GENTERAL GENETICS (BIOL 2510)
WINTER QUARTER 2014
Study Guide – Exam 4

Chapter 13

What is differential gene expression?
Differential gene expression is the expression of different genes by cells with the same genome, due to presence/absence of transcription factors.

List three important differences between the structure of DNA and RNA.
-Uracil for RNA instead of Thymine for DNA nucleobases
-OH group instead of H
-RNA is single stranded

RNA has complex secondary structure - this often plays an important role in function. What is secondary structure as it relates to RNA? Why does it form like this in RNA (and not DNA)?
-single-stranded RNA molecule (or a single-stranded DNA molecule) will form a secondary structure with the lowest energy content
-this means that if there are complementary portions of the single-stranded RNA, those portions will form double-stranded RNA
-some RNAs have unusual (non-Watson-Crick) base pairing
-examples: hairpin loop, bulge loops, interior loops, multi-branched loops.

Describe the function of mRNAs, rRNAs, tRNAs, snRNAs, miRNAs, and siRNAs.
mRNAs: carries the complement of a DNA sequence and transports it from the nucleus to the ribosome where protein is made, it has the inverted complementary of the original master DNA
rRNAs: type of RNA that combines with proteins to form ribosomes
tRNAs: acts as a molecular interpreter, incorporates anino acids during translation, matches amino acids with codons in MRNA using anticodons.
snRNAs: Small nuclear RNA. It combines with protein to form a spliceosome.
miRNAs: micro RNA, regulates gene expression by blocking translation or degrading mRNA
siRNAs: small interfering RNA, complimentary RNA binds to mRNA to inhibit translation

What is the template strand? Relative to the template strand, in what direction does transcription occur? Which DNA strand is used as the template? What element(s) associated with specific DNA strands will determine if it will be used as a template? Can units of transcription overlap (on opposite strands)?
Template strand is the transcribed strand of DNA. Transcription always occurs in the 5 prime to 3 prime direction. Both DNA strands can be used as a template. The RNA promoter is a DNA sequences and it decides which strand is the template strand. Yes units can overlap because both strands can be used at the same time.

GENTERAL GENETICS (BIOL 2510)
WINTER QUARTER 2014
Study Guide – Exam 4

There are three components of a transcriptional unit. What are they?
-Promoter: defines where RNA Polymerase binds to start and which direction it moves. Core sequences recognized by the RNA Polymerase holoenzyme (which is a functional RNA).
-RNA-coding region: mRNA itself
-Terminator: coding region stops

What are the two key elements associated with bacterial promoters? What enzyme complex recognized these elements?
-10 (pribnow box) and -35 regions. The enzyme that recognizes these elements is the holoenzyme.

What role does the sigma factor play in the function of the bacterial RNA polymerase?
The sigma factor is required for promoter recognition and initiation. Without sigma, RNA Polymerase will initiate transcription randomly. Sigma factor binding is required to make a functional RNA polymerase.

Compare and contrast the three major steps of transcription (prokaryotes vs. eukaryotes).
Transcription is mostly the same between prokaryotes and eukaryotes, especially during the elongation phase. However it does differ slightly in the initiation and termination phases.

Initiation: In prokaryotes, RNA polymerase itself specifically recognizes and binds to the promoter. In eukaryotes a collection of proteins called transcription factors mediate the binding of RNA polymerase and the initiation of transcription.

Compare and contrast Rho-dependent and Rho-independent termination.
Independent = inverted repeats are present on the DNA sequence near termination and are transcribed,
can complementary pair into a hairpin structure,
followed by sequence of poly-A residue,
weak A-U bonds allow dissociation of DNA-RNA pairing

Dependent = Rho protein* binds to the RNA and moves towards 3' end and RNA polymerase,
RNA polymerase pauses at termination hairpin,
Rho has helicase activity that causes DNA-RNA hybrid to unwind and transcription ends

How many RNA polymerases are present in most eukaryotes? Which transcribes mRNA?

GENTERAL GENETICS (BIOL 2510)
WINTER QUARTER 2014
Study Guide – Exam 4

There are three RNA polymerases in most Eukaryotes. They are:
RNA Polymerase I (larger rRNAs)
RNA Polymerase II* (pre-mRNAs, some snRNAs and miRNAs)
RNA Polymerase III (tRNAs, small rRNAs, some snRNAs and miRNAs)

Compare and contrast the core promoter and regulatory promoter in eukaryotes.
Core promoter: bound by general transcription factors; basal transcription apparatus. Core promoter is where the holoenzyme can bind.
Regulatory promoter: (immediately upstream)-bound by transcriptional apparatus
Regulatory promoter can be highly variable and with enhancers it leads to differential gene expression.

Do eukaryotes have proteins that act like the sigma factor? If so, what is it?
Yes, eukaryotes have proteins that act like the sigma factor. It is called the TBP (TATA binding protein), which is part of the TFIID that binds to the TATA box.

Compare and contrast bacterial and eukaryotic transcriptional termination. How does termination occur in Pol II transcripts?
-continues to synthesize beyond coding sequence
-end of pre-mRNA designated by consensus sequence
-cleavage cuts pre-mRNA into 2 pieces
-Rat1 attaches to 5' end moves toward 3' end (degrades nucleotides; reaches pol.; terminates transcription; binds to loose RNA, released when reaches DNA)

Chapter 14