

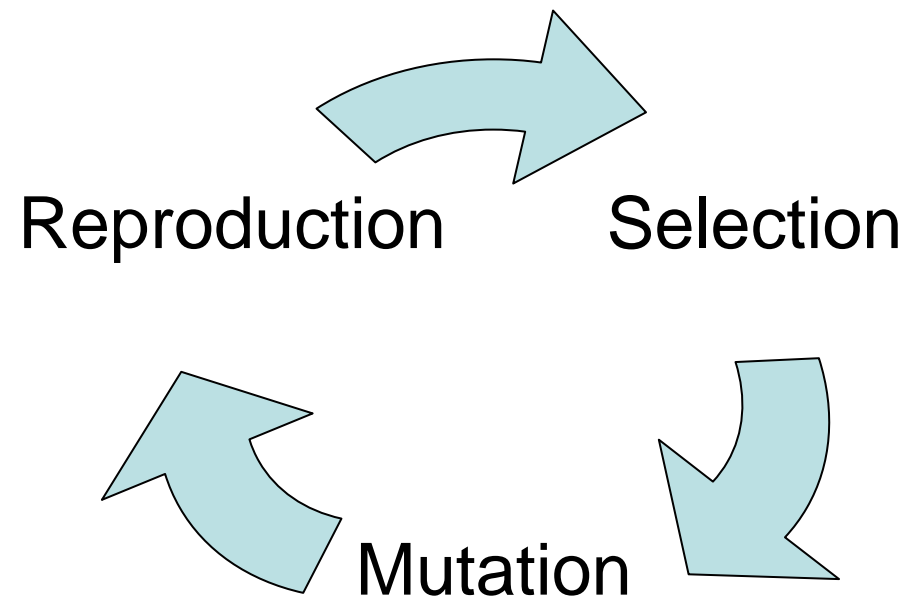
Why start with an RNA World?

Georg Urtel

Basics


Evolution

- Evolution is a mechanism which is associated with mutation, selection and reproduction

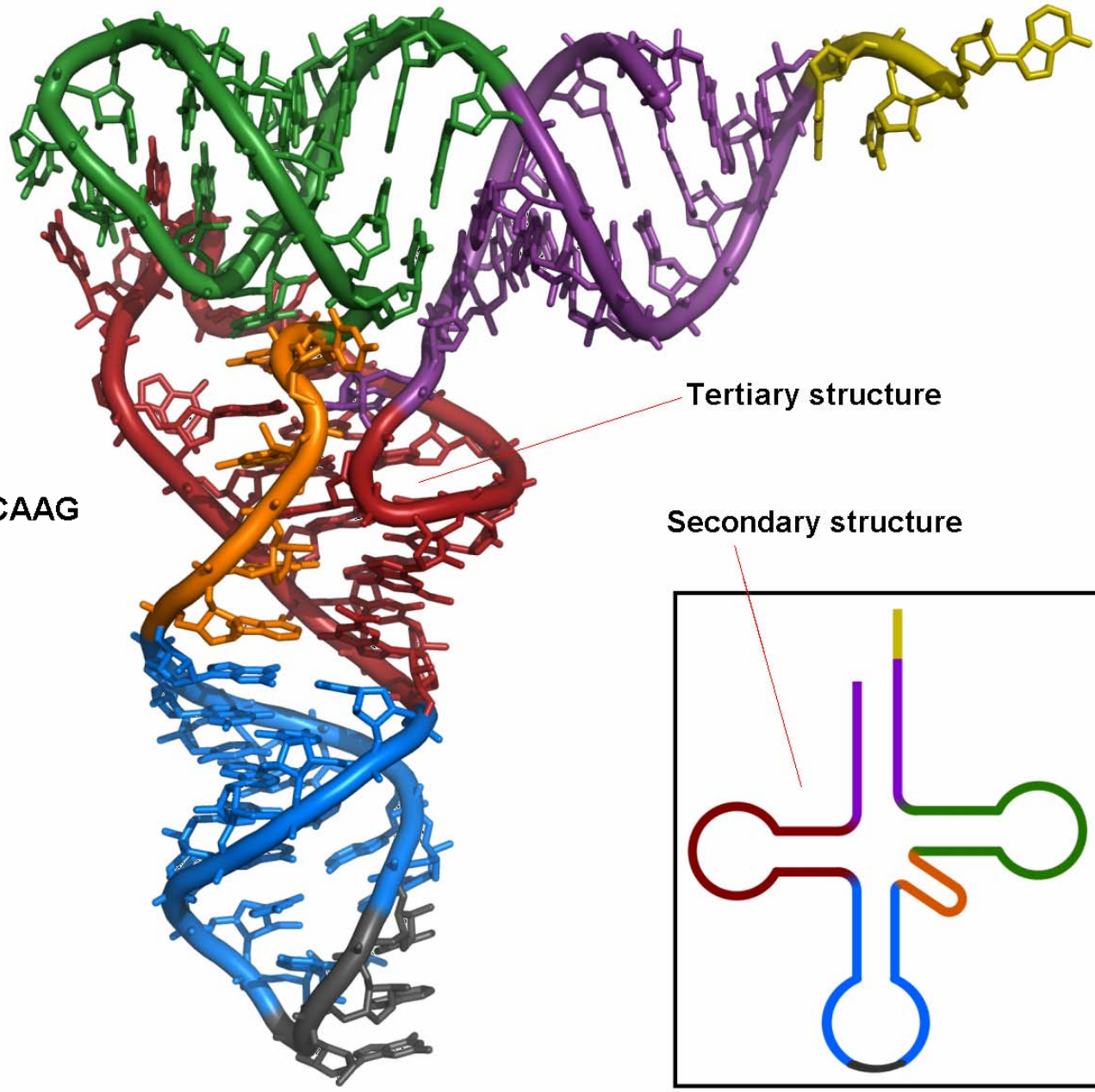


Why start with an RNA World?

RNA (Ribonucleic acid)

- Build out of four nucleotides, with bases **A**denine, **C**ytosine, **G**uanine, **U**racil
- RNA has only one strand (DNA has two)
 It is less complex and less stable

Primary structure: UGUCAAG




Tertiary structure

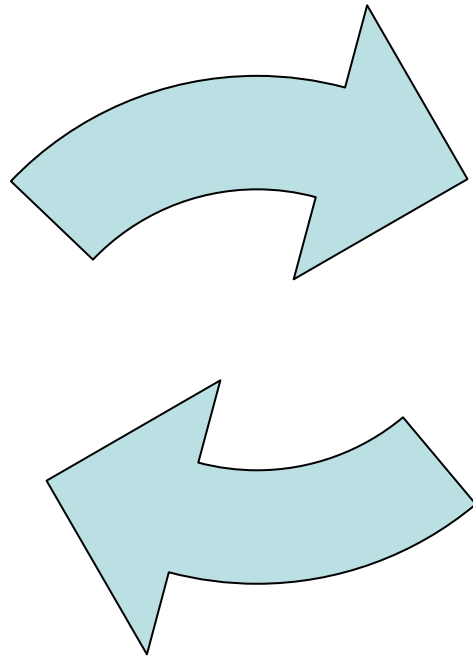
Secondary structure

Protein biosynthesis

or: How do we get a protein from a gene?

- Transcription: RNA-polymerase copies the information of the DNA onto a RNA strand (thymine is replaced by uracil)
- Introns, non-coding RNA regions, are removed (splicing)
 messenger RNA (mRNA)
- mRNA is transported to a ribosome to begin the translation
- In the ribosome, the mRNA is „read-out“ tripletwise
- To every mRNA triplet fits a tRNA molecule (transfer RNA)

Where does life come from?

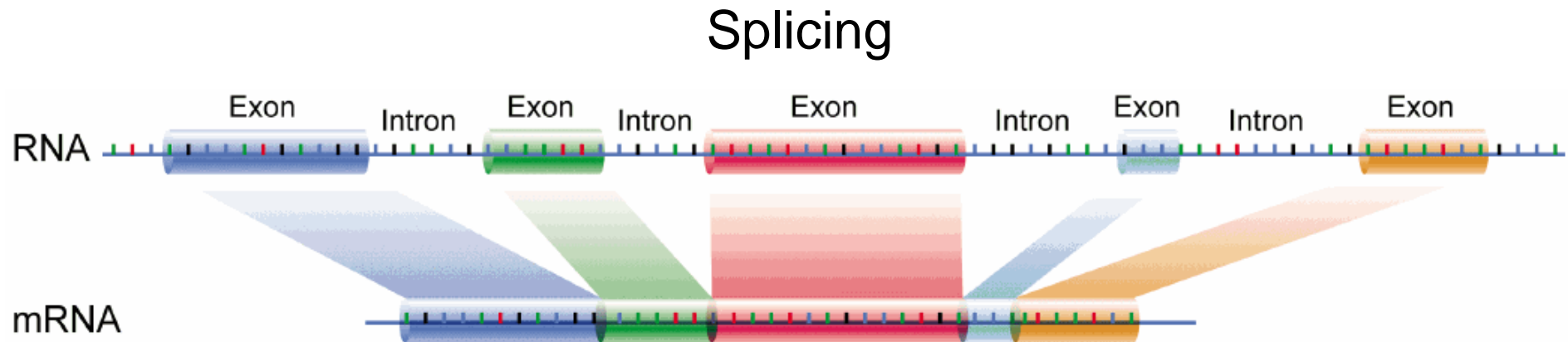


Why start with an RNA World?

What is special about RNA?

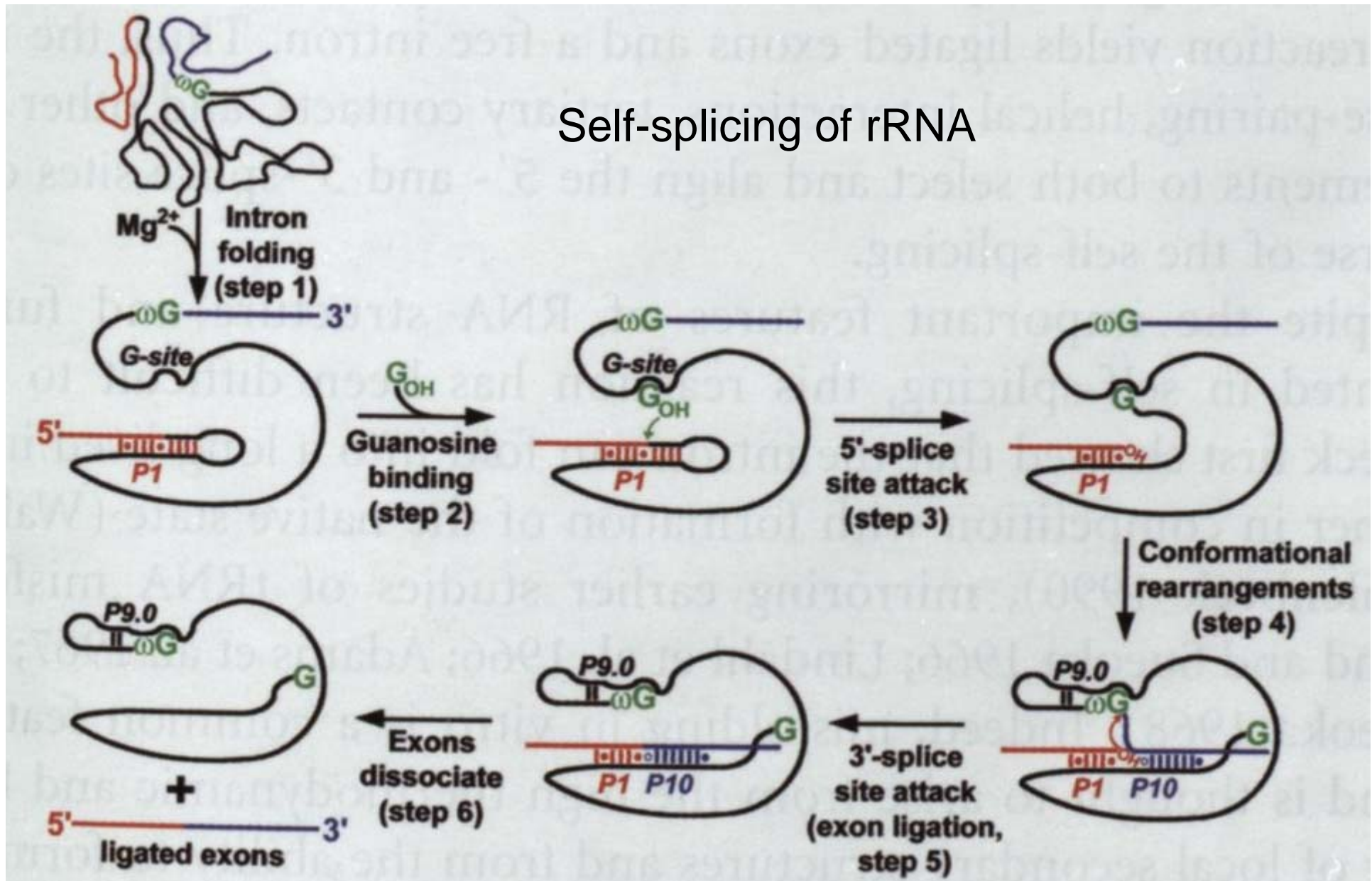
Functions

- From protein biosynthesis we know: RNA can store information
- But RNA can also act as an catalysator
Example: Self-splicing of rRNA of *Tetrahymena thermophila*





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Self-splicing of rRNA



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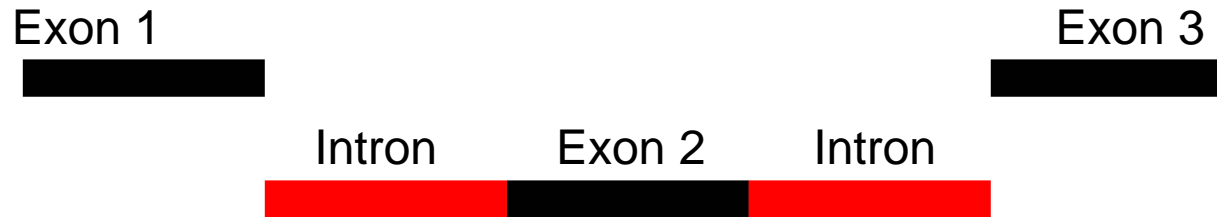
Recombination via self-splicing

- Reversible mechanism  The intron can splice into appropriate nucleotide sequences
 Recombination is possible (new gene combinations)





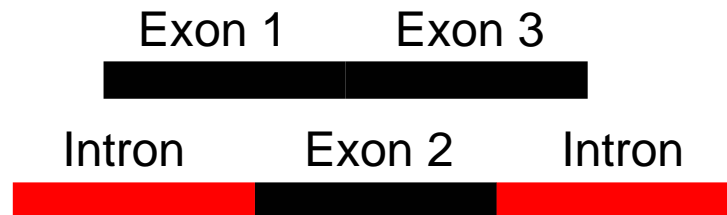
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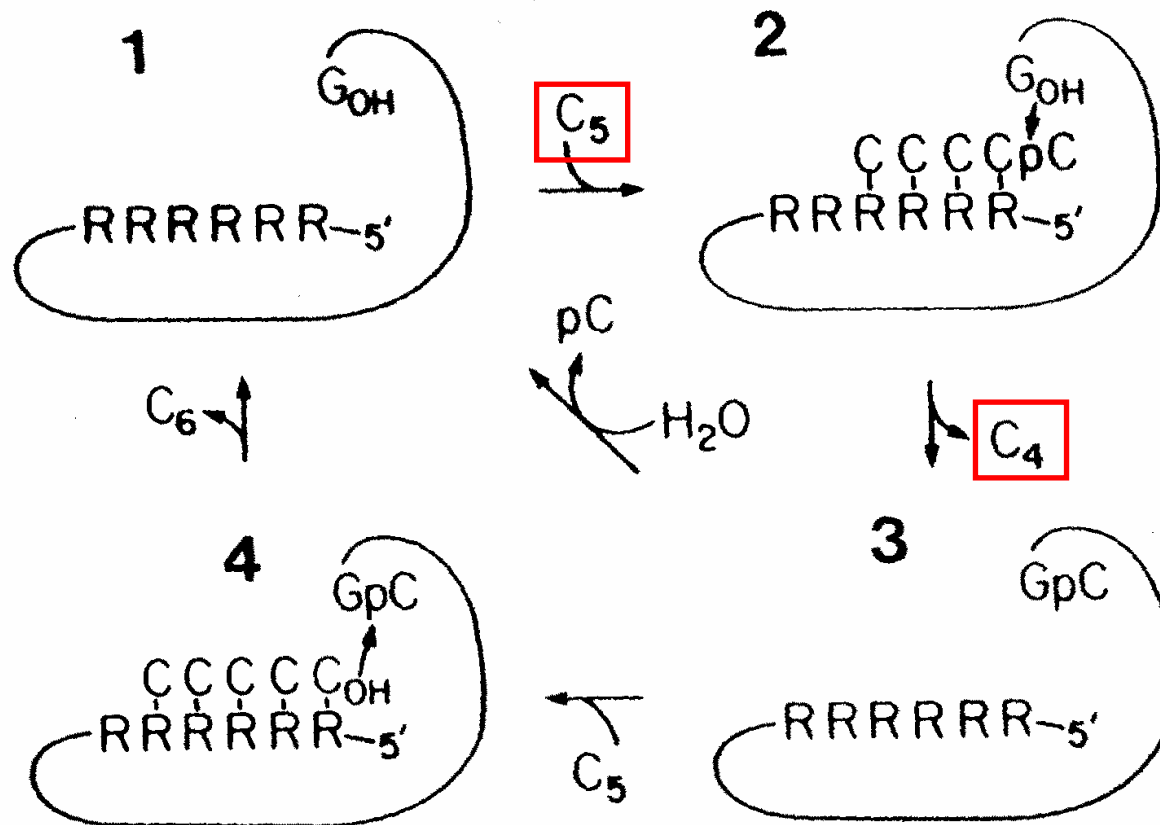
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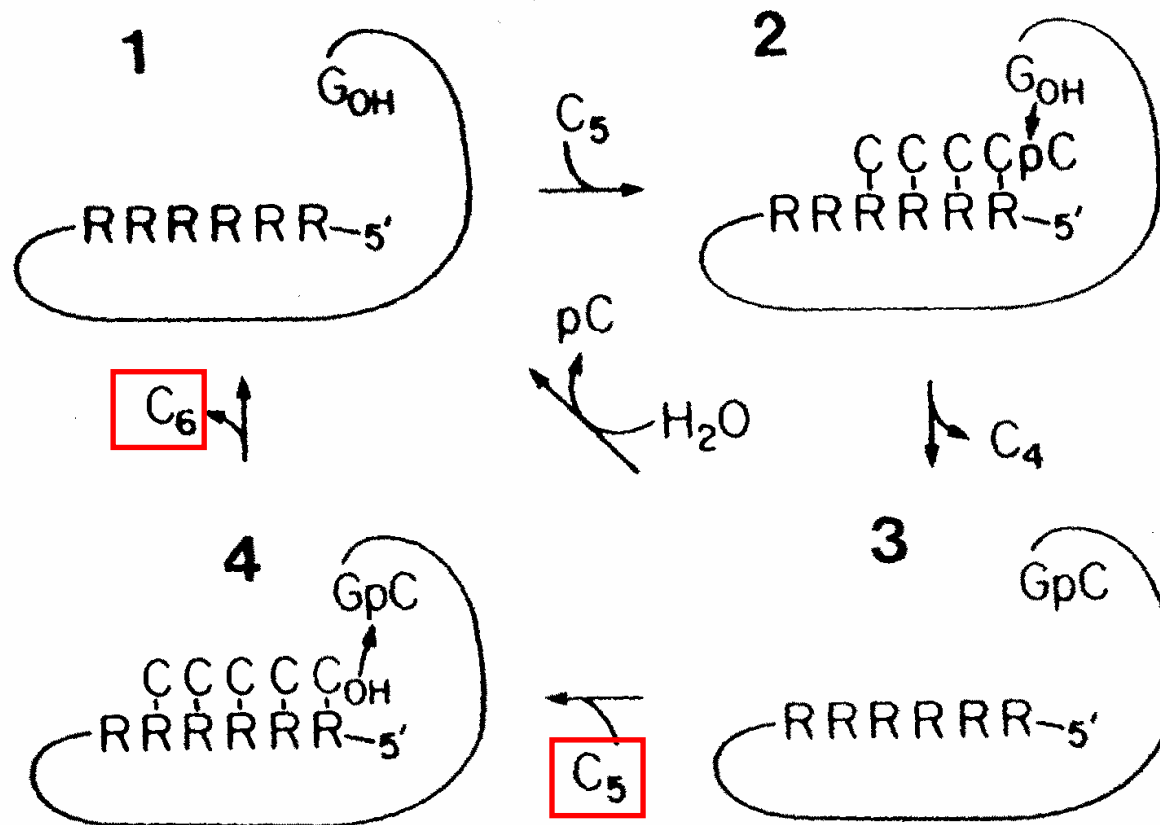
The Tetrahymena intron

- The shortened intron itself is a ribozyme (RNA enzyme)
- It can catalyze the cleavage and ligation of nucleotide chains



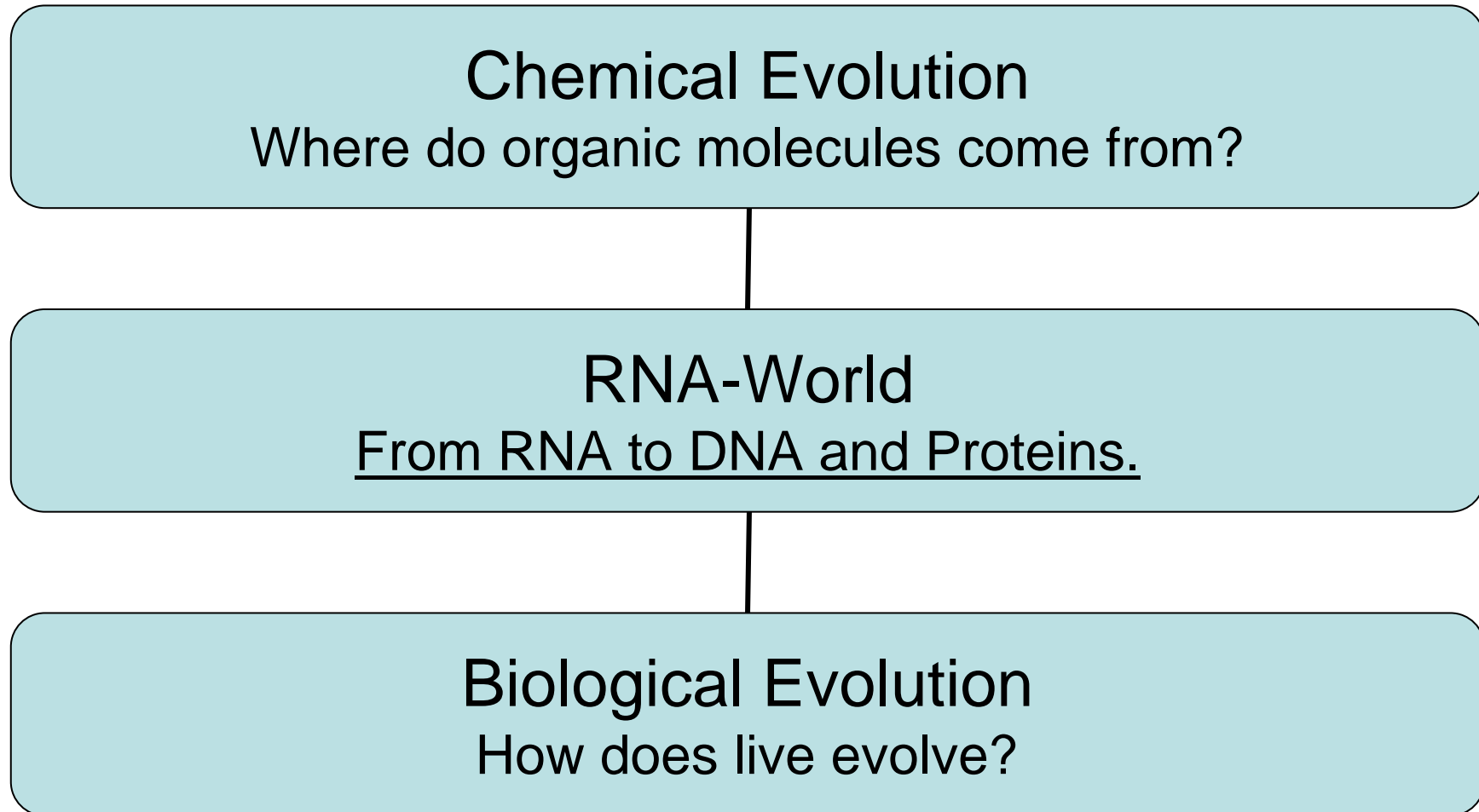
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The RNA-world-hypothesis

What is the RNA World?



The RNA World

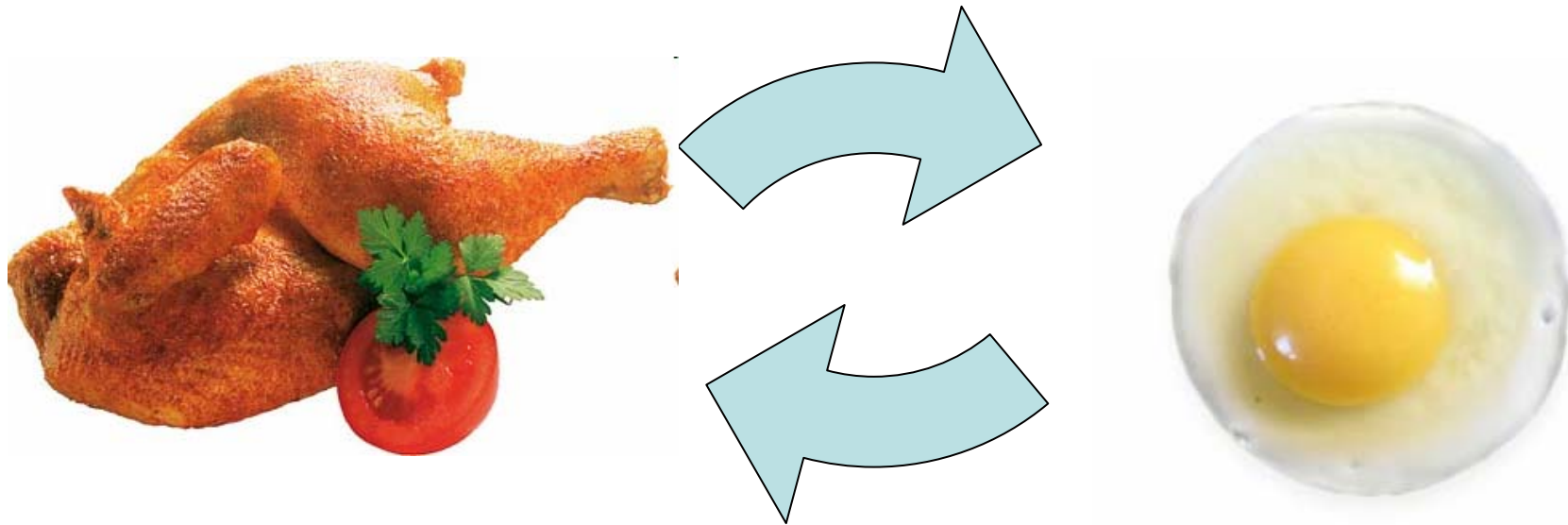
- From protein biosynthesis we know: RNA can store information
- But RNA can also act as an enzyme (ribozyme)
- This duality is the basis of the RNA-world-hypothesis

The RNA World

- 1. RNA catalyses the production of RNA from a nucleotide soup (mutation & recombination)
- 2. Development of RNA, which can bind amino acids; arrange them according to a RNA template
→ Proteins
- 3. Reverse transcription → DNA

Why start with an RNA world?

- From RNA we get Proteins and DNA



Why start with an RNA World?

Literature

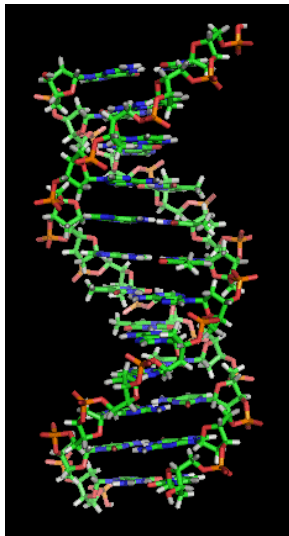
- The RNA World, Gilbert, Nature 319, 618 (1986)
- The intervening sequence RNA of Tetrahymena is an enzyme, Zaug and Cech, Science 231, 470 (1986)
- The RNA World – Gesteland, Cech, Atkins

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DNA and proteins

- DNA (Deoxyribonucleic acid)
 - Build out of four nucleotides: Adenine, Cytosine, Guanine, Thymine on a backbone
 - Spiral structure
- Proteins
 - Build out of twenty amino acids: Alanine, asparagine,...
 - Structure not obvious (folding)



Why start with an RNA World?

Functions

- Proteins are molecules with various functions (machines, enzymes,...)
- The DNA is the blueprint for the proteins