

Scientists reveal driving force behind evolution

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Scientists at the University of Liverpool have provided the first experimental evidence that shows that evolution is driven most powerfully by interactions between species, rather than adaptation to the environment.

The team observed viruses as they evolved over hundreds of generations to infect bacteria. They found that when the bacteria could evolve defences, the viruses evolved at a quicker rate and generated greater diversity, compared to situations where the bacteria were unable to adapt to the viral infection.

The study shows, for the first time, that the American [evolutionary biologist](#) Leigh Van Valen was correct in his 'Red Queen Hypothesis'. The theory, first put forward in the 1970s, was named after a passage in Lewis Carroll's *Through the Looking Glass* in which the Red Queen tells Alice, 'It takes all the running you can do to keep in the same place'. This suggested that species were in a constant race for survival and have to continue to evolve new ways of defending themselves throughout time.

Dr Steve Paterson, from the University's School of Biosciences, explains: "Historically, it was assumed that most [evolution](#) was driven by a need to adapt to the environment or habitat. The Red Queen Hypothesis challenged this by pointing out that actually most [natural selection](#) will arise from co-evolutionary interactions with other species, not from interactions with the environment.

"This suggested that [evolutionary change](#) was created by 'tit-for-tat' adaptations by species in constant combat. This theory is widely accepted in the science community, but this is the first time we have been able to show evidence of it in an experiment with living things."

Dr Michael Brockhurst said: "We used fast-evolving viruses so that we could observe hundreds of generations of evolution. We found that for every viral strategy of attack, the bacteria would adapt to defend itself, which triggered an endless cycle of co-evolutionary change. We compared this with evolution against a fixed target, by disabling the bacteria's ability to adapt to the virus.

"These experiments showed us that co-evolutionary interactions between species result in more genetically diverse populations, compared to instances where the host was not able to adapt to the parasite. The virus was also able to evolve twice as quickly when the [bacteria](#) were allowed to evolve alongside it."

The team used high-throughput DNA sequencing technology at the Centre for Genomic Research to sequence thousands of virus genomes. The next stage of the research is to understand how co-evolution differs when interacting species help, rather than harm, one another.

The research is published in journal *Nature*.

Provided by University of Liverpool

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