Types of RNA

Different types of RNAs and their functions

Those RNAs carrying the code for protein synthesis are called “coding RNAs” or “messenger RNAs (mRNAs)”. Surprisingly, recent evidence revealed that very little of our human genome sequences (less than 2%) could actually end up producing proteins. However, most of the rest genome sequences are actively transcribed to generate the so-called “non-coding RNAs (ncRNAs)”. These ncRNAs do not undergo translation to synthesize proteins, but may hold the key to broaden our understanding of gene regulation and human diseases. Many of them are reported to serve as various regulatory elements in the genome, whereas most are still of unknown importance to gene regulation.

Different types of RNAs:

Coding-RNA (messenger RNA; mRNA)

Messenger RNA (mRNA) carries the genetic code from DNA in a form that can be recognized to make proteins. The coding sequence of the mRNA determines the amino acid sequence in the protein produced. Once transcribed from DNA, eukaryotic mRNA briefly exists in a form called “precursor mRNA (pre-mRNA)” before it is fully processed into mature mRNA.

This processing step, which is called "RNA splicing", removes the introns—non-coding sections of the pre-mRNA. There are approximately 23,000 mRNAs encoded in human genome.

Non-coding RNA (ncRNA)

- ***Ribosomal RNA (rRNA):***

  Ribosomal RNA is the catalytic component of the ribosomes. In the cytoplasm, rRNAs and protein components combine to form a nucleoprotein complex called the ribosome which binds mRNA and synthesizes proteins (also called translation).

- ***Transfer RNA (tRNA):***

  Transfer RNA is a small RNA chain of about 80 nucleotides. During translation, tRNA transfers specific amino acids that correspond to the mRNA sequence into the growing polypeptide chain at the ribosome.

- ***Small nuclear RNAs (snRNA; 150 nt):***

  Small nuclear RNAs are always associated with a group of specific proteins to form the complexes referred to as "small nuclear ribonucleoproteins (snRNP)" in the nucleus. Their primary function is to process the precursor mRNA (pre-mRNA).

- ***Small nucleolar RNAs (snoRNA; 60-300 nt):***

Small nucleolar RNAs are components of small nucleolar ribonucleoproteins (snoRNPs), which are complexes that are responsible for sequence-specific nucleotide modification.

- ***Piwi-interacting RNAs (piRNA; 24-30 nt):***

Piwi-interacting RNAs bind the PIWI subfamily proteins that are involved in maintaining genome stability in germline cells. Piwi-interacting RNAs also play a role in gametogenesis.

- ***MicroRNAs (miRNA; 21-22 nt):***

MicroRNAs are small ncRNAs of ~22 nucleotides (nt) and the most widely studied class of ncRNAs. These RNA species mediate post-transcriptional gene silencing through RNA interference (RNAi), where an effector complex of miRNA and enzymes can target complementary mRNA by blocking the mRNA from being translated or accelerating its degradation. In human, miRNAs are estimated to regulate the translation of >60% of protein-coding genes.

- ***Long noncoding RNAs (lncRNA):***

Long noncoding RNAs are a heterogeneous group of non-coding transcripts larger than 200 nt in size and make up the largest portion of the mammalian non-coding transcriptome. It is estimated that more than 8,000 lncRNAs encoded in the human genome. LncRNAs are essential in many physiological processes. To date, various mechanisms

of gene regulation by some lncRNAs have been reported, whereas most are still of unknown function.

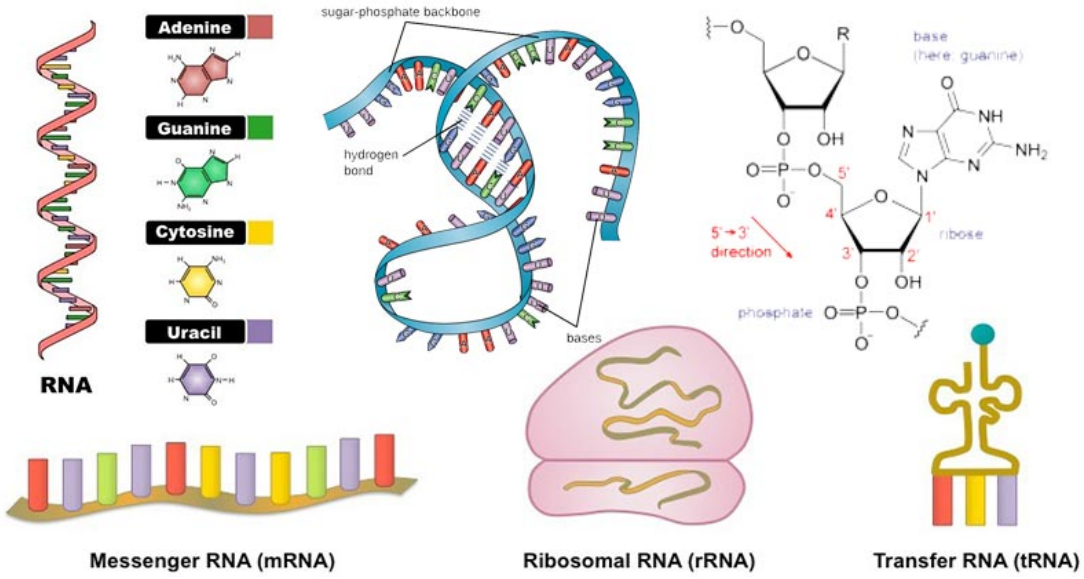

FIG: Different types of RNA

Structure of tRNA

A **transfer RNA** (abbreviated **tRNA** and formerly referred to as **sRNA**, for **soluble RNA**) is an adaptor molecule composed of RNA, typically 76 to 90 nucleotides in length, that serves as the physical link between the mRNA and the amino acid sequence of proteins. Transfer RNA does this by carrying an amino acid to the protein synthetic machinery of a cell called the ribosome. Complementation of a 3-nucleotide codon in a messenger RNA (mRNA) by a 3-nucleotide anticodon of the tRNA results in protein synthesis based on the mRNA code. As such, tRNAs are a necessary

component of translation, the biological synthesis of new proteins in accordance with the genetic code.

The tRNA structure consists of the following:

- A 5′-terminal phosphate group.
- The acceptor stem is a 7- to 9-base pair (bp) stem made by the base pairing of the 5′-terminal nucleotide with the 3′-terminal nucleotide (which contains the CCA 3′-terminal group used to attach the amino acid). In general, such 3′-terminal tRNA-like structures are referred to as 'genomic tags'. The acceptor stem may contain non-Watson-Crick base pairs.
- The CCA tail is a cytosine-cytosine-adenine sequence at the 3′ end of the tRNA molecule. The amino acid loaded onto the tRNA by aminoacyl tRNA synthetases, to form aminoacyl-tRNA, is covalently bonded to the 3′-hydroxyl group on the CCA tail. This sequence is important for the recognition of tRNA by enzymes and critical in translation. In prokaryotes, the CCA sequence is transcribed in some tRNA sequences. In most prokaryotic tRNAs and eukaryotic tRNAs, the CCA sequence is added during processing and therefore does not appear in the tRNA gene.
- The D arm is a 4- to 6-bp stem ending in a loop that often contains dihydrouridine.
- The anticodon arm is a 5-bp stem whose loop contains the anticodon. The tRNA 5′-to-3′ primary structure contains the anticodon but in reverse order, since 3′-to-5′ directionality is required to read the mRNA from 5′-to-3′.

- The T arm is a 4- to 5- bp stem containing the sequence TΨC where Ψ is pseudouridine, a modified uridine.
- Bases that have been modified, especially by methylation (e.g. tRNA (guanine-N7-)-methyltransferase), occur in several positions throughout the tRNA. The first anticodon base, or wobble-position, is sometimes modified to inosine (derived from adenine), queuosine (derived from guanine), uridine-5-oxyacetic acid (derived from uracil), 5-methylaminomethyl-2-thiouridine (derived from uracil), or lysidine (derived from cytosine).

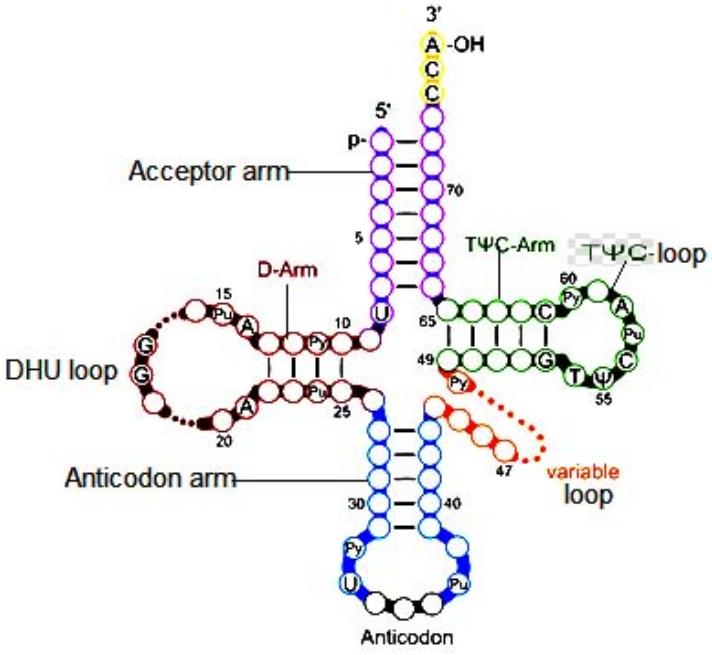

FIG: Structure of tRNA

References:

En.wikipedia.org>wiki>Transfer_RNA

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