TOPIC 7.2: TRANSCRIPTION

Sections of a Gene

A gene is a sequence of DNA which is transcribed into RNA
- Most genes encode proteins, but some do not (e.g. tRNA)

A gene sequence has three main sections:
- **Promoter** (transcription initiation site)
- **Coding sequence** (the region transcribed)
- **Terminator** (transcription termination site)

As DNA is double stranded, only one strand is transcribed
- The *antisense* strand **is** transcribed into RNA
- The *sense* strand is **not** transcribed into RNA

Transcription

RNA polymerase binds to a promoter and unwinds DNA
- It breaks the H bonds between complementary bases

Nucleoside triphosphates bind to complementary bases
- In RNA, uracil pairs with adenine instead of thymine

RNA polymerase covalently joins the nucleotides together
- The two extra phosphates are released (provides energy)

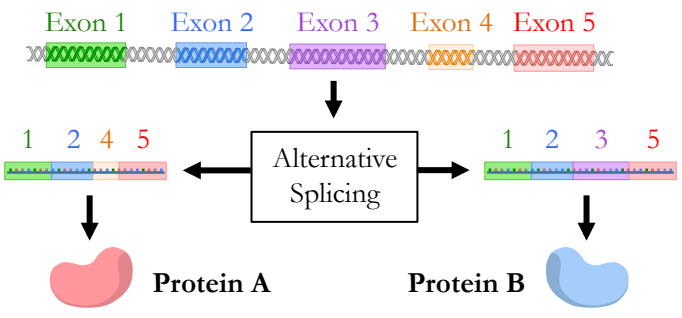
Transcription occurs in a 5' → 3' direction *(antisense strand)*
- At the terminator site, RNA polymerase is detached and the RNA sequence is released (and the DNA rewinds)

Splicing

Eukaryotic cells modify RNA after transcription has occurred
- Modifications must occur to produce mature mRNA

Non-coding regions within genes are removed (**splicing**)
- Introns are non-coding regions in genes (intruding)
- Exons are the coding regions of genes (expressing)

Exons can be selectively removed to form different proteins from the same gene (this is called **alternative splicing**)

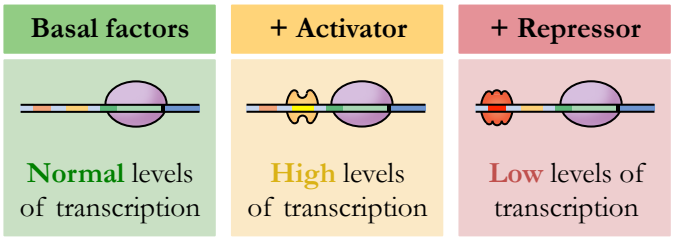


Gene Expression

Transcription Factors

Gene expression is regulated by proteins *(transcription factors)* that bind to specific sequences associated with a promoter
- Activators bind enhancer sites *(⬆ rate of transcription)*
- Repressors bind silencer sites *(⬇ rate of transcription)*

The presence of regulatory proteins may be tissue-specific or may be influenced by chemical signals (e.g. hormones)



Nucleosomes

Nucleosomes also help regulate transcription in eukaryotes
- Histones proteins have protruding tails that determine how tightly the DNA is packaged within nucleosomes

Modifications to these tails alters the DNA packaging:
- Acetylation makes DNA **less** tightly packed
- Methylation makes DNA **more** tightly packed

Cells package DNA differently according to genetic needs
- Active genes remain unpackaged as euchromatin
- Inactive genes are tightly packed as heterochromatin

DNA Methylation

DNA can also be directly methylated to change expression patterns of genes over time in response to external stimuli
- Increased methylation = decreased transcription

Methylation Patterns in Twins Over Time