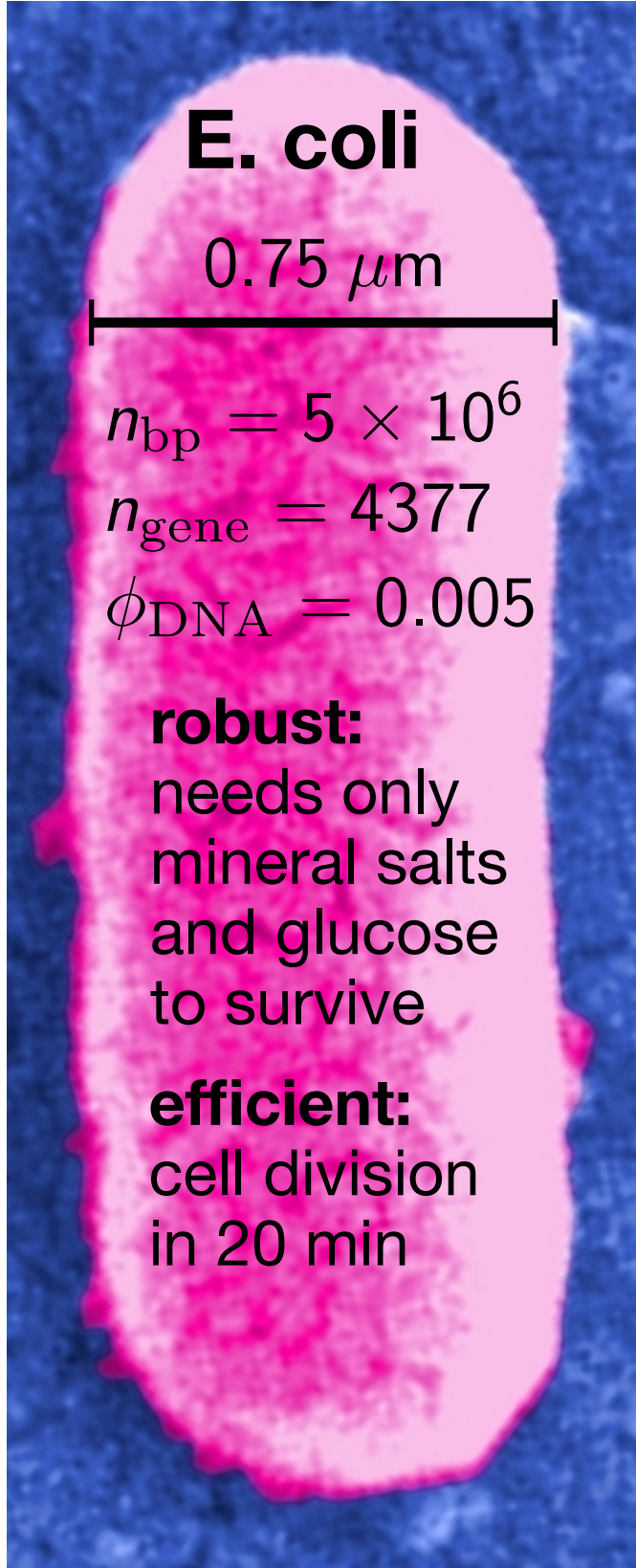
How small can you make a cell?



How small can you make a cell?

M. genitalium

one of the smallest organisms capable of independent growth and reproduction

$n_{\mathrm{bp}} = 6 \times 10^5$

$n_{\mathrm{gene}} = 525$

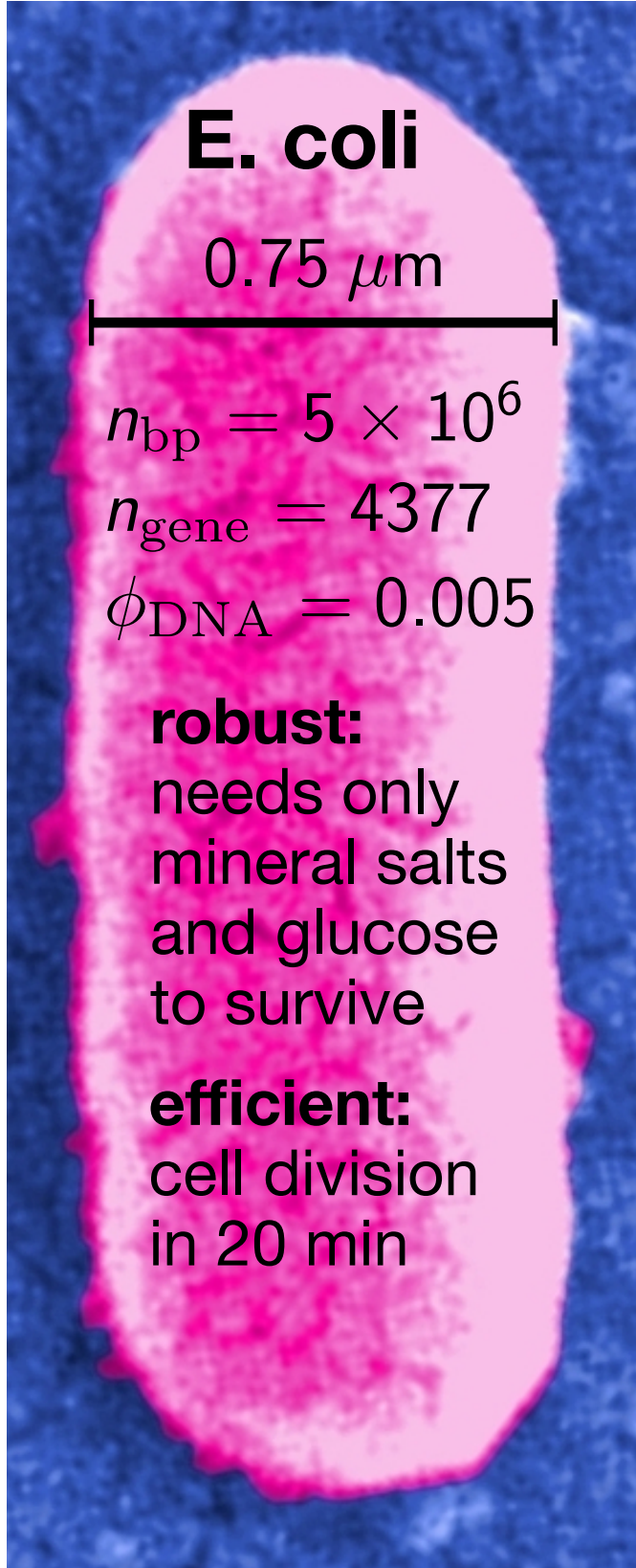
$\phi_{\mathrm{DNA}} = 0.05$

limited metabolism: needs to import most small organic molecules from environment

survives as a parasite in human genital tract

slow: cell division in 10 hours

E. coli



How small can you make a cell?

Lambda phage virus

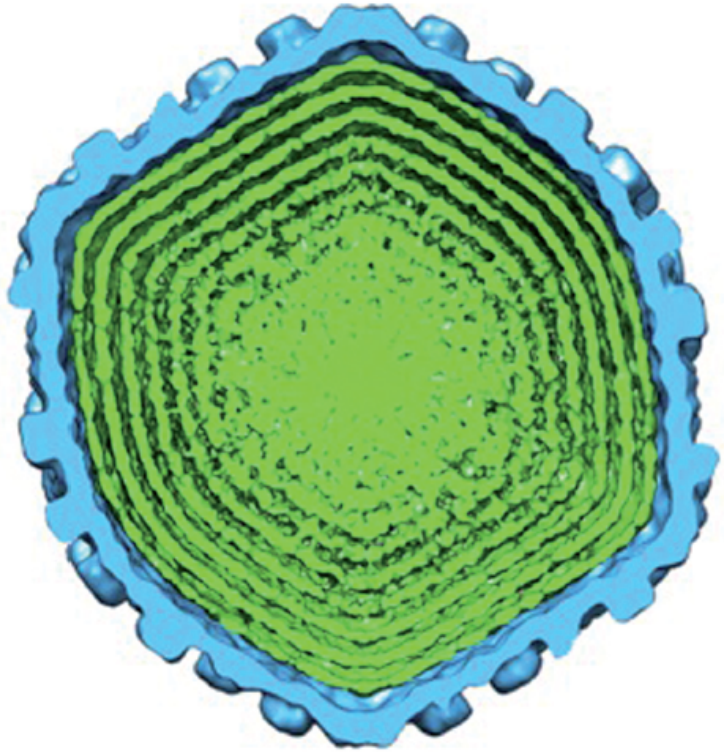
$n_{\mathrm{bp}} = 5 \times 10^4$

$n_{\mathrm{gene}} = 50$

$\phi_{\mathrm{DNA}} = 0.55$

0.06 μm

zoomed view:



DNA tightly packaged into virus head with room for nothing else

no independent metabolism or capacity to reproduce

E. coli

0.75 μm

$n_{\mathrm{bp}} = 5 \times 10^6$

$n_{\mathrm{gene}} = 4377$

$\phi_{\mathrm{DNA}} = 0.005$

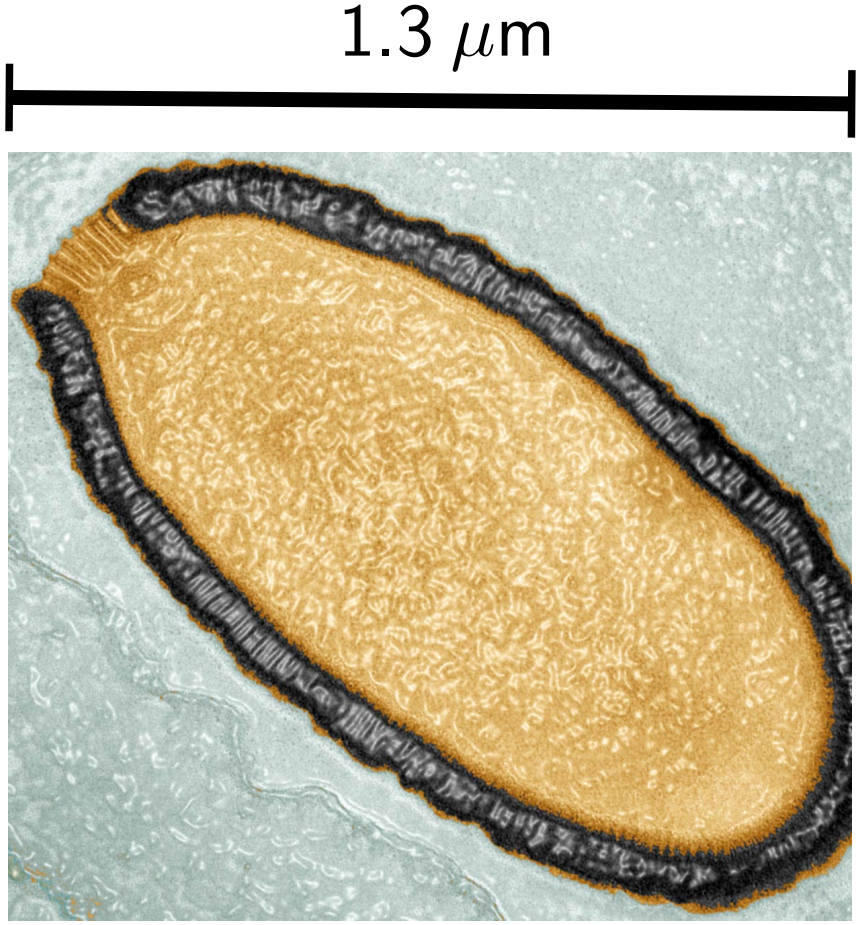
robust: needs only mineral salts and glucose to survive

efficient: cell division in 20 min

How small can you make a cell?

Pithovirus sibericum

largest known virus, reported in 2014 from a 30,000 year old Siberian permafrost sample



$n_{\mathrm{bp}} = 6 \times 10^5$

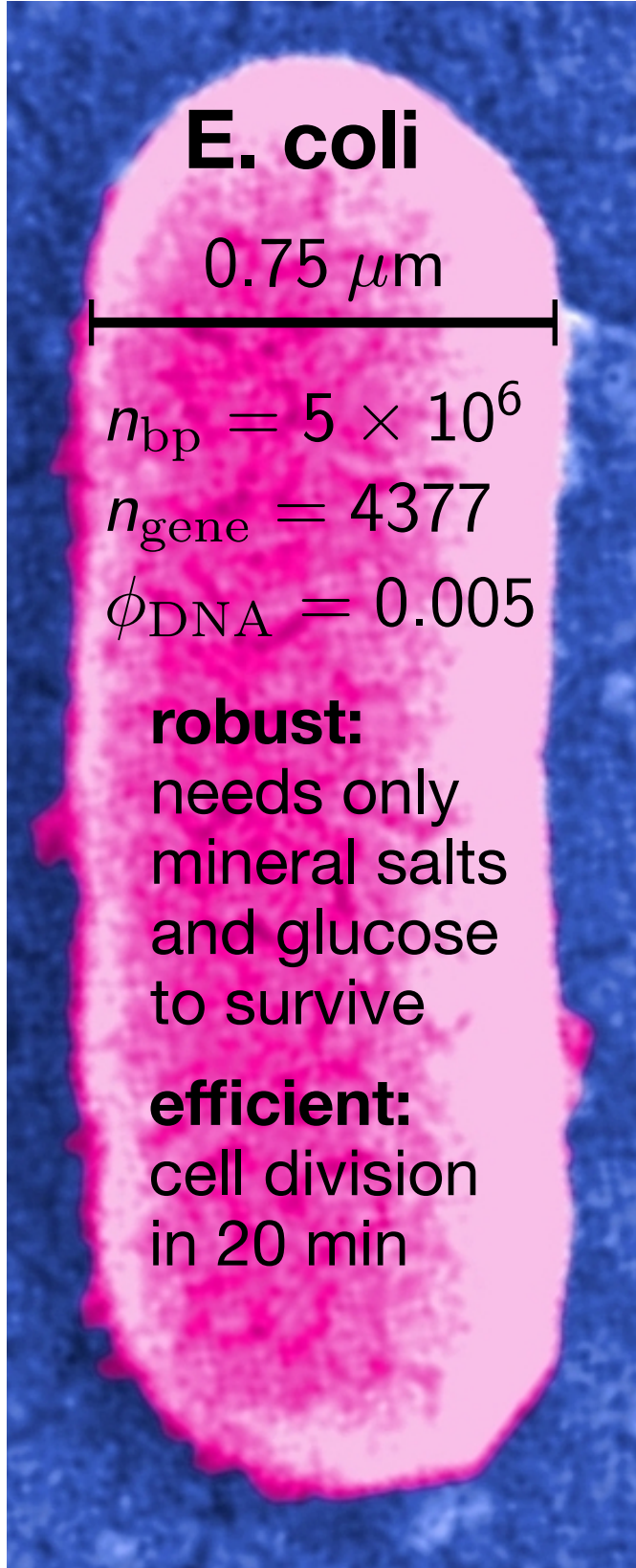
$n_{\mathrm{gene}} = 467$

$\phi_{\mathrm{DNA}} = 0.002$

Quite roomy inside!

A former bacterium that has jettisoned its protein machinery to replicate parasitically in amoebas?

See: http://www.radiolab.org/story/shrink/

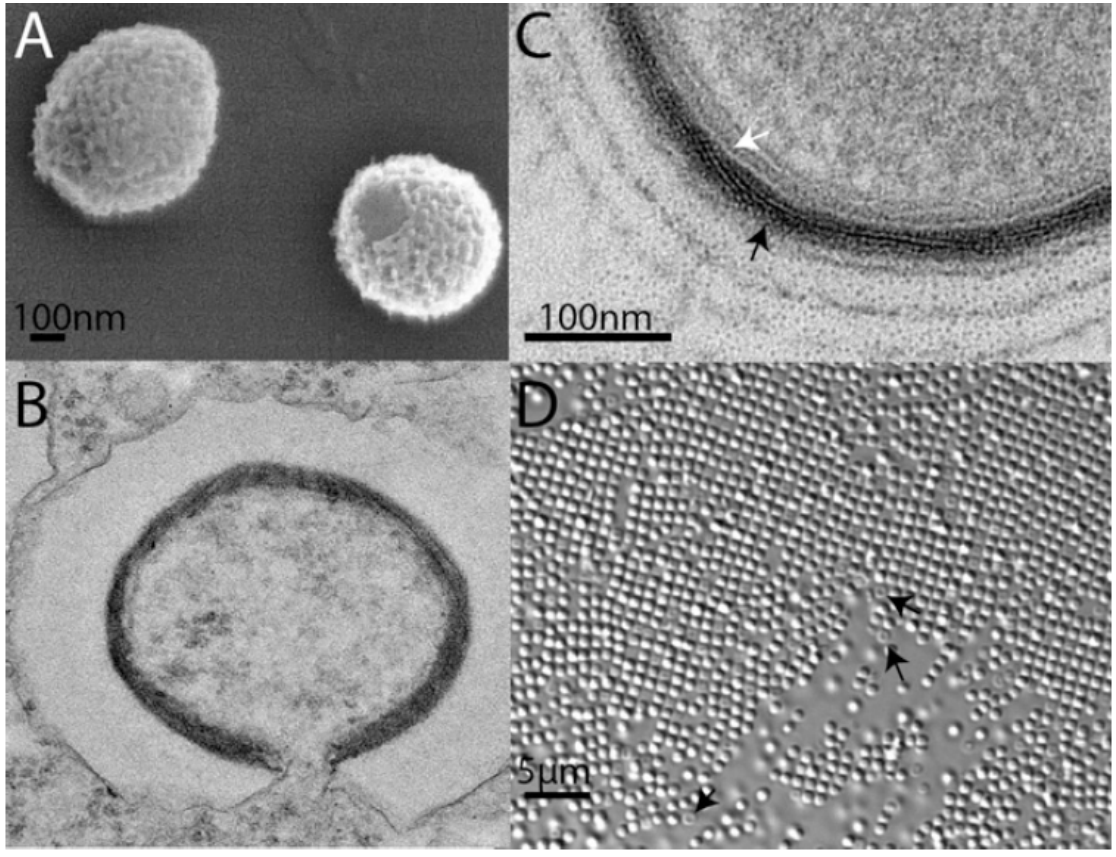


More giant viruses raised from the dead

From the Proc. Natl. Acad. Sci. in September 2015:

In-depth study of *Mollivirus sibericum*, a new 30,000-y-old giant virus infecting *Acanthamoeba*

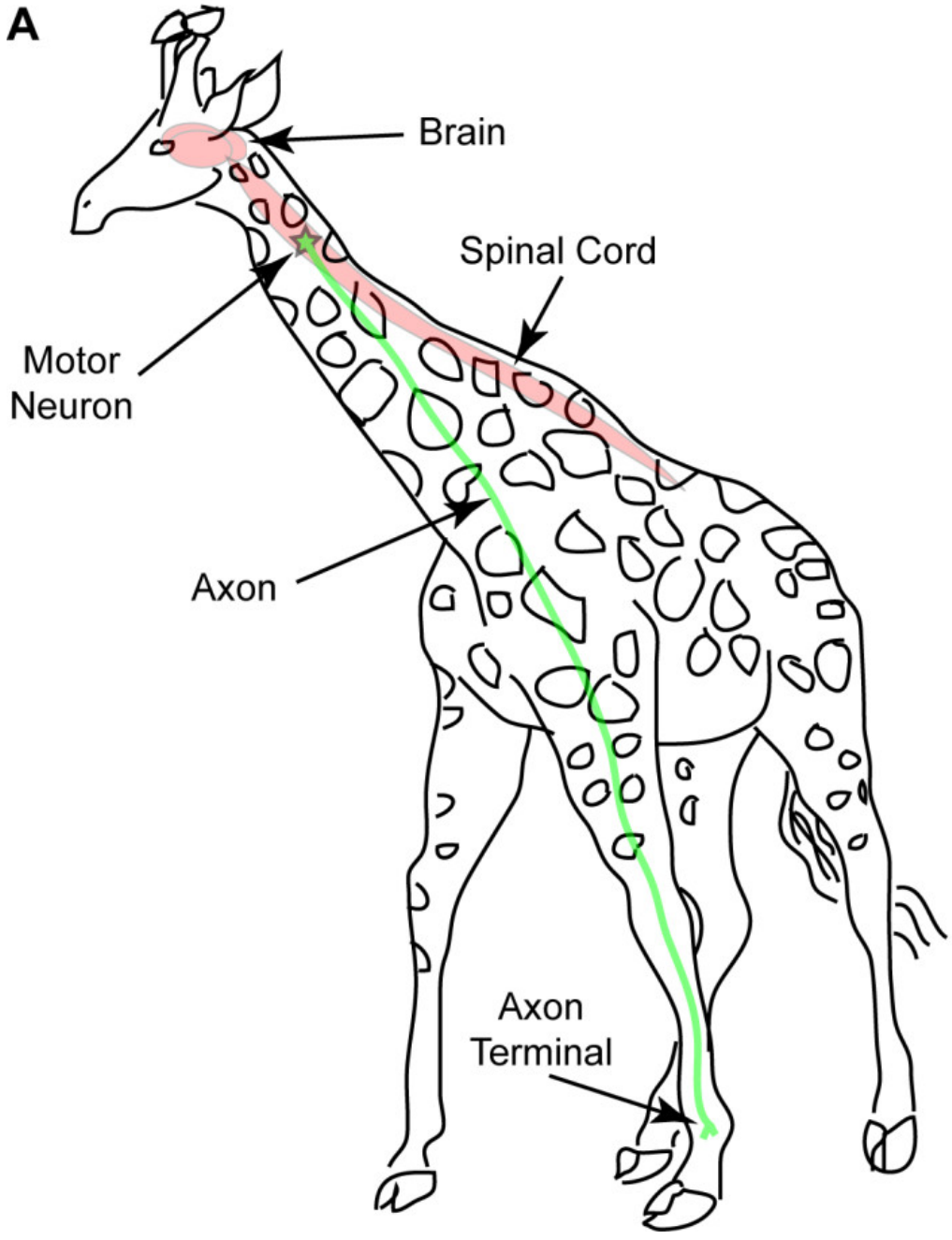
Matthieu Legendre[a,1], Audrey Lartigue[a,1], Lionel Bertaux[a], Sandra Jeudy[a], Julia Bartoli[a,2], Magali Lescot[a], Jean-Marie Alempic[a], Claire Ramus[b,c,d], Christophe Bruley[b,c,d], Karine Labadie[e], Lyubov Shmakova[f], Elizaveta Rivkina[f], Yohann Couté[b,c,d], Chantal Abergel[a,3], and Jean-Michel Claverie[a,g,3]

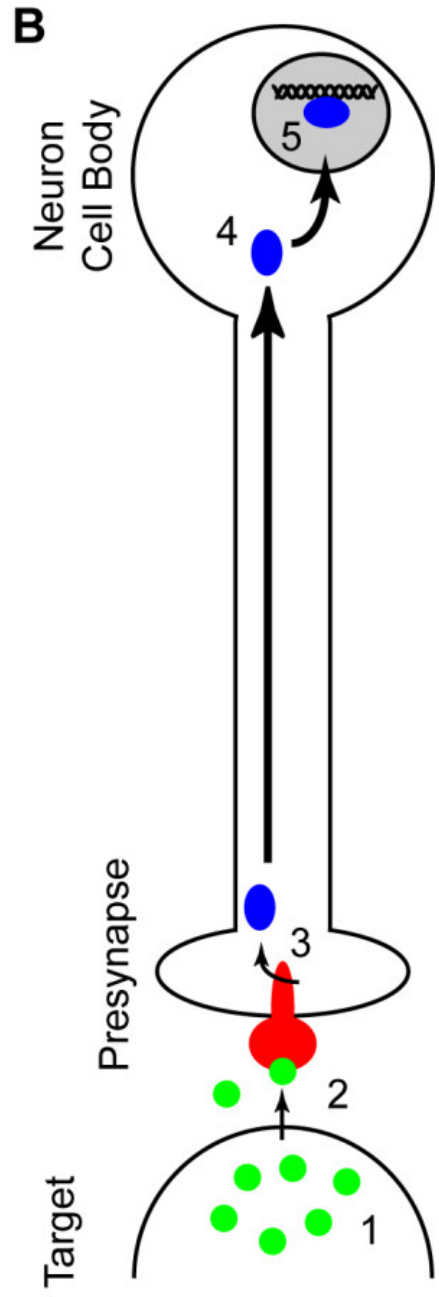


They found an unusual number of ribosome-related proteins in the virus volume. There is certainly plenty of space to store them.

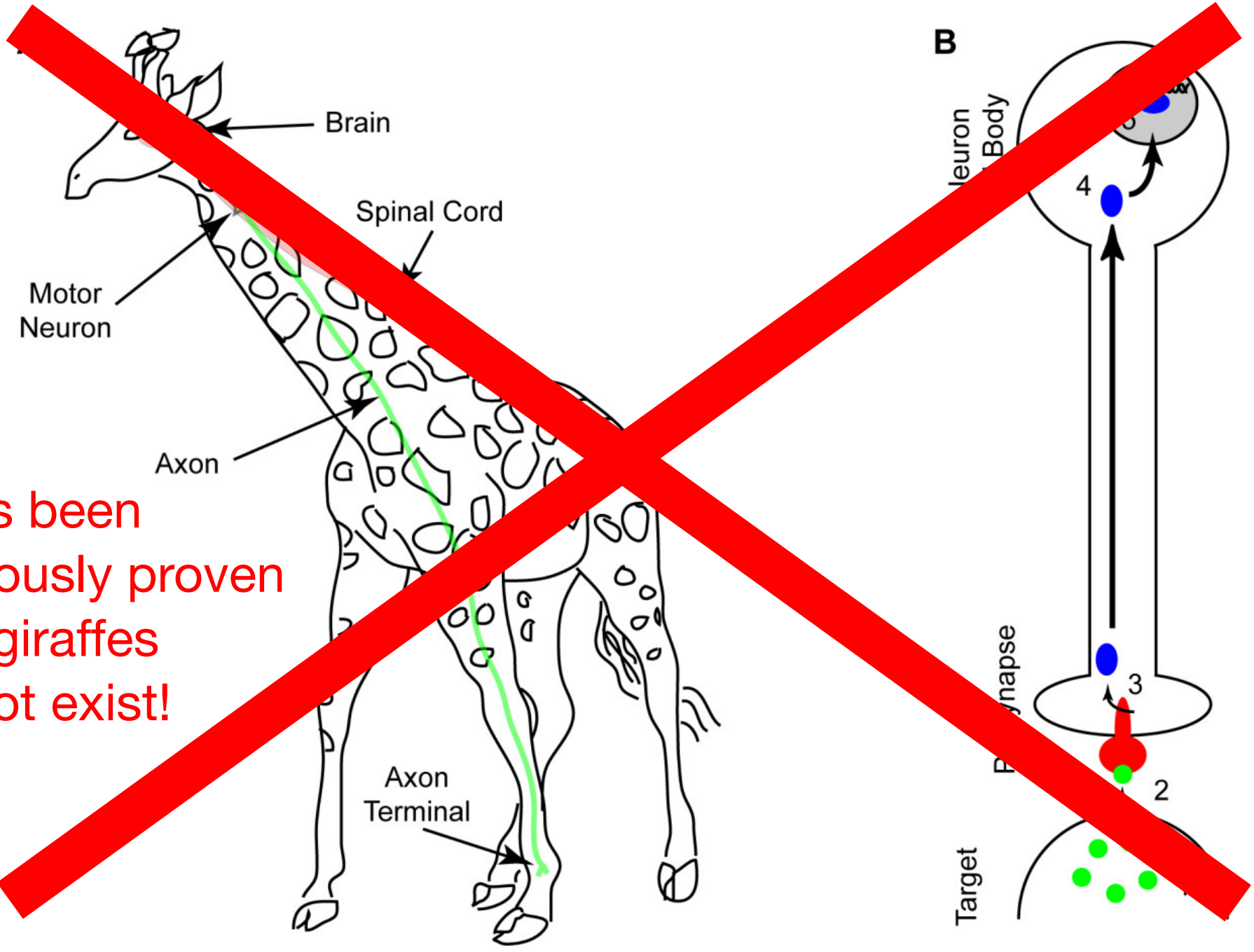
"The fact that two different viruses retain their infectivity in prehistorical permafrost layers should be of concern in a context of global warming."

How big can you make a cell?





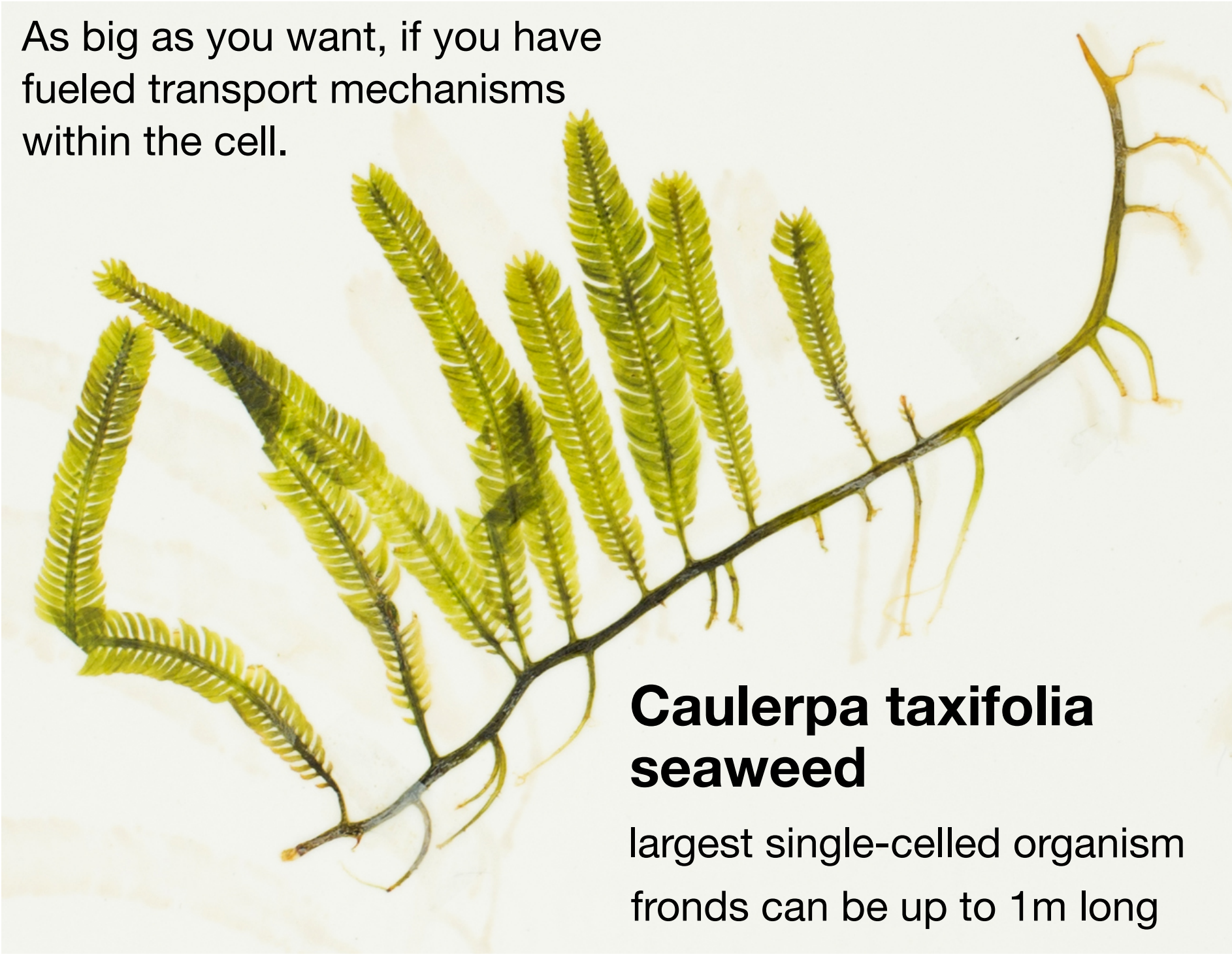
How big can you make a cell?



It has been rigorously proven that giraffes do not exist!

How big can you make a cell?

As big as you want, if you have fueled transport mechanisms within the cell.



Caulerpa taxifolia seaweed

largest single-celled organism

fronds can be up to 1m long