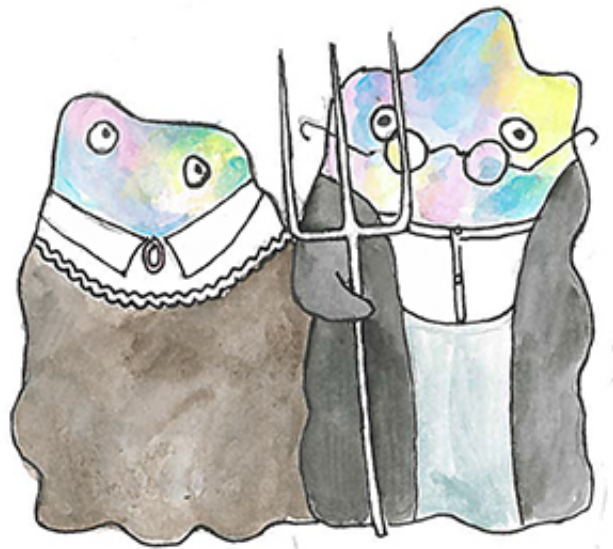


Bacterial infection makes farmers out of amoebae

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In a twist on an already surprising symbiosis, scientists at Washington University in St. Louis have discovered that infection with an inedible bacteria transforms social amoebae from nonfarmers into primitive farmers who carry with them edible bacteria. Credit: E. Magdalena L.

In 2011 the Queller-Strassmann lab, then at Rice University, made a startling announcement in *Nature Letters*. They had been collecting single-celled amoebae of the species *Dictyostelium discoideum* from the soil in Virginia and Minnesota.

While the laboratory strain of Dicty grazes contentedly on bacteria provided for it by its keepers, roughly a third of the wild strains turned out to be primitive farmers. When food was short, they gathered up bacteria, carried them to new sites and seeded the soil with them.

News of the discovery of the "world's smallest farmer" went viral.

At the time most people assumed that the [amoebae](#) were somehow in charge in this relationship. They were, after all, bigger, their spores sometimes contained bacteria, and they ate the bacteria.

Perhaps the farming amoebae had different genes than the non-farming amoebae.

The lab has since moved to Washington University in St. Louis, where David Queller, PhD, is the Spencer T. Olin Professor in Arts & Sciences, and Joan Strassmann, PhD, is the Charles Rebstock Professor of Biology, also in Arts & Sciences.

Now in the August 24 issue of *Proceedings of the National Academy of Sciences*, joined by postdoctoral research associate Susanne DiSalvo, PhD, they reveal that things are a bit more complicated than first thought.

Bacteria, not amoebae, may be in charge; but not the bacteria the amoebae are farming. There is a third member of this symbiotic relationship.

Surveying the bacteria found in association with their stable farmer clones, they found both both edible and inedible bacterial species, but the assemblage always included bacteria of the *Burkholderia* genus. This was intriguing because amoeba raised on a lawn of *Burkholderia* die; this is not a genus of bacteria they find edible.

Investigating further, the scientists soon learned that when they infected nonfarmer amoebae with *Burkholderia*, the bacteria were transformed into farmers. Once infected, they began to pick up and carry bacterial passengers, such as the food bacteria *Klebsiella pneumoniae*.

And if farmer strains of amoebae were treated with antibiotics that killed the *Burkholderia* bacteria, they reverted to the non-farming type and no longer picked up or carried [food bacteria](#).

The scientists concluded that *Burkholderia* have both pathogenic and beneficial properties; pathogenic ones that facilitate infection and beneficial ones that promote the maintenance of a relationship once established.

Symbiosis apparently benefits all three partners. Dicty that carry edible bacteria are better able to survive starving times; and bacteria that hitchhike on Dicty are dispersed more widely. Dicty sometimes eat the edible [bacteria](#), but the *Burkholderia* sometimes eat the Dicty.

"Now we know that *Burkholderia* are the drivers," said DiSalvo, "likely to benefit by exploiting new terrain and sometimes harming their vehicle in the process."

More information: *Burkholderia* bacteria infectiously induce the proto-farming symbiosis of *Dictyostelium* amoebae and food bacteria, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1511878112

Provided by Washington University in St. Louis

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