RNA processing

prokaryotic cell

RNA processing happens in the cytoplasm. Prokaryotes have minimal processing of their mRNA.

Eukaryotic cell

Overall
The RNA processing is coupled with transcription**.** The capping enzyme will add 5’ caps to immature RNA which is necessary for elongation of transcription. RNA pol II will recruits proteins for RNA splicing. Polyadenylation factors will add the poly-A tail before the end of transcription. This corporation could stabilise the transcription and protect immature RNA from degradation.

Process
·Add five caps through a 5’-5’ linkage. The 5’ cap is formed by condensation of a molecule of GTP with the triphosphate at the 5’ end of the transcript.
·The introns are removed by the transesterification reaction. And splicesome which is a large protein complex catalyst this reaction. There are five subunits(U1 U2 U4 U5 U6) which are called snRNPs contained in spliceosomes.
· Spliceosomal introns generally have the dinucleotide sequence GU at the 5’ ends and AG at the 3’ ends, and these sequences mark the sites where splicing occurs so U1 recognises and binds with the 5’ splice site. Then splice branch point which always is an adenine, a necessary point for forming the lariat intermediate, is recognized by BBP.
· The poly-pyrimidine tract near the intron will be bound by U2AF65. Its role is to assist in defining the splice site, working in conjunction with other splicing factors to ensure the accuracy of the splicing reaction.
·The 3' splice site is located at the junction between the exon and the intron, marking the end of the exon and is recognized and bound by U2AF35. Identification and binding of the 3' splice site are essential for initiating the splicing reaction, ensuring the proper connection of exons.
Then the binding steps finish and it comes to splicing reactions. At the onset of splicing, the pre-mRNA undergoes structural rearrangement.

- During this process, snRNPs U1 and U4 are released from the pre-mRNA to allow the splicing reaction to proceed.
- Following the structural rearrangement of the pre-mRNA, the first transesterification reaction takes place. This reaction results in the release of exon 1 from the pre-mRNA, which will become part of the mature mRNA.
- After the first transesterification reaction, the intron forms a structure similar to a "lariat," resembling a closed loop.
- Other rearrangements then bring together the freed exon 1 and intron/exon 2 junction This ensures the correct connection of exons, building the mature mRNA.
- After the successful connection of exons, the second transesterification reaction takes place. This reaction joins exons 1 and 2 together, forming a continuous coding sequence in the mature mRNA.
- Finally, the lariat intron structure is released, no longer part of the splicing reaction

RNA has alternative splicing so one gene can generate more than one product. An exon can also shuffle which means it can rearrange and recombine to a new gene. After the splicing, At the 3' end of the pre-mRNA, there is a specific signal sequence known as the "polyA" signal.

- An endonuclease complex recognises this signal and cleaves the pre-mRNA, cutting it at the position specified by the signal. Following the cleavage, a special enzyme called poly(A)

polymerase (PAP) adds approximately 200 adenine (A) nucleotides to the newly generated 3' end. And no templated needed.

- This results in forming a long polyadenine tail often referred to as the "poly(A) tail."
- Poly(A) binding protein (PABP) binds to the poly(A) tail, protecting it from degradation and playing a role in regulating mRNA function.

tRNA and rRNA also have processing. tRNA synthesis typically occurs in the cell nucleus. They are initially synthesised as longer precursor tRNA molecules with extra sequences and structural elements. The long precursor tRNAs need to be processed to generate functional tRNAs. This involves several steps, such as Cleavage, modification and folding.