

Alien Cells

It sounds like science fiction; Researchers study alien biology to uncover the secrets of the alien's extraordinary health. Only it's not science fiction; It's research at Mote. Okay, so the alien has fins and swims in our oceans—sharks are still pretty foreign to most of us and they seem to develop cancer rarely, if at all.

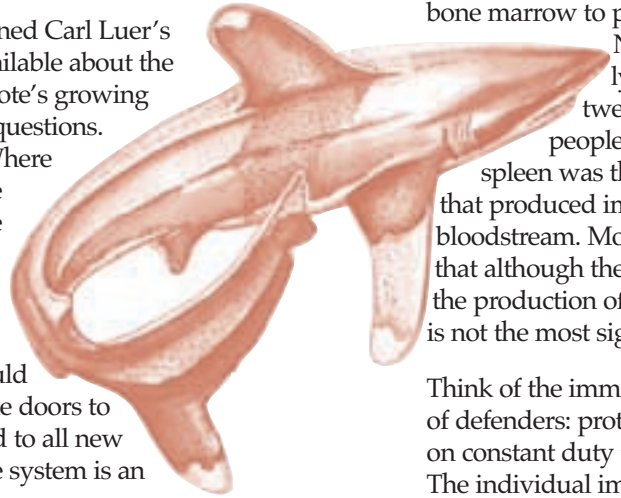
Dr. Carl Luer, Mote's Marine Biomedical Research Program Manager, has been studying the cells of sharks and their cousins, skates and rays, for, well, decades. The secrets of "alien" super-health don't come easy.

When Dr. Luer joined Mote's research team in 1979, he was charged with developing a biomedical research program to study cancer resistance in sharks. The first research efforts exposed sharks and skates to potent chemical carcinogens to see if that exposure would cause them to develop cancer. Ten years of experiments down the road, none of the exposed animals had developed cancer so Luer's team knew they were looking at the right animals, but maybe not in the right way — yet. In the meantime, the world had been struck by a global tragedy: AIDS. As research poured in from around the world, much of it pointed to the importance of the human immune system.

Dr. Luer's team decided to refocus its efforts on the immune system of the shark. "We wanted to see what role the immune system played in sharks' apparent resistance to disease—not just to understand the sharks, but because we can learn more about the human immune system from understanding theirs."

In 1991, when immunologist Dr. Cathy Walsh joined Carl Luer's team, there was still only limited information available about the cellular function of the shark immune system. Mote's growing team of researchers began zeroing in on the key questions. What kinds of immune cells did sharks make? Where did they make those cells? What functions do the cells have and ultimately, how are shark immune cell functions regulated?

Mote's biomedical researchers had taken on a major challenge: creating a comprehensive and detailed shark biological map. If successful, it could lead them to information that could help open the doors to improvements in human therapies or maybe lead to all new therapies. Like a lot of science, the shark immune system is an unfolding mystery.



UNUSUAL TISSUE SITE
Found only in sharks, skates and rays, these unique tissue sites produce important regulatory factors that control immune response.

Tissue imprint of the epigonal organ of a blacknose shark



Dr. Carl Luer

Understanding Shark Immune Cells

When Mote research turned to shark immune cells, the scientific community knew little about the shark immune system. Everyone, of course, agreed that shark cells were not extraterrestrial, but that was about where the agreement ended. Over the last decade, Mote biomedical research has helped write the book on shark immune cells, providing the relevant chapters for two definitive works on shark biology that are scheduled for publication soon.

Immune Cell Production

Unlike mammals, sharks do not have bone marrow to produce immune cells. Nor do sharks have lymph nodes. Fifteen, twenty years ago, most people assumed that the spleen was the primary shark organ that produced immune cells for the bloodstream. Mote research revealed that although the spleen is involved in the production of shark immune cells, it is not the most significant site.

Think of the immune system as a group of defenders: protective cells that circulate on constant duty throughout the body. The individual immune cells follow chemical instructions, called "regulatory factors," that dictate how and when to go on alert or into an all-out defense against an invader — like cancer. So where do these all-important regulatory factors come from?

"INNER SPACE"
For nearly a quarter of a century, Mote shark biomedical research has investigated elasmobranch biology one day and a few million cells at a time.

Dr. Luer's team found that sharks, skates and rays produce immune cells in two unique tissue sites that other animals don't even have. These unique tissue sites are associated with the reproductive organs and the esophagus, and it is there that the regulatory factors for sharks, skates and rays are produced. The secrets of super-health are still elusive, but some of the secrets of shark biology are becoming clear.

Keeping Shark Cells Alive

In order to study the immune system, Mote needed a way to keep shark cells alive in a laboratory setting for 4-6 days. There was no pre-existing formula, so Dr. Luer's team invented one. Sound simple? It took several years, but research couldn't advance until they had it. Once Mote had shark immune cells in short-term culture, the biomedical team was able to experiment with cell defenses to gain an understanding of the different cell functions.

"We're still trying to understand exactly what functions shark immune cells have and how they're regulated," says Dr. Luer, "but we are making progress."

On the T Cell Trail

For humans, we know that T cells, which are produced by the thymus, are important to immune function. But in sharks, it's a different story. In fact, when Mote began its research, most marine biologists

thought the shark didn't even have a thymus. It took several years, but Mote researchers successfully identified the location of the shark thymus. It was in a part of the body where the organ was easily destroyed if the shark was not carefully dissected.

In humans, one of the things that T cells do is mediate the body's rejection of tissue that can occur in organ transplants. Do T cells function similarly in sharks and skates? Dr. Luer's team is currently doing graft rejection studies to figure it out.

25 Years Looking at "Alien" Cells

Ask Carl Luer what he's done for the last quarter of a century and he laughs. "It's not a weekend project," he says. Then he shrugs, "Welcome to science."

Like many areas of science, shark biomedical research is moving forward through collaboration. "We are learning about gene structure through our collaboration with the University of South Florida Children's Research Institute in St. Petersburg. From work with the Moffitt Cancer Research Institute, we're gaining an understanding of some of the immune regulatory functions. Our collaboration with Clemson University has helped us compare immune function in sharks to other animals."

Will the shark immune system point the way to improved human medical therapies? Maybe. Science seldom uncovers answers as quickly as science fiction might lead us to believe possible. One thing is certain: Mote's biomedical team will continue its research ... one day and about a million cells at a time.



THE LARGEST SHARK RESEARCH ORGANIZATION IN THE WORLD
Mote's Biomedical Research Program operates from the Center for Shark Research which also studies shark, ray and skate conservation biology, population dynamics, reproduction and vision. Mote is the largest shark research organization in the world and has been designated by the U.S. Congress as a national center for shark research.