There are many ways to build a car: from stretch limousines to tiny economy cars, as long as the vehicle drives and is reasonably safe, no one design is inherently right or wrong.

Comparing different models is useful, says Mark Field of the School of Life Sciences at the University of Dundee, because it quickly makes clear what the essence of a car is. Early cars tended to be very similar to each other. Now cars are more variable, versatile, and complex than ever. Some use petrol, some diesel, some use electricity, others run on hybrid systems. All something need to pass for a car is four wheels, a means to take in energy, and a propulsion system that is geared so it can speed up and slow down.

As a biologist interested in the mechanics of eukaryotic evolution, Field applies the same sort of comparison to living organisms as well. If you look at what's different between one car and another, it can tell you something about its owner or its purpose, he says. And if you look at how organisms have changed over time, you can learn something about the complexity of evolution.

"Say you have a stretch limousine with a minibar, that tells you something about how it is being used," Field says, "This is for a rich person or a party. Now, if you do the same with living organisms, you can gain insight into what are life's true necessary components and what is part of an organisms unique lifecycle."

In an article recently published in Genome Biology Evolution, Field and Koreny (a former postdoc in Field’s laboratory) investigated the origins of one of the basic nuclear components originally believed to be unique to animals—the lamina proteins that give structure to the nucleus and play an important role in regulating developmental genes. These proteins provide structure to the nuclear envelope and organize the chromosomes. (Dysfunctional laminar proteins are associated with rare diseases such as progeria, which causes drastically premature aging.)

For the past three or four decades nearly everything researchers know about lamina proteins has come from animals, mainly mammals. Prevailing thought held that lamina proteins were relatively recent evolutionary inventions—perhaps within 500 Myr—as other eukaryotes did not have these structures. The story, as revealed by Koreny and Field, is more complex.

In previous work, Field’s laboratory has identified a protein in trypanosomes (parasitic protozoa that infect the blood) that apparently did the same job as animal lamins.

“But it’s very clear from the genome that they completely lack the lamin genes,” Field says. Around the same time, other groups were finding lamin analogs in plants, proteins apparently not derived from animal lamins (Ciska and de la Espina 2013).

“We have potentially three systems: an animal system, a plant system, or a trypanosome systems, says Field. “That made us wonder where the lamins actually really came from, was it a new innovation within animals, or was it something that was much more ancient?”

It’s an interesting question, says Koreny, because the answer gives a picture of the family tree of eukaryotes.

“To understand how the nucleus itself evolved is one of the fundamental questions in biology,” he says.

The researcher’s analysis was possible due to relatively newly available sequence data and analysis techniques (BLAST and HMMER iterative homology searches in particular). New tools had become available, new data sets and new sensitive search methods, allowing them to find proteins which would have escaped them before.

They found, to their surprise, a wide, though patchy, distribution of lamin proteins across a range of eukaryotic taxa. The authors conclude that lamins were probably present in the last eukaryotic common ancestor, but they were not retained in all groups. In fact, in some taxa, they didn’t find anything that looked like a laminar protein.

“That’s actually quite hard to explain,” says Koreny. “And we found in some of this taxa very diverse lamin sequences. So it looks like the lamins have the capacity to evolve very quickly—in the same taxonomic branch you can have quite different lamins.”
“What this tells us is that there may well be many more of these systems out there,” says Field. “That different organisms may be using quite different systems. It’s just that the lamin system is quite old and has been retained by many organisms in many different lineages, but it seems to have been replaced quite a bit, so it’s plastic.”

Having three or more lamina flavors to compare allows them to see, he says, what the real crux of the system is. In future research, Field and Koreny say they’d like to see more explorations of the structures and function of lamina and lamina-analog proteins.

**Literature Cited**

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