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Academic Minute

5:00 AM FRI OCTOBER 12, 2012

## Dr. Jeff Clune, Cornell University – Evolution and Embryology

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By BRADLEY CORNELIUS

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In today's Academic Minute, Dr. Jeff Clune of Cornell University reveals why the biology of life often takes a winding path through seemingly unnecessary developmental stages.

Jeff Clune is a visiting scientist in the Creative Machines Lab at Cornell University where he studies evolutionary computation, a technology that uses natural selection to bypass engineering and evolve artificial intelligence, robots, and physical designs. His work has been featured in a number of publications and he holds a Ph.D. from Michigan State University.

About Dr. Clune

### Dr. Jeff Clune – Evolution and Embryology

Something very strange happens as animals develop from single-celled embryos into fully formed adults. Many animal embryos, including our own, build tissue structures that they never use, and that later disappear. Scientists since Darwin have been puzzled by this phenomenon, wondering why these wasteful, unnecessary developmental steps are not removed by natural selection. It's comparable to a construction crew building a roller coaster, razing it, and building a skyscraper on the same ground. Why not just skip ahead and build the skyscraper?

A new technology allowed my colleagues and I to investigate this question. We recreate evolution inside a computer by making virtual worlds in which digital organisms compete with each other to have as many offspring as possible. Just like real organisms, the offspring sometimes have random mutations in their genomes that make them different from their parents. Usually such mutations hurt the offspring, but every once in a while they create an organism that is more fit, furthering the evolution of the species.

In a computer, evolution can happen extremely fast, so we get to watch populations evolve before our eyes. We discovered that seemingly unnecessary developmental steps are left in place to avoid disrupting a process that works. Evolution is essentially saying that if the shoe fits well enough, don't change a thing.

In retrospect, this makes a lot of sense. Each new embryonic structure is built in a delicate environment that consists of everything that has already developed. Mutations that alter that environment, such as by eliminating an unused structure, can disrupt later stages of development. An engineer would simply skip the unnecessary step, but evolution does not start over from scratch. It instead makes small adjustments to existing processes, and keeps whatever works.

This exciting new technology helped us settle an age-old question, and we learned that many structures that seem unnecessary make an important contribution after all.

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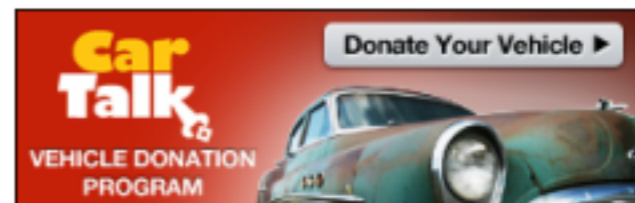
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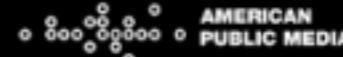
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