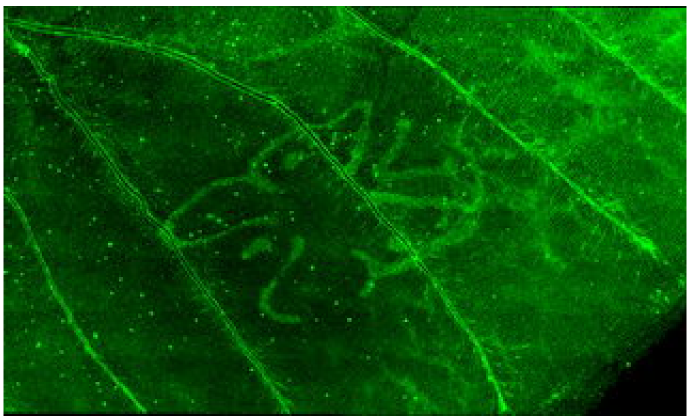
Lasers Let Scientists Test Gene Function in Butterfly Wings

November 20 2006



Green fluorescent protein is produced in precise patterns on the butterfly wing by laser activation of the correspondent gene through a cut-out stencil. Credit: University at Buffalo

The University at Buffalo team that developed the world's first transgenic butterfly now has developed an innovative tool that will allow scientists studying "non-model" organisms to test directly the function of certain genes, even in the absence of genome sequencing information.

The researchers demonstrated their method by stenciling the silhouette of a butterfly right on the surface of a butterfly's wing, an affect that they achieved by using lasers to turn on fluorescent marker genes in this very precise pattern (see photo). The butterflies were otherwise unaffected.

The paper describing this research was published in BMC *Developmental Biology*, an open-access journal; a copy of the paper is available at www.biomedcentral.com/1471-213X/6/55/abstract .

Biologists studying "model" organisms, like the fruit fly or the mouse, have at their disposal highly sophisticated and efficient tools that allow them to explore functional genetics in these animals.

But researchers seeking to discover how genes work in other organisms have had a limited set of tools with which to test gene function. Most of these tools are very difficult to localize to particular areas of the developing animal, especially since the regulatory code of such organisms still is poorly understood.

"With this research, we have developed a tool to test gene function in an animal where these kinds of tools were not available before," said Diane Ramos, a doctoral candidate in the UB Department of Biological Sciences in the College of Arts and Sciences and co-first author on the paper with Firdous Kamal, who earned his master's degree from the Department of Electrical Engineering in the UB School of Engineering and Applied Sciences.

"We hope to inspire other researchers working in non-model organisms to use these kinds of techniques to answer fundamental questions about what genes do, which will allow interesting comparisons between species."

According to Antonia Monteiro, former UB assistant professor of biological sciences and leader of the UB research team, the method involves introducing a heat-sensitive piece of regulatory DNA into the genome of butterflies along with the genes that they wanted to activate at precise positions and times during wing development.

"As the laser heats up specific cells on the butterfly wing, genes that sit next to this regulatory sequence get turned on, allowing for specific clusters of cells on the wing to fluoresce," said Monteiro, assistant professor of ecology and evolutionary biology at Yale University.

The UB/Yale researchers now are using this tool to connect the heat switch to the genes that have been implicated in controlling the intricate patterns on butterfly wings.

"We want to be able to turn on or shut down specific genes on the developing butterfly wing in order to test their function in coloring the wing," said Monteiro.

She added that the tool also may be useful to scientists working on the color patterns of other insects, fish, birds or plants who could use similar systems to perturb the expression of genes implicated in specific developmental pathways.

"Now they may be able to attempt to use a laser beam to direct gene expression to particular clusters of cells," she said.

The new tool was tested in a transgenic line of Bicyclus anynana butterflies containing the GFP reporter gene -- a common jellyfish marker gene -- attached to a Drosophila heat shock promoter, which produced the same heat-sensitive response in butterflies.

In addition to Ramos, Kamal and Monteiro, co-authors on the paper are Alexander N. Cartwright, Ph.D., UB professor of electrical engineering, and Ernst Wimmer, from Georg-August-University Gottingen in Germany.

Source: University at Buffalo