

New physics law could predict genetic mutations

July 20 2022



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Genetic mutations could be predicted before they occur using a new law of physics, according to a study from the University of Portsmouth.

The paper finds the second law of information dynamics, or "infodynamics," behaves differently to the [second law of](#)

[thermodynamics](#)—a discovery that could have massive implications for future developments in [genome research](#), [evolutionary biology](#), computing, [big data](#), [physics](#), and cosmology.

Lead author Dr. Melvin Vopson is from the University's School of Mathematics and Physics. He says that "in physics, there are laws that govern everything that happens in the universe, for example how objects move, how energy flows, and so on. Everything is based on the laws of physics."

"One of the most powerful laws is the second law of thermodynamics, which establishes that [entropy](#)—a measure of disorder in an isolated system—can only increase or stay the same, but it will never decrease."

This is an undisputed law linked to the arrow of time, which shows that time only goes one way. It flows in a single direction and can't go backwards.

He says "imagine two transparent glass boxes. In the left side you have red gas molecules, which you can see, like red smoke. In the right side, you have blue smoke, and in between them is a barrier. If you remove the barrier, the two gases will start mixing and the color will change. There is no process that this system can undergo to separate by itself blue and red again."

"In other words, you cannot lower the entropy or organize the system to how it was before without energy expense, because the entropy only stays constant or increases over time."

Dr. Vopson is an information physicist. His work explores [information systems](#), which can be anything from the disk in a laptop to the DNA and RNA in living organisms. This paper was written in collaboration with Dr. Serban Lepadatu from the University of Central Lancashire.

Dr. Vopson added that "if the second law of thermodynamics states that entropy needs to stay constant or increase over time, I thought that perhaps information entropy would be the same."

"But what Dr. Lepadatu and I found was the exact opposite—it decreases over time. The second law of information dynamics works exactly in opposition to the second law of thermodynamics."

Dr. Vopson claims this could be what drives genetic mutations in biological organisms.

"The worldwide consensus is that mutations take place at random and then natural selection dictates whether the mutation is good or bad for an organism," he explained. If the mutation is beneficial for an organism, it will be kept.

"But what if there is a hidden process that drives these mutations? Every time we see something we don't understand, we describe it as 'random' or 'chaotic' or 'paranormal,' but it's only our inability to explain it."

"If we can start looking at [genetic mutations](#) from a deterministic point of view, we can exploit this new physics law to predict mutations—or the probability of mutations—before they take place."

Dr. Vopson and colleagues analyzed real COVID-19 (SARS-CoV-2) genomes and found that their information entropy decreased over time:

"The best example of something that undergoes a number of [mutations](#) in a short space of time is a virus. The pandemic has given us the ideal test sample as SARS-CoV-2 mutated into so many variants and the data available is unbelievable."

"The COVID data confirms the second law of infodynamics and the research opens up unlimited possibilities. Imagine looking at a particular

genome and judging whether a mutation is beneficial before it happens. This could be game-changing technology which could be used in genetic therapies, the [pharmaceutical industry](#), evolutionary biology, and pandemic research."

The paper is published in *AIP Advances*.

More information: Melvin M. Vopson et al, Second law of information dynamics, *AIP Advances* (2022). [DOI: 10.1063/5.0100358](https://doi.org/10.1063/5.0100358)

Provided by University of Portsmouth

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