Delegating the dirty work is a key to evolution

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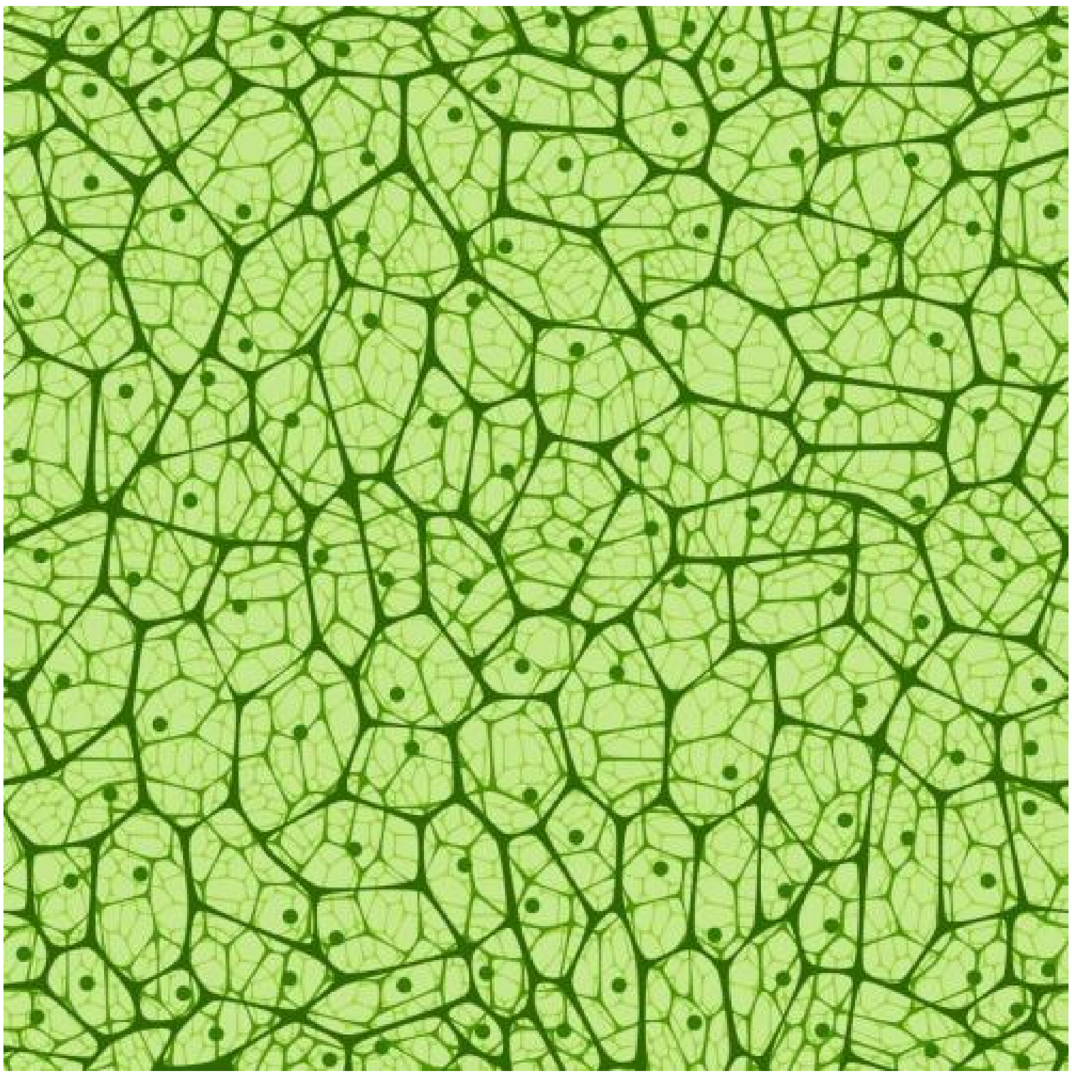

MSU research shows that having special cells doing the dirty work help organisms evolve. Credit: MSU

We have hundreds of types of cells in our bodies – everything from red blood cells to hair follicles to neurons. But why can't most of them create offspring for us?

New research at Michigan State University suggests that separating germ cells – sperm and eggs –from somatic cells – all other cells – preserves the genetic building blocks while allowing organisms to flourish in a somewhat hazardous environment.

The results, which appear in the current issue of *PLOS Biology*, show that having somatic cells do the organism's dirty work helps explain this beneficial evolution.

"The idea we're exploring is that multicellular organisms set aside germ cells to protect their genetic material, letting other cells – the soma – do the dirty work that damages DNA, their genetic building blocks," said Heather Goldsby, who conducted the research at MSU's BEACON Center for the Study of Evolution in Action.

While this study was focused on cells in multicellular organisms, some of the same themes apply to other natural systems. Beehives provide one potential example. The queen would be the germ cell, carrying out the sole task of maintaining the hive's population; and the worker bees would be the somatic cells, fulfilling all of the other necessary duties needed to ensure the hive's health.

Rather than use bees or living organisms for their experiments, the researchers used Avida, a software environment developed at MSU in which self-replicating computer programs compete and evolve.

"The digital organisms in Avida evolve complex traits and behaviors in a natural and open-ended fashion," said Charles Ofria, director of the MSU Digital Evolution laboratory. "Avida is a powerful platform for exploring big evolutionary questions, much faster and more transparently than could ever be done with natural organisms."

This splitting of cellular duties is a hallmark of major transitions in evolution. The team's virtual organisms started with a set of identical cells that initially took no risks, and consequently, reaped no rewards. The organisms slowly evolved to perform some of the highly lucrative dirty work, risking their genomes to do so.

They only truly thrived, however, once they evolved somatic cells that bore the brunt of the dirty work, along side germ cells that transmitted a "clean" genome to the next generation.

Interestingly, the somatic cells performed even more complex functions once they were freed from the burdens of reproduction, which led to higher fitness for the organism as a whole, Ofria added.

As a consequence of doing more dirty work, the soma gets bombarded with mutations. This explains in part why organisms age.

"One theory as to why we age is that our cells become mutated or damaged due to stress," said Goldsby, now at the University of Washington. "This played out during our experiments. The older organisms accumulated harmful mutations and began to perform tasks slower, or to age, while the younger ones outperformed them."

Provided by Michigan State University

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