

Origin of Life in the Lab?

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Nonequilibrium Mechanisms for the Onset of Life

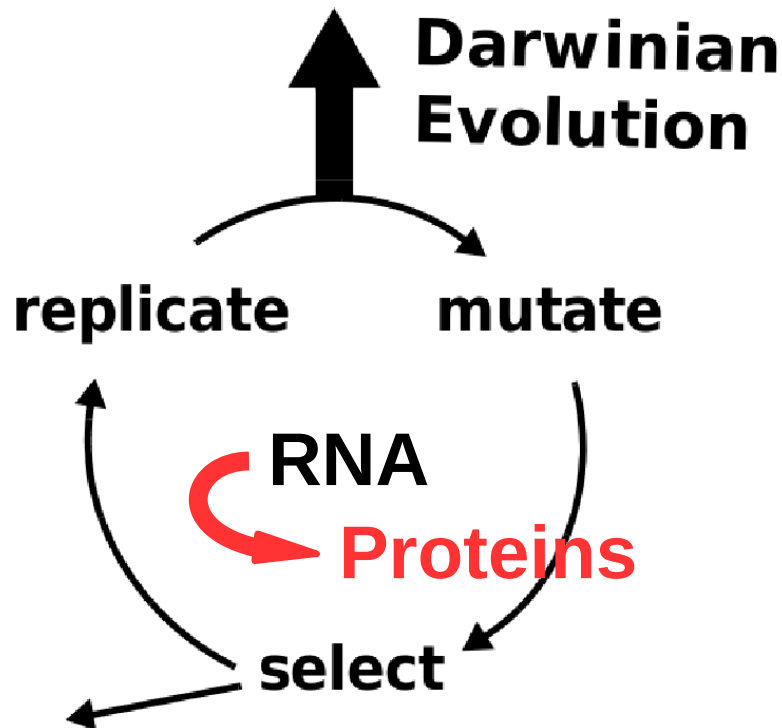
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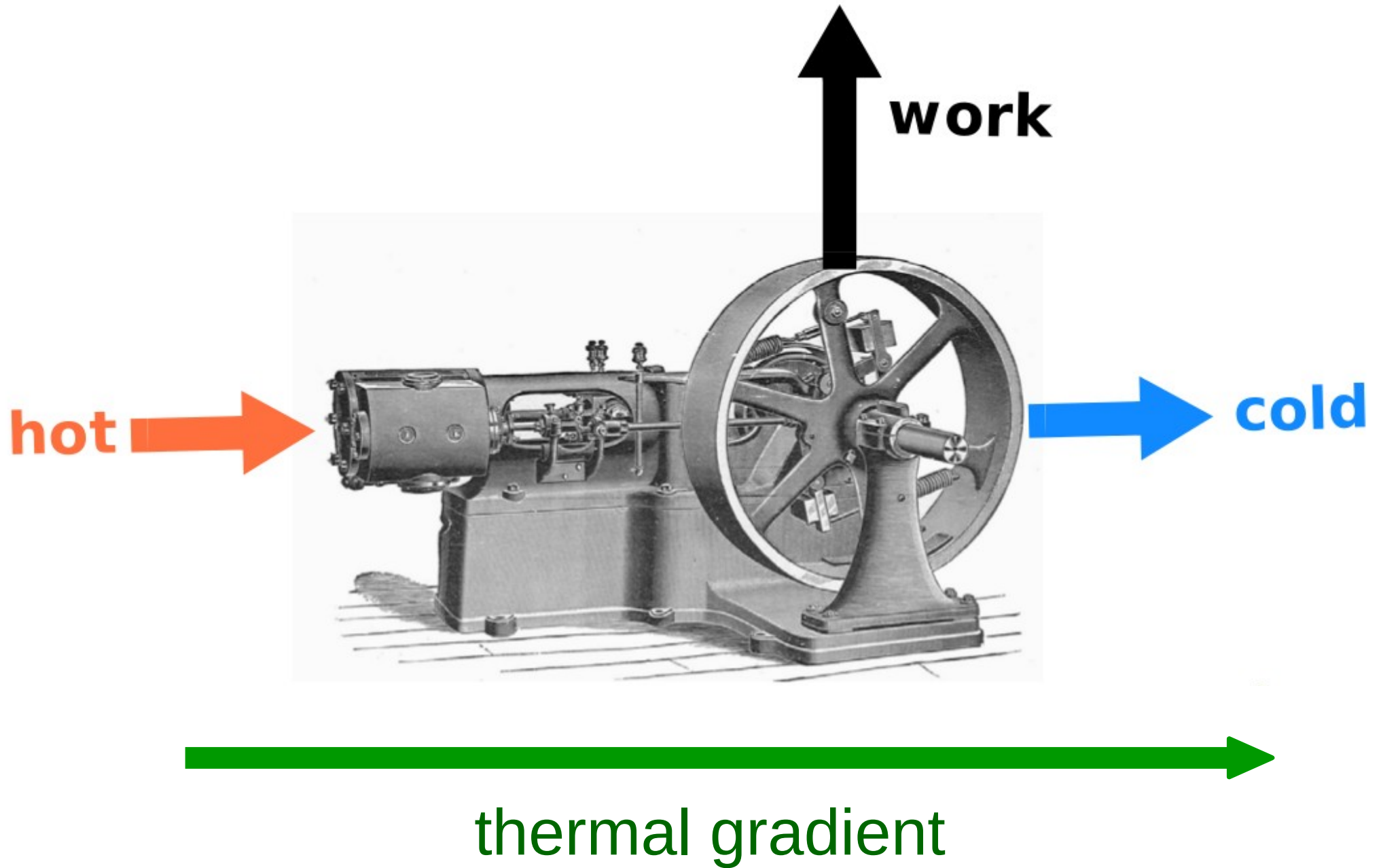


Life as we know it

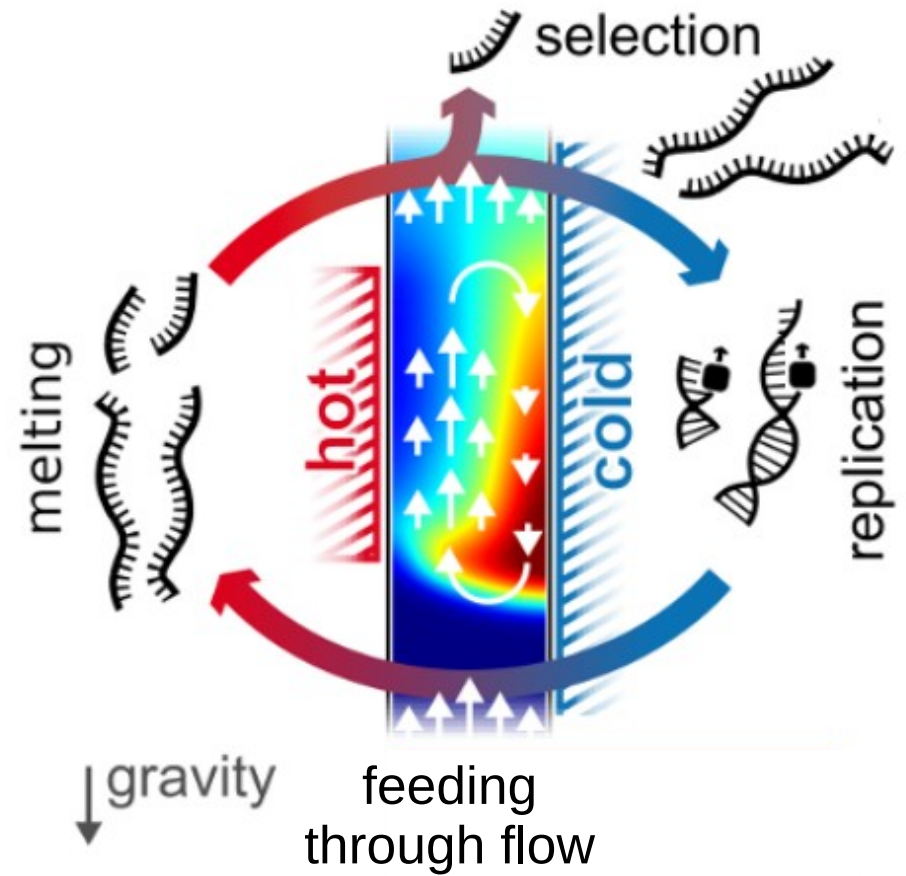
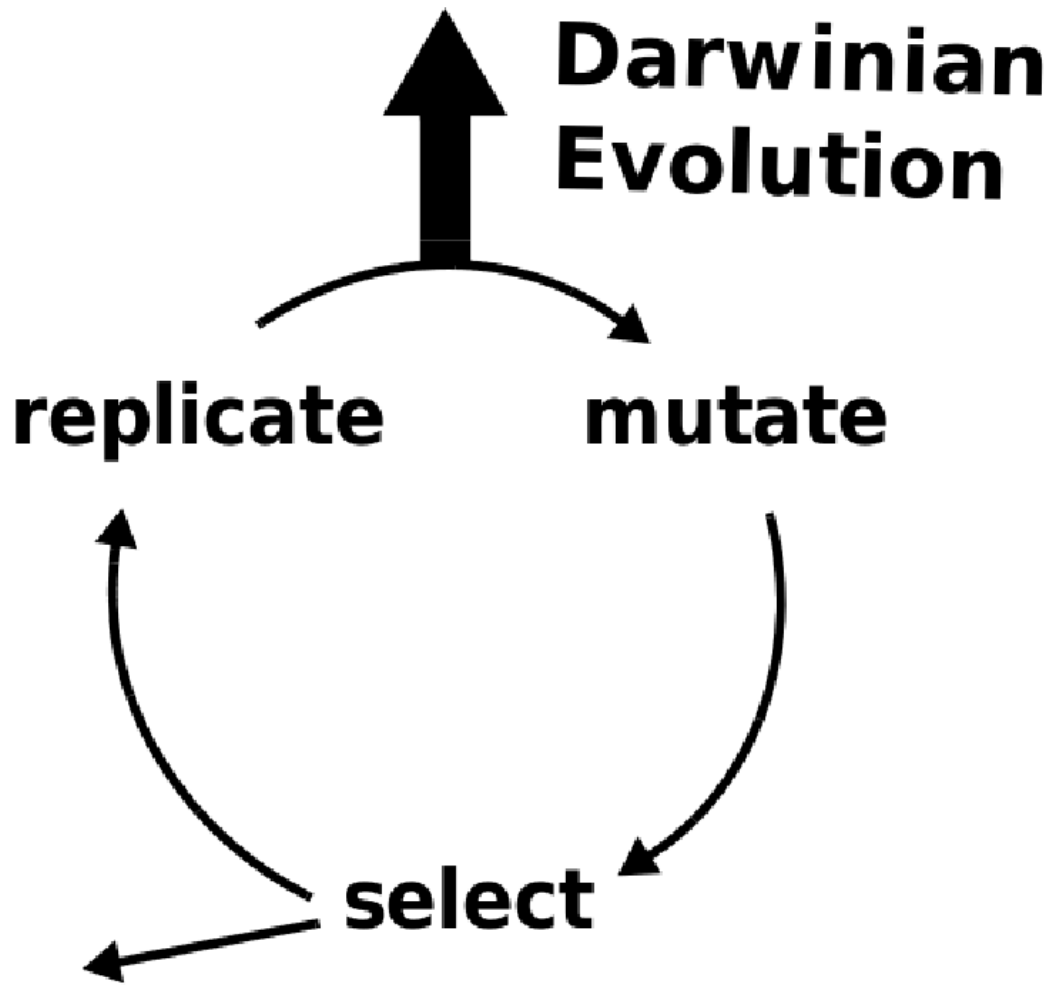
Replication of Genetic Information ...
... to create Proteins from Genes ...
... in a crowded Soup of Nutrients ...
... far from Equilibrium.



Far from Equilibrium



Far from Equilibrium

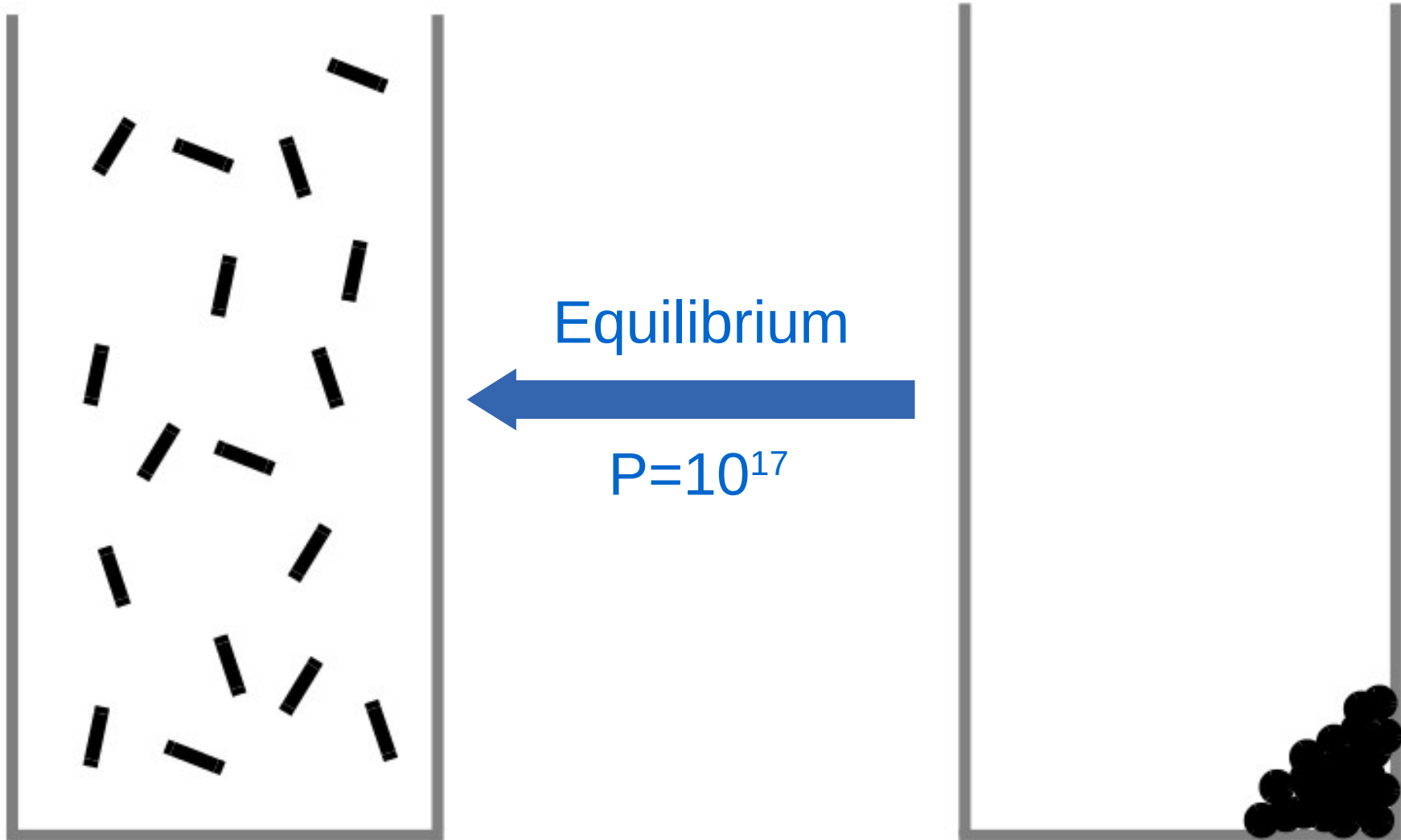


to create chemical complexity of life



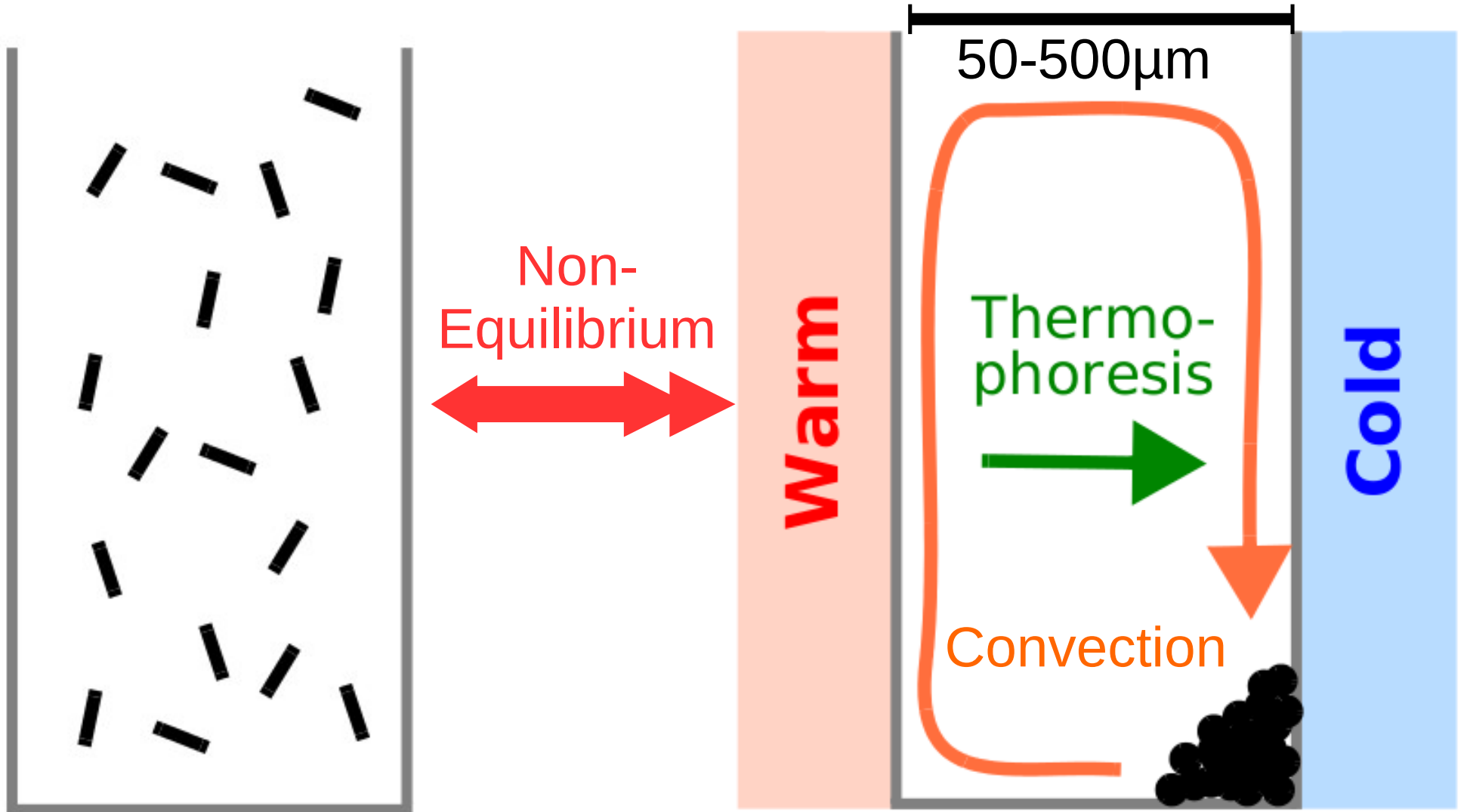
thermal gradient

Equilibrium

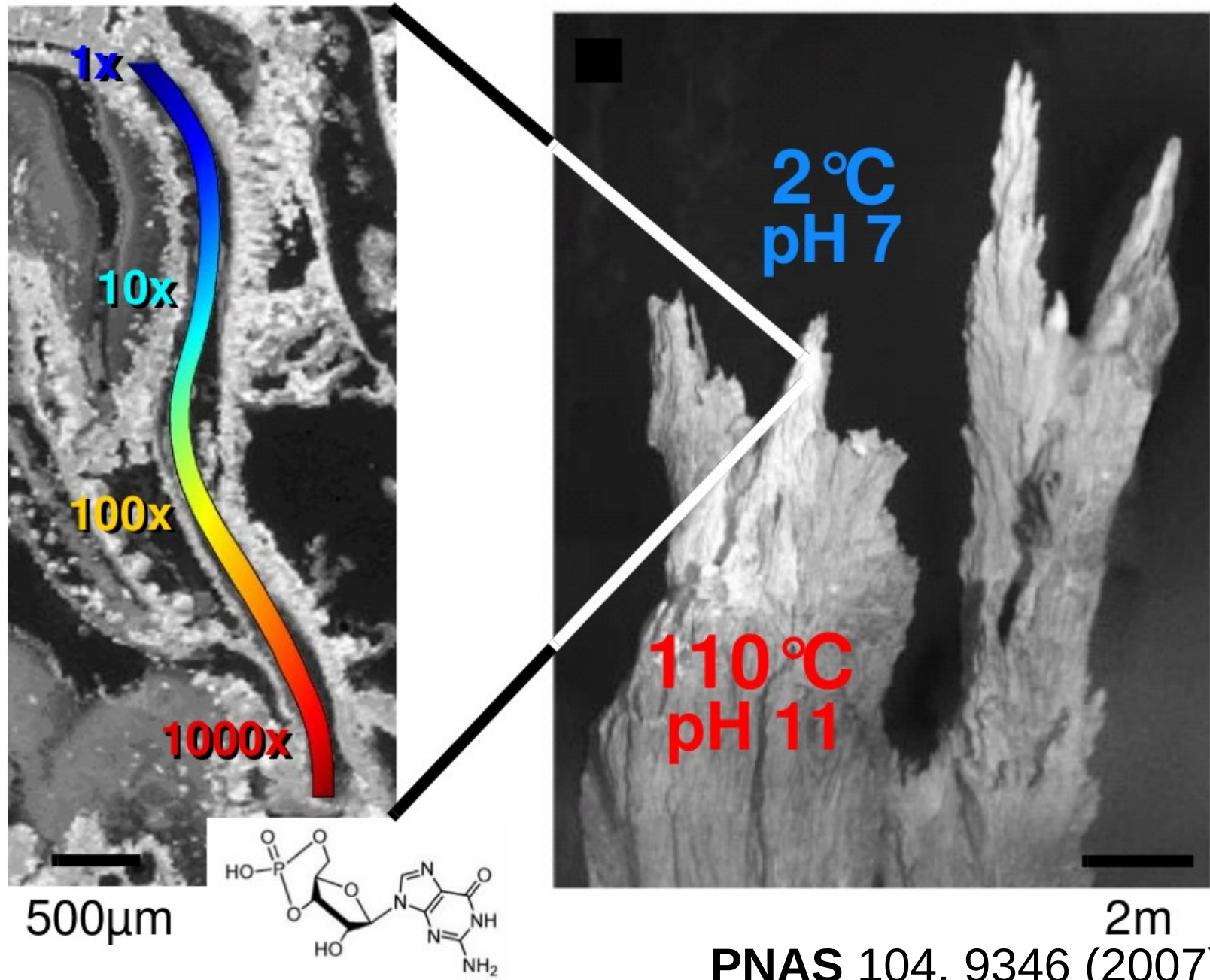


Far from Equilibrium

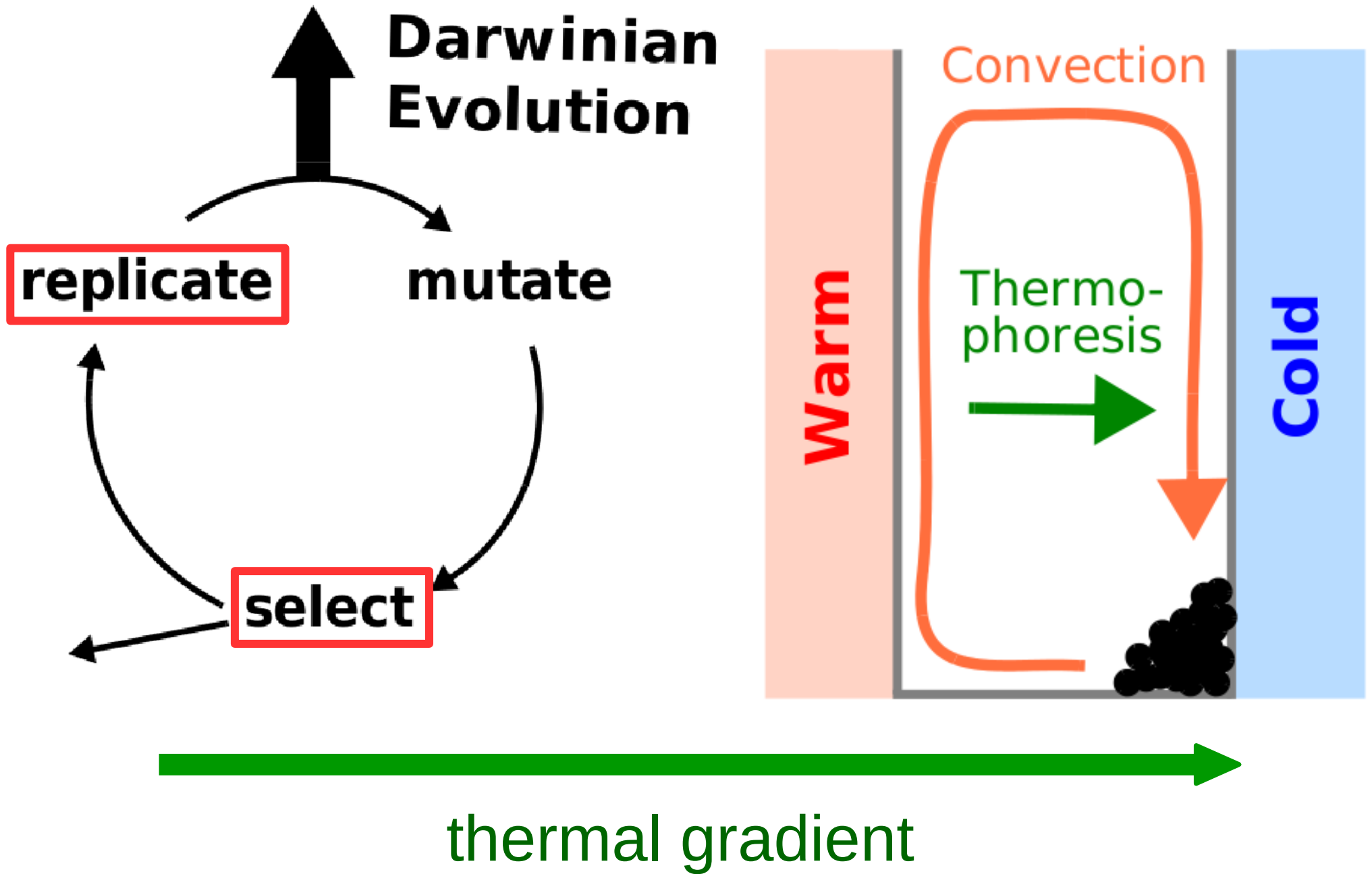
Thermal
Molecule Trap



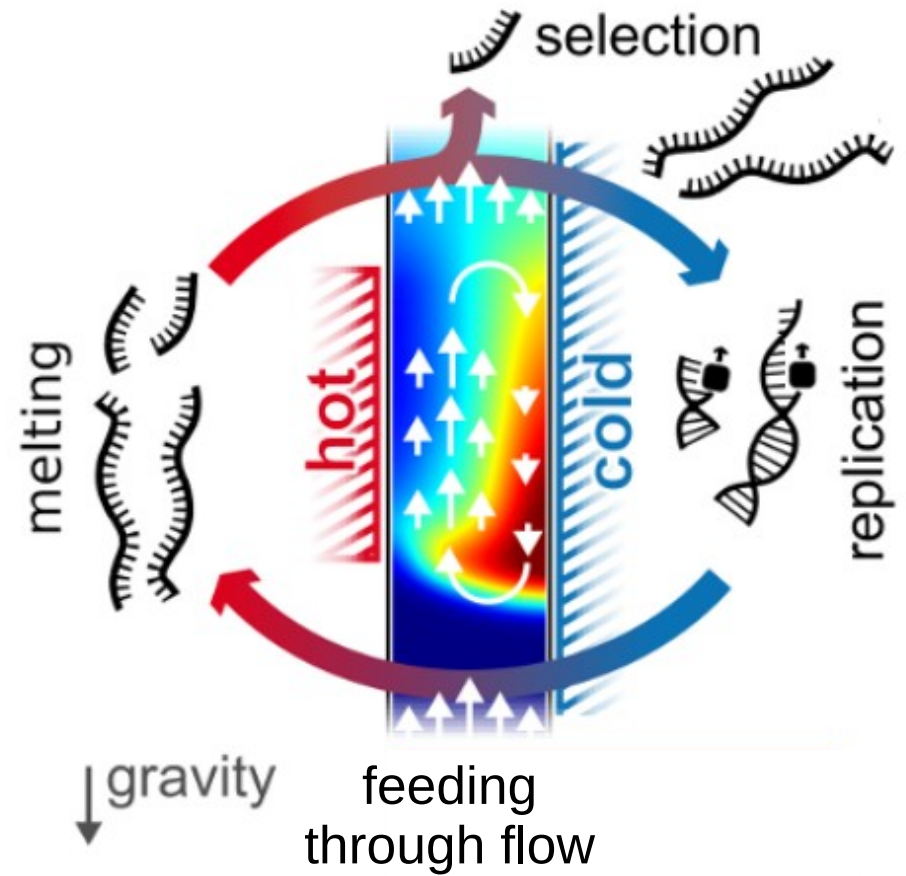
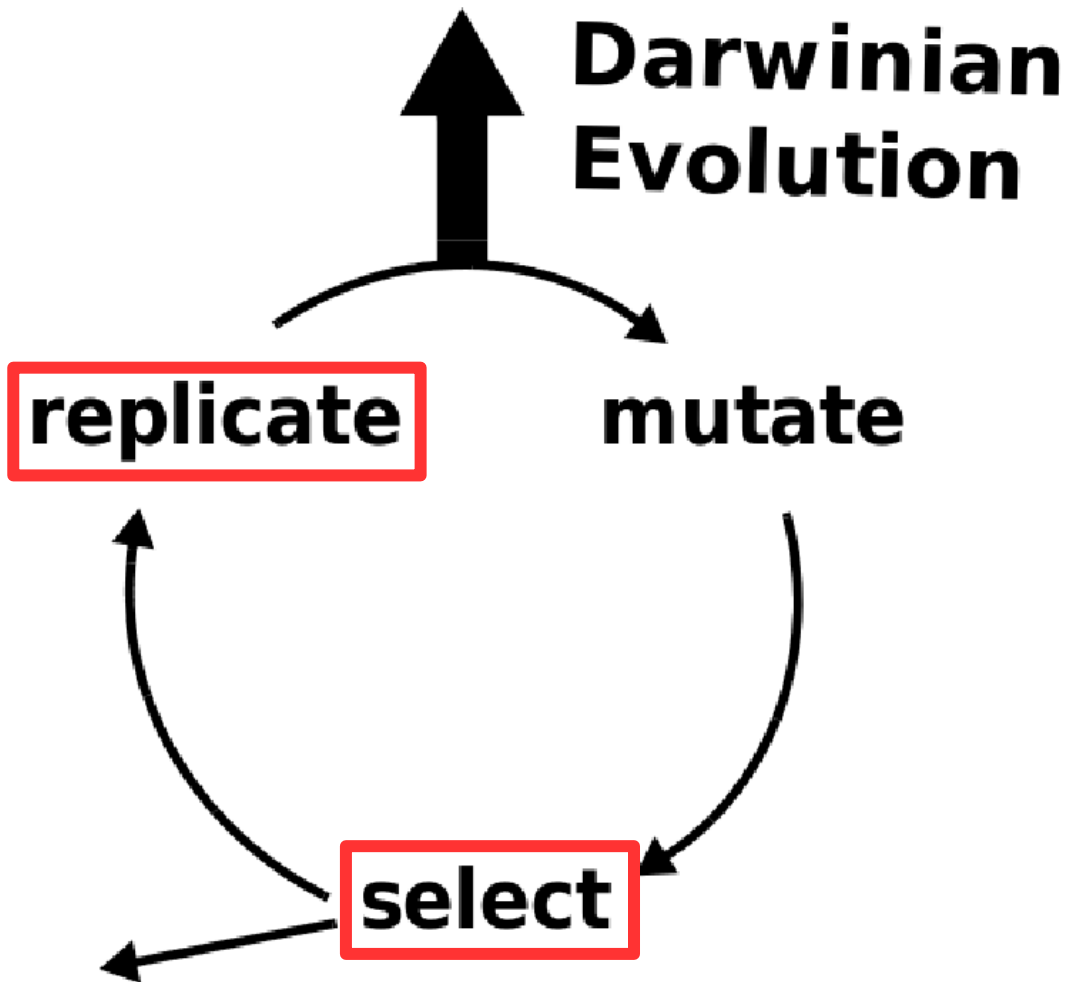
Thermal Trap



Far from Equilibrium



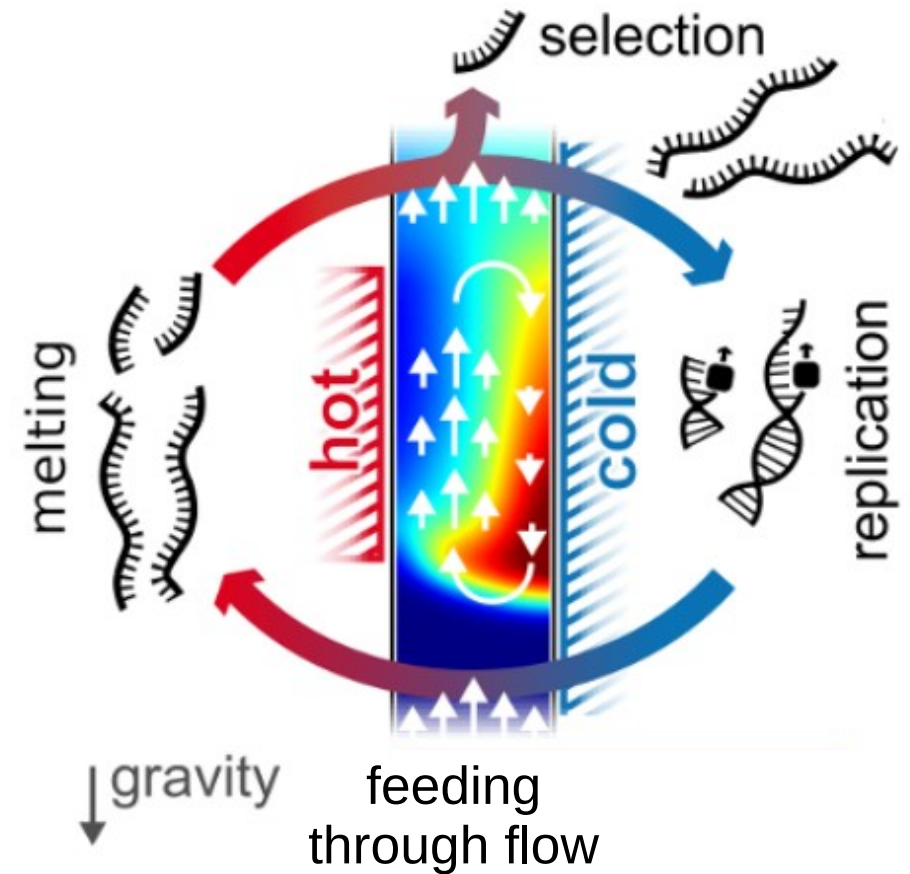
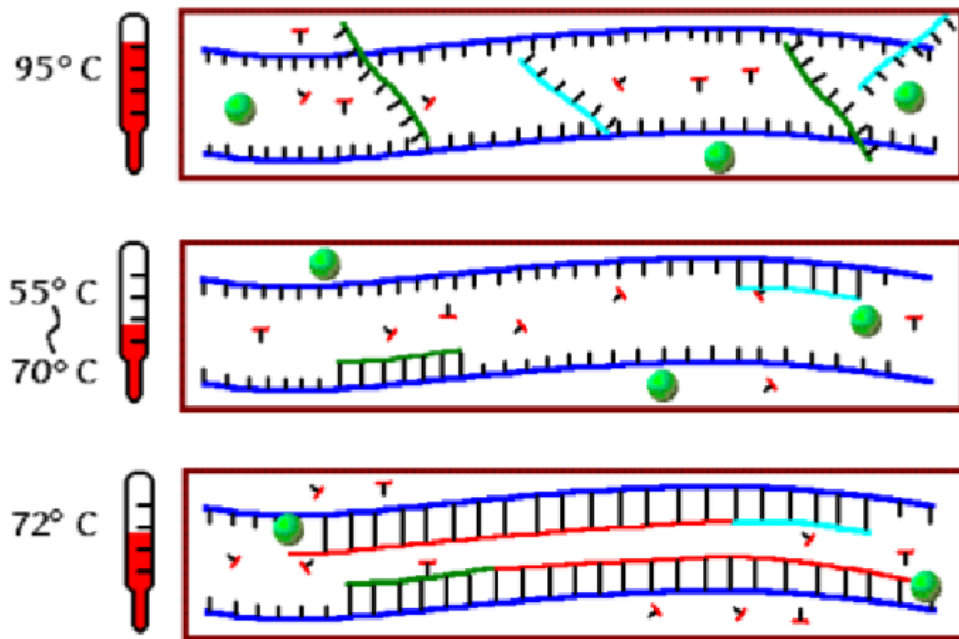
Far from Equilibrium



thermal gradient

Replication of Genetic Information

Strand Separation



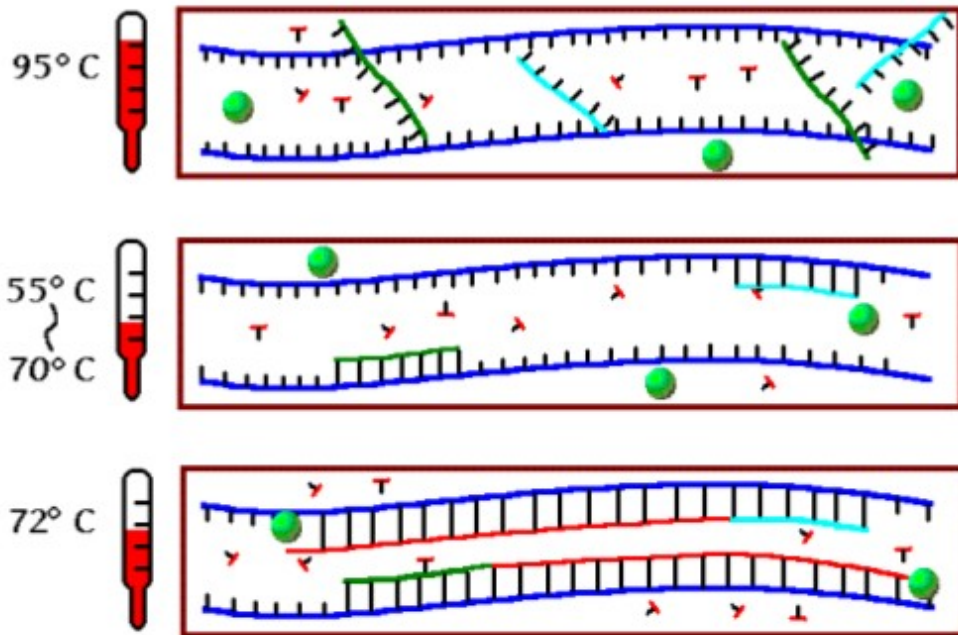
Mast & Braun, PRL, 104, 188102 (2010)



thermal gradient

Replication of Genetic Information

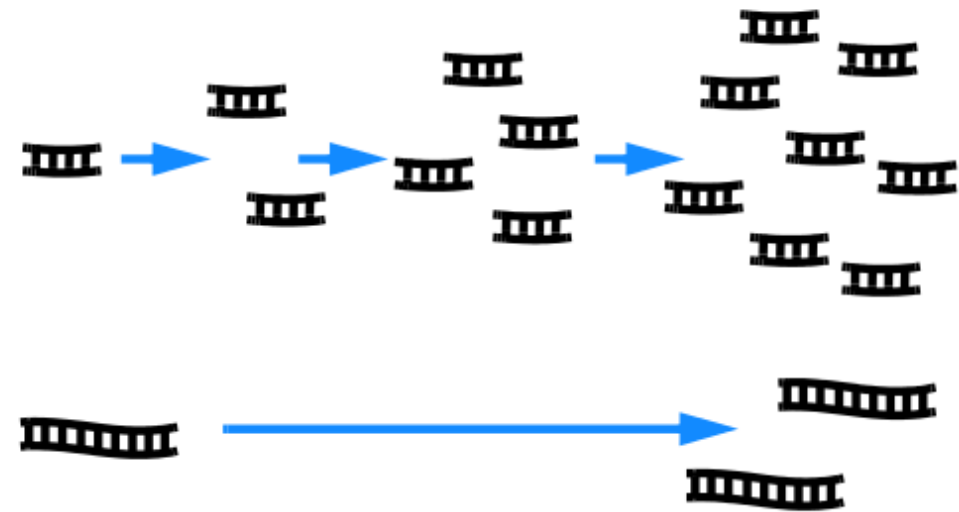
Strand Separation



Polymerase
Chain
Reaction
(PCR)



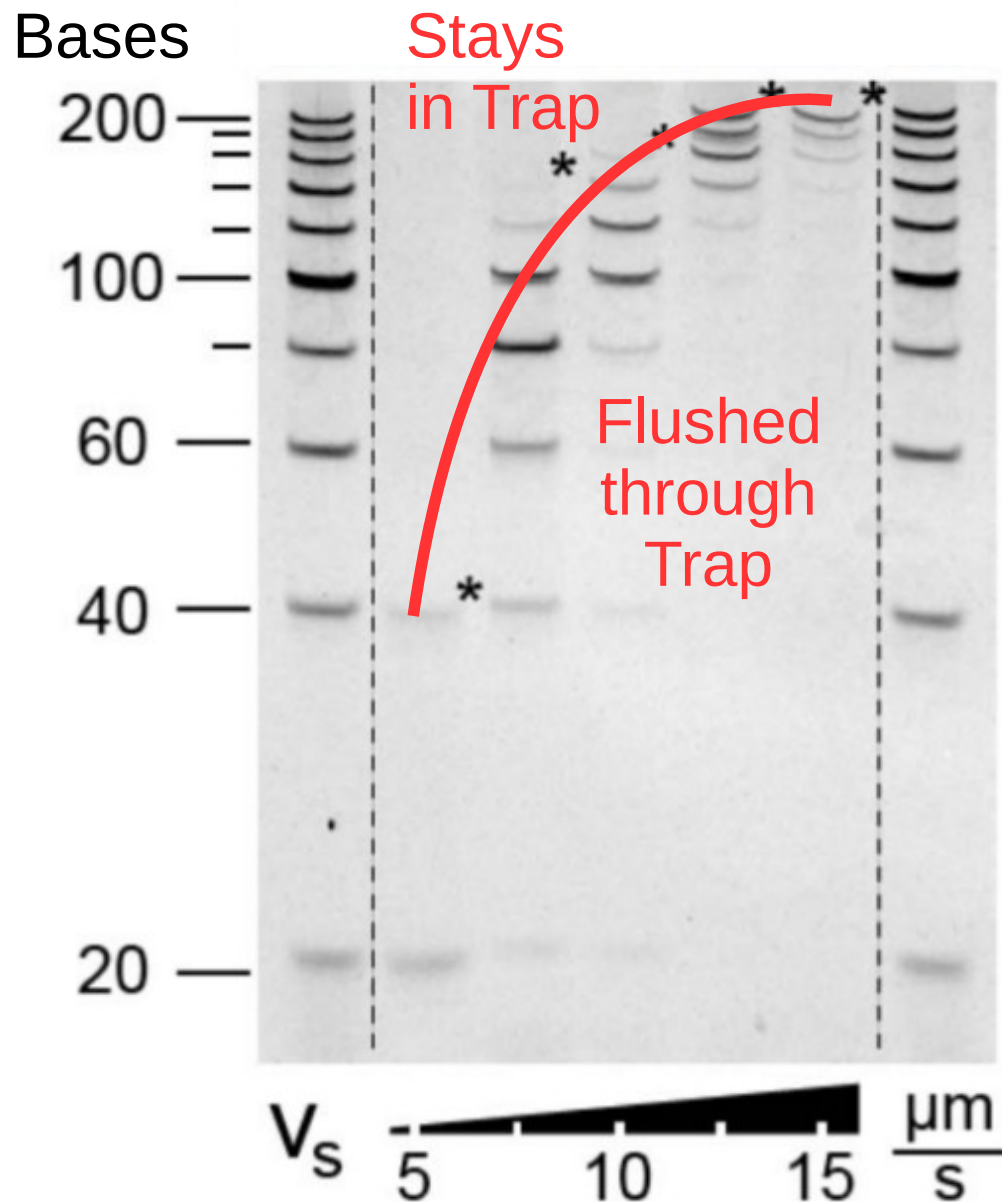
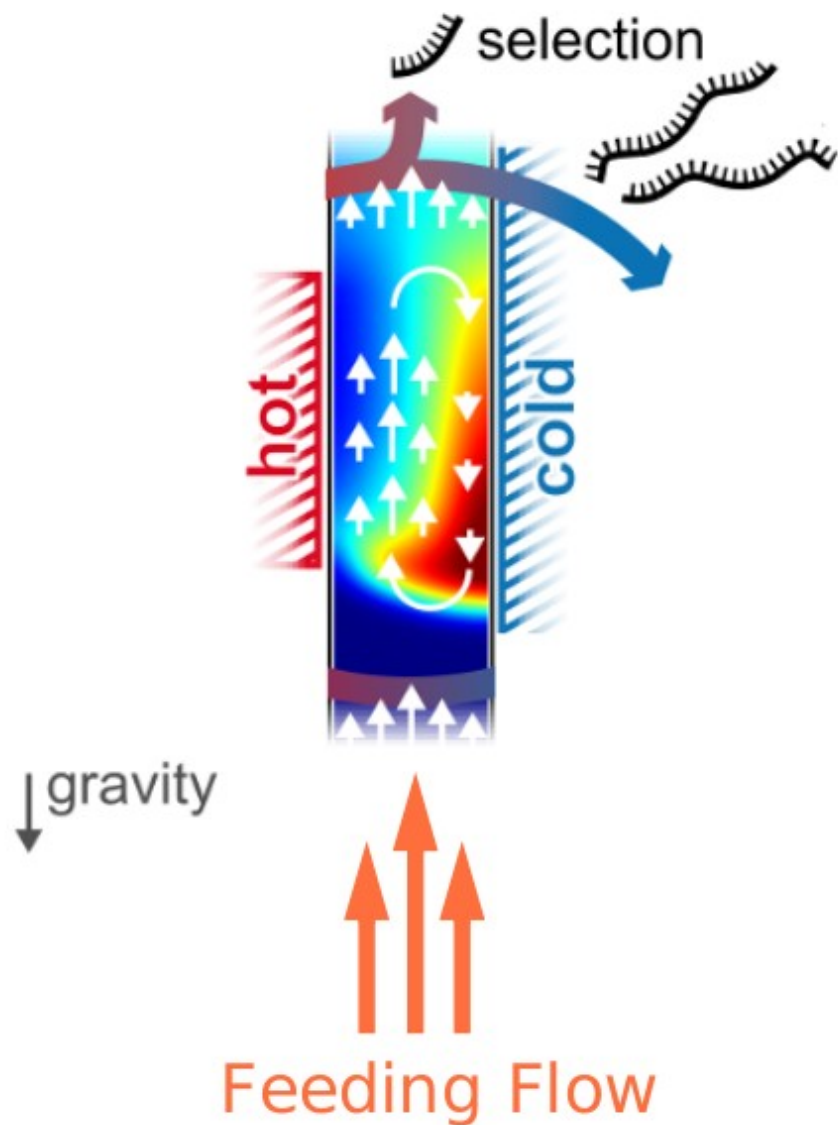
Tyranny of the Shortest



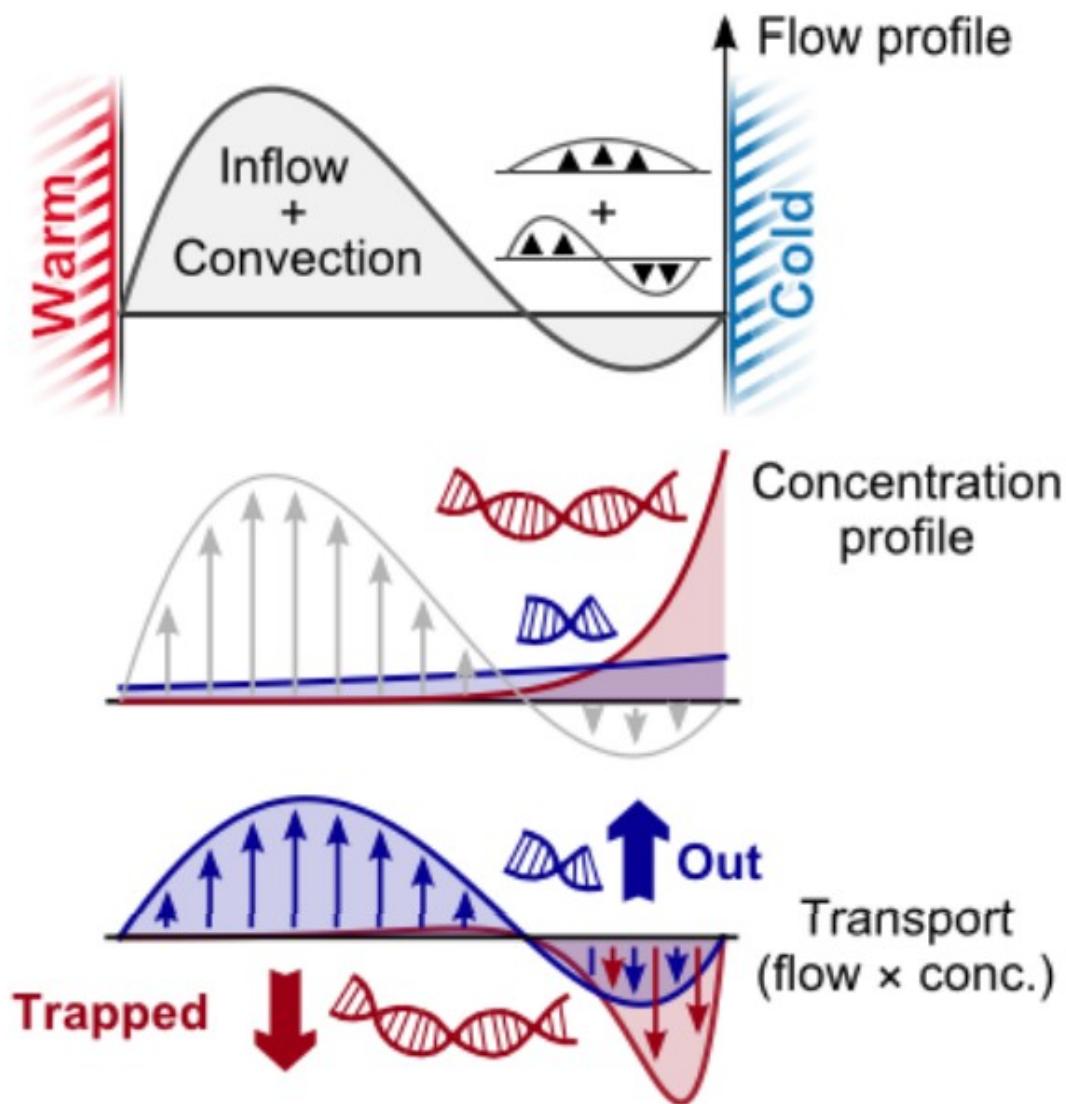
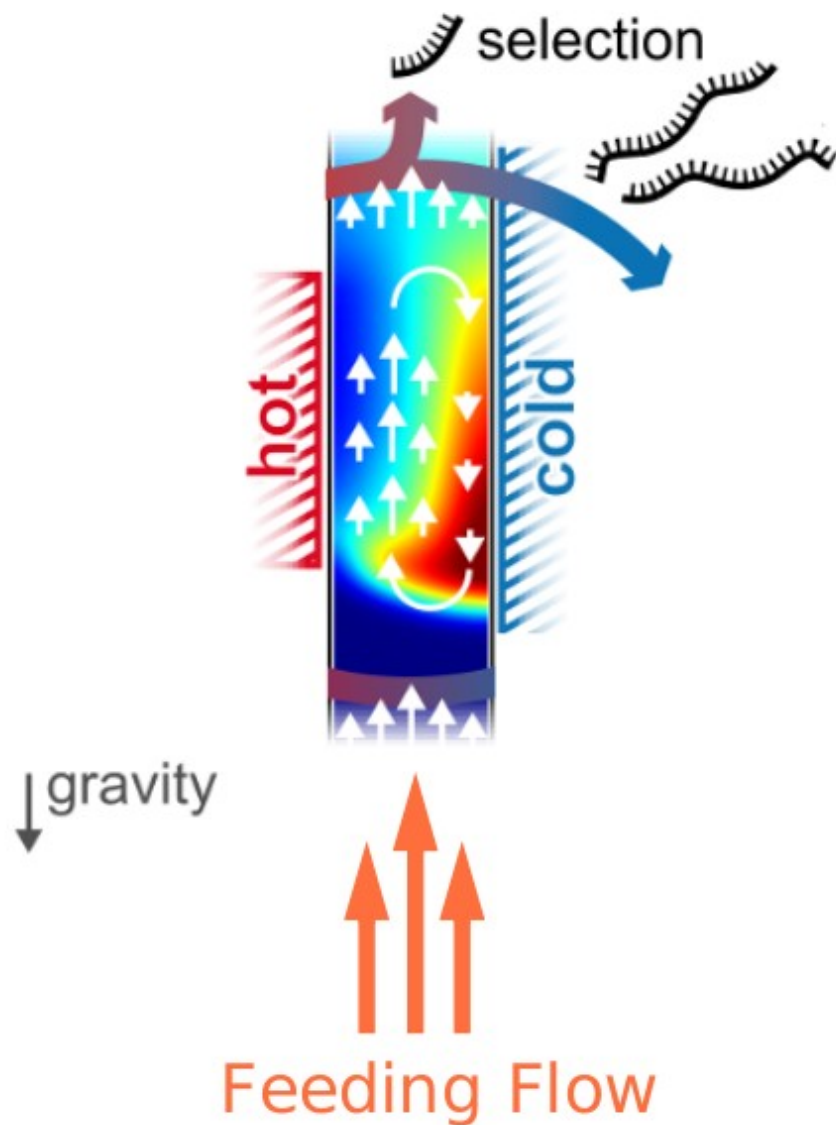
Spiegelman 1967

Removal of
genetic information

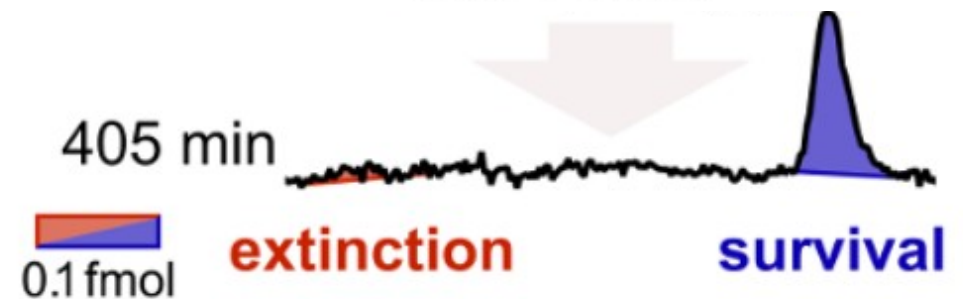
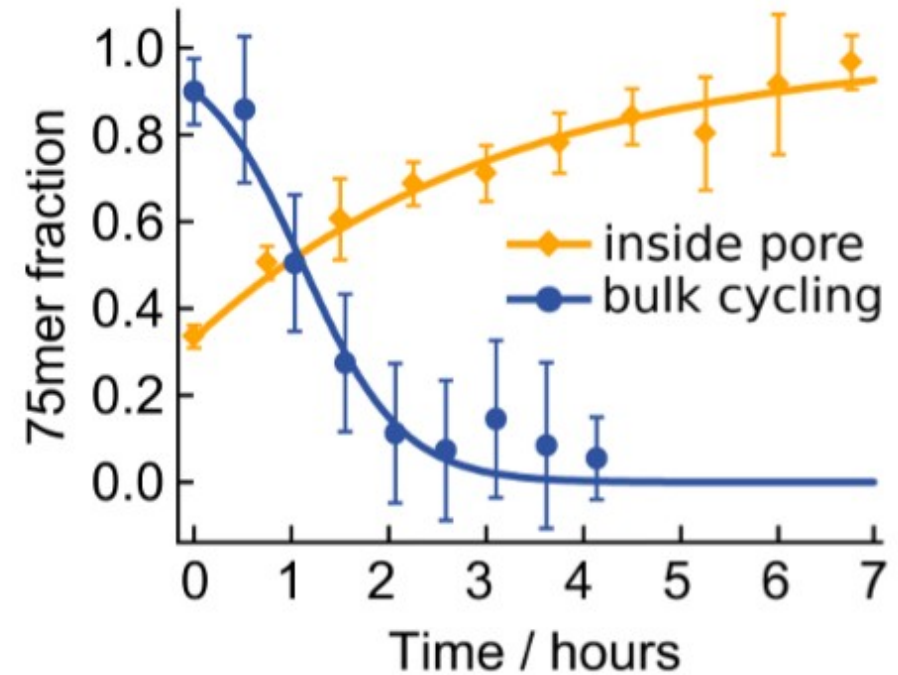
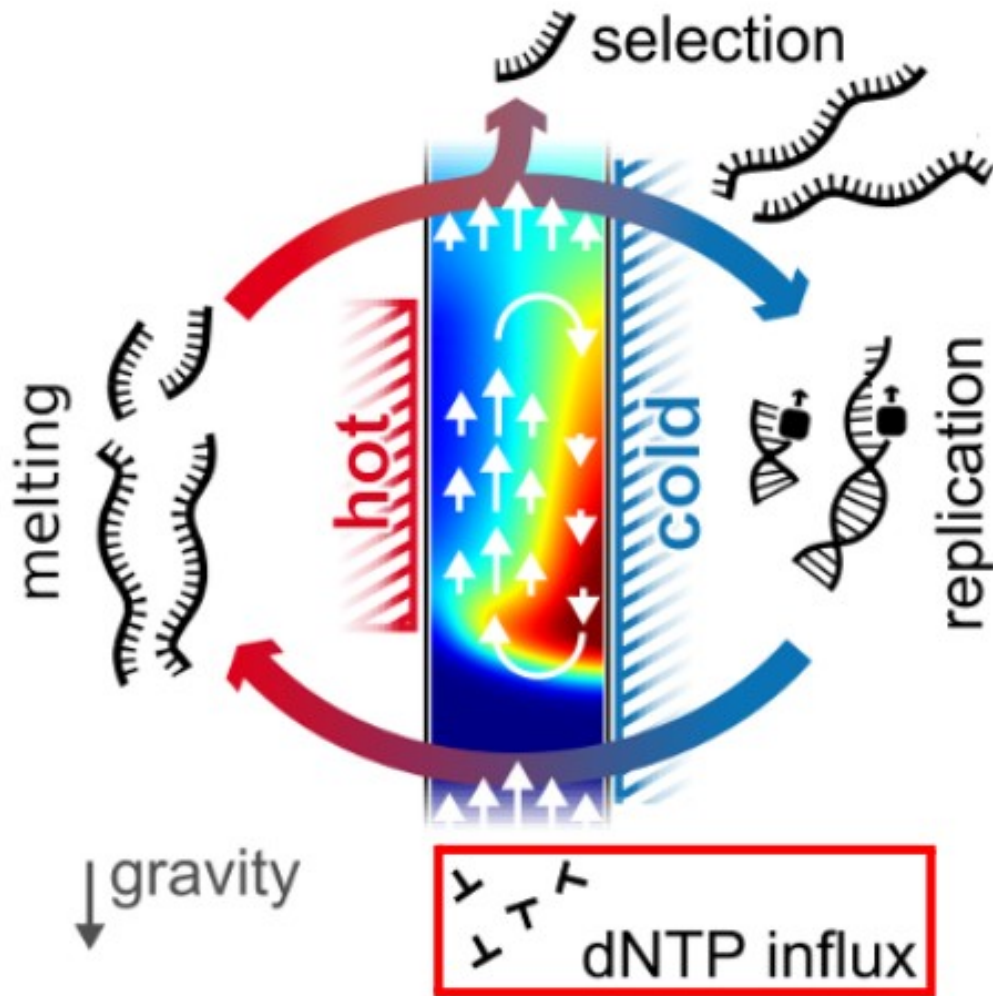
Selection ...



Selection ...



Selection and Replication



$$dc_i/dt = (rep_i - dil_i) \cdot c_i$$

$$c_L / (c_S + c_L) = (1 + A \cdot e^{\Delta k \cdot t})^{-1}$$

Fitness: 36mer 0.87; 75mer 1.03

Will we solve the Origin
of Life problem on Earth?

No

there are not
enough 'fossils'

Can we construct
primitive life-like systems?

Maybe

if Nature gives
us enough clues

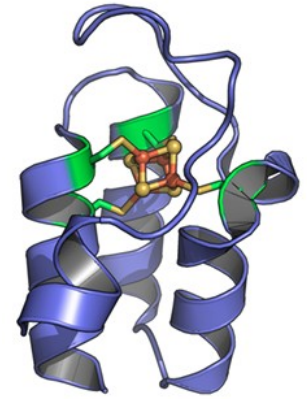
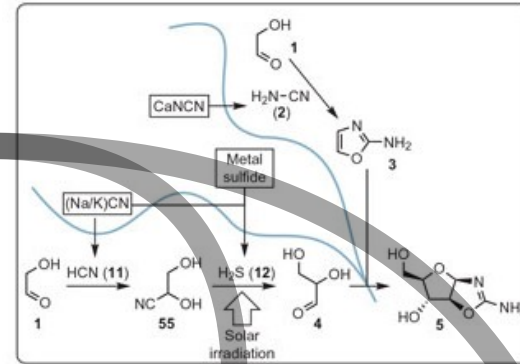
Will we discover interesting
Science on the way?

Sure

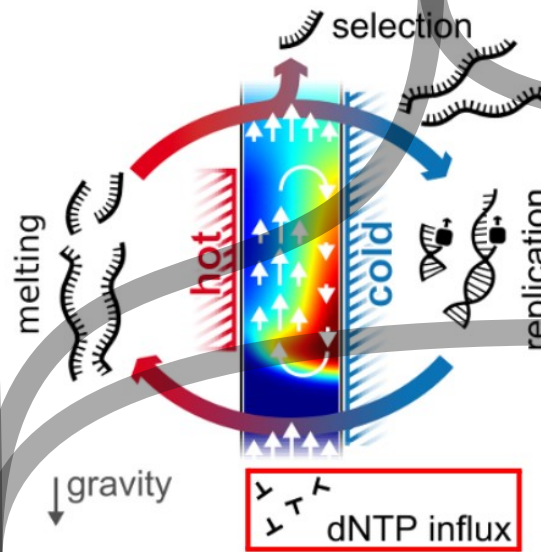
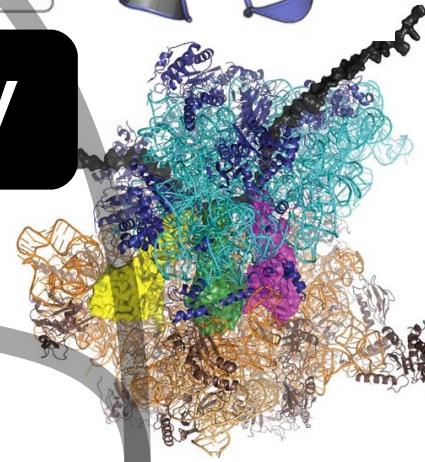
if we do
experiments

Origins of Life

Geology

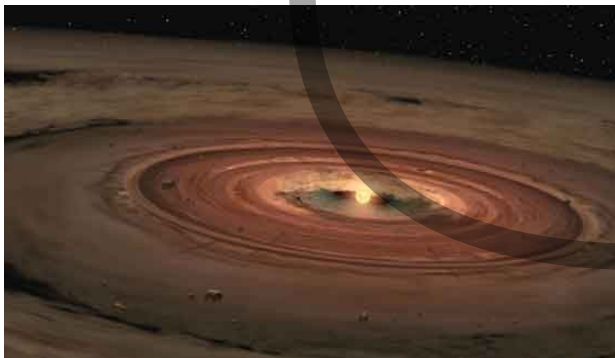


Chemistry

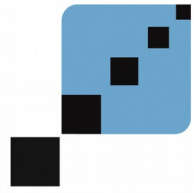


Biology

Astronomy



Physics



CeNS

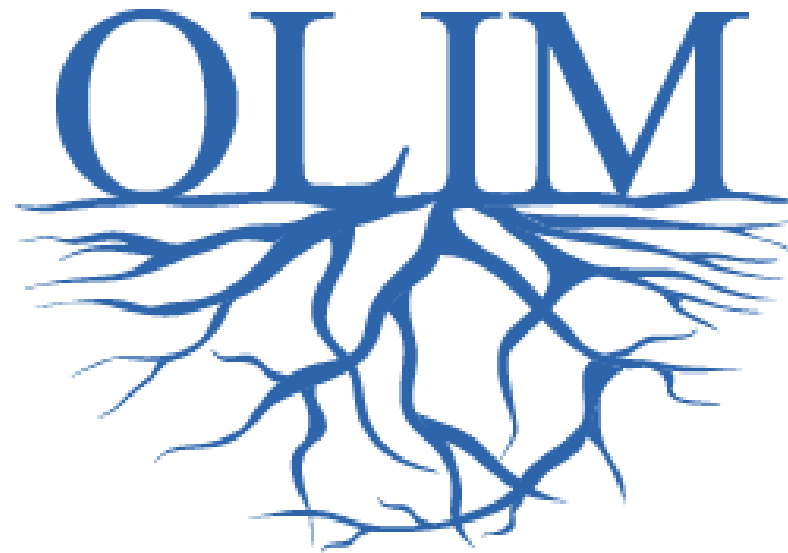
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Technische Universität München



Max Planck Institute
of Biochemistry



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Petra Schwille