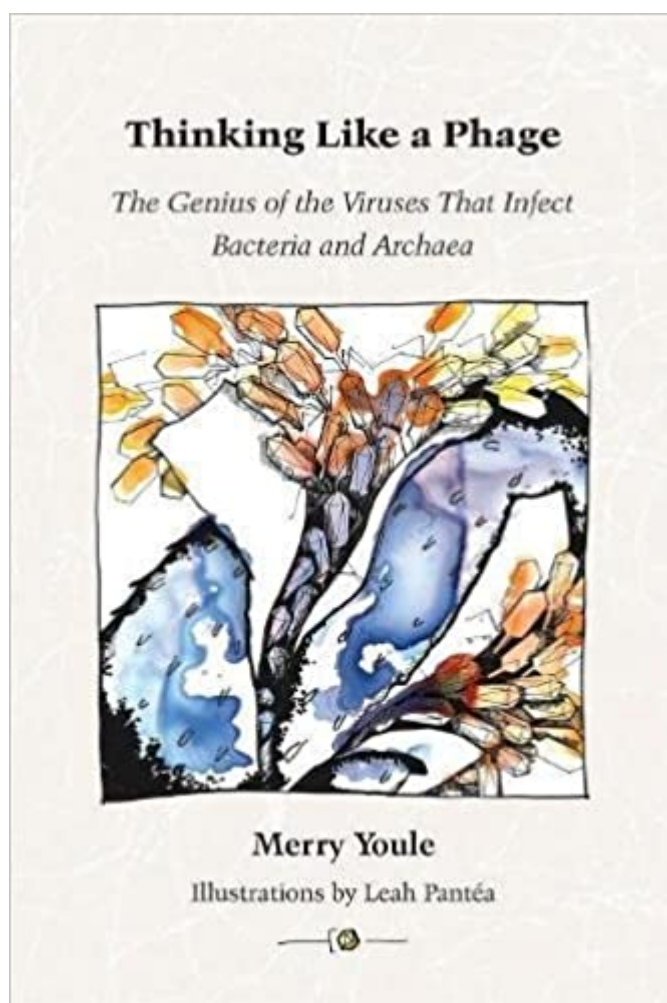


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# Thinking Like A Phage: The Genius Of The Viruses That Infect Bacteria And Archaea



## Synopsis

It isn't easy to be a phage. First, what is a phage? A phage is a virus that infects Bacteria. To succeed, a phage must encounter, recognize, and enter a particular type of bacterial cell, then coerce it to make more phages rather than more cells. Of course, the cell resists this hostile takeover in numerous ways, all of which the successful phage overcomes. The triumphant phage then proceeds with its replicative business. In this engaging book, Merry Youle relates some of the tactics used by 21 featured phages to outwit their host and successfully maintain their own lineage generation after generation. This ongoing contest of wits is a matter of life and death for both players. A phage chromosome arriving in its intended host cell is met by the cell's state-of-the-art defenses. Unless it dodges or neutralizes every one, it will be chopped into a nutritious snack for the cell. If the phage survives, it then quickly diverts the cell's machinery to production of more phages, rather than more cells. Under skillful phage supervision, manufacture of phage components proceeds at top speed, with all parts produced when needed and in the quantities required. As the pieces come off the assembly line, they self-assemble into sophisticated transport packages, each carrying a phage chromosome and capable of delivering it into a new host cell. When a new crop of progeny is ready—perhaps 25, 100, or more of them—the phage ruptures the cell to free them all and send them out into the world in quest of hosts of their own. Overall, a balance is maintained so that both the phages and their hosts thrive. Many phages have the option to instead follow a different script. When they arrive in a host, they can opt to delay immediate hostile takeover and to instead form a coalition with the host for mutual benefit. In this case, as the cell grows and divides, the phage is replicated and inherited by both daughter cells. This can continue for many generations. However, if the cell encounters life-threatening difficulties, the phage ends the alliance and switches to rapid replication. Cell rupture and release of the new generation follows quickly. Each step of the way presents challenges that test the ingenuity of the phages. In this book, tales of phage prowess are accompanied by pertinent electron micrographs; every chapter is enlivened by informative illustrations created by San Diego fine artist Leah Pantano. The writing focuses on strategies and underlying principles, with a minimum of jargon. Since some knowledge of molecular biology is required to appreciate phage wizardry, a primer of the needed basics is provided for those unfamiliar with that subject. Thus, these phage adventures can be enjoyed by a wide audience. Despite being the most abundant life form, the phages—being much smaller than even the microbes they infect—elude our everyday perception. Thinking Like a Phage offers a tour of this unseen dimension of life on Earth. Whether you are an expert or new to the phage world, these vignettes drawn from phage life will intrigue you.

Awareness of this vast, creative, yet invisible realm can enrich your appreciation for the living world of which we, as Homo sapiens, are only a small part.

## Book Information

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## Customer Reviews

It took about 100 years of phage research for us to realize that phages (and viruses in general) dominate cellular life, there being 10 to 100 times more phages than hosts. Wherever hosts live, phages seem to be there, too. Phages were also front and center when the field of molecular biology emerged. These messages should be distributed to the entire biology-oriented public in an easily readable way. Youle's phage book certainly offers this opportunity. Very good for newcomers and those who do not remember anymore. --- Dennis Bamford, Professor Emeritus, University of Helsinki Thinking Like a Phage is an engaging book that has the reader imagining what it is like to be a bacteriophage and to encounter the various challenges it faces, be it an obstinate cell wall, CRISPR fortifications, or a multitude of eager phage competitors. The range of depth and breadth of Thinking Like a Phage will delight every reader from the phage aficionado to the student eager for immersion in the fascinating world of bacteriophages. --- Graham F. Hatfull, HHMI Professor, University of Pittsburgh Whether you are an advanced high school or college student, a general science enthusiast, or an established researcher or biology teacher seeking stimulating ways to introduce concepts in the classroom, Thinking Like a Phage is enjoyable and informative reading. The author, Merry Youle, astutely chooses specific phages to illustrate key life-cycle stages, viral-host interactions, and evolutionary concepts. The writing is witty and engaging, yet technically accurate and thorough. Together, the original artwork and the enthusiastic

prose produce an unusually refreshing scientific narrative. --- Bentley Fane, Professor, University of Arizona

The phage phield has a nasty little secret: there is not a good introductory book for students and others interested in the most abundant life forms on the planet. Merry Youle has fixed this in the extraordinarily well-written *Thinking Like a Phage*. Concise, well-balanced in topics and current with the latest research, TLAP is a delight to read for the novice and expert alike. The incredible illustrations by Leah Pantea are both informative and beautiful. TLAP is the overview that the phage phield needs and a phascinating journey through the world's most interesting biology. ---

Forest Rohwer, Professor, San Diego State University

My students will enjoy reading scientific information that is presented in such a clear, interesting and exciting manner. Chapter 1 is the best introduction to bacteriophage biology I have seen yetââhits all of my favorite topics! The book spotlights many of the usual suspect phage that we donât talk a lot about but that I want my students to know exist, as well as some of the truly weirdo phage. ---

Sally Molloy, Assistant Professor, University of Maine

Our world is populated by untold numbers of creatures, but none are more abundant than the viruses that infect bacteria: the phages. This unseen realm plays a huge role in every ecosystem, yet its very existence is nearly universally unnoticed. It badly needs an advocate, and none serve better than Merry Youle. In these pages, she portrays this domain with aptly chosen examples, each described in an inviting, sometimes even witty, narrative. Be prepared to enter a splendid garden and view Nature at its most ingenious. ---

Moselio "Elio" Schaechter, Distinguished Professor Emeritus, Tufts University School of Medicine

Merry Youle is coauthor of two previous booksâLife in Our Phage World and Coral Reefs in the Microbial Seasâand of more than a dozen research papers. She also contributed over 40 phage-related posts to Elio Schaechter's ASM-sponsored blog, *Small Things Considered*. She plans to continue writing about her beloved phages from her home on the Big Island.

Great for anybody interested in microbiology, viruses, life, science, how the world really works, and/or having their mind frequently blown. It's extremely approachable and full of little moments of genius and you won't come out of it looking at the world the same way.

Merry Youle, the Phage Whisperer, is back with another nuanced, insightful, and profound work. This book is both detailed enough for the serious student of viruses and broad enough to engage any newcomer. The glue that binds this book together is the author's deep sense of wonder at the workings of the world that rings through in every sentence, and specifically how viruses - the

master manipulators of life - get business done. The author's passion for the subject matter is tangible and refreshing and filled me with a sense of newfound excitement to explore the world more. A real gem.

I'm not a biologist, but I found this book to be strangely intriguing nevertheless. It delves into life at the micro level more interesting to me than most works of science fiction. The phage, it seems, is a remarkable bit of life that may or may not actually be alive, depending on how one defines the concept of life. The aspect of the book that was most engrossing was the way in which these creatures invade larger host organisms, and then, like the key to some cosmic lock, turn the host's DNA towards their own purposes. The first of these purposes is, of course, self-replication, but that's just the start of the strange odyssey of the phage. If the invasion of a living host organism seems macabre, it must be said also that these entities are responsible for much of the genetic innovation underpinning the evolving process of life. So these infinitely small, and incomprehensibly multitudinous creatures, both destroy life and bring forth new life in the process. So if I understand the thrust of this book correctly, admittedly a stretch for a layman such as myself, it seems the phage is a sort of cross between a magician and an engineer, recreating and redefining life towards its own elaborate and mysterious ends. The process it uses to accomplish this task is what the book is about and it is indeed the stuff of real life science fiction.

I like it. In the spirit of the HHMI SEA-PHAGES educational program, the author has conveyed life-style appropriate names to classic, well-studied phages and to those more recently discovered with intriguing structures, niches or hosts. If you desire a more a more technical monograph on phage biology, seek R. Calendar's "The Bacteriophages". But if you'd like to introduce first year biology students or students and readers of any discipline, this is good place to start. The book covers the molecular biology of several phage types without being over technical. Representative but not exhaustive(ing) references are provided and there is a comprehensive glossary sufficient to carry any new phage explorer into the field. I would recommend it to first year and wizened students of microbiology, molecular biology and bacteriophages everywhere. Leah Pantea's illustrations of ink and watercolor are a fabulous accompaniment. Whether intended or not, the colorful flow of watery blues with earthy browns among the cells and phage imbue the figures with the impression of phage throughout the planet..... which they are! And with the watercolors----- I see a T-shirt and coffee mug industry in the making!

"I have been an AARP member for quite some time so it was as surprise to me to learn there is an entire kingdom of living things around and in me, of which I had no knowledge. Merry's book was a little too technical for me but, her footnotes were excellent and I learned a lot about phages from this book. When I was in school phages were only very small things that could attack viruses. I now know phages have complicated lives, are critical to our environment and are a life form that needs a lot of study. This is a good book for people interested in a new life systems and whos education, like mine, skipped or only touched on phages.

"Thinking Like a Phage" does what many books on the microbial world fail to do: consider the life cycle of bacteriophages from their perspective rather than that of the humans who study them. Merry Youle's sense of wonder gives each phage a personality that lets her human audience connect with them without overly anthropomorphizing the viruses. Complemented by Leah Pantea's watercolor illustrations and Ben Darby's pen and ink portraits, the textual descriptions of phages and their world of stalking, infecting, and exploiting their prey comes alive. Youle does assume her audience has a small background in basic molecular biology; however, her humor and conversational tone makes this book accessible to those who aren't scientists in the phage field.

In this book Merry Youle provides a beautifully drawn and articulated introduction into the amazing world of bacteriophages. The book remains accessible enough to be of interest to the curious undergrad or general audience, while also elegantly explaining intricate details of bacteriophages in a way that will educate even the most seasoned phage veteran. One example of this is how Youle has renamed the phages within her book, taking inaccessible jargon, such as  $\phi$ 49, and transforming it into the descriptive and memorably named 'Skinny' phage based on its thin, filament-like structure.

Another good book where Merry Youle has made a difficult topic readable. A good book for people with the love of science.

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