Closer to a Cure

Can this sea creature help reverse human hearing loss?

The starlet sea anemone *(Nematostella vectensis)* produces a self-healing protein. UL Lafayette research suggests this marine animal could hold a cure for human deafness.

DR. GLEN WATSON and his graduate students are working to answer an intriguing question: Can one species heal another? The answer may lie within the starlet sea anemone.

A cell biologist, Watson has studied sea anemones since 1978. Since arriving at UL Lafayette in 1989, he has received more than $1.37 million in federal funding to continue his work.

Starlet sea anemones, which feed on brine shrimp, possess an extraordinary ability, Watson said. When the cells they use to detect their prey are damaged, they can heal themselves.

Watson and his team are exploring cellular and genetic connections among starlet sea anemones, zebrafish and humans, with the hope of someday contributing to a cure for deafness. The three species are among the relatively few whose entire genetic code is known and readily available to researchers.

The species also have similarities at the cellular level, Watson explained. Hair cells are found on the anemones' tentacles, on the fishes' scales, and in humans' inner ears. At the tip of these cells are finger-like projections called stereocilia, which are interconnected by linkages called tip links.

Anemones rely on the hair cells to detect the movements of the anemones' prey, brine shrimp, as they swim by. Hair cells on the lateral lines of fish allow them to orient themselves while swimming in a current. Human hair cells respond to vibrations in inner-ear fluid, sending electrical signals to the brain, which are interpreted as sound, music or language.

What's interesting, said Watson, is what happens in the different species when the hair cells' tip links are damaged.

"Most forms of human deafness come from a death of the hair cells," he explained. Noise-induced hearing loss can be caused by a single event, such as an explosion, or by exposure to loud sounds over an extended period of time. "The hair cell pivots in response to sound, but when it pivots too much, the tip links are ripped apart. As a result, the hair cells die and hearing is lost."

In mammals, including humans, hearing loss is typically painless and permanent. But in some fish and in the anemones, it's a different story. The fish re-grow damaged hair cells and tip links, replacing them in a few days. Starlet sea anemones go to work even faster, making the fix in a matter of hours, using a mix of proteins that bind with calcium to repair the tip links. "Tip links use calcium as a kind of glue, giving the tip link its structure," Watson explained.

Watson and his team have learned that the protein mixture produced by the anemones can be used to heal the damaged hair cells of blind cave fish. The research team is also studying the effects of the protein mixture on zebrafish.

Nesha Calais, a doctoral student pursuing a degree in environmental and evolutionary biology, carried out the experiments.

She placed healthy fish in a tank containing calcium-depleted water for 15 seconds; that's long enough for their tip links to be broken. The fish became disoriented, their movements chaotic. Calais then placed them in water that contained anemone hair-cell proteins. "They were perfectly fine. It's as if they were never damaged," she said.

Watson finds that result amazing. "Proteins from a primitive, invertebrate animal can not only repair anemone hair cells, they can repair vertebrate hair cells as well."

He suspects the starlet sea anemone proteins might have an effect on some types of human deafness. The two species share a number of common genes, including a gene anemones use to produce cadherin 23, a calcium-dependent protein, which forms tip links. Mutations in the cadherin 23 gene cause deafness in both mice and humans.

The next logical research subjects would be mice, whose genetic code has also been unlocked, Watson said.

He remains hopeful that one day his work might lead to a cure for deafness and other disorders, such as impaired balance.

"If you can make new hair cells, as fish do, or if you can keep the hair cells you have from dying, then you can cure deafness."