The Origin of Spots

'Nature' publishes a study co-written by a University of Dayton professor on the evolution of spot pattern development on a fruit fly's wings.

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A University of Dayton biology professor may be on his way to answering the old proverb: Can a leopard change its spots?

University of Dayton professor Thomas Williams and his colleagues at the University of Wisconsin have identified the biological source of spot pattern development on a fruit fly's wings, which may help explain the developmental and evolutionary processes that have contributed to the remarkable variety of color patterns in other animals, such as butterflies, or even leopards.

Nature published the research findings online April 7 in an article titled "Generation of a novel wing colour pattern by the Wingless morphogen." The article will appear in print in a later issue of Nature.

The research team found that a protein signal used in wing formation has evolved in one fruit fly species to take on an additional role of creating a new wing pigmentation pattern.

"We want to know how an old set of genetic information that instructs the building of the fruit fly wings is utilized in a new way to regulate a new trait — in this case, pigmentation," Williams said. "Now the hunt is on to find the genetic changes that caused this new wingless morphogen function."

Williams said this field of study — how so-called "genetic switches" can act differently to turn genes "on" and "off" — has applications in human health.

"Much of the variation in health among humans seems to be due to genetic differences that reside outside the protein-encoding portions of the genes themselves," he said. "These so-called 'non-coding DNA sequences' are where genetic switches are found. So we're now grappling with how genetic differences in these switches affect the use of our genes and hence our overall health."

In the 1980s, as scientists began uncovering the inventory of genes possessed by diverse animals, they found radically different organisms have a very similar set of genes, suggesting that much of the earth's biological diversity comes not from the genes themselves but on how those genes are used, Williams said. Since then, developmental biologists have focused their attention on understanding how this similar set of genes, including those for morphogens, is used differently.

A morphogen is a protein substance, much like a hormone, that is secreted by cells in embryo development sending a signal to nearby cells to produce specific responses. Morphogen messages typically regulate tissue development and relative position such as informing one group of cells to form the top of the arm and another group to form the bottom of the arm. The concentration of the morphogen is also important, as cells farther away from the morphogen respond differently than those nearby.

"What this means is that we need to shift the emphasis from looking for different genes and instead understand how the same genes are used differently, how these genes are being turned on and off," Williams said. "And that's the work I'm doing, trying to track traits and identify the genetic changes that alter existing genetic switches or create new switches."

Williams conducted the research featured in Nature as a postdoctoral fellow at the University of Wisconsin. He co-wrote the article with lead researchers Thomas Werner and Shigeyuki Koshikawa and corresponding author Sean Carroll.

The University of Dayton hired Williams in 2009. As an evolutionary developmental biologist, he is fascinated by development, evolution and human genetics and plans to continue his research on understanding why members of the same species look and behave differently.


"The University of Dayton has an ambitious agenda for recruiting the very best young scholars to expand the scope and the impact of our research in the biosciences," said Paul Benson, dean of the University of Dayton College of Arts and Sciences. "I am delighted to see Dr. Williams' research program advance in his first year at the University of Dayton."

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University. I am equally pleased he was attracted to Dayton not only for the collaborative research environment in our biology department but also because of our core commitment to the education of students at both the undergraduate and graduate levels. Tom Williams is a fine example of the teacher-scholar model the University strives to cultivate across our entire faculty.”

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