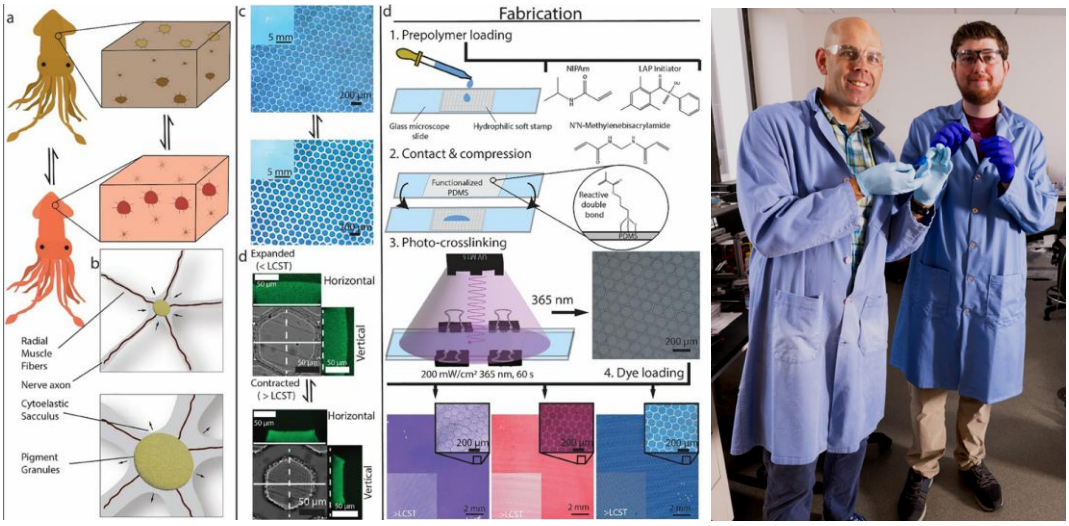
Show Notes 1 August 2025

Story 1: Husker [University of Nebraska-Lincoln] **researchers developing cephalopod-inspired synthetic skins**

Source: University of Nebraska-Lincoln website

Link: https://news.unl.edu/article/husker-researchers-developing-cephalopod-inspired-synthetic-skins

See research paper Synthetic Chromatophores for Color and Pattern Morphing Skins here: https://advanced.onlinelibrary.wiley.com/doi/10.1002/adma.202505104?af=R



- Taking a cue from ocean-dwelling species, University of Nebraska–Lincoln researchers are developing synthetic skins that will support the emergence of next-generation “soft” machines, robots and other devices.

- The skins closely approximate the mechanical action of the chromatophores found in cephalopods – squids, octopi, cuttlefish and other species.

- Chromatophores are micrometer to millimeter-scale organs that contain pigment sacs that become more visible as small radial muscles pull on the sac, making the pigment expand under the skin. These tiny structures are responsible for their astonishing ability to change color and pattern in real time.

    - More on the role of chromatophores:
        - **Camouflage**: Helps them blend into surroundings to avoid predators or ambush prey.
        - **Communication**: Used in mating displays, warnings, and social signaling.
        - **Disruption**: Breaks up body outlines to confuse visual predators.
        - **Environmental Adaptation**: Some species can adjust brightness based on ambient light, possibly using light-sensitive proteins in their skin.

- *"We are working in an emergent area sometimes called autonomous materials,"* said Stephen Morin, author of a new paper in the journal Advanced Materials. *"Autonomous materials have the ability to interact, sense and react with their environment in the absence of user input."*

- These synthetically developed soft skins mimic the cephalopods' color switching and led to the fabrication of stretchable arrays of microstructured, stimuli-responsive versions, Morin said. Multiple layers of these synthetic chromatophores could be programmed to respond to specific environmental stimuli, making them well-suited for applications in soft robotics and human-machine interfaces.

- **Other possibilities:** These materials could be used as environmental sensors and for information display and signaling, in some cases replacing existing display technologies that are electrically powered and require rigid, inflexible components such as computer screens.

- That could include display and reporting technologies that are inherently stretchable and conformable.

- *“You could have a wearable technology that simultaneously reports the temperature, pH, humidity, all sorts of different parameters in a given environment. Doing that with traditional technologies, it would be challenging to measure all of those at the same time.”*

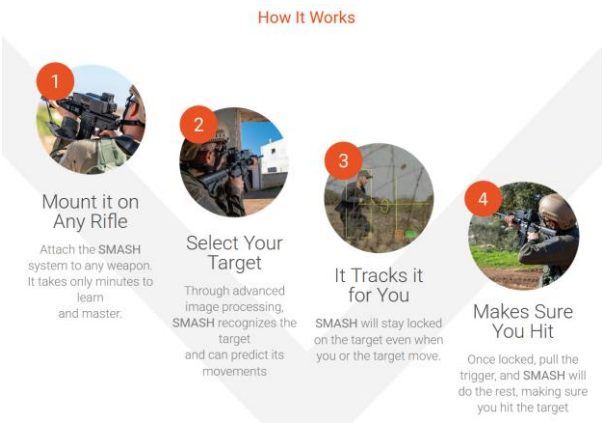
Story 2: US soldiers get smart rifle scopes that *[aim and help]* shoot enemy drones on their own

Source: Interesting Engineering Story by Kapil Kajal

Link: https://interestingengineering.com/military/us-army-rolls-smart-rifle-scopes

See also: https://www.smart-shooter.com/

A U.S. Soldier assigned to 3rd Squadron, 2nd Cavalry Regiment peers through the scope of a Smartshooter SMASH 2000L attached to an M4A1 carbine rifle during Project Flytrap. US Army



- In a significant technological leap toward countering small unmanned aerial drones, the US Army has begun fielding the SMASH 2000L, an artificial intelligence-enabled smart fire control system designed to give soldiers a precision edge against airborne threats.

- The system was demonstrated during a multinational live-fire exercise where the device was affixed to M4A1 carbines to engage drones in flight successfully.

- Developed by Israeli defense firm Smart Shooter, the SMASH 2000L transforms a standard rifle into a high-precision anti-drone platform.

- The system uses an AI-driven fire control unit equipped with electro-optical sensors, computer vision, and proprietary target acquisition software.

- The system scans, detects, locks on, and tracks small aerial targets, such as quadcopters or fixed-wing drones, and only permits the rifle to fire when a guaranteed hit is computed.

- Smart Shooter's system uses real-time image processing and automatic target recognition to help shooters hit their targets accurately. It also syncs recoil to ensure precise shots, even when facing fast and tricky aerial threats.

Story 3: Can 3D-Printed Skin Save Soldiers? *The US Army Thinks So*

Source: NextGenDefense.com Story by Joe Saballa

Link: https://nextgendefense.com/3d-printed-skin-save-soldiers/

- The US Army is teaming up with researchers at the University of Hawaii to explore how 3D-printed skin and other lab-grown tissues could treat troops with chemical, biological, and burn-related injuries.

- The work is part of a new collaboration with the University of Hawaii aimed at taking bioprinting tech out of the lab and into the field, potentially offering life-saving tools in some of the world's most remote and high-risk zones.

- Under the agreement, researchers are developing *organ-on-a-chip systems* and bioprinted tissue models, such as layers of human skin, to better understand how the body responds to chem-bio exposure.

- **Side note, what are organ-on-a-chip systems?** — also called microphysiological systems—are miniature devices that simulate the structure and function of human organs. They're revolutionizing biomedical research by offering a more accurate, ethical, and cost-effective alternative to animal testing.

- What Are They?
  - Microfluidic devices about the size of a USB stick or AA battery
  - Lined with **living human cells** that mimic organ-specific tissues
  - Contain tiny channels that replicate **blood flow, air movement**, or mechanical forces like breathing or peristalsis

- How They Work
  - Two parallel channels are separated by a porous membrane
  - One channel holds organ-specific cells; the other mimics blood vessels
  - Fluid flow and mechanical strain simulate real-life conditions like muscle contractions or lung expansion

- These models could one day help fast-track treatments for injuries caused by burns, poisonous gases, or drug-resistant bacteria on the battlefield.

- Under a broader research and development agreement, the team plans to deploy bioprinters and other manufacturing tools in austere environments across the Indo-Pacific.

- The aim? To create remote, pop-up labs that can produce custom medical solutions on demand, boosting readiness in areas far from traditional support hubs.

Story 4: Scientists create liver organoids with functional blood vessels

Source: News Medical Life Sciences website – Institute of Science Tokyo

Link: https://www.news-medical.net/news/20250717/Scientists-create-liver-organoids-with-functional-blood-vessels.aspx

- Scientists from the Institute of Science Tokyo and Cincinnati Children's Hospital have developed liver organoids with working blood vessels—an advancement that addresses a long-standing challenge in tissue engineering.

- **Key Highlights:**

    - **Functional Vasculature Achieved**: Using a novel 3D culture technique, researchers guided four types of precursor cells to self-organize into liver organoids with proper blood vessel networks.
        - **Side note**: A precursor cell is a type of cell that's partway along the journey from a stem cell to a fully specialized cell.

    - **Medical Application**: These organoids produced clotting factors when tested in a hemophilia A mouse model, suggesting potential for long-term treatment solutions.

    - **Challenge Addressed**: The liver's complex blood vessels have been difficult to replicate in labs, limiting the use of organoids in studying and treating liver diseases.

- **Why It Matters**: Unlike current hemophilia treatments requiring regular injections, these organoids may one day restore natural clotting factor production in patients.

Honorable Mentions

Story: Researchers use high-tech drones with exceptional vision to revolutionize how farmers grow food: 'Farmers are looking for ways to assess their crops'

Source: The Cool Down Story by Calvin Coffee

Link: https://www.msn.com/en-us/health/nutrition/researchers-use-high-tech-drones-with-exceptional-vision-to-revolutionize-how-farmers-grow-food-farmers-are-looking-for-ways-to-assess-their-crops/ar-AA1GI8Iz

- A new drone-powered innovation is helping farmers grow hemp more efficiently, potentially transforming sustainable agriculture.
- Researchers at the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) have developed a method to monitor hemp crops from the air using drones equipped with cameras and supported by artificial intelligence.
- The breakthrough, published in an American Society for Horticultural Science journal, provides farmers with a new tool to optimize fertilizer use, saving money and reducing harmful nitrogen overfertilization that can damage local ecosystems and food supplies through nutrient toxicity, disease susceptibility, and environmental pollution.
- "Farmers are looking for ways to assess their crops throughout the year to make informed fertilizer decisions," said Zack Brym, UF/IFAS agronomy professor and lead researcher on the study.

Story: Replicating Real-Life Blood Vessels to Cure Vascular Disease

Source: Texas A&M website Story by Bailey Noah

Link: https://stories.tamu.edu/news/2025/05/28/replicating-real-life-blood-vessels-to-cure-vascular-disease/

Jennifer Lee, a biomedical engineering master's student at Texas A&M University, joined Dr. Abhishek Jain's lab and designed an advanced vessel-chip that could replicate variations in vascular structure.

Credit: Texas A&M University College of Engineering

- Blood vessels are like big-city highways; full of curves, branches, merges and congestion. Yet for years, lab models replicated vessels like straight, simple roads.

- To better capture the complex architecture of real human blood vessels, researchers in the Department of Biomedical Engineering at Texas A&M University have developed a customizable vessel-chip method, enabling more accurate vascular disease research and a drug discovery platform.

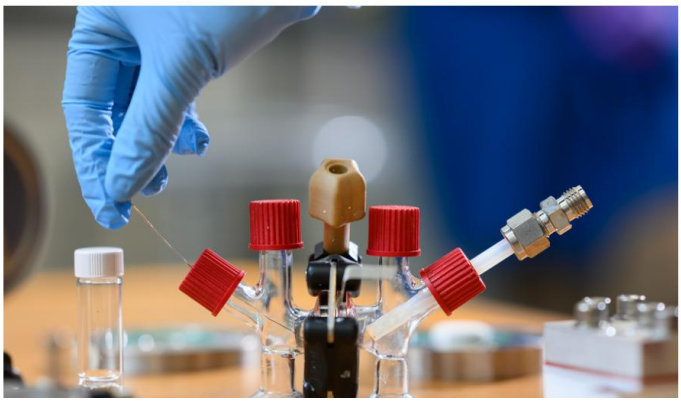
- Vessel-chips are engineered microfluidic devices that mimic human vasculature on a microscopic scale. These chips can be patient-specific and provide a non-animal method for pharmaceutical testing and studying blood flow. Jennifer Lee, a biomedical engineering master's student, joined Dr. Abhishek Jain's lab and designed an advanced vessel-chip that could replicate real variations in vascular structure.

- "There are branched vessels, or aneurysms that have sudden expansion, and then stenosis that restricts the vessel. All these different types of vessels cause the blood flow pattern to be significantly changed, and the inside of the blood vessel is affected by the level of shear stress caused by these flow patterns," Lee said. "That's what we wanted to model."

Story: New fuel cell could enable electric aviation - *These devices could pack three times as much energy per pound as today's best EV batteries, offering a lightweight option for powering trucks, planes, or ships.*

Source: MIT News Story by David L. Chandler

Link: https://news.mit.edu/2025/new-fuel-cell-could-enable-electric-aviation-0527



An H-cell modified with electrodes and an ion-conducting ceramic membrane to conduct sodium-air fuel cell experiments.

Credit: Gretchen Ertl

- Batteries are nearing their limits in terms of how much power they can store for a given weight. That's a serious obstacle for energy innovation and the search for new ways to power airplanes, trains, and ships. Now, researchers at MIT and elsewhere have come up with a solution that could help electrify these transportation systems.

- Instead of a battery, the new concept is a kind of fuel cell — which is similar to a battery but can be quickly refueled rather than recharged. In this case, the fuel is liquid sodium metal, an inexpensive and widely available commodity. The other side of the cell is just ordinary air, which serves as a source of oxygen atoms. In between, a layer of solid ceramic material serves as the electrolyte, allowing sodium ions to pass freely through, and a porous air-facing electrode helps the sodium to chemically react with oxygen and produce electricity.

- In a series of experiments with a prototype device, the researchers demonstrated that this cell could carry more than three times as much energy per unit of weight as the lithium-ion batteries used in virtually all electric vehicles today. Their findings are being published today in the journal Joule, in a paper by MIT doctoral students Karen Sugano, Sunil Mair, and Saahir Ganti-Agrawal; professor of materials science and engineering Yet-Ming Chiang; and five others.

Story: MIT's high-tech 'bubble wrap' turns air into safe drinking water — even in Death Valley

Source: LiveScience.com Story by Damien Pine

Link: https://www.livescience.com/technology/engineering/mits-high-tech-bubble-wrap-turns-air-into-safe-drinking-water-even-in-death-valley

(Image credit: Ilias Katsouras jr via Getty Images)

- MIT researchers have created a high-tech "bubble wrap" capable of collecting safe drinking water directly from the air — even in Death Valley, the driest desert in North America.

- The new water harvester is a major step towards providing safe, accessible drinking water to people across the globe — and works wherever you may find water vapor in the air, scientists said in a new study published June 11 in the journal Nature Water.

- The water harvester is made from hydrogel (a highly water-absorbent material) that is enclosed between two layers of glass — much like a window. At night, the device absorbs water vapor from the atmosphere. During the day, the water condenses on the glass thanks to a coating that keeps the glass cool. The liquid water then drips down the glass and is collected in a system of tubes.