlock provides a barrier between two areas of separate ‘air,’ that is, areas with different levels of pressure. Because it doesn’t have an airlock, the entire capsule will depressurize, and the crew will test out the environment with SpaceX’s newly designed suits. News outlets called this potentially dangerous, as all four crew members will be exposed to an unpredictable space environment without ever being in space before. A few possible issues discussed were the inability to relock the vehicle’s hatch and toxins released from repressurization. SpaceX, however, has taken precautionary measures to make sure this doesn’t happen, and no such accident was reported at the time of arrival. Spacewalking, however, requires a lot of oxygen, and scientists predicted the aircraft will only last 5 to 6 days. The Falcon 9’s life support systems had not been designed to

support spacewalks, and major adjustments and additions, especially in the environment suite, were made to make it possible. In all, the spacewalk lasted a little less than 2 hours, starting at 6:12 am ET and ending at 7:58 am ET.

The mission ended with the landing of the crew on September 15, 2024.

The mission, along with its spacewalk, was to conduct 36 missions partnering with 31 institutes. One of their missions is to test technologies that can be used in "future long-duration space missions" (Chow). The ultimate goal is to advance human health and potentially improve inhabitation information for Mars.

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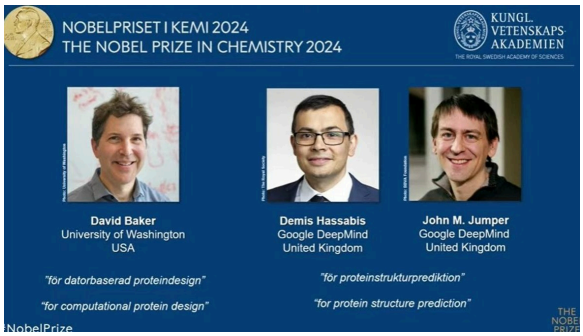
2024 Nobel Prize in Chemistry awarded to David Baker, Demis Hassabis, and John M. Jumper

Daphne Panie '27 - 12/31/24



The 2024 Nobel Prize in Chemistry was awarded to three scientists, David Baker, Demis Hassabis, and John M. Jumper, for their major contributions to predicting and designing the structure of proteins. Encoded by DNA and RNA, proteins are crucial to human survival as they make up the building blocks of life. They drive the behavior of all living things, from viruses to humans. Proteins are single-string compounds that acquire a specific structure that defines their function, meaning that the key to understanding proteins' function is to discover how they wrap themselves. One of the major challenges in this field was designing the precise shape of the different proteins, which was called "the protein folding problem". One person on the Nobel Prize committee for chemistry showcased the importance of this discovery in chemistry as he declared: "In order to understand how proteins work, you need to know what they look like, and that's what this year's laureates have done."

Half of the Nobel Prize went to David Baker, while the other half went to Demis Hassabis and John M. Jumper. David Baker, from the University of Washington, used computational protein design to invent new proteins, while Demis Hassabis and John M. Jumper both from Google Deepmind, used an AI to predict protein structure.

Demis Habissis and Joh Jumper, the youngest chemistry Nobel prize winner for 70 years, both work at Deepmind, which was founded by DemisHabissis, along with one of his childhood friends, in 2010. They started exploring technologies, such as AlphaFond, that could solve some scientific problems. They later created an AI that can predict the shape of the 200 million + proteins in the human body that scientists have identified. AI-powered drug discovery and development is a growing area of science and will make maany breathtaking discoveries in the future. The chair of the Nobel Committee for Chemistry declared: "Four years ago in 2020, Demis Hassabis and John Jumper managed to crack the code. With skillful use of artificial intelligence, they made it possible to predict the complex structure of essentially any known protein in nature,"

David Barker designed his first new protein in 2003 and he and his research team have not stopped creating protein since that time. He also designed proteins that could be used as medication or sensors. He also developed a computational program enabling scientists to design their own protein with different shapes and functions which will allow for many breakthroughs in the field of medicine. Barker's Institute for Protein Design hosts multiple startups in these fields such as Vilya, whose goal is to create therapeutic molecules, or MonodBio which is a diagnostic biosensor company.

The Chair of the Nobel Price of Chemistry declared that the Nobel Price of Chemistry was actually really a "breakthrough in biochemistry". In the future, as technology advances and scientists have more advanced tools, major breakthroughs will be accomplished, especially in the fields of biology and chemistry.

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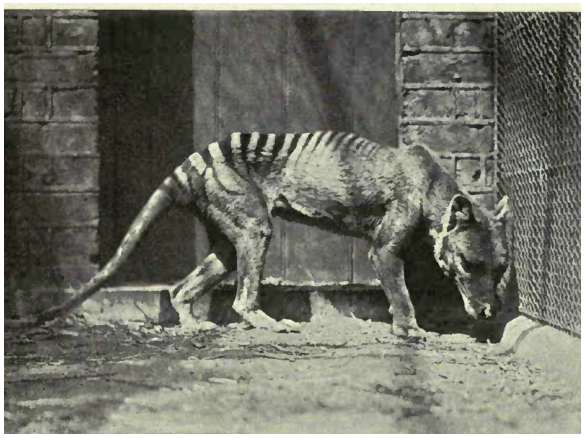
Are Tasmanian Tigers Coming Back?

Aarush Dey '27 - 12/31/24



What are they?
The Tasmanian tiger, or thylacine, was a marsupial with many canine-like characteristics. Despite its name, it wasn't actually a tiger but got the nickname from the stripes on its back. Thylacines were carnivores that went extinct due to overhunting, habitat loss, and competition with other animals, fully going extinct in 1936. They have since become a symbol of the importance of protecting endangered species to prevent future extinctions but now scientists are doing everything they can to "reverse time" and bring back this elegant creature.

How is this possible?
The concept of bringing back Tasmanian tigers, or in other words, "de-extincting" them has recently gained a surge of attention. Researchers at Colossal Biosciences and the University of Melbourne have announced breakthroughs last month that have advanced us a couple steps forward to resurrecting this long-extinct carnivorous marsupial. Colossal Biosciences is a company known for its genomic resurrection efforts involving the Dodo Bird, Wooly Mammoth, and Tasmanian tiger. Recently, they were able to "assemble the most complete Tasmanian tiger genome to date", according to an article from USA Today. Colossal Biosciences gained attention in 2021 by boldly announcing its intention to use gene editing techniques to bring back the wooly mammoth. The research aimed to modify elephant DNA to incorporate traits characteristic of mammoths, such as thick fur and a layer of fat, to enhance the survival of these hybrid animals in the Siberian tundra. This general methodology is now being reapplied to the Tasmanian tiger. A preserved, century-old Tasmanian tiger head has enabled scientists to extract fragile RNA molecules from the sample, allowing them to observe which of the thylacine's genes were active in specific tissues. "With this new resource, we can determine what a thylacine could taste, smell, see, and even understand aspects of its brain function," said Professor Andrew Pask from the University of Melbourne. Though not fully completed, the scientists are confident in their ability to fill in the missing gaps of the genome, buttressing de-extinction efforts. Successfully piecing together the full genome would be an immense leap forward, significantly

increasing the likelihood of the Tasmanian tigers' resurrection.

What are the drawbacks and moral conflicts?

It is without doubt that implementing such a new technological concept would come with its own valid critiques and questions. Many argue that bringing back an animal that went extinct almost a century ago would simply be cruel. In many ways this is true; the climate and ecosystems 100 years ago are drastically different from the ones today. This is not a negative consequence but simply a fact, and bringing a species into a habitat it was never meant to live in could have quaking impacts on wildlife in that area. Others believe that de-extinction is simply too difficult and is instead just feeding misinformation online. Professor Jeremy Austin from the Australian Centre for Ancient DNA told the Sydney Morning Herald in 2022 that "De-extinction is a fairy tale science," when Colossal's project was brought to the public view.

Key Takeaways

Though a controversial topic, the de-extinction efforts surrounding Tasmanian Tigers are a scientific marvel nonetheless. It would be a significant scientific achievement, proving that modern technology could potentially reverse some human-caused extinctions. This "de-extinction" effort also serves as a reminder of the importance of protecting endangered species today, encouraging stronger conservation efforts to prevent future extinctions.

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Achieving Carbon Neutrality via Hydrogen Energy in South Korea: Implementation and Challenges

Tia Agarwal '26 - 12/31/24

South Korea's successful and rapid transition into hydrogen energy is due to their large scale investments and target for this century. The country is a leader in harnessing hydrogen energy ever since the establishment of The Hydrogen Energy Network (HyNet) in 2019. That same year South Korea adopted the Hydrogen Economy Road map, planning to create a large hydrogen industry to increase its industrial competitiveness and create a new source of revenue. Their targets for 2040 include increasing the annual consumption market from 130,000 tons to 5.26 million and increasing SK's Fuel Cell Electric Vehicles (FCEV), which is powered by the fuel cell powered by hydrogen, to 3 million domestically manufactured vehicles. By 2020, there will be 10,000 FCEVs on the road, the highest in the world, and double the number from 2019. Following the roadmap, South Korea's National Assembly passed the "Hydrogen Law", which allows the government to provide hydrogen technology companies incentives such as tax exemptions, loans, and subsidies. The government planned to spend $701.9 million dollars on hydrogen technology in FY2021, additionally committing $2.34 billion to create a private hydrogen vehicle industry by 2022. They were successful, more than half of all FCEV's in the world were being produced in South Korea. As South Korean conglomerate Hyundai took the spot as the world's top FCEV producer, holding 60% of the market share.

So why hydrogen? As of 2024, South Korea is Asia's fourth largest economy, manufacturing its main source of revenue. According to the 2022 report of the European Union's EDGAR (Emissions Database for Global Atmospheric Research), South Korea ranked as the ninth highest greenhouse gas emitter in the world. Its climate crisis has been highlighted by disastrous flooding caused by heavy rainfall in the last 3 years. While the country has companies such as Samsung SDI and LD Energy Solutions as the biggest players in the Energy Storage System (ESS) industry, it's hard to incorporate their technology into South Korean renewable energy plants. Researchers attribute this to the country's inhospitable terrain and exposure to natural disasters. Traditional renewable energy sources are too expensive to maintain with South Korea's strict ESS's laws protecting plants from fire or natural disasters.

Hydrogen power solves these problems by reducing a need for constant generation (no need to depend on power sources such as wind, sun), and lasting with a refuelable, battery type power source. Following their hydrogen implementation strategy, the country used three 'pilot cities' Ulsan, Ansan and Wanju to test hydrogen's scope of application. By integrating the plan into some of their major commercial cities, South Korea aims to integrate hydrogen infrastructure quickly. True to that, as CSIS finds, the city of Ulsan is seeking to produce hydrogen from petrochemical complexes that will fuel FCEVs and buildings.

However, there are some downsides to South Korea's hydrogen over-reliance. Since hydrogen doesn't exist alone in this world, it needs to be extracted via separation methods such as electrolysis from water or separation from carbon fossil fuels. The energy [and money] required to extract hydrogen is often greater than the energy produced. Therefore relying on hydrogen as a power-source may not be efficient for the country. Creating hydrogen fuel cells require expensive materials such as platinum and iridium, which are found in small quantities on the planet, but are essential as catalysts to run the fuel cells. The final challenge, which has also been a concern for other renewable energy sources, is infrastructure. Right now, there isn't much to support hydrogen refueling and storage. For South Korea to implement FCEV regulations, they must invest into infrastructure that would support recharging and storage of fuel cells. Not only is it a huge initial investment, it is also not certain how viable hydrogen energy will be in the future. To conclude, as South Korea looks towards hydrogen energy as a potential solution for its energy crisis, it must build on infrastructure challenges and manage costs to see if the investment produces a desirable return.

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Humans sympathize with, and protect, AI bots from playtime exclusion, finds study

Sejal Mackey '27 - 12/31/24

AI, which is quickly becoming increasingly popular when using almost any kind of website, has also started to gain prominence as becoming a friend to a user and engaging in social interactions. In an Imperial College London study, humans began to gain sympathy for AI bots that were ostracized from a fun game.

Empathy is wired into humans. There's no doubt that humans are built to stop unfairness for other humans. But with AI, it becomes questionable on how humans view sociable robots as having feelings or not. The study included 244 human participants, as researchers studied how they responded to an AI virtual agent being excluded by a human in the game called "Cyberball." The game was simply just players passing a virtual ball to each other on screen, but some games included the AI bot being excluded from the game of catch. Participants often favored throwing the ball to the bot after the unfair treatment, with older participants being more likely to notice and adjust the unfairness.

As AI companions become more popular, users would start to become more likely to include them as team members and engage with them socially. This can be an advantage in work scenarios, but unhealthy if AI is used to replace human interactions. It's important to help people distinguish between virtual and real interactions so that they do not fall into unhealthy patterns with AI bots. The Cyberball game also might've had some faults, as it doesn't exactly represent how humans interact in real-life scenarios with chatbots or voice assistants. New experiments, that would include face-to-face conversations with AIs in different settings, will help test how far these findings go in human to AI interactions.

Overall, this study raises questions about how the future of AI will look when interfering with human life. Humans could start to see AI as social beings, but this blurs the lines of AI being a tool or a friend – which could cause misplaced emotional attachment. As a suggested solution, researchers of this study recommend avoiding designs that make AI very human-like because of the connections humans could make with it.

Ultimately, AI should be used in a way with a clear distinction between humans and robots. This is the most ethical design that helps human social nature stay healthy. However, this study raises an important question: how can AI developers make their AI bots the most helpful but still ethical?

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SpaceX launches a Starship rocket and catches the booster in giant metal arms

Daphne Panie '27 - 12/31/24

Space Travel, a children's dream, may now become a reality as a major breakthrough in this field was made a couple of weeks ago. On October 13, 2024, Elon Musk, the CEO of SpaceX, Tesla, and Starship, made history as he caught the booster of his Super-Heavy Starship rocket using two metallic arms, also known as "chopsticks", in Southern Texas. The rocket, named Starship, is a fully reusable transportation system, allowing SpaceX to reuse the most expensive part, drastically lowering the space travel costs. Elon Musk's rocket will be used to transport persons and cargo to the Earth's orbit, the Moon, Mars, and beyond. It is the most powerful rocket ever created and is capable of carrying hundreds of metric tons. It is also capable of carrying more than 100 persons during long periods of time during future interplaneterial flights. On its way to Mars, in low Earth atmosphere, Starship would be refueled using a fuel tanker before starting its journey to Mars.

This was the successful fifth attempt and received much praise from scientists and astronauts. After having taken off and reached a height of 65km, the super heavy booster separated from the core rocket. The rocket then accomplished a loop around the Earth before coming back above the Indian Ocean. Meanwhile, the booster fell back on Earth freely at a speed of more than thousands of miles an hour. As it came closer to the tower, Starship relighted three of its engines to slow down, before being finally caught by two metallic arms. Catching the booster, rather than making it launch on a platform dramatically reduces the cost as there is no need to create a complex launching platform.

Forty minutes later, the rocket successfully landed in the Indian Ocean, achieving Musk's second objective. SpaceX managed to preserve some hardware, which was an unexpected victory, making it easier to attempt more launches in the future.

As thousands of criteria must have been met for the rocket to be receipted by the metallic arms, SpaceX's achievement is breathtaking in the field of space travel. Elon Musk's vision of space travel to the Moon, Mars, and beyond, and humans becoming a multi-planetary species is slowly turning into a reality. In roughly two years, the planets will be almost perfectly aligned and the space travel conditions will be optimal, which leads SpaceX planning to attempt sending the first human to Mars.

Elon Musk has no plan to stop there and wants to proceed to more tests in the future. However, the US Federal Aviation Administration (FAA) stated that SpaceX would not be permitted to try more launches before November, as the FAA needs to review the license and the potential impacts that this rocket can have on the environment.

As a response to this considerable achievement, a former Canadian astronaut, Chris Hadfield posted on social media: "There was an enormous step forward in human capability today. Makes me even more excited for our collective future. Congratulations to all at SpaceX!"

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