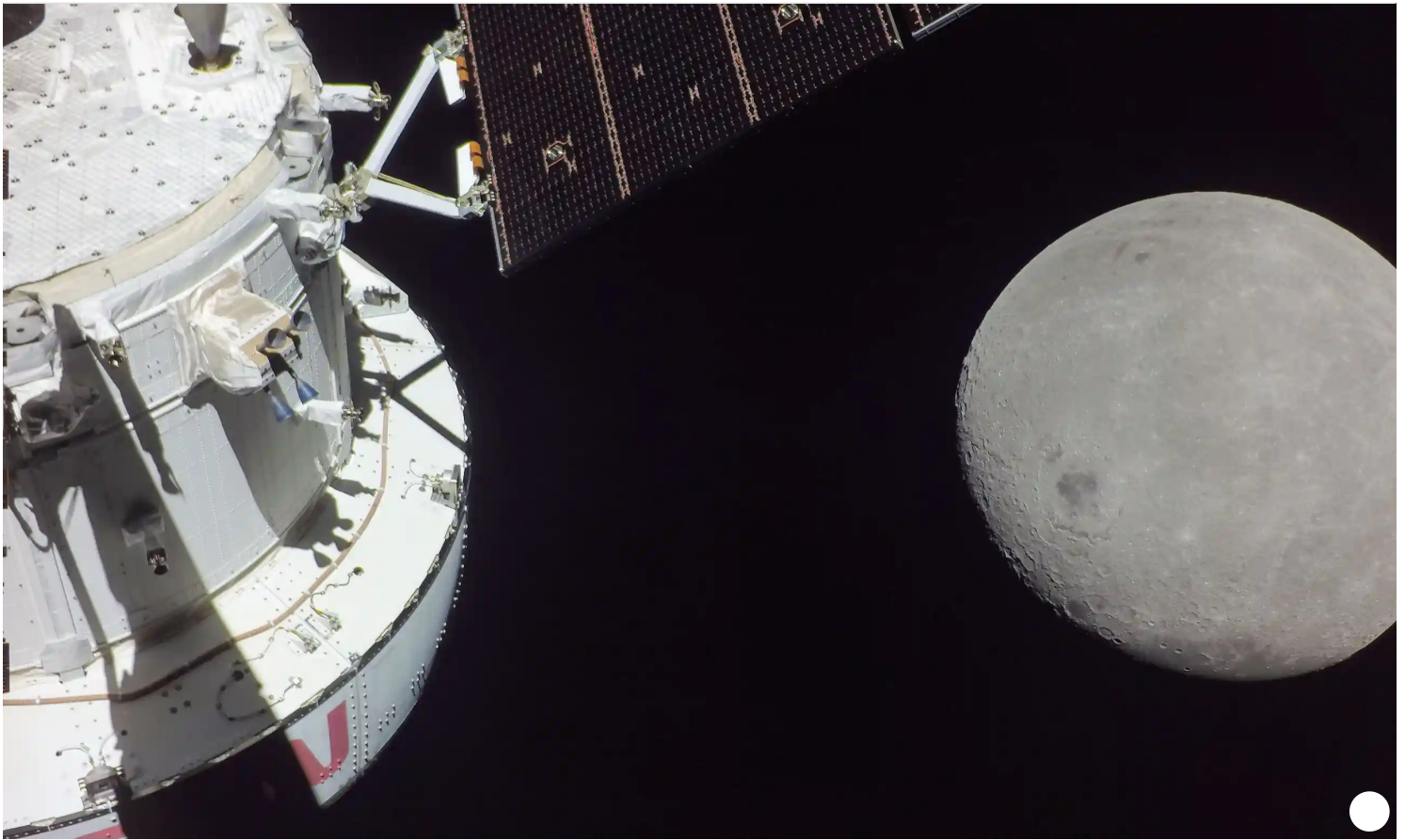


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The 10 biggest science stories of 2022 - chosen by scientists

From moon missions to fast-charging batteries and AI-sourced antibiotics, in no particular order, the year's significant scientific developments

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1. The Dart and Orion missions

The year opened with a bang. Or rather, it didn't. The successful film *Don't Look Up*, in which a comet is found to be on a collision course with Earth, had been released just before Christmas 2021. In the bleak days of post-festive gloom, the news media were on an adrenaline high, chasing any and every story about potential asteroid collisions to cheer us all up. Five asteroids were to pass close to the Earth in January alone! Happily for the health and wellbeing of humanity, none was predicted to come within a whisker of hitting the planet. Nonetheless, the possibility of an asteroid colliding with Earth is a reality - the globe is covered in craters from previous impacts, and it is well known that 65m years ago, dinosaurs became extinct following the impact of an asteroid about 10km across. Can anything be done about saving us from this existential extraterrestrial threat? Fortunately, the international space community has taken the first steps towards reducing the risk of an asteroid catching us unawares. The [joint Nasa- Esa mission Dart](#) (Double Asteroid Re-Direction Test) was an ambitious attempt to alter the trajectory of a small asteroid (Dimorphos) as it orbited a slightly larger asteroid (Didymos), by sending a spacecraft to crash into it. In October, we learned that the mission had been even more successful than anticipated, and that [the orbit of Dimorphos had changed](#) - showing that we could, if given sufficient time, alter the path of an asteroid if it were on a collision course with Earth.

As well as asteroid activity, our moon has been in the news, as a destination of choice for a new generation of astronauts. This year, it is 50 years since the Apollo 17 mission, the last time a human set foot on the moon. So it is a cause for celebration that Artemis, another joint Nasa-Esa programme, has started its operation to return people to the moon. The first phase of the mission, the Orion

6. Elite mathematicians

The Fields medal recognises outstanding mathematical achievement for existing work. Often described as the Nobel prize of mathematics, it is awarded every four years to recipients under the age of 40.

Congratulation to Prof James Maynard, who was awarded a Fields medal this year for his “spectacular contributions” to analytic number theory, “which have led to major advances in the understanding of the structure of prime numbers and in Diophantine approximation”.

One of his standout proofs was to prove the following: there are infinitely many prime numbers whose decimal representation does not contain the digit 7.

Such a simple statement to understand but not very easy to prove. Maynard joins an elite list of British mathematicians who have won the medal.

Congratulations also to one of the other Fields medallists, [the Ukrainian mathematician Maryna Viazovska](#), the second woman to win the award. The mathematician Henry Cohn stated: “Viazovska manages to do things that are completely non-obvious that lots of people tried and failed to do.” She was cited for many mathematical accomplishments, in particular her proof that an arrangement called the E8 lattice is the densest packing of spheres in eight dimensions. **Nira Chamberlain**

Prof Nira Chamberlain is president of the Institute of [Mathematics](#) and its Applications

7. Soft cell, hard cell...

When we think about what influences how the cells inside our bodies develop, we often think of biological or chemical factors. But physical forces - what’s known as the “mechanical” environment - can be just as critical to a cell’s journey. The ability of cells to sense and respond to their mechanical environment has been known for several decades: for example, stem cells grown on soft jelly-like gels will become different cell types compared with stem cells grown on stiff glass-like surfaces.

▲▲ Brillouin microscopy is non-damaging, allowing you to ‘see’ the stiffness of cells without touching them

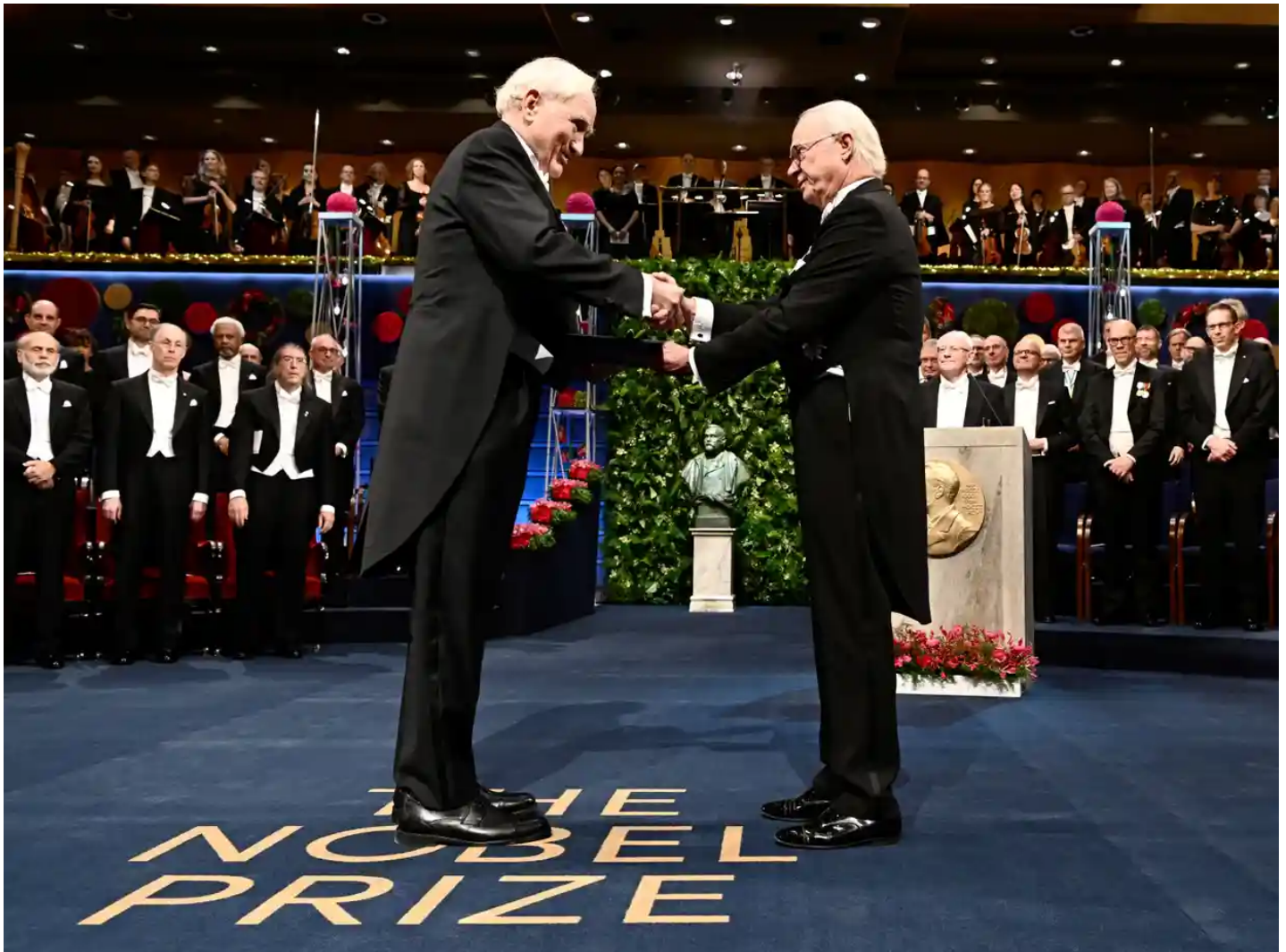
Early signs of diseases such as cancer and Alzheimer’s are often associated with changes in cell stiffness. However, it has been difficult to measure the stiffness of cells and organs inside our bodies, and how they change during development and disease. Tools to measure cell mechanical properties have relied on applying forces to the cell - essentially poking or cutting a cell and seeing how it responds. This is often invasive and damaging, and isn’t easily performed on living cells or organs inside animals, let alone humans.

This year, two research groups, [one from Germany](#), and [one from the US](#), published separate studies demonstrating groundbreaking improvements in a method to measure cell-stiffness, known as Brillouin microscopy. This optical method is non-damaging, allowing you to “see” the stiffness of a material without having to touch it. Developments in this technique this year have significantly advanced imaging speed and resolution, and reduced photo-damage, making the method now widely applicable for observing changes in cell mechanical properties in living animals.

This method will provide a powerful tool for early diagnosis of diseases such as cancer, atherosclerosis and Alzheimer’s. It will also revolutionise how scientists can measure and track the mechanical changes of our cells during normal development, and critically improve our understanding of the importance of mechanical forces in biology. **Yanlan Mao**

Yanlan Mao is professor of developmental biophysics at University College London

8. Quantum entanglement untangled



John F. Clauser (above, left) receives the Nobel prize in physics from King Carl XVI Gustaf of Sweden (right). He was honoured for his work on quantum entanglement, along with fellow pioneers Alain Aspect and Anton Zeilinger. Photograph: Jonas Ekströmer/TT/Rex/Shutterstock

“Spooky action at a distance.” That’s what Albert Einstein called quantum entanglement, which is when two quantum particles have to be considered as a single entity, since influencing one of them affects the other even when they are far apart.

In October this year, the three pioneers of quantum information science, Alain Aspect of the University of Paris-Saclay, John Clauser of JF Clauser & Associates, and Anton Zeilinger of the University of Vienna were awarded the Nobel prize in physics for their contributions to understanding quantum entanglement.

There are many reasons to enjoy this long overdue award. For the sheer beauty of providing new insights into an exciting area of fundamental phenomena. For laying the groundwork for breakthroughs in quantum computers to carry out complex calculations that would be impossible on a conventional computer, and in quantum encryption that could allow secure communications. For spurring more experiments to address one of the great questions of science - how to reconcile quantum mechanics with Einstein’s general theory of relativity.

And finally, for demonstrating another example of the importance of curiosity-driven basic science leading to real-world applications that could change the way we live and work. **Saiful Islam**

Saiful Islam is professor of materials science at Oxford University

9. Nature positive



Greenpeace activists hold up banners at Cop15, the UN biodiversity conference, in Montreal, Canada, earlier this month. Photograph: Canadian Press/Rex/Shutterstock

A huge moment for biodiversity is still ongoing as I write: the much-delayed [15th meeting](#) of the parties to the Convention on Biological Diversity in Montreal, which will set a course for nature recovery from now until 2050. These international agreements feed into national legislation, such as the UK's Environment Act. Alongside this, companies are making bold commitments to become “nature positive”, meaning that their activities should, overall, lead to nature being in a better state.

Nature-positive commitments need to translate into real, measurable - and attributable - recovery of nature. This is very challenging, though, partly because many products have tortuous supply chains so that the companies themselves don't always know what the biodiversity impact of their activities is. For example, nickel is a crucial component of our daily lives, being used in the production of stainless steel. Yet how often do we stop and think about where the nickel in our cutlery or electric car batteries has come from, and how producing it has affected the environment?

One impact is the clearance of forests in areas where nickel ore is mined. Ambatovy nickel mine, the biggest mine in Madagascar, is one of a growing number of businesses to have made a commitment to [leave nature in no worse a state](#) as a result of its operations. The mine compensated for its forest clearance by putting measures in place to stop clearance of forest by local people for agriculture elsewhere. This year, Katie Devenish and colleagues at Bangor University [published a paper](#) looking at whether they had succeeded. Using sophisticated methods to separate out the effects of the mine's activities from other factors leading to forest loss, the researchers demonstrated that the mine was on track to prevent at least as much deforestation as it had caused. The study is a model for how scientists can carry out thorough and independent evaluations of companies' environmental commitments, reducing the temptation to greenwash.

We need many more studies like this, that link the esoteric world of high-level policy-making to realities on the ground, in all sectors from mining, to food, to transport and infrastructure. Then we will have a much better chance to hold our governments and companies to account, and reverse the loss of nature, wherever it takes place. **EJ Milner-Gulland**

EJ Milner-Gulland is a professor of biodiversity at Oxford University

10. Battery charge



📍 Lithium extraction at Bristol Lake in the Mojave Desert, California. This year researchers have made progress in building sodium-based batteries, which could reduce the need for destructive mining methods. Photograph: David McNew/Getty

It's one of the greatest unappreciated stories of our time: the incredibly rapid improvements in battery technology that will form the foundation of an electrified world as we wean ourselves off fossil fuels.

Of course there are questions. What about the costs? Will batteries ever really store enough energy for their size to power something like a large plane? And where will we get all the rare metals necessary to build them?

That's why my story of the year is the October *Nature* paper by [Chao-Yang Wang and co-authors](#), describing a way to charge energy-dense batteries incredibly quickly - in just a few minutes. It really highlights the phenomenal speed at which battery chemists, engineers and technologists are rising to the challenge. If you can charge a car battery in 10-12 minutes, charging more frequently becomes much less of a problem, allowing for smaller batteries that are cheaper and less resource-intensive to make.

We are also seeing huge progress in battery technologies based on cheap, abundant sodium instead of expensive and relatively rare lithium, as well as methods to make all these batteries far easier to recycle.

The basic principles of a battery haven't changed, but the potential of the newest versions is astonishing and getting better all the time. [Helen Czerski](#)

Helen Czerski is a research fellow at the department of mechanical engineering, University College London

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