

# Biogenesis

- All life arises only by the reproduction of preexisting life



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# Abiogenesis

- Theory that refers to the origins of life
  - Life on Earth developed from nonliving materials that became ordered into molecular aggregates that were eventually capable of self-replication and metabolism

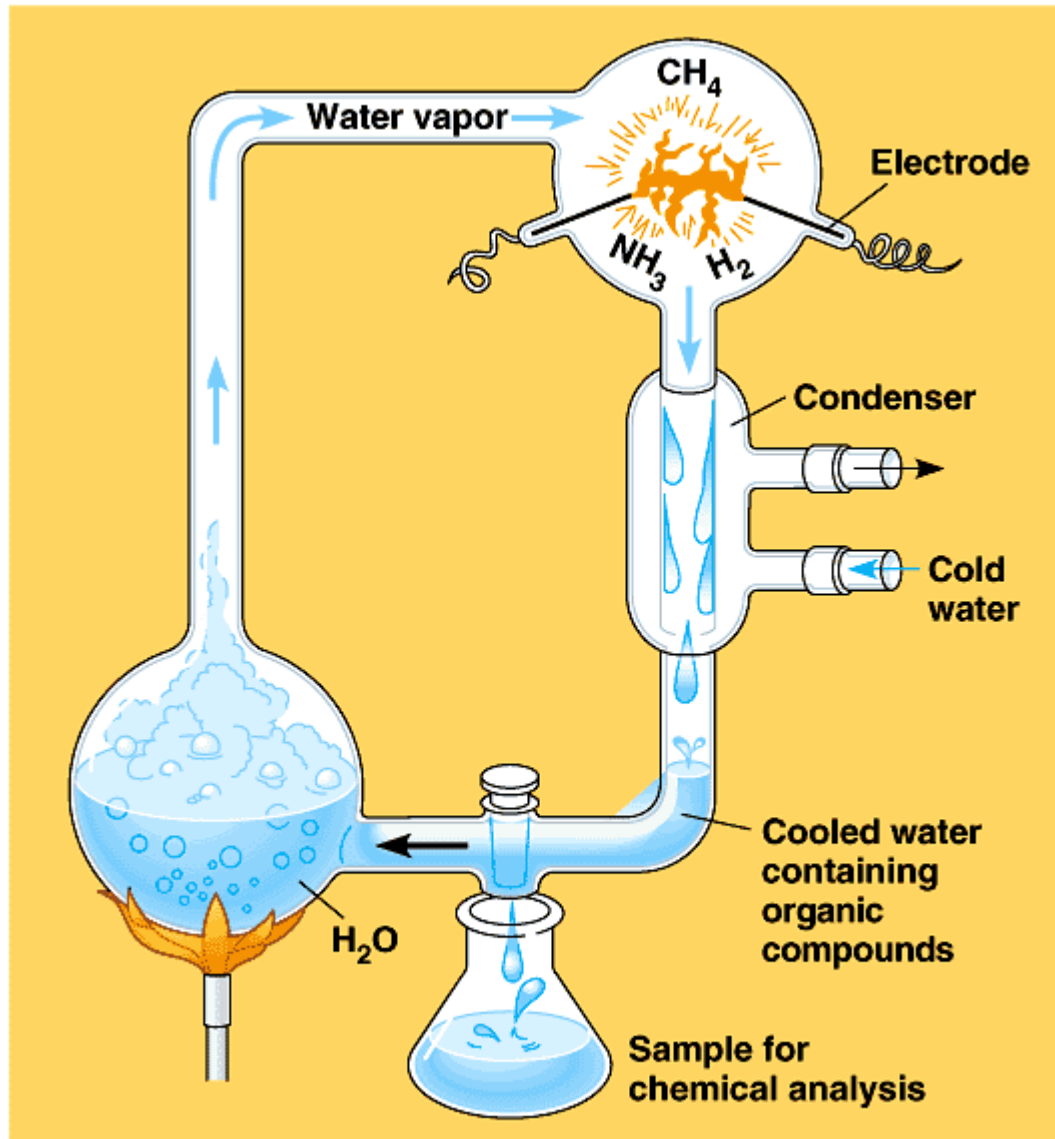
# Four stage hypothesis for origins of life

1. Abiotic synthesis of organic molecules
2. Joining of small molecules into polymers
3. Origin of self-replicating molecules
4. Packaging of molecules into “protobionts”

# 1. Abiotic synthesis of organic molecules

- 1920's: Oparin and Haldane independently postulated that conditions on the primitive Earth favored chemical reactions that synthesized organic compounds from inorganic ones

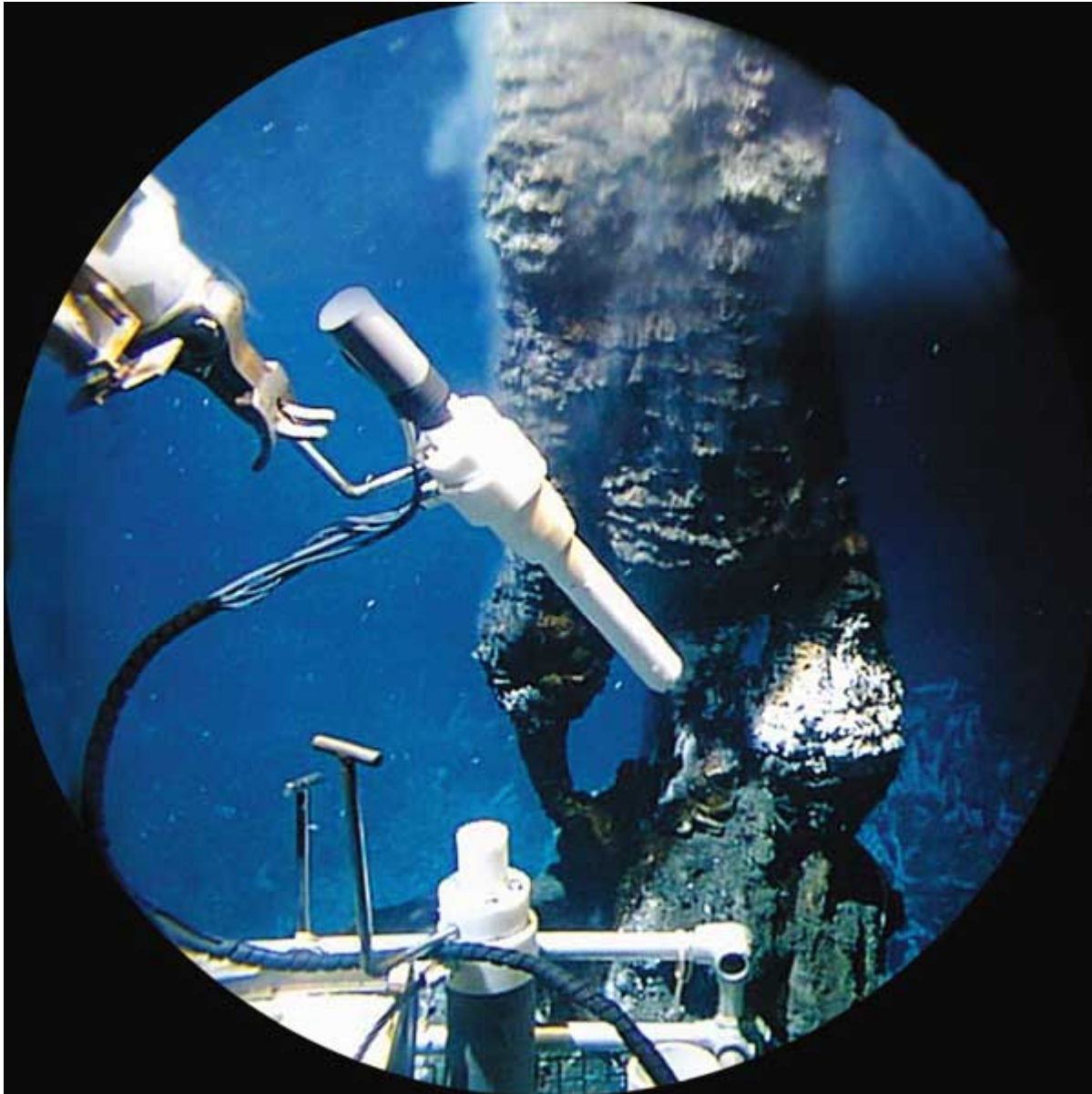
# The Miller-Urey Experiment



## 2. Joining of small molecules into polymers

- Linkage of organic molecules to form polymers without the help of enzymes has been observed

# Deep-sea vents

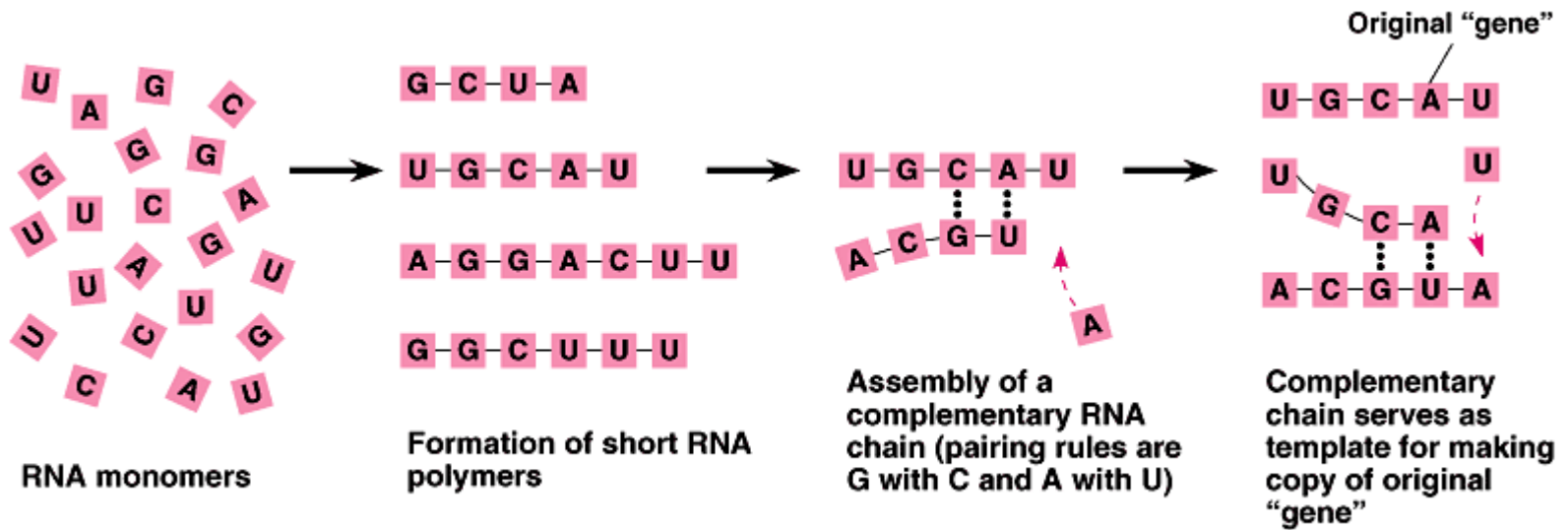


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### 3. Origin of self-replicating molecules

- First hereditary material is thought to have been RNA. Abiotic replication of RNA has been shown in the lab

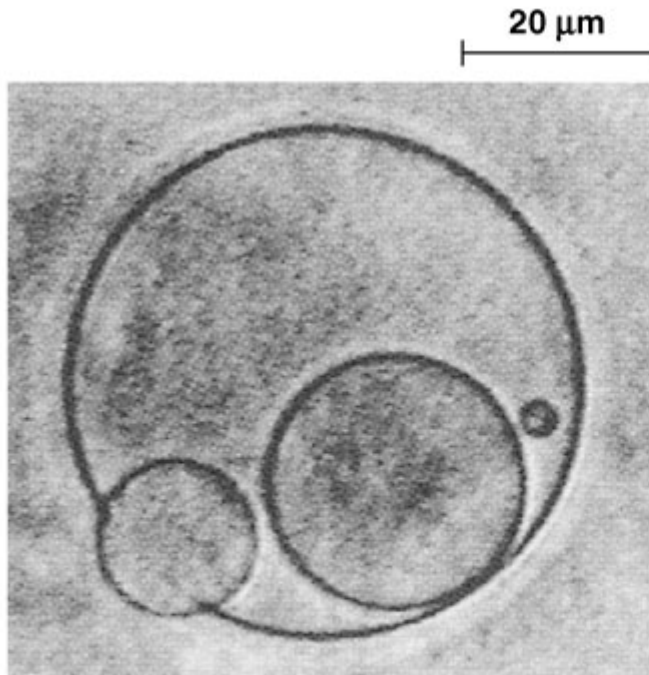
# Abiotic replication of RNA



## 4. Packaging of molecules into “protobionts”

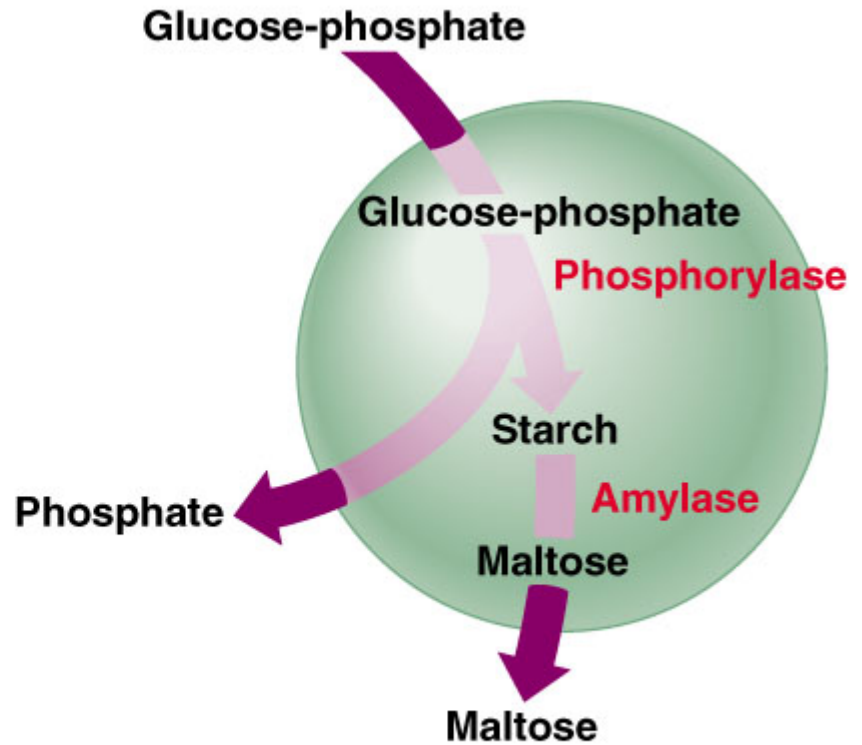
- Laboratory experiments demonstrate that protobionts could have formed spontaneously from abiotically produced organic compounds

# Laboratory versions of protobionts



**(a) Simple reproduction**

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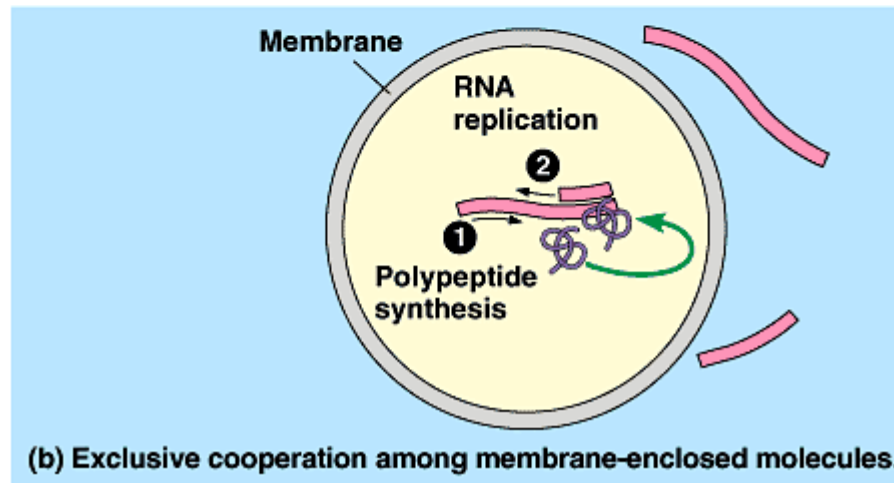
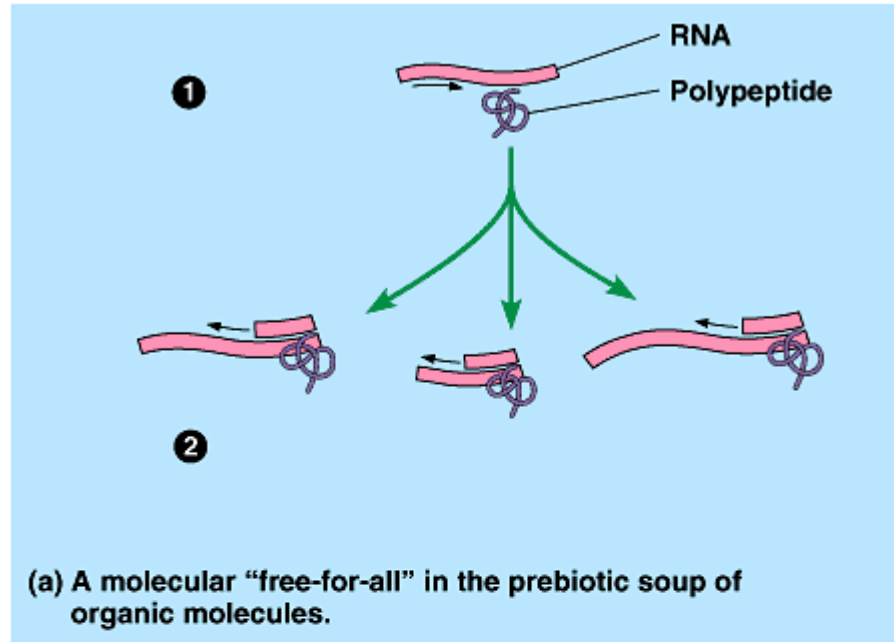


**(b) Simple metabolism**

# Natural selection could refine protobionts

- Once protobionts developed, they could now evolve as whole units and molecular cooperation could be refined

# Hypotheses for the beginning of molecular cooperation



# Debate about the origins of life

- Organic compounds could have reached the Earth from space
- Life could have started on the sea floor
- Life is not restricted to Earth