Sea urchin genome suprisingly similar to man and may hold key to cures

December 7 2006

Sea urchins are small and spiny, they have no eyes and they eat kelp and algae. Still, the sea creature's genome is remarkably similar to humans' and may hold the key to preventing and curing several human diseases, according to a University of Central Florida researcher and several colleagues.

UCF Professor Cristina Calestani was part of the Sea Urchin Genome Sequencing Group, which recently completed sequencing of the sea urchin genome and published its findings in the November issue of *Science*. The National Institutes of Health funded most of the nine-month project.

The genome of the purple sea urchin is composed by 814 "letters" coding for 23,300 genes.

Sea urchins are echinoderms, marine animals that originated more than 540 million years ago. The reason for the great interest in sequencing the sea urchin genome is because it shares a common ancestor with humans. Sea urchins are closer to human and vertebrates from an evolutionary perspective than other more widely studied animal models, such as fruit fly or worms. The purple sea urchin, in fact, has 7,000 genes in common with humans, including genes associated with Parkinson's, Alzheimer's and Huntington's diseases and muscular dystrophy.

"Another surprise is that this spiny creature with no eyes, nose or hears has genes involved in vision, hearing and smell in humans," Calestani

said. "The comparison of human genes with their corresponding ancestral sea urchin genes may give important insight on their function in humans, in the same way the study of history helps understanding the reality of our modern world."

The genome sequencing project was led by Erica Sodergren and George Weinstock at the Baylor College of Medicine-Human Genome Sequencing Center in Houston, along with Dr. Richard Gibbs, director of the Baylor center, and Drs. Eric Davidson and Andrew Cameron at the California Institute of Technology.

Of particular interest to Calestani is the way the sea urchin's immune system works. The human immune system has two components: innate immunity, with which we are born, and acquired immunity, which is the ability to produce antibodies in response to an infection. Sea urchins only have innate immunity, and it is greatly expanded with 10 to 20 times as many genes as in human.

"Considering that sea urchins have a long life span -- some can live up to 100 years -- their immune system must be powerful," Calestani said. "Sea urchins could very well provide a new set of antibiotic and antiviral compounds to fight various infectious diseases."

The sea urchin has been used for many years as a research model to study embryonic development.

Cell development is very complicated. In order to properly regulate just one gene expression of a single-cell layered gut of the sea urchin larva, at least 14 proteins binding the DNA at 50 sites are needed, Calestani said.

"Multiply that hundreds of times and you begin to understand the level of complexity involved in human development," she added.

Using a "simple" creature like the sea urchin embryo to uncover the molecular basis underlying development offers several experimental advantages compared to the use of mice. Raising sea urchin embryos is easy and inexpensive. One female can provide up to 20 millions eggs. The embryos develop in just three days and are transparent. Also, single cells can be easily observed live in the embryos.

"If we know how these biological processes work, then we can begin to figure out how to intercede to repair and to heal," Calestani said. "It holds a lot of promise."

Calestani is continuing her work with sea urchins at UCF in Orlando by examining the development of pigment cells found in the marine creatures. Those cells also might provide some insight into human immunity to diseases.

Source: University of Central Florida