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Molecular devices

RNA polymerase II transcribes the nucleotide sequence of the DNA of a gene into the same sequence of **pre-messenger RNA (pre-mRNA)**. RNA polymerase II reads the DNA in the 5' to 3' direction, terms illustrated by the mRNA figures (1.7) and (1.9), and so the nose of the pre-mRNA is the 5' end. Several enzymes then fashion and attach a **cap** to the 5' end of the pre-mRNA and add a **poly-A tail** of some 200 adenosine nucleotides to the 3' end. A **spliceosome** then deletes most **introns** and some **exons** from the pre-mRNA and so makes one of several possible mRNA transcripts from the same gene according to the immediate needs of the cell, a process known as **alternative splicing**. Introns contain special sequences of nucleotides that tell the spliceosome to cut them out. Proteins that bind to the pre-mRNA tell the spliceosome which exons to delete and which to keep. The production of these proteins is an important control mechanism. The nucleus exports mature mRNAs through its pores into the cytosol but inside the endoplasmic reticulum where **ribosomes translate** the mRNA into many copies of the needed protein. A **micro RNA (miRNA)** determines how many copies of protein ribosomes make from an mRNA by binding to a **seed** in its a sequence of nucleotides that lies in the tail of the mRNA between the code for the protein and the poly-A tail. This region is the 3' untranslated region (**3' UTR**). The miRNA is some 21 nucleotides long and binds to the six-nucleotide seed by AU and GC Crick-Watson pairing.

3.1 Transport

Eukaryotic cells are too big to rely upon diffusion.