



ISRAEL MATTERS!

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Still More Israeli Weird Science!

In the February 2022 issue of *Israel Matters* we introduced you to a goldfish that could drive its fish tank around the campus of Ben Gurion University of the Negev, Tel Aviv research that detected liars based on the movements of facial muscles, and 3D-printed meatless meat inspired by research at the Technion Israel Institute of Technology. In September of 2023, we told you about a Tel Aviv University study that mapped Tel Aviv's urban heat islands by attaching sensors to bats and setting them loose, stylish sunglasses that help you hear better, and a 3D printed miniature human heart. Well, we're back with a new year, and what could be better than getting inspired by fresh ideas and new thoughts! *Israel Matters* is proud to present its latest edition of Israeli Weird Science.

Shake Your Tail Petal!! Have you ever looked at a field of flowers and wondered if they communicate or coordinate in some way? Dating back to Charles Darwin, botanists have known for a long time that growing plants exhibit cyclical movements known in scientific lingo as "circumnutation." *That* flowers and other plants move around in these weird helical patterns is clear, but *why*? Researchers at Tel Aviv University



have found the answer, and it has to do with that coordination question posed earlier. If sunflowers are densely planted in a field where they shade each other, they grow in a zigzag pattern - one forward and one back - so as not to be in each other's shadow. This way they are able to maximize the illumination from the sun across the entire collective of sunflowers in the patch. Again, how do the sunflowers know how to do this? Tel Aviv botanists grew sunflowers in a high-density environment and photographed them during growth, taking pictures every few minutes. The photographs were then combined to create a time-lapse movie. By tracking the movement of each sunflower, the researchers observed that the flowers were "dancing" a lot! This dance of the sunflowers led each flower to find a sweet spot where it could enjoy the sun without blocking its neighbors' ability to do the same. It's somewhat like a crowded dance party, where individuals move around to create more space: if they move too much, they'll interfere with the other dancers, but if they move too little, the crowding problem won't be solved, leaving one corner of the square overcrowded and the other empty. Sunflowers exhibit a similar communication dynamic—a combination of responding to the shade of neighboring plants and making random movements to catch some sun.

Real Life Mission Impossible or how to hack a computer controller to help make the world a safer place! Strange as that sounds, that was the message when Technion Israel Institute of Technology researchers went to the famed Black Hat cybersecurity conference this past August. Some background – controllers are hardware devices or software programs that manage or direct the flow of data. Controllers can be cards,

microchips, or any other hardware/software combination that manages communications between two systems. Controllers are used in a wide range of systems, including critical systems such as aircraft, vehicles, production lines, power stations, gas and oil pipelines, smart homes, traffic lights, and even nuclear reactors. Communications (as in the passing of instructions) to such important systems must be impenetrable to prevent bad actors from infiltrating and disrupting or even destroying them.

OK, so where do the Technion scientists come in? Well, first let's meet Siemens corporation, which makes controllers that are widely considered to be among the most secure in the world. There on the stage at Black Hat, the Technion master-hackers



demonstrated that they were able to break the Siemens secure communication protocol, enabling them to completely take over the controller! The attack was carried out on the CPU 1515SP controller shown above, and for the first time took control of the software common to all controllers in the series. The Technion researchers hope that the takeover, which was of course demonstrated on isolated controllers not integrated into essential systems, will help Siemens improve its security mechanisms. Siemens controllers are found at various critical junctions, including nuclear reactors. This issue made headlines about 15 years ago when a breach of Siemens controllers via the Stuxnet computer worm led to significant damage to the reactors in Natanz, Iran. Stuxnet is considered one of the most destructive malwares, as it allows not only damage to controllers but also the concealment of that damage. We'll leave it to you to think about who helped pull Stuxnet off!

Cleaning Up Our Plastic Planet (and maybe having some for dinner). On land and at sea, we are drowning in billions of tons of plastic waste. These plastics disintegrate into tiny particles called microplastics that pollute the air and the water, penetrating vegetation and the bloodstreams of humans and other animals. Though some plastics are biodegradable, most are not. Biodegradable plastics are less than 20% of all plastics produced, and existing processes for breaking them down are cumbersome.



Enter researchers from Israel's famed Weizmann Institute of Science in Rehovot (a university named after Israel's first president, Chaim Weizmann). These chemists and materials scientists have created a new composite plastic that degrades easily using bacteria! It is cheap, easy to prepare, and strong. The main discovery was the combination of cellulose, employed extensively in making medicines and cosmetics, with tyrosine, an amino acid that forms very strong nanocrystals. And here's a surprise – tyrosine crystals can be found in various types of hard cheese! Now the idea is not to make plastic out of cheese (though some of you might think that American slices have managed to make cheese out of plastic), but since both cellulose and tyrosine are edible, in principle the newly developed Weizmann biodegradable plastic could actually be eaten! Is it tasty? Apparently, we'll have to wait to find out. You see, since the production process in the lab is not hygienic enough for foodstuffs, the researchers have yet to take a nibble!

Shana Tova to everyone from *Israel Matters!*