

Can Viruses be *Identified* as Zoetic (Living) Beings?

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Despite the fact that viruses are the most abundant beings around humans, scientists have still struggled to answer the question of whether viruses can be classified as being alive (zoetic) or not. Both sides have argued compelling points for decades, but there still is not a clear answer to the question. However, based on analysis of modern research on viruses and the book *A Planet of Viruses* by Carl Zimmer, the idea that viruses follow non-zoetic patterns has ample evidence to back it up, compared to its opposing views. The multifarious amount of evidence behind this idea will be scrutinized in this report, as will its refuting views/evidence.

The official Merriam-Webster Dictionary refers to a virus as “an infective agent that is regarded either as extremely simple microorganism or as extremely complex molecule, that typically contains a protein coat surrounding an RNA or DNA core of genetic material but no semipermeable membrane, that is capable of growth and multiplication only in living cells”. There are approximately 10^{31} viruses (Weitz and Wilhelm) on Earth, which is about 100 million times more in quantity than stars in the universe. Despite the fact that there are a multitudinous amount of viruses on Earth, there is still much more characteristics and patterns of viruses that puzzle scientists. The main dispute among virologists is the controversy behind whether viruses are alive or not. Supporters of zoetic viruses normally argue that Mimi viruses (large viruses) have genomes that are the size of normal organisms, or that viruses’ protein coats and internal RNA folds similarly to living cells (scientists deduced this through examining and tracing evolutionary trees). However, there are strong refutation points against the idea that

viruses are alive. These refuting virologists argue that most viruses lack many of the properties that scientists associate with living organisms. Primarily, they lack the ability to reproduce/grow without the aid of a host cell, don't use the typical cell-division approach to replication, and don't contain many essential enzymes that are found in most living organisms. Due to the plethora of evidence that refutes the zoetic capabilities of viruses, it can be deduced that this view of viruses is more scientifically accurate than the opposing view.

The idea that viruses are identified as non-zoetic beings is scientifically accurate, based on the plethora of evidence that backs it up (based on modern research and *A Planet of Viruses*). The primary and biggest piece of evidence regards the fact that viruses lack certain properties that assist with reproduction (reproduction is one of the essential components that distinguishes life). Viruses have to invade other living cells in order to reproduce, which is not the same as internal reproduction (internal reproduction is a big characteristic that classifies living organisms). Specifically, the viruses do not have cells, which means that they cannot even undergo cellular replication. Because viruses do not have cells (or cellular replication), they cannot grow in size (another characteristic of living organisms). According to modern research (*A Planet of Viruses*), scientists “could find no instructions in a virus for making a ribosome, for example, the molecular factory that turns RNA into proteins” (Zimmer). Ribosomes and internal proteins (made by ribosomes) are found in nearly all living organisms, including bacteria. Viruses simply have an outer coat of protein, but no means of producing proteins internally. In addition to this compelling evidence, viruses have no means of maintaining homeostasis, which is the last characteristic of distinguishing living organisms. Viruses

simply have “an outer protein coat and RNA” within in (Zimmer). They lack enzymes that can help maintain homeostasis, such as phosphohexose isomerase, lactic dehydrogenase, biosynthetic enzymes, etc. (as long as there is a specific amount of enzymes that maintain homeostasis, it can be confidently stated as a living organism). It can clearly be deduced that “viruses appear to lack much of the genetic information and components required to be truly alive” (Zimmer). The lack of this essential information and components cannot allow viruses to reproduce internally (without aid), grow at a specific rate, and maintain homeostasis through specific enzymes, which are all integral characteristics that distinguish a living organism.

While there is compelling evidence against zoetic viruses, there are also some counter arguments (that believe in zoetic viruses). Some scientists believe that the Mimi virus is a big piece of evidence for zoetic viruses. Mimi viruses are the biggest types of viruses (that underwent many mutations), which still follow similar patterns of regular viruses. However, Mimi viruses have replication enzymes and ribosomes, which is not normally found in viruses. Scientists argue that since Mimi viruses have these components (found in living organisms) that distinguish viruses as living beings. Also, scientists believe that the folding pattern of the outer protein coat (surrounding a virus) is similar to internal protein folding of living organisms (found 446 similar folding patterns between viruses and living cells, out of 5080). However, when analyzed closely, these evidence points may not represent zoetic viruses in an accurate standpoint. While Mimi viruses have similar components to living organisms, they may have had to undergo many mutations to reach their big size (by deriving cellular DNA into their genome when taking over a host cell) . They could have originally been small viruses, that grew in size

after taking over many host cells. Hence, it doesn't accurately represent a zoetic view of viruses. Also, even though scientists have "identified 442 protein folds that are shared between cells and viruses" (Yates), it still does not distinguish viruses as zoetic beings, as protein folding is not a distinguishing characteristic of life. Hence, the evidence/argument behind zoetic viruses may not be as scientifically accurate as its counter-argument, because viruses still "appear to lack much of the genetic information and components required to be truly alive" (Zimmer).

As more complex and deadly viruses are arising in the general population, scientists are continually trying to analyze and identify uniform trends among viruses (so that certain viruses can be eradicated if necessary). Laurie Garrett, a Pulitzer prize-winning science journalist, commented on the topic of the rise in pandemic levels, due to the complexity of viruses, "without equity, pandemic battles will fail... viruses will simply recirculate, and perhaps undergo mutations or changes that render vaccines useless, passing through the unprotected populations of the planet" (Garrett). The principle method in identifying trends in viruses is determining if viruses are actually alive or not, which led to this modern day controversy. Based on the evidence gathered from modern day virus research and *A Planet of Viruses*, the idea that viruses are not alive (non-zoetic) is more scientifically accurate, compared to the idea that viruses are alive. Viruses are proven to be non-zoetic based on their composition, because they only contain a protein coat and RNA, which means that they cannot internally reproduce, grow, or maintain homeostasis/metabolism (all characteristics of living organisms). The counter-arguments to these points did not accurately represent the standpoint that viruses are alive. These arguments analyzed Mimi viruses (which could have been a regular, non-

zoetic virus that underwent mutations) and protein folding (which is not a distinguishing characteristic of living organisms). After reading all of the compiled virology research in Carl Zimmer's *A Planet of Viruses*, it was interesting and shocking to see how quickly these viruses mutated, as small viruses evolved into the world's deadly diseases, such as HIV or the Marburg virus. However, research has improved since the first discovery of viruses by Ivanovsky and Beijerinck, and virologists are able to better contain or reduce the severe effects of these dynamic, non-zoetic beings.

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