

BIOLOGY 205
Midterm I - 25 May 2007
(90 points total)

Name _____

Multiple choice questions – 3 points each (please circle the letter of single best answer).

1. When eucaryotic DNA is hybridized with mature (i.e., processed) mRNA, the hybrid molecules contain loops of single-stranded DNA. These regions of DNA are called:
 - A. retroviruses
 - B. exons
 - C. introns
 - D. UTRs
 - E. transposons

2. Which of the following correctly ranks the structures in order of **size**, from *smallest* to *largest*?
 - A. nucleotide → codon → gene → chromosome
 - B. gene → chromosome → codon → nucleotide
 - C. chromosome → gene → codon → nucleotide
 - D. nucleotide → chromosome → gene → codon
 - E. chromosome → codon → gene → nucleotide

3. For decades, we have known that the nucleus contained DNA and histone proteins. The prevailing early opinion was that the histone proteins were the genes and the DNA was a simple “string” that held them together. The reason for this belief was that...
 - A. proteins are made of 20 amino acids and DNA is made of four nucleotides
 - B. proteins take a greater variety of three-dimensional forms
 - C. proteins have four different levels of structure; DNA has only two
 - D. proteins can vary in their polarity and charge; DNA cannot
 - E. all of these are correct

4. Which of the following is **NOT** an example of a transcription factor, DNA binding protein motif?
 - A. Helix-turn-helix
 - B. Zinc fingers
 - C. Leucine zippers
 - D. Arginine toes
 - E. Homeodomains

5. The molecular biological method that takes advantage of dideoxynucleotide triphosphates?
 - A. PCR
 - B. RFLP
 - C. Sequencing
 - D. Cloning
 - E. Hybridization

6. When considering the control of gene expression in both Eucarya and Bacteria, which of the following is NOT generally a true feature?
- A. Bacteria have multiple genes under single control, these are called operons.
 - B. Eucarya have multiple RNA polymerases.
 - C. Bacteria use a relatively simple array of transcription factors.
 - D. Bacteria use both local and distal control mechanisms, called enhancers or silencers.
 - E. Eucarya must contend with accessibility issues regarding their chromatin.
7. The TATA box is:
- A. a sequence rich in A's and T's common to the promoter region of many genes
 - B. an operator site that aids in the regulation of transcription
 - C. an enhancer consensus sequence
 - D. an activator sequence necessary for proper translation
 - E. an enricher sequence needed for translocation
8. Each of the following statements are correct regarding Eucaryotic genes and genomes EXCEPT?
- A. Introns are common
 - B. Repeat sequences are common
 - C. Capping, tailing and splicing of mRNA is required
 - D. Polysomes inside the nucleus are common
 - E. Enhancers and silencers are common
9. The universal genetic code is best described as:
- A. degenerate but not ambiguous
 - B. ambiguous but not redundant
 - C. both ambiguous and redundant
 - D. neither ambiguous nor redundant
 - E. missense but not nonsense
10. Imagine that a novel life form is found deep within Mar's Ice Cap. Evaluation of its DNA yields a big surprise in that it only has purines (A's and G's). In addition, it is found that a codon for this life form contains four bases. How many different amino acids maximum could this organism be composed of?
- A. 4
 - B. 8
 - C. 16
 - D. 32
 - E. 64

11. **Match** the single best answer (enzyme) with the corresponding statement regarding DNA replication. The choices may be used once, more than once, or not at all (2 points each, with one free miss).

Your choices are:

1. Synthetase
2. Primase
3. Helicase

4. DNA Polymerase III
5. DNA Polymerase I
6. Ligase

- | | |
|---|---|
| _____ Joins tRNA with an amino acid | _____ Replaces RNA with DNA |
| _____ Unwinds double helix | _____ Critical that it does NOT mutate |
| _____ Forms short segments of RNA | _____ Forms Okazaki fragments |
| _____ Connects short segments of DNA | _____ Functions as a rotary motor |
| _____ Able to proofread in 3' to 5' direction | _____ Required more often on lagging-strand |

12. **Match** the single best answer with the statements below. The choices may be used once, more than once, or not at all (2 points each, with one free miss).

Your choices are:

1. Transduction
2. Transposition
3. Translation

4. Transformation
5. Translocation
6. Transcription

- _____ A DNA segment “jumps” from one location to another.
- _____ Protein synthesis
- _____ *Bacteria* often have proteins on their surface that recognize and take in “naked” DNA.
- _____ Movement as the “A-site” becomes the “P-site”.
- _____ Heat killed pneumonia-causing bacteria and harmless mutant strain are both injected into mice. The mice develop pneumonia and die.
- _____ A sequence of DNA that has inverted repeats on either end is found scattered throughout the chromosome of corn.
- _____ In Eucaryotes, requires RNA polymerase II and many general factors to begin.
- _____ Bacterial strains A and B are growing together in a medium that has been infected with viruses. After a short time, a new strain of bacteria is detected that is very similar to strain A but has a few characteristics of strain B.
- _____ & _____ These two processes are coupled together spatially in Bacteria.

Short answer – Number of points in parentheses.

- 13. (6 points)** Consider the figure on the back page regarding gene control mechanisms. Briefly, what is the main conceptual difference between mechanisms (1 & 2) vs. (4 & 5) in terms of the pros and cons of regulating at these steps from the cell's point of view?
- 14. (6 points)** What are three specific mechanisms (AND when do these occur) for introducing genetic variation from one generation to the next in sexually reproducing organisms?
- 15. (4 points)** (A) During which stage of **mitosis** do the centromeres holding the chromatid pairs together separate with characteristic chevrons or V-like structures resulting AND (B) what causes this separation to occur?

16. (8 points) (A) Briefly describe the difference among the following point mutations: **silent, missense, nonsense, and frameshift** in terms of a single base pair change. (B) How many amino acids would be affected in a potentially translated polypeptide that is 12 amino acids long (i.e., a 12-mer that includes methionine), if the point mutations you described above occurred somewhere in the 3rd codon?

17. Extra Credit (9 points max) Briefly describe the structure and function of **three** different cellular systems that combine proteins along with necessary RNAs to *catalyze* covalent bond formation and/or hydrolysis reactions (i.e., function as ribozymes)?

Figure for question 13:

