1. **New Technology Extracts Oxygen and Fuel from the Waters of Mars, Brings Colonisation a Step Closer**

Currently, the only way to make oxygen and hydrogen (used for breathing and fuel, respectively) from the salty water found on Mars is by way of [electrolysis](https://en.wikipedia.org/wiki/Electrolysis) – a process that is not only expensive, but would also be difficult to perform on the planet’s surface.

And yet, the methods of electrolysis are not all the same. Case in point, researchers at Washington University in St Louis have recently developed a simplified and less costly version of electrolysis, capable of performing well under regular terrestrial conditions, as well as conditions similar to those prevailing on the Red Plant itself.

“Our Martian brine electrolyser radically changes the logistical calculus of missions to Mars and beyond. This technology is equally useful on Earth where it opens up the oceans as a viable oxygen and fuel source,” said Vijay Ramani of Washington University.

The new system could help researchers overcome a key obstacle to crewed missions to Mars, namely – the necessity of producing oxygen and fuel on-site. And since both public and private space agencies are considering the possibility of eventual colonisation, this issue will only become more relevant as time goes on.

According to Ramani, the technique developed at his lab can produce 25 times more oxygen than the Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) suite aboard NASA’s Perseverance rover scheduled to land on Mars on 18 February 2021, while using the same amount of power.

In addition, the system is capable of producing hydrogen that could be used to fuel the trip back to Earth, which would significantly cut down on costs and simplify the operation, while also making space missions within the Solar System more viable in the process.

The high performance of the novel brine eletrolyser comes down to a lead ruthenate pyrochlore anode developed by the team in conjunction with a platinum on carbon cathode, as well as the optimal use of traditional electrochemical engineering principles.

“Paradoxically, the dissolved perchlorate in the water, so-called impurities, actually help in an environment like that of Mars,” said joint first author Shrihari Sankarasubramanian. “They prevent the water from freezing and also improve the performance of the electrolyser system by lowering the electrical resistance.”

Beyond applications for space travel, the system could also be used for producing oxygen on submarines and during deep sea exploration.

1. **Black Holes Gain new Powers When They Spin Fast Enough**

General relativity is a profoundly complex mathematical theory, but its description of black holes is amazingly simple. A stable black hole can be described by just three properties: its mass, its electric charge, and its rotation or spin. Since black holes aren’t likely to have much charge, it really takes just two properties. If you know a black hole’s mass and spin, you know all there is to know about the black hole.

This property is often summarized by the no-hair theorem. Specifically, the theorem asserts that once matter falls into a black hole, the only characteristic that remains is mass. You could make a black hole out of a Sun’s worth of hydrogen, chairs, or those old copies of National Geographic from Grandma’s attic, and there would be no difference. Mass is mass as far as general relativity is concerned. In every case the event horizon of a black hole is perfectly smooth, with no extra features. As Jacob Bekenstein said, black holes have no hair.

But with all its predictive power, general relativity has a problem with quantum theory. This is particularly true with black holes. If the no-hair theorem is correct, the information held within an object is destroyed when it crosses the event horizon. Quantum theory says that information can never be destroyed. So the valid theory of gravity is contradicted by the valid theory of the quanta. This leads to problems such as the [firewall paradox,](https://briankoberlein.com/post/hole-y-war/) which can’t decide whether an event horizon should be hot or cold.

Several theories have been proposed to solve this contradiction, often involving extensions to relativity. But the difference between standard relativity and these modified theories can only be seen in extreme situations, making them difficult to study observationally. But a new paper in Physical Review Letters shows how they might be studied through the spin of a black hole.

Many modified relativity theories have an extra parameter not seen in the standard theory. Known as a massless scalar field, it allows Einstein’s model to connect with quantum theory in a way that isn’t contradictory. In this new work, the team looked at how such a scalar field connects to the rotation of a black hole. They found that at low spins, a modified black hole is indistinguishable from the standard model, but at high rotations the scalar field allows a black hole to have extra features. In other words, in these alternative models, rapidly rotating black holes can have hair.

The hairy aspects of rotating black holes would only be seen near the event horizon itself, but they would also affect merging black holes. As the authors point out, future gravitational wave observatories should be able to use rapidly rotating black holes to determine whether an alternative to general relativity is valid.

Einstein’s theory of general relativity has passed every observational challenge so far, but it will likely break down in the most extreme environments of the universe. Studies such as this show how we might be able to discover the theory that comes next.

1. **Use of IT in Medical Education**

Worldwide use of computer technology in medicine began in the early 1950s with the rise of the computers. In 1949, Gustav Wagner established the first professional organization for health informatics in Germany. Health informatics also called Health Information Systems is a discipline at the intersection of information science, computer science, and health care. It concerns with the resources, devices, and methods required for optimizing the acquisition, storage, retrieval, and use of information in health and biomedicine. Health informatics tools include computers, clinical guidelines, formal medical terminologies, and information and communication sytems. It is applied to the areas of nursing, clinical care, dentistry, pharmacy, public health, occupational therapy, and (bio)medical research.

With the development in IT, there has been a significant change in medical education all over the world. The changes is that majority of the medical students are computer literate these days. New information on medical topics is readily accessible via the Internet and handheld computers such as palmtops, personal digital assistants (PDA). Information Technology can assist medical education in various ways such as in college networks and internet. Computer-assisted learning (CAL), Virtual reality (VR), Human patient simulators are some options. With the help of college networks and Internet, the medical students as well as the teachers may stay in contact even when they are off college.

Rapid communication can be established with the help of e-mails and course details, handouts, and feedbacks can be circulated easily. Many medical schools these days use online programs such as "Blackboard" or "student central" to underline and coordinate their courses. Such programs allow speedy access to information and quick turnaround of evaluation and messaging, and allow all tutors, assessors, and students at any site to look at the curricular context of their own particular contribution. Similarly, the Internet provides opportunities to gain up-to-date information on different aspects of health and disease and to discuss with colleagues in different continents via net conferencing. Free access to Medline, various medical journals, online textbooks and the latest information on new development in medicine also encourages learning and research.  
  
Another example of a significant advancement that IT has provided to hospitals is the development of electronic medical records (EMR). This technology can convert medical information into a single database. Not only does this technology reduce paper costs, it allows healthcare providers to access pertinent patient information such as medical history, medications, insurance information, etc with just the click of a mouse. The ability to care for patients with a record that is integrated with laboratory and pharmacy information, and provides point of service information regarding preventive services, diagnosis, treatment, and follow up represents a dramatic advance in patient care.

There is no argument over the influence of IT in medicine and education. But there are still many areas which need to be improved before we could utilise IT to its full extent. Last but not the least, however advanced the technology gets, it can never replace the interaction the doctors and students require with the patient and the clinical judgments which make great doctors.

1. **The impact of information technology on medicine**

No-one can deny that information technology (IT) is changing the way that medicine is practised. The fact that you are actually reading this editorial is clear evidence of it. This journal would probably not be in existence if it weren’t for the availability of effective and affordable IT.

Most of the early applications of IT were geared towards number crunching. The heart of any computer is the central processing unit (CPU) where arithmetic and logic operations are carried out. In the early days of computing, emphasis was on pure processing power for mathematical and statistical purposes, and at this time the impact on medicine was minimal.

Things changed however when the focus of attention shifted to the relationship between the human and the computer and the ways in which a human can become more productive and information-efficient with the help of IT. There followed a systematic analysis of human tasks and activities and an attempt to improve these by means of computer applications. Medicine then became fertile ground for development, and the concepts of expert systems in medicine emerged, with systems for computer-aided history-taking and diagnosis. In the long run, however, it was the more mundane IT applications such as word-processing and database management systems that penetrated the everyday practice of the working clinician, and even more the world of health services management. The first sectors of hospital activity that benefitted tangibly from IT were patient administration, laboratories and accounts – not surprising, considering the large volumes of numeric data that these sectors handle. At the same time, clinical activities involving calculations were greatly facilitated – the days of nomograms were numbered.

The next significant development was the convergence of information and communication technologies. This led to a veritable boom in networking both within and between organisations. The first major effect of this, in the early 90's, was the evolution of data sharing concepts and the emergence of integrated information systems. Hospital information systems developed and started to take rich data (sounds, images, movies) on board. The acquisition, storage and transmission of medical data, especially from medical instrumentation, became increasingly digital, rendering the total electronic health record feasible. The second major effect of networking, in the mid 90's, was the explosive growth of the Internet. It became feasible to move data and information quickly and cost-effectively between any two networked PC's on the planet. This increased the potential for the communication of medical information among health professionals and patients immeasurably. The full impact of the Internet on medical practice has still to emerge.

There is no sign of slowing down in the rate of development and proliferation of information and communication technologies. In the next ten years we can expect more sophisticated human-computer interfaces with efficient voice and handwriting recognition; the penetration of techniques such as tele-surgery into mainstream clinical practice; sophisticated undergraduate and postgraduate computer-based training; and better structuring and portability of integrated electronic health records. The challenge for health professionals is to harness the new power at their disposal for the benefit of their patients.

1. **Farm automation**

Farm automation, often associated with “smart farming”, is technology that makes farms more efficient and automates the crop or livestock production cycle. An increasing number of companies are working on robotics innovation to develop drones, autonomous tractors, robotic harvesters, automatic watering, and seeding robots. Although these technologies are fairly new, the industry has seen an increasing number of traditional agriculture companies adopt farm automation into their processes.

New advancements in technologies ranging from robotics and drones to computer vision software have completely transformed modern agriculture. The primary goal of farm automation technology is to cover easier, mundane tasks. Some major technologies that are most commonly being utilized by farms include: harvest automation, autonomous tractors, seeding and weeding, and drones. Farm automation technology addresses major issues like a rising global population, farm labor shortages, and changing consumer preferences.

The traditional livestock industry is a sector that is widely overlooked and under-serviced, although it is arguably the most vital. Livestock provides much needed renewable, natural resources that we rely on every day. Livestock management has traditionally been known as running the business of poultry farms, dairy farms, cattle ranches, or other livestock-related agribusinesses. Livestock managers must keep accurate financial records, supervise workers, and ensure proper care and feeding of animals. However, recent trends have proven that technology is revolutionizing the world of livestock management. New developments in the past 8-10 years have made huge improvements to the industry that make tracking and managing livestock much easier and data-driven. This technology can come in the form of nutritional technologies, genetics, digital technology, and more.

Livestock technology can enhance or improve the productivity capacity, welfare, or management of animals and livestock. The concept of the ‘connected cow’ is a result of more and more dairy herds being fitted with sensors to monitor health and increase productivity. Putting individual wearable sensors on cattle can keep track of daily activity and health-related issues while providing data-driven insights for the entire herd. All this data generated is also being turned into meaningful, actionable insights where producers can look quickly and easily to make quick management decisions.

Animal genomics can be defined as the study of looking at the entire gene landscape of a living animal and how they interact with each other to influence the animal’s growth and development. Genomics help livestock producers understand the genetic risk of their herds and determine the future profitability of their livestock. By being strategic with animal selection and breeding decisions, cattle genomics allows producers to optimize profitability and yields of livestock herds.

Sensor and data technologies have huge benefits for the current livestock industry. It can improve the productivity and welfare of livestock by detecting sick animals and intelligently recognizing room for improvement. Computer vision allows us to have all sorts of unbiased data that will get summarized into meaningful, actionable insights. Data-driven decision making leads to better, more efficient, and timely decisions that will advance the productivity of livestock herds.

**6. Researchers developing AI system to protect killer whales**

Ruth Joy, a statistical ecologist and lecturer in SFU’s School of Environmental Science, is leading a project that uses artificial intelligence and machine learning to classify whale calls. The ultimate goal of the neural network project is to develop a warning system to help protect endangered southern resident killer whales from potentially fatal ship strikes.

The project is [supported with $568,179 in funding from Fisheries and Oceans Canada](https://www.canada.ca/en/fisheries-oceans/news/2020/12/government-of-canada-continues-protecting-southern-resident-killer-whales-through-new-technologies.html) under the Oceans Protection Plan–Whale Detection and Collision Avoidance Initiative.

The goal is to develop a system that will monitor sounds received from a network of hydrophones 24 hours a day, detect whale calls and send real-time alerts to vessels notifying them to slow down or change course when whales are in the area.

The team is working with citizen scientists and the Orcasound project to provide several terabytes of whale call datasets, being collected by Steven Bergner, a computing science research associate at SFU’s Big Data Hub.

Bergner says the acoustic data will be used to ‘teach’ the computer to recognize which call belongs to each type of cetacean. The project requires interdisciplinary expertise and brings together experts from fields such as biology, statistics and machine learning. “In the end, we are developing a system that will be a collaboration between human experts and algorithms,” he says.

Orcas or killer whales that are seen along the West Coast are divided into four distinct populations: the salmon-eating southern and northern residents, the transients, which prey on seals or other whales, and offshore, which mostly prey on sharks. Each orca population is further categorized into families called pods. Each pod has its own dialect and each population of orca has calls that differ from the other population.

Think of orca calls as being similar to people who speak the same language but are from different countries. Individuals will have an accent shared by speakers in the country and often an accent specific to a particular state or province within that country.

1. **Science Fiction Meets Neuro-Reality: Organoids to Rebuild the Brain**

Computer-augmented brains, cure to blindness, and rebuilding the brain after injury all sound like science fiction. Today, these disruptive technologies aren’t just for Netflix, “Terminator,” and comic book fodder — in recent years, these advances are closer to reality than some might realize, and they have the ability to revolutionize neurological care.

Neurologic disease is now the world’s leading cause of disability, and upwards of 11 million people have some form of the permanent neurological problem from traumatic brain injuries and stroke. For example, if a traumatic brain injury has damaged the motor cortex — the region of the brain involved in voluntary movements — patients could become paralyzed, without hope of regaining full function. Or some stroke patients can suffer from aphasia, the inability to speak or understand language, due to damage to the brain regions that control speech and language comprehension.

Thanks to recent advances, sometimes lasting neurologic disease can be prevented. For example, if a stroke patient is seen quickly enough, [life-threatening or -altering damage can be avoided](https://www.pennmedicine.org/for-patients-and-visitors/find-a-program-or-service/neurology/stroke/patient-stories/jim-story), but it’s not always possible. Current treatments to most neurologic disease are fairly limited, as most therapies, including medications, aim to improve symptoms but can’t completely recover lost brain function.

H. Isaac Chen, MD, an assistant professor of Neurosurgery at the Perelman School of Medicine and a neurosurgeon at the Corporal Michael J. Crescenz Veterans Affairs Medical Center, is working to address this challenge. Chen calls the effort to improve how people function neurologically — instead of addressing disease symptoms — “the holy grail of clinical neuroscience.”

Chen suspects that implanting neural tissue like a [brain organoid](https://www.pennmedicine.org/news/news-blog/2018/october/mini-organs-next-gen-lab-model-not-the-child-of-frankenstein) could rebuild brain circuitry. His research is focused on the cerebral cortex — the part of the human brain that sets us apart from other animals. The cerebral cortex supports basic functions such as movement, visual sensation, and higher-order cognitive processes, like working memory and the ability to plan.

Chen’s hope is to use brain organoids or other similar neural tissues to create these artificial cortical processors in the lab, and insert them into the brain when there is a problem — thereby replacing the bad processors in the brain.

To push this idea forward, there’s an effort underway to understand how brain organoids can become part of the brain. Chen is currently focused on the visual cortex, analyzing how brain organoids connect to the visual system of rats and how they respond when the animal sees patterns of light. Remarkably, when light is aimed into the rat’s eye, neurons in the organoid become active, signalling that these cells are communicating with the rat’s own brain cells.

1. **Travelling to Mars in just 3 Months could be Enabled by a New Nuclear Engine**

With chemical rockets approaching their theoretical limits, engineers have been looking at nuclear energy in attempts to build an engine suitable for covering large distances in space. If such engines are to be used for crewed missions outside the Earth’s atmosphere, they would have to be light and safe to operate under the conditions prevailing in outer space.

Now, Ultra Safe Nuclear Technologies (USNC-Tech) had recently announced the development of a concept for a new Nuclear Thermal Propulsion (NTP) engine that’s about twice as efficient as chemical rockets, as well as safer and more reliable than previous NTP designs. The blueprints for the new engine have already been submitted to NASA.

If the goal of using nuclear propulsion is realised, the duration of trips from Earth to Mars would be reduced to just 3 months, and further ventures into deep space could finally become a reality.

The new engine is powered by Fully Ceramic Micro-encapsulated (FCM) fuel based on High-Assay Low Enriched Uranium (HALEU). The latter is derived from reprocessed civilian nuclear fuel, enriched to between 5 and 20 per cent, and encapsulated into particles coated with zirconium carbide (ZrC).

In addition to being obtainable with current supply chains and manufacturing plants, FCM is also more rugged and suitable for use at high temperatures, which allows for safer reactors, high thrust, and high [specific impulse](https://en.wikipedia.org/wiki/Specific_impulse), previously achievable only with highly-enriched uranium.

Apart from use during future trips to Mars, the new fuel could also be rolled out to the commercial market, and made available to NASA and the US Department of Defence for the purposes of private missions.

“Key to USNC-Tech’s design is a conscious overlap between terrestrial and space reactor technologies,” said Dr Paolo Venneri, CEO of USNC-Tech. “This allows us to leverage the advancements in nuclear technology and infrastructure from terrestrial systems and apply them to our space reactors.”

1. **Transparent electronic books and human-looking robots: the new field of ‘organic electronics’**

Electronicsmade from carbon rather than silicon could lead to a new generation of medical devices, sensors and perhaps even robots, according to Professor Andreas Hirsch, chair of organic chemistry at Friedrich-Alexander-University Erlangen-Nürnberg in Germany. We spoke to Prof. Hirsch about the emerging research field known as organic electronics.

**What are organic electronics?** --Traditional electronics are based on solid silicon which is used to create semiconductors. These are inorganic (meaning they don’t contain carbon). In contrast, organic electronics use carbon-based molecules – either small molecules or polymers, which are long chains of molecules. Almost all biological molecules are organic compounds, but so are substances made from hydrocarbons like petrochemicals, oils and plastics. A lot of people might think of polymers in particular as being non-conductive – for example plastic polymers are used to insulate copper wires. But some organic polymers and molecules can conduct electricity.

**How do they differ from traditional silicon-based electronics?---**Organic compounds have some advantages over inorganic compounds. They are lightweight, they can be flexible and transparent – all things that differ substantially from classical silicon technology. They can also be cheaper to produce.

**Where are they being used at the moment?--**Probably the use that most people will encounter is in screen technology. Organic LEDs (OLEDs) are now quite common in mobile phones and you can buy televisions with them too. But even before that, liquid crystal devices (LCDs), which can be considered as a kind of organic electronics, have been used in many applications for years.

**What other applications are there for organic electronics**?--Their use in photovoltaic devices is an important issue. Silicon-based technology is superior in many ways, certainly where efficiency is concerned and their long term stability. But it is very expensive to generate single crystalline silicon and it is hard to control its morphology (shape and structure). It isn’t very flexible or transparent and cannot be made very thin. This is where organic photovoltaics start to have an edge – they can be made very thin, you can make devices that cover a large area with them and they are flexible, which is a big advantage in many applications, such as solar panels and large light emitting displays.

**What about in sensors?--**This is still an emerging field, but it is very promising. If you think of graphene – which is a two-dimensional layer of carbon one atom thick – it is highly conductive but also extremely sensitive. Just a single molecule of carbon monoxide, for example, has an influence on the conductance which can be measured. Again, it is flexible, can be made in large areas and is transparent.

**How do you turn graphene into a sensor?--**This is something my own group has been working on. One of our research projects – GRAPHENOCHEM – was really just looking at whether we could make graphene in larger quantities, as when we started (in 2010) it was being created by peeling Scotch tape off a piece of graphite. We wanted to know if we could use wet chemistry approaches (using liquids) to make it in larger quantities.

**Do you think organic electronics might eventually replace silicon computers?--**I think it is much more likely to be a complementary system. Our work is very prototype just now, so I don’t know whether we can really make an organic state computer that can work at the level of normal silicon-based computers. I doubt that a little bit. But if you think about biological systems where the response doesn’t have to be so fast, there could be an advantage there (because it is hard to get silicon to interact with biological molecules). We could see organic electronics being used in medical devices or biogenic robotics at the interface with the biological system.

**10 . Modern Greenhouses**

In recent decades, the Greenhouse industry has been transforming from small scale facilities usedc primarily for research and aesthetic purposes (i.e., botanic gardens) to significantly more large-scale facilities that compete directly with land-based conventional food production. Combined, the entire global greenhouse market currently produces nearly [US $350 billion](https://medium.com/agrilyst/lets-talk-about-market-size-316842f1ab27) in vegetables annually, of which U.S. production comprises less than one percent.

Nowadays, in large part due to the tremendous recent improvements in growing technology, the industry is witnessing a blossoming like no time before. Greenhouses today are increasingly emerging that are large-scale, capital-infused, and urban-centered.

As the market has grown dramatically, it has also experienced clear trends in recent years. Modern greenhouses are becoming increasingly tech-heavy, using LED lights and automated control systems to perfectly tailor the growing environment. Successful greenhouse companies are scaling significantly and located their growing facilities near urban hubs to capitalize on the ever-increasing demand for local food, no matter the season. To accomplish these feats, the greenhouse industry is also becoming increasingly capital-infused, using venture funding and other sources to build out the infrastructure necessary to compete in the current market.

1. **New Synthetic Biomaterial Can Repair Hearts, Muscles, and Vocal Cords**

Scientists from McGill University develop new biomaterial for wound repair.

Combining knowledge of chemistry, physics, biology, and engineering, scientists from McGill University develop a biomaterial tough enough to repair the heart, muscles, and vocal cords, representing a major advance in regenerative medicine.

“People recovering from heart damage often face a long and tricky journey. Healing is challenging because of the constant movement tissues must withstand as the heart beats. The same is true for vocal cords. Until now there was no injectable material strong enough for the job,” says Guangyu Bao, a PhD candidate in the Department of Mechanical Engineering at McGill University.

The team, led by Professor Luc Mongeau and Assistant Professor Jianyu Li, developed a new injectable hydrogel for wound repair. The hydrogel is a type of biomaterial that provides room for cells to live and grow. Once injected into the body, the biomaterial forms a stable, porous structure allowing live cells to grow or pass through to repair the injured organs.

“The results are promising, and we hope that one day the new hydrogel will be used as an implant to restore the voice of people with damaged vocal cords, for example laryngeal cancer survivors,” says Guangyu Bao.

The scientists tested the durability of their hydrogel in a machine they developed to simulate the extreme biomechanics of human vocal cords. Vibrating at 120 times a second for over 6 million cycles, the new biomaterial remained intact while other standard hydrogels fractured into pieces, unable to deal with the stress of the load.

“We were incredibly excited to see it worked perfectly in our test. Before our work, no injectable hydrogels possessed both high porosity and toughness at the same time. To solve this issue, we introduced a pore-forming polymer to our formula,” says Guangyu Bao.

The innovation also opens new avenues for other applications like drug delivery, tissue engineering, and the creation of model tissues for drug screening, the scientists say. The team is even looking to use the hydrogel technology to create lungs to test COVID-19 drugs.

1. **Computer Conservation: Lily Xu Uses Artificial Intelligence To Stop Poaching Around the World**

Lily Xu knew from a young age how much the environment and conservation mattered to her. By 9 years old, she’d already decided to eat vegetarian because, as she put it, “I didn’t want to hurt animals.” Xu grew up believing her passions would always be separate from her professional interest in computer science. Then she became a graduate student in Milind Tambe’s Teamcore Lab, and everything changed.

Xu is now doing award-winning research into using machine learning and artificial intelligence to help conservation and anti-poaching efforts around the world. Her recent paper, “Learning, Optimization, and Planning Under Uncertainty for Wildlife Conservation,” won the 2021 INFORMS Doing Good with Good OR Student Paper Competition.

“From our earliest conversations, it was crystal clear that Lily was very passionate about sustainability, conservation, and the environment,” said Tambe, the Gordon McKay Professor of Computer Science at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS). “This was also the reason our wavelengths matched and I went out of my way to recruit her and ensure she joined my group.”

In the Teamcore Lab, Xu helped develop Protection Assistant for Wildlife Security (PAWS), an artificial intelligence system that interfaces with a database used by park rangers to record observations of illegal poaching and predict which areas are likely to be poaching hotspots. The system makes it easier for rangers to choose the best locations to patrol.

Xu played a lead role in implementing field tests of the PAWS program. Through Tambe, Xu and her lab mates, Srepok’s rangers greatly increased the number of poachers’ snares they removed throughout the sanctuary.

Xu has always loved nature, but didn’t get to experience much of it while growing up in the Maryland suburbs of Washington, D.C. Once she got to Dartmouth College as an undergraduate in 2014, she finally got to immerse herself in the outdoors.

“I went hiking and camping for the first time as part of my freshman orientation trip, just absolutely fell in love with it, and then spent as much time as I could outdoors,” she said. “That made me even more attuned to how precious the natural environment is, and how much I care about doing my part to preserve it.”

She eventually began to help organize Dartmouth’s first-year trip and took on leadership roles with the school’s sophomore trip and canoe club. That’s continued at Harvard, where she’s mentored four students since the summer of 2020, and been part of several mentorship teams.

1. **IBM claims advance in quantum computing**

IBM has unveiled an advanced "quantum" processor that is part of an effort to build super-fast computers. These machines could revolutionize computing, harnessing the strange world of quantum physics to solve problems beyond reach for even the most advanced "classical" ones. But the hurdles in building practical, large-scale versions have kept quantum computers confined to the lab.

The new chip has 127 "qubits", twice as many as the previous IBM processor. Qubits (quantum bits) are the most basic units of information in a quantum computer. The company called its new Eagle processor "a key milestone on the path towards practical quantum computation". But one quantum computing expert said more details were needed to assess whether it represented a significant advance.

Recent years have seen a surge of interest in the machines because of their potential to vastly improve computing power. They could be used to help develop new materials and medicines or improve aspects of artificial intelligence. Quantum computers tap into the strange way matter behaves at very small scales.

In classical computers, the unit of information is called a "bit" and can have a value of either one or zero. But its equivalent in a quantum system - the qubit - can be both one and zero at the same time. This is the concept of superposition, where something can exist in multiple states at once. To harness their power, multiple qubits must be linked together, a process called entanglement. And with each additional qubit added, the computational power of the processor is effectively doubled. The Eagle processor follows the company's 65-qubit Hummingbird, unveiled in 2020, and the 27-qubit Falcon, in 2019.

"The arrival of the Eagle processor is a major step towards the day when quantum computers can outperform classical computers for useful applications," senior vice-president and research director Dr Darío Gil said.

"Quantum computing has the power to transform nearly every sector and help us tackle the biggest problems of our time."

An important step is to demonstrate what has been loosely dubbed "quantum supremacy". In 2019, Google said its 53-qubit Sycamore quantum processor had surpassed the performance of a conventional computer - on a particular task - for the first time. Google researchers published the results in the prestigious academic journal Nature. At the time, scientists from IBM questioned some of Google's figures and its definition of quantum supremacy. Regarding the new Eagle chip, Prof Scott Aaronson, from the University of Texas at Austin, said: "I look forward to seeing the actual details." On his blog, the quantum computing expert added that information released so far by IBM lacked key parameters he used to assess quantum-computing progress. In 2016, IBM was the first company to put quantum computing on to the cloud, opening up access to the machines for more users.