

An Introduction to Molecular Biology and RNA motifs

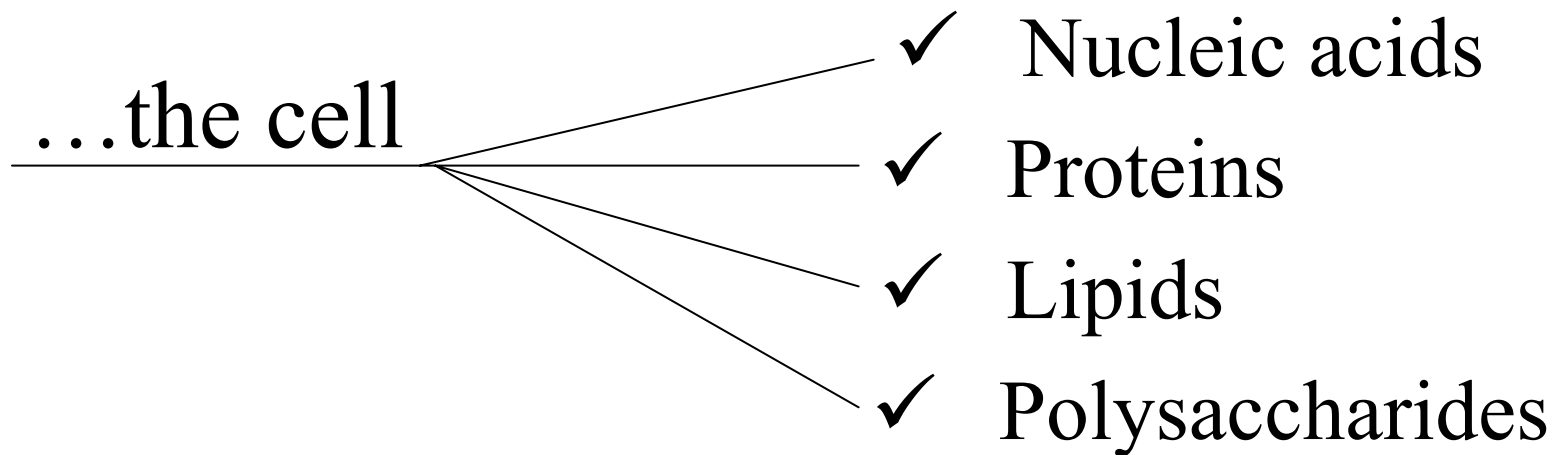
Dimitrios Palitskaris



What is life?

Metabolize, Reproduce, Evolve
...viruses?

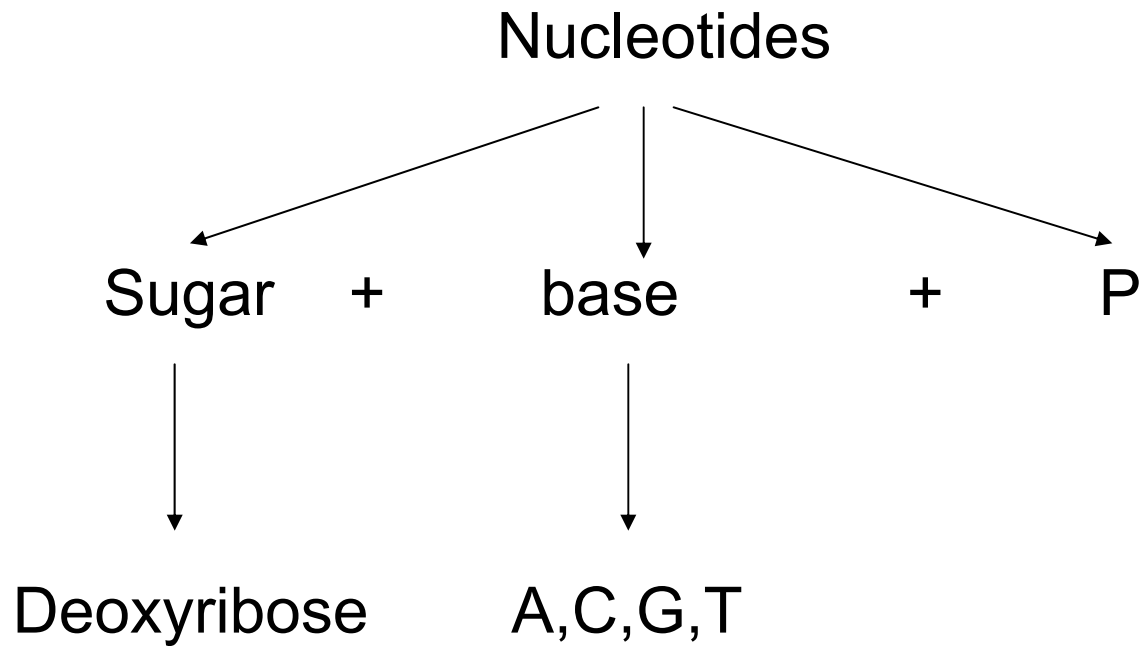
Life and its cornerstone



Nucleic Acids



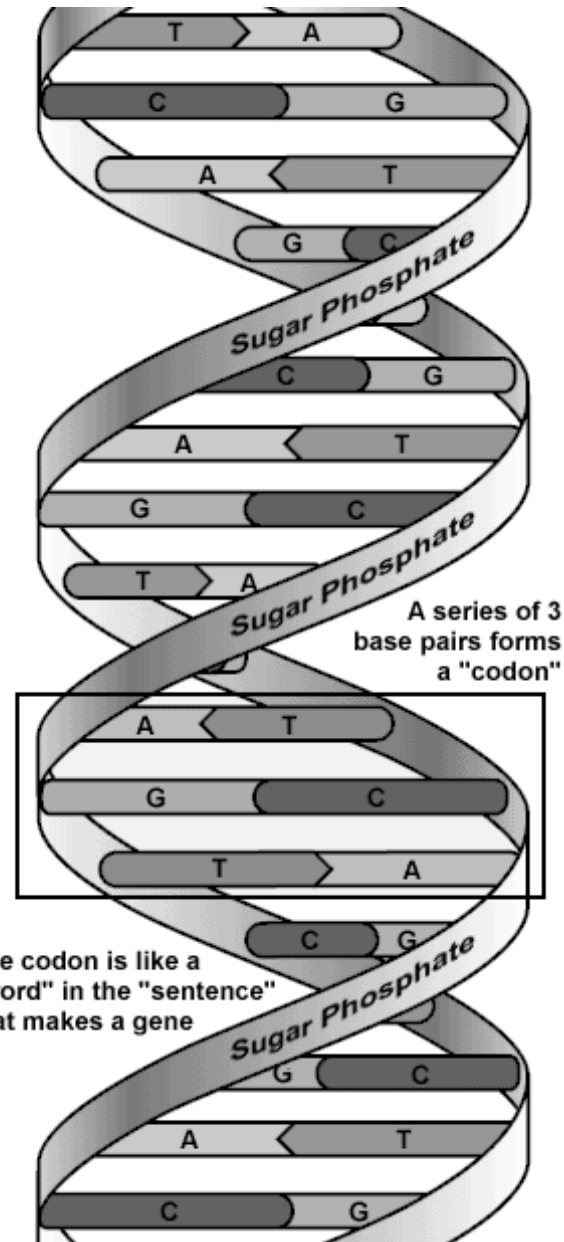
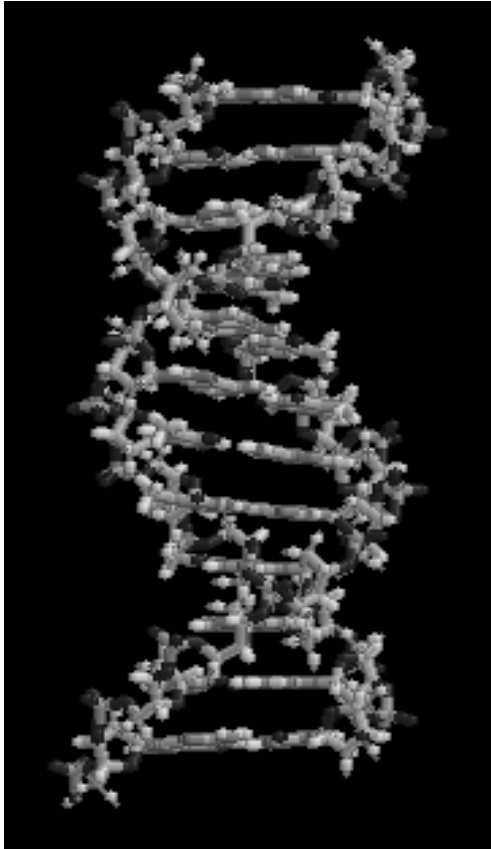
1. DNA



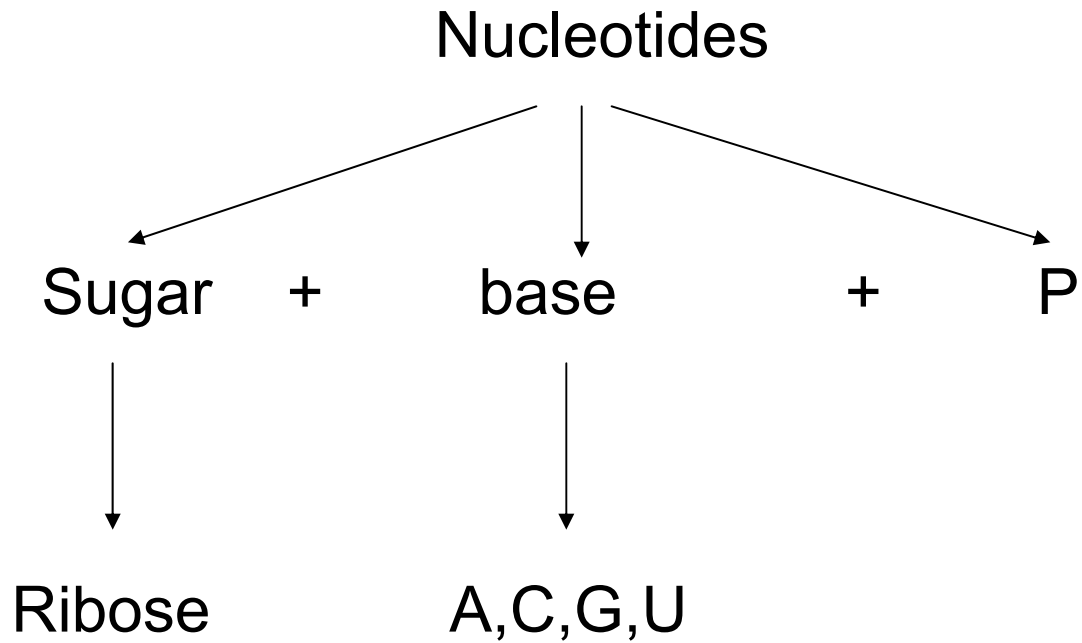
1. DNA

- Double stranded
- A-T & C-G (complementary bases)
- 5' P → 3' OH

1. DNA

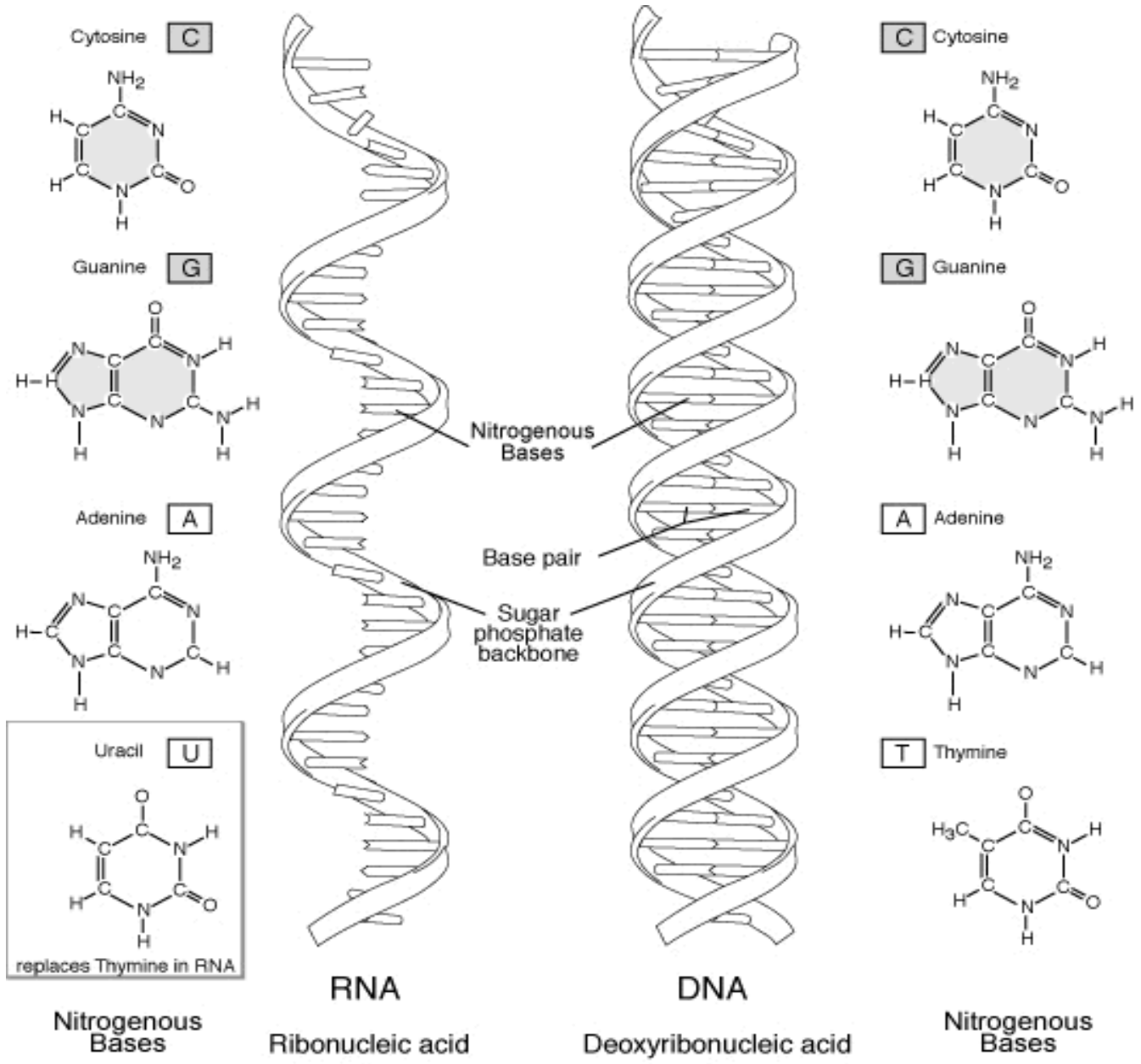


2. RNA



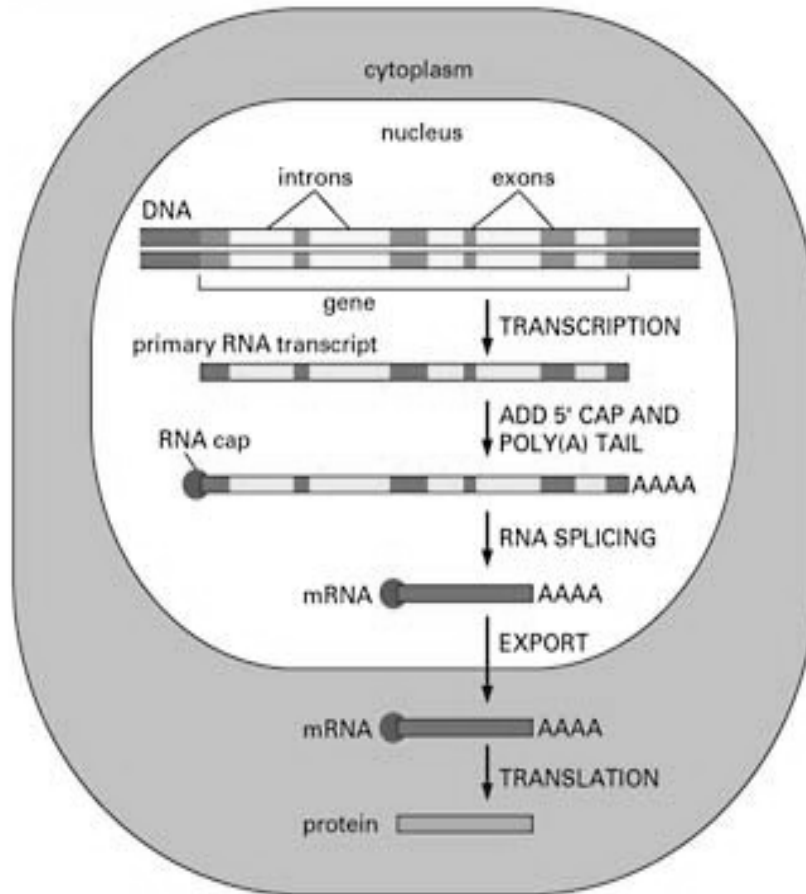
2. RNA

- Single stranded
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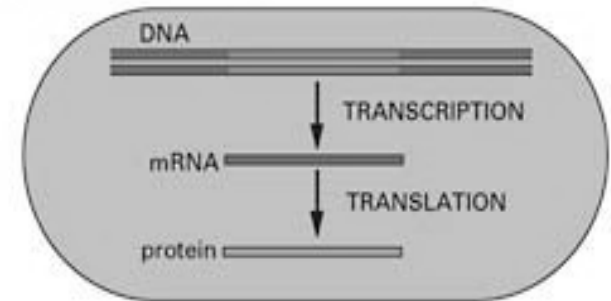


Central Dogma of Biology

(A) EUKARYOTES

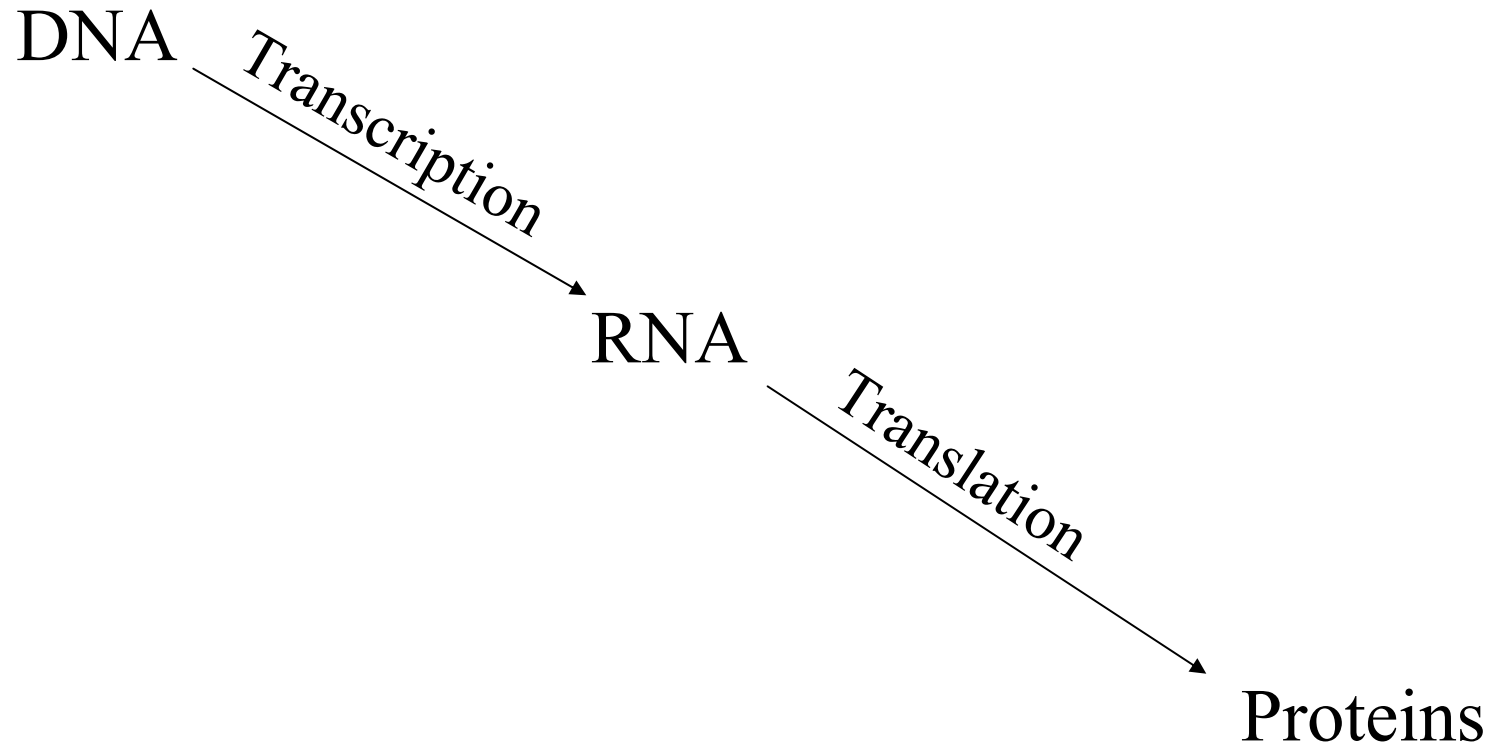


(B) PROCARYOTES



http://www.accessexcellence.org/AB/GG/steps_to_Prot.html

Let's Review...



Why is RNA important?

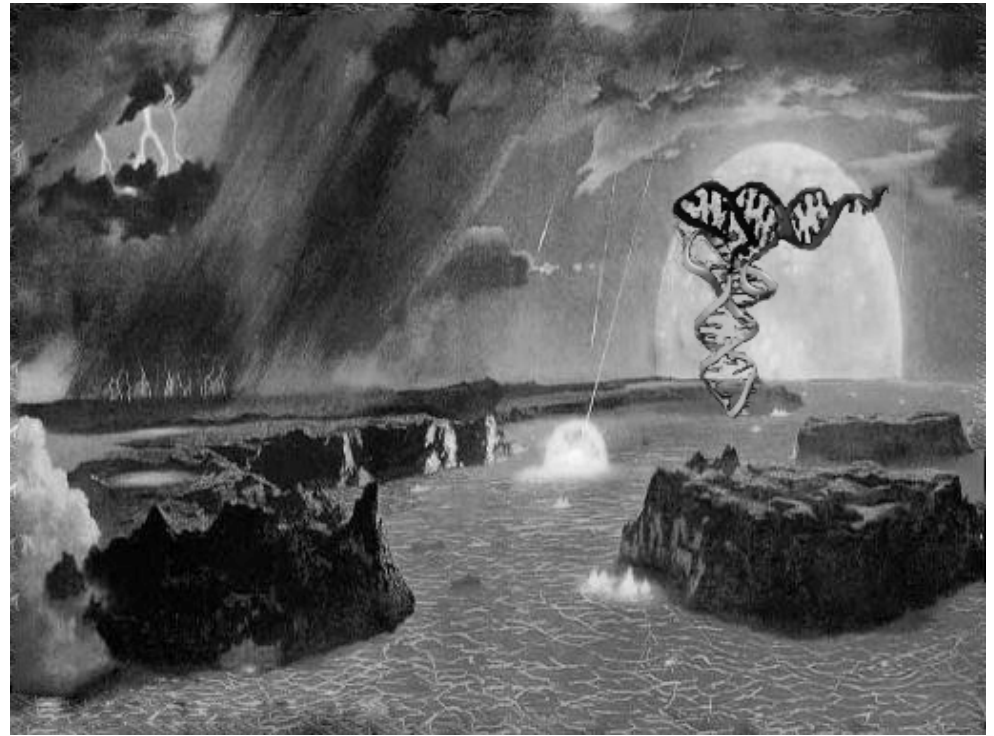
RNA-World Hypothesis

DNA

carries genetic information

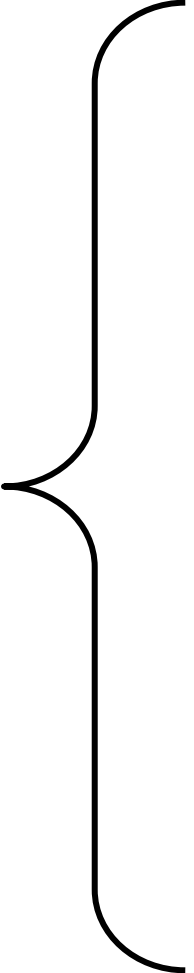
Proteins

act as enzymes (catalysts)



RNA only can do both!

Types of RNA

- 
- mRNA (messenger)
 - tRNA (transfer)
 - rRNA (ribosomal)
 - snRNA (small nuclear)
 - snoRNA (small nucleolar)
 - scaRNA (small cajal body-specific)
 - miRNA (micro)
 - siRNA (small interfering)
 - gRNA (guide)
 - eRNA (efference)
 - tmRNA

Non coding RNA (ncRNA)

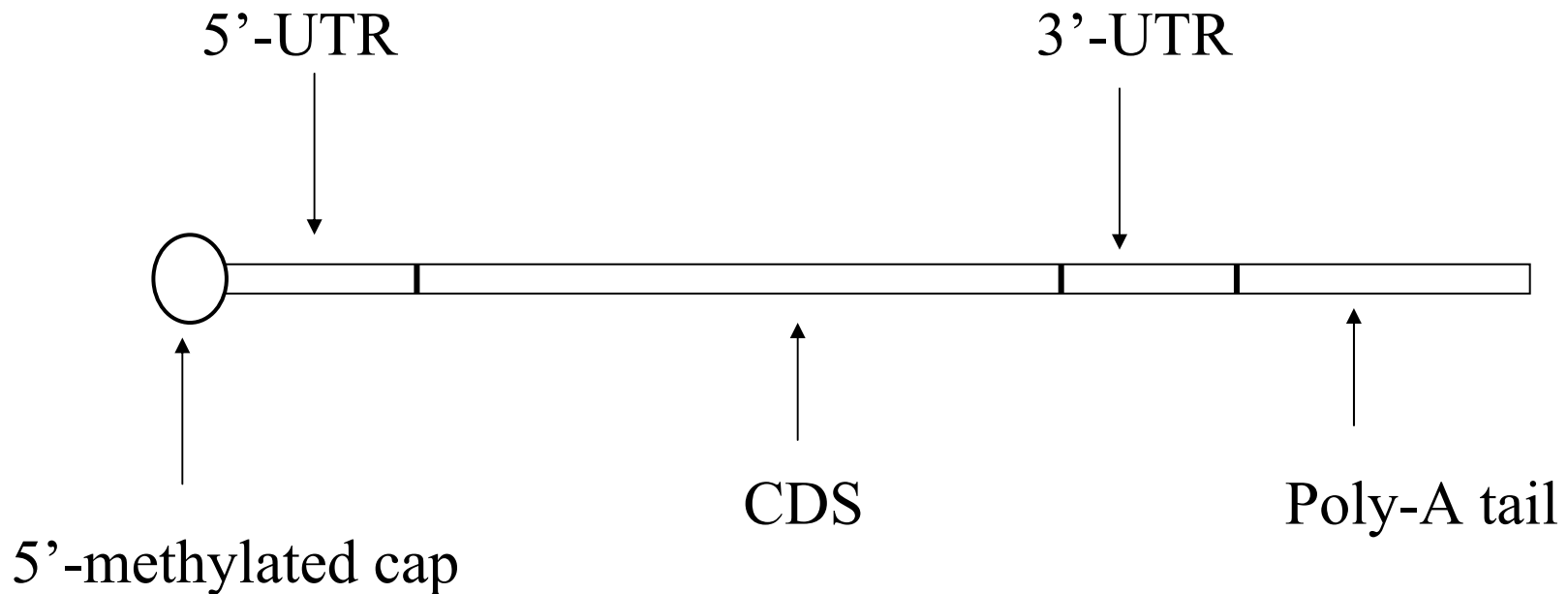
Any RNA that isn't translated into proteins

Includes:

tRNA, rRNA, snRNA, snoRNA, miRNA, gRNA, efference RNA, Signal recognition particle RNA, pRNA, tmRNA

RNA genes

What about mRNA?



UTR= UnTranslated Regions

CDS= CoDing Sequence

ncRNA vs. mRNA

ncRNA

Any RNA that isn't translated into proteins

mRNA

Contains untranslated regions (5'UTR, 3'UTR)

However UTRs are not considered ncRNA

Structure

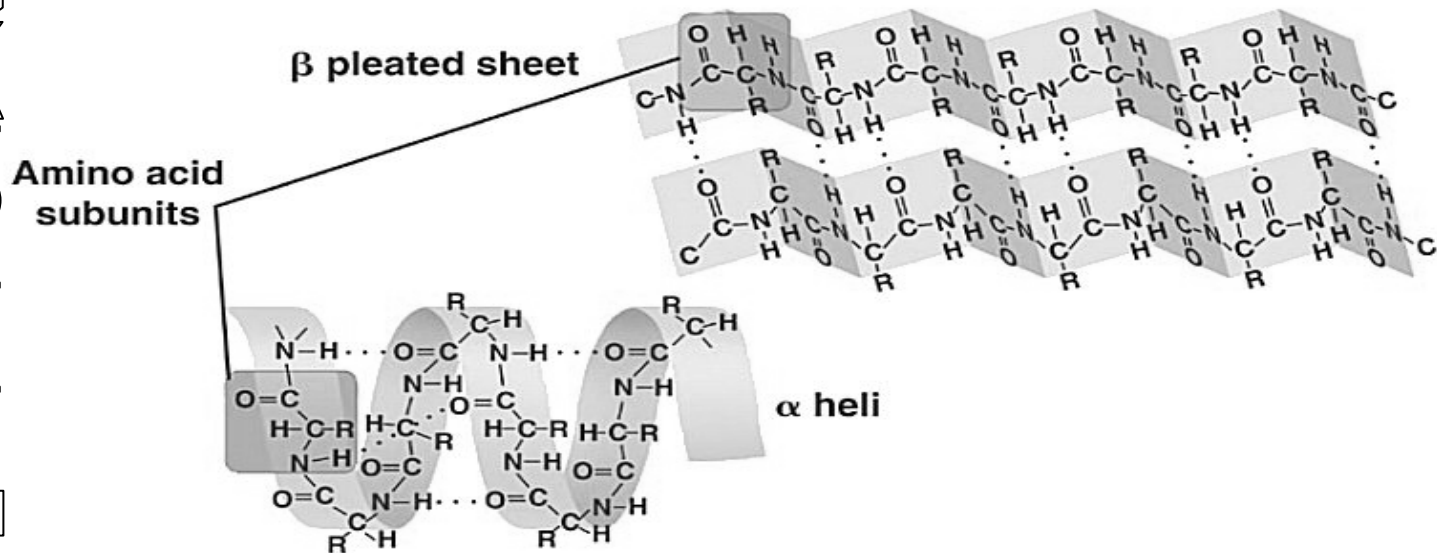
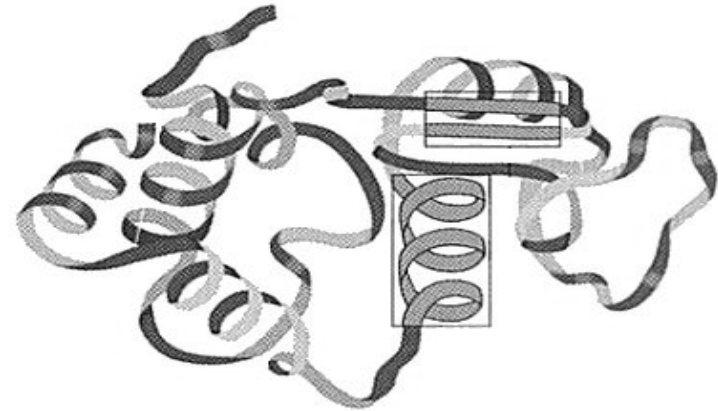
In proteins we have:

- Primary structure (sequence itself)
- Secondary structure (general 3d form of *local segments*)
- Tertiary structure (overall shape, fold)
- Quaternary structure (multi-subunit complex)

Example:

LMSVHSILFSSEHSEHV

L
G
A
Q
Q
M
M
T
G
Y
A
T
D
E
E
L
P



RNA structure

Likewise, we have:

- Primary (sequence)
- Secondary (direct base pairing)
- Tertiary (3d shape in space)

RNA motifs

or RNA elements or regulatory elements
or binding sites or RNA signals

Small RNA segments required for a certain interaction of the RNA with its environment.

They allow a controlled release of information in the cell from an RNA.

RNA motifs

Function of motif depends on:


- Sequence
- Secondary structure (specific bp)

Functions include:

- Protein binding
- Basepairing to another RNA
- Modifying a nucleic acid bond

Types of RNA motifs

- Single-strand regions
- Helices (or stems)
- Bulges
- Hairpin loops
- Internal loops
- Junctions



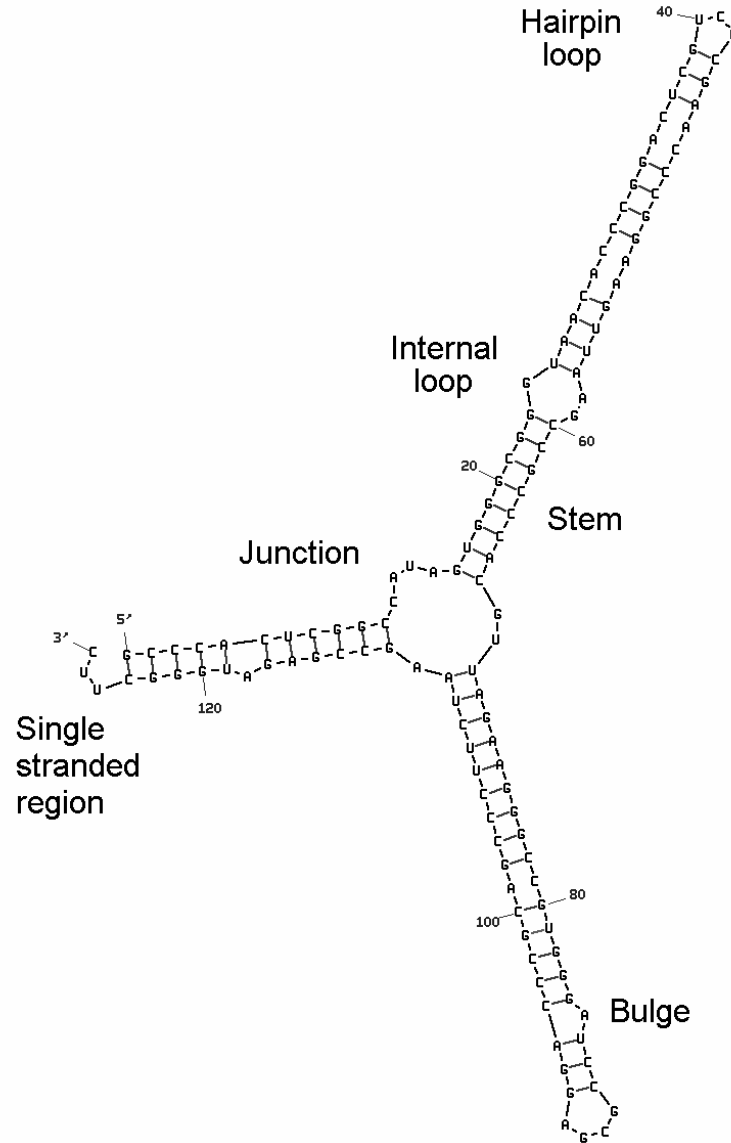
Result of :

- WC bp
- non WC bp (mismatch)
- unpaired bases

→

A comprehensive example

→

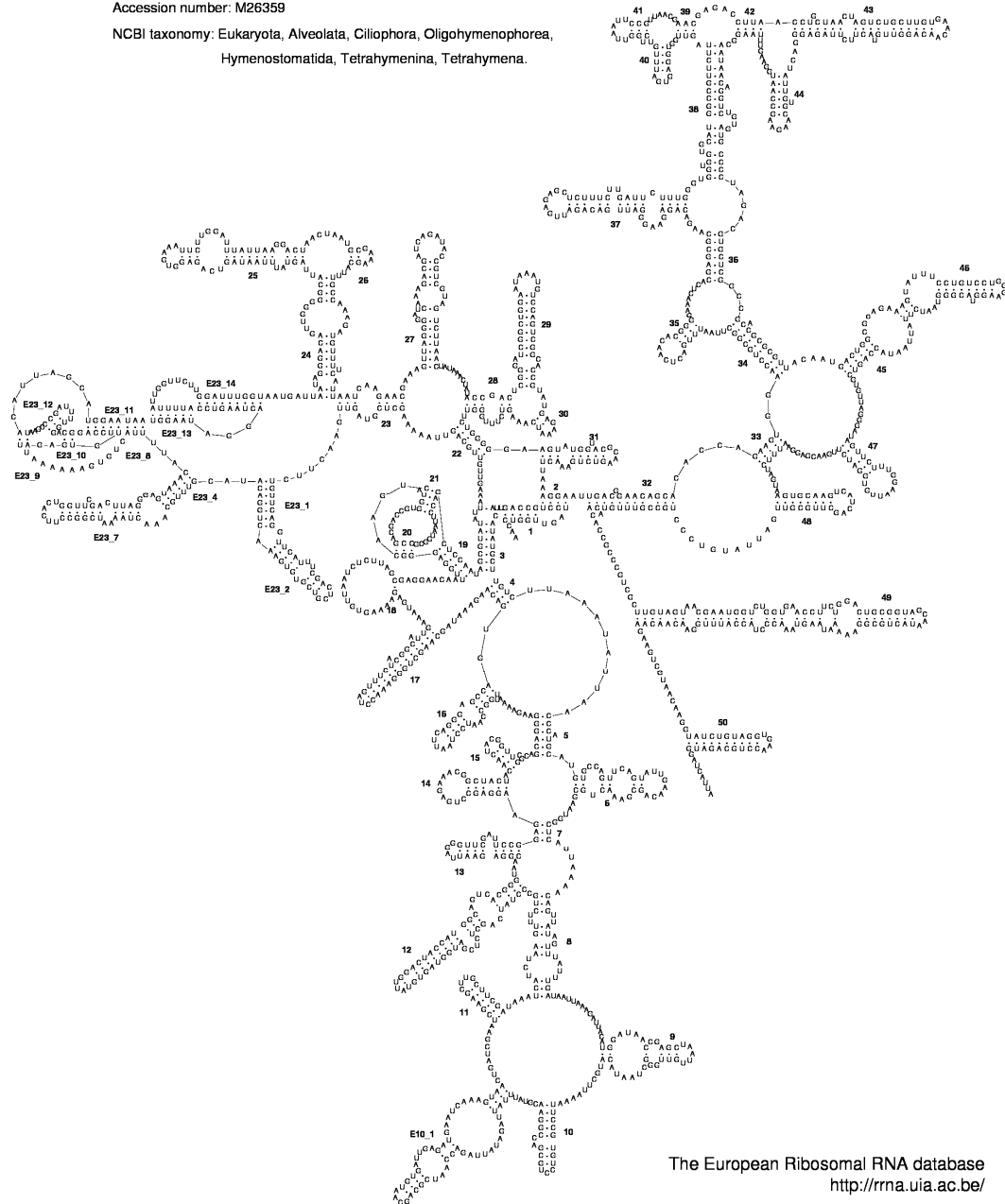


Tetrahymena canadensis SSU rRNA secondary structure model

Accession number: M26359

NCBI taxonomy: Eukaryota, Alveolata, Ciliophora, Oligohymenophorea,

Hymenostomatida, Tetrahymenina, Tetrahymena.



Let's
make it
more
interesting...

RNA motifs

Regulatory effects:

- Regulation of translation
- Processing of RNA
- Catalytic modification of other RNAs
- Transport & position in the cell
- Stability of the RNA-transcript
- Expression of the encoded protein

References:

- P. Bengert, T. Dandekar, D. Ostareck, A. Ostareck-Lederer, Thomas Dandekar, *RNA Motifs and Regulatory Elements*, 2nd edition, Springer, 2002
- <http://en.wikipedia.org/>

Picture Resources:

- Nicolle Rager Fuller, National Science Foundation
- <http://genetics.gsk.com/graphics/>
- <http://www.kazusa.or.jp>
- www.accessexcellence.org
- <http://employees.csbsju.edu/hjakubowski>
- <http://kvhs.nbed.nb.ca>
- <http://rrna.uia.ac.be>
- www.genomenewsnetwork.org

Animation Resources:

- Molecular and Cellular Biology Learning Center,
Virtual Cell Animation Collection

<http://vcell.ndsu.nodak.edu/>

- <http://www.pbs.org/wgbh/nova/genome/dna.html#>
- <http://www.pwc.k12.nf.ca/wadey/biotech/dna1.swf>
- <http://en.wikipedia.org/>

Biology and RNA motifs

THE

END