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Perfection is a myth, show 50,000 bacterial generations

Updated 17:13 15 November 2013 by **Bob Holmes**
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When it comes to evolution, there is no such thing as perfection. Even in the simple, unchanging environment of a laboratory flask, bacteria never stop making small tweaks to improve their fitness.

That's the conclusion of the longest-running evolutionary experiment carried out in a lab.

In 1988, Richard Lenski of Michigan State University in East Lansing began growing 12 cultures of the same strain of *Escherichia coli* bacteria. The bacteria have been growing ever since, in isolation, on a simple nutrient medium – a total of more than 50,000 *E. coli* generations to date.

Every 500 generations, Lenski freezes a sample of each culture, creating an artificial "fossil record". This allows him to resurrect the past and measure evolutionary progress by comparing how well bacteria compete against each other at different points in the evolutionary process.

No upper limit

After 10,000 generations, Lenski thought that the bacteria might approach an upper limit in fitness beyond which no further improvement was possible. But the full 50,000 generations of data show that isn't the case. When pitted against each other in an equal race, new generations always grew faster than older ones. In other words, fitness never stopped increasing.

Their results fit a mathematical pattern known as a power law, in which something can increase forever, but at a steadily diminishing rate. "Even if we extrapolate it to 2.5 billion generations, there's no obvious reason to think there's an upper limit," says Lenski.

Lenski's results suggest that evolution never reaches a pinnacle of perfection where progress stops, even in the simplest and most constant environments. "There is always tinkering to do, and you can always improve things a little bit," says Joachim Krug, a physicist at the University of Cologne in Germany who studies evolutionary theory.

Ever-decreasing returns

That undermines one of the favourite metaphors of evolutionary biology, which sees species evolving towards peaks of fitness in a landscape of possibilities. In the real world, species live in ever-changing environments. "What this result says is that there are even more ways of adapting to environments than we imagined," says John Thompson, an evolutionary biologist at the University of California at Santa Cruz.

No one knows whether Lenski's results are likely to hold for other species, because no one else has anything close to 50,000 generations of data. However, Krug suspects that a similar pattern would be likely.

Indeed, Lenski and his colleagues also show that fitness should be expected to follow a power-law pattern, given the assumption that as overall fitness increases, each further mutation has a smaller effect on average.

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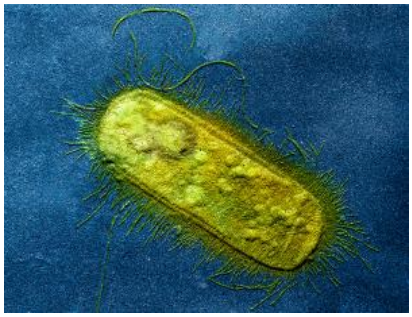

Not perfect *(Image: Biophoto Associates/SPL)*

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Correction: *When this article was first published on 15 November 2013, the title incorrectly referred to yeast. This has now been corrected.*

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would it still be that way if we had never gone global? We rewind time, erase our ancestors, and hit play

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