

# FINAL EXAM REVIEW SESSION

## MBG\*2040

This mock final exam contains 2 parts: multiple choice and short answer. You are encouraged to work with your peers to find the correct answers! Don't forget to take notes of the questions that you want to take up later! Good luck!!

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### PART 1. MULTIPLE CHOICE

1. Pick the most correct statement about DNA replication in Eukaryotes:

- a) DNA Polymerase  $\delta$  and  $\epsilon$  have both 5' to 3' and 3' to 5' exonuclease activity.
- b) DNA Polymerase  $\delta$  and  $\epsilon$  have only 3' to 5' exonuclease activity.
- c) DNA Polymerase  $\delta$  replicates the leading strand.
- d) DNA Polymerase  $\epsilon$  replicates the lagging strand.

2. In what ways does chromosomal DNA replication in prokaryotes differ from in eukaryotes?

- a) In eukaryotes there multiple origins of replication per chromosome.
- b) Prokaryotes have discontinuous replication.
- c) DNA replication occurs in the nucleus in prokaryotes.
- d) In replication in eukaryotes DNA polymerase skips over the DNA wrapped around nucleosomes because it contains introns.

3. A charged tRNA which has 3'AUG5' as its anticodon, will typically carry

- a) Methionine
- b) Valine
- c) Methionine or valine
- d) Histidine
- e) Tyrosine

4. Which of the following statements are INCORRECT about tautomeric shifts?

- a) The enol form of G can base pair with the keto form of T.
- b) The imino form of A can base pair with the amino form of C.

c) The imino and enol forms of bases (purines and pyrimidines) are rare forms that change the base-pairing characteristics allowing errors to occur during DNA replication.

**d)** Tautomeric shifts result primarily in transversion mutations

e) More than one of the above are incorrect.

5. When a regulator is bound to DNA only in the presence of an effector and transcription is on this is

**a)** Positive control, repression

b) Positive control, induction

c) Negative control, repression

d) Negative control, induction

6. In a species of fly, smooth wings (**W**) are dominant to wrinkled wings (**w**) and red bodies (**R**) are dominant to yellow bodies (**r**).

A **WwRr** and **wwrr** fly mate and produce the following offspring:

Phenotype	Number of Offspring
Smooth, red	778
Smooth, yellow	162
Wrinkled, red	158
Wrinkled, yellow	785

**What is the percent recombination frequency for this cross?**

a) 12%

b) 25%

**c)** 17%

d) 45%

7. Which of the following is not true about human DNA?

a) Diploid set of chromosomes

b) Usually larger than bacterial DNA

c) Packed using nucleosomes

**d)** Organized into negative supercoils

8. Which of the below statements is not true?

**a)** Allopolyploids are a result of crosses between 2 or more species that are usually related

b) Autopolyploids contain identical chromosome sets that are derived from the same species

c) An aneuploidy organism lacks a chromosome or has an extra chromosome

d) Meiotic nondisjunction can cause polyploidy in organisms

e) Down Syndrome is an example of an aneuploidy

9. Use the following information for questions 15-18. Tay Sachs is an autosomal recessive mutation with a frequency of 0.017 in this population. Therefore,  $t_s = 0.017$  and  $T_S = 0.983$ . What are the chances somebody is a carrier ( $T_S t_s$ ) in this population?

- a) 0.017
- b) 0.983
- c) 0.0167
- d) 0.033
- e) 0.066

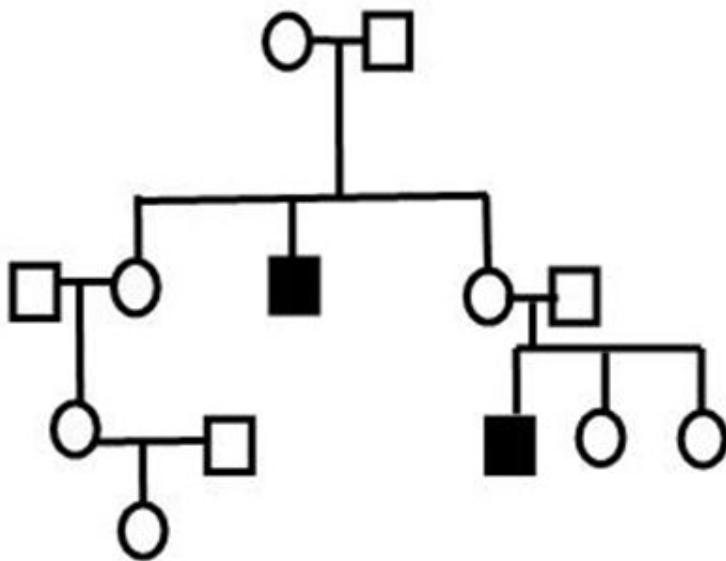
10. What proportion of individuals are expected to have the Tay Sachs disease?

- a) 0.000289
- b) 0.033
- c) 0.017
- d) 0.983
- e) 0.9663

**PART 2. SHORT ANSWER**

**PEDIGREE**

Below is a pedigree showing a rare disease, Skittle Midas disease.



1. What sort of pattern of inheritance is this?

Recessive autosomal

2. What is the probability that IV-1 is a carrier?

1/6

3. If individual III-1 has a child with an affected male, what is the probability that their first child will be affected?

1/6

## DNA REPLICATION

### 1. Which scientists discovered the DNA structure?

J. Watson, F. Crick, M. Wilkins and R. Franklin

### 2. A linear, double-stranded DNA is 12,000 bp long (12kb)

Answer the following questions for this DNA:

a. How many complete turns of the double helix?

1200 turns

b. What is the length of this molecule in  $\mu\text{M}$ ?

1200 turns  $\times$  3.4nm/turn = 4080 nm

c. How many phosphorus atoms are there, assuming one phosphorus atom per nucleotide?

24,000

d. If there are 40% A in this DNA, how much G are there?

10%

### 3. What are some major differences between prokaryotic and eukaryotic replication?

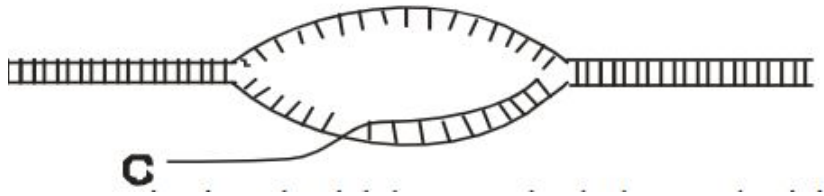
1. Telomerase activity in eukaryotes
2. 15+ DNA polymerases in eukaryotes, prokaryotes have 5 (mainly I and III for replication)
3. linear chromosome replication versus theta replication
4. eukaryotes have many origins of replication
5. eukaryotes have shorter RNA primers and Okazaki fragments
6. oriC in prokaryotes
7. eukaryotes "have origin of licensing" where nucleosomes are disassembled before S phase
8. prokaryotes replicate anytime, no nucleus

### 4. Match scientists with their work

- |   |   |  |
|---|---|--|
| 1. James Watson & Francis Crick                     | d | a. proved that semi-conservative model was the correct copying mechanism for DNA |
| 2. Meselson & Stahl                                 | a | b. Crick's wobble hypothesis   |
| 3. Marshall Nirenberg, Gobind Khorana, Philip Leder | c | c. decipher the genetic code   |
| 4. Francis Crick                                    | b | d. proposed the double helical DNA model   |

## TRANSCRIPTION

1. This is a transcription bubble. Label the polarities of strands and identify template & non-template strand



2. A double stranded DNA has the following sequence on one strand: 5' ATCGATCTGA 3'  
What would be the mRNA transcribed from this double-stranded DNA?

5'-AUCGAUCUGA-3'

3. The following DNA sequence resides in the promoter region of a prokaryotic gene

```
GGTTGACATGCGCAAGTTAGCAAGTATAATCCTTCACTTT  
CCAACTGTACGCGTTC AATCGTTCATATTAGGAAGTGAAA
```

Identify the following:

- Location of the -35 and -10 sequences
- Strand polarities
- Identify +1 position

4. How many of the following statements are CORRECT? If wrong, reword to make it correct.

- The poly(A) tail of mRNA is added post-transcriptionally by the enzymatic addition of adenine nucleotides to the 3' end by poly(A) polymerase.

TRUE

- In processing of a eukaryotic mRNA, joining of exons results from formation of a phosphodiester bond between the terminal nucleotide at the 3' end of the first exon and the terminal 5' end of the next exon.

TRUE

- Capping of eukaryotic mRNAs involves the addition of a guanine nucleotide, usually 7-methyl guanine.

TRUE (TO 5' END)

- Most eukaryotic mRNAs are synthesized as a precursor RNA that is modified by removal of introns and joining of exons to form a mature mRNA.

TRUE

## TRANSCRIPTION (CONTINUED)

### 1. How is the apolipoprotein-B mRNA edited?

Edited by cytidine deaminase which converts C to U, converts glutamine to a stop codon (prematurely truncated).

### 2. Summarize the key points and functions for each of the below types of RNA.

**tRNA:** transfer RNA, 3'OH of tRNA to 2'COO- of amino acid

**rRNA:** ribosome structural units made by RNA poly I (in eukaryotes)

**snRNA and snoRNA:** small nuclear RNA and small nucleolar RNA, spliceosomes, snoRNA edits tRNA

**miRNA:** inhibit translation of mRNA

**Long noncoding RNA:** regulates gene transcription

## GENETIC CODE (TRANSLATION)

### 1. What feature of the genetic code explains degeneracy?

Degeneracy refers to the fact that there are 61 amino acid codons but only about 30 tRNA.

### 2. Briefly explain the Crick's Wobble hypothesis.

The third position of the mRNA codon can wobble with the first position of the anticodon.

### 3. What are the main differences between prokaryote & eukaryote translation initiation?

Prokaryote	Eukaryote
<ul style="list-style-type: none"><li>• Shine dalgarno (5'-AGGAGG-3') positions ribosome</li><li>• 30S + 50S=70S</li><li>• fMet</li></ul>	<ul style="list-style-type: none"><li>• 7 MG polyA tail position ribosome</li><li>• Kozak sequence (GCC A/G CC)</li><li>• 40S + 60S=80S</li><li>• normal Met</li></ul>

### 4. Fill in the blank to complete termination step in protein translation:

Termination occurs when stop codon enters the A site of the ribosome

The stop codons are **UAA, UAG, UGA**

Release factor 1 recognizes **UAA & UAG** stop codons while release factor 2 recognizes **UGA & UAA** stop codons

RF1 & RF2 binding alters activity of **peptidyl transferase** causing water molecule being added to the carboxyl terminus of the nascent polypeptide releasing the polypeptide and leading to termination

## TRANSPOSABLE ELEMENT

### 1. What is the purpose of the Activator factor (Ac) and the Dissociation factor (Ds)?

Ac encodes transposase, allowing Ds to move! If Ac is near Ds, Ds can be excised from the chromosome.

### 2. What are the similarities & differences between retrovirus and retrotransposons?

Similarities: both use reverse transcriptase

Differences:

- retroposons do not have terminal inverted repeats, instead have 5' and 3' untranslated region and polyA tail, encode endonuclease
- retro-virus like elements have terminal inverted repeats and short direct repeating sequences, encode integrase

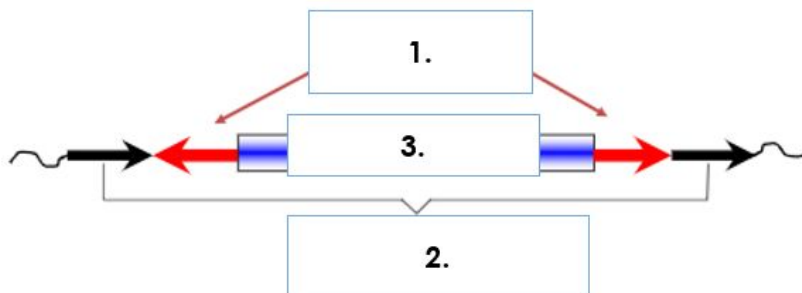
### 3. What are the 2 major components of human transposable elements?

LINES and SINES. Only SINE that can move is Alu, the others require reverse transcriptase from LINES.

### 4. Where can you find the following transposons? (Eukaryote or Prokaryote)

- Cut and paste transposon (both)
- Replicative transposon (prokaryotes)
- Retrotransposon (eukaryotes)

### 5. General structure of Cut and Paste transposon? Fill in the blank



1. Inverted terminal repeats
2. direct repeats
3. transposase

### 6. What is the first step of the mechanism of movement of Tn3 replicative transposon from a donor plasmid to a recipient plasmid?

Cointegration is the first step. Donor plasmid and recipient are integrated and the Tn3 is replicated. Revolvase cleaves the large plasmid into 2 new plasmids.

## MUTATION

### 1. Which of the following DNA repair mechanisms match with each of the following statements?

1. Light-dependent repair a
2. Base excision repair d
3. Nucleotide excision repair b
4. Mismatch repair c
5. Recombination f
6. Translesion DNA polymerase e



**CONGRATULATIONS! YOU HAVE REACHED THE END OF THE MOCK EXAM!  
WE HOPE YOU LEARN SOMETHING TODAY AND GOOD LUCK IN YOUR EXAM TOMORROW!**

Merry Christmas

