

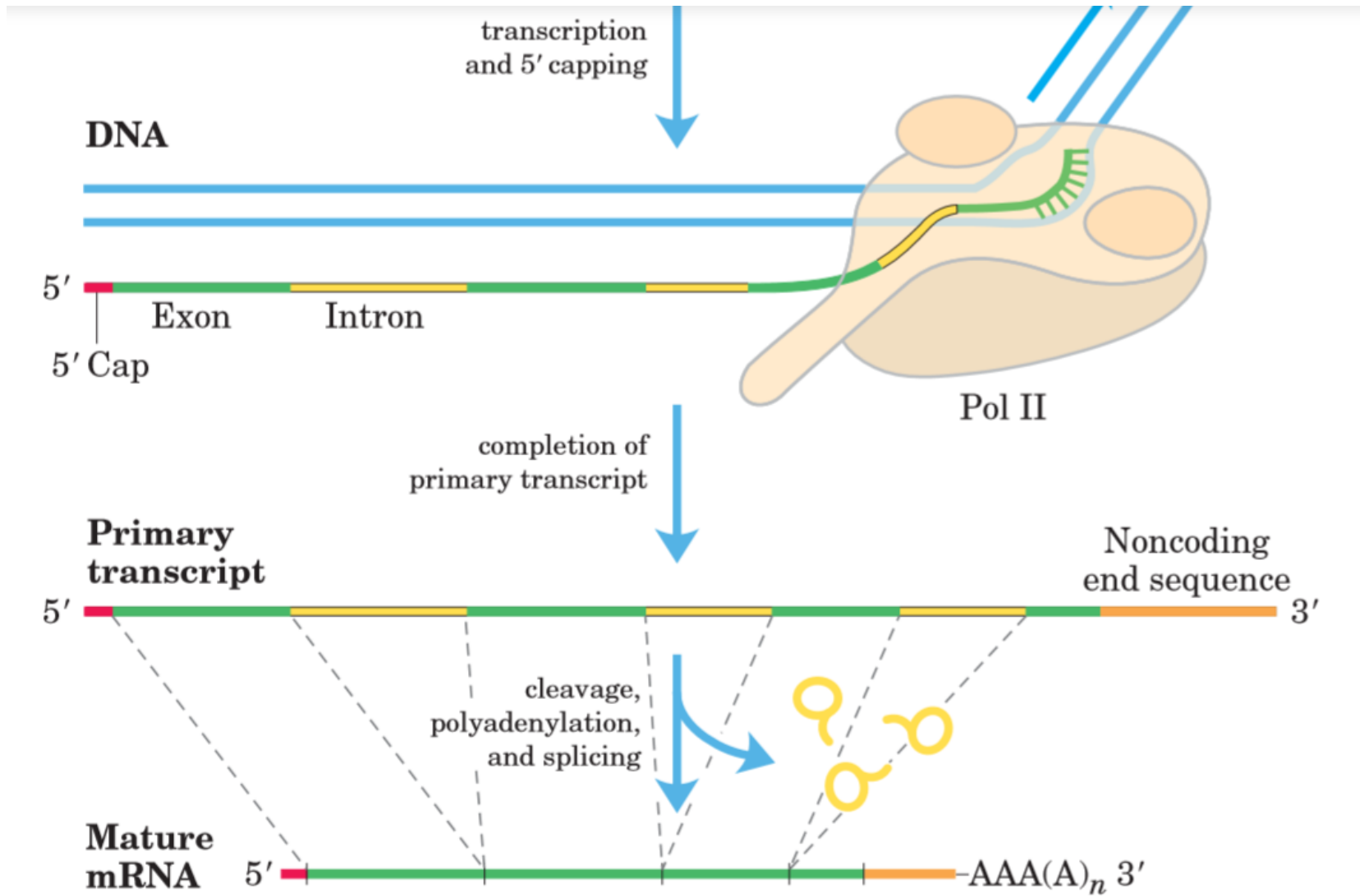
RNA processing and gene expression regulation

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RNA processing

- Many of the RNA molecules in bacteria and virtually all RNA molecules in eukaryotes are processed to some degree after synthesis.
- Perhaps the most extensive processing of primary transcripts occurs in eukaryotic mRNAs and in tRNAs of both bacteria and eukaryotes.
- The primary transcripts of bacterial and eukaryotic tRNAs are processed by the removal of sequences from each end (cleavage) and in a few cases by the removal of introns (splicing). Many bases and sugars in tRNAs are also modified; mature tRNAs are replete with unusual bases not found in other nucleic acids

- Most eukaryotic mRNAs have a 5' cap, a residue of 7methylguanosine linked to the 5-terminal residue of the mRNA through an unusual 5,5-triphosphate linkage (guanylyltransferase).
- 3' Poly(A) tail is added by polyadenylate polymerase in template independent manner.



- Of the 4,000 or so genes in the typical bacterial genome, or the perhaps 29,000 genes in the human genome, only a fraction are expressed in a cell at any given time.
- Some gene products are present in very large amounts: the elongation factors required for protein synthesis.
- Requirements for some gene products change over time.

- During development of a multicellular organism, some proteins that influence cellular differentiation are present for just a brief time in only a few cells.
- Specialization of cellular function can dramatically affect the need for various gene products; an example is the uniquely high concentration of a single protein—hemoglobin—in erythrocytes.

- The cellular concentration of a protein is determined by a delicate balance of at least seven processes, each having several potential points of regulation.
- 1. Synthesis of the primary RNA transcript (transcription)
- 2. Posttranscriptional modification of mRNA
- 3. Messenger RNA degradation

- 4. Protein synthesis (translation)
- 5. Posttranslational modification of proteins
- 6. Protein targeting and transport
- 7. Protein degradation
- Of the regulatory processes mentioned above, those operating at the level of transcription initiation are the best documented.

- Genes for products that are required at all times, such as those for the enzymes of central metabolic pathways, are expressed at a more or less constant level in virtually every cell of a species or organism.
- Such genes are often referred to as **housekeeping genes**. Unvarying expression of a gene is called **constitutive gene expression**.

- For other gene products, cellular levels rise and fall in response to molecular signals; this is regulated gene expression.
- Gene products that increase in concentration under particular molecular circumstances are referred to as **inducible**; the process of increasing their expression is **induction**.
- The expression of many of the genes encoding DNA repair enzymes, for example, is induced by a system of regulatory proteins that responds to high levels of DNA damage.
- Conversely, gene products that decrease in concentration in response to a molecular signal are referred to as **repressible**, and the process is called **repression**.