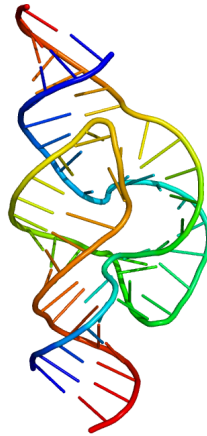


## CONCEPT: RNA AND THE ORIGINS OF LIFE

### Properties of RNA

- RNA has unique properties which indicate it \_\_\_\_\_ both DNA and Proteins
  - RNA can fold into complex 3D structures
  - **Ribozymes** are RNA molecules that can catalyze chemical reactions
    - Form by creating complex structures which catalyze chemical reactions
  - The shape of RNA can respond to small molecules, or other RNAs
    - Conformational changes allow for regulation of various chemical reactions

### **EXAMPLE:** 3D Structure of a Ribozyme

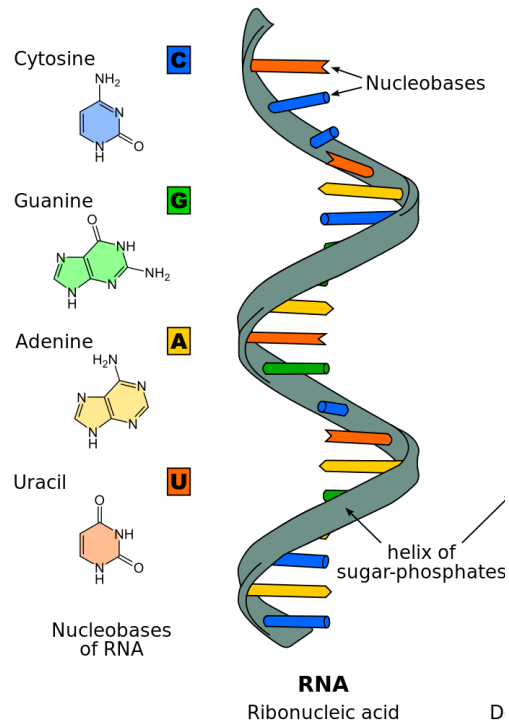


### Requirements of Life

- Life requires the ability to \_\_\_\_\_ information
  - *Heredity*, which is the ability to pass genetic information to offspring is required for life
    - Today, the mechanisms of heredity require significant amounts of energy and organic chemicals
  - Polynucleotide chains are able to store information
    - Guide their own formation and replication
- Life requires the ability to \_\_\_\_\_ (catalyze) chemical reactions
  - Life sustaining chemical reactions occur too slowly to happen by chance
    - RNA can catalyze chemical reactions

- Today, RNA has the ability to catalyze the formation of proteins (rRNA in ribosomes)
  - Likely a remnant of evolution: RNAs were thought to be present before proteins

**EXAMPLE:** RNA as an information storage molecule



Evolution of RNA

- There were likely three main phases in the history of life
  1. The pre-RNA world provided the ability to catalyze reactions before the creation of RNA
    - There likely was a polymerase-like structure that was chemically simpler than RNA
    - Eventually, this transitioned into RNA – and may have even catalyzed the first RNA molecules
      - This potentially could have occurred before the first cell arose
  2. The RNA world
    - Chemical reactions likely occurred in compartments – to \_\_\_\_\_ chemical reactions
    - The first cell likely had a membrane bilayer with catalytic RNA inside
      - Because it was in a separate compartment, it could evolve
    - At this time the RNA molecules likely could self-replicate

3. Eventually, a transition to DNA occurred

- It is more \_\_\_\_\_ than RNA – deoxyribose is more complicated to make than ribose
- Eventually became the permanent information storage molecule

## **PRACTICE**

1. Choose all of the following properties that indicates RNA pre-dated both DNA and proteins.
  - a. RNA has the ability to catalyze chemical reactions
  - b. RNA is extremely stable
  - c. RNA can fold into complex 3D shapes
  - d. RNA can store information
  - e. RNA is more complicated to make than DNA

2. Ribozymes have catalytic functions because of why?
- a. They bind to proteins, which allow them to exert their effect on other molecules
  - b. They are translated into proteins
  - c. They can fold into 3D conformations that act similarly to proteins
  - d. None of the above