

The Origin of Life

What is life???

The Origin of Life

What are the properties of living systems?

1. Self duplication with information transfer
2. Discrete change

Living systems are systems that reproduce themselves closely, but that mutate as well and can reproduce their mutations.

Life requires:

Carbon Nitrogen Oxygen Hydrogen

Reducing Atmosphere: Carbon - CH_4

Nitrogen - NH_3

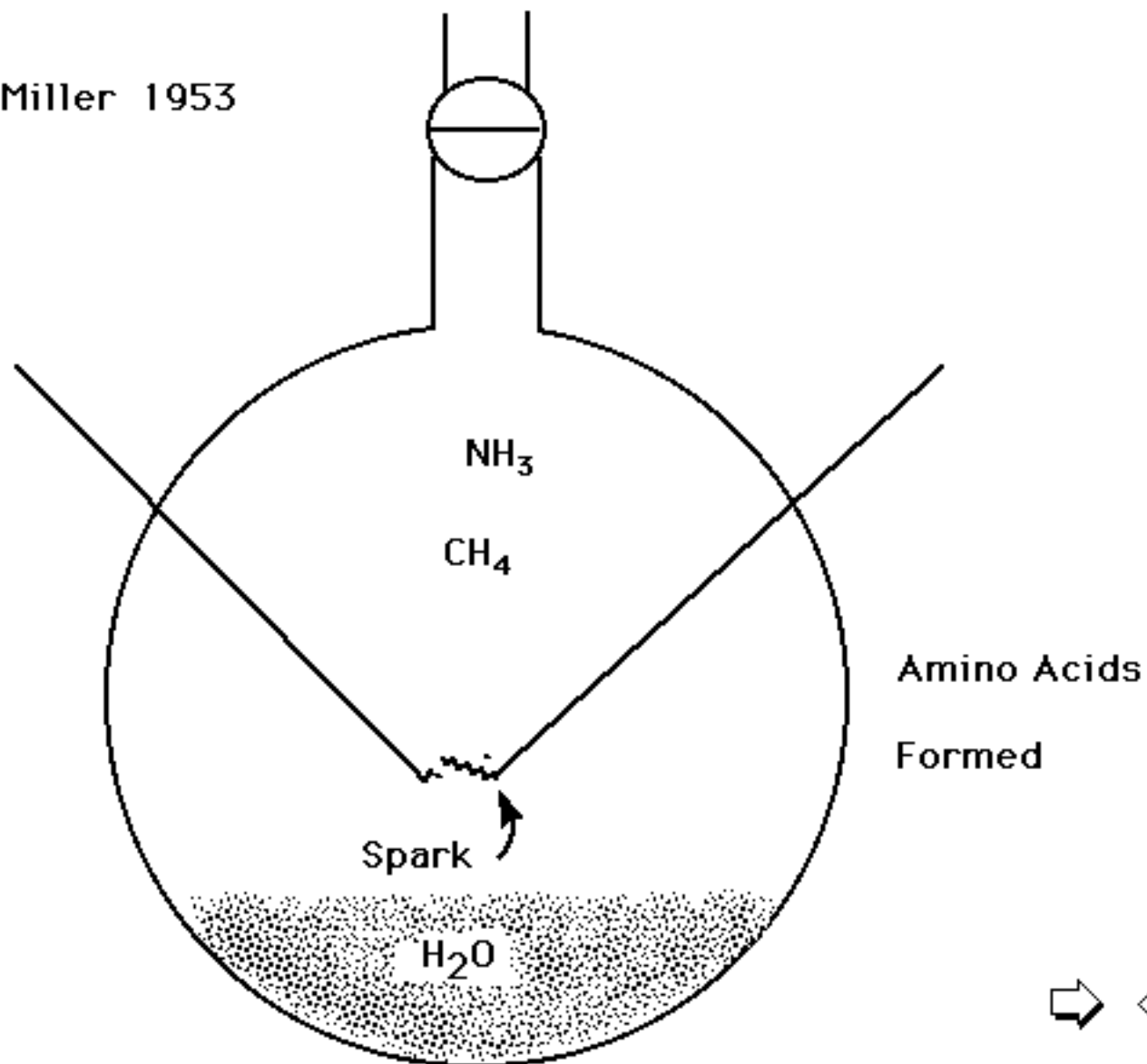
Hydrogen, Oxygen - H_2O

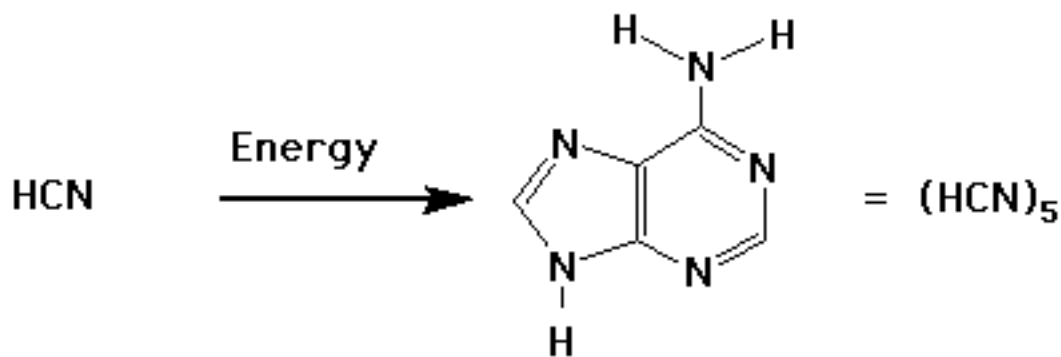
Nonreducing Atmosphere: Carbon - CO_2

Nitrogen - N_2

Hydrogen, Oxygen - H_2O

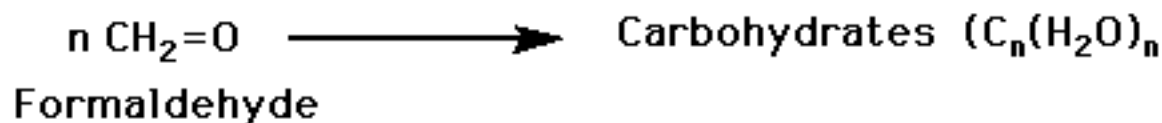
Stanley Miller 1953

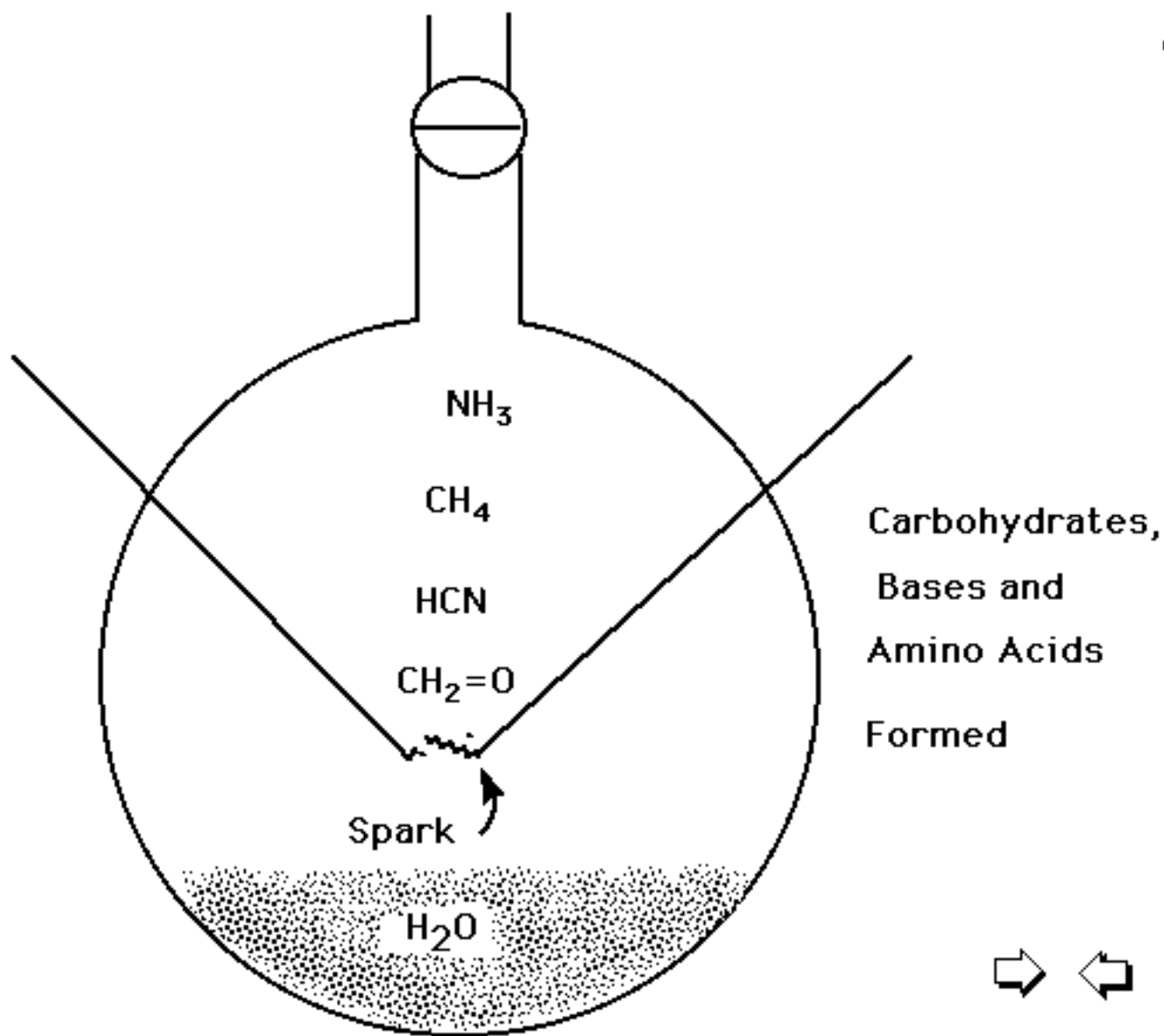




Adenine

One of the Nucleic Acid Bases



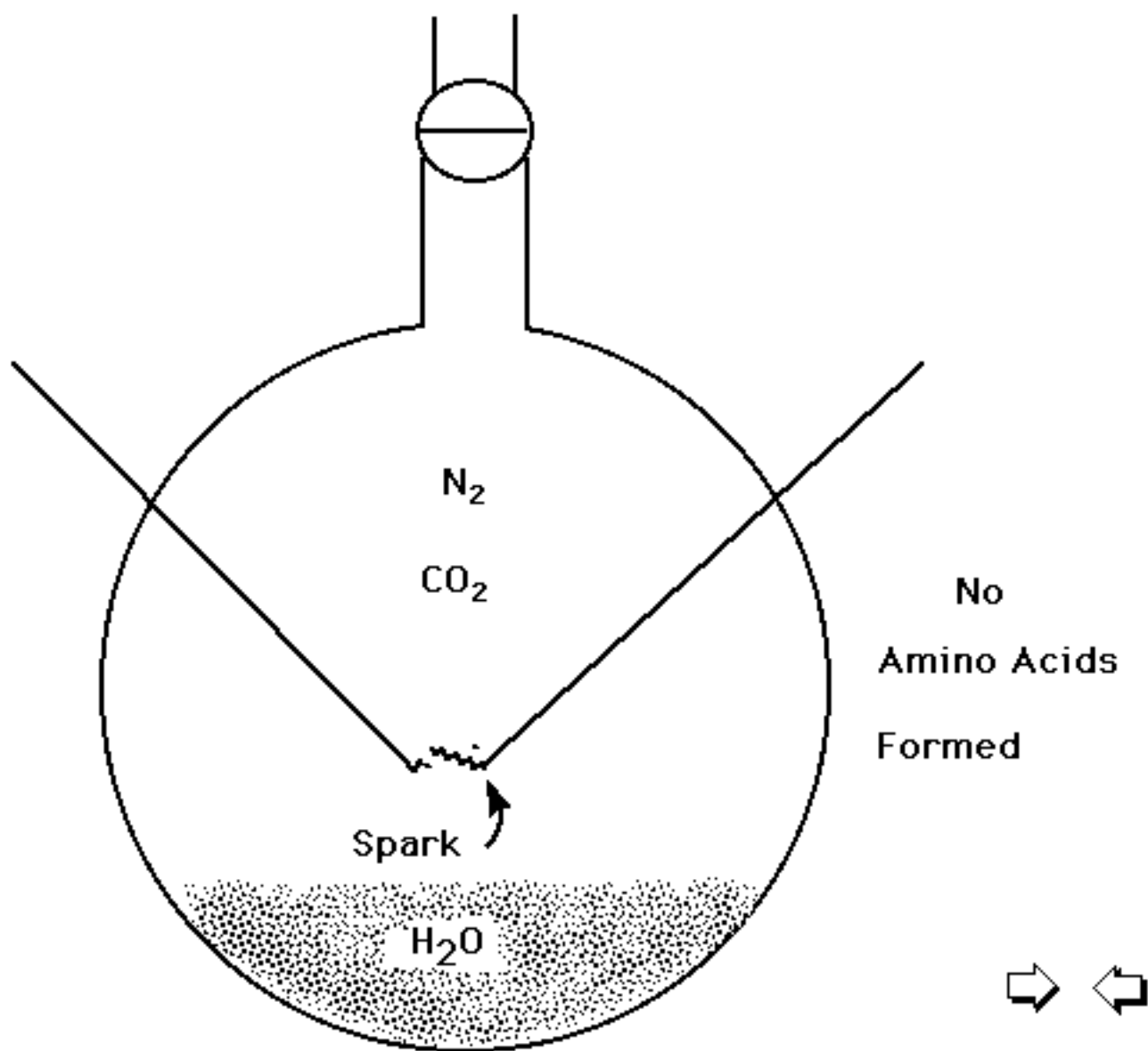


There is considerable controversy regarding the atmosphere of the primitive earth:

Reducing: C = CH_4 ; N = NH_3 ; O, H = H_2O

Nonreducing: C = CO_2 ; N = N_2 ; O, H = H_2O

It is clear that there was no free oxygen
Free oxygen did not occur until living organisms evolved photosynthesis



Some Origin of Life Scenarios

- 1. Life began in hydrothermal vents**
- 2. Inorganic catalysis was important**
 - a. Clay minerals were the first living things**
 - b. Nitrogen fixation by oxides**
- 3. Extraterrestrial origin of life**

Some Interstellar Molecules

Hydrogen H_2

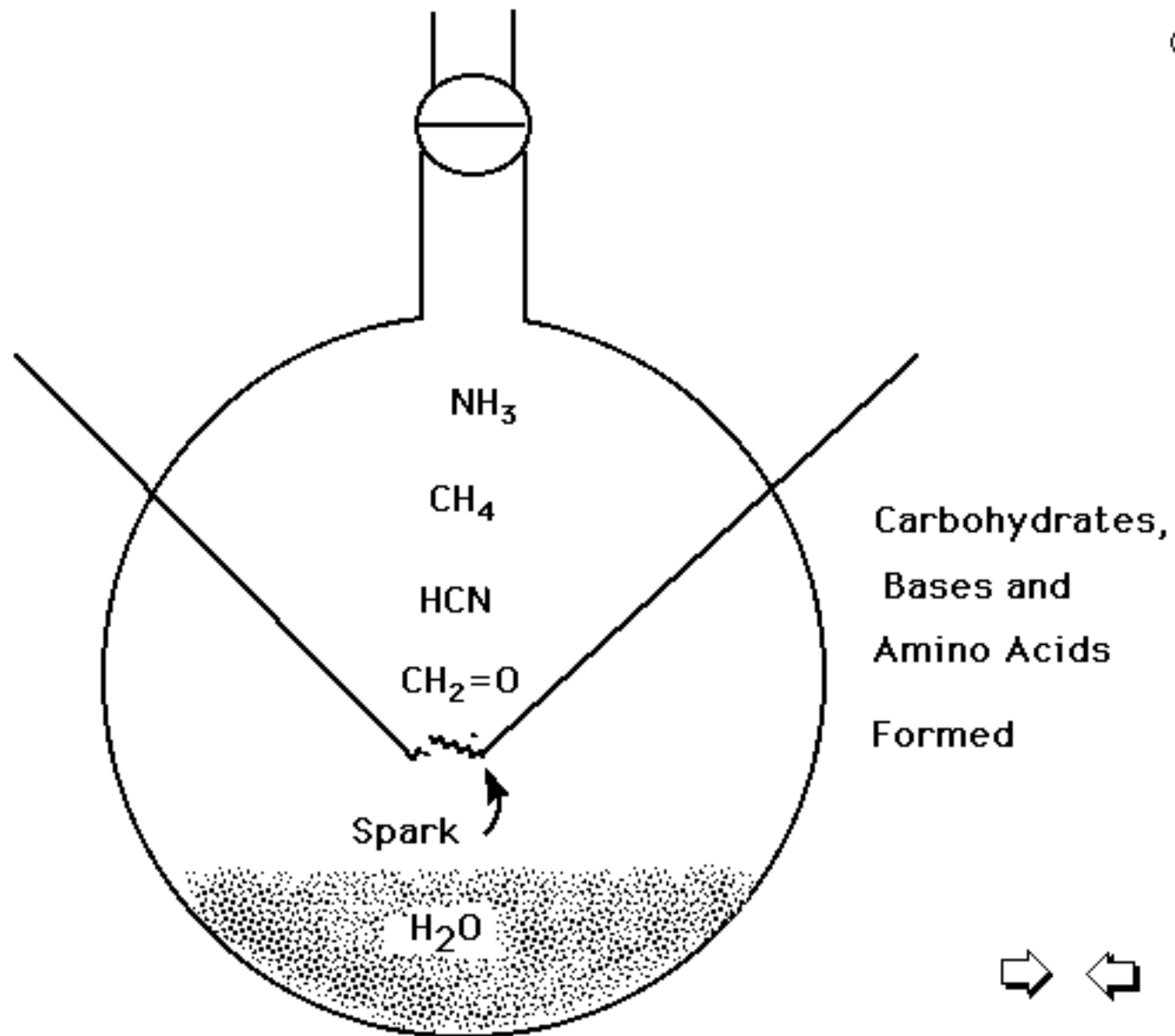
Methane CH_4

Ammonia NH_3

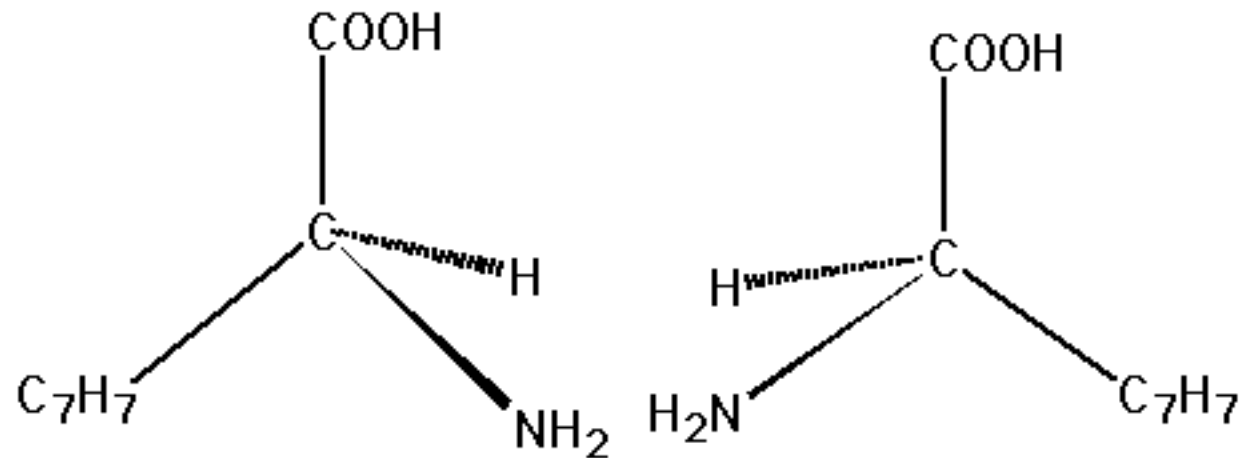
Water

Hydrogen Cyanide HCN

Formaldehyde $\text{CH}_2=\text{O}$



Amino acids and other biological molecules have been isolated from meteorites and lunar samples



2 Enantiomers of an Amino Acid

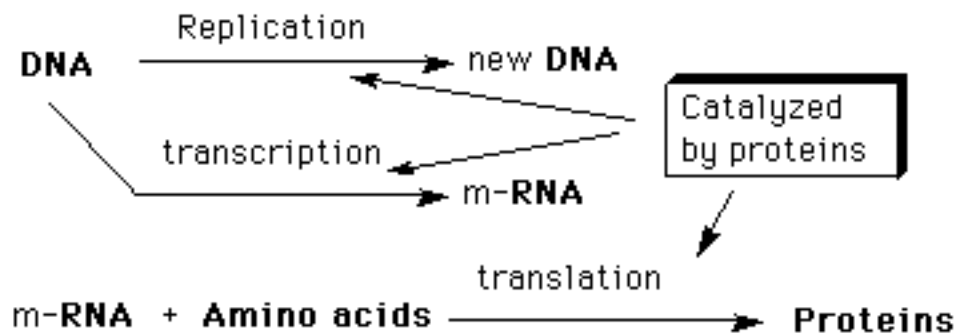
The Origin of Life

What are the properties of living systems?

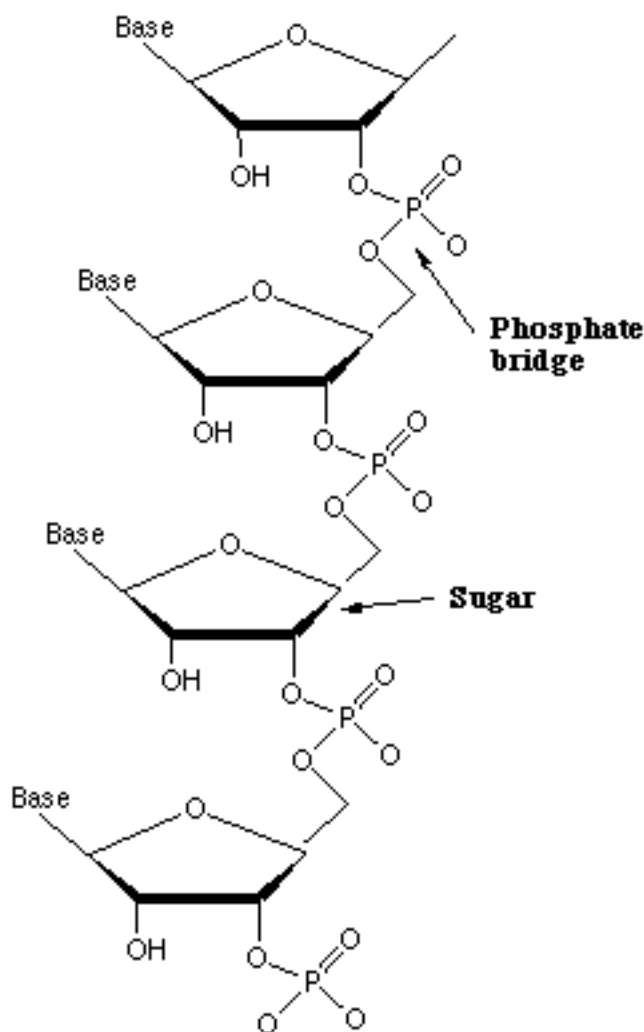
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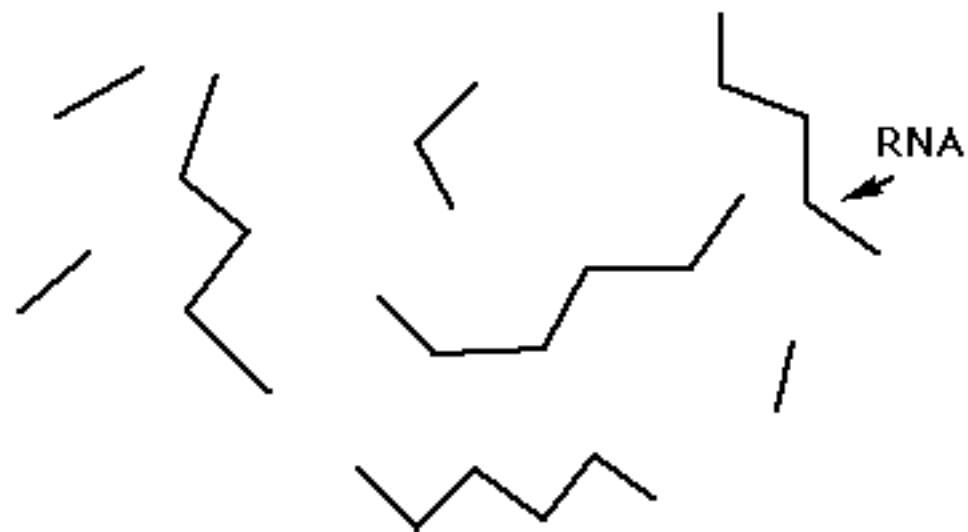
The central dogma of Molecular biology



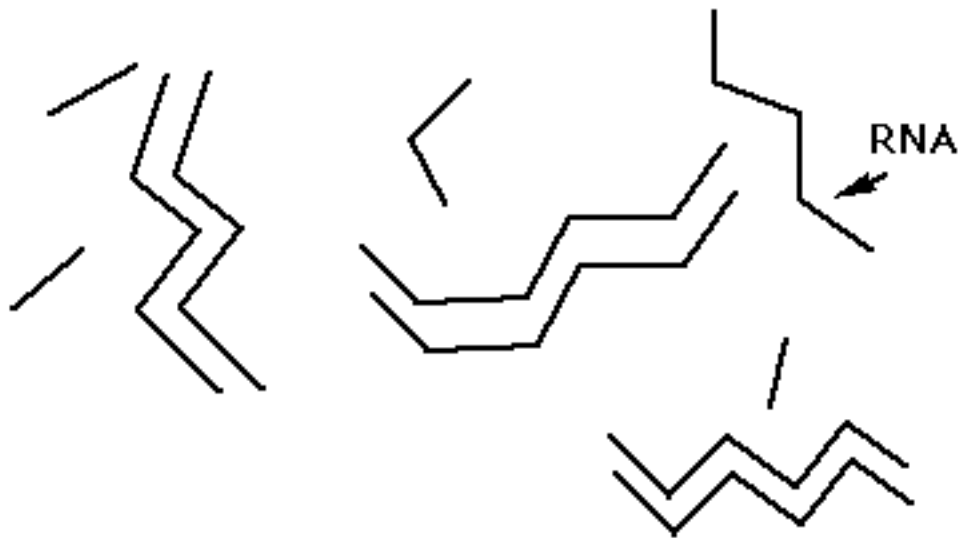
RNA as the first Self-replicating molecule



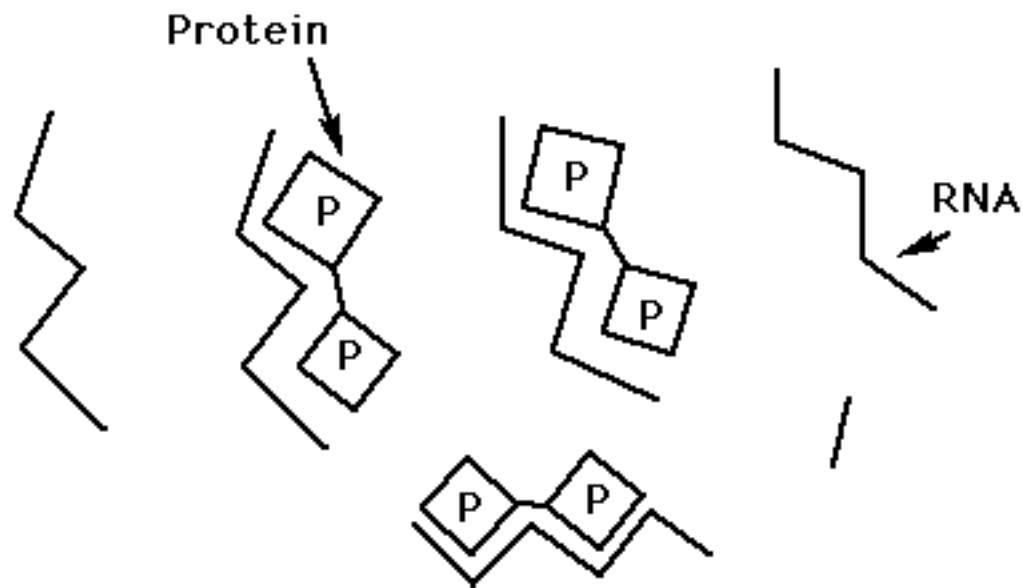
Life evolves in an RNA world



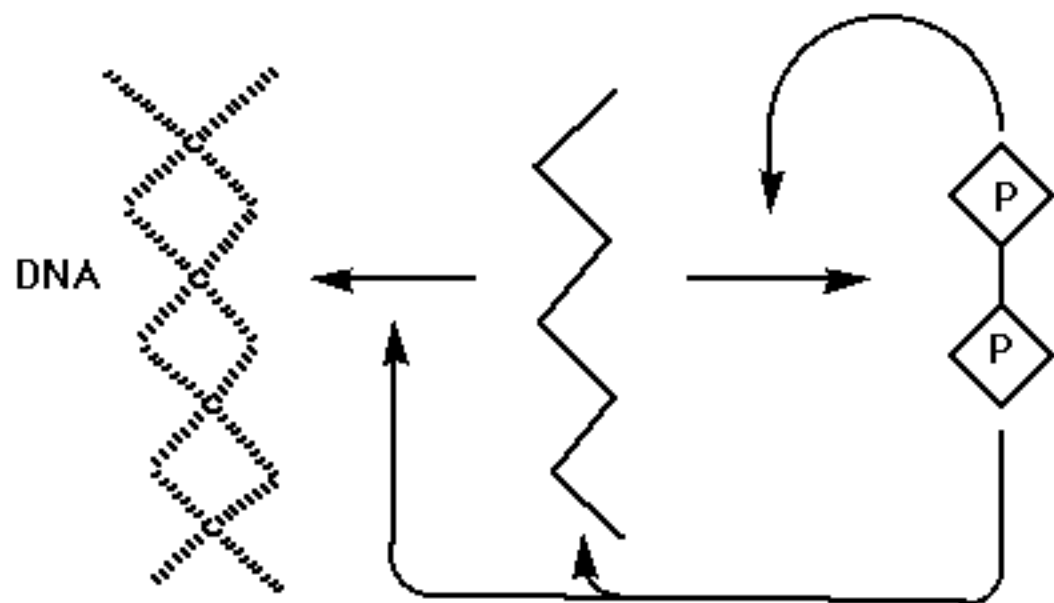
RNA forms from ribose and other organic compounds



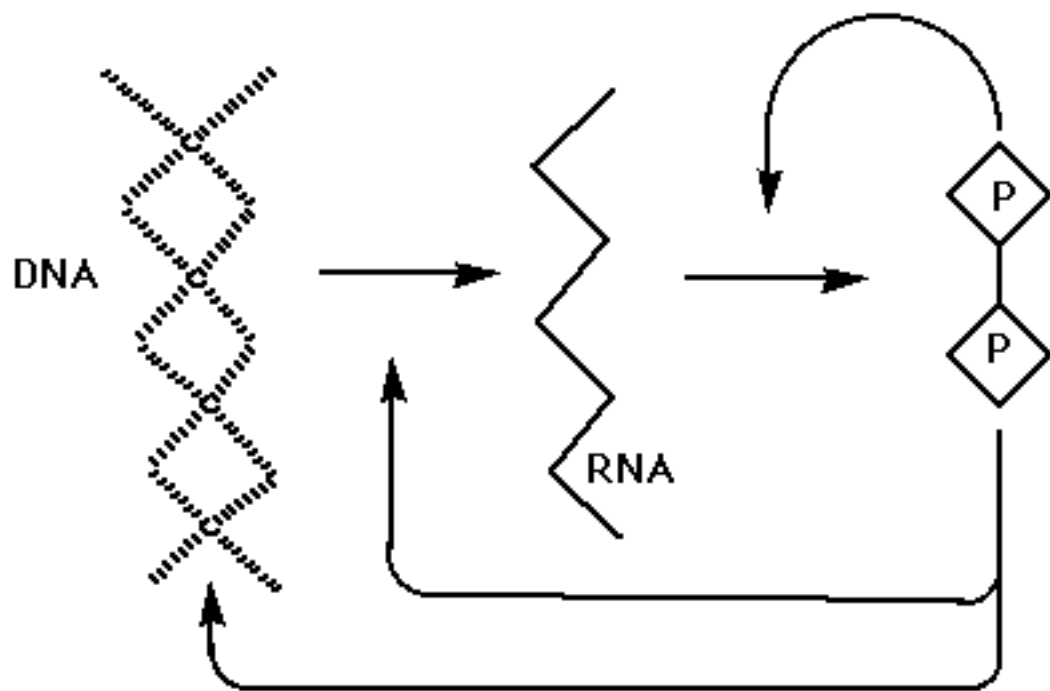
As RNA molecules evolve, they "learn" to copy themselves



RNA molecules begin to synthesize proteins that can serve as catalysts



The proteins help RNA replicate and synthesize proteins more efficiently. They also help the RNA make double stranded versions of itself that evolve into DNA.



DNA takes over. It uses RNA to make proteins which in turn help DNA make copies of itself and transfer its genetic information to RNA

SUMMARY:

BIOCHEMICALS OF LIFE AROSE BY ONE OR MORE OF THE PROPOSED SCENARIOS, SO HAVE NUCLEIC ACIDS, PROTEINS, CARBOHYDRATES, LIPIDS.

KNOW THAT PHOSPHOLIPIDS IN WATER WILL SPONTANEOUSLY FORM VESICLES ENCLOSING WATER AND ITS CONTENTS

PROPOSE THAT PHOSPHOLIPIDS ENCLOSED OTHER MOLECULES TO FORM THE FIRST PRIMITIVE CELLS

NEXT QUESTION:

**HOW DID ALL THE COMPLEX AND
VARIED FORMS OF LIFE ON EARTH
DERIVE FROM THESE FIRST PRIMITIVE
CELLS?**

**THIS WAS THE MAJOR QUESTION AT THE
BEGINNING OF THE 19TH CENTURY**