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RESEARCH NEWS

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Proteins Harbor A Shocking Tale of Evolution

A team of scientists from the Howard Hughes Medical Institute at the University of Chicago has found that a ubiquitous protein may explain how relatively sudden changes in body shape occur in a species.

Working with fruit flies, HHMI investigator Susan Lindquist and colleague Suzanne L. Rutherford found that under normal circumstances, heat shock protein 90, Hsp90, suppresses genetic signals that can alter body shape. Heat shock proteins are induced by stress, and they confer protection against heat, oxygen shortages and free radical damage. When the level of Hsp90 in cells is reduced by half, which mimics what can happen when animals undergo stress, malformed wings, eyes, legs and antennae develop. Astonishingly, the experiments showed that the deformed flies survived, bred and passed on these variations to subsequent generations that have normal Hsp90 function.

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> **— Susan Lindquist**

In the November 26, 1998, issue of the journal *Nature,* Lindquist and Rutherford suggest that Hsp90 enables genes to store instructions for sudden structural change. Such rapid changes may occur when a species' environment changes drastically and a slightly different body shape might provide a better chance of survival.

Initially, the variations observed by Lindquist and Rutherford arose in only 1 to 3 percent of a given population of flies. By selectively breeding the deformed flies, however, the researchers demonstrated that in just a few generations, 80 to 90 percent of the progeny exhibited the deformity.

Many heat shock proteins double as molecular "chaperones" that escort proteins through the process of folding into their final three-dimensional shape. Hsp90 is one of the most abundant chaperones, but little is known about its function beyond the fact that it interacts with proteins essential for cell proliferation and embryonic development.

"Hsp90 seems to help a lot of these proteins when maintain a stable state," Lindquist said. "It's like a support function. Basically, its job is to take care of other proteins that tell a cell what it is supposed to be doing. These proteins are often unstable because they need to change their shapes in response to the various signals that regulate growth and development."

Lindquist and Rutherford found that when they increased the temperature of developing fly embryos, many more deformed flies were born. Moreover, a similar range of deformities was observed when the flies were fed a chemical that blocks Hsp90 function.

Lindquist and Rutherford believe their experiments suggest that environmental stress may uncover pre-existing genetic variation that provides a means for animals to quickly adapt to shifts in environment. If so, Hsp90 would be the first such molecular mechanism that underlies drastic morphological change rather than the small, progressive change that is known to occur in evolution.

This flood of morphological change may help explain the great flurry of diversity unleashed on Earth about 570 million years ago during the Cambrian period. According to the fossil record, dozens of new animals in astounding shapes and sizes first appeared during the Cambrian period.

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