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From personalized medicine to nano-particles

Weizmann Institute of Science encourages cooperation across fields

• By LINDA GRADSTEIN
The Media Line

A physicist, a chemist, and a biologist walk into a bar. It's not the first line of a joke, but a daily occurrence at the Weizmann Institute in Rehovot, which encourages cooperation among disciplines.

"I come from physics and computer science," Elad Schneidman, an associate professor of Neurobiology told The Media Line. "My group deals with the question of how large groups of cells in the brain work together and how large groups of animals work in a group. There are many billions of neurons in your brain and they talk to each other with sequences of electrical pulses – it's like a giant Morse code, and we're looking for the dictionary."

If you can decipher this language, he says, you can learn more about what is going on in the brain and how it processes information.

He is studying data from experiments where the activity of hundreds of cells is recorded simultaneously.

One such place is the retina, in the back of the eye, and the other is the visual system of the zebra fish – a small tropical fish that is completely transparent when it's young. "With state of the art microscopy and special dyes, our experimental collaborators can see the neurons firing," he said, as he smiled at the dozen fish swimming in a tank – which are used to study group behavior.

"Each person has 100 billion neurons but every day we lose tens of thousands of neurons," Schneidman said. "If we can figure out how these neurons communicate, we can learn a lot about the brain and about collective behavior of groups."

In another building, Eran Elinav, a senior researcher in the Immunology Department, has crossed over from being a clinical physician to becoming a scientist. Now he is working in the field of personalized medicine.

"We are gaining a lot of knowledge in genomics and in other scientific fields that enable us to better characterize each individual patient and to tailor individual treatment," he said.

For example, he said, until 10 years ago, all cancer patients were treated with the same protocol.

Personalized medicine, based on the person's individual genetic makeup, enables doctors to address each unique person.

The idea of personalized medicine began in 2000, with the mapping of the human genome. "The first time cost an estimated $1 billion; now the simplest mapping of our genome can be done for $1,000, while the cost of a simple mapping of our personal microbial genome is as low as $100," according to Elinav.

Elinav works on what he calls the "microbiome," the microbes that each person carries.

"I'm talking about trillions of bacteria that reside in and around us – on the skin, gut, genital-urinary tract – but also hundreds of viruses, fungi and parasites, all of them form a world within a world, an ecosystem that interacts with the host and has fundamental impact on every aspect of our physiology and on the development of many important diseases," Elinav said.

It is also far easier to change the "microbiome" than it is to change the human genome, although that will become doable eventually as well.

Elinav also offers hope for those of us who are fighting a few extra pounds. Mice injected with gut bacteria associated with obesity began to gain weight after just a few days. The opposite occurred when mice were given "lean gut bacteria."

This whole field is only a few years old, and is expected to expand dramatically in the near future.

A third "cross-border" scientist is Dan Oron of Weizmann's Physics Department.

"My work is on the border between material science and optical physics," he told The Media Line. "These are two communities that have a lot of links, in commercial products like lasers and optical memory devices like compact discs."

Oron says that his current research evolved out of a conversation he had with other Weizmann scientists in the hallway, in the field of nano particles – which can be used for alternative energy.

"Think of a rock. You can hold it in your hand," Oron said. "Nano crystals are very small versions [of] a very tiny rock that has dimensions of about a fraction of a millionth of an inch and contains a few thousand, or tens of thousands, of atoms."

These nano particles, he says, can be used to make photo-voltaic cells for solar power that are far more cost effective than those currently on the market.

"Our goal is to make something even less efficient but ten times cheaper than crystalline silicon cells," Oron said. "The reason nano materials can do this is because fabrication of nano materials is much cheaper. You need equipment that is slightly more than cookery."