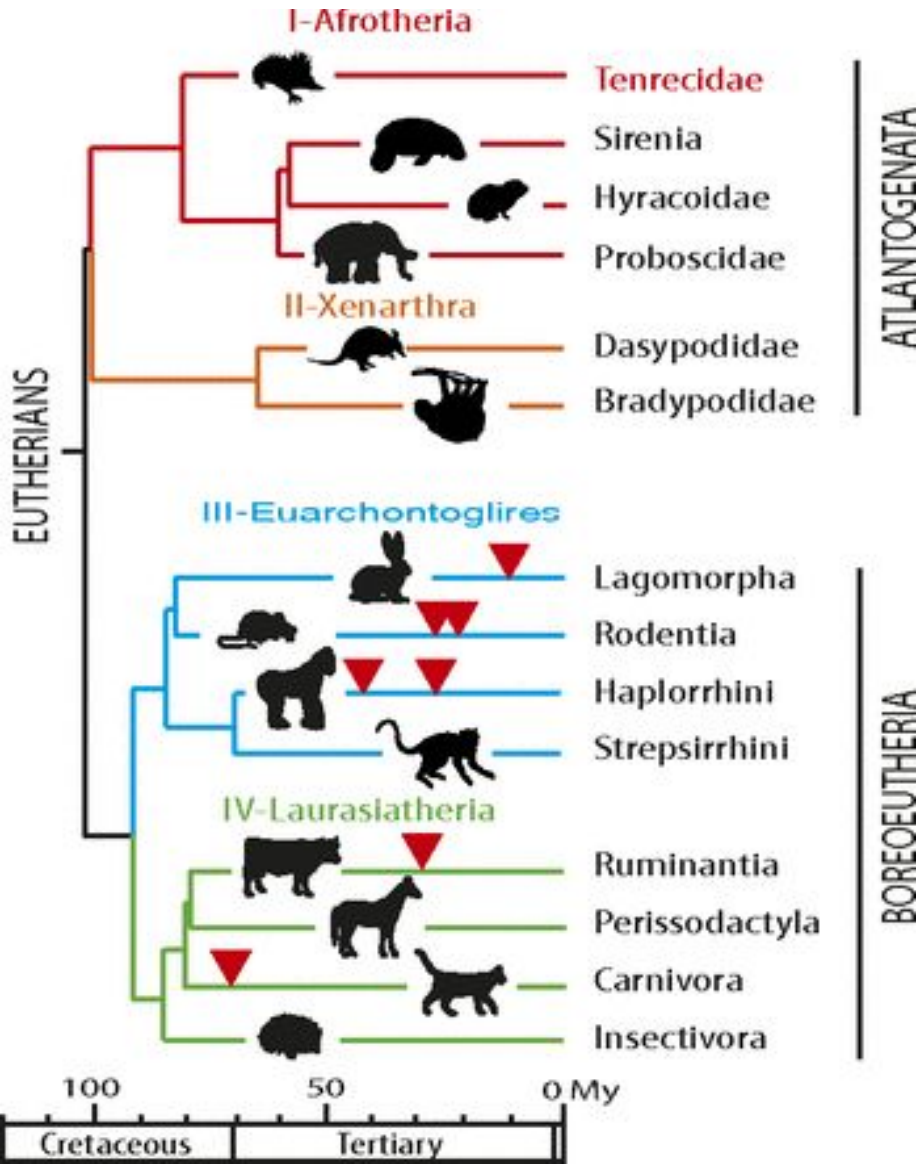
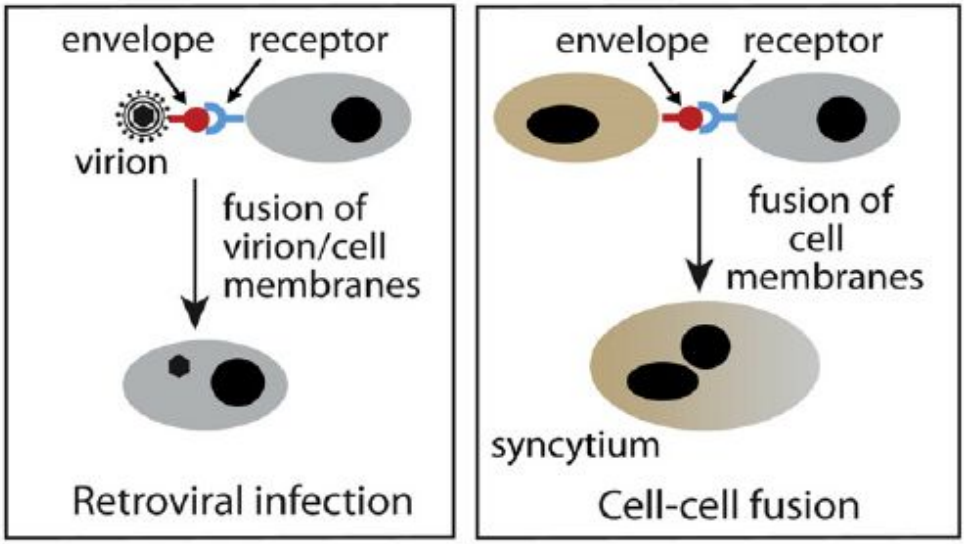
Віруси, що подарували нам плаценту

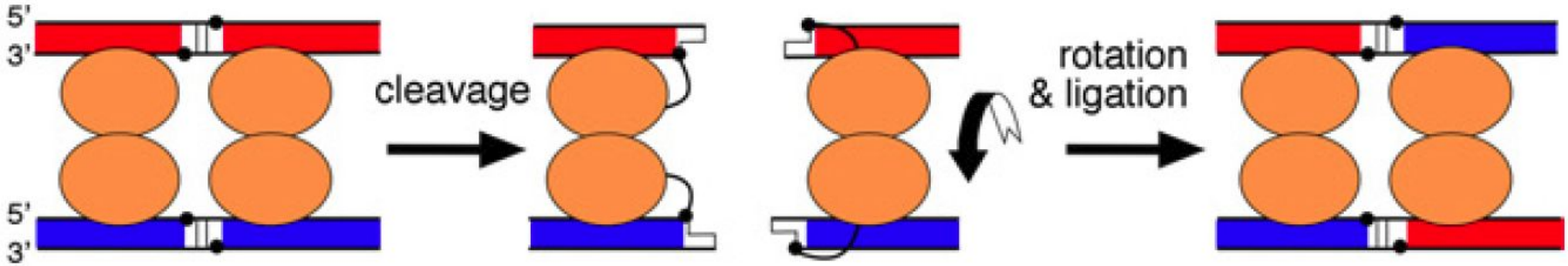


- ретроВіруси становлять більше 8 % нашого геному
- Ретротранспозони
- Вірусні промотори та енхансери

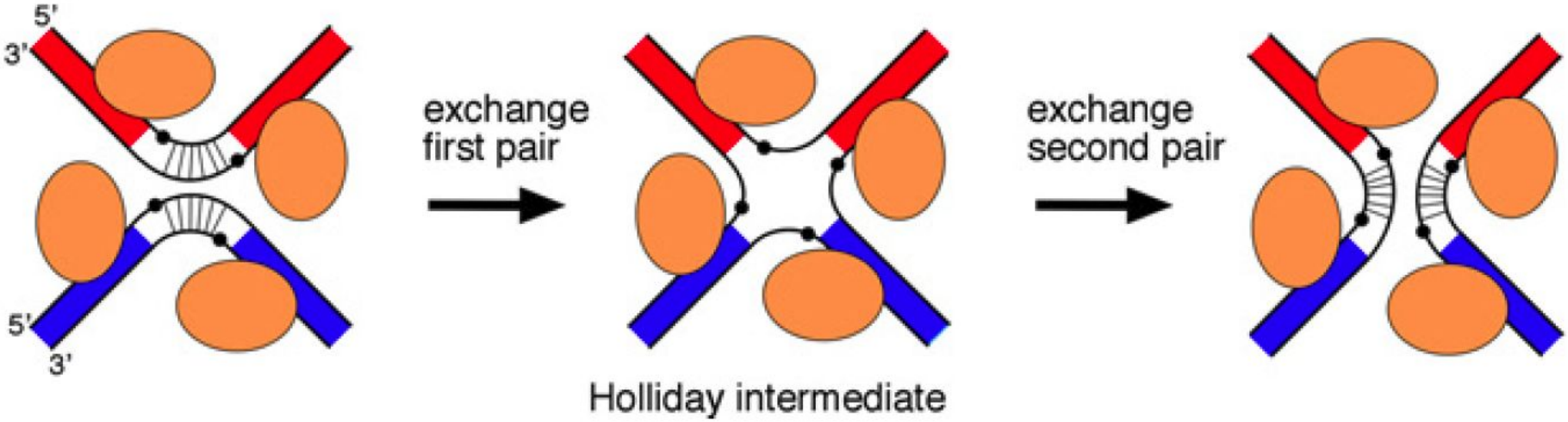


палеовирусология

A Serine recombinases



B Tyrosine recombinases



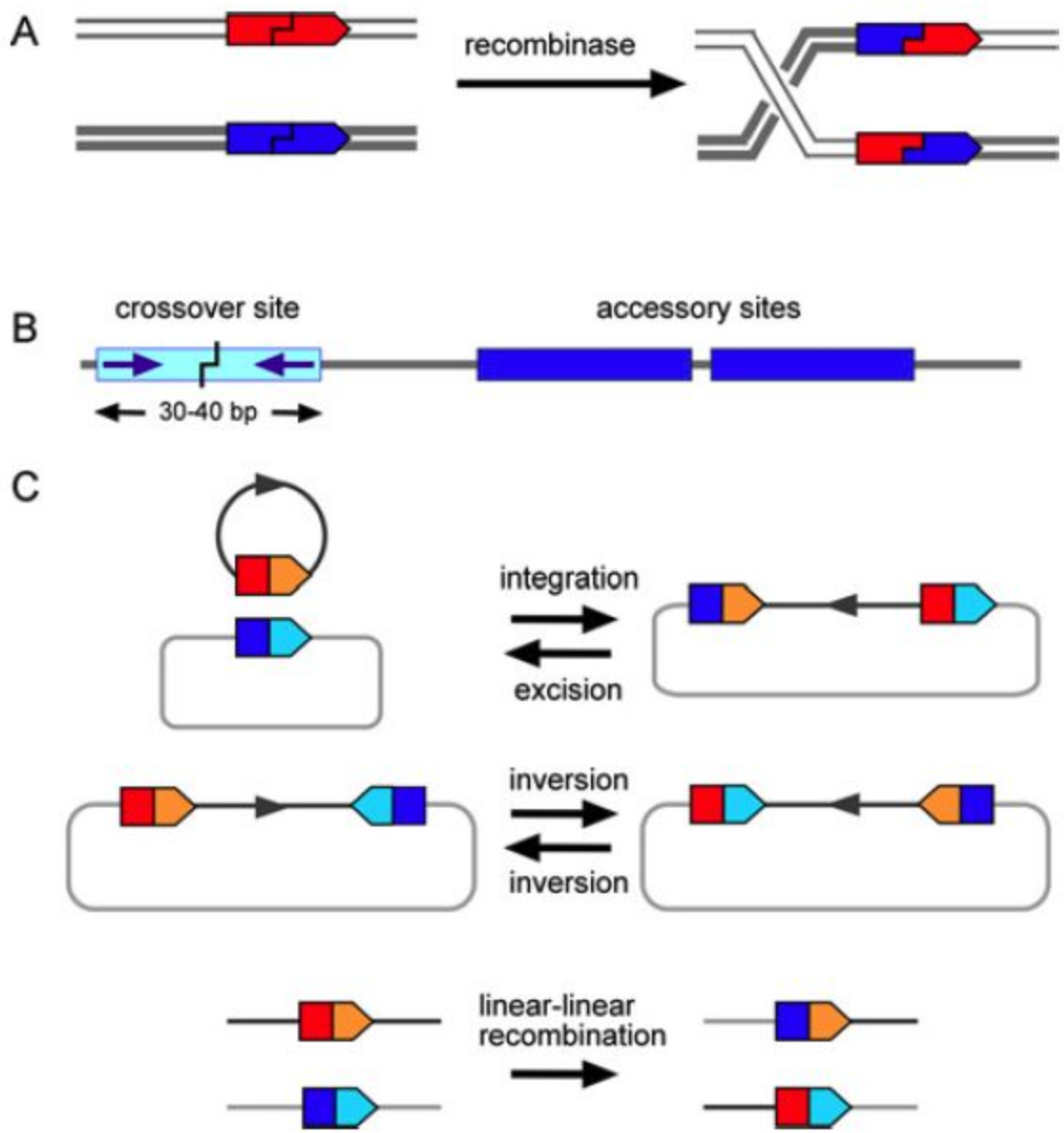
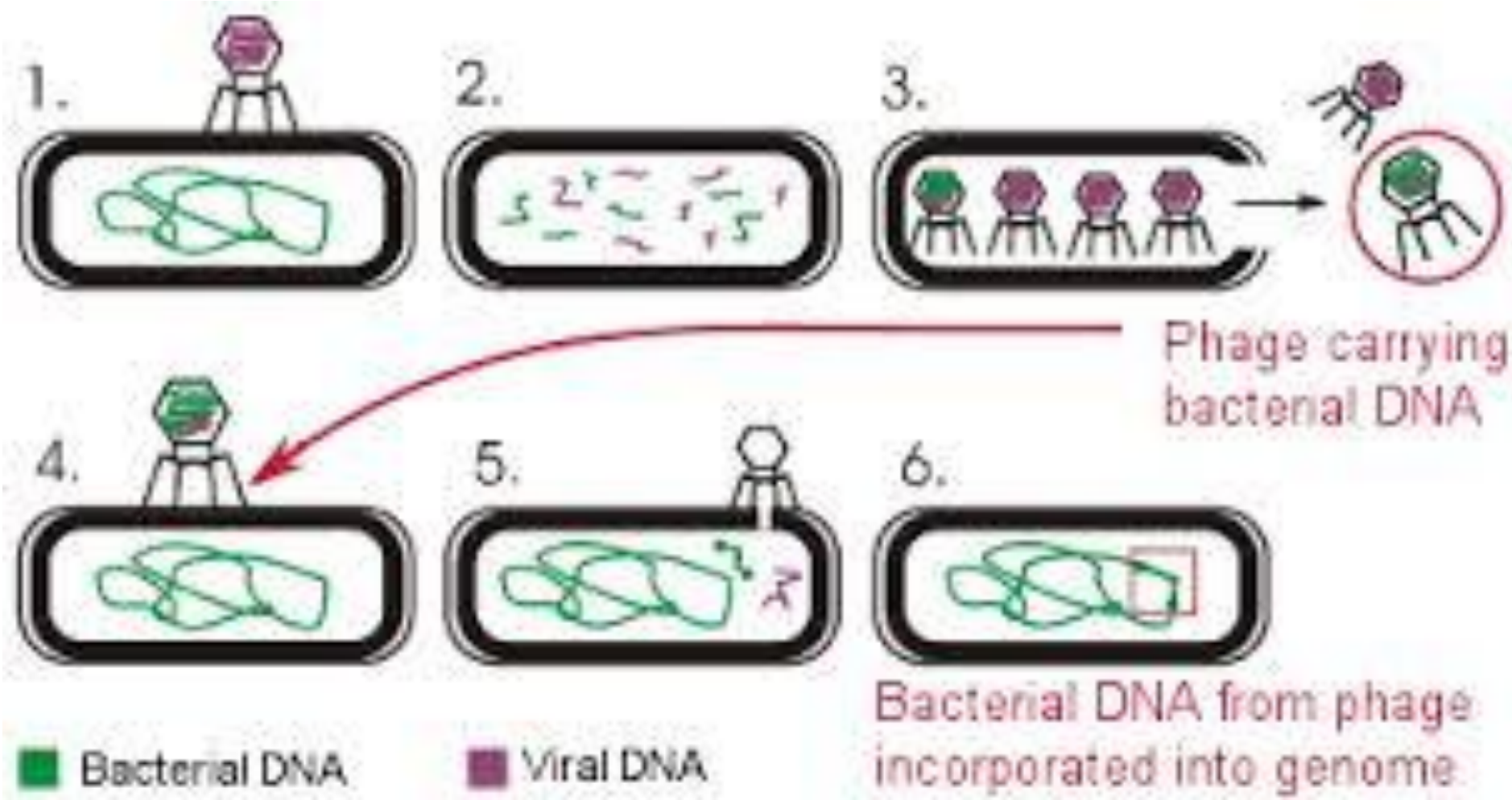


Figure 1 Site-specific recombination: the basics

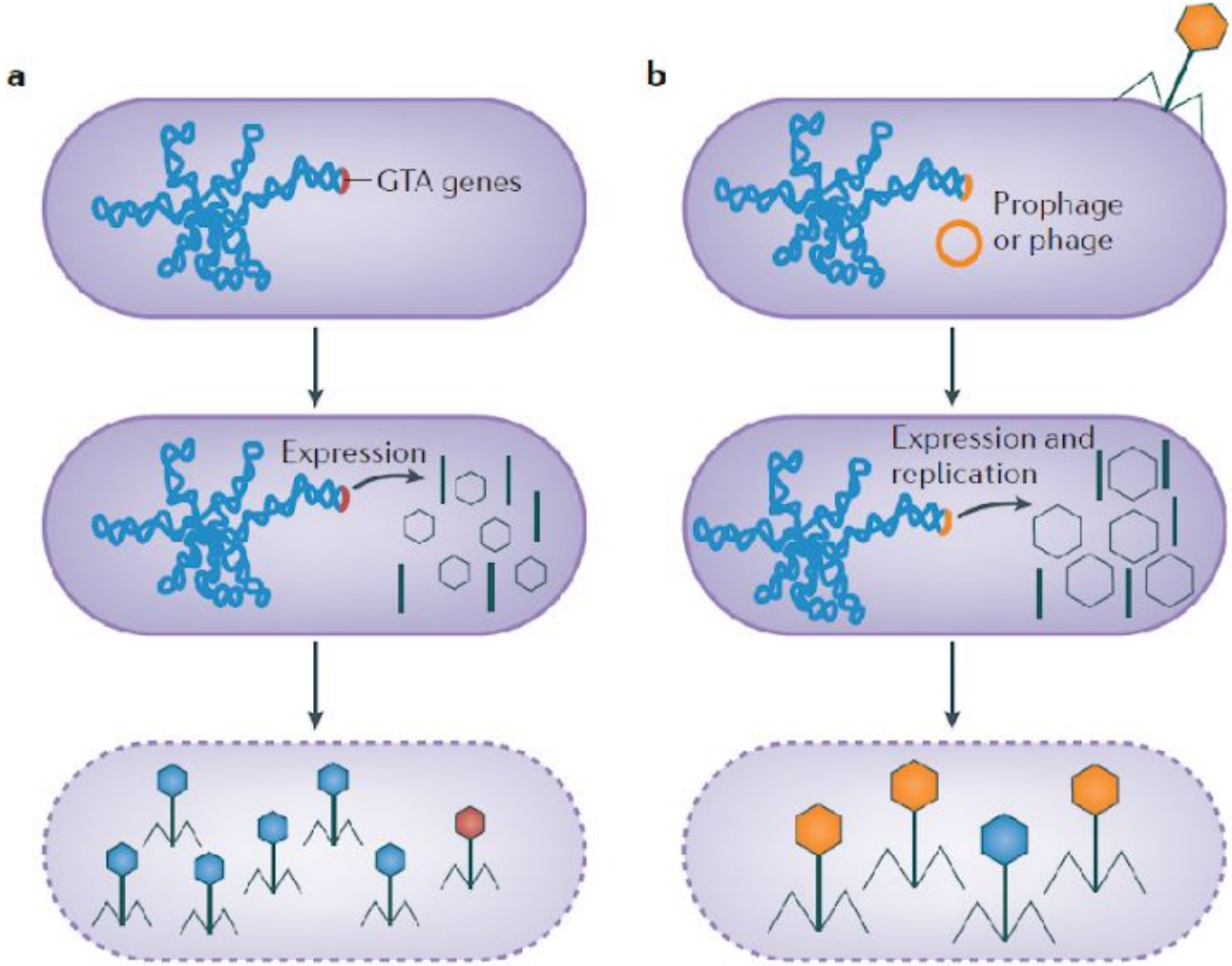
Фагові фактори вірулентності деяких патогенних бактерій

Бактерія	Фаг	Продукт	Фенотип
Vibrio cholerae	CTX phage	холерний токсин	холера
Escherichia coli	lambda phage	shigalike токсин	геморагічна діарея
Clostridium botulinum	clostridial phages	токсин ботуліну	ботулізм
Corynebacterium diphtheriae	corynephage beta	дифтерійний токсин	дифтерія
Streptococcus pyogenes	T12	еритрогенний токсин	червона лихоманка

Перевізники генів

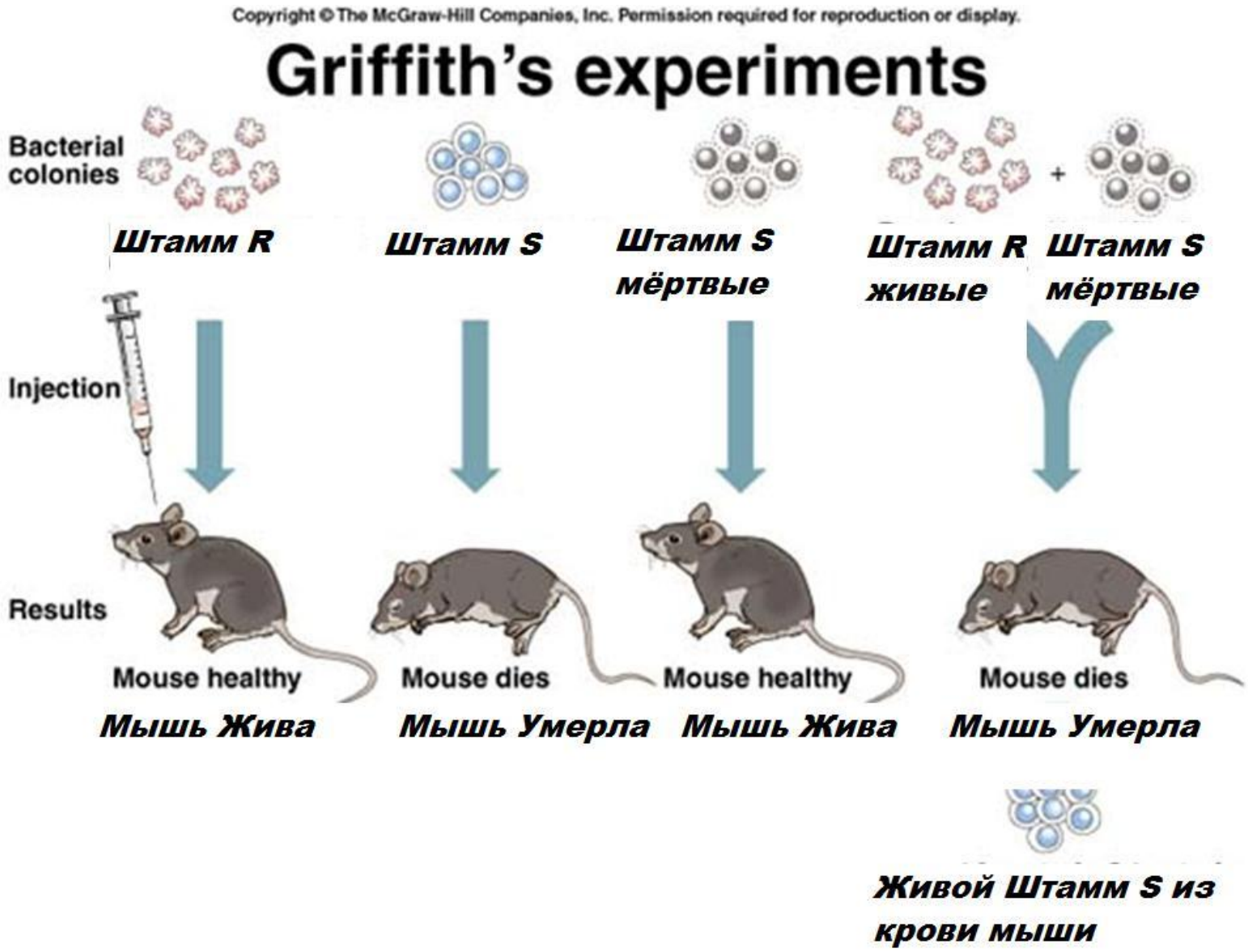


Gene transfer agent

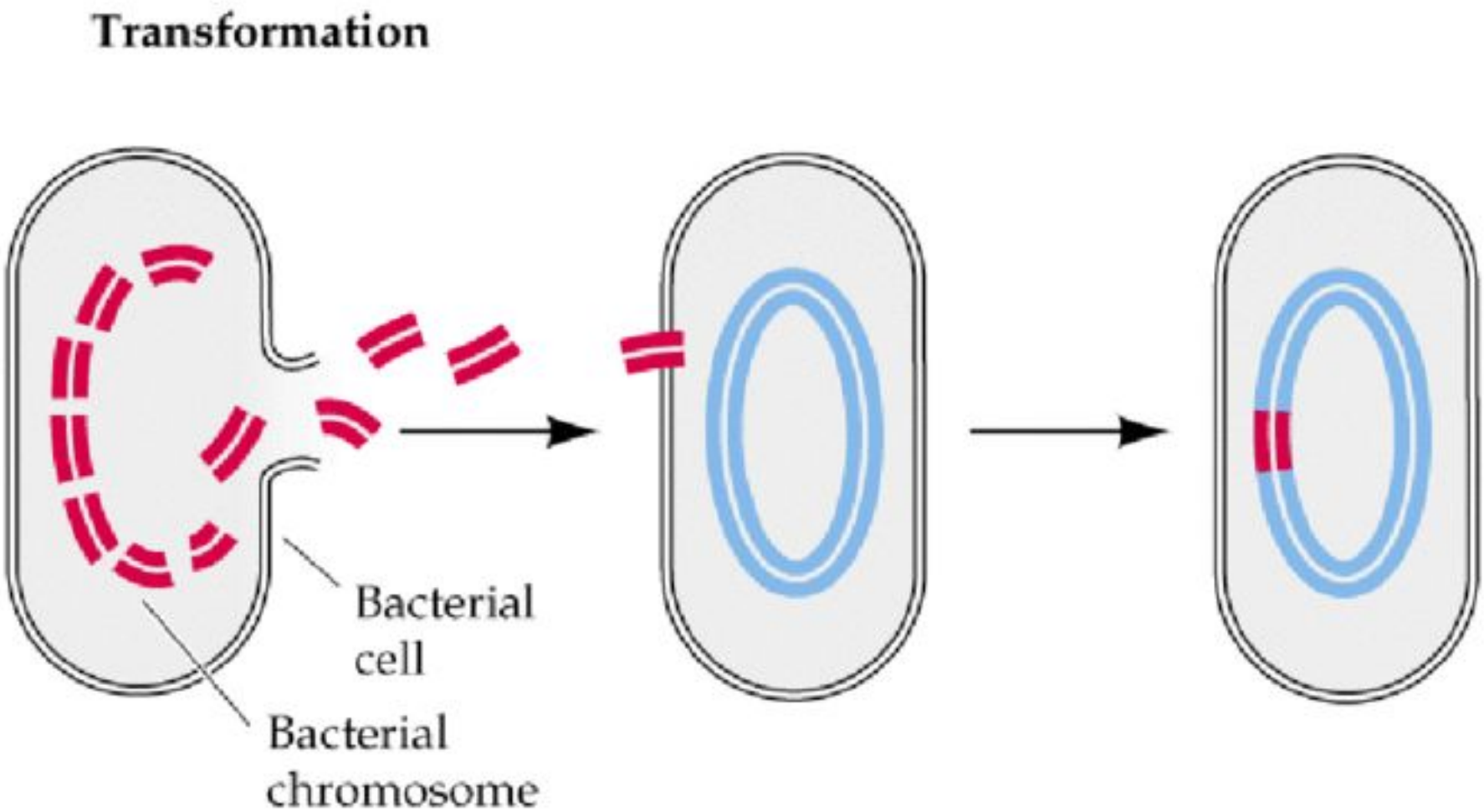


бактерії

Відкриття трансформації



А що, як знадобиться?



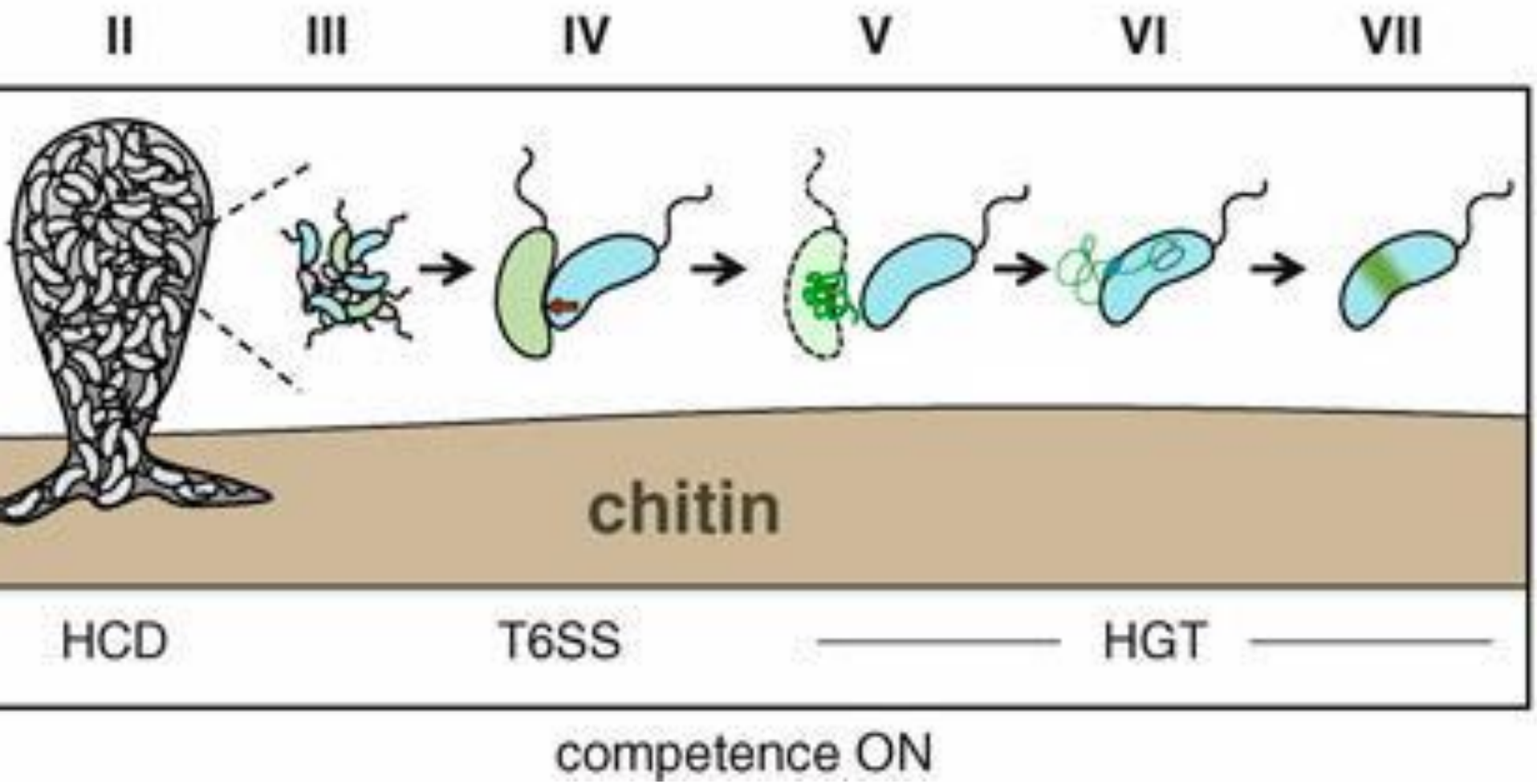
Permission pending from Sinaur Associates, Inc.

Figure 8.25 The mechanism of genetic transformation in bacteria. Some similarity is needed for the donor and recipient to align. Genes *a*, *b*, *c*, and *d* may be mutations of genes *A*, *B*, *C*, and *D*.

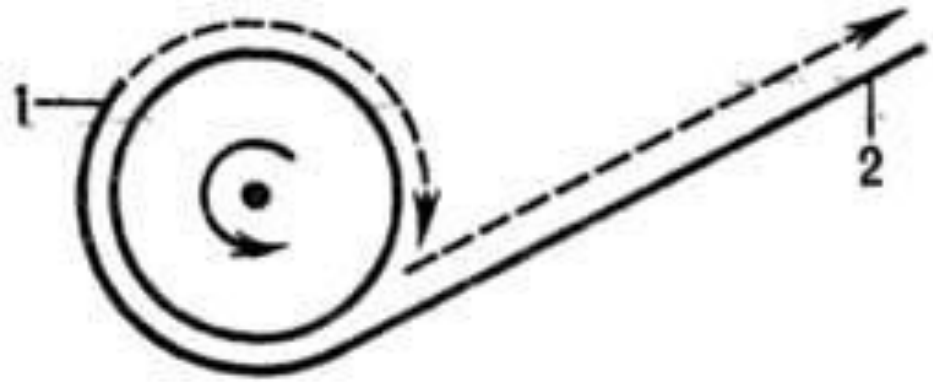
Як це могло еволюціонувати?

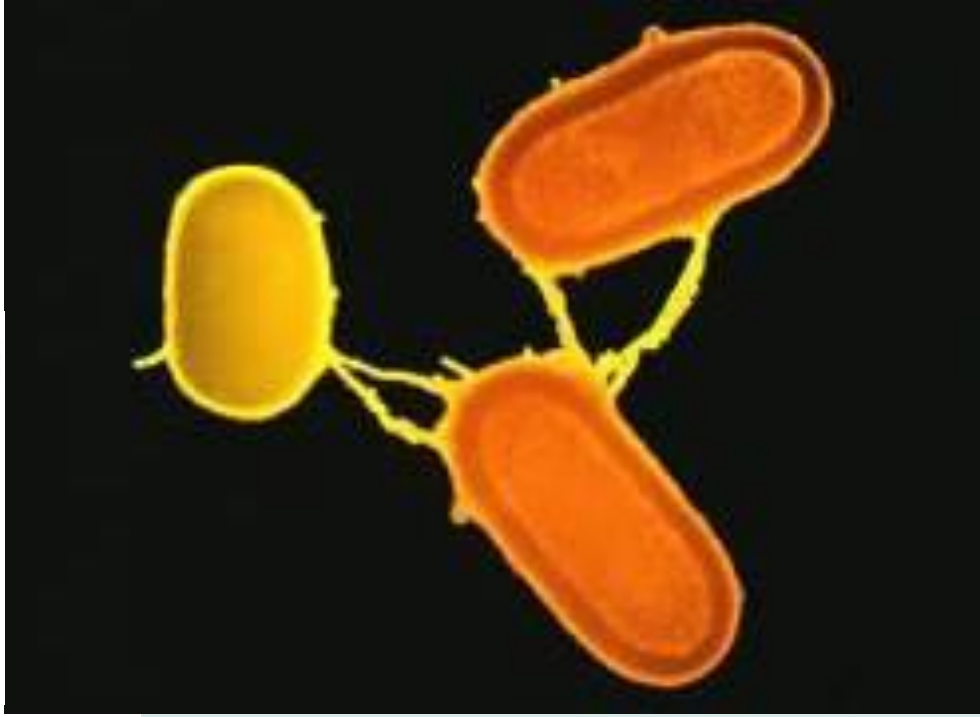
- 1) репарація – частота трансформації зростає після пошкодження днк
- 2)хочеться їсти
- 3)нові гени у несприятливих умовах

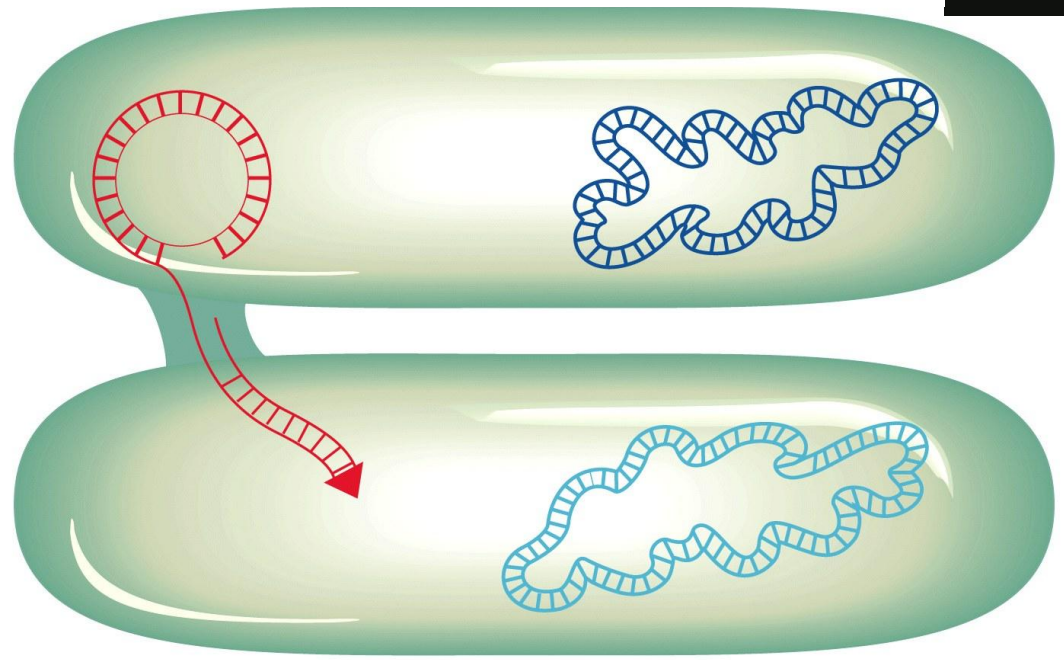
Вбивство заради генів



Поділишся зі мною генами?







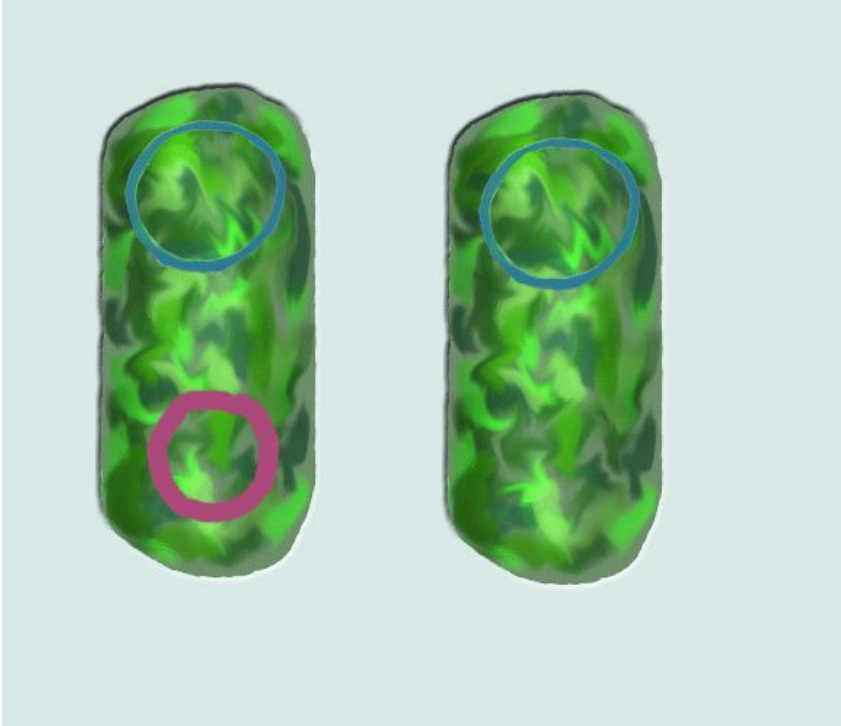
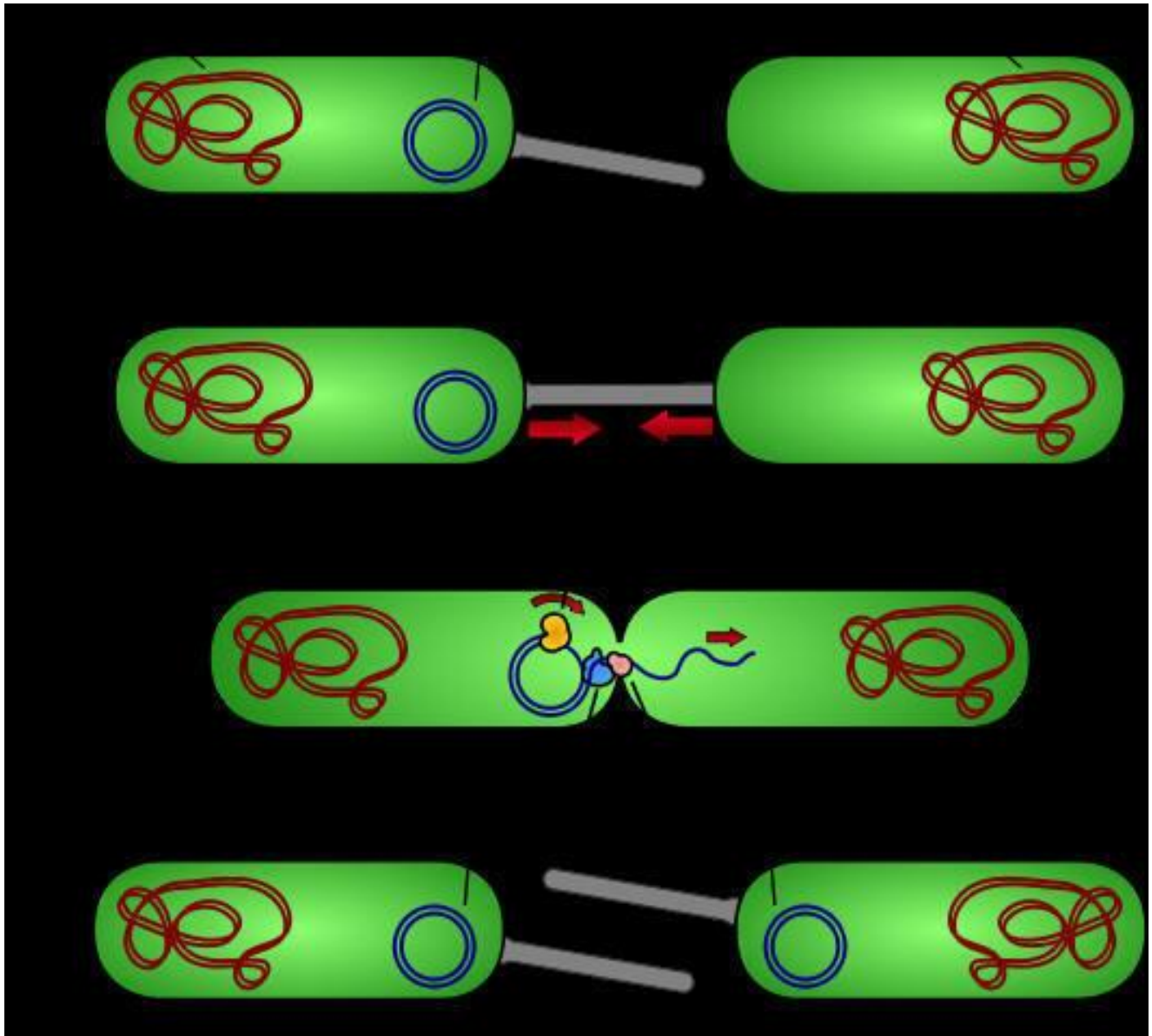
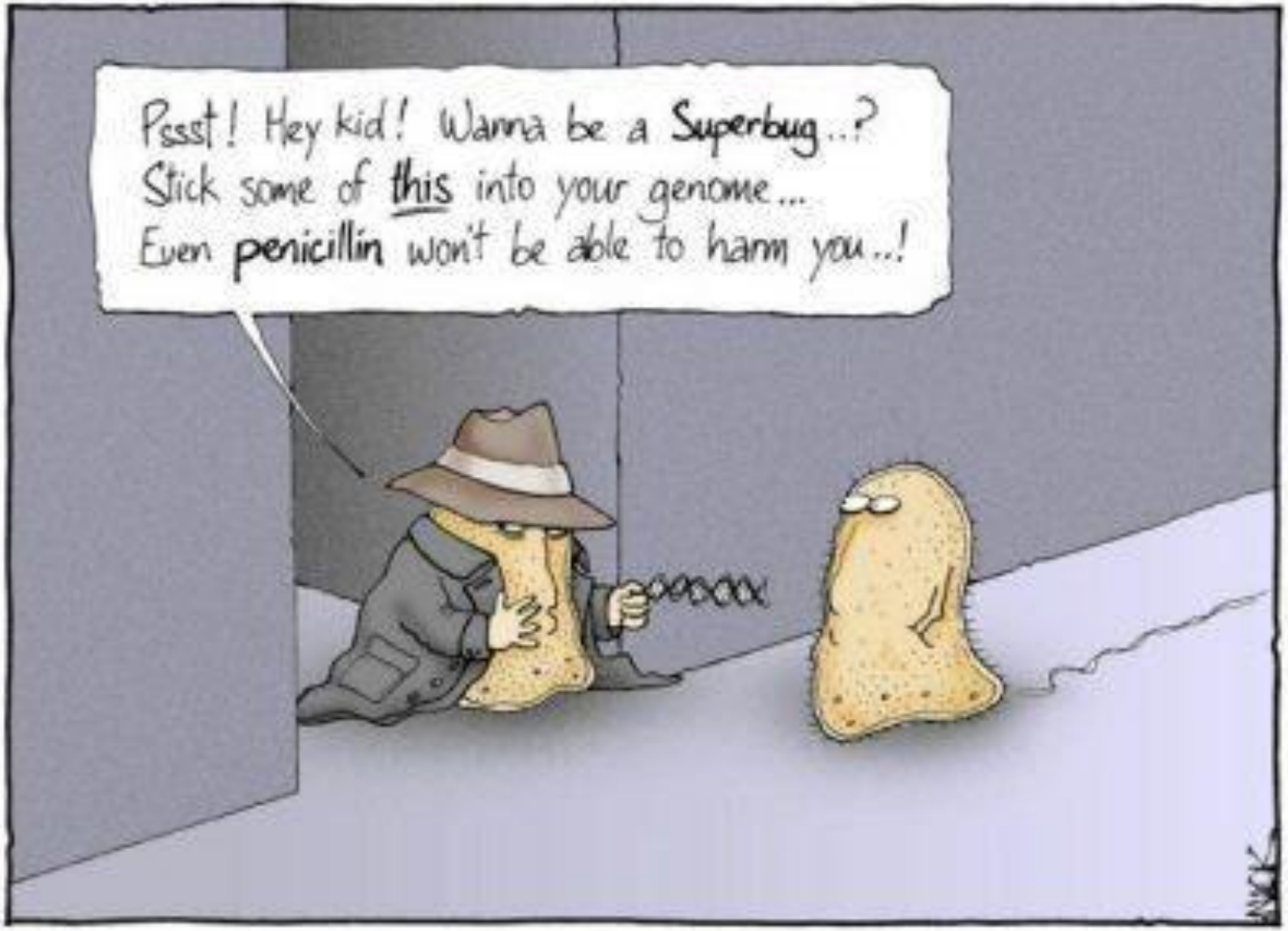


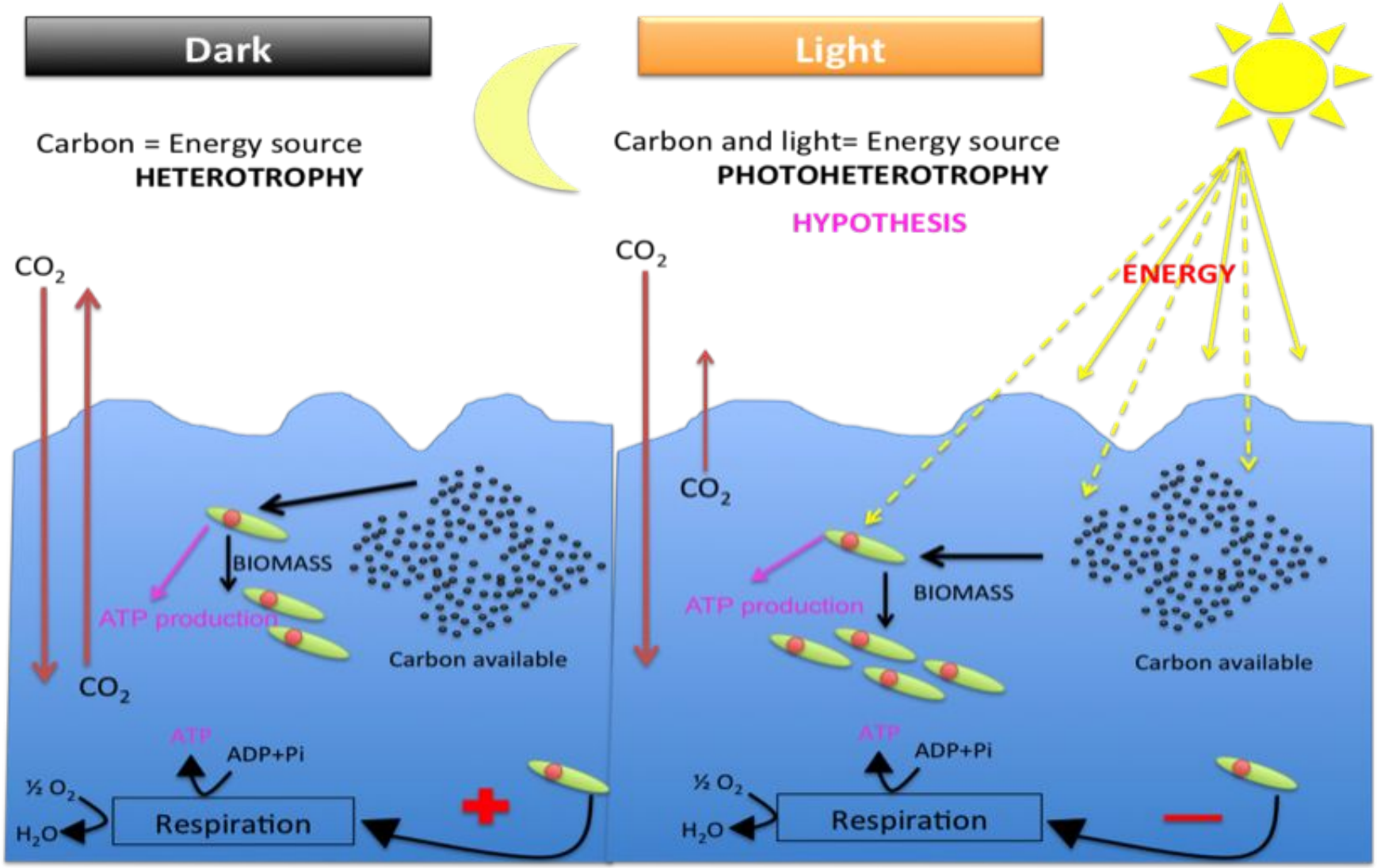
Figure 5-8b
Introduction to Genetic Analysis, Tenth Edition
© 2012 W. H. Freeman and Company





It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.

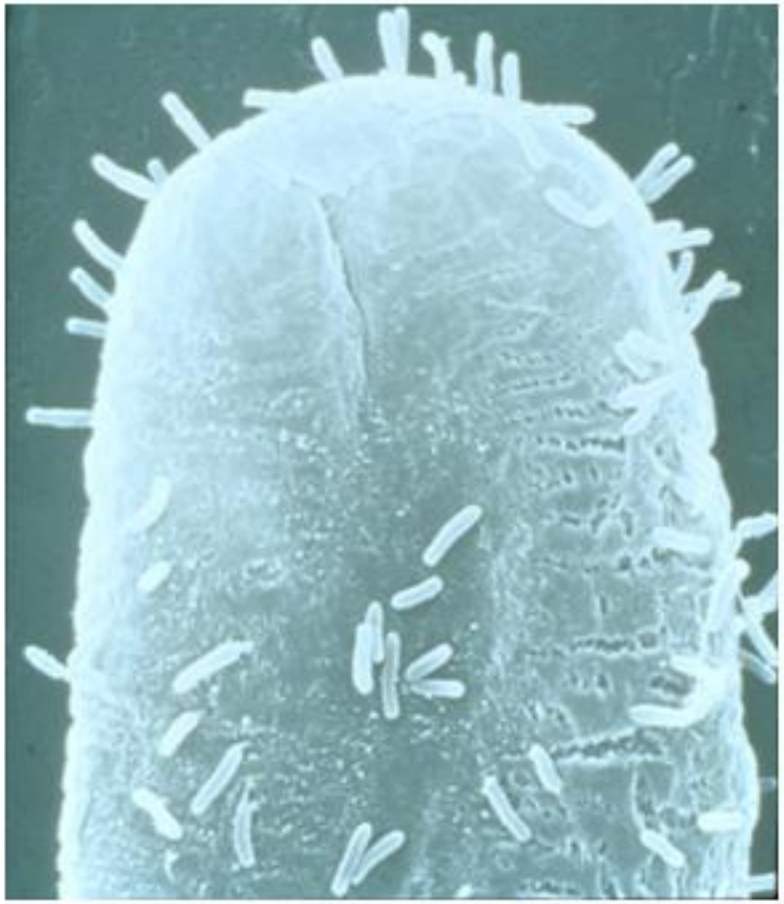
Океан генів


Dark
Carbon = Energy source
HETEROTROPHY
CO2
CO2
BIOMASS
ATP production
Carbon available
ATP
ADP+Pi
½ O2
H2O
Respiration
Light
Carbon and light= Energy source
PHOTOHETEROTROPHY
HYPOTHESIS
CO2
CO2
ENERGY
ATP production
BIOMASS
Carbon available
ATP
ADP+Pi
½ O2
H2O
Respiration

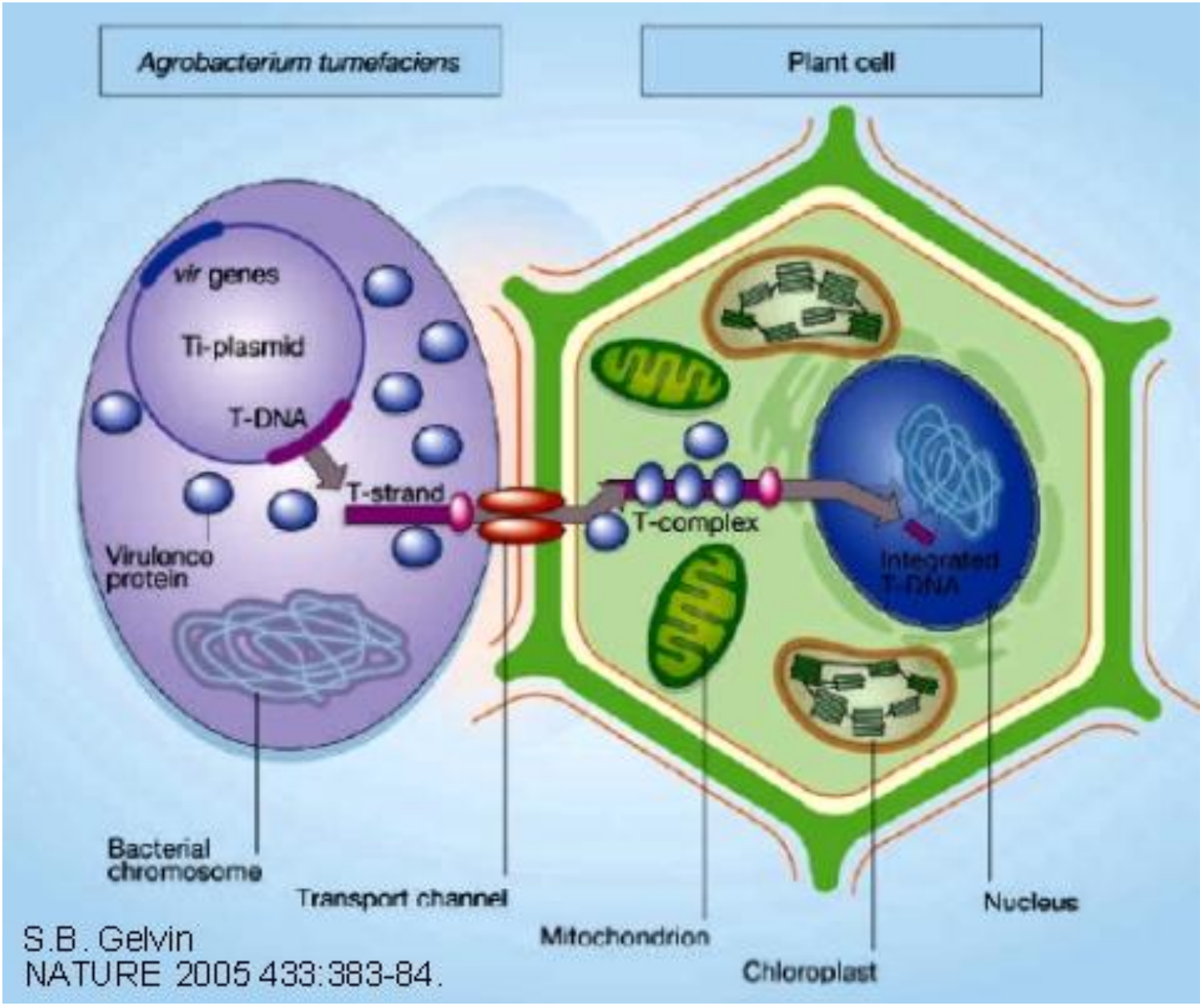
Agrobacterium tumefaciens

Природный генный инженер

Опухоль, вызванная внедрением бактериальной ДНК в растительные клетки

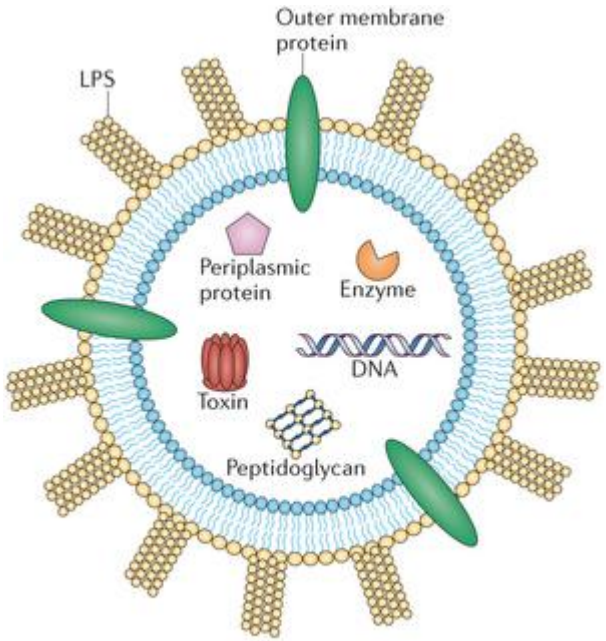


Агробактерии на поверхности растительной клетки

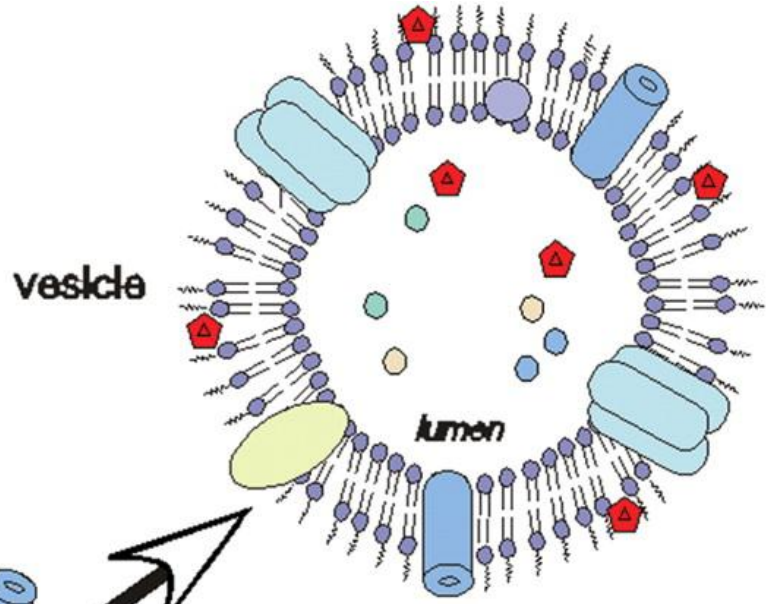


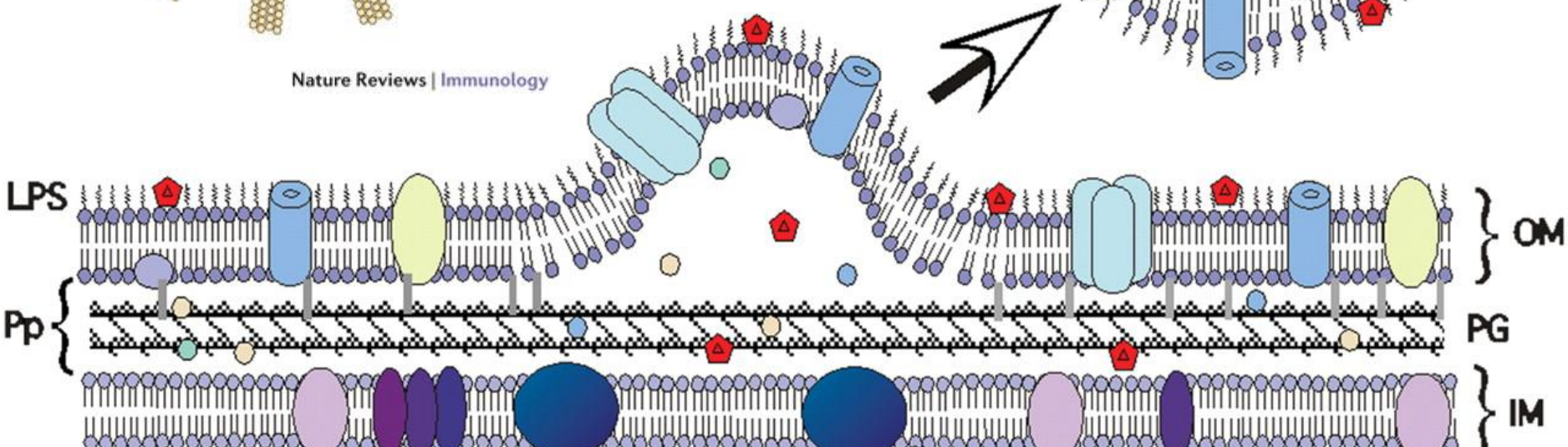
S.B. Gelvin
NATURE 2005 433:383-84.

Outer membrane vesicles

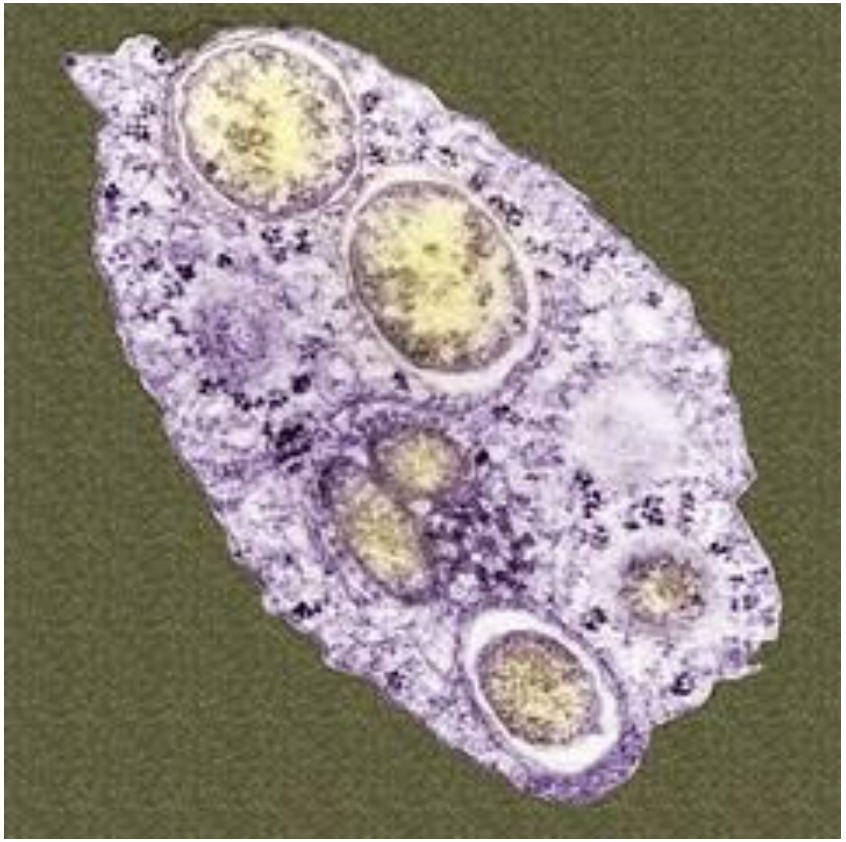


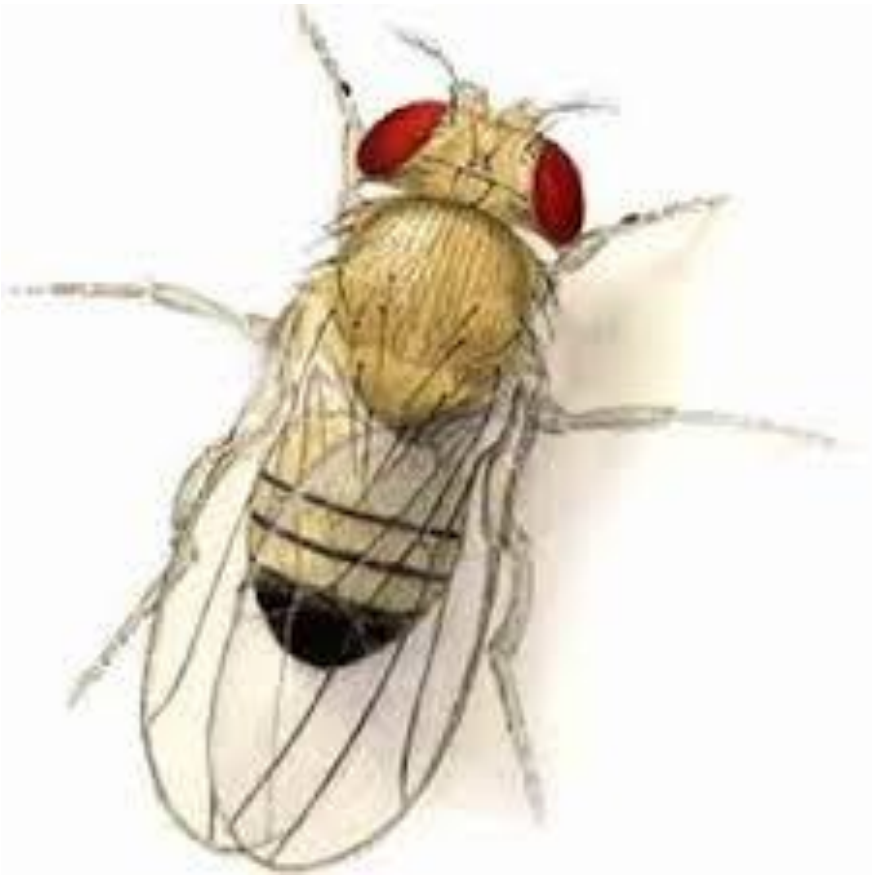
Nature Reviews | Immunology



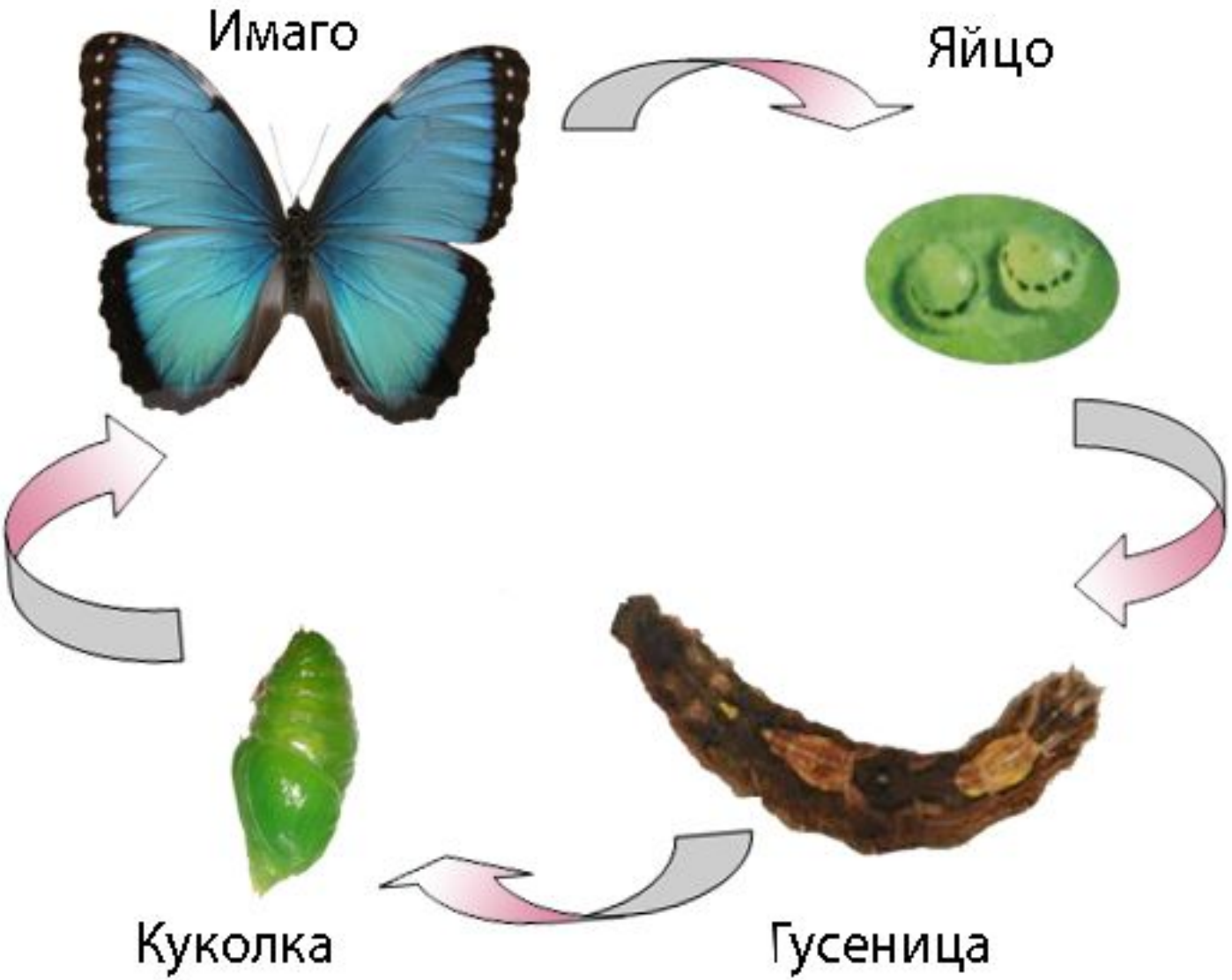


Повелитель мух

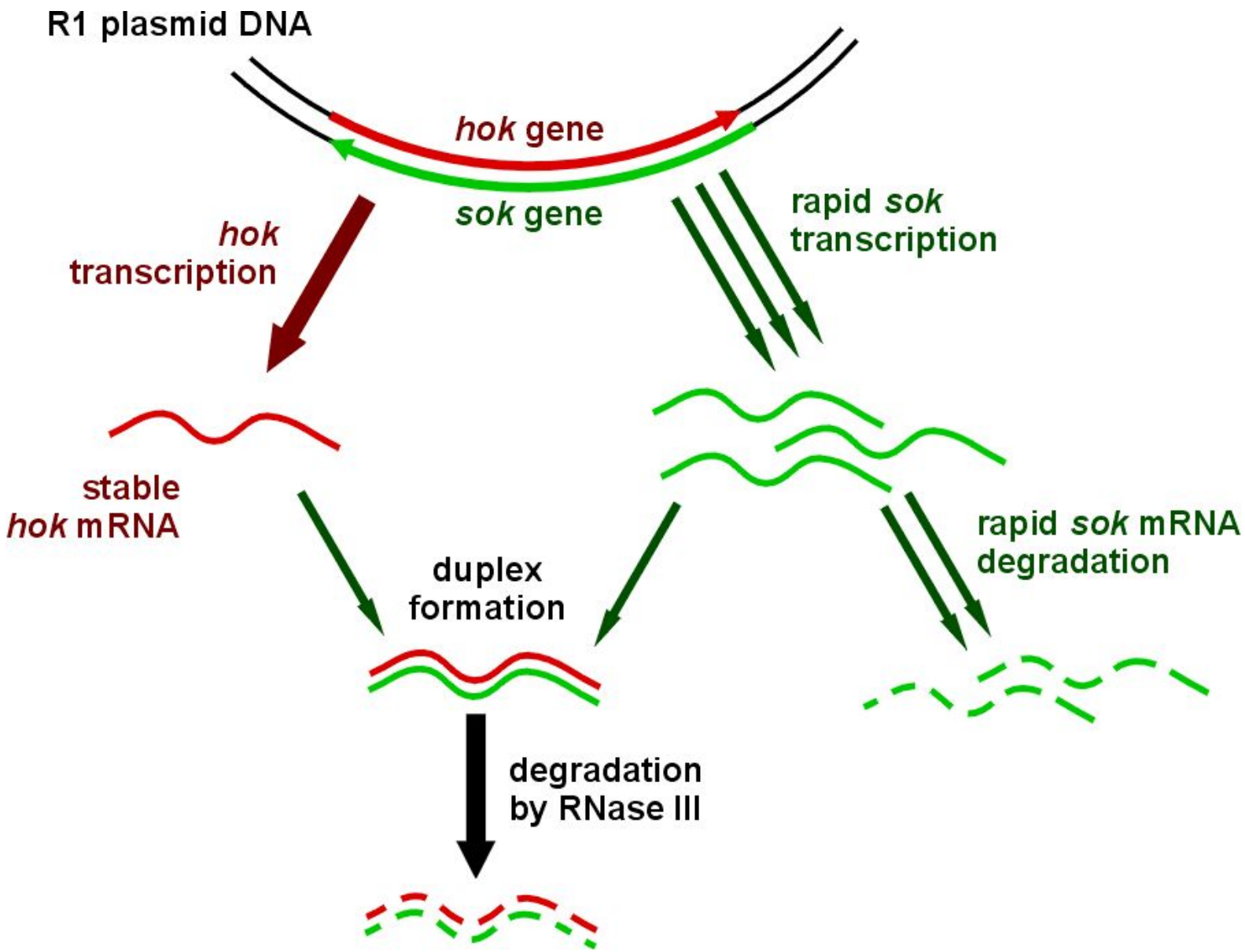




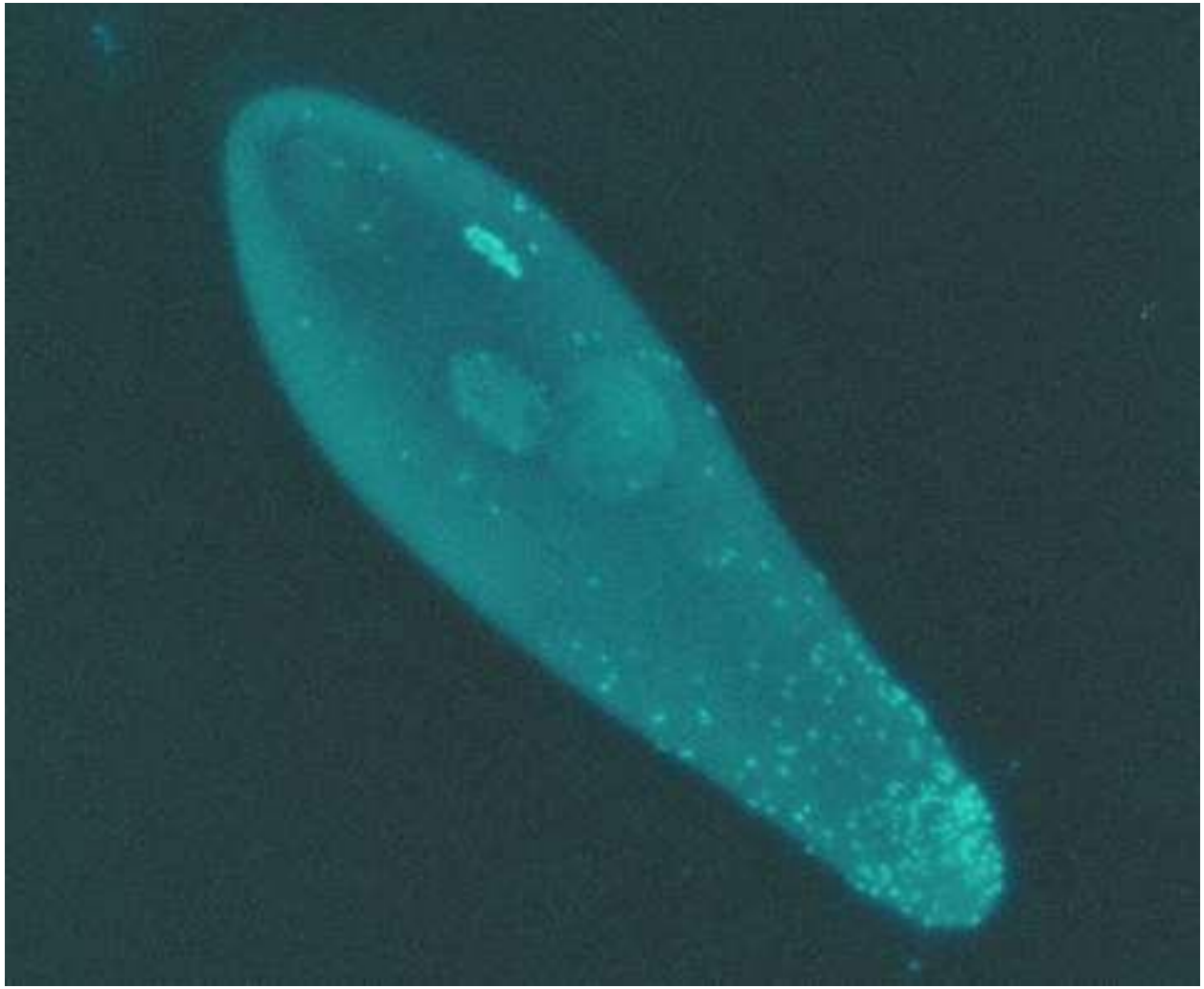
Повелитель мух



Без мене помреш!

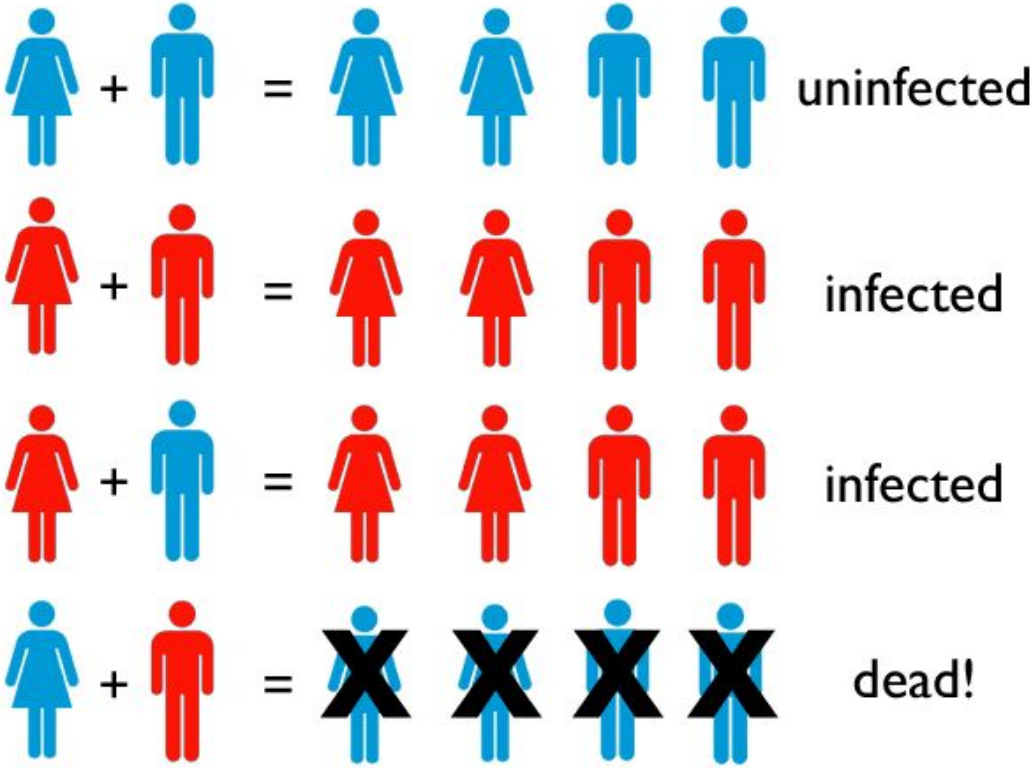


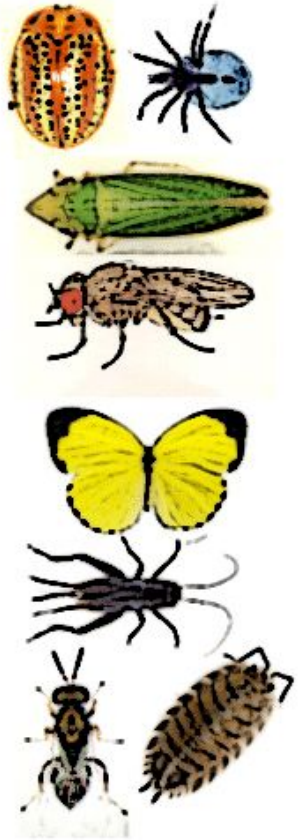
Змінюючи стать



Творці нових видів

Cytoplasmic Incompatibility

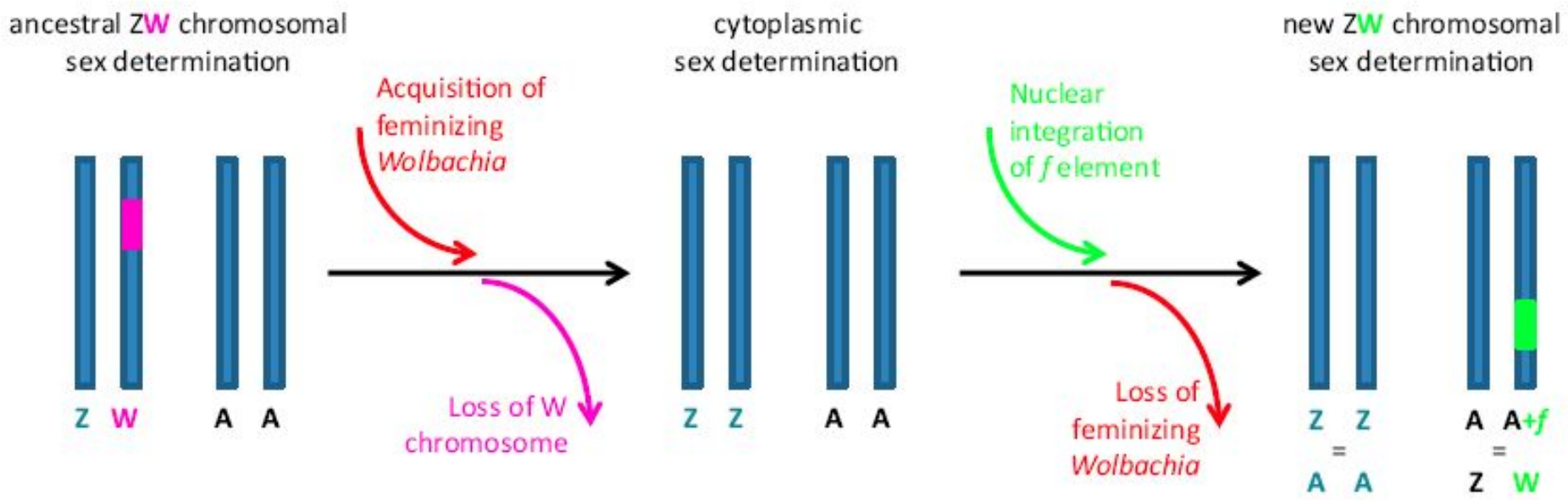




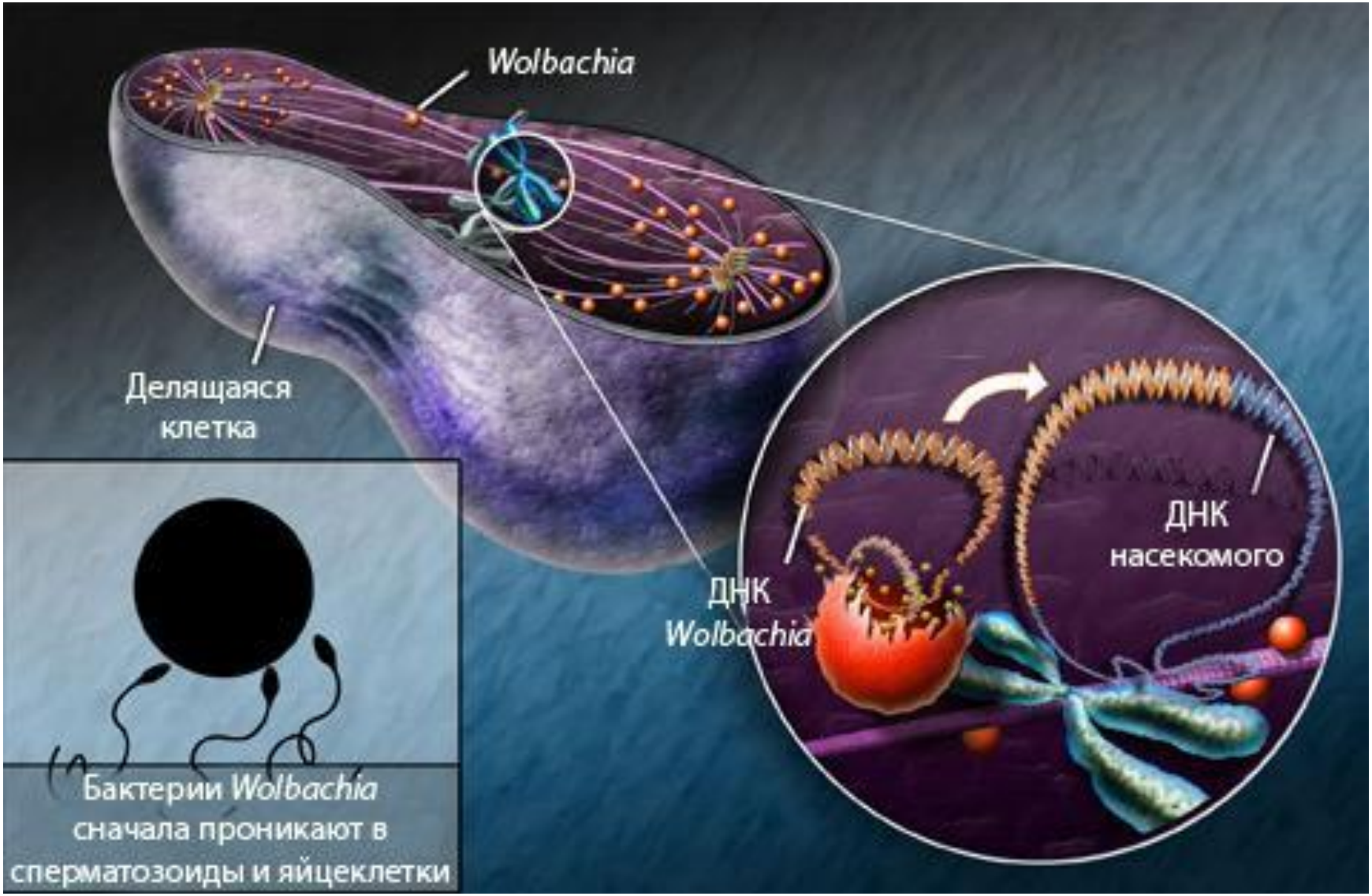
Infected males are incompatible with uninfected females

Творці нових видів

- в Північній Америці виявлені форми цвіркунів, не здатні схрещуватися один з одним, які, однак, після курсу лікування тетрацикліном раптово стають цілком сумісними і починають давати живе і здорове гібридне потомство ...


ancestral ZW chromosomal sex determination
Z W
A A
Acquisition of feminizing Wolbachia
Loss of W chromosome
cytoplasmic sex determination
Z Z
A A
Nuclear integration of f element
Loss of feminizing Wolbachia
new ZW chromosomal sex determination
Z Z
=
A A
A A+f
=
Z W

А чи не занадто?



еукаріоти

нематоди

9595513
John Takai | Dreamstime.com
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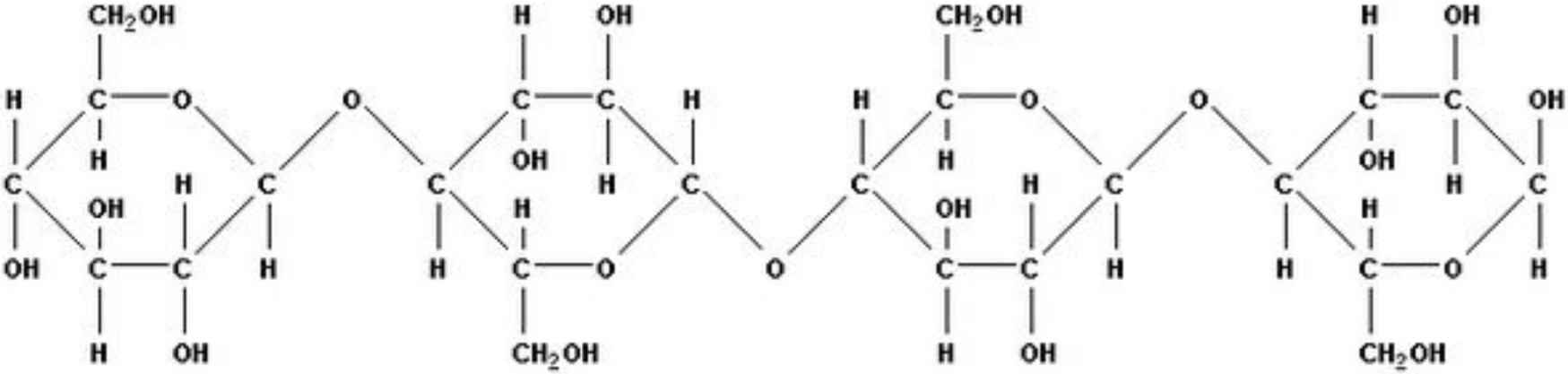
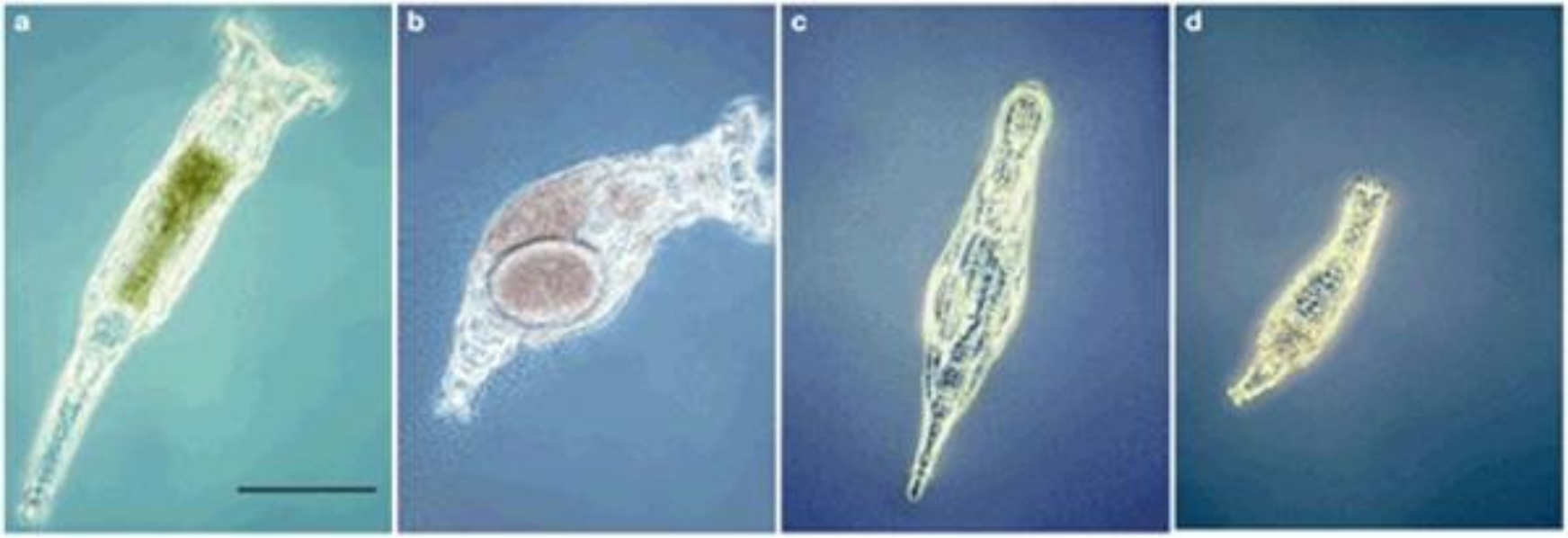


Коловертки

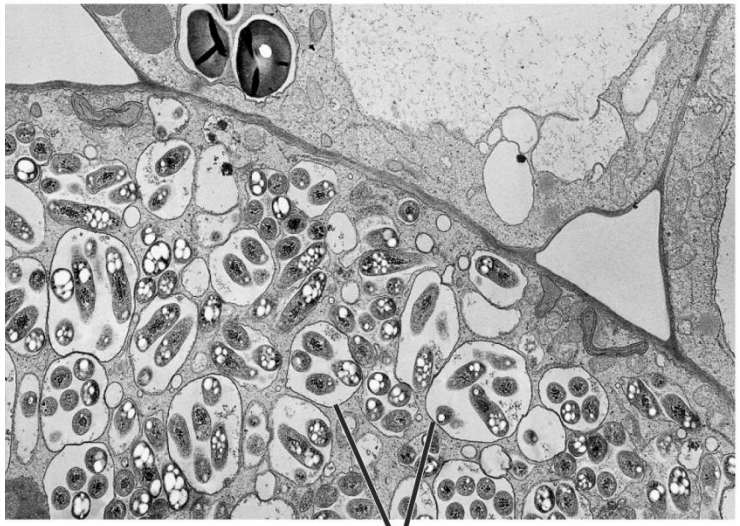
Крадії генів тварин, рослин, грибів й бактерій

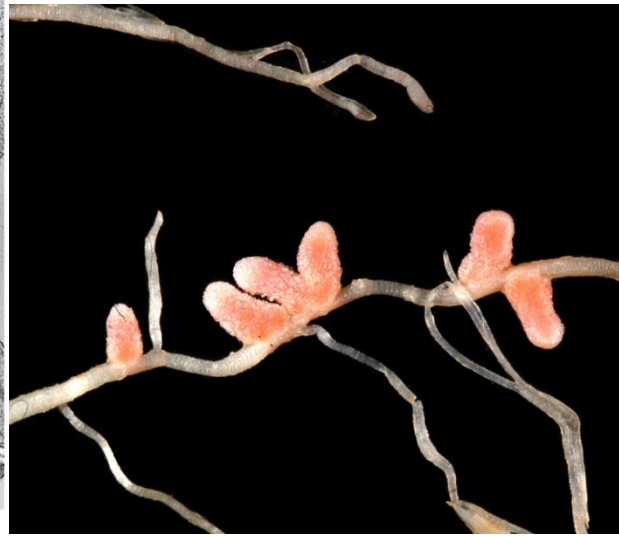


Факт №7. Раффлезия – паразитическое растение, получившее один из митохондриальных генов от своего хозяина – лианы *Tetrastigma*

Charles C. Davis and Kenneth J. Wurdack. **Host-to-Parasite Gene Transfer in Flowering Plants: Phylogenetic Evidence from Malpighiales** // *Science*. 2004. V. 305. P. 676 – 678.

Звідки взяти гемоглобін?





```
                 +         +         +         +        50
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1MBN  -VLSEGEWQLVLHVWAKVEADVAGHGQDILIRLFKSHPETLEKFDRFKHL
          *    *+        *+        +      *  +  *

                         E                   F

                   +         +         +         +
1FSL  VDPT----NPKLTGHAEKLFALVRDSAGQLKASGTVVADAALGSVHAQKA
1MBN  KTEAEMKASEDLKKHGVTVLTALGAILKKKGHHEAELKP--LAQSHATKH
     50          +*  *     +         +          *+  ** *

                G                    H

       100          +         +         +         +
1FSL   VTDPQ-FVVVKEALLKTIKAAVGDKWSDELSRAWEVAYDELAAAIKKA--------
1MBN  -KIPIKYLEFISEAIIHVLHSRHPGDFGADAQGAMNKALELFRKDIAAKYKELGYQG
       100        *+         +         +   *     +       150
                   *                    *
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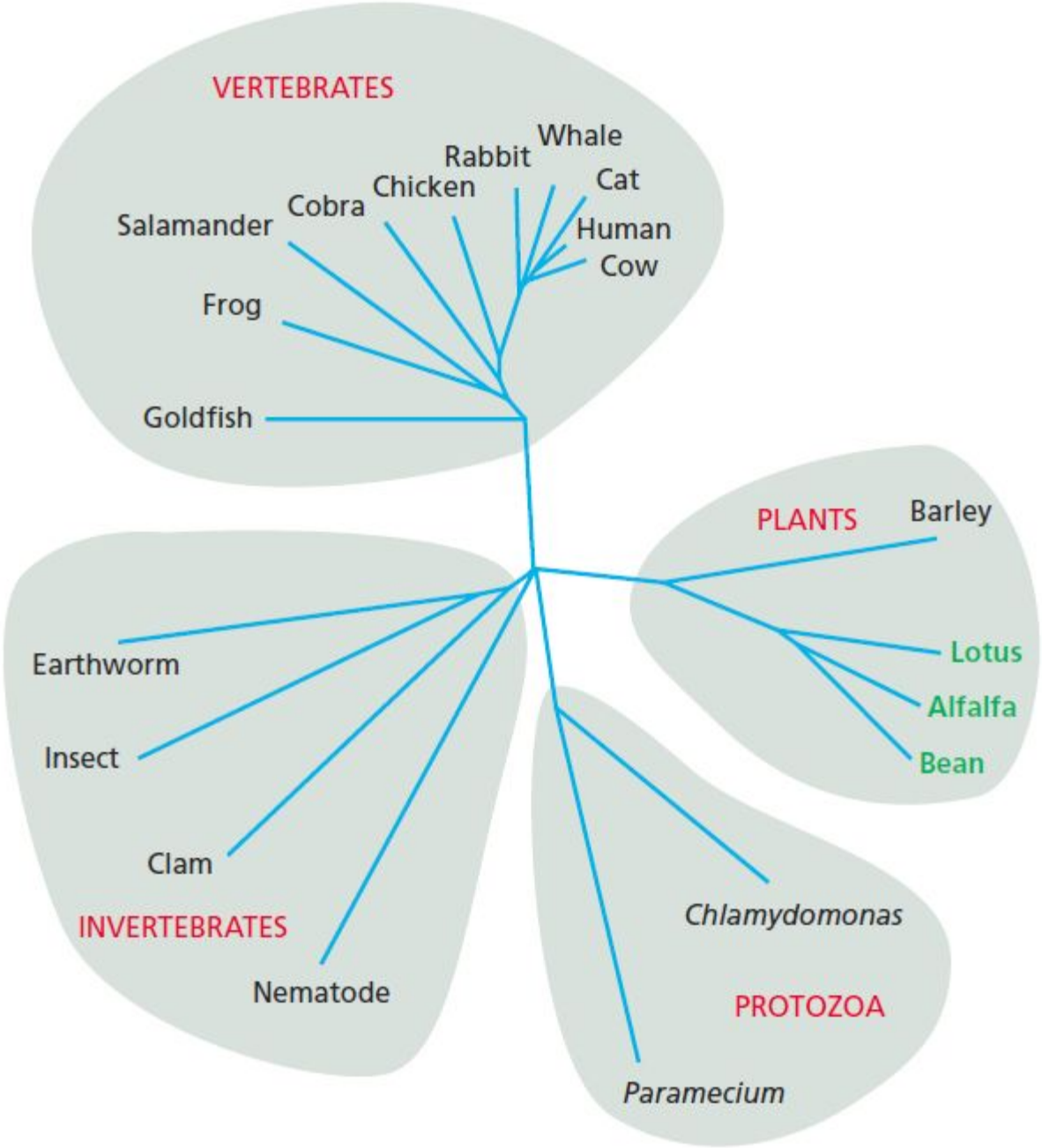
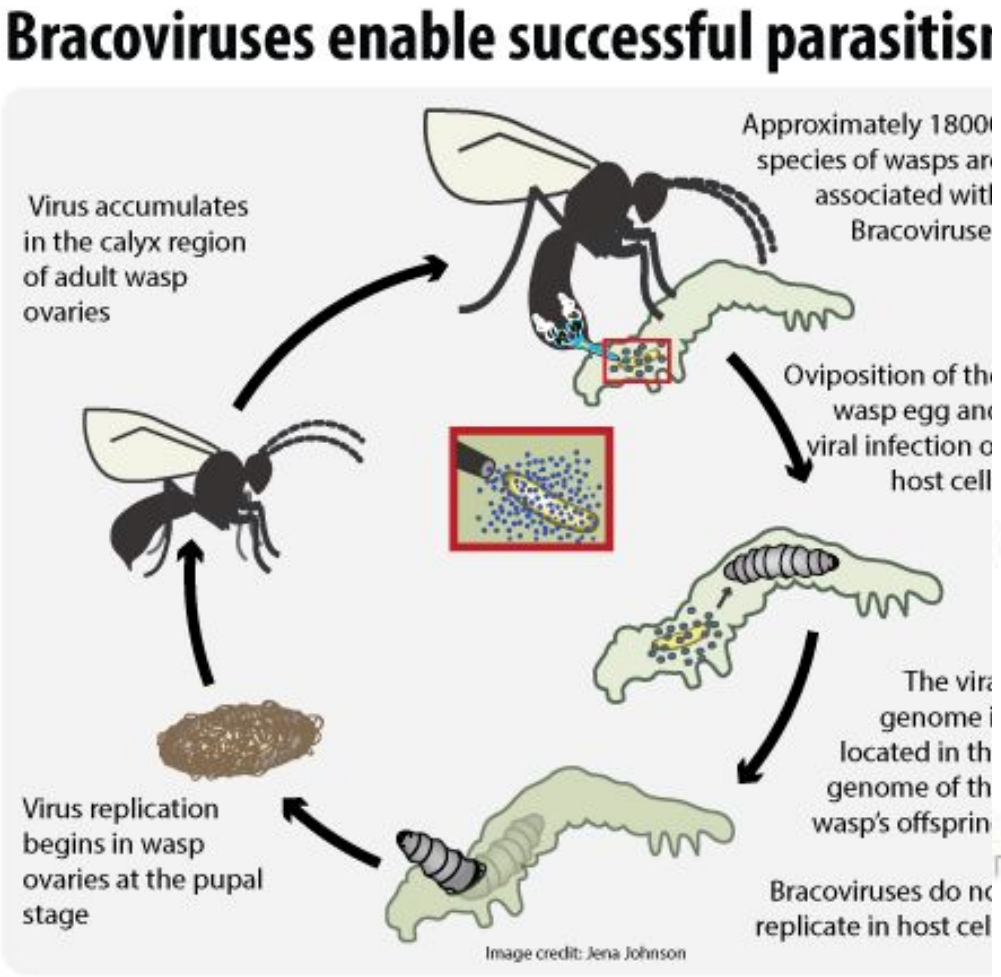
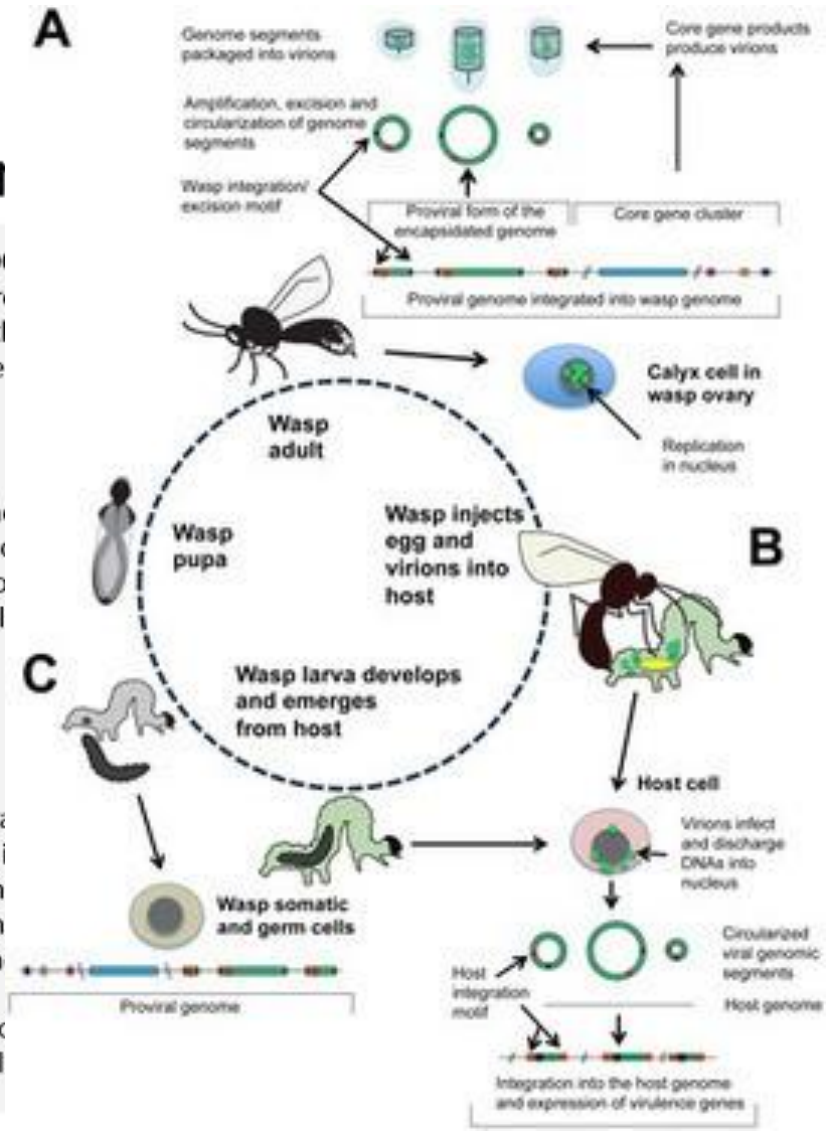
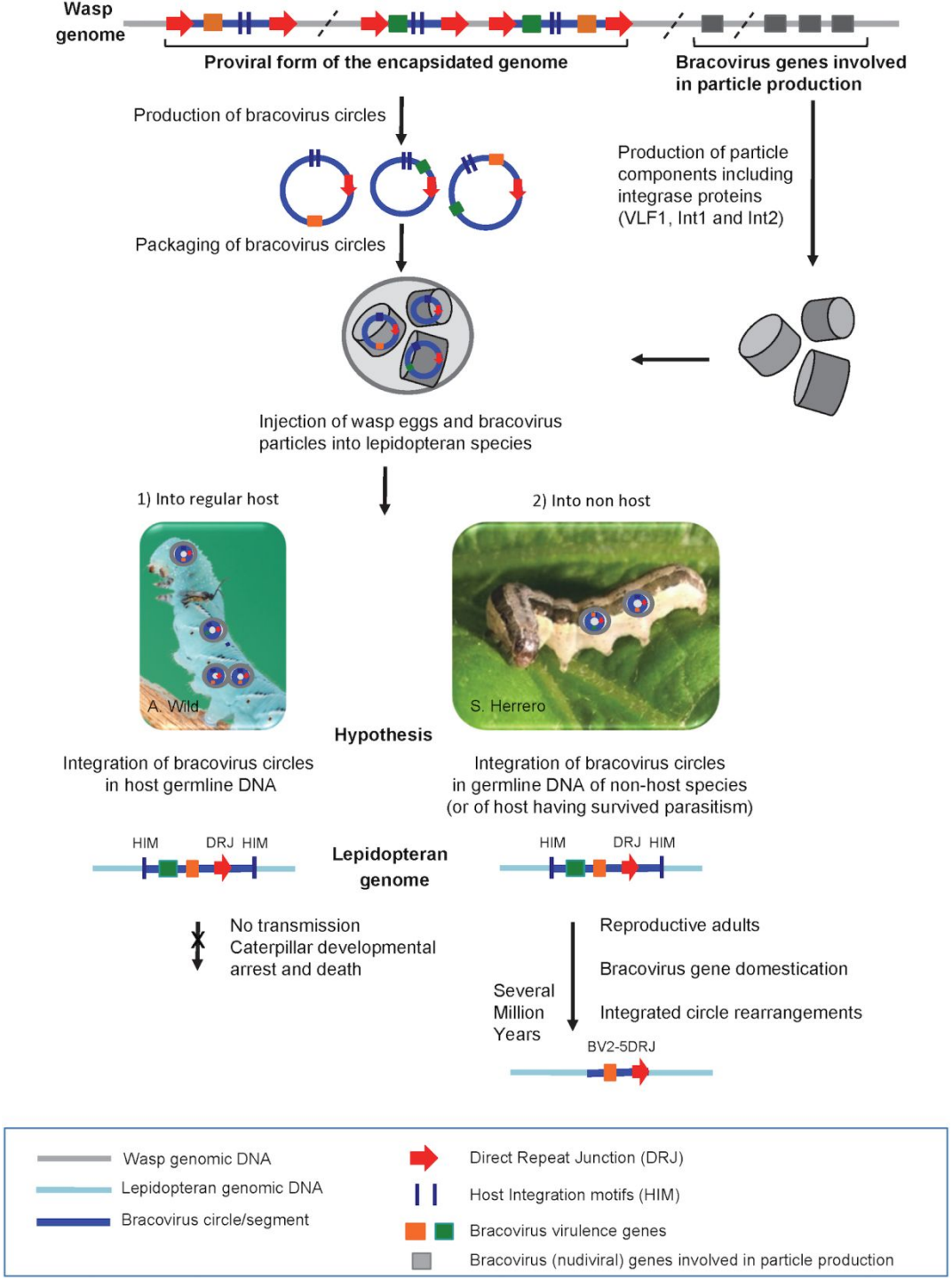


Figure Q1–2 Phylogenetic tree for hemoglobin genes from a variety

Паразитичні наїздники та одомашнені віруси

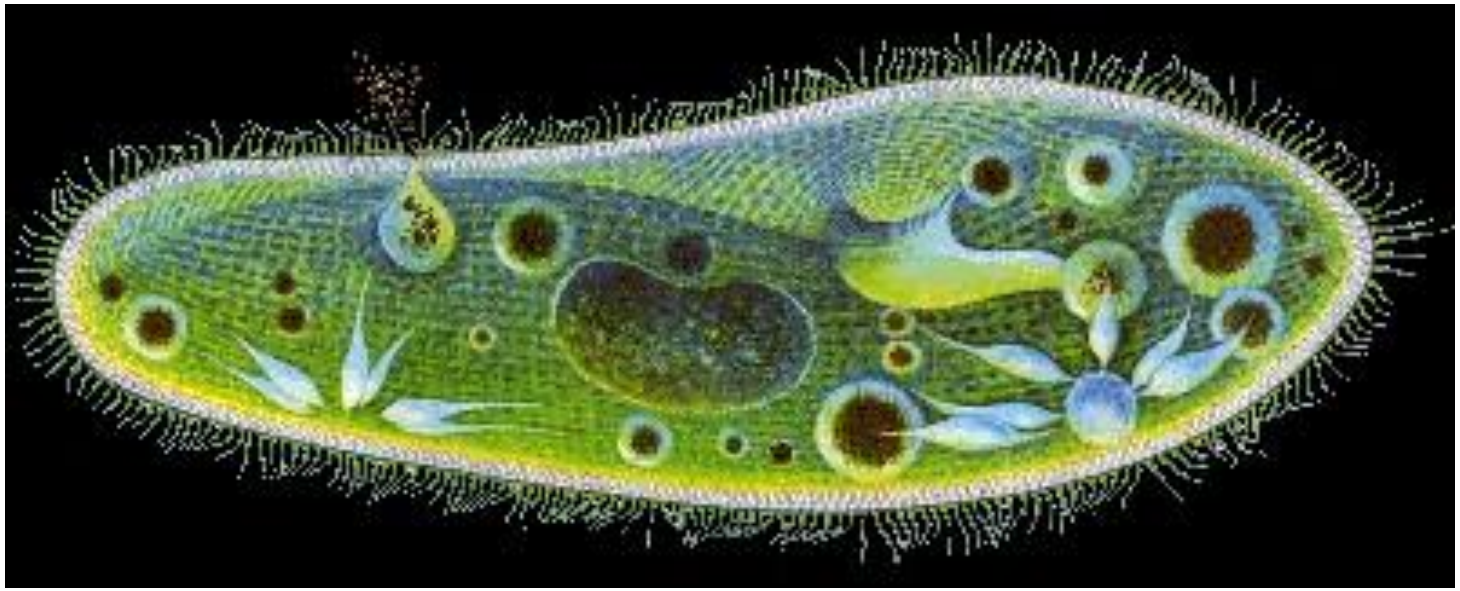


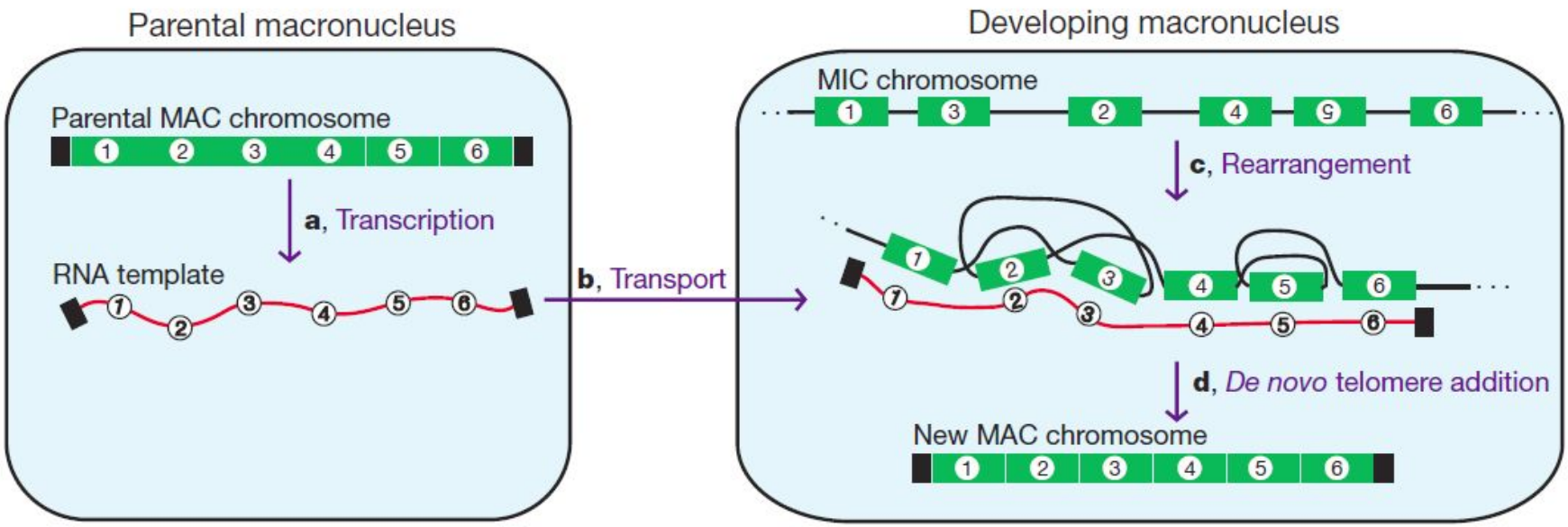



Wasp genome
Proviral form of the encapsidated genome
Bracovirus genes involved in particle production
Production of bracovirus circles
Production of particle components including integrase proteins (VLF1, Int1 and Int2)
Packaging of bracovirus circles
Injection of wasp eggs and bracovirus particles into lepidopteran species
1) Into regular host
2) Into non host
A. Wild
S. Herrero
Hypothesis
Integration of bracovirus circles in host germline DNA
Integration of bracovirus circles in germline DNA of non-host species (or of host having survived parasitism)
HIM
DRJ
HIM
Lepidopteran genome
HIM
DRJ
HIM
No transmission
Caterpillar developmental arrest and death
Several Million Years
Reproductive adults
Bracovirus gene domestication
Integrated circle rearrangements
BV2-5DRJ
Wasp genomic DNA
Lepidopteran genomic DNA
Bracovirus circle/segment
Direct Repeat Junction (DRJ)
Host Integration motifs (HIM)
Bracovirus virulence genes
Bracovirus (nudiviral) genes involved in particle production

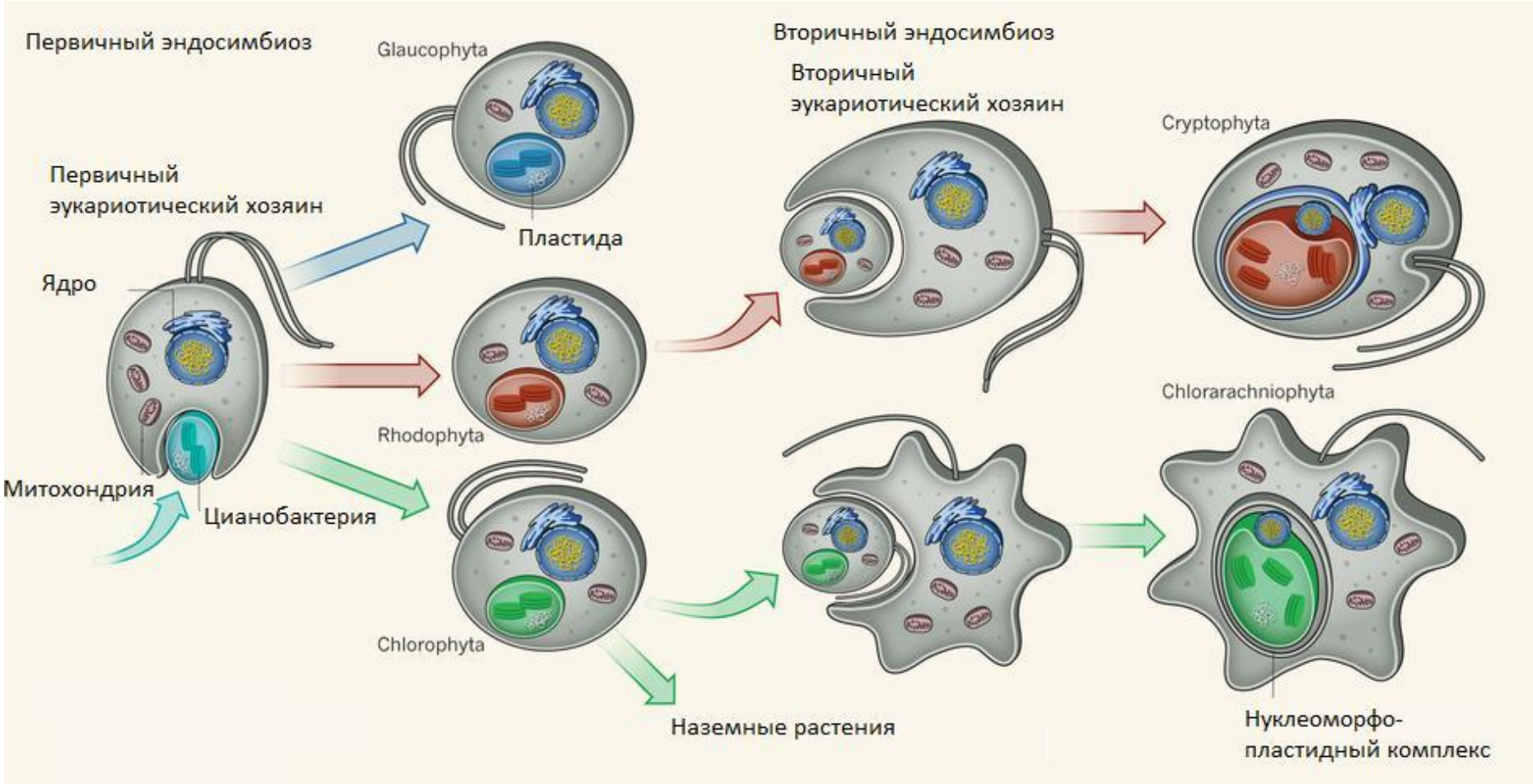
The final mark is successful because it works on many levels, some of which is subtle. It's credible, approachable and deeply layered. Starting with a Monarch butterfly perched on a green blade of grass, which is also a check mark and even a 'V' for verification. All positioned on a blue-sky background resulting in a powerful blend of eye-catching, positive colors that portrays "a better future."

The final designs for the verification seal and logo:

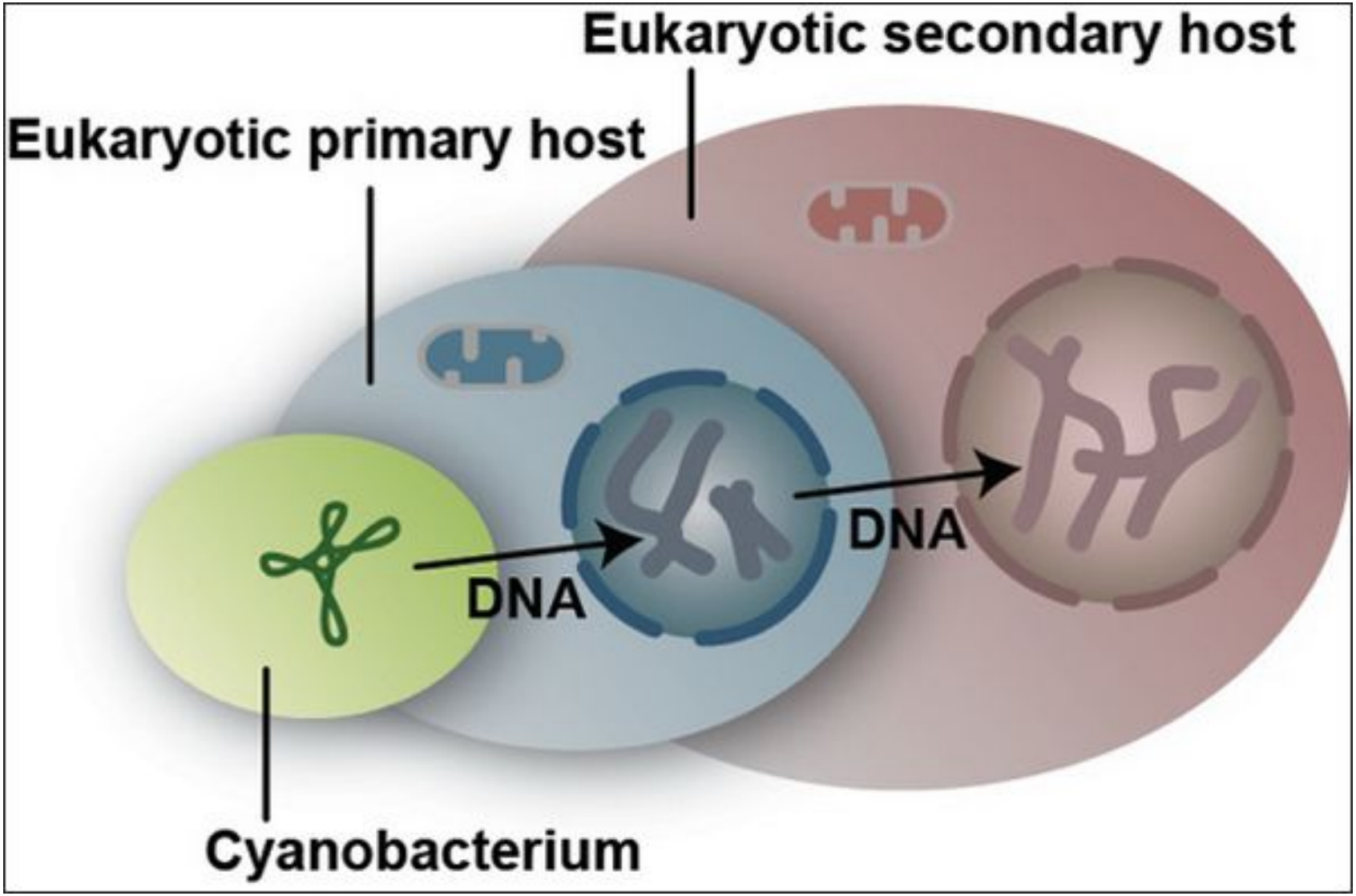



Parental macronucleus
Parental MAC chromosome
1 2 3 4 5 6
a, Transcription
RNA template
b, Transport
Developing macronucleus
MIC chromosome
c, Rearrangement
d, De novo telomere addition
New MAC chromosome

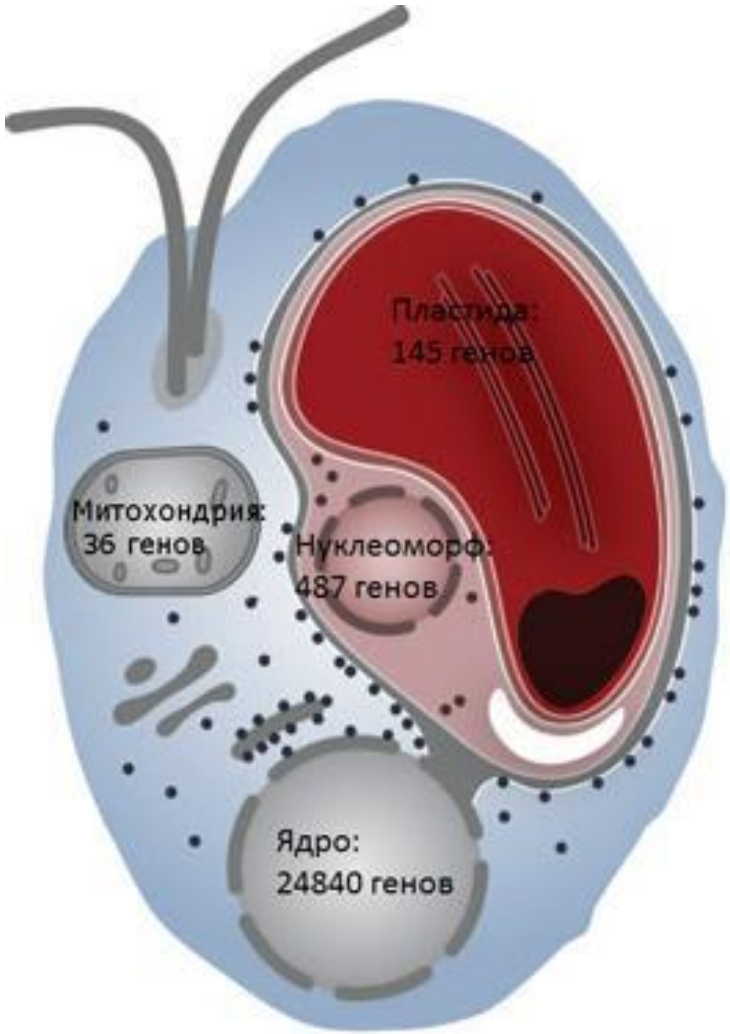
Предки прокаріот у наших клітинах



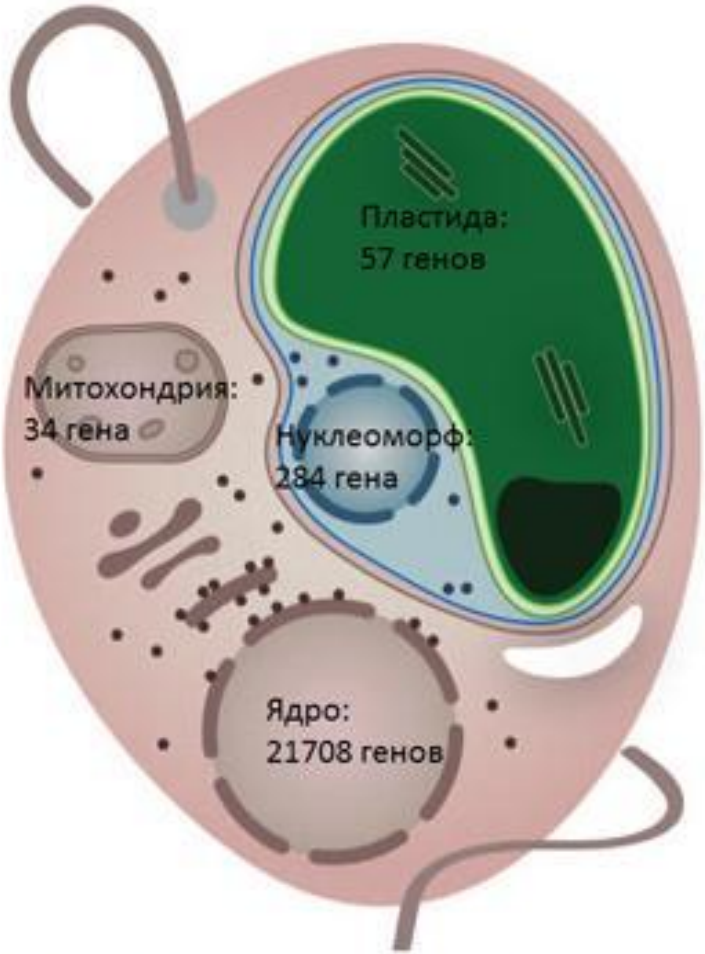
Вкладені конструкції



Матрёшки в природе



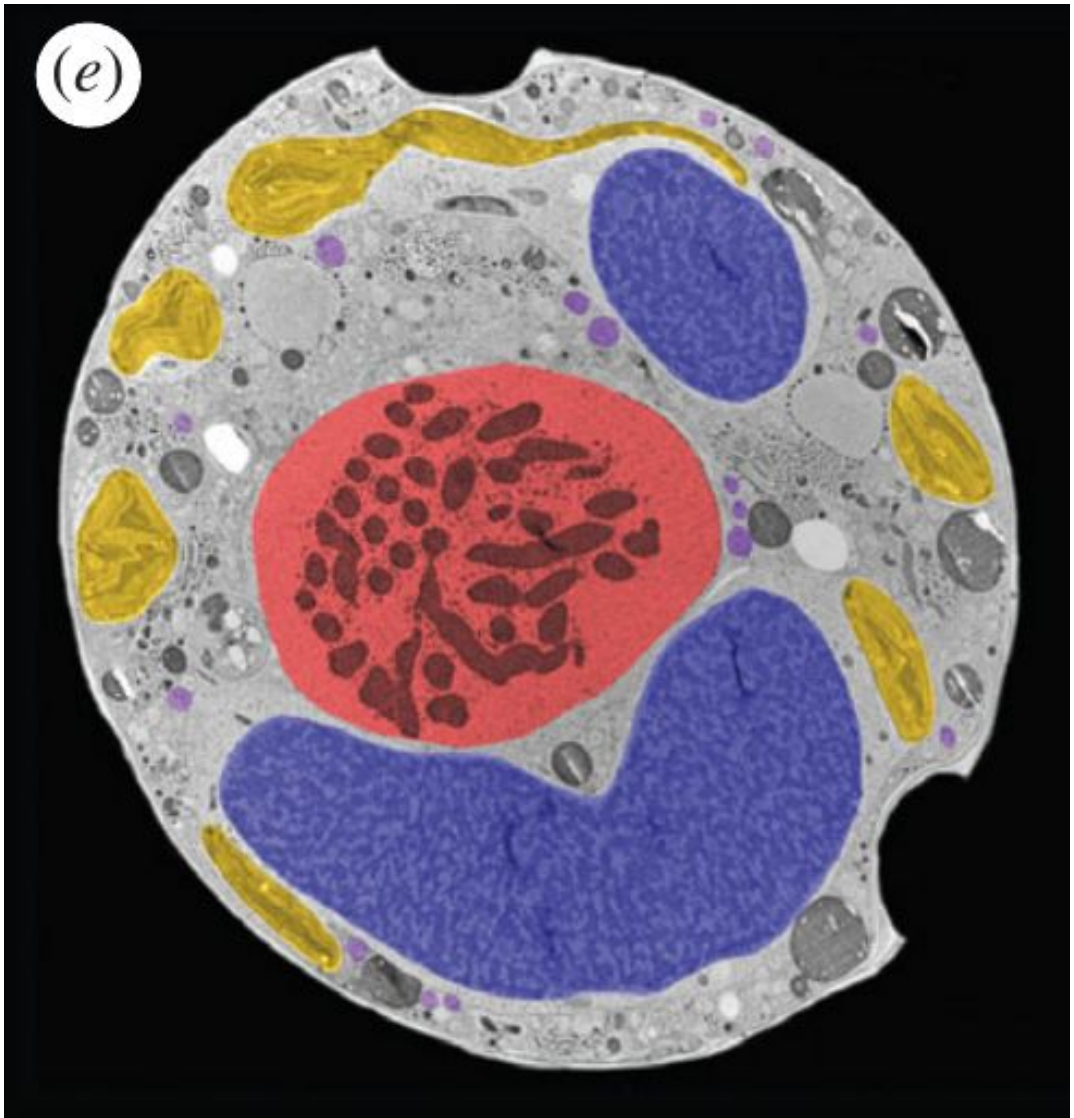
Криптофитовая водоросль *Guillardia theta*



Хлорарахниофитовая водоросль *Bigelowiella natans*

П’ять геномів в одному організмі

- Таким чином, всередині клітини дурінскіі на правах хлоропласта живе еукаріотна симбіонт, всередині якого - ще один еукаріотна симбіонт, і вже тільки всередині того - Прокаріотно симбіонт, який, власне, і фотосинтезує. Тут ендосимбіоз вже не вторинний, а третинний. У клітці дурінскіі генетично об'єднати чотири організму. І це якщо не вважати мітохондрій, які є як у дінофлагелляти, так і у діатомеї, причому і ті й інші функціонують



Ендосимбіоз
Прокаріотичні гомологи еукаріотичних генів

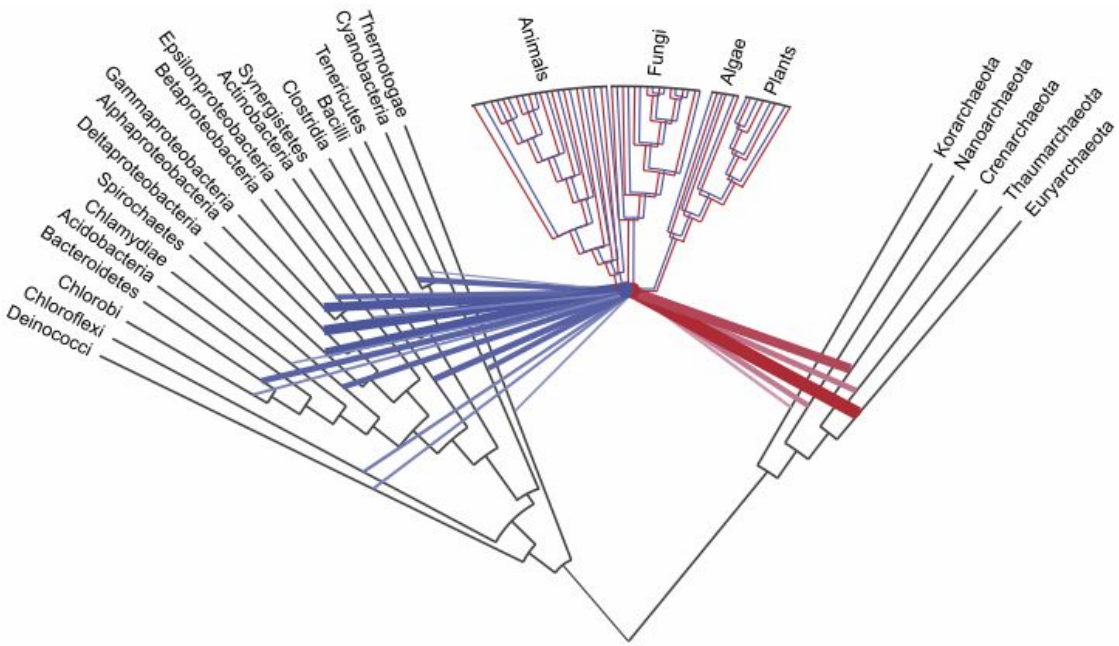


Fig. 8.—Network linking apparent prokaryotic donors to the eukaryote common ancestor according to the present findings. This network based on a traditional phylogenetic tree to which lateral edges were added. Color intensity and width of the lateral edges reflect the frequencies with which these groups appear as sisters to the eukaryotic clade.

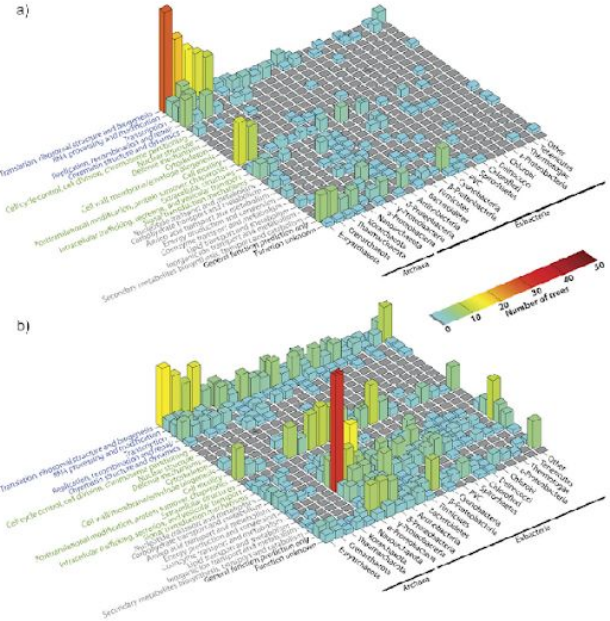
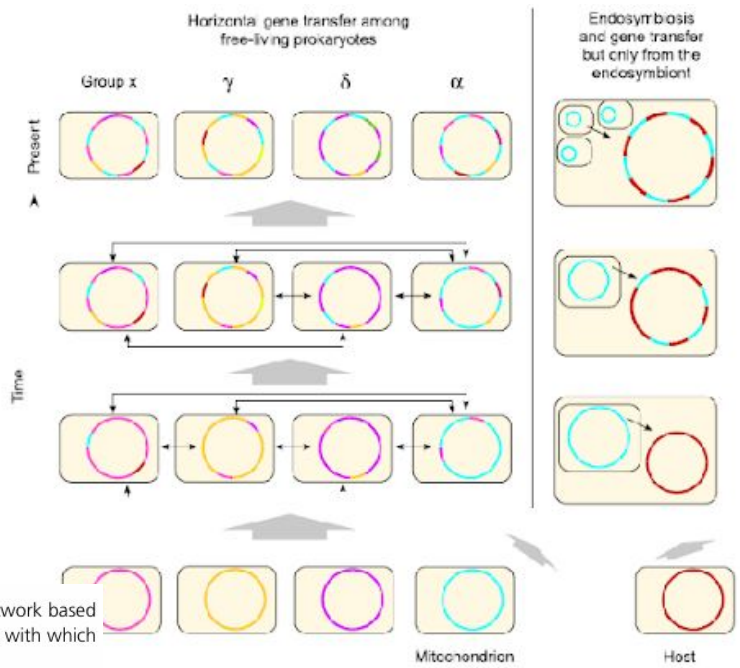
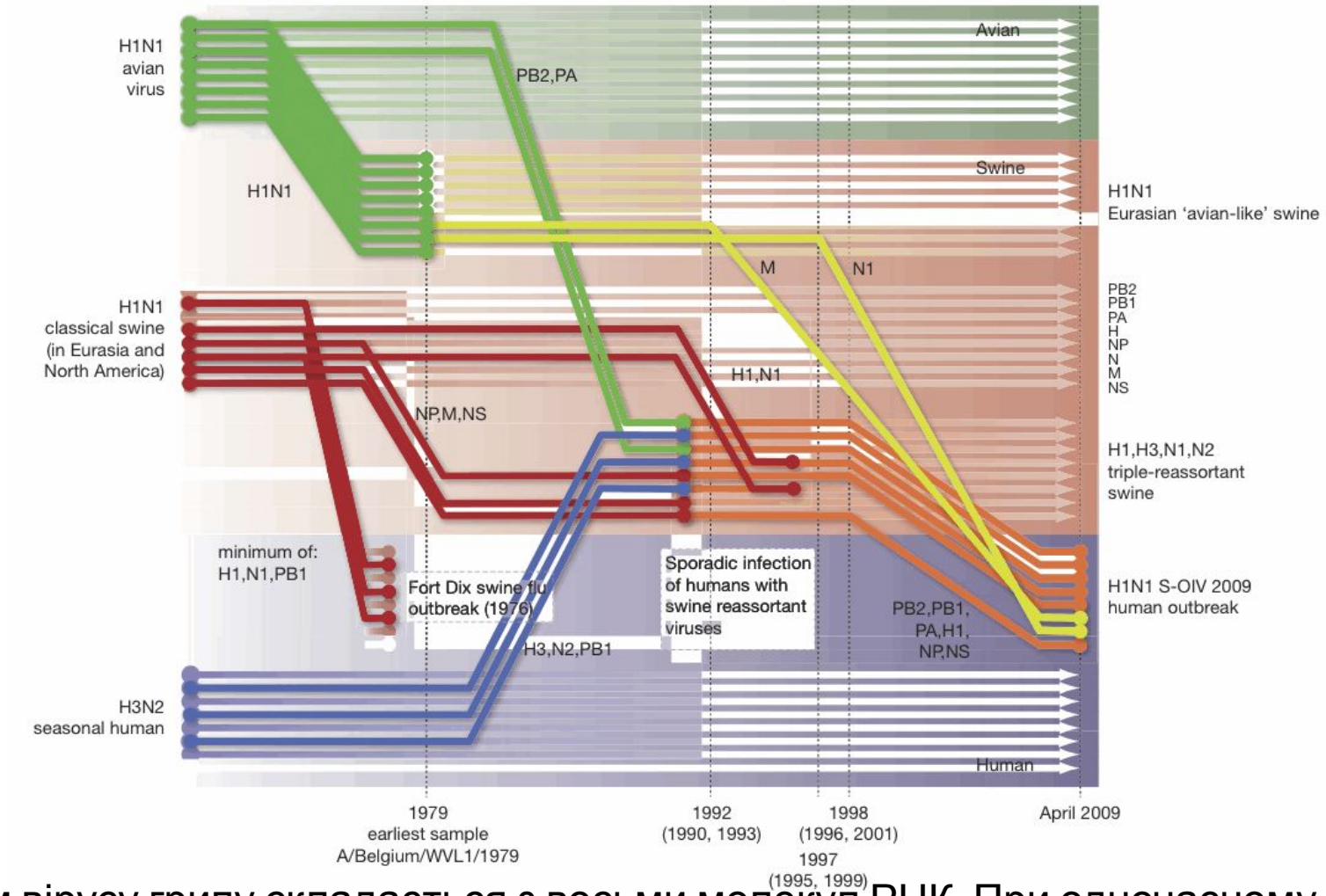


Fig. 4.—Three-dimensional bar graphs of prokaryotic groups found as sister groups to the eukaryotes distributed across functional cate rding to KOG groups. The four main groups are information storage and processing (classes colored in blue), cellular processes and sig es colored in green), metabolism (classes colored in gray), and poorly characterized proteins (classes colored in black). (a) Including the data with 68 or fewer prokaryotic sequences. (b) Including the data from trees with more than 68 bacterial sequences. Bar height and color in often a certain group was found in a tree belonging to a certain category.



Реасортація вірусів

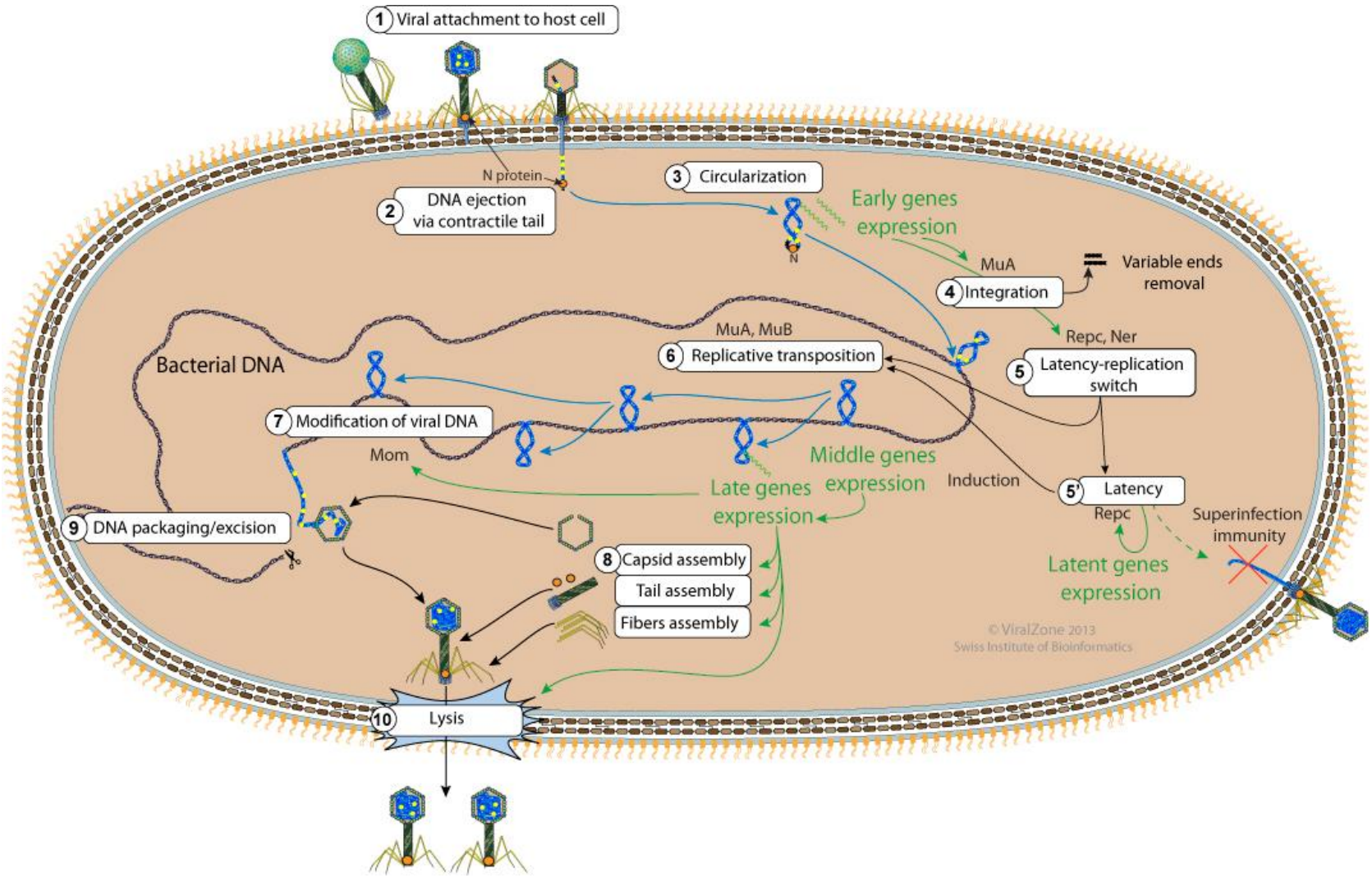


Геном вірусу грипу складається з восьми молекул РНК. При одночасному зараженні клітини двома штамами відбувається випадкова реасортація цих РНК у дочірніх віріонах

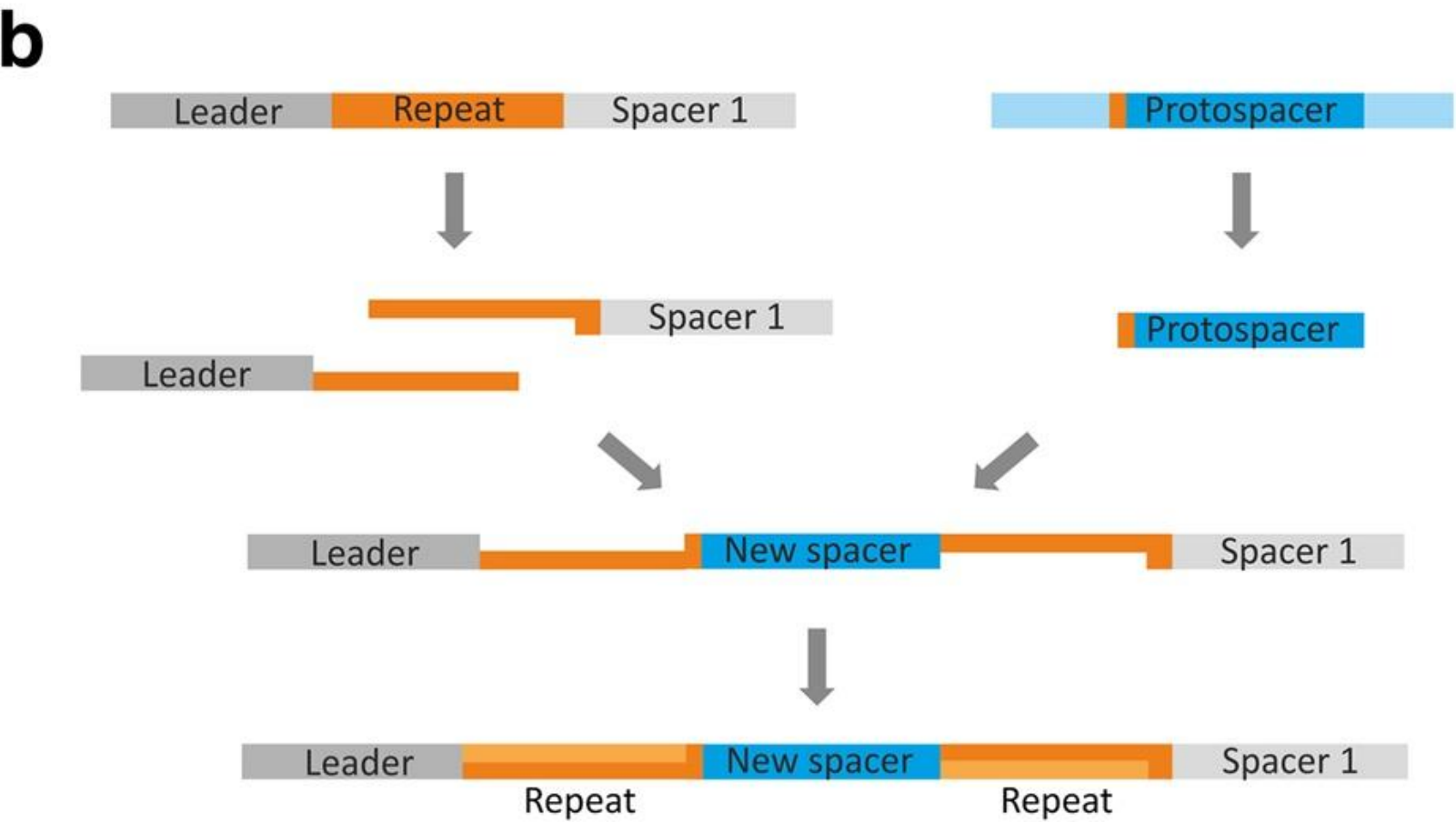
Хочу хлоропластів!

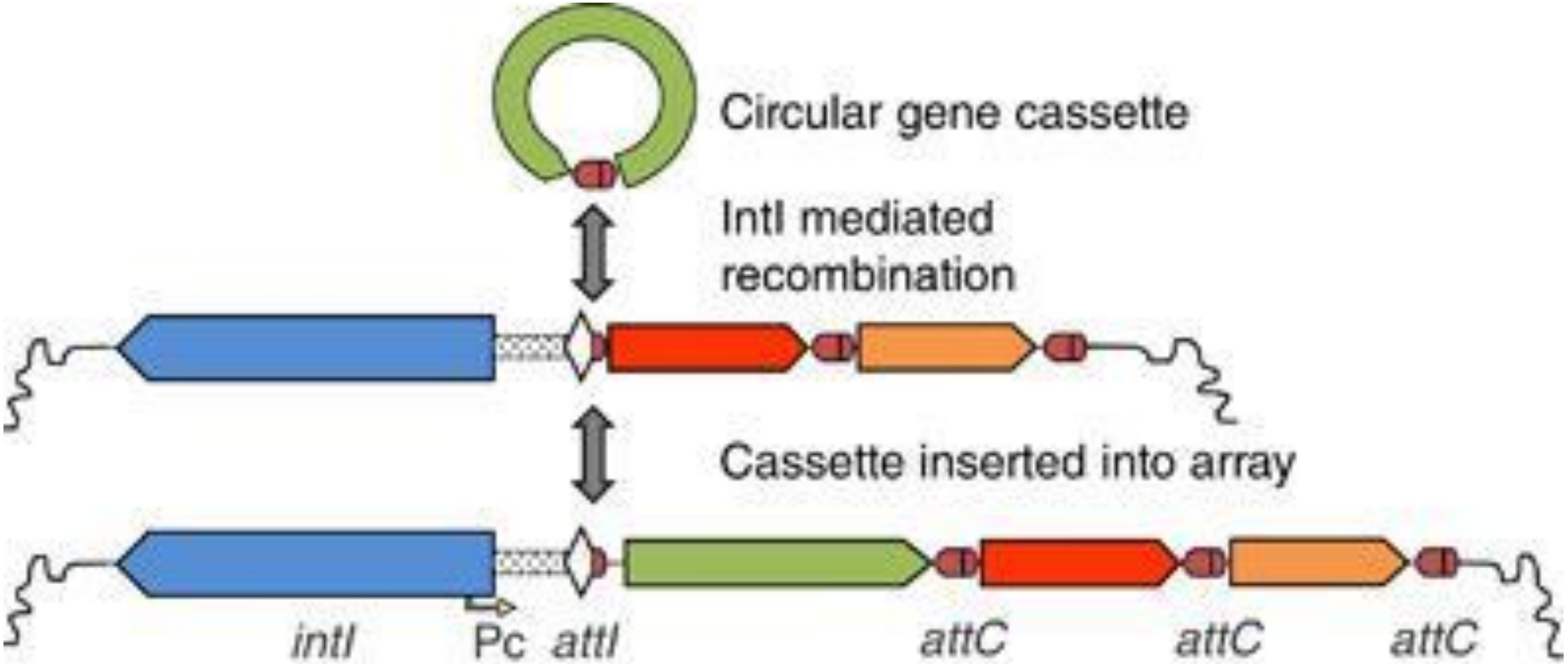
Про імунну систему

Проти вірусів їх же зброєю

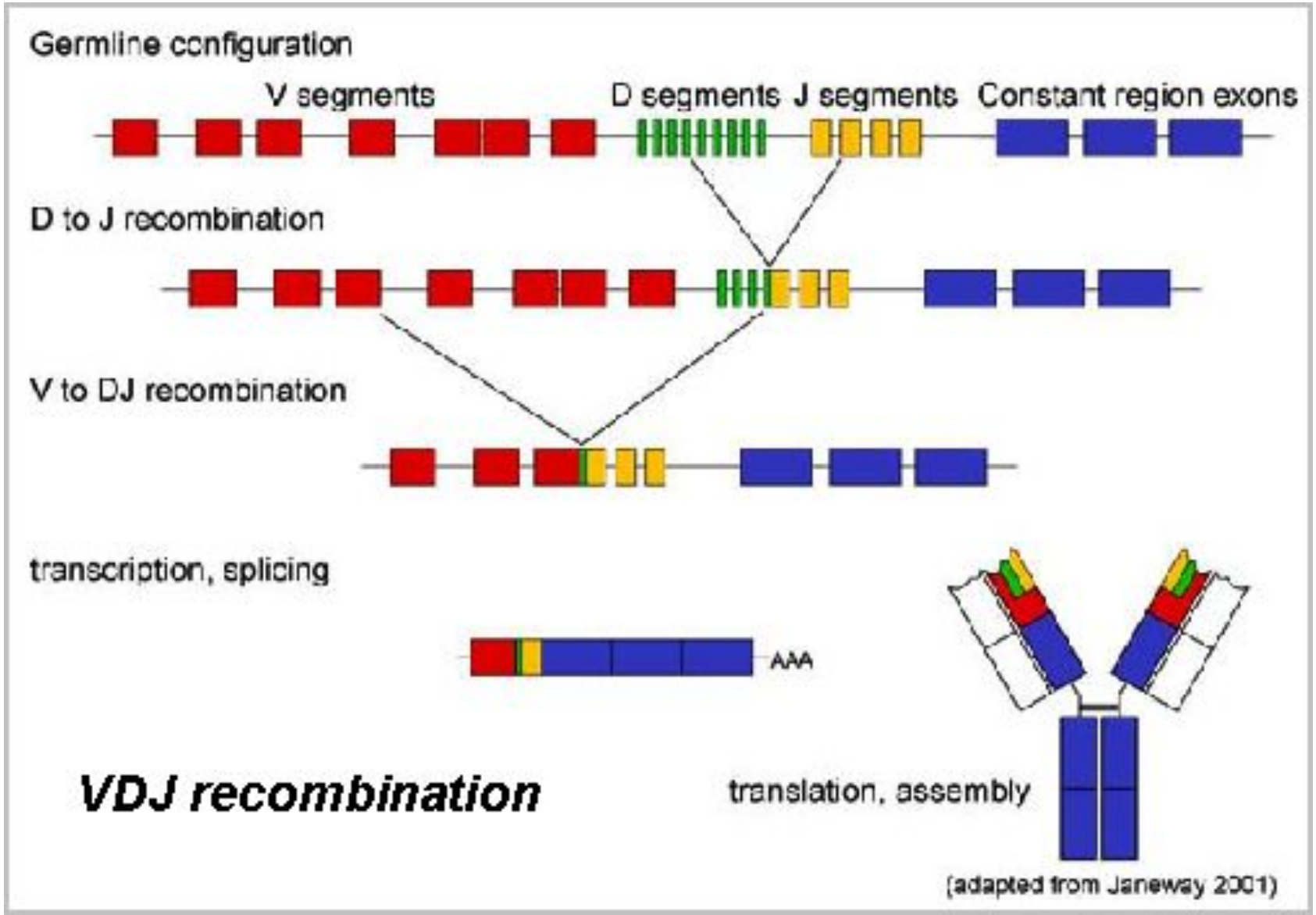


CRISPR-CAS9


b
Leader
Repeat
Spacer 1
Protospacer
Spacer 1
Protospacer
Leader
Leader
New spacer
Spacer 1
Leader
New spacer
Spacer 1
Repeat
Repeat

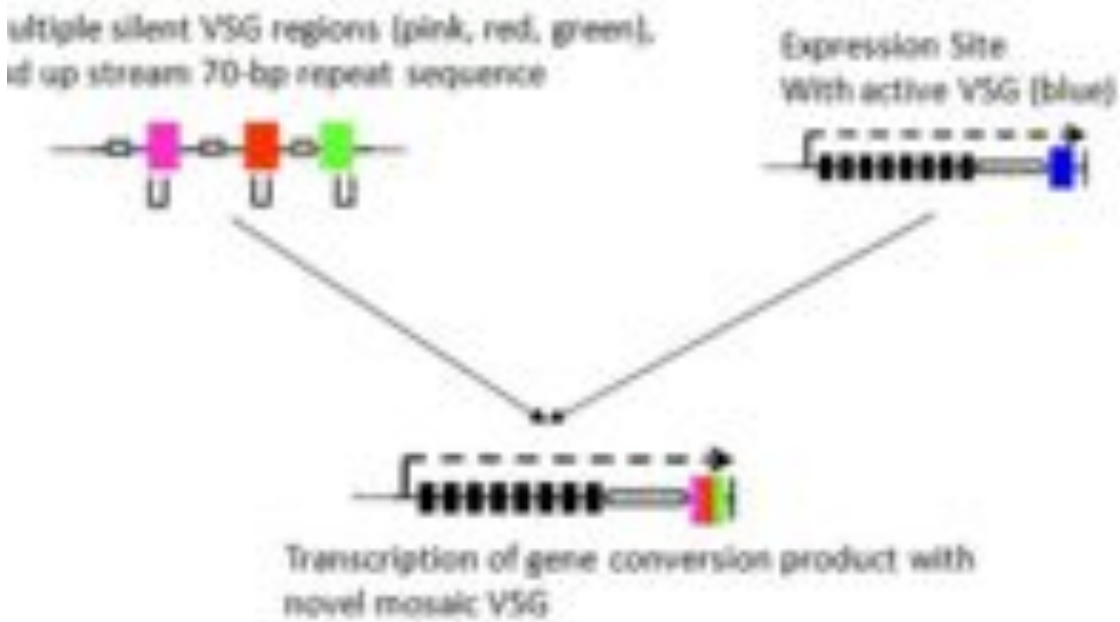

Circular gene cassette
IntI mediated
recombination
Cassette inserted into array
intI
Pc
attI
attC
attC
attC

V(D)J-рекомбінація



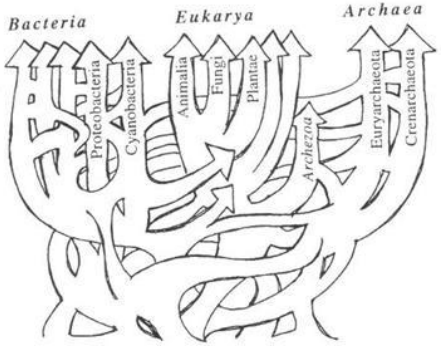
VSG and

D. Segmental VSG Conversion



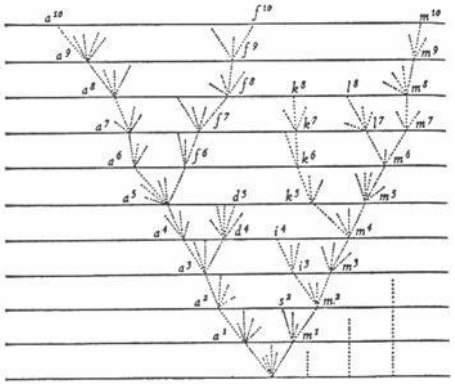
Еволюція-дерево чи сітка?

2. Данные геномики позволяют утверждать, что в ходе эволюции происходили массивные генные переносы как внутри царств, так и между ними.

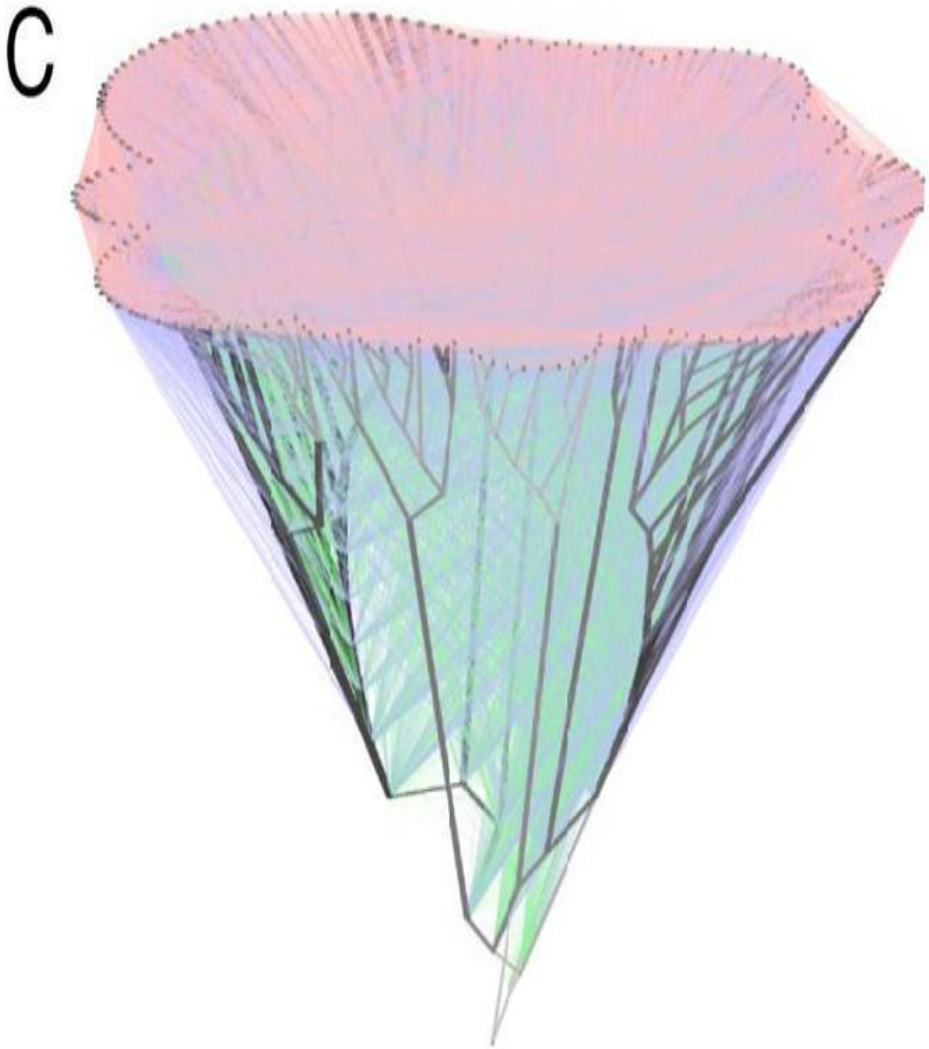


Картина эволюционных связей в мире предковых прокариот представлена

1. Традиционные представления о филогении, базирующиеся на представлениях о дивергенции, недостаточны для понимания генеалогии видов.



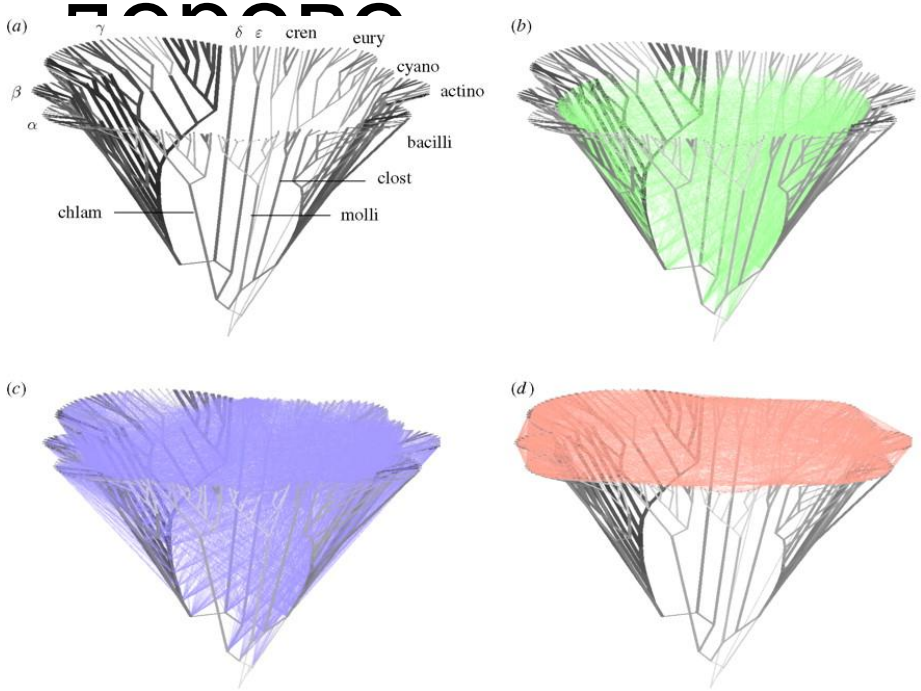
Дарвиновская схема дивергенции: ветви древа расходятся, чтобы больше никогда не сойтись.

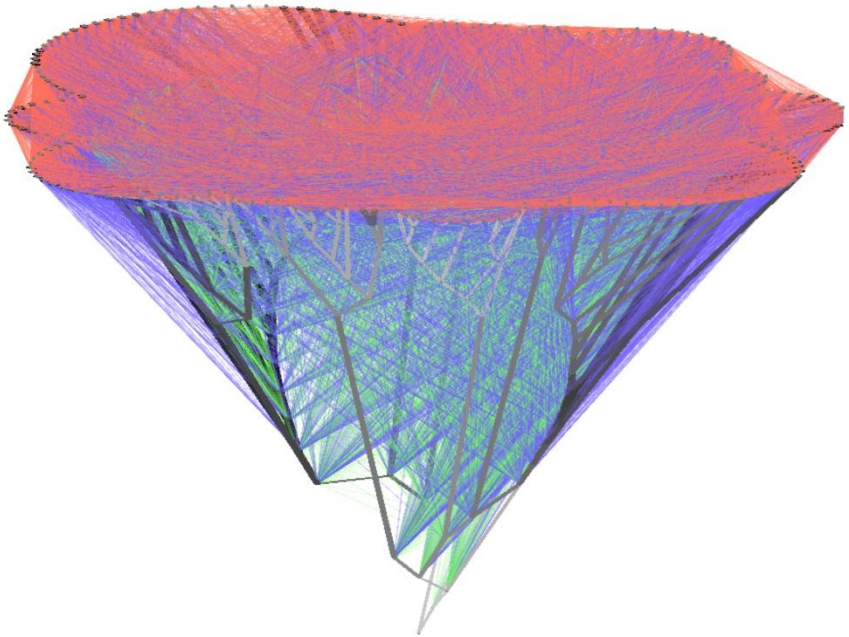


Трехмерная схема эволюции прокариот

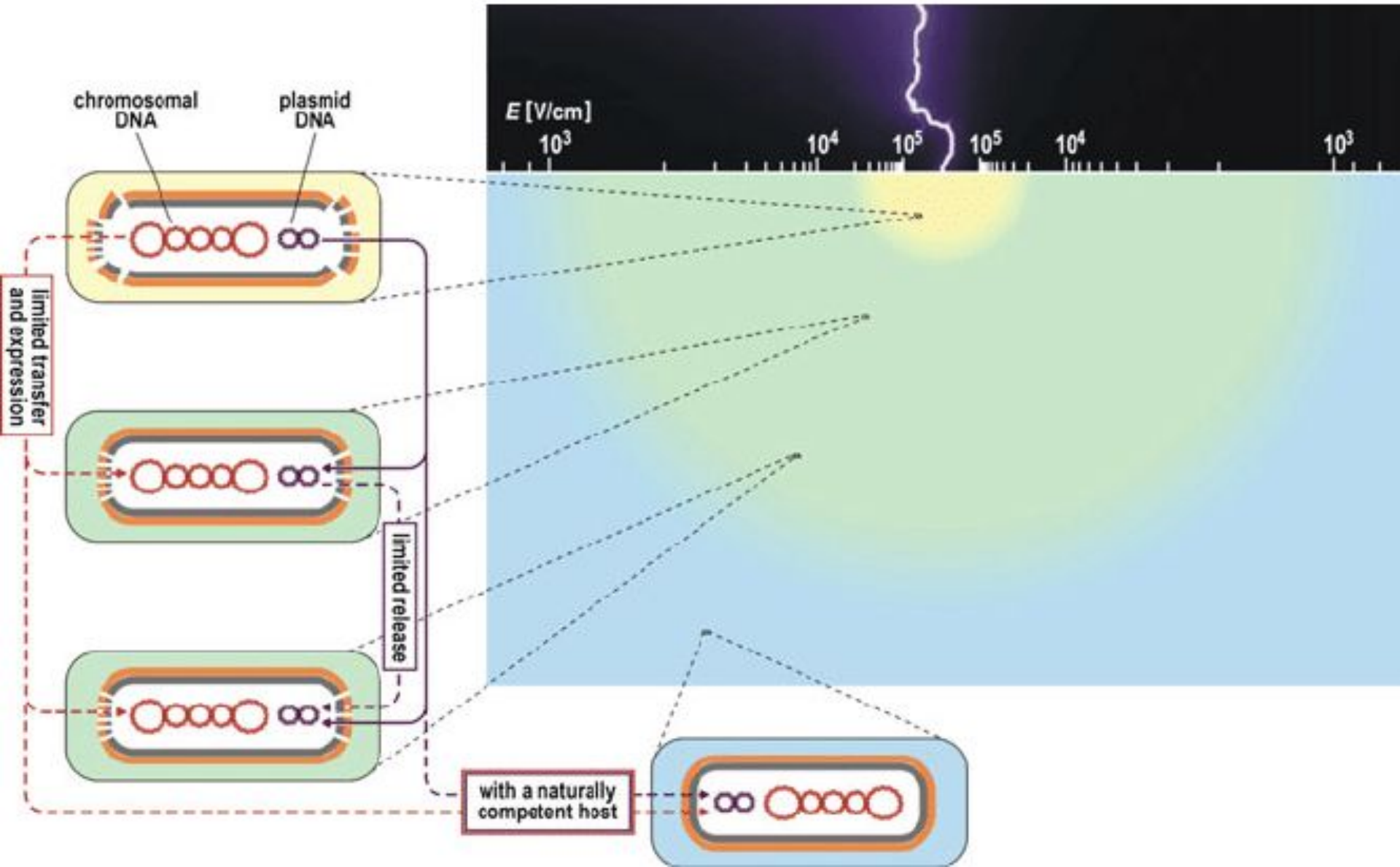
ГПГ

Еволюція прокаріот сітка а не дерево





- among 539,723 genes distributed across 181 sequenced prokaryotic genomes at least 81 +- 15% of the genes in each genome studied were involved in lateral gene transfer at some point in their history


chromosomal DNA
plasmid DNA
E [V/cm]
10^3
10^4
10^5
10^5
10^4
10^3
limited transfer and expression
limited release
with a naturally competent host

Дякую за увагу!