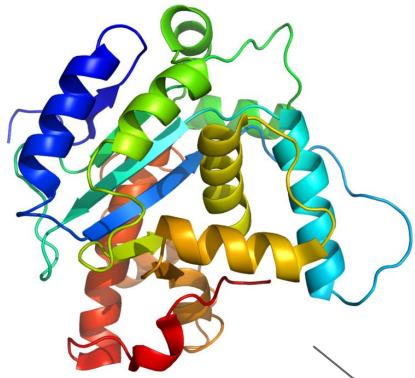




Multilateral Evolutionary Transitions in Individuality (ETIs)

Subhana Ahmed, Lakshmi Bhavana Gurram, Dr. Zachariah I. Gochau-Wright
TCNJ Biology Department

What is an Evolutionary transition in individuality (ETI)?



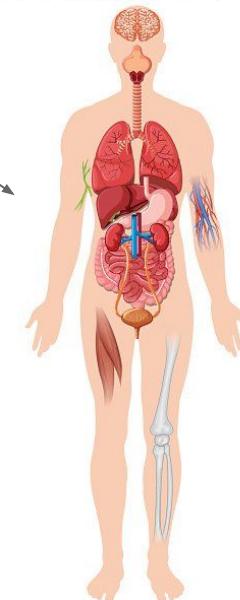
Britannica.com



aaqr.org



istockphoto.com



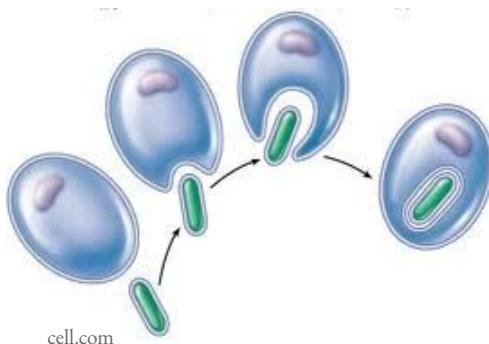
bio.libretexts.com



Adapted from Gochau-Wright 2019

Evolutionary Transitions in Individuality (ETIs)

Egalitarian
transition



Evolution of a eukaryotic cell

Fraternal
transition



Evolution of an animal

Queller 1997

**How can we define
transitions that
aren't exclusively
fraternal or
egalitarian?**

Multilateral ETIs

- Fraternal and egalitarian transitions co-occur in some organisms



seaweed.ie

Ulva green algae (sea lettuce)



nationalgeographic.com

Reef forming Scleractinian corals

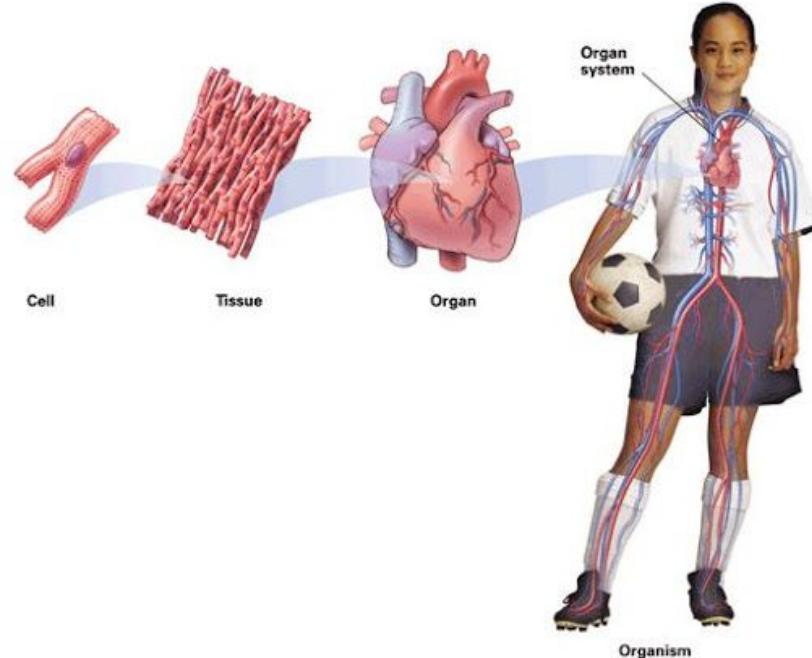


chemistry.harvard.edu

Origin of life

What Makes Us an “Individual”?

- Indivisibility
- High Cooperation and Low Conflict
- Division of Labor
- Discreteness
- Group-level Adaptations
- Multilevel Selection 2 (MLS2)



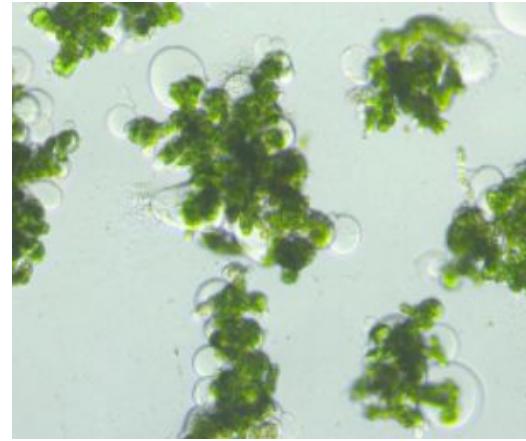
Ulva (Sea Lettuce)

- **Fraternal transition** → transition from unicellularity to multicellularity
- **Egalitarian transition** → *U.mutabilis-Roseovarius-maribacter* tripartite community



seaweed.ie

Ulva grown in presence of bacteria



Spoerner et al. 2012

Axenic cultures of *Ulva*

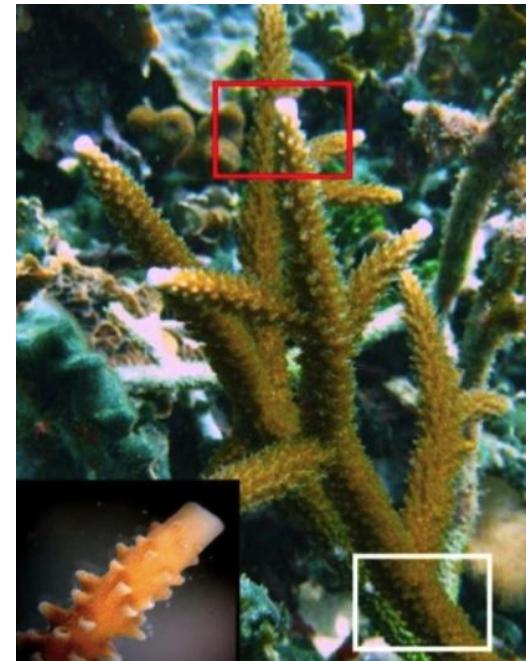
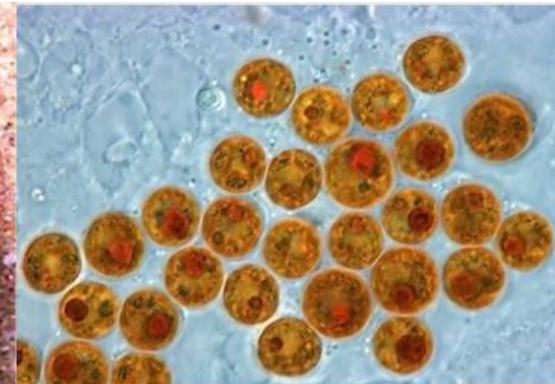
Spoerner et al. 2012

Scleractinian Corals

- **Fraternal transition** → polyps transition to colony level
- **Egalitarian transition** → symbiotic relationship between corals and dinoflagellate



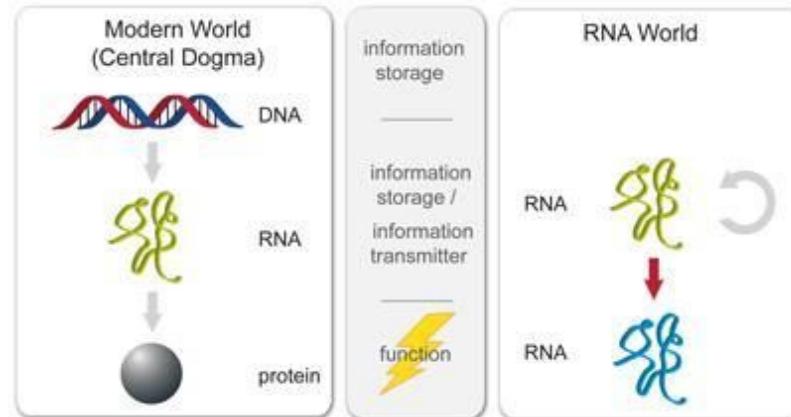
Hemond et al. 2014



Hemond et al. 2014

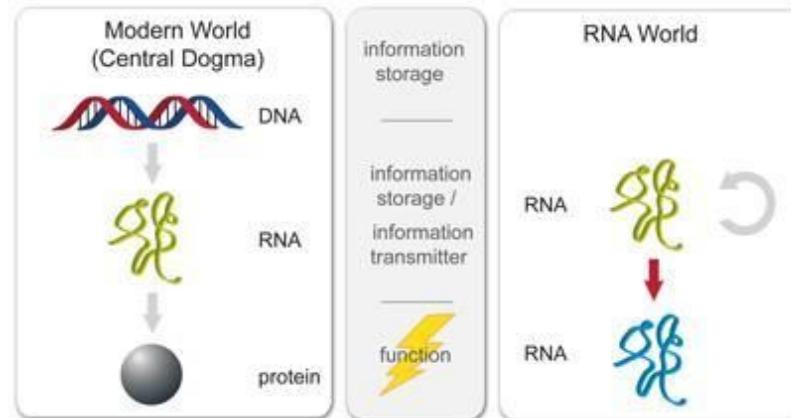
The RNA World hypothesis of the origin of life

- RNA acted as both a genetic information-storing molecule and a catalytic molecule.



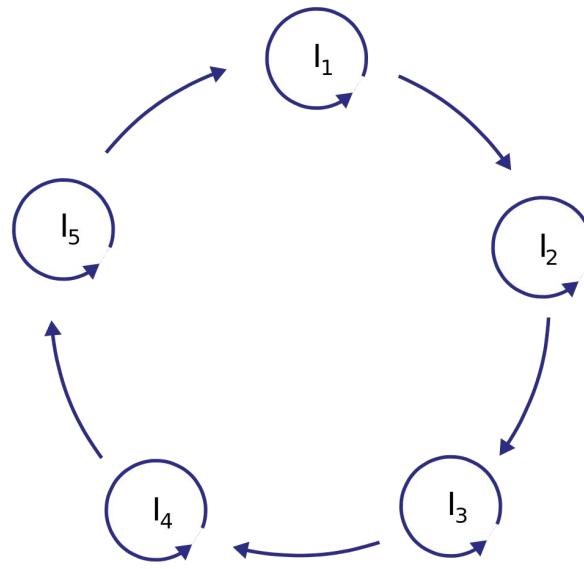
The RNA World hypothesis of the origin of life

- RNA Polymerization → RNA molecules copying itself
 - **Fraternal** → single RNA replicator
 - **Egalitarian** → different RNA replicators



The Hypercycle

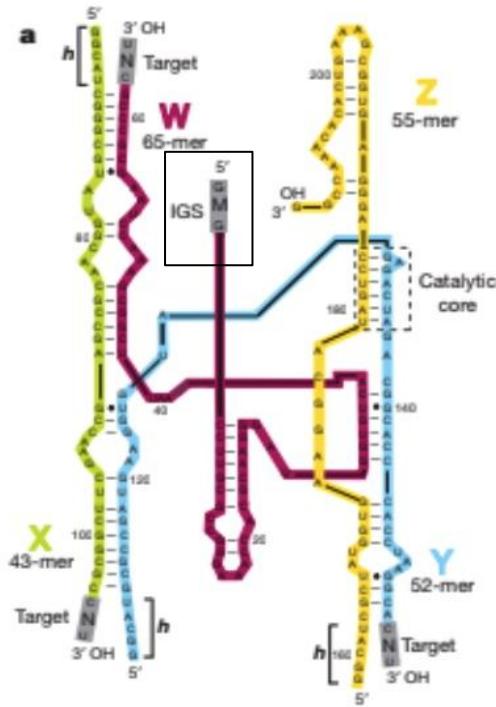
- Autocatalytic networks recirculating to catalyze each other



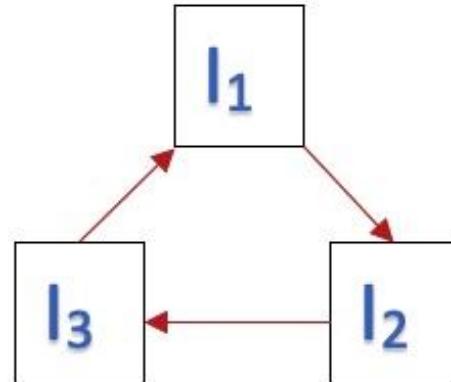
wikipedia.org

Cooperative Reassembly of Ribozymes

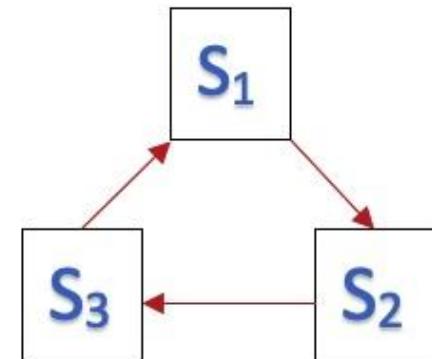
Fragmented Ribozymes



Mismatched Cooperative System

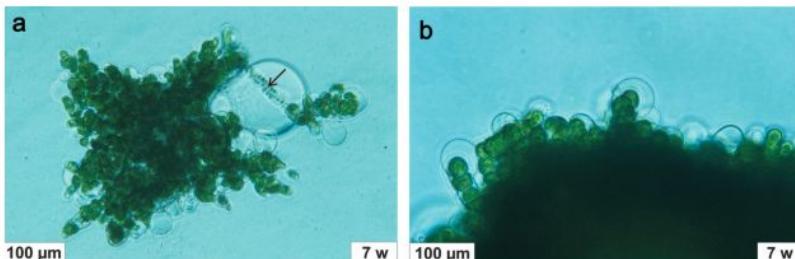


Purely Autocatalytic System



Summary

Ulva without bacteria



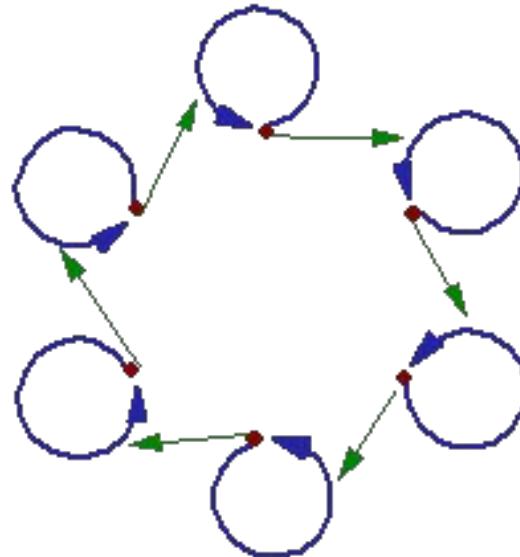
Spoerner et al. 2012

Scleractinia without dinoflagellates



Marinebiology.org

Catalytic System



Biological Examples of MSTs

Acknowledgements

Dr. Zachariah I. Gochau-Wright, Mentor

For his continued guidance, advice, and support of our research development and analysis.

Zack Bishop, Dr. Richard Michod, Dr. Matthew Herron, and Ms. Dinah Davison (ABD)

For their valuable insight on our research findings.

Supported by:

- Mentored Undergraduate Summer Experience 2020, School of Science
- HHMI



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