These Multiple choice are choose the single best correct answers.

1. ***Which statement is false?***
A) In eukaryotes, histones are poorly conserved. *
B) There are at least five different classes of histones.
C) Histones in the Tetrahymena macronucleus have a very high level of acetylation.
D) Histones are richer in lysine and arginine residues than most other proteins.
E) The 30nm fiber form of chromatin is more compact than the beads on a string form.

2. ***A core nucleosomes is composed of*** (choose the best answer)
A) two copies each of histone H2A, H2B, H3 and H4 and 147 bp of DNA.*
B) two copies each of histone H2A, H2B, H3 and H4 and 1470 bp of DNA.
C) four copies each of histone H2A, H2B, H3 and H4 and 147 bp of DNA.
D) four copies each of histone H2A, H2B, H3 and H4 and 1470 bp of DNA.
E) choice A) except that all of the histones must be acetylated.

3. ***When histone H1 is incorporated into a nucleosome***
A) the nucleosome is about to be moved by a remodeling enzyme.
B) it means that replication of the DNA has just occured.
C) it increases the probability that condensation of the chromatin will occur.*
D) it means that the underlying DNA is probably a core promoter.

4. ***In vitro, the rate of transcription from DNA is***
A) higher when histones are present than when histones are absent.
B) lower when histones are present than when histones are absent. *
C) proceeds in the wrong direction unless histones are present

5. ***Where would you most likely find chromatin in the beads on a string conformation?***
A) Heterochromatin
B) Actively transcribed chromatin *
C) Silenced chromatin
D) Deacetylated chromatin
E) 30 nm fiber chromatin

6. ***The following two phrases refer to the same type of event.***

Modifications of a histone that cause the interaction with the DNA to change.

The movement of a nucleosome from one position to another.

What is this event called?
A) chromatin immunoprecipitation
B) chromatin modulation
C) chromatin remodeling *

7. ***A histone acetyl transferase*** modifies some chromatin. Please choose a likely next event.
A) A chromodomain-containing transcription factor binds the modified nucleosomes and then binds a DNA element in the underlying DNA.
B) A bromodomain-containing transcription factor binds the modified nucleosomes and then binds a DNA element in the underlying DNA. *
C) A bromodomain in the CTD of RNA polymerase II binds to the chromatin and then associates with the core promoter.

8. ***This figure is from the laboratory of Dimitris Thanos who studies the regulation of the human interferon gene (IFN-beta).***

The figure shows the results of his immunoprecipitation assay.

Someone suggests that the reason that the 5 hr alpha-TBP lane does not show a band is because less chromatin was extracted from these cells than was extracted at time-point 6hrs

Which row of data would he use to refute this accusation?

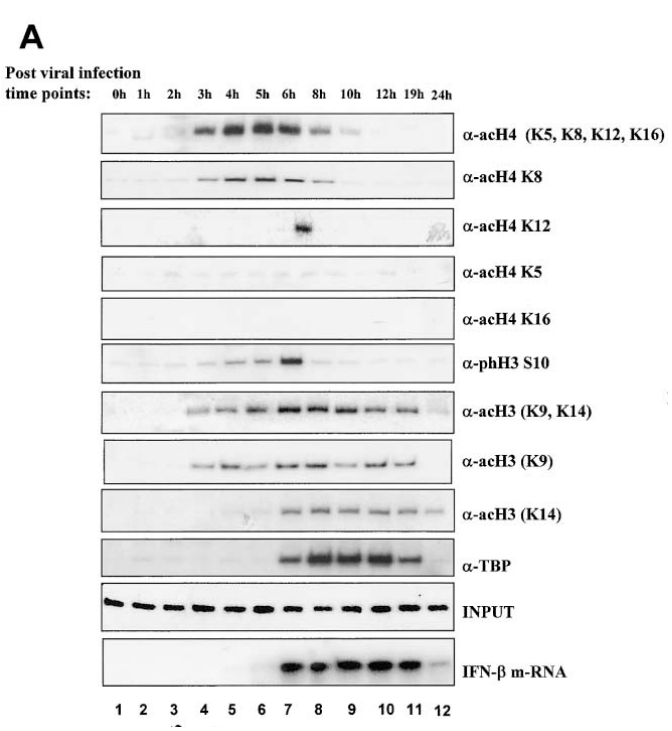
A) α-acH4 (H5, K8, K12, K16)

B) α-acH3 (K9, K14)

C) α-TBP

D) INPUT *

E) INF-β mRNA



9. ***Histone acetylation can disrupt the interaction between adjacent nucleosomes***

A) because acetylated nucleosomes are targeted for degradation
B) because it causes nucleosomes to release the DNA.
C) because it prevents histone H1 from forming a bridge between histone H1 in two adjacent nucleosomes.
D) because it prevents the N-terminal tail of histone H4 interacting with an acidic pocket in the H2A-H2B dimer in the next nucleosome. *

10. ***Enhancers can activate promoters even if they are some distance from the promoter. This is thought to be because***

1. architectural transcription factors can bend the DNA and bring the enhancer closer to the promoter.
2. the activators that bind the enhancers then slide along the DNA until they find the promoter.
3. the complex that binds the enhancer is so large that it occupies all of the space between the enhancer and the promoter.
4. insulators can be used loop out DNA between the enhancer and the promoter.
5. looping out of the DNA allow them to "reach" the promoter.

Please choose the most complete answer

A) Numbers 1 and 5 comprise the most complete and best answer.
B) Numbers 2 and 5 comprise the most complete and best answer.
C) Numbers 2 and 3 comprise the most complete and best answer.
D) Numbers 1, 4 and 5 comprise the most complete and best answer *

11. ***SWI/SNF***

A) is chromatin remodeling enzyme* B) is a protein that binds insulators

12. ***Which histone modifications are recognized by TFIID?***

A) acetylation of histone H3 at positions K9 and K14. *
B) acetylation of histone H4 at K8.

13. ***Which histone H3 modifications are associated with transcriptional activation of a promoter?***

A) K4 methylation & H9 acetylation & S28 phosphorylation *
B) K27 methylation & H4 acetylation
C) K27 methylation & H9 acetylation & S28 phosphoryaltion

14. ***By itself, methylated H3K9 inhibits transcription but in the presence of methylated H3K4 and methylated H4K20 the three modifications act together to stimulates transcription. This is evidence that***

A) that chromodomains are "repulsed" by H4K20 methylation
B) histone modifications are being read as a code in which groups of modifications have specific meaning. *
C) that modified histones are read one at a time by the transcriptional machinery.

15. ***Insulators***

A) are HDACs and block enhancer activity by deacetylating the flanking nucleosomes.
B) can block the activity of an enhancer and can block the encroachment of condensed chromatin *
C) bind enhancers and prevent their use.
D) can prevent the use of a particular splice site and can prevent the use of a particular polyA site

16. ***A histone acetyl transferases enzyme was first purified from***

A) a mammalian cancer cell line which whose rapid growth rate required high levels of gene expression and therefore high levels of HAT activity.
B) Drosophila - an insect whose salivary glands have very high levels of gene expression and are therefore rich in HAT activity.
C) Saccharomyces - a yeast that has 16 linear chromosomes.
D) Tetrahymena - a protozoa that has a macronucleus and a micronucleus.*

17. ***During the first purification of a histone acetyl transferase the position of the enzyme in a gel was detected by***

A) impregnating the gel with histones and then soaking it in radiolabeled acetyl CoA. The HAT transfers the radiolabel to the surrounding histones to produce a radiolabeled band. *
B) impregnating the gel with nuclear extract, a plasmid carrying a promoter, and radiolabeled ribonucleotides. Acetylation of the histones helped to activate the promoter and the radiolabeled RNA accumulated to produce a radiolabeled band.
C) using column containing acetylated histones. The chromodomain of the HAT bound the acetylated histones causing the HAT to stick to the column. The HAT could be eluted from the column in nearly pure form with a simple change in the concentration of salt in the buffer.

18. ***Here is a procedure that we discussed in class.***

1. isolate mRNA from a cell type
2. treat with a phosphatase to remove all 5' phosphates (broken mRNAs).
3. remove the phosphatase
4. use a de-capping enzyme to remove the 5'-CAPs from the full length mRNAs
5. this provides free 5' phosphates
6. use RNA ligase to attach a RNA molecule (the ANCHOR) of known sequence to these 5' phosphates
7. Perform PCR from the anchor to a downstream primer that specifically anneals to the gene that you are studying.

Which statement is true?

A) This is called 5'-RACE. It is used to insure that you obtain a cDNA that contains all of the exons of the gene under study.
B) This is called 5'-RACE. It is used to insure that you obtain a cDNA representing the 5'-end of the mRNA under study. *
C) This is called mRNA-specific PCR. It is used to insure that you obtain a cDNA made from mRNAs but not cDNA made from rRNA, tRNA or snRNAs.

19. ***Within a gene a mutation occurs that moves a branch point 500 bp down stream of its original position.*** The most likely consequence is that

A) mRNA splicing will employ a different acceptor site. *
B) mRNA splicing will employ a different donor site.
C) splicing will not occur.
D) transcription will terminate prematurely.

20. ***The architectural transcription factor Lef-1***

A) can by itself stimulate transcription from core promoters.
B) regulates gene expression by cutting the DNA.
C) is a transcription factor that stimulates transcription by bending the DNA and bringing other transcription factor binding sites closer to the core promoter. *
D) is a histone acetyl transferase

21. ***A mutant is made that removes the CTD domain of RNA Polymerase II.*** Which are likely reasonable consequences? CHOOSE THE ONE BEST ANSWER

A) alternative splicing of pre-mRNA is altered
B) translatability of the mRNA is altered
C) CAP-ing of the mRNA does not occur, polyadenylation does not occur
D) the rate of nuclear transport of the resulting mRNA is vastly reduced
*E) All of these are reasonable phenotypes. **

22. ***The branch point refers to an adenosine containing ribonucleotide, _____ , that during splicing has a phosphodiester bond on its 5' carbon, on its 3' carbon and on its 2' carbon.*** Choose the correct statement to fill in the blanks.

A) at end of the 5' exon
B) at the beginning of an intron
C) at the end of an intron
D) within an intron *

23. ***Chromodomains bind***

A) acetylated histones
B) methylated histones *
C) only non-acetylated and non-methylated histones
D) phosphorylated histones

24. ***During mRNA splicing, which snRNA(s) base pair with the 5' splice (donor) site?***

Choose the best answer.

A) U1, U5 and U6 *
B) U1
C) U2 and U6
D) U2, U4 and U5
E) All U snRNAs base pair with the 5' splice (donor site).

25. ***During splicing, an unusual type of base pairing occurs. What is it and what does it do?***

A) G to C base pairing that helps to draw the 3' end of exon 1 close to the 5' end of exon 2
B) G to G base pairing that helps to draw the 3' end of exon 1 close to the 5' end of exon 2 *
C) G to A base pairing that helps to draw the branch point close to the beginning of the intron
D) G to G base pairing that helps to draw the branch point close to the beginning of exon 2

26. ***During mRNA splicing the first chemical alteration made to the pre-mRNA is***

A) the addition of a hydroxy group to the 2' position of the branch point nucleotide
B) an endonuclease cleavage that breaks the 5' to 3' phosphodiester bond located between exon 1 and the intron
C) a transesterification that produces a 5' to 2' phosphodiester bond between the end of exon 1 and the branch point. *

27. ***For most eukaryotic mRNAs, the absence of a polyA tail will***

Which answer is **NOT** correct?

A) probably prevent it from leaving the nucleus.
B) shorten the half-life of the RNA.
C) reduce the efficiency of its translation.
D) reduce the efficiency of its splicing. *

28. ***Which of the following techniques is the best one to use to map the position of an active promoter(s)?***

A) Degenerate PCR
B) DNaseI hypersensitivity *
C) Gel Shift (EMSA or electrophoretic mobility shift assay
D) Massively parallel DNA sequencing

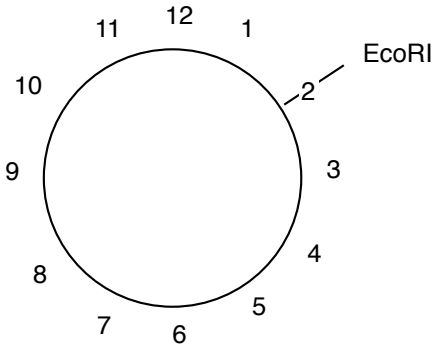
29. ***The guanine ribonucleotide of the 5'CAP***

A) is added post-transcriptionally *
B) is the first nucleotide of the gene to be transcribed
C) is generated by the deamination of adenine

30. ***The 5' CAP on a mRNA has a guanine ribonucleotide that is connected in a***

A) 5' to 5' phosphodiester bond to the first nucleotide to be transcribed.
B) 5' to 5' phosphodiester bond to the second nucleotide to be transcribed.
C) 5' to 2' phosphodiester bond to the first nucleotide to be transcribed.
D) 5' to 5' triphosphate bond to the first nucleotide to be transcribed.*
E) 5' to 2' triphosphate bond to the first nucleotide to be transcribed.

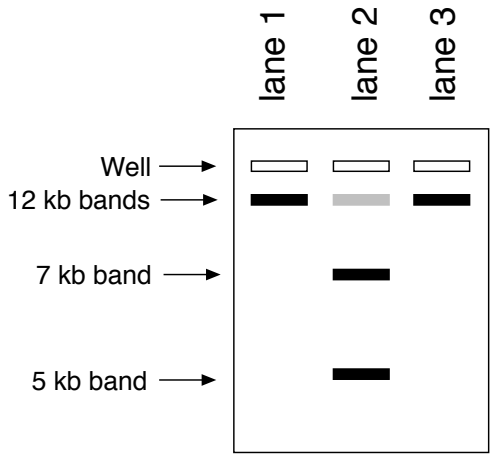
31. Here is a map of a plasmid. It is within a mammalian cell and it has been wrapped up in nucleosomes. It contains one promoter. The promoter is turned on and then the DNA with the associated nucleosomes are isolated from the cell. This chromatin is digested with DNase I. The concentration of DNaseI is low and therefore hypersensitive sites are cut first. You stop the digestion at this point, destroy the DNaseI and then remove all of protein from the DNA.



The remaining DNA is divided into two aliquots. Aliquot #1 is loaded into lane 1. Aliquot #2 is digested with EcoRI and loaded into lane 2.

One aliquot is loaded into lane 1. Aliquot #1 is digested with EcoRI. Then both aliquot #1 is loaded into lane 1 and aliquot #2 is loaded into lane #2.

After the gel has finished running it looks like this ---->



The digested DNA is then run on an agarose gel. To produce the pattern shown ---->.

Merely based on the pattern of bands you should be able to answer the following question.

Where is the most likely location of the promoter? Choose one.

A. at position 5.

B. at position 9

C. at position 7.

D. at position 7 or at position 9, one cannot be sure *

E. at position 5 or position 7, one cannot be sure

32. ***Concerning polyadenylation, which of statement is not correct?***

A) Involves something called CTD
B) occurs in the nucleus and the cytoplasm
C) occurs on transcripts made from RNA polymerase I *
D) RNA polymerase II participates in the process

33. ***WIth respect to gene transcription, what does relative expression mean?***

A) It refers to the expression level from a gene in terms of the actual number of transcripts produced by the gene.
B) It can mean the amount of expression from one gene in comparison to another gene (perhaps expressed as a ratio). *
C) It can mean the amount of expression from a gene in comparison to something like total cellular RNA.

34. ***Exon definition***

A) refers to that really cut look that genes get when they work out regularly.
B) refers to a process in which sequences in the exons are recognized and used to define the boundaries of the intron. *
C) refers to a splicing mechanism that does not involve branch points, nor snRNAs U1, U2, U5 or U6.
D) refers to rule that all exons must end with a GT and begin with an AT (GT-AT rule).

35. ***What list of features is correct for massively parallel sequencing?***

A) Formaldehyde cross-linking, binding of antibody, sonication, purification of DNA sequences.

B) Reversible chain termination, binding of antibody, capillary electrophoresis and analysis of millions of sequencing reactions simultaneously.

C) Reversible chain termination, ligation of adaptors, capillary electrophoresis, sequencing-by-synthesis.*

Poster questions ----------

36. ***In the paper entitled Systemic RNAi in C. elegans requires the putative transmembrane protein SID-1, one of the experiments showed that SID-1 likely functioned in receiving transport of an RNAi signal.*** Which of the following is true;

A) The SID-1 mutant was determined to be cell autonomous which means that the mutant phenotype can only be seen in cells that contain the mutant gene.*

B) The SID-1 mutant was determined to be cell autonomous which means that the mutant phenotype can only be seen in cells adjacent to cells that contain the mutant gene.

C) The SID-1 mutant was determined to be cell non-autonomous which means that the mutant phenotype can only be seen in cells that both contain no GFP and contain SID-1.

37. ***In the paper entitled Point mutations define a sequence flanking the AUG initiator codon that modulates translation by eukaryotic ribosomes the author alters a hypothetical translation initiation context to examine the effect on translation efficiency.*** Which of the following positions has the greatest effect on the efficiency of translation?

A) -2 and -5
B) -3 and +4*
C) -1, +2,-,4 and -5
D) -2 and +4

Codon Usage by amino acid.

F	L	S	Y	C	W	P	H	Q	R
TTT	TTA	TCT	TAT	TGT	TGG	CCT	CAT	CAA	CGT
TTC	TTG	TCC	TAC	TGC		CCC	CAC	CAG	CGC
	CTT	TCA				CCA			CGA
	CTC	TCG				CCG			CGG
	CTA	AGT							AGA
	CTG	AGC							AGG

I	M	T	N	K	V	A	D	E	G
ATT	ATG	ACT	AAT	AAA	GTT	GCT	GAT	GAA	GGT
ATC		ACC	AAC	AAG	GTC	GCC	GAC	GAG	GGC
ATA		ACA			GTA	GCA			GGA
		ACG			GTG	GCG			GGG