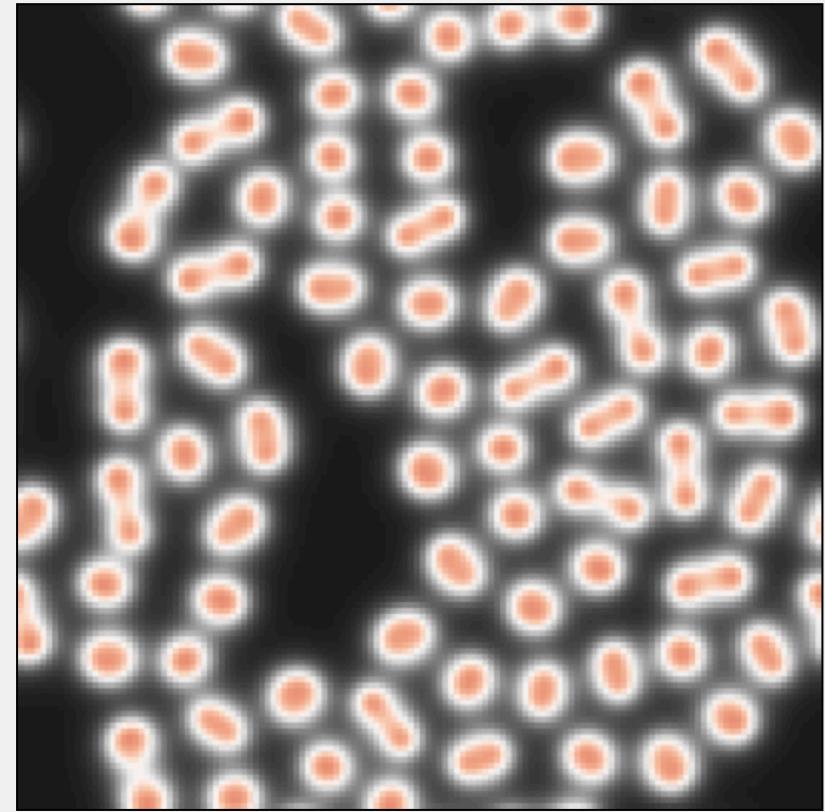


# Weird Life

Sarah Maurer



# No Cells?



Keith Haring

Lava Lamp

Cell Division

Alien Graffiti

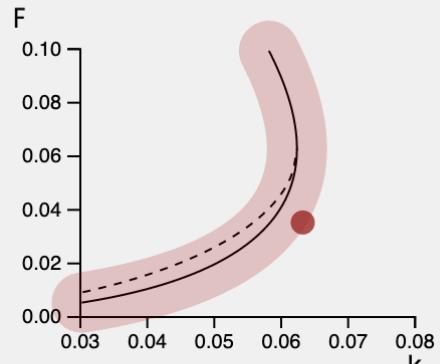
Dirk's Favorite

Targets and Spirals

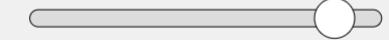
Bacteria

Orli's switch

$F=0.035$        $k=0.063$



normal

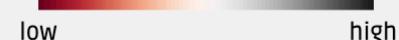


tangent



Show U Concentration

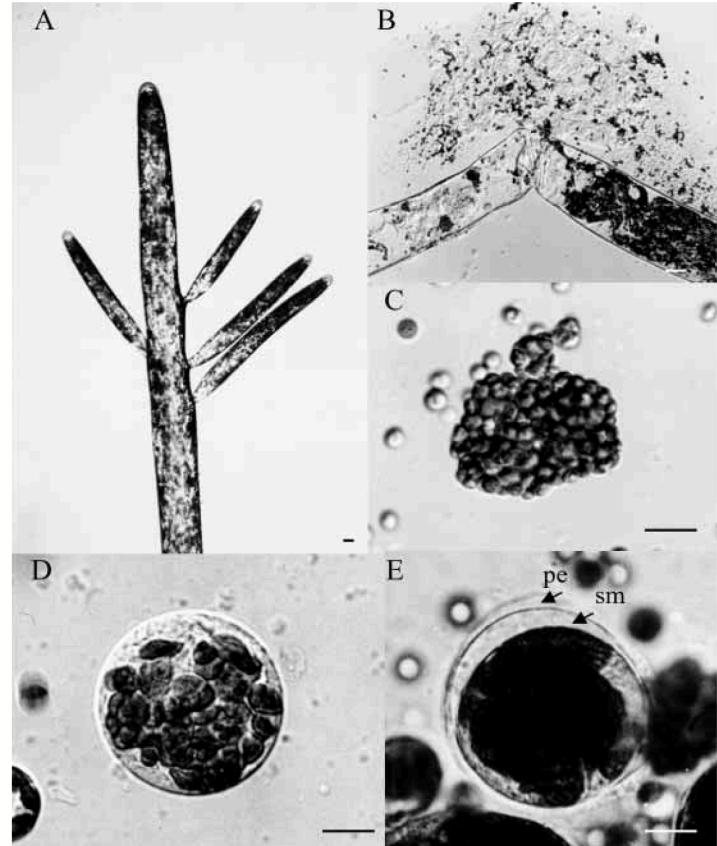
Show V Concentration



# Membrane-less Cells?

Organization of  
chemical gradients

- Mineral surfaces
- Coacervates
- Oil droplets
- Aerosols

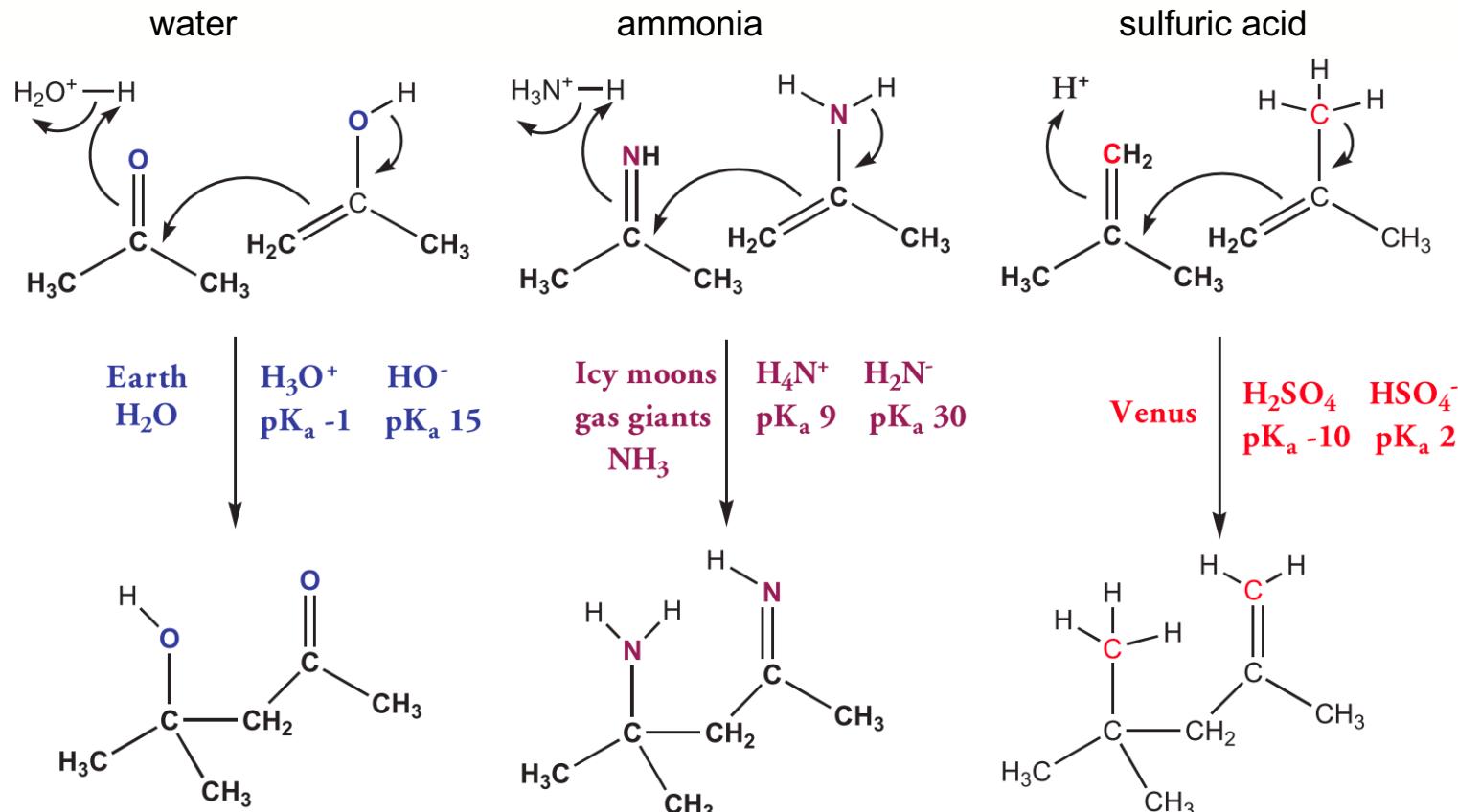


Hollants, J., Declyre, H., Leliaert, F., De Clerck, O., & Willems, A. (2011). Life without a cell membrane: Challenging the specificity of bacterial endophytes within Bryopsis (Bryopsidales, Chlorophyta). *BMC Microbiology*, 11. <https://doi.org/10.1186/1471-2180-11-255>

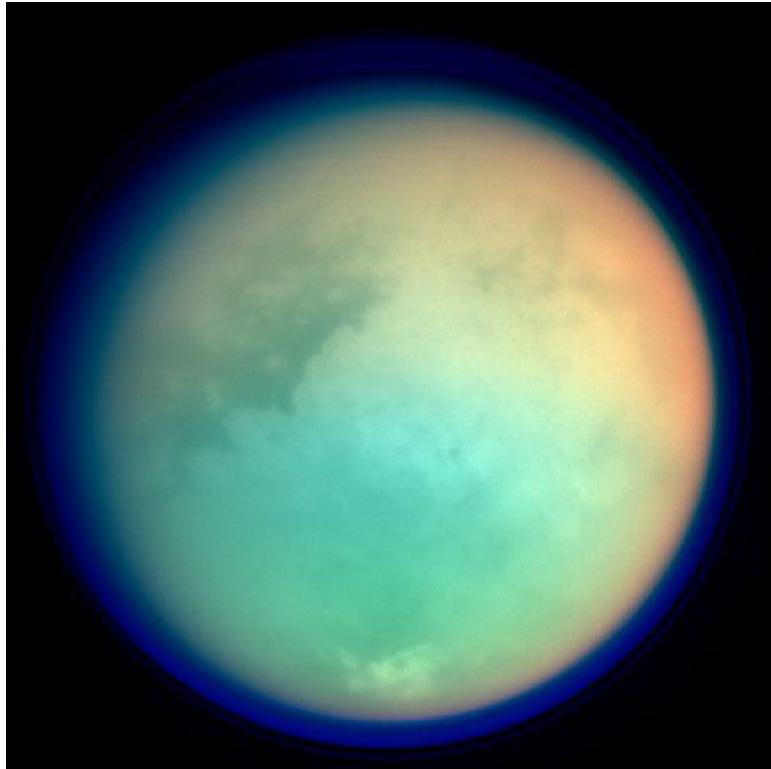
Kim, G. H., Klotchkova, T. A., & Kang, Y. M. (2001). Life without a cell membrane: regeneration of protoplasts from disintegrated cells of the marine green alga *Bryopsis plumosa*. *Journal of Cell Science*, 114(Pt 11), 2009–2014. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11493637>

# No water? Polar solvents

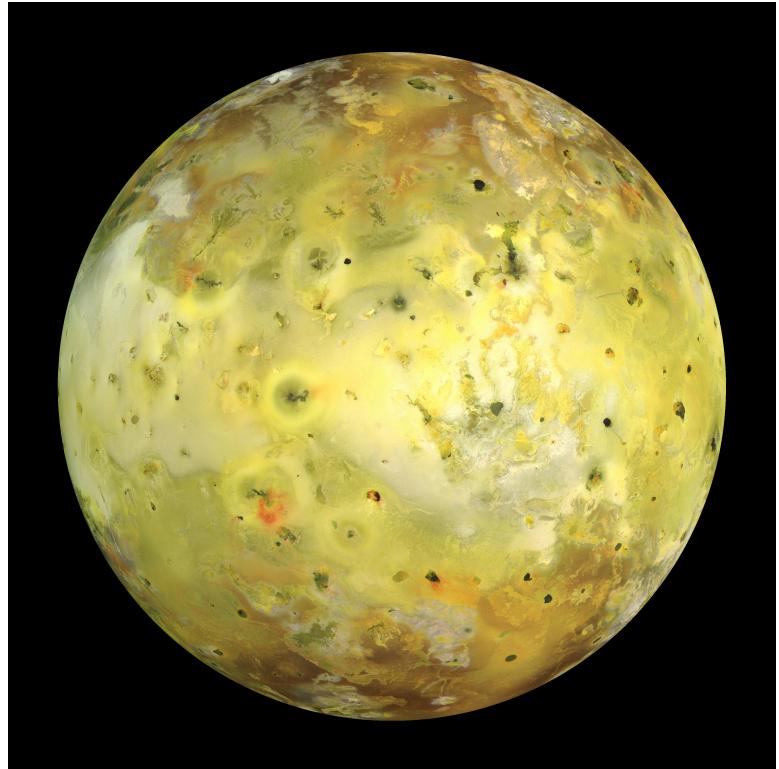
Carbon carbon bond formation in different solvents:



# No water? Non-polar solvents

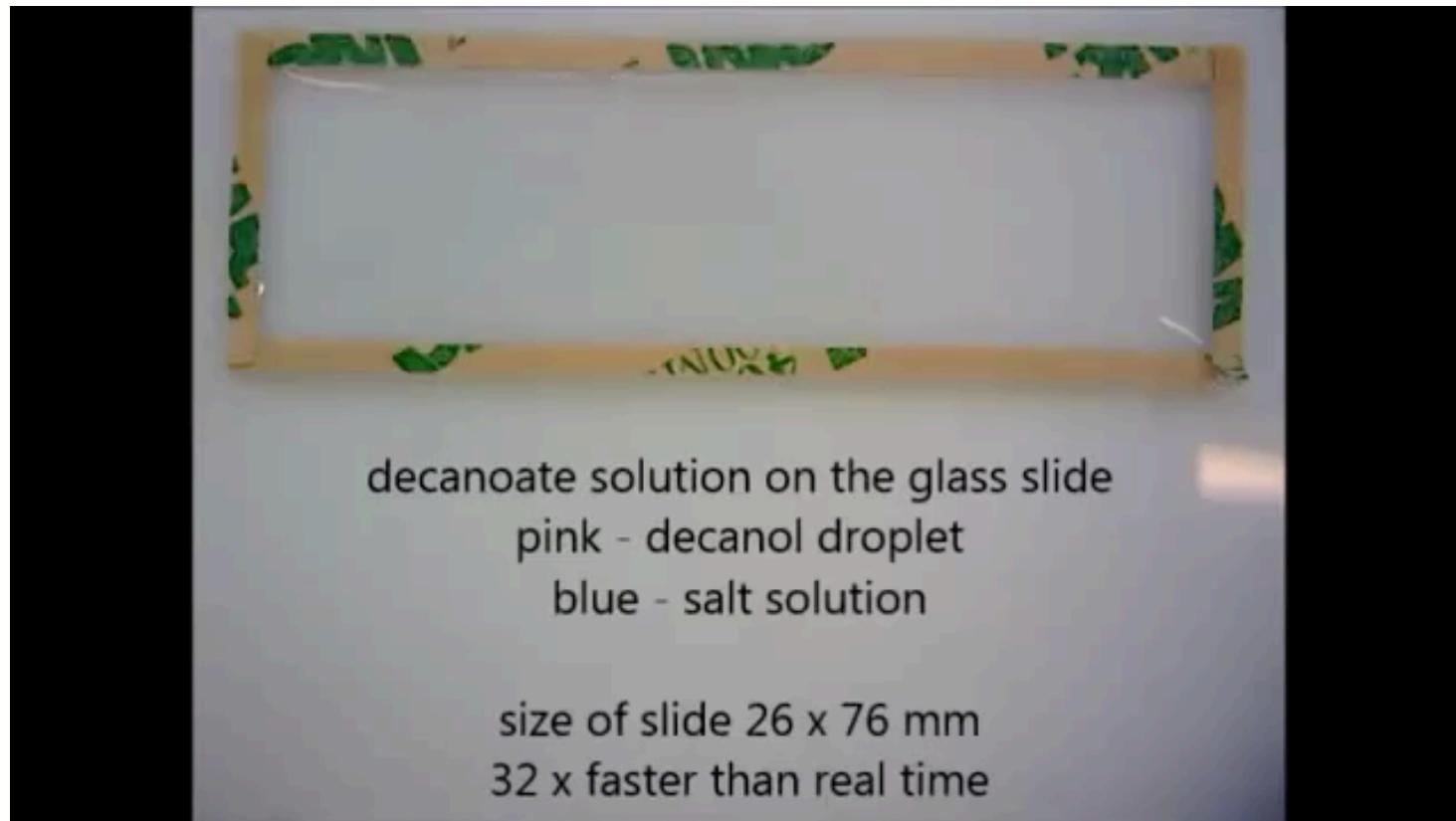


Titan  
liquid ethane/methane  
very cold



Io  
liquid sulfur  
Hotter than Earth

# No water? Non-polar solvents



# No liquid?

## Solids

- Ices?
- Very slow metabolic rates (longer time scales)

## Gases

- Higher temperatures
- Less stable large molecules
- Much larger (galaxy level?)

*What other substrates could life exist in?*

*Would we recognize it?*