Biogenesis

• All life arises only by the reproduction of preexisting life
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
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


Formation of short RNA polymers

Assembly of a complementary RNA chain (pairing rules are G with C and A with U)

Complementary chain serves as template for making copy of original “gene”

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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

(b) Simple metabolism

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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

(a) A molecular “free-for-all” in the prebiotic soup of organic molecules.

(b) Exclusive cooperation among membrane-enclosed molecules.

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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