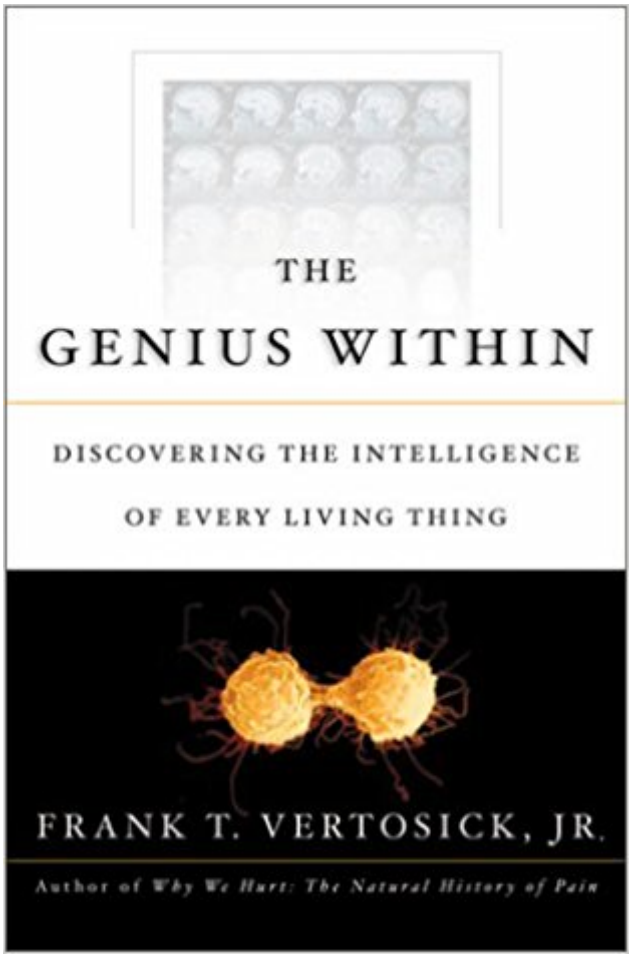
# The Genius Within: Discovering The Intelligence Of Every Living Thing



## Synopsis

Can bacteria be as smart as we are? Can ants think? And fish? Yes, says Frank Vertosick, a neurosurgeon who combats our elitism about intelligence in this brilliant book.A gifted writer and author of the widely praised Why We Hurt, Vertosick shows us that intelligence--the ability to react to the outside world, to change behavior, and survive-can be found wherever life exists. He demonstrates the keen intelligence of our immune system, how lowly bacteria mutate and outwit antibiotics, and how canny cancer cells elude our natural defenses.A fascinating journey through worlds of unknown science and an unsettling argument against our valuing of brain intelligence above all else, The Genius Within tells a fascinating scientific story, one that could shake our ethical foundation to its core.

## Book Information

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## Customer Reviews

If we’re so smart, why are we still at the mercy of treacherous microorganisms? The Genius Within: Discovering the Intelligence of Every Living Thing asks readers to let go of brain worship and look at the incredible problem-solving skills of viruses, ants, and other lowly creatures. Neurosurgeon Frank T. Vertosick Jr. seems an unlikely candidate to write a book celebrating noncerebral intelligence, but his knowledge helps him draw comparisons that others might miss. The fast-moving genetic intelligence of bacteria and immune systems might not match the precision of digital computers, but they have devised arms races much more complex--and deadly--than our comparatively paltry efforts. Vertosick’s grasp of what it means to behave intelligently comes through clearly, even if he

is as stumped as anyone trying to define the I word. Exploring parallels between neural networks, insect colonies, and our own brains, he finds common ground and shows that, as far as evolution is concerned, we're not so bright. It's not all bad, though: we're very good at what we do, and Vertosick hopes that we can learn to use our intelligence more wisely. --Rob Lightner

All life is intelligent, according to neurosurgeon Vertosick: "To be alive, one must think." A practicing neurosurgeon, Vertosick maintains that intelligence the ability to store experience and to use it to solve future problems is an emergent property of groups. Thus, bacteria, the immune system, and enzymes can be as smart as the human brain. All of these entities operate within networks that communicate and adapt to change in true Darwinian fashion. He further believes that this network paradigm of problem-solving originated at the cellular level. Unfortunately, some of his ideas, which he admits are highly speculative, seem merely an exercise in semantics. He completely avoids the issue of consciousness, which he dismisses as "irrelevant to his argument." At times, he seems unnecessarily provocative, labeling those who would disagree with him as "brain chauvinists" and arrogantly rejecting nonclinical biologists as lacking in the proper perspective. On the plus side, Vertosick, who also wrote Why We Hurt, is a skillful writer who makes frequent, effective use of analogies. His engaging descriptions of biological, chemical, and physical processes will appeal to a wide readership. Appropriate for public and academic libraries. Laurie Bartolini, Illinois State Lib., Springfield 

This is a relatively good book to read. However, the promisethat the author makes in not being technical is only particallytrue. First, he concentrates too much on the medical explanationsthat, at times, are not entirely relevant. Second, his analogiesare silly at times particularly when the concept isalready well understood without the analogy. One has to knowthat the number of analogies given is not directly proportionalto how clear the concept will become to the reader.But as I said, this is a good book and if you can live bythe parts of the book that are irrelevant you may learnsomething new about the concept of intelligence and howintelligence can be observed in seemingly "dumb" things.

I did not like the way any of the story lines.

"The Genius Within" is a must read for the non-specialist interested in science. It is a thought provoking work; very speculative, but grounded in mainstream scientific fact and theory. I thoroughly

enjoyed reading it...twice. It’s a bit technical at times, so some familiarity with the science involved is recommended. Also, if you happen to be more interested in "intelligent" animal behavior as such, rather than in its biochemical, microbiological and systemic underpinnings, you may want to look elsewhere.In this book, the author explores the notion the "networks" underlie the phenomenon we call life, and that life is synonymous with the information processing - intelligence - they architect. We tend to think of intelligence as a unique feature of brains, our conscious ones in particular (he calls this "brain chauvinism"), but he contends that all life is intelligent, or at least as "intelligent as it needs to be", and sets out to prove it.In simplest terms, he defines intelligence as the ability to solve problems related to survival. This seems to run counter to mainstream evolutionary theory, where the survival of species is basically as matter of, well, "dumb luck". But the author views intelligence as a collective phenomenon firmly embedded within this framework; as an "emergent behavior" of large groups of highly interactive biological entities (Including sub-cellular enzymes) otherwise engaged in a contingency-driven, random struggle for survival. The architecture that endows such groups with "emergent properties" is called, for want of a better word, a "network" by the author.The details of what the author means by a "network" is closely argued and beyond the scope of this review. In general, a biological "network" is a large collection of "selfish", randomly interacting entities whose components are capable of two or more relatively stable, but reversible, states (more active/less active, faster/slower, stronger/weaker), and whose components can variously enhance or impede each other’s status over time, resulting in a collective "energy landscape" patterned by forces impinging on the network. The former allows for basic information storage (the biological equivalent of zeros and ones), and the latter for collective information storage (pattern recognition/memory) concerning the environment, allowing the collective to respond to environmental stimuli in, ultimately, a manner conducive to its survival. Overall, the architecture of a "network" harnesses the random, contingent interactions of its constituents into the directed or, as the author would claim, intelligent actions we associate with life at every level of biological organization.The author spends much of the book "fleshing out" these and other abstractions, particularly with respects to interacting aggregates composed of things such as cellular enzymes, bacteria and somatic cells, what he calls "party networks" as opposed to "hard wired networks", though he does give ample attention to the latter (he is, after all, a brain surgeon). To assess intelligence from the "outside in", he employs a modified version of the Touring Test throughout these forays. Without making any assumptions about them based on what they are or how they’re organized, he queries each system with a problem, and waits for a response. He queries an infectious bacterial species with a new antibiotic and, within months, it develops immunity. He

queries the human immune system with the aforementioned bacteria and, within weeks, it develops an effective resistance. In these and other instances, he argues for an "intelligent" response from each based on their participation in network architecture, no more or less effective for the overall survival of its hosts than the quickened responses of "hard wired" brains.I gave this book a five-star rating, and with good reason, but I’m not entirely in agreement with its conclusions. Although "networking" is arguably a characteristic of all living systems, it seems somewhat disingenuous to define intelligence as the ability to solve problems regardless of the time frame involved. Given enough time and numbers, "dumb luck" will achieve results that appear intelligent, and so will tempt teleological interpretations. Mainstream evolutionists have long had to contend with our compulsion to put a "forger" between the hammers of chance and the anvil of necessity. Like them, I suspect the author’s hypothesis, however plausible, is just another in a series of attempts to inject Vitalism into biology, "networks" here replacing the less than scientific musings of an earlier age.But then again, maybe I’m just a "brain chauvinist".

Vertosick puts forth a point of view that we need to start thinking a bit more open-mindedly about what intelligence is. He gives very convicing examples of how things like the immune system, bacterial colonies, even cancer cells are intelligent. And relates them all to a Big Concept: Networks. He proposes that not just brains, but all types of intelligent systems are networks with emergent properties from lots of interactions and from Darwinian processes. I feel as I read it that he has taken a number of ill-formed, fuzzy Ideas that I have been thinking about, and made them clear and tangible. He is a great writer, who uses a lot of analogies to help us through the sometimes very technical material. It is one of those books that every thinking person must read, and I promise it will change you.

This book is breathtaking in its scope and originality. I find it difficult to describe how important it is within a short review. This will just be a sample. The Genius Within is simply the best overview of biology, evolution and intelligence we have. Vertosick extends the neural network model to explain how all intelligent systems work. Intelligent systems include organisms, parts of organisms, and associations of organisms. His basic idea is that any system that processes information to maintain and preserve itself in competition with other systems must be considered intelligent. He shows how general the neural network model of intelligence can be, applying it to metabolic cycles in the cell, to concerted action by communities of cells, both loosely connected in colonies and tightly connected in multicellular organisms. The hard wiring of vertebrate nervous systems is shown to be a special

case of this general paradigm. A key concept is that of the "party network." This is a wireless network like the one formed by conversations at a cocktail party. People spend various amounts of time with each other on the basis of their common interests. The differing levels of affinity between pairs of party goers plays the same role as the connection weights between neurons in a neural network. Each of the people at the party is connected with every other by the network of interactions that take place over time, but some are more strongly connected than others. The mobility of the neurons (people in this case) in initiating new connections (conversations) makes hard wiring unnecessary to the development of network structure in the group. You can show the network in action by having one person introduce a piece of controversial information to one other person at the beginning, then asking each of the partygoers what he thinks about the subject at the end. The metabolic processes of a cell form a party network of interacting enzyme and substrate systems. These systems are connected through the interchange of substrate and products. The result is a network that transforms a few simple substrate molecules into the vast variety of interconnected macromolecules that defines the structure of the cell. This is an example of intelligence working at the basic level of molecular biolgy. Vertosick shows how this model works for the combined action of bacteria in overcoming the effects of antibiotics, to the development of effective antibodies by immune systems, to the coordinated actions of social insects, and up through the evolutionary scale to the function of brains and nervous systems in vertebrates. Evolution itself is seen though the model to be a manifestation of intelligence in organisms that uses genetic variation as a problem solving tool. The genes themselves are not the source of evolutionary change, but the repository of genetic information used by the organism. Vertosick gives the example of cloning to illustrate the primacy of the cell machinery over the genes. If you introduce a nucleus from one somatic cell into another somatic cell, nothing terribly interesting will happen. But if you replace the nucleus of a fertilized ovum with the same somatic nucleus, a new organism will develop, following the genetic blueprint of the implanted somatic nucleus. The developmental initiative comes entirely from the cytoplasm of the ovum, which uses the information supplied by the DNA of the implanted nucleus to construct a new organism. This is just the beginning of the story presented in The Genius Within. Although I’m familiar with the general outlines of Vertosick’s thinking from my own work, I found a new and original idea on almost every page. The result is a synthesis that draws on many scientific fields to produce a unifed theory of life and intelligence. The theory itself takes the form of an extended neural network, robust to the necessary incompleteness of some relatively minor details. There will surely be quibbles from many who can’t see the whole picture, who have turf to protect, or who simply can’t tear themselves away from obsolete orthodoxies. (Vertosick deals effectively with

some of the criticisms in an Addendum.) But this is a truly revolutionary work. Five star books are fortunately fairly common. The Genius Within is as rare as a royal flush. Read it and weep with pleasure.



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