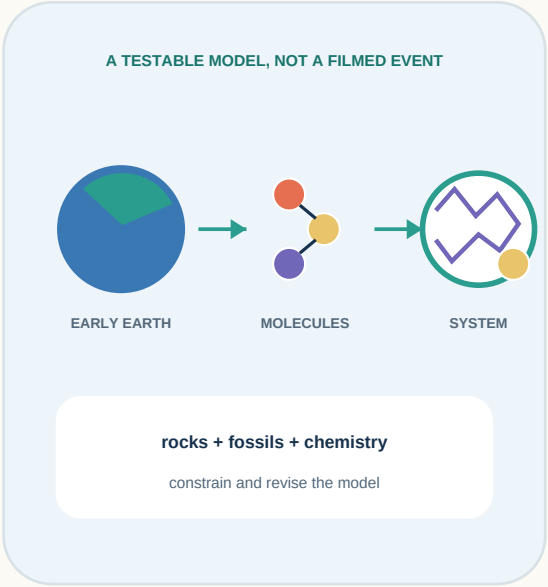
AP BIOLOGY | UNIT 7

TOPIC 7.12

Origins of Life on Earth

Scientists use geological, fossil, and chemical evidence to build and revise models of how the first living systems could have emerged.



A POSSIBLE SEQUENCE

EARTH COOLS → stable conditions

ORGANICS → building blocks

SYSTEMS → information + boundary

EVOLUTION → inheritance + selection

BY THE END, YOU SHOULD BE ABLE TO...

1. Place major evidence on an approximate Earth-history timeline.
2. Explain what chemical evidence can and cannot demonstrate.
3. Connect RNA, base-pairing, and replication to genetic continuity.

CENTRAL IDEA

Evidence can support the plausibility and timing of steps, but no single experiment recreates or proves the complete historical pathway.

1 Evidence constrains the story

Earth formed about 4.6 billion years ago. Independent evidence types constrain when conditions became suitable and which chemical steps are possible.

A DEEP-TIME FRAMEWORK



THREE EVIDENCE STREAMS

GEOLOGICAL EVIDENCE

OBSERVATION

Ancient rocks record oceans, atmosphere, and changing surface conditions.

SUPPORTS

A physical timeline for habitable environments.

FOSSIL EVIDENCE

OBSERVATION

Microfossils and chemical signatures indicate early biological activity.

SUPPORTS

Life existed by about 3.5 billion years ago.

CHEMICAL EVIDENCE

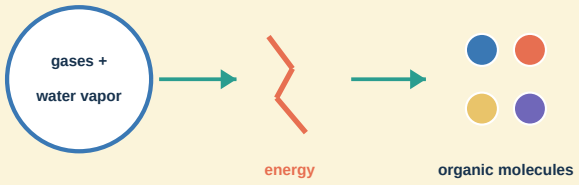
OBSERVATION

Organic molecules form in experiments, meteorites, and energy-rich settings.

SUPPORTS

Abiotic synthesis of building blocks is possible.

PREBIOTIC CHEMISTRY EXPERIMENTS



Result: some organic building blocks can form without life under simulated conditions. This supports plausibility, not the creation of life itself.

EVIDENCE VS. INFERENCE

Evidence: a rock, fossil, isotope pattern, or repeatable chemical result. Inference: the explanation that best connects those observations. Scientific models remain revisable when new evidence appears.

2 RNA offers a bridge between chemistry and heredity

The RNA world hypothesis proposes that early RNA-like molecules could both store information and catalyze reactions.

WHY RNA IS CENTRAL TO THE HYPOTHESIS

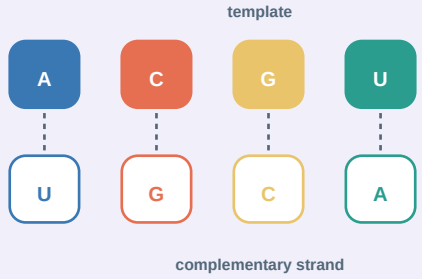
INFORMATION
base sequence

CATALYSIS
ribozymes speed reactions

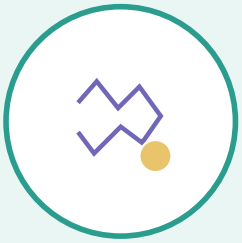
COPYING
base-pairing guides a template

CONTINUITY
variants pass forward

BASE-PAIRING CAN PRESERVE A SEQUENCE



PROTOCELLS CREATE A BOUNDED SYSTEM



A membrane-like boundary can:

- concentrate reactants
- maintain internal conditions
- link information with reactions

compartmentalization alone is not life

WHAT A SELF-SUSTAINING EVOLUTIONARY SYSTEM NEEDS

REPLICATION
Information must be copied with enough accuracy.

HERITABLE VARIATION
Copying differences must pass to descendants.

DIFFERENTIAL SUCCESS
Some variants must persist or reproduce more.

MODEL CHECK

SUPPORTED	RNA can carry sequence information; some RNA molecules act as catalysts.
PROPOSED	RNA-like systems preceded DNA/protein-based cells.
OPEN	The exact location, order, and pathway to the first cells remain uncertain.