Precious GEMS: Genome Enable Marine Science

In 2003, the Human Genome Project formally unveiled the completion of its 13-year initiative to discover all 20,000-25,000 human genes. Since then, science has never been the same.

At the Rosenstiel School, scientists scrutinize marine life for the “inner” information that could help us learn more about our environment and ourselves. Under the heading, Genome Enable Marine Science or GEMS, scientists are already using the genome to learn about how genes affect how the body works. Genes are the basic, functional units of heredity, each occupying a specific place on a chromosome. The study of many or most of these thousands of genes is genomic science. Scientists study thousands of genes simultaneously to identify their function and to understand how those genes allow organisms to survive the changing environment.

At the Heart of It
If you’ve ever wondered why there are so many cholesterol drugs or why one person responds better to one particular medication over another seemingly similar product, the answer may be found in minnows. By using this marine model, Rosenstiel School scientists have found a genetic set of keys to unlock the mystery of why some people can eat fatty food and not suffer from heart disease or why some medical treatments work more effectively in some people than others. While a few genes guide cardiac metabolism, it varies by person (or creature), which of the genes is most important to the process. GEMS allows scientists to see which of the thousands of minnow genes “turn on” to process fats, sugars, or other foods.

Finding the Perfect Specimen
Sometimes the key to genomic research comes in finding a marine specimen with unique qualities. This approach has led Rosenstiel scientists to discover how toadfish handle ammonia toxicity, or how small marine organisms deal with metal pollutants. Ultimately, these studies could lead to developing a clinical strategy or drug to help humans with early-onset liver disease due to ammonia or metal toxicity.

Working to Prevent Red Tide...At The DNA Level
A leader in red tide research, Rosenstiel School has taken a high-tech approach to studying Karenia brevis, the algae blamed for Florida’s red tides. Again, using GEMS, the scientists hope to reveal what factors help trigger and feed the harmful algal blooms and how they relate to environmental conditions, such as currents and weather.

The Genetic Make Up of Global Climate Change
The trend in global climate change and “carbon cycling” research is to investigate some of the most abundant marine organisms, which are very small microbes. Their life cycles, despite their small size, are incredibly important to the process that moves carbon between atmosphere and ocean. A Rosenstiel School scientist is leading an international team of investigators in collaboration with the Department of Energy to completely sequence the genomes of two microscopic photosynthesizing organisms. These creatures also can be used to understand how bigger, more complex plants evolve. The scientists will use the genomes as a map of the organisms’ capabilities to observe in real-time the way these organisms experience and react to particular situations. It allows us to learn more about their role in carbon cycling, the factors controlling their growth, and the dynamics of other organisms.

Only the Beginning
Without a doubt, genomics’ possibilities is exciting for Rosenstiel School researchers. Other projects are equally promising. Coral reef experts are sequencing RNA for corals and other species heavily impacted by humanity, such that we can recommend ways to better manage, protect, and propagate them. Marine biologists are discovering the DNA-based mechanisms of memory and learning in humans, through the study of simplified marine organisms, such as the sea hare. Other scientists are developing diagnostic DNA-based methods to identify protected species such that poaching can be minimized. Ultimately, these cutting-edge approaches will keep Rosenstiel School at the forefront in marine biology and fisheries research, blazing the trail of scientific excellence.