

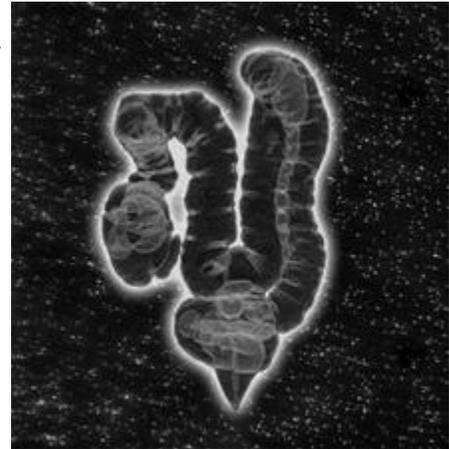
# DISCOVER

Science, Technology, and The Future

## [My Excrement, Myself: The Unique Genetics of a Person's Gut Viruses](#)

Identical twins don't share everything. The mix of viruses in a person's gut, a new [study](#) says, is unique to each of us, even if we share nearly all our DNA with another person. That is, at least according to our poop.

This year scientists have been working to [decode the genetics](#) of the beneficial microbes that live inside us, like the bacteria that help us digest food. But those trillions of bacteria have partners of their own—beneficial viruses. Jeffrey Gordon and colleagues wanted to see what those viruses were like, and how they differed from person to person. To do it, they studied fecal samples that came from four sets of identical twins, as well as their mothers.



Each identical twin had virus populations that didn't resemble those of their sibling—or anybody else, for that matter.

Remarkably, more than 80 percent of the viruses in the stool samples had not been previously discovered. “The novelty of the viruses was immediately apparent,” Gordon said. The intestinal viromes of identical twins were about as different as the viromes of unrelated individuals [[MSNBC](#)].

In addition, those viruses appeared to be stable over time, as opposed to the ever-shifted bacterial populations in people. And the virus-bacterium relationship in our gut, the study suggests, is different than in many other places. Viruses that infect [bacteria](#) and take advantage of them to replicate are called bacteriophages, and the two often enter an evolutionary arms race of new attacks and defenses.

Not inside us, though.

When the researchers probed deeper, they found that many of the bacteriophages carried bacterial genes that help microbes survive the anaerobic conditions in the colon. “You could see that these viruses were porting around genes that could benefit their host bacteria,” Gordon says. If the viruses transfer those genes to other bacteria that don't normally carry them, that could help genetically disadvantaged bacteria evolve to live better in the colon [[Science News](#)].

If our gut [viruses](#) are truly unique, then the question for future research becomes: Why? And how does one's unique viral population become established?

Gordon's study also shakes up our picture of who's the boss. We've talked before about humans' [reliance on our resident bacteria](#), without which we could not survive. But if bacteria are reliant upon viruses to shake up their genetics and help them survive the harsh environment of human intestines, are not viruses the true lords of our guts? Says microbiologist David Relman:

"It could be that viruses are the real drivers of the system because of their ability to modify the bacteria that then modify the human host," he says. "So this study is in some ways looking into the genesis of the human body by seeing what viruses within it are up to" [[Nature](#)].

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*Image: Gordon et. al.*

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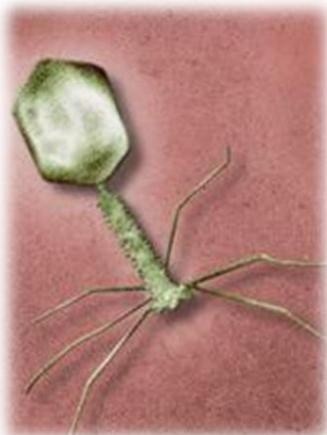
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News

## The gut's 'friendly' viruses revealed

DNA sequencing reveals a new world of bacterial viruses in our intestines.

Amy Maxmen



In the gut, viruses that normally prey on bacteria seem to live in harmony them.

DR. HAROLD FISHER, VISUALS UNLIMITED /SCIENCE PHOTO LIBRARY

In the latest exploration into the universe of organisms inhabiting our bodies, microbiologists have discovered new viral genes in faeces. They find that the composition of virus populations inhabiting the tail ends of healthy intestines (as represented in our stools) is unique to each individual and stable over time. Even identical twins — who share many of the same intestinal bacteria — differed in their gut's viral make-up.

More than 80% of the viral genetic sequences found, which included sequences characteristic of both animal and bacterial viruses, have never been reported previously. "This is a largely unexplored world," says Jeffrey Gordon at Washington University in St Louis, Missouri, and an author on the paper, which is published in *Nature* today<sup>1</sup>. "We are truly distinct lifeforms — sums of microbial and human parts."

More than 10 trillion bacteria normally inhabit the gastrointestinal tract, where they synthesize essential amino acids and vitamins, produce anti-inflammatory factors and help break down starches, sugars and proteins that people could not otherwise digest. Within and among these bacteria live bacterial viruses, or bacteriophages, which affect bacterial numbers and behaviour as they either prey on bacteria or co-exist with them, shuttling genes from one bacterium to another.

This microscopic dynamic ecosystem affects our lives in ways we still do not fully understand. Indeed, the rise in the incidence of food allergies in Western societies has led to hypotheses that extreme hygiene disrupts the ability of microbes to colonize human guts, resulting in a lack of tolerance to usually harmless foods.

"This study is looking into the genesis of the human body by seeing what viruses within it are up to."

To explore this provocative hypothesis, researchers must first understand the complete composition of the microbial ecosystem of the healthy body. To this end, Gordon's group and others are beginning to catalogue the human 'microbiome', all the microorganisms living in the human body, using advanced DNA sequencing technologies. Until now, however, such attention has primarily focused on the bacteria rather than viruses.

"This is a wonderful study," says David Relman, a microbiologist at Stanford University in California, who is involved with the US National Institute of Health's Human Microbiome Project. "It could be that viruses are the real drivers of the system because of their ability to modify the bacteria that then modify the human host," he says. "So this study is in some ways looking into the genesis of the human body by seeing what viruses within it are up to."

## **Microbial truce**

According to the new study, bacterial viruses in the terminal gut or colon seem to exist in a more stable state than do similar communities in the environment, such as in the oceans. Faeces from each individual — four pairs of identical twins and their mothers — carried a distinct viral community that varied by less than 5% over the course of a year. The bacterial viruses also

appeared to mainly be lying low as 'prophages' rather than multiplying and killing the bacteria they infect.

"In oceans, the modality of viruses has tended to be predatory," comments Edward DeLong at the Massachusetts Institute of Technology in Cambridge. "Now the interesting thing here is that the system in the faecal microbiota seems to be driven by prophages, which tend to basically integrate their genetic material into the host genome and hide there — it's a much more stable situation."

"This kind of stability implies that there is a symbiosis between bacteria and viruses," comments Martin Blaser at New York University Medical Center. "This is different from a predator-prey, or an arms race, situation. This is a picture of a more settled existence, in which the different populations are working together."

The team found genes encoding proteins never detected before in bacterial viruses. When in bacteria, these proteins are part of pathways responsible for carbohydrate metabolism and amino-acid synthesis. Viruses carrying such genes might alter them and insert them into gut bacteria, potentially changing a person's metabolism.

Because human nutrition partly depends on the relationship between bacteria and their viruses, understanding the dynamics of that relationship might yield treatments for obesity, allergies and other maladies. "This human ecosystem is quite important because it determines what we can do and what we can eat," says DeLong. "That's why we should care about this."

## • **References**

1. Reyes, A. *et al.* Nature 466, 334-340 (2010). | [Article](#)