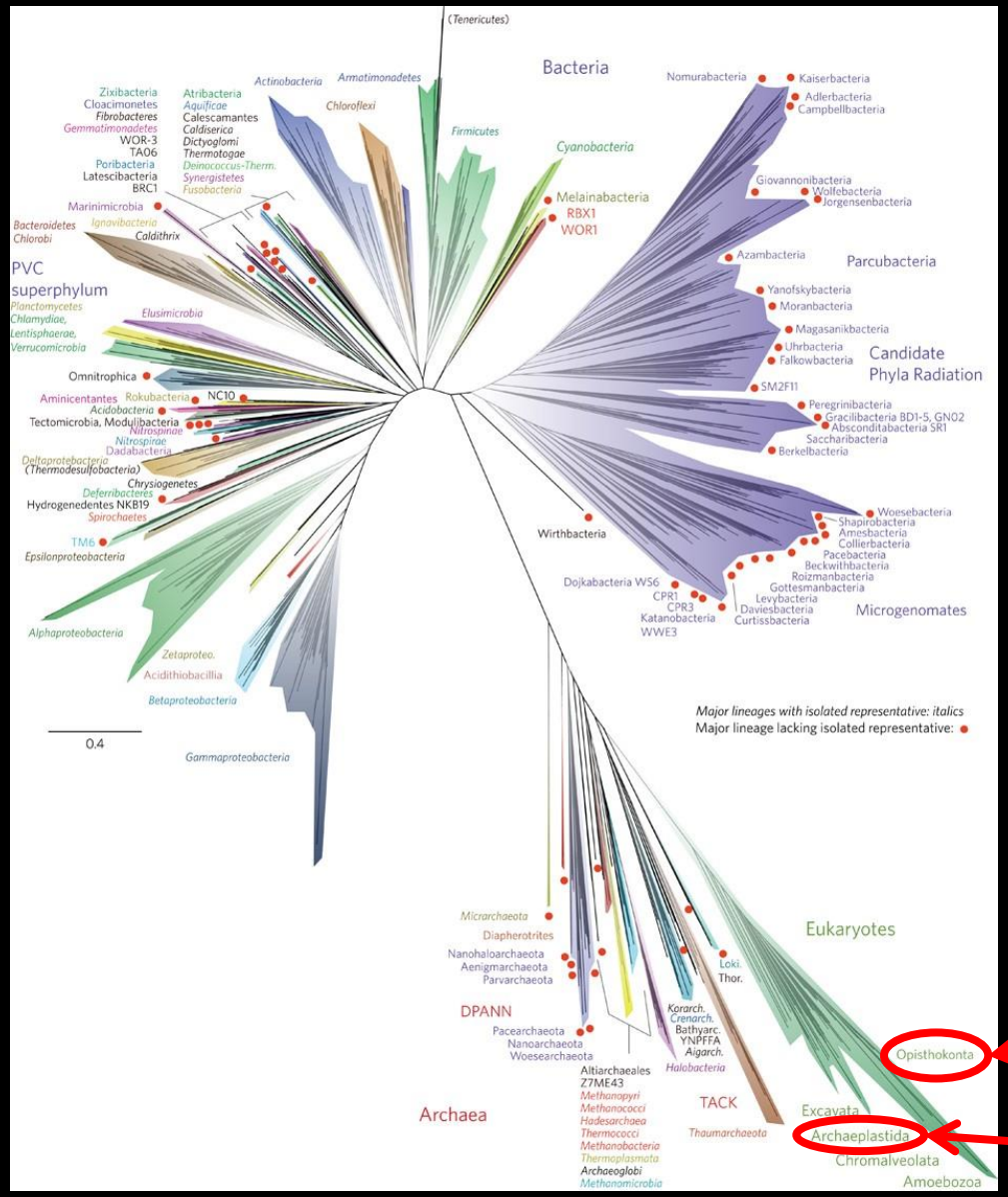

STRANGER
THINGS
OF THE
MICROCOSMOS



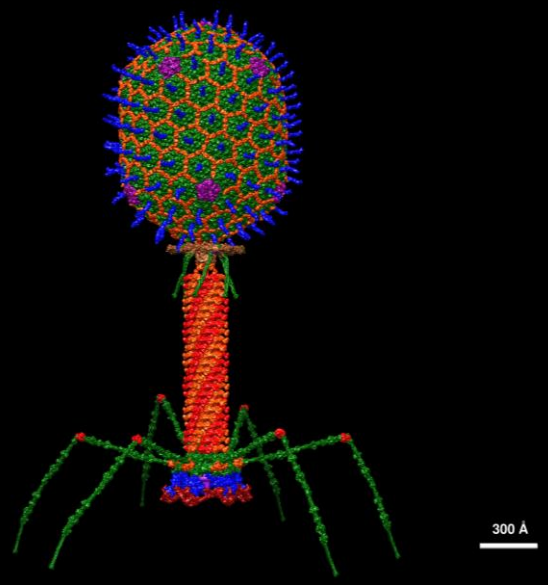
THE TREE OF LIFE

Animals and fungi

Plants

From Hug *et al*. (2016). A new view of the tree of life. Nature Microbiology. https://doi.org/10.1038/nmicrobiol.2016.48

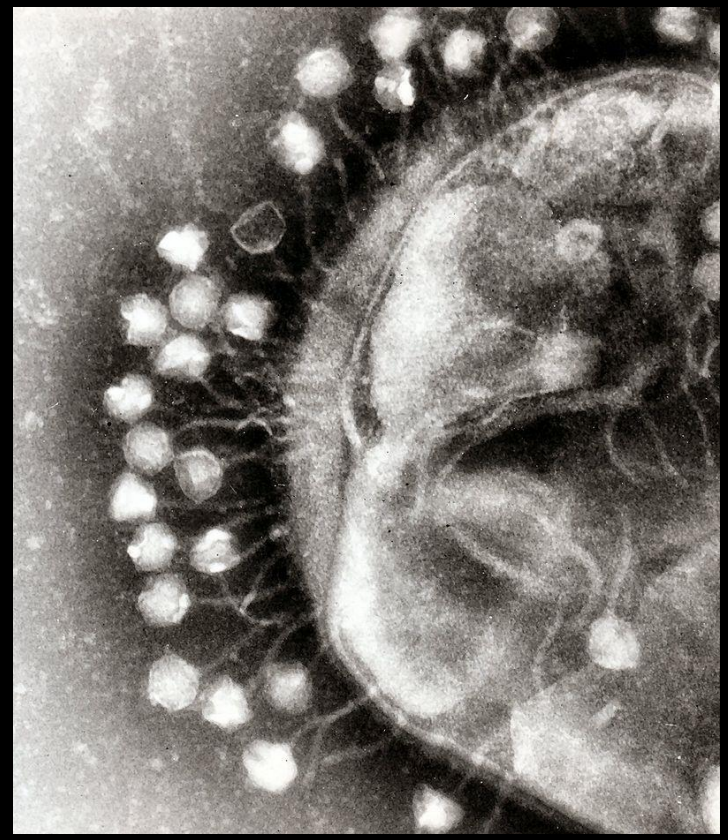
Bacteriophage



From Dr. Victor Padilla-Sanchez

$\sim 10^{31}$ on Earth

Bacterium



From Professor Graham Beards - en:Image:Phage.jpg, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=5035798

INTRO TO MOLECULAR BIOLOGY

1940s

" THEORY OF SELF-REPRODUCING AUTOMATA"

Turing Machine

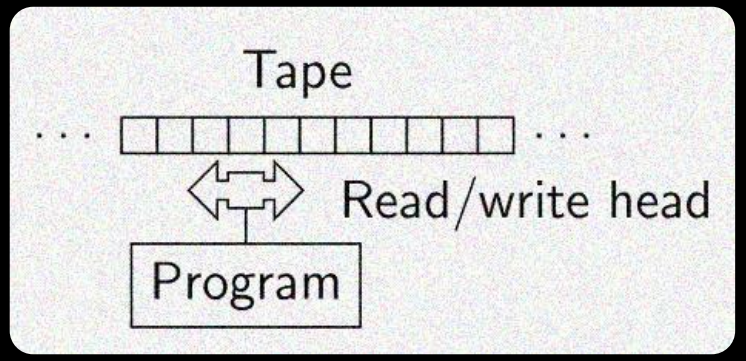
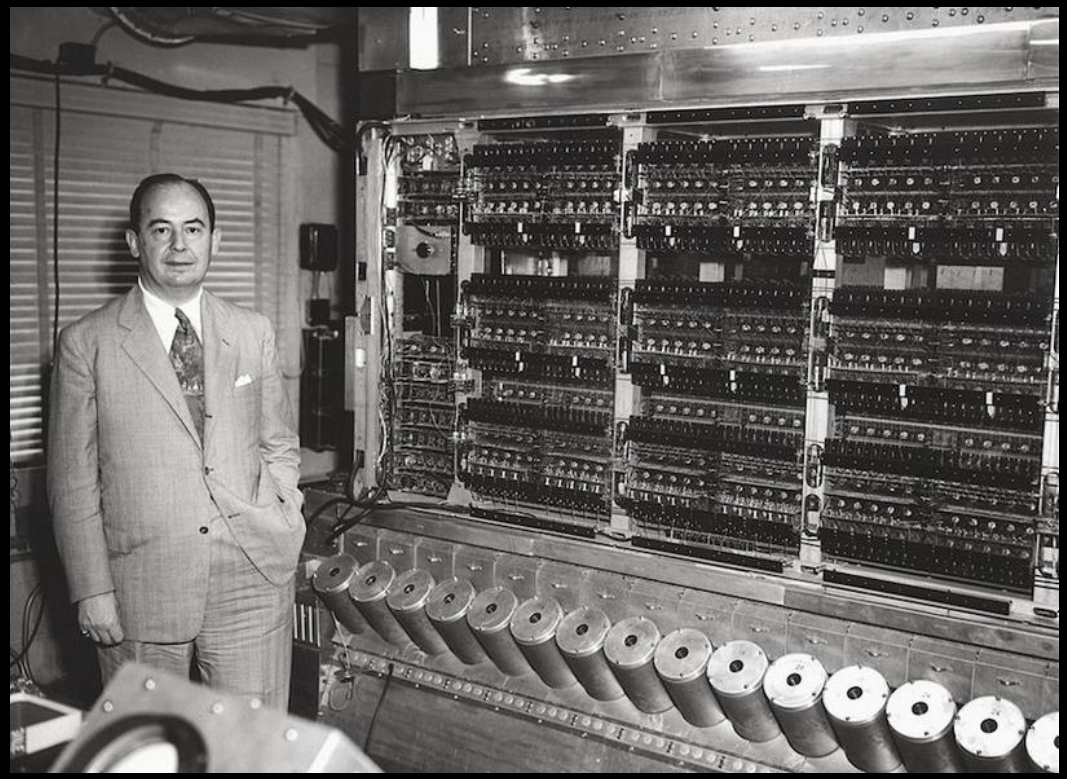


Illustration by Ludger Humbert

Von Neumann

Photograph from Getty Images



INTRO TO MOLECULAR BIOLOGY

1950s

Genetic information is encoded in long tape-like molecules (DNA) containing sequences of symbols

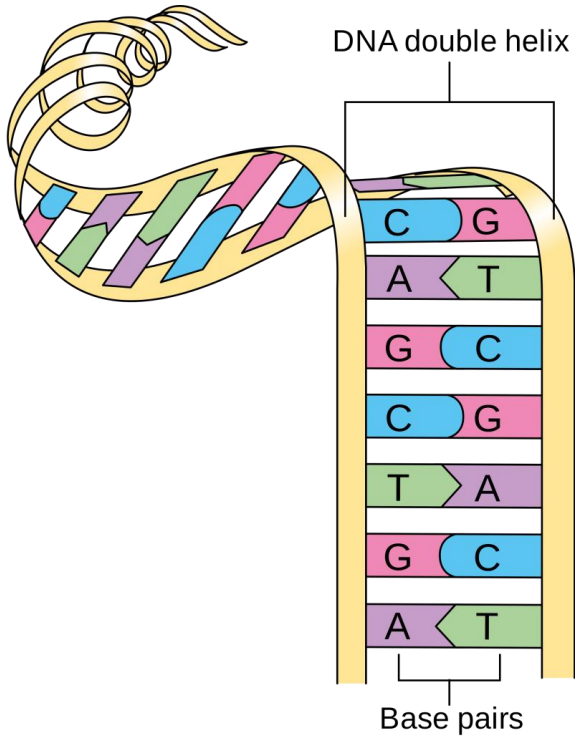
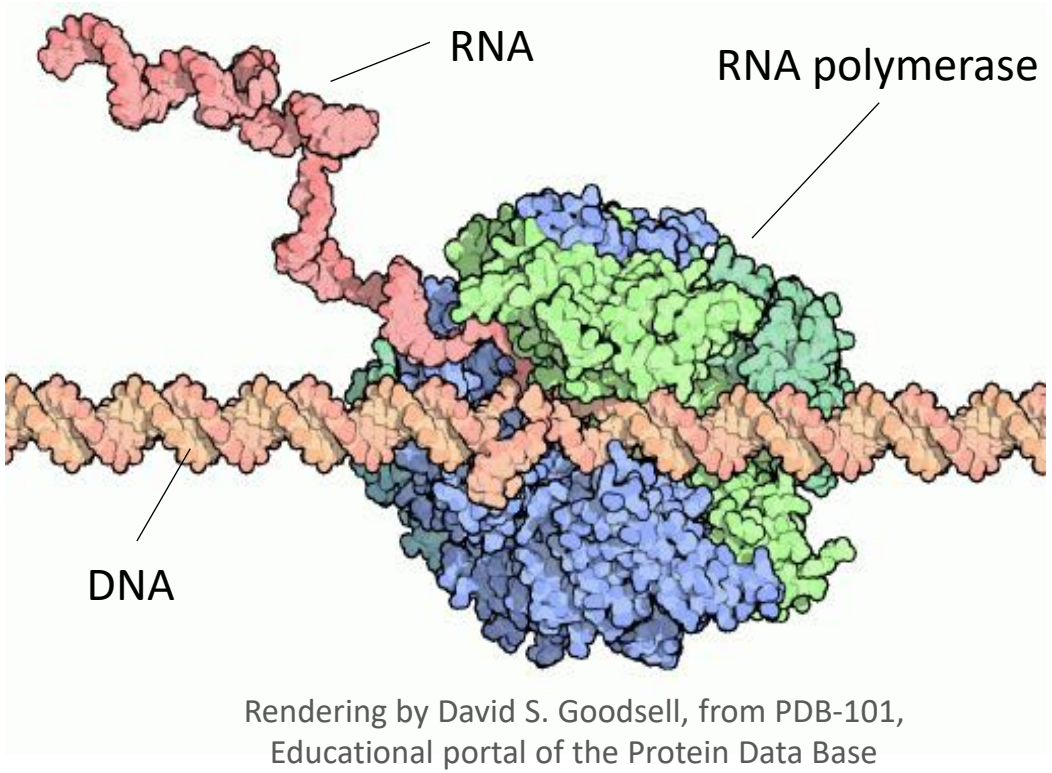


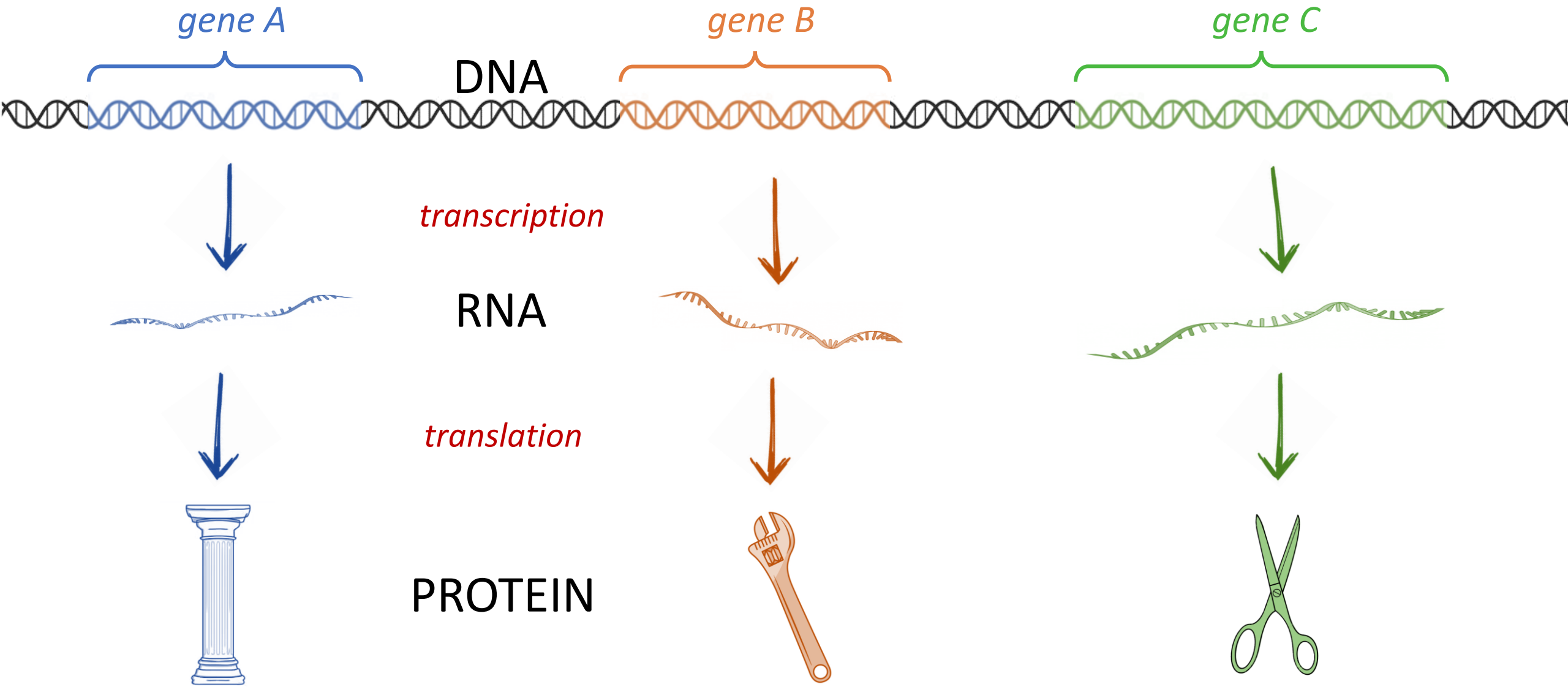
Image from
https://nebula.org/blog/dna-structure-model/

There are molecular machines that can slide on DNA and read specific parts when needed.

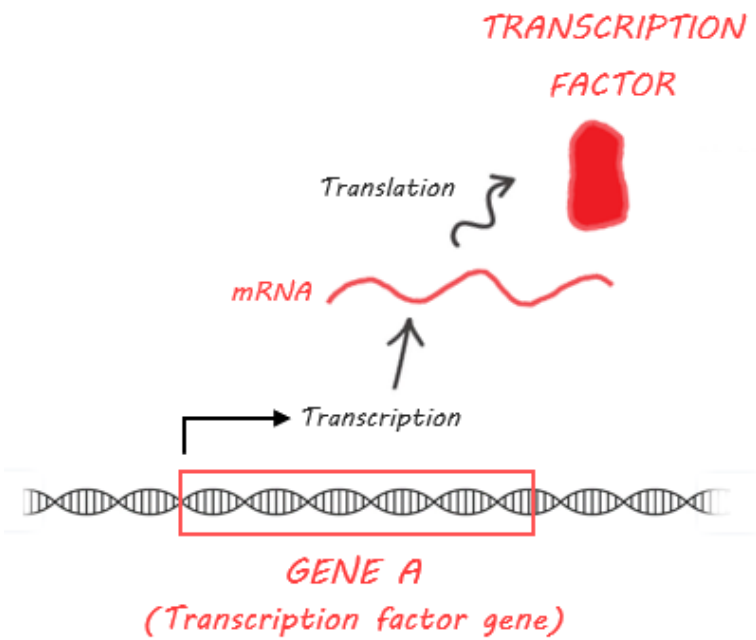


Rendering by David S. Goodsell, from PDB-101,
Educational portal of the Protein Data Base

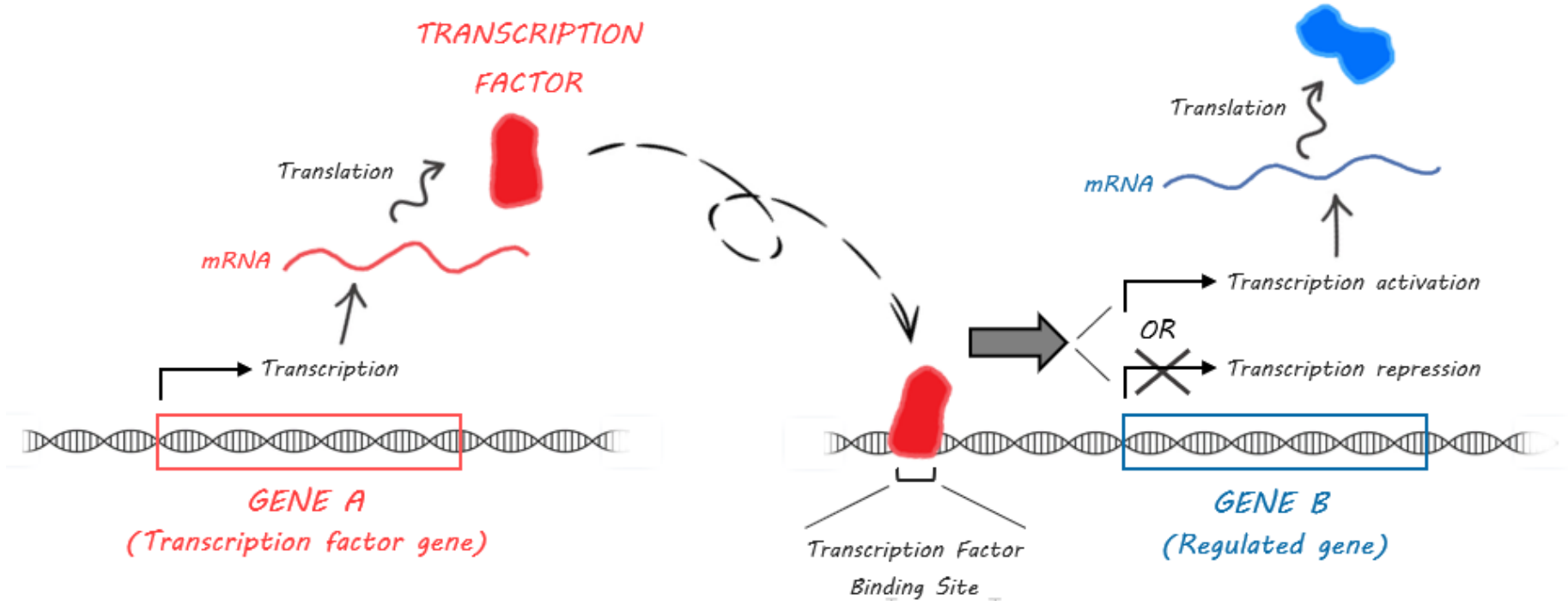
INTRO TO MOLECULAR BIOLOGY

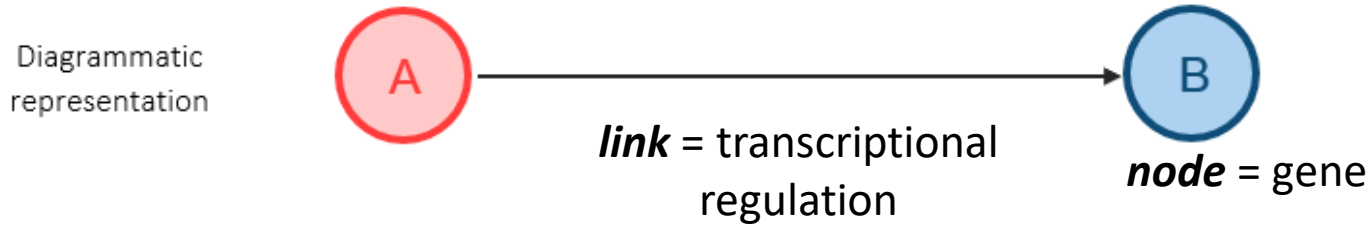


Gene Regulation: TRANSCRIPTION FACTORS



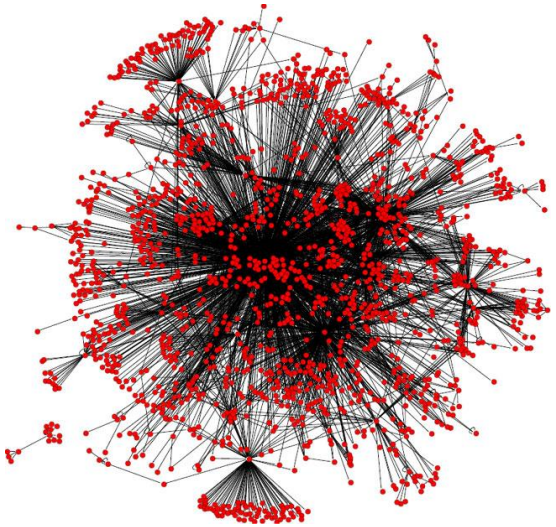
Gene Regulation: TRANSCRIPTION FACTORS





link = transcriptional regulation

node = gene



Transcriptional Regulatory Network of *E. coli*

Published in *Front. Microbiol.*, 19 August 2022
https://doi.org/10.3389/fmicb.2022.918015

"The transcriptional regulator CtrA controls gene expression in Alphaproteobacteria phages: Evidence for a lytic deferment pathway"

Elia Mascolo[1], Satish Adhikari[2], Steven M. Caruso[1], Tagide deCarvalho[3], Anna Folch Salvador[4], Joan Serra-Sagristà[4], Ryland F. Young[5], Ivan Erill[1]* and Patrick D. Curtis[2]*

[1]Department of Biological Sciences, University of Maryland, Baltimore County, United States
[2]Department of Biology, University of Mississippi, United States
[3]Keith R. Porter Imaging Facility, College of Natural and Mathematical Sciences, University of Maryland, Baltimore County, United States
[4]Department of Information and Communications Engeneering, Universitat Autònoma de Barcelona, Spain
[5]Center for Phage Technology, Texas A&M University, United States

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THE UNIVERSITY of MISSISSIPPI

UAB Universitat Autònoma de Barcelona

TEXAS A&M UNIVERSITY

proud to be a research parasite

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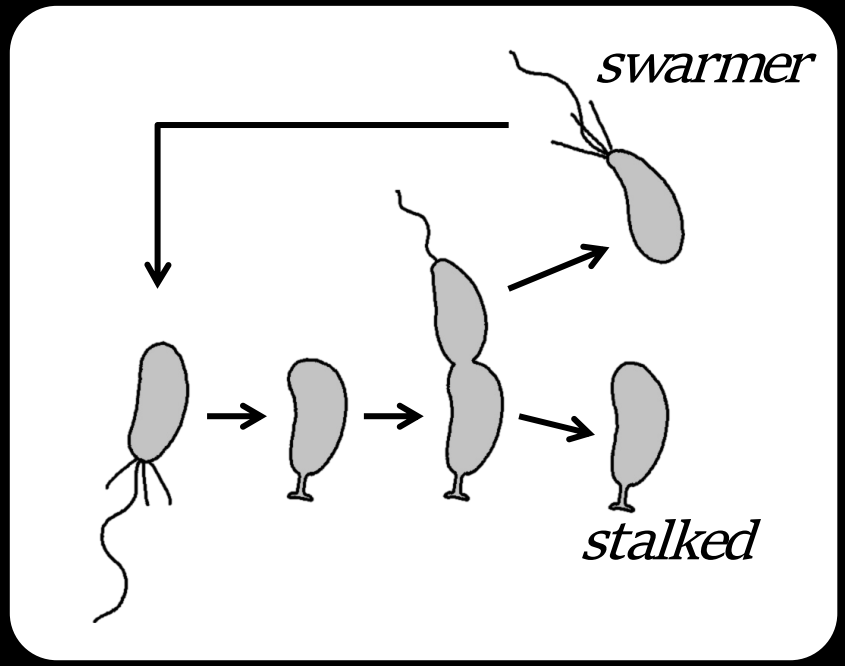
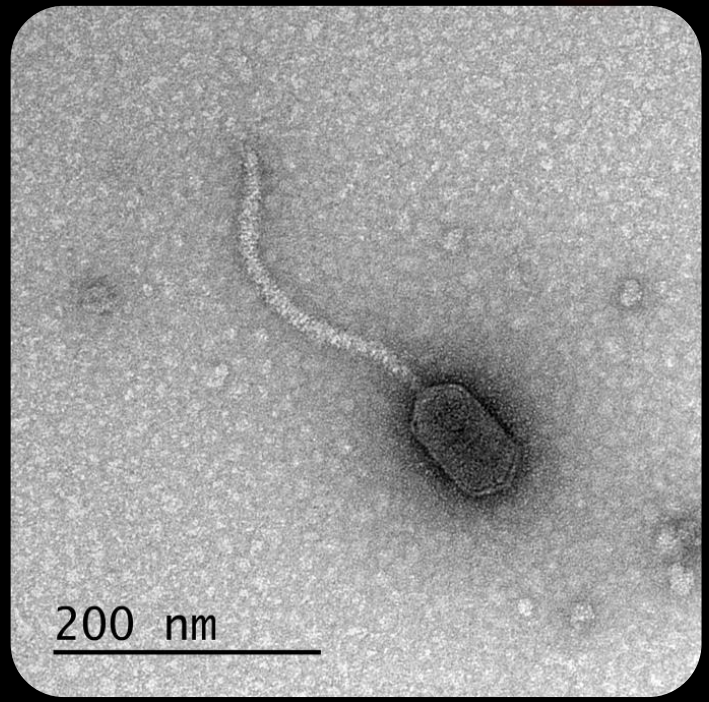
Brevundimonas



CtrA-regulated life cycle

Delta Phage



...TTAA.....TTAA...

Delta phage genome

```
    1 cgttaaggtt aatgcgatca gttctcgtta accttaacac cgcgttaaca ttaaaagtta
   61 aggttaacgg gacatggcga acagacatgg ttaatcggca taaacgccgt taacgttaaa
  121 agttaaggtt aatgaggcgt taacgccgtt aaccattaac aaacatggtt aaccggccgt
  181 taatcacgaa tatggttaat gttctcatca ttaccggaac attaaccagt ccgcagaacg
  241 cagtccgaac gaaaacggaa cgtttgcgaa ctccaacttt ttcgacccat gacaccggag
  301 agggcctaaa accgctccac ggggctaaaa acggcctttc tgggcattct cgttatggca
                                    ⋮
86881 aggcaagtgt gtgacgatgt aaaaatacct cttagcatgg gactatctta ttatacttaa
86941 taaaataaaa taaagaataa aagctaaaac cgggctccct tggccgcaga tagcgcagtc
87001 cgggtcaaaa acggtgaagg tgatgcggaa aatcggtttc gatcctgtga gcgccggatt
87061 ttcggtgaag gtgaatcgga aaatcagttt ggaagctggg atcagatgaa aaccgaggaa
87121 aatcagcata aaacggggtt aacacgccgt taacgttaaa aagtaaggtt aacgcggcat
87181 taaggttaat gggccgttaa ccttaatagt tagggttaat gacgc
```

Dr. Patrick Curtis

University of Mississippi

...TTAA.....TTAA...

Delta phage genome

```
     1 cgttaaggtt aatgcgatca gttctcgtta accttaacac cgcgttaaca ttaaaagtta
    61 aggttaacgg gacatggcga acagacatgg ttaatcggca taaacgccgt taacgttaaa
   121 agttaaggtt aatgaggcgt taacgccgtt aaccattaac aaacatggtt aaccggccgt
   181 taatcacgaa tatggttaat gttctcatca ttaccggaac attaaccagt ccgcagaacg
   241 cagtccgaac gaaaacggaa cgtttgcgaa ctccaacttt ttcgacccat gacaccggag
   301 agggcctaaa accgctccac ggggctaaaa acggcctttc tgggcattct cgttatggca
                                    ⋮
 86881 aggcaagtgt gtgacgatgt aaaaatacct cttagcatgg gactatctta ttatacttaa
 86941 taaaataaaa taaagaataa aagctaaaac cgggctccct tggccgcaga tagcgcagtc
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 87181 taaggttaat gggccgttaa ccttaatagt tagggttaat gacgc
```
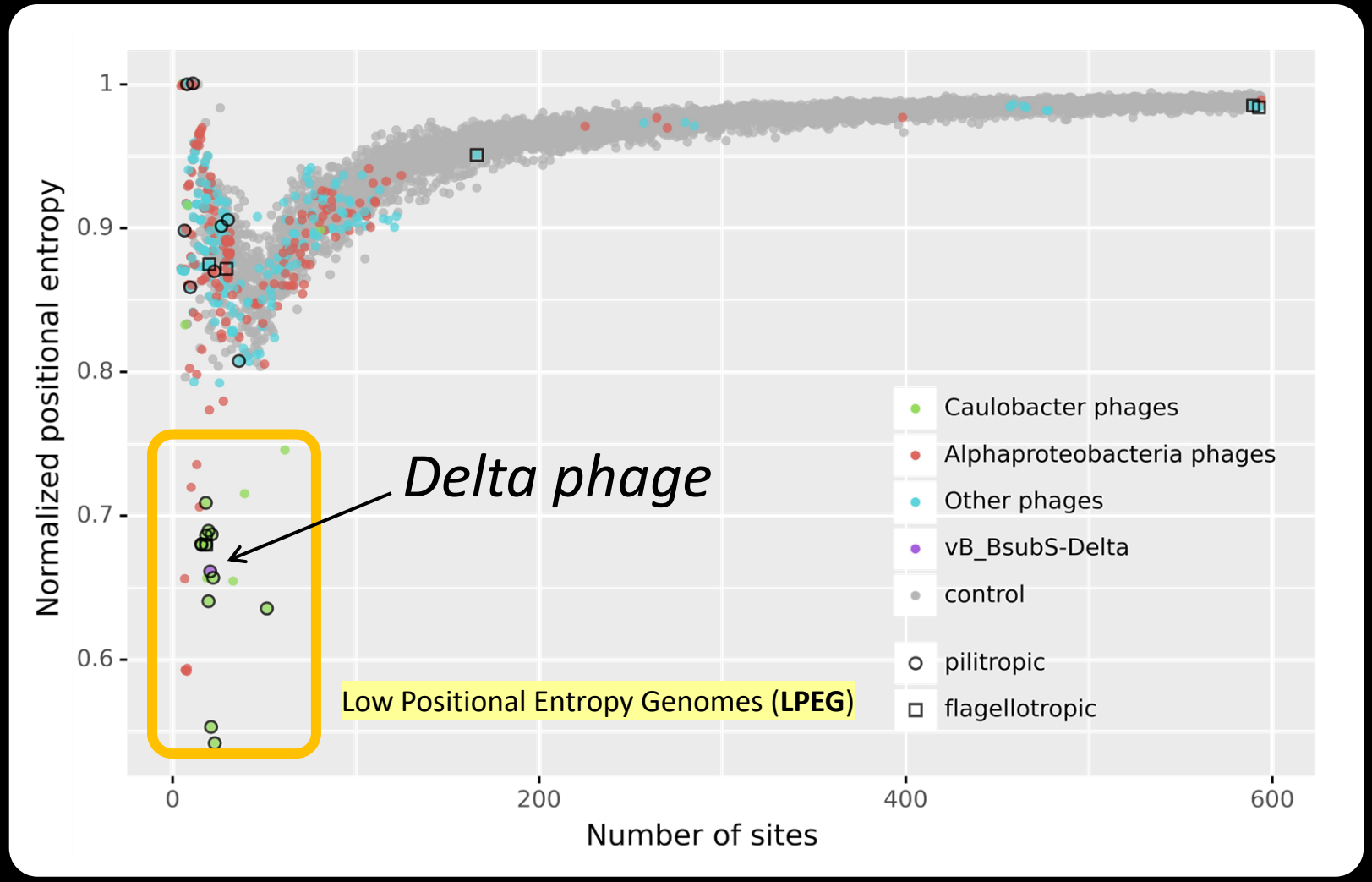
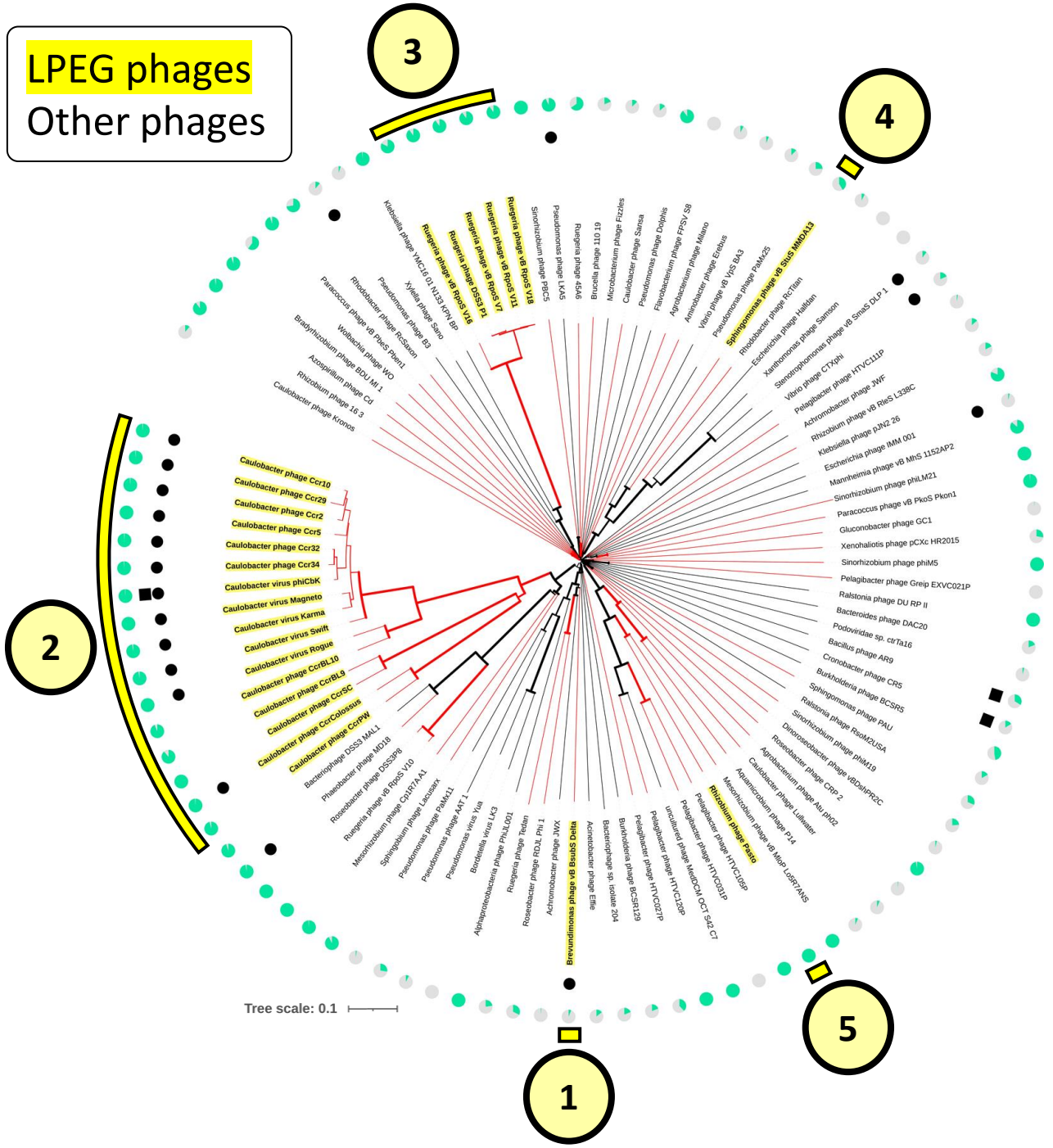

Dr. Patrick Curtis

University of Mississippi

POSITIONAL ENTROPY



LPEG phages
Other phages



CONVERGENT EVOLUTION

1. Delta phage
2. Caulobacter phiCbK-like phages
3. Ruegeria phages
4. Sphingomonas phage vB_StuS_MMDA13
5. Rhizobium phage Pasto

LYTIC DEFERMENT

Instead of killing the swarmer, the virus waits for it to join a colony, using the infected swarmer as a trojan horse.

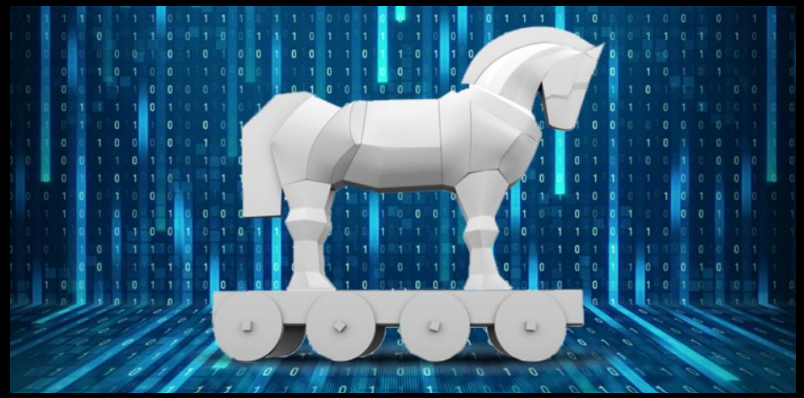


Image from CyberHoot
https://cyberhoot.com/cybrary/trojan-horse/

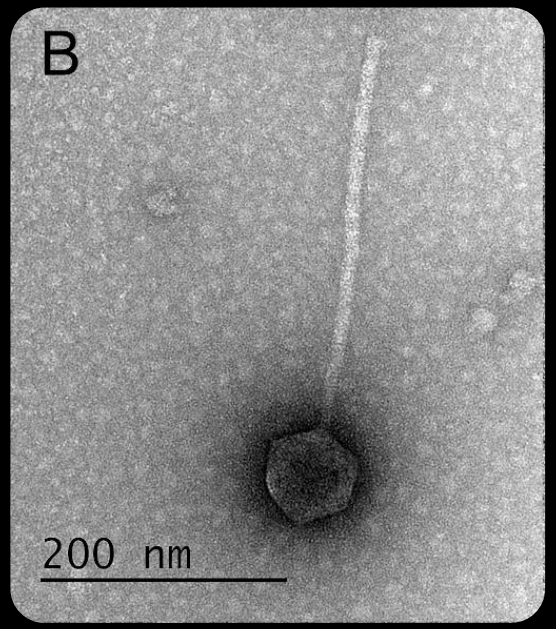
Published in *ISME J.*, 31 October 2023
https://doi.org/10.1038/s41396-023-01548-0

"Simultaneous entry as an adaptation to virulence in a novel satellite-helper system infecting Streptomyces species"

Tagide deCarvalho[1,†], Elia Mascolo[2,†], Steven M. Caruso[2], Júlia López-Pérez[3], Kathleen Weston-Hafer[4], Christopher Shaffer[4], Ivan Erill[2]

[1] Keith R. Porter Imaging Facility, College of Natural and Mathematical Sciences, University of Maryland Baltimore County, Baltimore, MD, United States
[2] Department of Biological Sciences, University of Maryland Baltimore County, Baltimore, MD, United States
[3] Departament de Genètica i Microbiologia, Universitat Autònoma de Barcelona, Bellaterra, Spain
[4] Department of Biology, Washington University in St. Louis, St. Louis, MO, United States

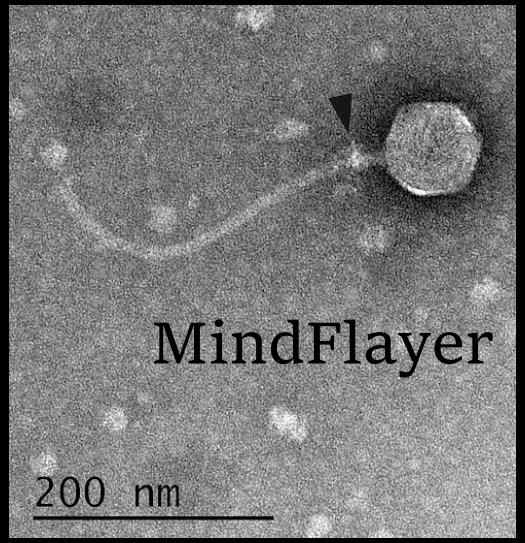
THE MIND FLAYER

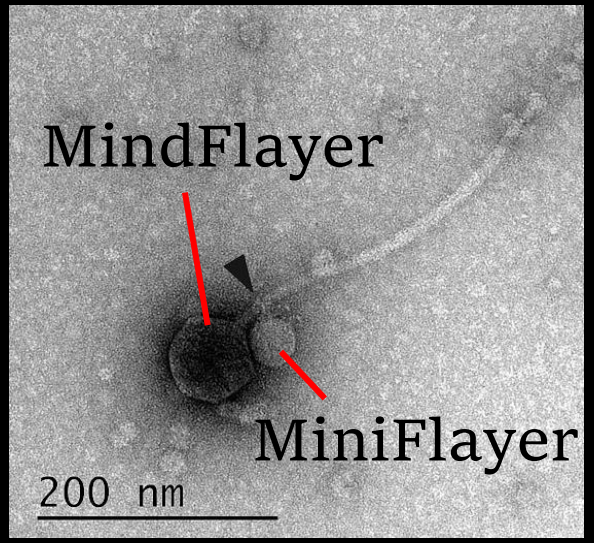


THE MINI FLAYER

UMBC PHAGE HUNTERS

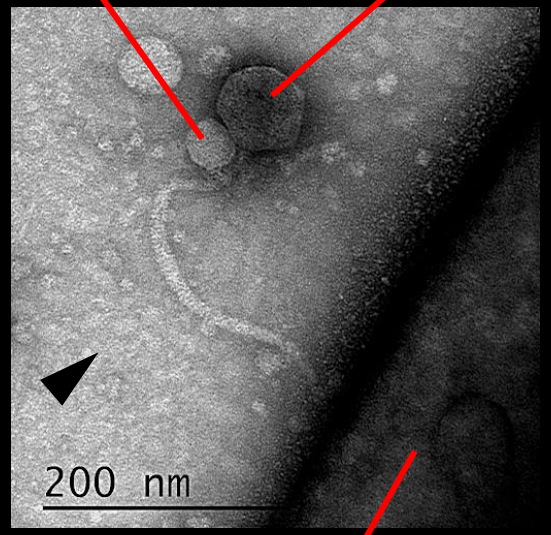
Dr. Tagide deCarvalho
UMBC





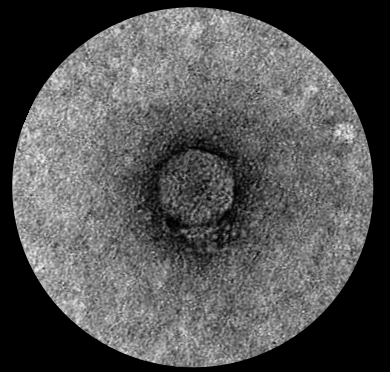
MiniFlayer

MindFlayer



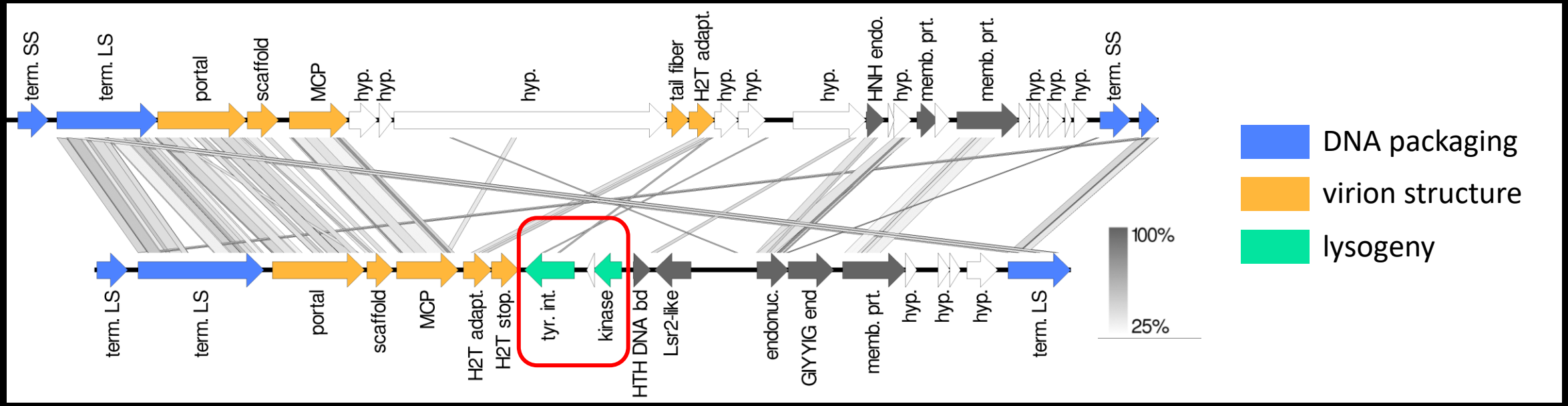
Streptomices scabei
(the infected bacterium)

MiniFlayer



A "VAMPIRE"?

MiniFlayer



MulchRoom

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Júlia López-Pérez
Joan Serra-Sagristà
Ryland F. Young
Kathleen Weston-Hafer
Christopher Shaffer

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PHAGE HUNTERS BIOLOGICAL SCIENCES UMBC

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Thanks!

Elia Mascolo

eliam1@umbc.edu

x

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