

20.109
Laboratory Fundamentals in
Biological Engineering

Module 1
Nucleic Acids
Class 1

Office Hours: by appointment

Hunting virus (2005)



The Microbial World

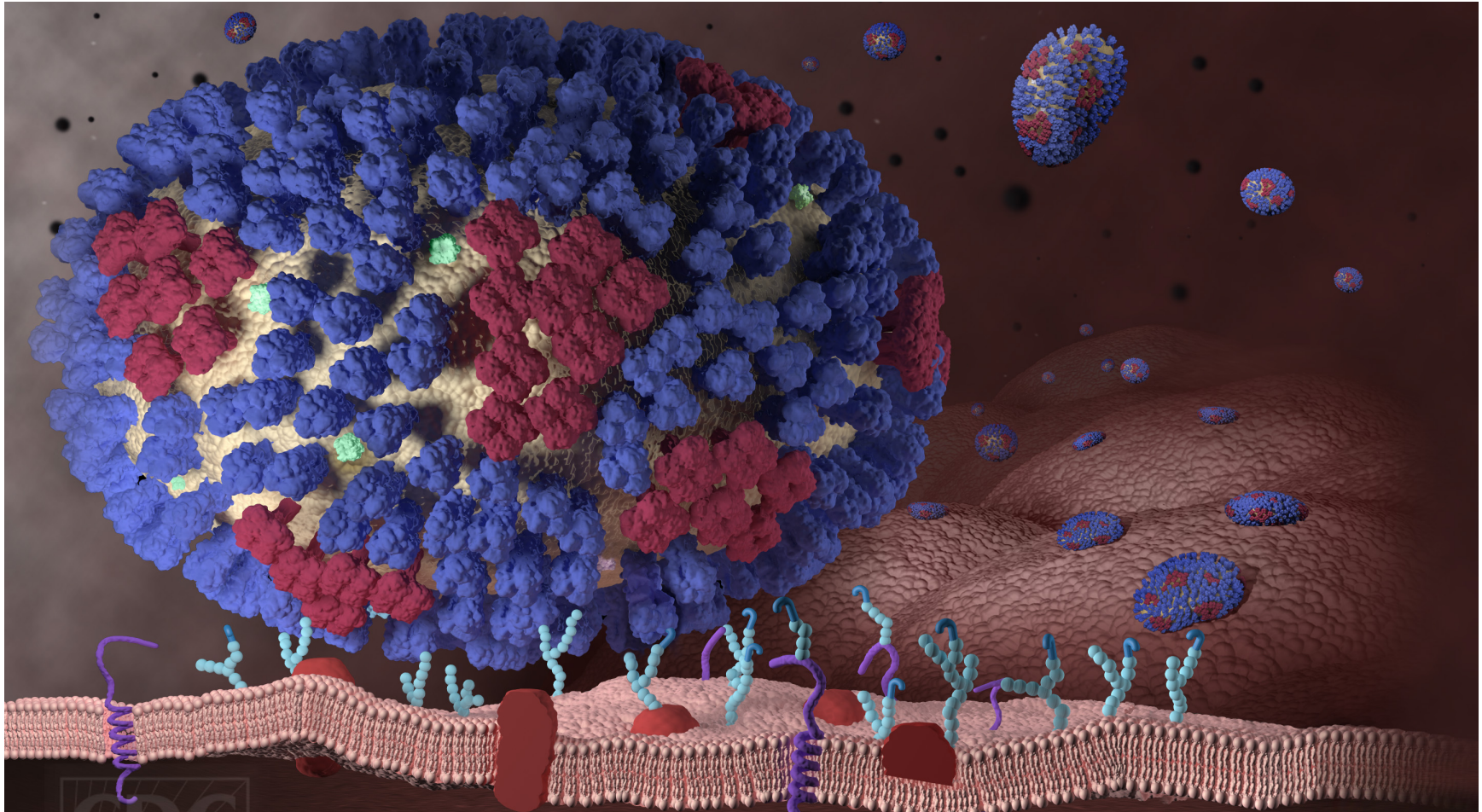
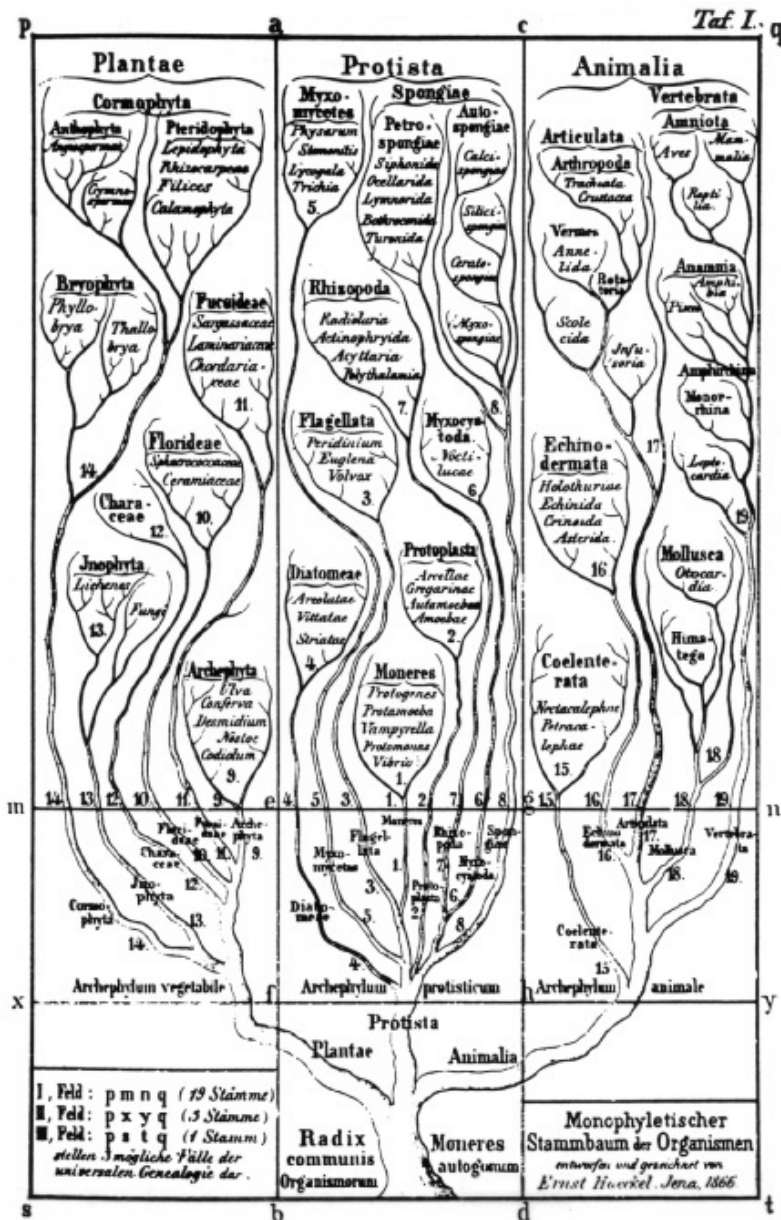
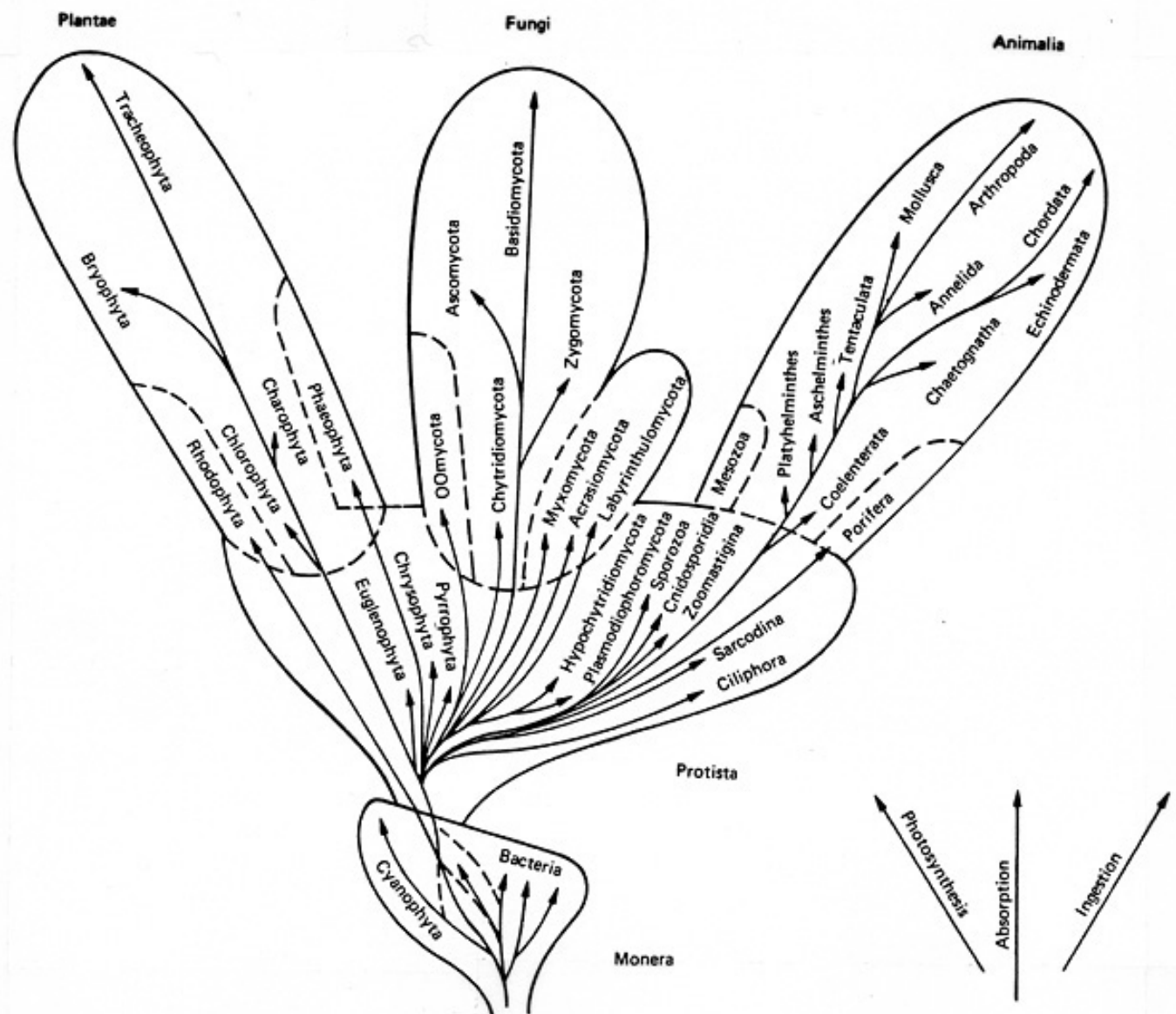


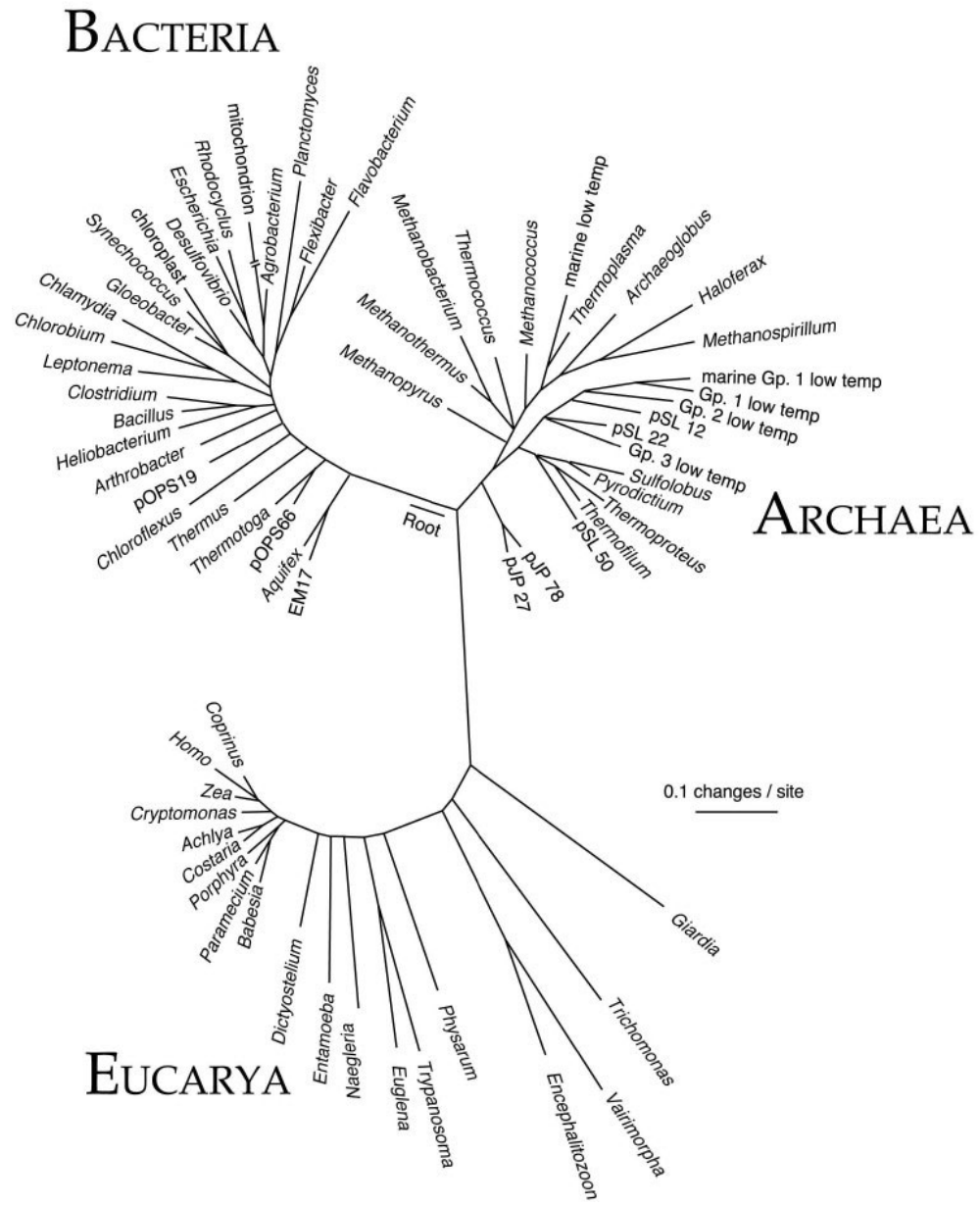
Image from CDC



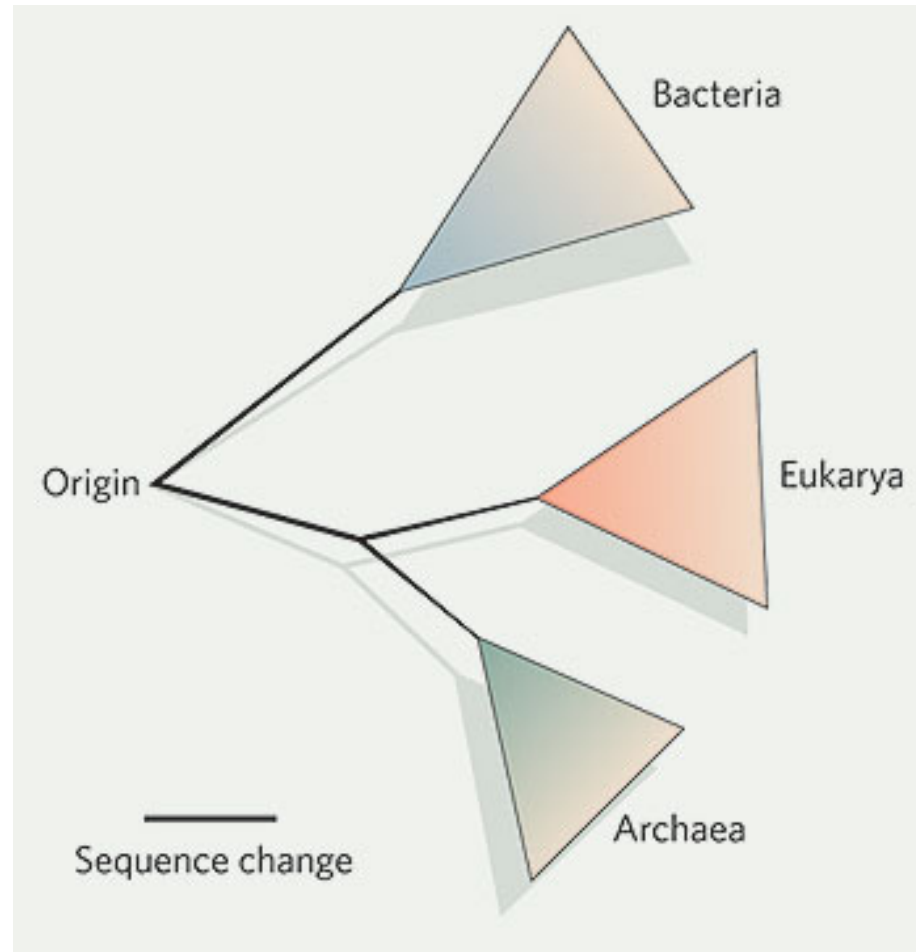
Haeckel (1866), a Swiss naturalist, was the first to create a natural kingdom for the microbes, which had been discovered nearly two centuries before by Antony van Leeuwenhoek



Whittaker, 1967



Revised tree of life



The Microbial World

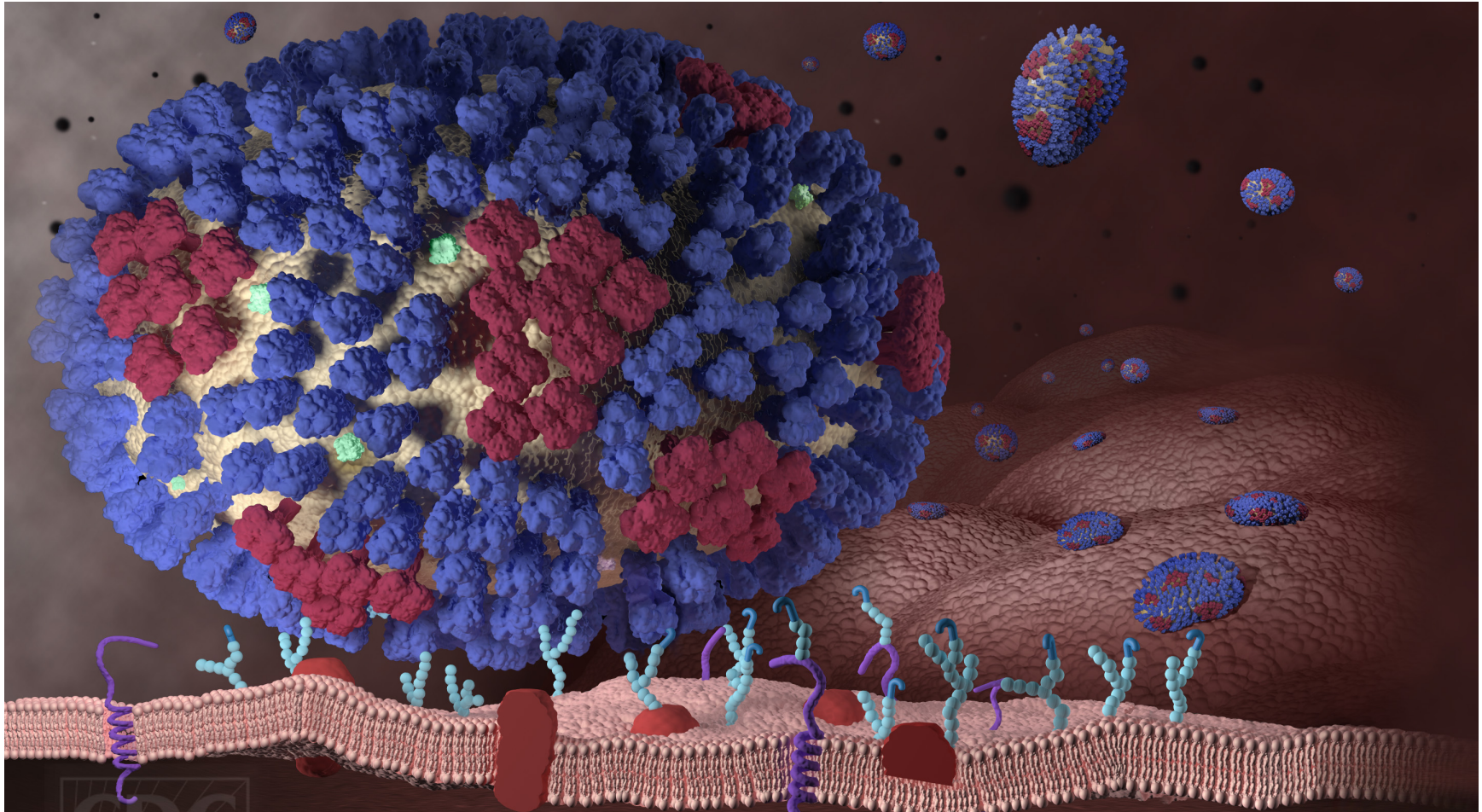


Image from CDC

articles

Nucleotide sequence of bacteriophage Φ X174 DNA

F. Sanger, G. M. Air*, B. G. Barrell, N. L. Brown†, A. R. Coulson, J. C. Fiddes, C. A. Hutchison III‡, P. M. Slocombe§ & M. Smith'

MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK

A DNA sequence for the genome of bacteriophage Φ X174 of approximately 5,375 nucleotides has been determined using the rapid and simple 'plus and minus' method. The sequence identifies many of the features responsible for the production of the proteins of the nine known genes of the organism, including initiation and termination sites for the proteins and RNAs. Two pairs of genes are coded by the same region of DNA using different reading frames.

strand DNA of Φ X has the same sequence as the mRNA and, in certain conditions, will bind ribosomes so that a protected fragment can be isolated and sequenced. Only one major site was found. By comparison with the amino acid sequence data it was found that this ribosome binding site sequence coded for the initiation of the gene G protein¹⁴ (positions 2,362–2,413).

At this stage sequencing techniques using primed synthesis with DNA polymerase were being developed¹⁸ and Schott¹⁷ synthesised a decanucleotide with a sequence complementary to part of the ribosome binding site. This was used to prime into

Viral Class

DNA viruses

RNA viruses

**RNA ↔ DNA
viruses**

Viral Genome

ssDNA

dsDNA

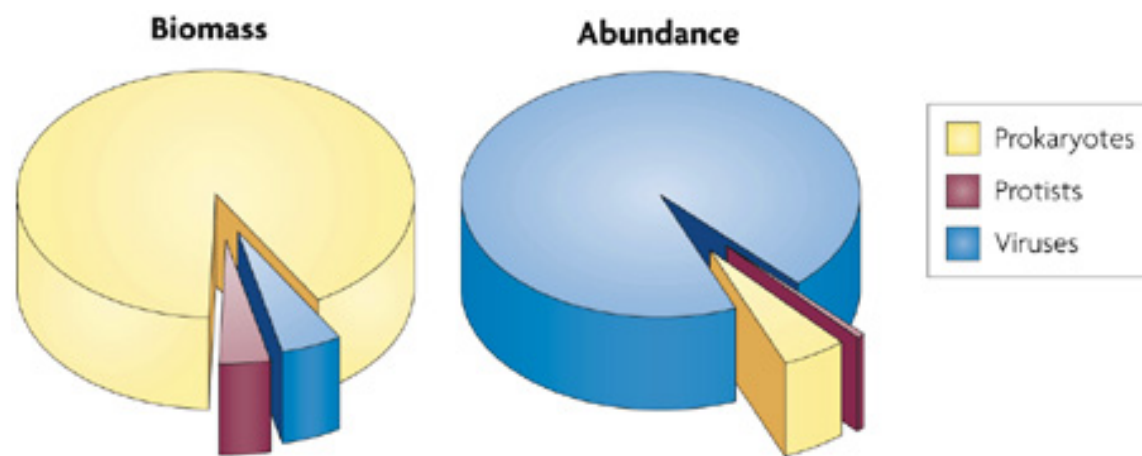
ssRNA

dsRNA

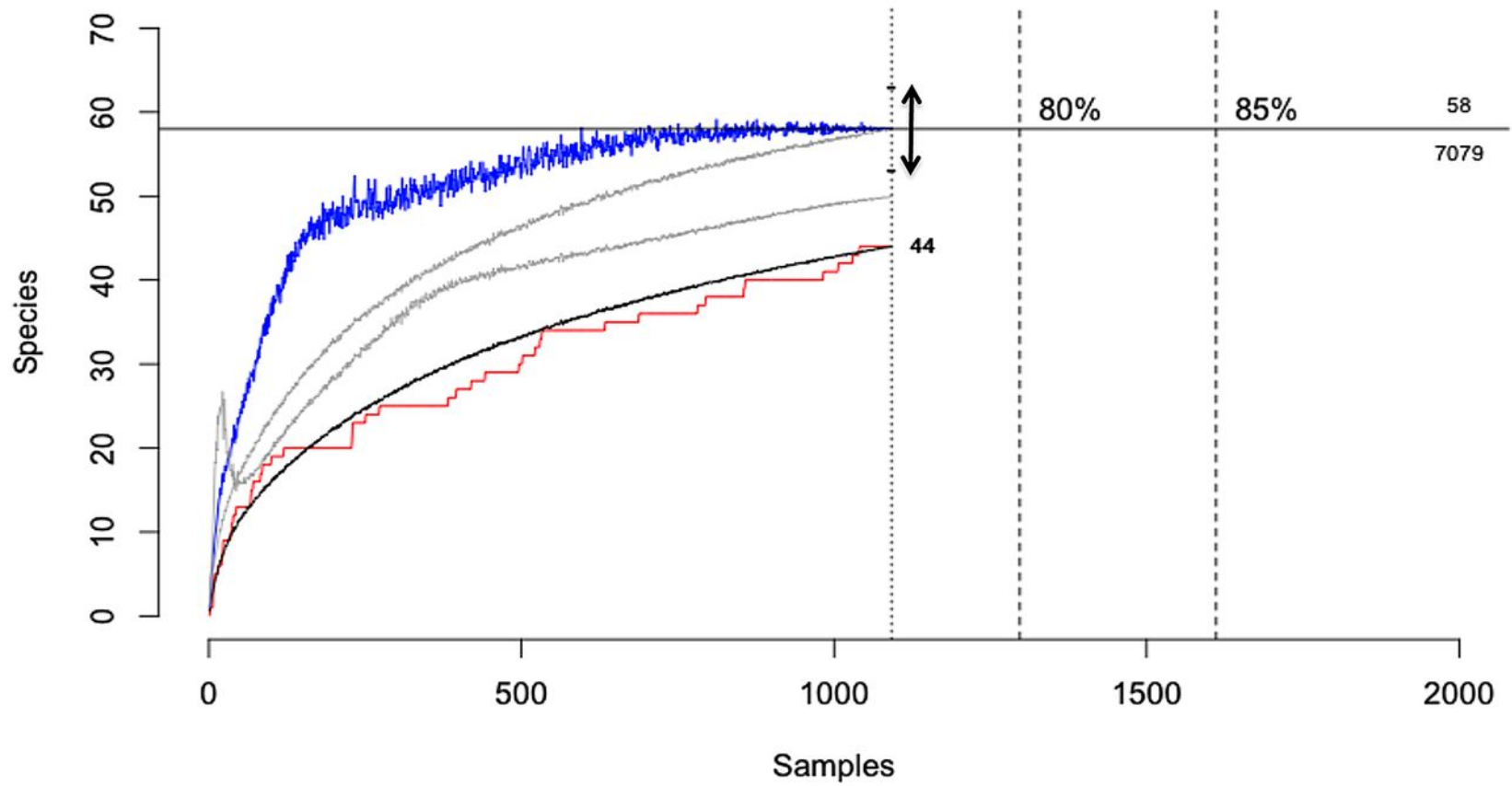
ssRNA
(Retroviruses)

dsDNA
(Hepadnaviruses)



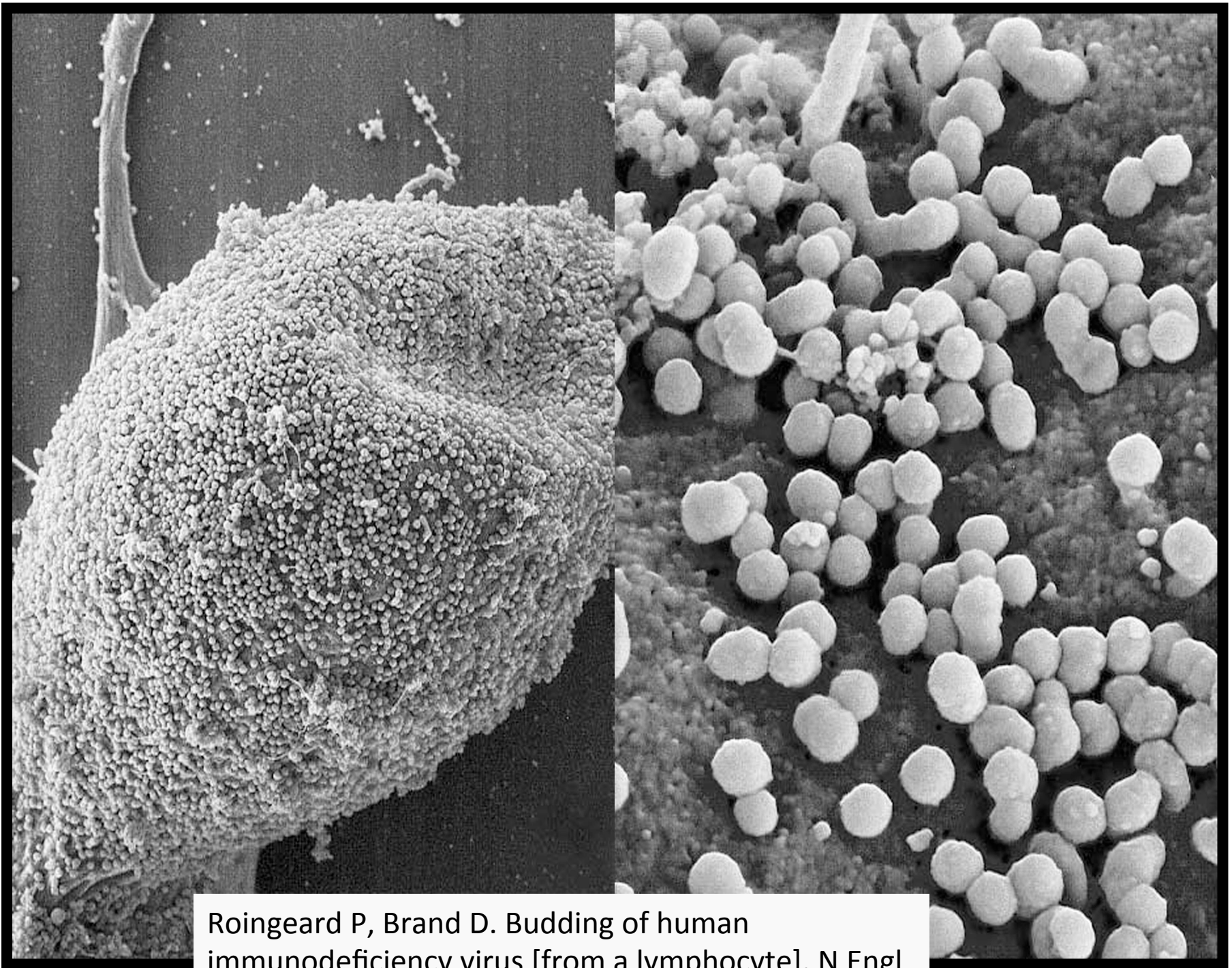


Viral discovery curve.



Anthony S J et al. mBio 2013; doi:10.1128/mBio.00598-13



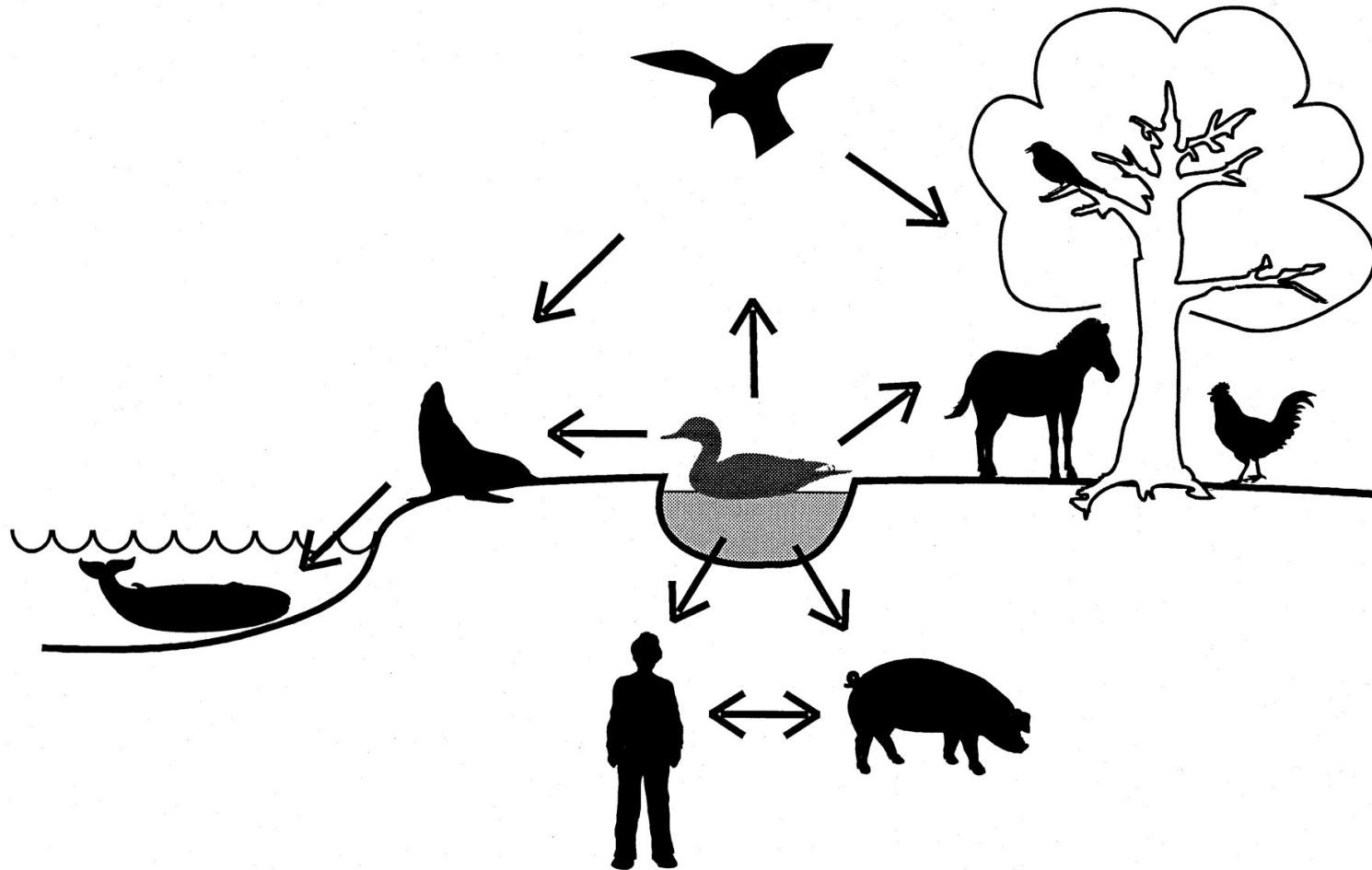


Roingeard P, Brand D. Budding of human immunodeficiency virus [from a lymphocyte]. N Engl

Microbes in our World

- Microbial communities (e.g. – human gut)
- Fermentation (e.g. – beer)
- Industrial products (e.g. – medicinals, cosmetics, etc...)
- Nitrogen fixation, nutrient cycles in ecosystems.

Influenza Disease Ecology (measure, model)



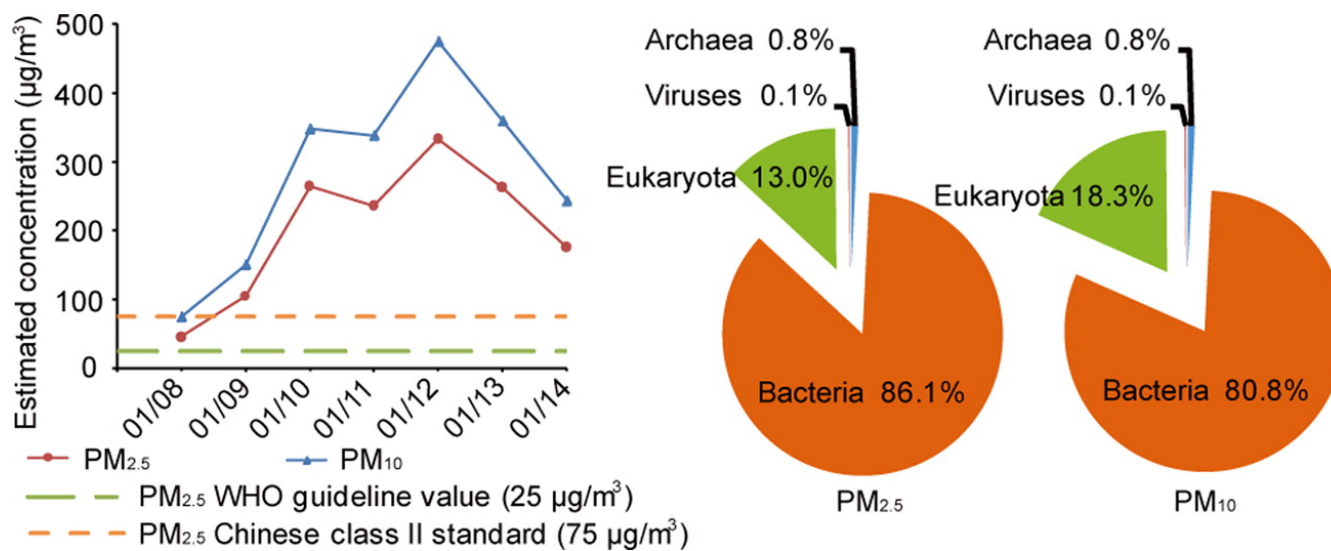
The microbial environment

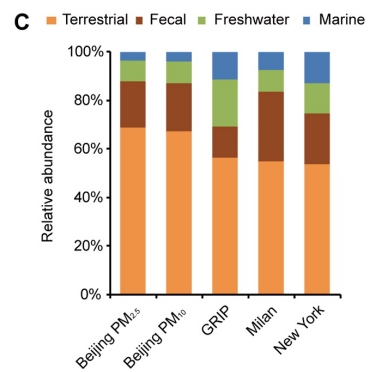
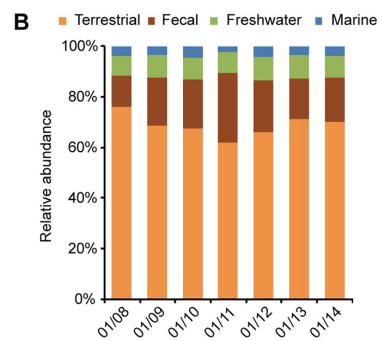
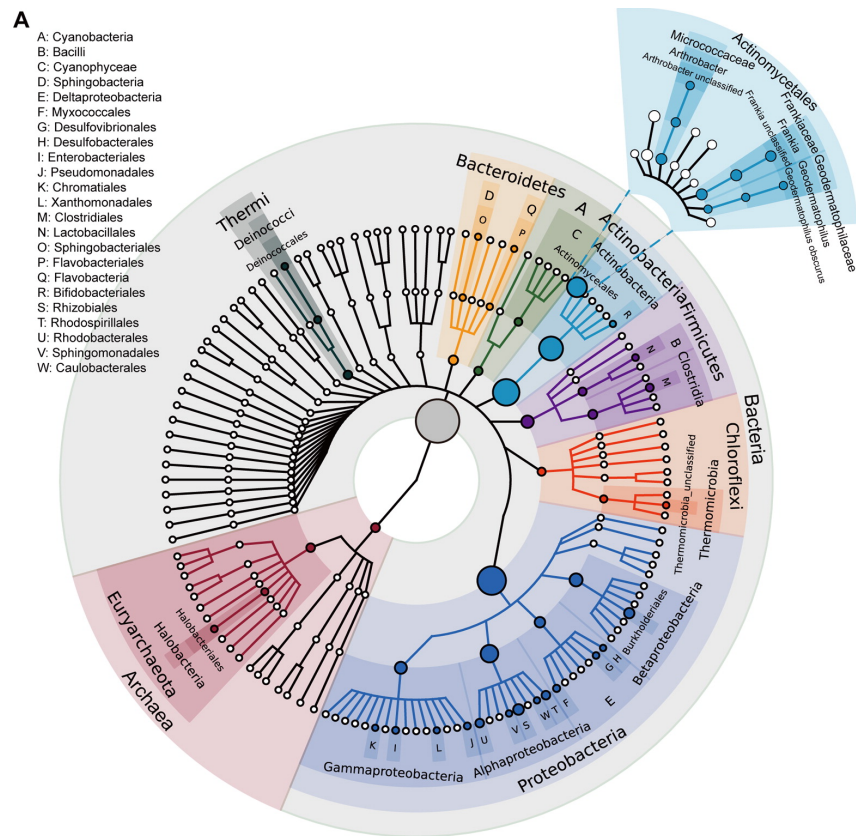
Scientific American interactive
microbiome



Discovering the microbial environment

"Meet your microbes"



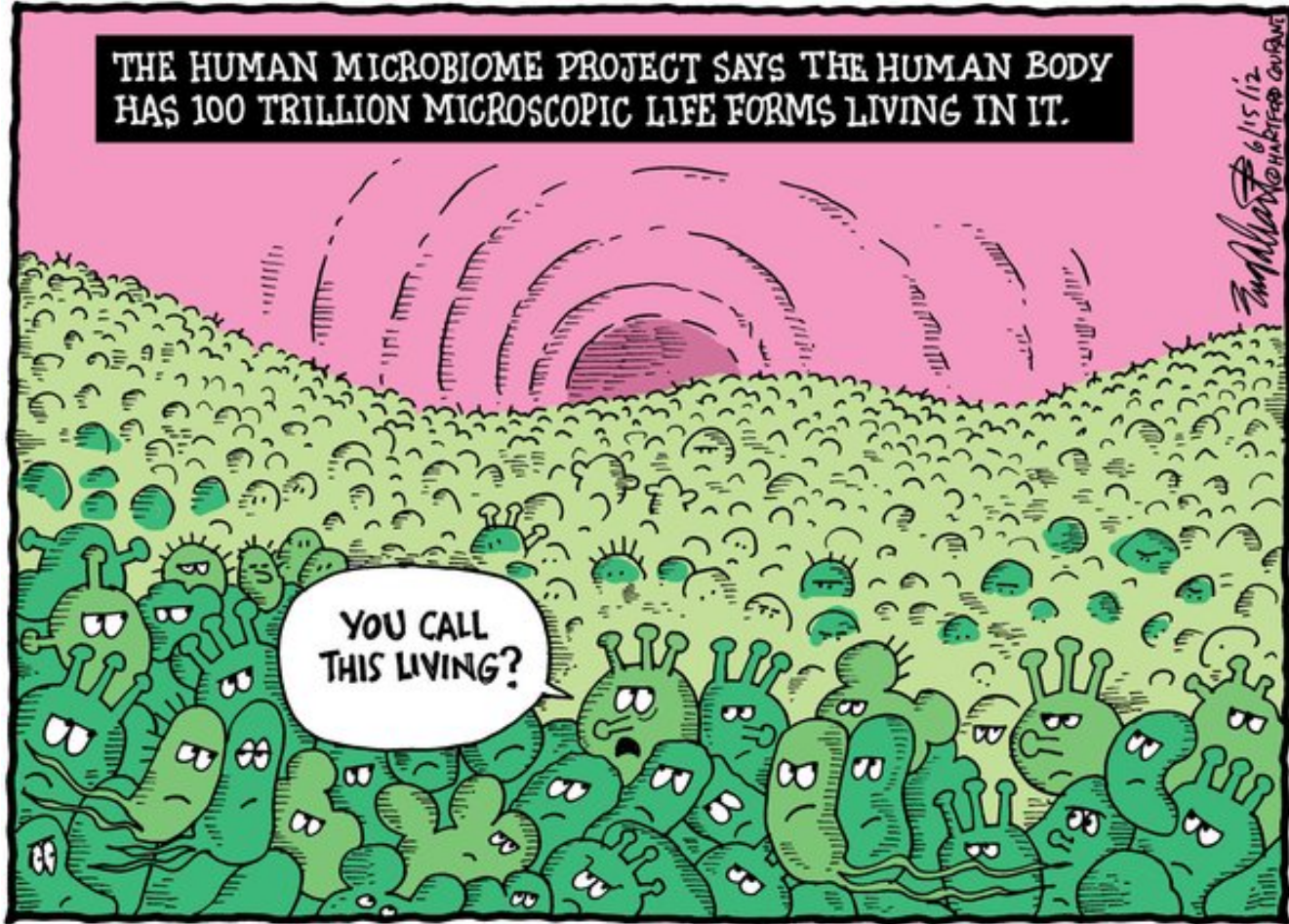


Published in: Chen Cao; Wenjun Jiang; Buying Wang; Jianhuo Fang; Jidong Lang; Geng Tian; Jingkun Jiang; Ting F. Zhu; *Environ. Sci. Technol.* **2014**, *48*, 1499-1507.

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THE HUMAN MICROBIOME PROJECT SAYS THE HUMAN BODY HAS 100 TRILLION MICROSCOPIC LIFE FORMS LIVING IN IT.



6/15/12
HARTFORD CONNECTICUT

YOU CALL THIS LIVING?

History of Molecular Biology

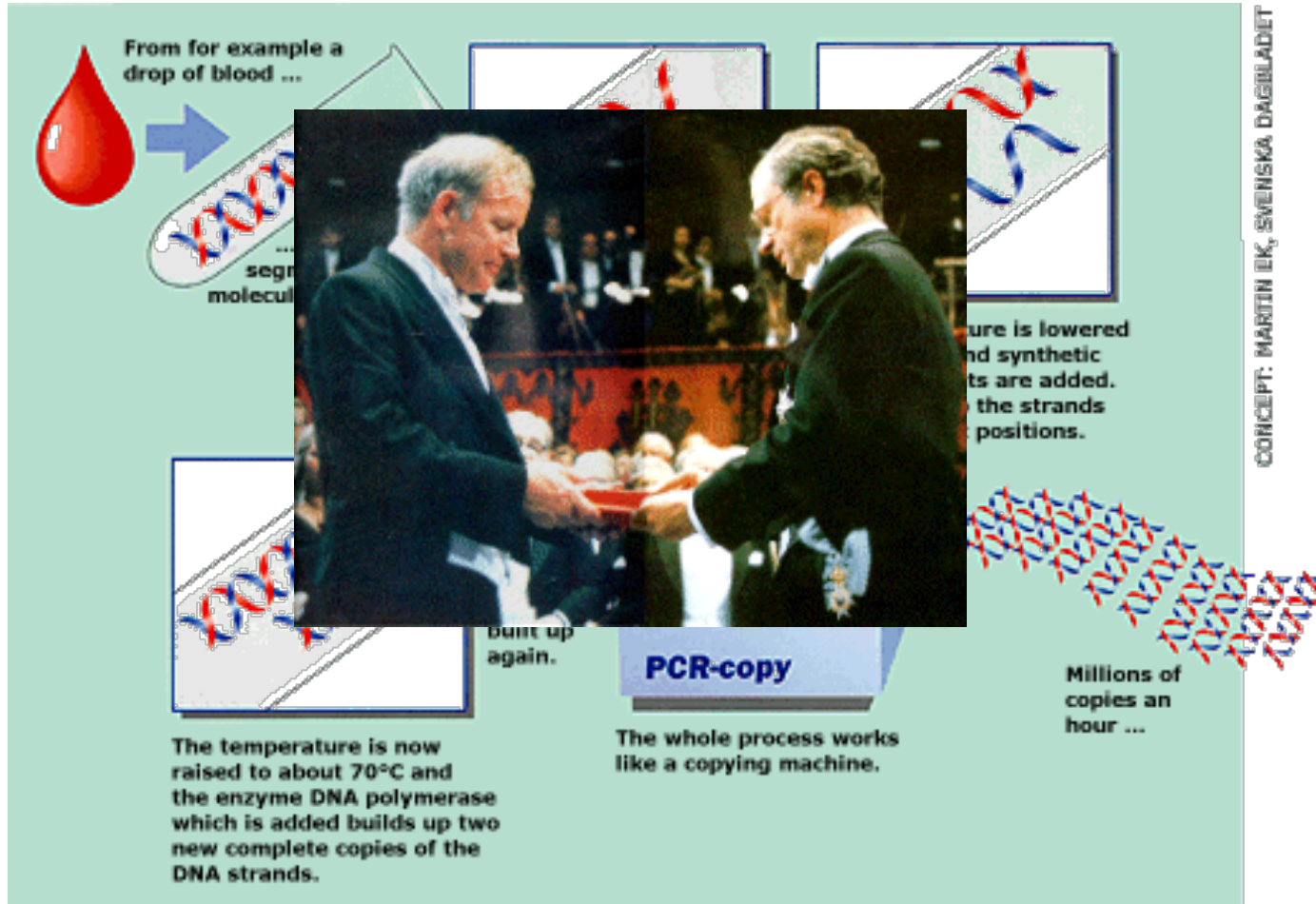
(quick version)

- Single problem - "structure and function of the gene"
- 1920s - Thomas Hunt Morgan and Herman Muller: Fruit fly mutation
- Term introduced in 1938
- 1940s - Max Delbrueck and Salvadore Luria establish "phage group"
- 1952 - Alfred Hershey and Martha Chase: DNA not protein

History of Molecular Biology (cont.)

- 1950s - Maurice Wilkins, Rosiland Franklin, Linus Pauling → Watson & Crick
- 1961 - Marshall Nuremburg and Heinrich Mattaei: linear structure/function relationship
- Subsequent: overlapping genes (1976), split genes (1977), alternative splicing (1978)
- 1962 Sanger sequencing
- 1980s PCR
- Many new fields pioneered incl. molecular evolution, model systems *C. elegans*

Inventing PCR



Module 1

- Learn techniques
- Design, analysis, interpretation
- Communication

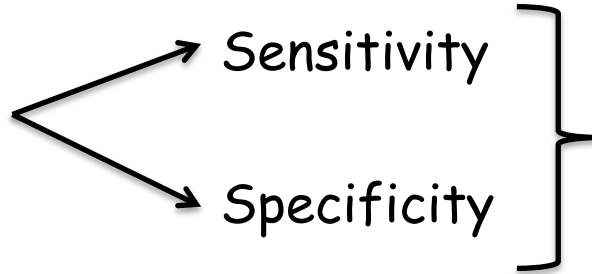
Our subject



Module 1

Explore
Microsporidia
Primer design
(2 strains)

Sample(s)



Evaluate &
compare
with class

Module 1

