

Published online: 14 October 2004; | doi:10.1038/

Giant virus qualifies as 'living organism'

Mark Peplow

Huge genome allows mimivirus to make its own proteins.

Roll up, roll up, to meet Mimi, the biggest virus in the world. This monster has just had its genome sequenced, and scientists say that, unlike its fellow viruses, it may truly be called 'alive'.

The virus's genetic sequence also holds clues that may explain the evolution of the very first cells possessing a nucleus of DNA.

Since the 1960s, scientists have argued about whether viruses are living organisms or just a bundle of very large molecules. Viruses are usually much smaller and simpler than bacteria, consisting simply of genetic material surrounded by a protein coat. A virus has to hijack another organism's biological machinery to replicate, which it does by inserting its DNA into a host. Bacteria, on the other hand, carry all that they need to reproduce independently, and thus qualify as alive.

Although it shows all the trademark features of a virus, the mimivirus is much more complex, says Jean-Michel Claverie, a biologist from the Institute of Structural Biology and Microbiology in Marseilles, France, who worked on the sequencing effort. If viruses were cars, Mimi would still be a car, he says, but it would be a luxury model with more gadgets. "It makes this DNA virus look like a new kind of parasitic life-form," he says.

Mimi carries about 50 genes that do things never seen before in a virus. It can make about 150 of its own proteins, along with chemical chaperones to help the proteins to fold in the right way. It can even repair its own DNA if it gets damaged, unlike normal viruses.

And although viruses can use either DNA or RNA to carry their genetic information, Mimi has both. "We are seeing an organism here. There is DNA, RNA and plenty of proteins," says Didier Raoult, a lead member of the team from the Mediterranean University in Marseilles, France, who reports the work in this week's *Science*¹.

Monster virus

Mimi was discovered in 1992, nestling inside an amoeba found inside a cooling tower in Bradford, UK, that was being investigated as the source of an influenza outbreak. Later research² showed that it was a real monster, measuring about 800 nanometres across, more than four times as big as a smallpox virus. The new study shows that its genome contains 1.2 million bases, which is more than many bacteria contain and makes it several times bigger than the largest DNA viruses. The bases make up 1,260 genes, which makes it as complex as some bacteria, the scientists say.

What's more, viral DNA often contains lots of 'junk' sequences, genetic material that does not seem to serve any useful function. Mimi, on the other hand, is lean and mean: more than 90% of its DNA does something specific.

As Mimi carries some genes involved with replication, this could have helped it to spread faster than other viruses, explains Anne Bridgen, a virologist from the University of Ulster, Northern Ireland. "I've never heard of viruses encoding something like this," she says.

Officially, the virus got its name because it mimics bacteria, says Raoult. "But my father, also a scientist, taught me a story about Mimi the Amoeba when I was very young, so it's also a tribute to him," he says.

Life lines

Although biologists sometimes divide life into three categories, the team says that Mimi is sufficiently different that it deserves a fourth branch of life all to itself.

Bacteria are the simplest branch, because they lack a nucleus to gather their genetic material together. Archaea are very similar, but are thought to have evolved separately because of their unusual cell membranes. Every other living thing is a eukaryote, that is, an organism that groups its genetic material into a nucleus inside its cells. But Mimi carries seven genes that are common to all cellular life, putting it on a par with the other life-forms, says Raoult.

Bridgen is less sure. "To say that this virus represents a fourth category would be overstating the evidence, but it may hint that the categorization into three domains is oversimplistic," she says.



The complex interior of a mimivirus, at a magnification of 200,000 (and coloured red).

© Didier Raoult, picture by N. Aldrovandi

Some scientists have speculated that eukaryotes originally evolved from collaboration between a virus and a bacterium. Bacteria could have supplied the ribosomes, the protein factories of the cell, and viruses might have injected their genetic material into a proto-nucleus. One weakness of the theory is that viruses generally lack some of the key genes seen in eukaryotes. But Mimi's complex genome includes these, lending support to the idea, says Raoult.

The team are now trying to find more giant viruses like Mimi, and are also busy working out exactly how it uses all its genes.

[▲ Top](#)

References

1. Raoult D., *et al.* *Science*, published online, doi:10.1126/science.1101485 (2004).
2. La Scola B., *et al.* *Science*, **299**. 2033 (2003). | [Article](#) | [ISI](#) |

[▲ Top](#)

Story from news@nature.com:
<http://news.nature.com/news/2004/041011/041011-14.html>



© 2004 Nature Publishing Group | [Privacy policy](#)