
# Show Notes 22 August 2025

## Story 1: Zapping Volunteers' Brains with Electricity Boosted Their Math Skills

Source: ScienceAlert.com Story by Charlotte Causit

Link: https://www.sciencealert.com/zapping-volunteers-brains-with-electricity-boosted-their-maths-skills

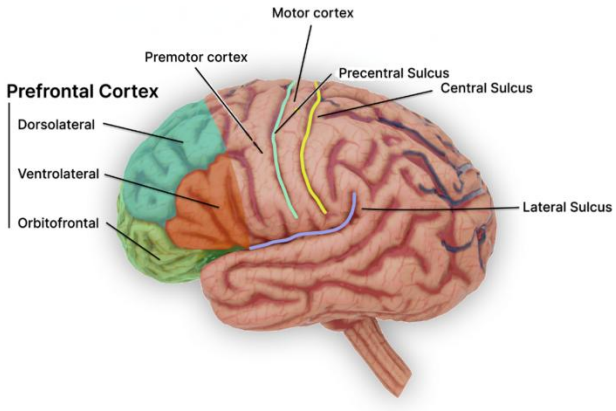
See research paper here: https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3003200&utm_source=pr&utm_medium=email&utm_campaign=plos006

(domin_domin/Getty Images)

- A new study suggests that mild electrical stimulation can boost arithmetic performance – and offers fresh insight into the brain mechanisms behind mathematical ability, along with a potential way to optimize learning.

- Roi Cohen Kadosh, a neuroscientist at the University of Surrey who led the research, and colleagues recruited 72 University of Oxford students, scanning their brains to measure connectivity between three key regions.

- They found that stronger connections between the dorsolateral prefrontal cortex, which governs executive function, and the posterior parietal cortex, involved in memory, predicted better calculation performance.




- When the researchers applied a painless form of brain stimulation using electrode-fitted caps – a technique known as transcranial random noise stimulation – the low math performers saw their scores jump by 25–29 percent.

**Story 2: Moon mining takes giant leap forward with plans to harvest lunar soil**

Source: Newsweek via MSN  Story by Joshua Rhett Miller

Link: https://www.msn.com/en-us/money/markets/moon-mining-takes-giant-leap-forward-with-plans-to-harvest-lunar-soil/ar-AA1JFqd9
See also: https://www.interlune.space/

*This is a news item from earlier this year, but I found it to be fascinating, and wanted to share*

A rendering of the Interlune Harvester, which will process moon dirt, or regolith, back onto the lunar surface, which will subsequently resemble a tilled field, according to company officials. courtesy of Interlune
© courtesy of Interlune

- Interlune, a Seattle-based startup founded by ex–Blue Origin executives, aims to mine helium-3 from the moon's surface.
    - Reminder: Blue Origin is a private American aerospace company founded by Jeff Bezos in 2000 with the ambitious goal of making space travel more accessible and sustainable through reusable rocket technology.
- Helium-3 is rare on Earth but The Moon's surface has been bombarded by solar wind for billions of years, embedding helium-3 in the regolith. Estimates suggest over a million metric tons may be present.
- **Why it is so important and valuable** - It could revolutionize quantum computing, fusion energy, medical imaging, and national security. Scientific & Commercial Relevance - Helium-3 has exponential growth in demand, particularly for cryogenics in quantum systems and potential fusion energy applications.
    - **Side note – more on why helium-3 is such a big deal:**
        - Helium-3 is prized not for what it is, but for what it *could* do—especially in the realm of clean energy and space exploration. Here's why it's such a hot topic:
        - **Aneutronic fusion:** Helium-3 can fuse with deuterium to produce energy *without* releasing harmful neutrons, unlike traditional fusion fuels. This means:
            - No radioactive waste
            - No neutron-induced damage to reactor materials

        - High energy yield: The reaction releases a large amount of energy, making it ideal for compact, efficient power sources.

    - Rare on Earth: Helium-3 is extremely scarce here, mostly produced from tritium decay or found in trace amounts in natural gas.

    - Abundant on the Moon: The Moon's surface has been bombarded by solar wind for billions of years, embedding helium-3 in the regolith. Estimates suggest over a million metric tons may be present.

    - Space Propulsion Potential - Fusion-powered spacecraft using helium-3 could achieve faster, more efficient interplanetary travel, thanks to its high energy output and clean reaction profile.

    - Scientific & Medical Uses
        - Used in cryogenics, neutron detection, and low-temperature physics, helium-3's unique properties make it valuable for cutting-edge research.

    - In short, helium-3 is a scientific unicorn: rare, powerful, and clean. Its potential to revolutionize energy and space travel is why companies and governments are eyeing the Moon as the next frontier for mining.

- Technology & Strategy

    - Interlune is designing excavators capable of processing 100 metric tons of moon regolith per hour, measuring helium-3 in parts per billion.

    - Partners include Vermeer Corporation, experts in industrial excavation, helping adapt terrestrial tech for lunar conditions.

    - The goal: a fleet of five harvesters working continuously and autonomously on the moon.

- Timeline & Funding

    - A prospecting mission is planned by end of 2027, with a full-scale harvesting mission by 2029.

    - Interlune has raised $18 million and secured contracts with the U.S. Department of Energy and Maybell Quantum for helium-3 purchases.

- Future payloads will liquify helium-3 on-site before returning it to Earth.

- If successful, Interlune could be the first firm to commercialize extraterrestrial resources.

**Story 3: University of British Columbia researchers create 3D-printed living lung tissue - Printed tissue enables better testing of drugs and disease pathways**

Source: University of British Columbia website

Link: https://news.ok.ubc.ca/2025/07/15/ubco-researchers-create-3d-printed-living-lung-tissue/

See research paper here: https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/10.1002/bit.29013

Note, last week we reported on this news: *Scientists create first mini lungs with built-in blood vessels, unlocking new insights for pulmonary vascular disease*

Dr. Emmanuel Osei has developed a way to 3D print tissue that resembles a living lung. This work could change how lung disease is studied and improve health options for those living with the illness.

- University of British Columbia researchers have developed a 3D bioprinted model of living lung tissue that closely mimics the complexity of human airways.

- **What They Created**

    - A hydrogel-based lung model using bioink made from polymer-modified gelatin and polyethylene glycol diacrylate.

    - Includes **m**ultiple cell types and vascular channels, simulating the mechanical and biological properties of real lung tissue.

- **Why It Matters**

    - Enables more accurate testing of respiratory diseases like asthma, Chronic Obstructive Pulmonary Disease [COPD], idiopathic pulmonary fibrosis, and lung cancer.

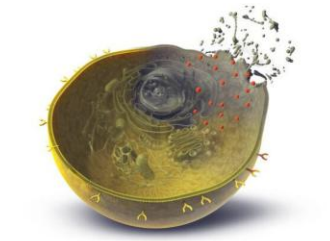
    - Reduces reliance on donated tissue samples, allowing researchers to recreate and expand tissue from small biopsies.

    - **Research Impact -** Improves drug testing and disease modeling by offering a physiologically relevant in vitro system.

- This innovation could accelerate the search for treatments and deepen our understanding of lung disease mechanisms.

**Story 4: AI designs molecular missiles to precisely target cancer cells**

First saw the new on Innovations-report.com, but recommend going to this link for the official news: https://www.dtu.dk/english/newsarchive/2025/07/ai-platform-designs-molecular-missiles-to-attack-cancer-cells



A new AI-based method can produce specially designed proteins in just a few weeks that can arm the T cells in the body's immune system to attack and kill cancer cells. Graphic: Claus Lunau. Credit: Claus Lunau.

- Researchers from the Technical University of Denmark and Scripps Research have developed an AI platform that designs custom proteins—nicknamed “molecular missiles”—to guide immune cells in targeting and destroying cancer cells.

- **Key Highlights:**

    - **Speed & Precision**: The AI can generate a new therapeutic protein in just **4–6 weeks**, dramatically faster than traditional methods that take years.

    - **Mechanism**: These proteins bind to pMHC molecules—structures on cancer cells that present specific peptides—allowing T cells to recognize and attack tumors.

    - **IMPAC-T Cells**: The team engineered T cells with AI-designed “minibinders” that successfully killed cancer cells in lab tests. These modified cells are called **IMPAC-T cells**.

    - **Safety Screening**: A built-in virtual safety check filters out proteins that might bind to healthy cells, reducing the risk of side effects.

    - **Personalized Therapy**: The method was also used to design binders for a unique cancer target in a melanoma patient, showing promise for tailored immunotherapy.

- **According to the team’s official announcement**: The team expects that it will take up to five years before the new method is ready for initial clinical trials in humans.

    - Once the method is ready, the treatment process will resemble current cancer treatments using genetically modified T cells, known as CAR-T cells, which are currently used to treat lymphoma and leukemia.

    - Patients will first have blood drawn at the hospital, similar to a routine blood test.

    - Their immune cells will then be extracted from this blood sample and modified in the laboratory to carry the AI-designed minibinders.

    - These enhanced immune cells are returned to the patient, where they act like targeted missiles, precisely finding and eliminating cancer cells in the body.
- This innovation could mark a major leap toward scalable, personalized cancer treatments.

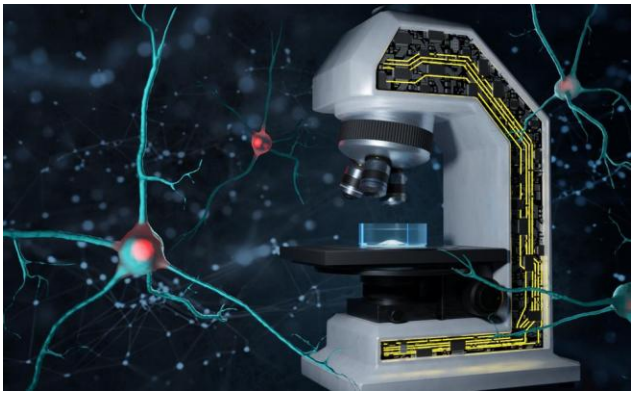
## Honorable Mentions

**Story: AI-powered microscope predicts, and tracks protein aggregation linked to brain diseases**

Source: EPFL News  [EPFL stands for *École Polytechnique Fédérale de Lausanne*, a prestigious public research university located in Lausanne, Switzerland]

Link: https://actu.epfl.ch/news/smart-microscope-captures-aggregation-of-misfold-2/

Research paper here: https://www.nature.com/articles/s41467-025-60912-0



- The accumulation of misfolded proteins in the brain is central to the progression of neurodegenerative diseases like Huntington's, Alzheimer's and Parkinson's. But to the human eye, proteins that are destined to form harmful aggregates don't look any different than normal proteins.

    - **Side note** - Misfolded proteins in the brain are abnormal versions of proteins that fail to fold into their correct three-dimensional shapes. This misfolding disrupts their normal function and can trigger a cascade of harmful effects, especially in neurodegenerative diseases.

- The formation of such aggregates also tends to happen randomly and relatively rapidly—on the scale of minutes. The ability to identify and characterize protein aggregates is essential for understanding and fighting neurodegenerative diseases.

- Now, using deep learning, EPFL researchers have developed a 'self-driving' imaging system that leverages multiple microscopy methods to track and analyze protein aggregation in real time—and even anticipate it before it begins.

- In addition to maximizing imaging efficiency, the approach minimizes the use of fluorescent labels, which can alter the biophysical properties of cell samples and impede accurate analysis.

- *"This is the first time we have been able to accurately foresee the formation of these protein aggregates,"* says recent EPFL Ph.D. graduate Khalid Ibrahim.

- *"Because their biomechanical properties are linked to diseases and the disruption of cellular function, understanding how these properties evolve throughout the aggregation process will lead to fundamental understanding essential for developing solutions."*

- More details from the research paper:

    - The process of protein aggregation, central to neurodegenerative diseases like Huntington's, is challenging to study due to its unpredictable nature and relatively rapid kinetics.

    - Understanding its biomechanics is crucial for unraveling its role in disease progression and cellular toxicity.

    - Brillouin microscopy offers unique advantages for studying biomechanical properties, yet is limited by slow imaging speed, complicating its use for rapid and dynamic processes like protein aggregation.

        - Time out – what is Brillouin microscopy?

            - Brillouin microscopy is a cutting-edge, non-invasive optical technique used to measure the mechanical properties of

biological materials—like cells, tissues, and even entire organisms—without physically touching or altering them.

- How It Works
    - It's based on Brillouin scattering, where laser light interacts with naturally occurring acoustic waves (phonons) inside a material.
    - This interaction causes a tiny shift in the light's frequency—called the Brillouin shift—which reflects the material's stiffness (elasticity) and viscosity.
    - By analyzing these shifts, researchers can create 3D maps of mechanical properties at microscopic resolution

- To overcome these limitations, we developed a self-driving microscope that uses deep learning to predict the onset of aggregation from a single fluorescence image of soluble protein, achieving 91% accuracy.
- The system triggers optimized multimodal imaging when aggregation is imminent, enabling intelligent Brillouin microscopy of this dynamic biomechanical process

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**Story:** Rolls-Royce teams up for advanced modular nuclear reactors to power 3 million homes

Source: InterestingEngineering.com  Story by Aman Tripathi

Link: https://www.msn.com/en-us/money/smallbusiness/rolls-royce-teams-up-for-advanced-modular-nuclear-reactors-to-power-3-million-homes/ar-AA1JOpTm

- Rolls-Royce is making major strides in modular nuclear reactor technology with its Small Modular Reactor (SMR) program. Here's the key takeaway from the article:

- **Modular Design & Manufacturing**
  - Each SMR will generate **470 megawatts of low-carbon energy**, enough to power over **1 million homes**.
  - **90% of each unit** will be built in factory conditions, streamlining production and reducing costs compared to traditional nuclear plants.

- **UK's First Fleet of SMRs**
  - Rolls-Royce SMR has been selected to build the **UK's first fleet** of small modular reactors.
  - The goal is to install up to **3 gigawatts** of nuclear capacity, equivalent to powering **3 million homes**.

- **International Collaboration**
  - Rolls-Royce signed an MoU with Czech firm **Škoda JS** to explore component production, expanding the supply chain and manufacturing capabilities.

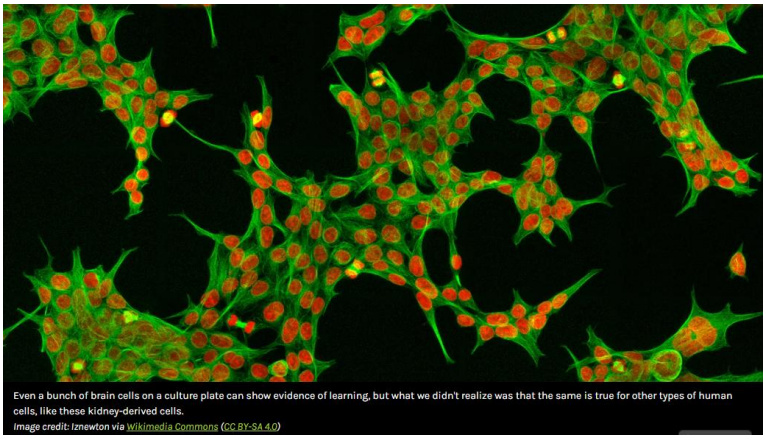
- **Faster, Cheaper, Safer**
  - The modular approach avoids delays seen in large-scale projects like Hinkley Point C.
  - SMRs offer a **radically different approach** using proven technology, with faster deployment and enhanced safety.

**Story: Cells Outside the Brain Show Signs of Memory And "Learning" For the First Time**

Source: IFL Science  Story by Laura Simmons

Link: https://www.iflscience.com/cells-outside-the-brain-show-signs-of-memory-and-learning-for-the-first-time-7945

See research paper here: https://www.nature.com/articles/s41467-024-53922-x



Even a bunch of brain cells on a culture plate can show evidence of learning, but what we didn't realize was that the same is true for other types of human cells, like these kidney-derived cells.
*Image credit: Iznewton via Wikimedia Commons (CC BY-SA 4.0)*

- A groundbreaking study led by New York University researchers has revealed that **non-neural cells—specifically kidney and nerve cells—can exhibit memory-like behavior**, challenging the long-held belief that memory is exclusive to brain cells.

- **Key Findings**

    - **Massed-Spaced Effect**: When exposed to repeated, spaced chemical signals (rather than a single prolonged dose), non-brain cells activated a "memory gene" more strongly and for longer durations—mirroring how neurons form long-term memories.

    - **Chemical Training Pulses**: The study used protein kinases A and C (PKA and PKC) to simulate learning signals. Multiple spaced pulses led to sustained gene activation, while single pulses had only short-lived effects.

    - **Luciferase Tracking**: Researchers engineered cells to glow when the memory gene was active, allowing them to visually track learning responses over time.

- **Implications**

    - **Fundamental Cellular Property**: The ability to learn from repetition may be a **universal feature of all cells**, not just neurons.

- **Health Applications**: This could reshape how we understand diseases and treatments—for example, how cancer cells “remember” chemotherapy patterns or how the pancreas “remembers” meal timing to regulate blood sugar.

- **Therapeutic Potential**: Insights from this research may lead to **new strategies for enhancing learning and treating memory-related disorders**.

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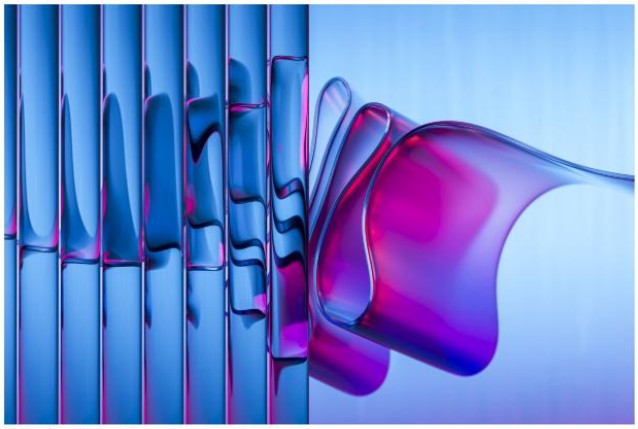
**Story:** A New Hidden State of Matter Could Make Computers 1,000x Faster

Source: Popular Mechanics Story by Darren Orf

Link: https://www.popularmechanics.com/science/a65531679/hidden-metallic-state/



Westend61 // Getty Images

- A new study highlights the remarkable ability of the quantum material tantalum disulfide, or 1T-$TaS_2$, to achieve a “hidden metallic state” that allows it to transition from metallic conductor to an insulator and vice versa.

- This could have huge implications for computing, as scientists expect it could push processors into the terahertz realm and improve computing speeds by a factor of 1,000.

- This mixed phase still requires temperatures around -63 degrees Celsius to stay stable, which is very cold, but much easier for engineers to work with that the near-absolute-zero temperatures required by other, related states.