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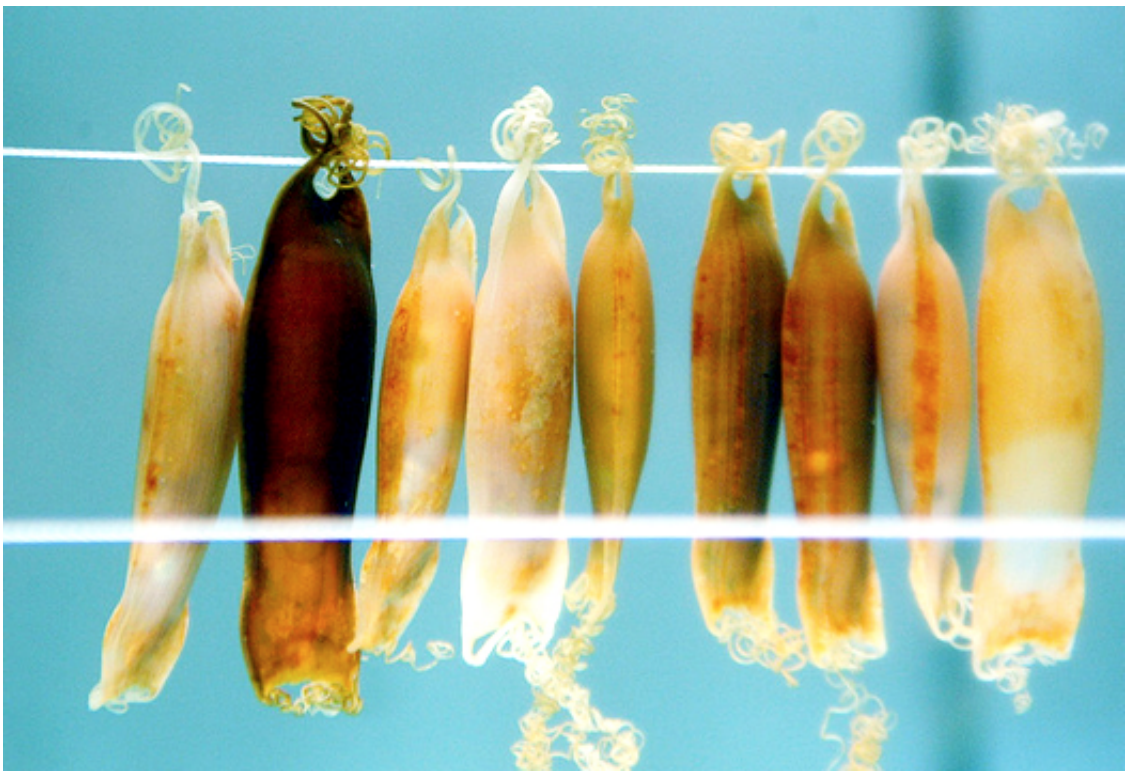
Science & Technology - *Posted by Layne Cameron-Michigan State on Friday, August 10, 2012 15:00 - 1 Comment* (No Ratings Yet)

'Unnecessary' steps help smooth evolution



"In a developing embryo, each new structure is built in a delicate environment that consists of everything that has already developed," says Jeff Clune. "Even if a structure is not actually used, it may set the stage for other functional tissues to grow properly." (Credit: "shark eggs" by Barcelona/Flickr)

MICHIGAN STATE (US) — After millions of years of evolution, why do organisms still build structures and go through developmental stages that seemingly serve no purpose?

"Many animals build tissues and structures they don't appear to use, and then they disappear," says Jeff Clune, lead author and former doctoral student at the BEACON Center of Evolution in Action at Michigan State University. "It's comparable to building a roller coaster, razing it, and building a skyscraper on the same ground. Why not just skip ahead to building the skyscraper?"

Why humans and other organisms retain seemingly unnecessary stages in their development has been debated between biologists since 1866. A new study, published in the *American Naturalist*, explains that organisms jump through these extra hoops to avoid disrupting a developmental process that works.

Straight from the Source

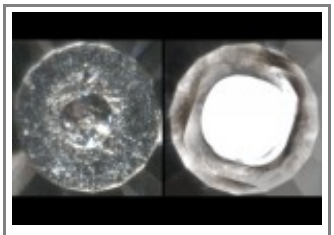
Read the original study

DOI: 10.5061/dryad.9k6k0

Clune's team called this concept the "developmental disruption force." But Clune says it also could be described as "if the shoe fits, don't change a thing."

"In a developing embryo, each new structure is built in a delicate environment that consists of everything that has already developed," explains Clune, who is now a postdoctoral fellow at Cornell University.

"Mutations that alter that environment, such as by eliminating a structure, can thus disrupt later stages of development. Even if a structure is not actually used, it may



set the stage for other functional tissues to grow properly."

Going back to the roller coaster metaphor, even though the roller coaster gets torn down, the organism needs the parts from that teardown to build the skyscraper, he adds.

"An engineer would simply skip the roller coaster step, but evolution is more of a tinkerer and less of an engineer," Clune says. "It uses whatever parts that are lying around, even if the process that generates those parts is inefficient."

An interesting consequence is that newly evolved traits tend to get added at the end of development, because there is less risk of disrupting anything important. That, in turn, means that there is a similarity between the order things evolve and the order they develop.

A new technology called computational evolution allowed the team to conduct experiments that would be impossible to reproduce in nature.

Rather than observe embryos grow, the team of computer scientists and biologists used BEACON's Avida software to perform experiments with evolution inside a computer. The Avidians—self-replicating computer programs—mutate, compete for resources, and evolve, mimicking natural selection in real-life organisms.

Using this software, Clune's team observed as Avidians evolved to perform logic tasks. They recorded the order that those tasks evolved in a variety of lineages, and then looked at the order those tasks developed in the final, evolved organism.

They were able to help settle an age-old debate that developmental order does resemble evolutionary order, at least in this computationally evolving system. Because in a computer thousands of generations can happen overnight, the team was able to repeat this experiment many times to document that this similarity repeatedly occurs.

Additional Michigan State researchers contributing to the study included BEACON colleagues Richard Lenski, Robert Pennock, and Charles Ofria. The research was

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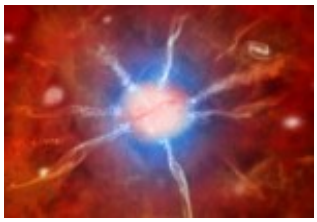

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funded by the National Science Foundation.

More news from Michigan State University: http://news.msu.edu/

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Tags: computer science, Cornell University, embryo, evolution, Michigan State University

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Onanymous
Aug 11, 2012 23:56

This is one of the most important clues to understanding how evolution works. Stephen Jay Gould wrote a lot about it – very accessible to the layman, for anyone who's interested.

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