USF biologists investigate gene-thieving sea slugs

TAMPA, Fla. (December 1, 2003) - How did the sea slug steal genetic material from algae? This is a question clue-sniffing University of South Florida biologists are keen on answering, but they can't indict the usual suspect for gene transfer - sexual reproduction. Sacoglossan sea slugs (Elysia crispata) don't mate with algae, a type of sea weed containing chlorophyll. To the contrary, sea slugs eat algae. So, how is it these sea slugs possess algae genes in their DNA? Is it highway robbery?

"In a sense,' says Skip Pierce, chair of USF's Biology department and one of the detectives who, along with his post-doc Steve Massey and biology graduate student, Nick Curtis, seek answers. 'What we are seeing is a case of horizontal gene transfer between two different species, a natural movement of DNA that does not depend on reproduction for the transfer.'

What interests the USF bio-detectives is that when more details are learned about horizontal gene transfer the knowledge may be applicable to gene therapy techniques that promise to change medicine and healthcare in the near future.

Here's how the slug's gene caper works:

"Sea slugs eat algae. The cells that line the digestive tract take up and save up the chloroplasts - chlorophyll-containing organelles in the algae,' explains Pierce. 'The captured chloroplasts can still photosynthesize - that is, like all plants, derive energy from sunlight - for up to four months.'

According to Pierce, if you shine light on the slugs, they produce oxygen and take up carbon dioxide, just like a plant. Even more surprising than the continued function, Pierce and his students have found that the stolen chloroplasts continue to synthesize proteins while they reside in the slug cells.

Using a number of gene tracking devices, including polymerase chain reaction (PCR), Pierce's students have discovered the presence of an algae gene in the sea slug genome that provides the codes for one of the chloroplast proteins. Is it a case of natural slight-of-hand or genetic theft? Both, perhaps. Trouble is, now that they have found that the gene stealing is a fact, they need to figure out how it happened.

"Transfer of genes between multicellular organisms has never been demonstrated before,' says Pierce.' So this species of sea slug and its own brand of genetic thievery becomes a very useful model to understand horizontal gene transfer.'

One possible accomplice is a retrovirus, one of the mechanisms that gene therapy pioneers are investigating for human-directed gene therapy that will scientifically slip genes into cells.

"Every specimen of E. chlorotica we have examined in the last ten years has contained retroviruses,' notes Pierce. 'The retrovirus is present in several types of cells, including the digestive cells and also in the chloroplasts. We are investigating the role the viruses may have in synchronizing the life cycle of the slug population as well as providing the means by which genes have moved from the nucleus of the algal cell into the slug DNA.'

Based on this research, Pierce and colleagues published a study in the Biology Bulletin (204:237-240, June 2003). Their work is funded by a grant from the National Science Foundation.

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