
Name: _____

Student #: _____

BIOL2107 Fundamentals of Genetics

Midterm 2

Version 2

March 16, 2014

Use the scantron form to answer the 15 multiple choice questions. Use the space provided to answer any 2 of the 3 short answer questions. You may use additional space in the workbooks to complete short answer questions but make sure you indicate this on the midterm workspace.

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Section A: Multiple Choice

1. Avery, MacLeod and McCarty confirmed that the “transforming principle” is composed of _____.
 - (a) mRNA
 - (b) tRNA
 - (c) DNA
 - (d) protein
 - (e) lipid

2. Humans have $2n=46$ chromosomes. How many linkage groups are present in an unfertilized egg?
 - (a) 0
 - (b) 2
 - (c) 23
 - (d) 46
 - (e) 48

3. The end of eukaryotic chromosomes are protected with repeat sequences called _____.
 - (a) termini
 - (b) telomeres
 - (c) telomerase
 - (d) terminase
 - (e) NHEJ

4. Ribosomes read mRNA in the _____ direction.
 - (a) 5' to 3'
 - (b) 5' to 2'
 - (c) 3' to 5'
 - (d) N-terminal to C-terminal
 - (e) C-terminal to N-terminal

5. The Hershey-Chase waring blender experiment used _____ to determine which macromolecule contained genetic information required to complete the T2 bacteriophage life cycle.
 - (a) ^3H labelled RNA and ^{32}P labelled DNA
 - (b) ^{32}P labelled DNA and ^{35}S labelled protein
 - (c) ^3H labelled RNA and ^{35}S labelled protein
 - (d) ^3H labelled DNA and ^{35}S labelled protein
 - (e) ^{32}P labelled RNA and ^{35}S labelled protein

6. Which of the following is a very common form of DNA base damage that results from the oxidation of a specific base.

- (a) DNA double strand break (DSB)
- (b) pyrimidine dimer (CPD)
- (c) depurination of guanine (AP site)
- (d) deamination of cytosine
- (e) 8-Oxo-2'-deoxyguanosine (8-oxodG)

7. Which of the following DNA repair pathways is considered error-prone?

- (a) nucleotide excision repair.
- (b) SOS system.
- (c) direct reversal
- (d) photolyase.
- (e) methyl-directed mismatch repair.

8. How many hydrogen bonds normally form between adenine and guanine in DNA?

- (a) 0
- (b) 1
- (c) 2
- (d) 3
- (e) 4

9. Nonsense-mediated decay _____.

- (a) eliminates many mRNAs containing nonsense mutations.
- (b) may result from frameshift mutations.
- (c) is a form of mRNA decay.
- (d) prevents the expression of truncated proteins.
- (e) all of the above

10. A man and a woman have 2 child. The parents are each heterozygous for a different disease-associated allele of the xeroderma pigmentosum group A gene (XPA). What is the probability that either of their children will be affected with the disease?

- (a) 0%
- (b) 25%
- (c) 50%
- (d) 75%
- (e) none of the above

Use the following DNA sequence information to answer questions 11 and 12:

Assume that the following DNA is transcribed from left to right.

5'-ATGTACTAAGCCGTAGCGTAA-3'

3'-TACATGATTCGGCATCGCATT-5'

11. What is the sequence of the template strand of DNA?

- (a) 5'-TACATGTAAGCCGTAGCGCAA-3'
- (b) 3'-ACGCGATAACGACTGTACATA-5'
- (c) 5'-ATGTACTCAGCCGTAGCGTAA-3'
- (d) 5'-TACATGATTCGGCATCGCATT -5'
- (e) 3'-TACATGATTCGGCATCGCATT-5'

12. Translate the RNA sequence to amino acid sequence using the following table:

		Second Letter				
		U	C	A	G	
1st letter	U	UUU Phe UUC UUA Leu UUG	UCU UCC Ser UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G
	C	CUU CUC Leu CUA CUG	CCU CCC Pro CCA CCG	CAU His CAC CAA Gln CAG	CGU CGC Arg CGA CGG	U C A G
	A	AUU AUC Ile AUA AUG Met	ACU ACC Thr ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G
	G	GUU GUC Val GUA GUG	GCU GCC Ala GCA GCG	GAU Asp GAC GAA Glu GAG	GGU GGC Gly GGA GGG	U C A G

Which amino acid sequence is correct?

- (a) Met-Tyr-Val-Ala-Ser-Ala-Stop
- (b) Met-Tyr-Ser-Ala-Val-Ala-Leu
- (c) Met-Tyr-Stop
- (d) Leu-Arg-Tyr-Gly-Stop
- (e) Met-Tyr-Tyr-Ala-Val-Ala-Stop

13. The DNA of a newly identified species of salamander contains 18% guanine. Approximately how much adenosine is predicted?

- (a) 25%
- (b) 50%
- (c) 18%
- (d) 32%
- (e) 28%

14. How many histone proteins are present in the core nucleosome?

- (a) 0
- (b) 1
- (c) 2
- (d) 4
- (e) 8

15. Which of the following is associated with actively transcribed regions of chromatin?

- (a) conditional heterochromatin
- (b) euchromatin
- (c) protochromatin
- (d) facultative heterochromatin
- (e) constitutive heterochromatin

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B. Short answers (Choose 2 of 3 questions, 5 marks each). Show all work.

1. A new ultraviolet (UV) sensitive syndrome (UVSS) was recently described in 6 unrelated patients (A-F). Skin cells derived from these patients are exquisitely sensitive to UV light and this characteristic was used to perform complementation analysis. Cells derived from these patients were fused together in pairs in the lab and then exposed to UV light. In these experiments, functional complementation between 2 fused cell lines resulted in a normal sensitivity to UV light (indicated by '+' in the table below) while a lack of complementation left fused cells sensitive to this DNA damaging agent (indicated by a '+/' or '-'). Use the following complementation table to answer the questions below.

	Patient A	Patient B	Patient C	Patient D	Patient E	Patient F
Patient A	-	+	+	-	+	-
Patient B		-	-	+	+	+
Patient C			-	+	+	+
Patient D				-	+	-
Patient E					-	+
Patient F						-

- (a) How many complementation groups are there? Indicate which patients fall into each complementation group. (2 marks)
- (b) If patient A is female and she has children with patient E (male), what is the probability that their children will be affected with UVSS (1 mark)?
- (c) This disorder is consistent with an underlying defect in DNA repair. What DNA repair pathway is most likely to be affected (1 mark)?
- (d) Name at least 1 human disorder that shares some of these characteristics and explain briefly (1 mark).

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2. Crossing over is an important source of new combinations of alleles.

(a) Outline the steps involved in crossing over initiated by the DMC1 protein (2 marks).

(b) Use a diagram to summarize the possible outcomes of both successful and failed crossing over (2 marks).

(c) What feature of both successful and failed crossover can lead to gene conversion and explain (1 mark)?

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3. Eukaryotic and prokaryotic gene expression differ in many respects. Identify and briefly explain any 5 differences in the processing required to convert DNA sequence to protein sequence.

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