

Student name _____ ID # _____

Second Mid Term Exam, Biology 2020, Spring 2002

Scores

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

21. _____

Total _____

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1. Matching (7 pts). Each answer is used exactly once

- | | |
|--|---|
| ___F___ Helicase | A. Prevent DNA strands from reannealing |
| ___B___ Topoisomerase | B. Relieves supercoils in DNA |
| ___C___ DNA polymerase | C. Uses an RNA primer |
| ___G___ Ligase | D. Oligonucleotide containing ribonucleotides and deoxiribnucleotides |
| ___E___ Primase | E. Makes RNA from DNA template |
| ___A___ Single strand binding proteins | F. Unwinds DNA duplex |
| ___D___ Okazaki fragment | G. Seals nicks in single stranded DNA |

2. (2pts) State 1 difference between DNA replication on the leading and lagging strands. (1 sentence)

Okazaki fragments on lagging strand
Ligase joins fragments on lagging strand
etc

3. RNA processing . A few words for each answer

A. (2 pts) Where are the sequences needed for correct RNA splicing?
At intron/exon borders and A in exon

B. (1 pt) Name the structure of the 5' cap of a mRNA? (don't say 5' cap)

7-me-G linked 5'to5'

C. (1 pt) State one function of the cap.

Prevents exonuclease from degrading mRNA
Allows binding to ribosome

D. (1 pt) Addition of a poly A tail is intimately linked to what other process during transcription?

termination

E. (1 pt) State one function of the poly A tail.
Prevents mRNA degradation by 3' to 5' exonuclease

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Prevents exonuclease from degrading mRNA

4. (5 pts) What might happen to energy production in a cell that had a mutation in the gene coding for pyruvate dehydrogenase? (Pyruvate dehydrogenase converts pyruvate to acetyl CoA plus CO₂.) Assume that glucose is the only energy source and that no functional enzyme is made in the mutant cell. Explain your answer being as specific as possible. Four or five sentences.

No citric acid cycle because no Acetyl CoA

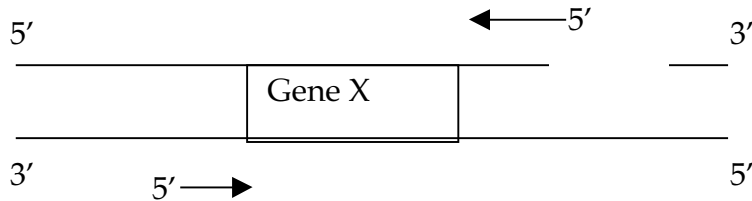
But respiration would proceed using NADH from glycolysis

Glycolysis would continue making a little ATP and NADH

Overall very low E production compared to normal cell

Mutation would be selected against and eliminated from population

5. Given the following representation of a 4000 base pair piece of double stranded DNA:



Your job is to design a primer pair to amplify the 1000 base pair Gene X using the polymerase chain reaction (PCR).

- A. (4 pts) Draw the primer pair on the diagram at the appropriate locations, indicating the approximate size of the primers relative to gene X
15 or 20 nucleotides
- B. (2 pts) Indicate the polarity of the primers

6. (5 pts) The strands of a DNA double helix can be separated by heating. If you raised the temperature of a solution containing the following 3 DNA molecules, in what order do you suppose they would “melt” (complementary strands separate)? Write ‘first to

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melt', 'second to melt' or 'third to melt' to the right side of each of the three sequences.
Explain your answer in a sentence or two.

- a) 5' GCGGGCCAGCCCCGAGTGGGTAGCCCAGG 3' LAST (lots of G/C)
3' CGCCCGGTCGGGCTCACCCATCGGGTCC 5'
- b) 5' ATTATGGGATATCTAGATACTATATTTAC 3' SECOND (mixed A/T
and G/C)
3' TAATACCCTATAGATCTATGATATAAATG 5'
- c) 5' ATAATTAAATAT 3' FIRST, short and all A/T
3' TATTAATTTATA 5'

7. Fermentation

- A. (1 pt) When you exercise strenuously your muscles convert pyruvate to what molecule? (1 or 2 words)

lactate

- B. (1 pt) Under what conditions do muscles produce this molecule? (1 word)

anaerobic

- C. (2 pts) What is the purpose of producing this molecule? (1 sentence)

Regenerate NAD⁺ to keep glycolysis running

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8. Nucleic acids

A. (6 pts) Below is a DNA double helix, a mRNA transcribed from the DNA, and the appropriate anticodon sequence. Fill in the following table:

C	G	T	A	C	A	DNA Double helix
5'						
G	C	A	T	G	T	
3'						
G	C	A	U	G	U	mRNA transcribed
3'						
	G	U	A			Appropriate tRNA anticodon
	5'					

B. (2 pts) Indicate polarity of all 4 strands by writing 5' or 3' to the left of each sequence.

9. (2 pts) Taq and Pfu are two kinds of DNA polymerases used in a PCR reaction. Taq has an error rate that is significantly greater than Pfu. What activity of Pfu do you think makes it less prone to error? 1 word answer.

proofreading

10. (6 pts) True/False

 F Loss of the 3'-5' exonuclease activity of DNA polymerase will slow the rate of DNA synthesis but not its fidelity (accuracy).

 F dATP inhibits the phosphofructokinase whereas ADP stimulates it.

 F All the nucleotides in a mRNA sequence are translated into protein.

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 T Transcription termination in prokaryotes involves formation of a loop of RNA with the bases hydrogen bonded to one another.

 F An individual ribosome can make only one type of protein

 T All tRNAs fold into particular 3D- structures that is important for their function

11. Tryptophan operon.

A. (2 pts) Is the tryptophan operon inducible or repressible?
Repressible

Based on your answer to A, what effect will the following mutations have on tryptophan biosynthesis (i.e whether tryptophan will be synthesized or not). Assume that all the mutations inactivate function completely. Give one sentence reasons for each answer.

B. (1 pt) Mutation in the promoter region. No transcription, off

C. (1 pt) Mutation in the operator region. Can't bind repressor, always on

D. (1 pt) Mutation in the gene coding for the repressor protein. Always on, can't bind operator

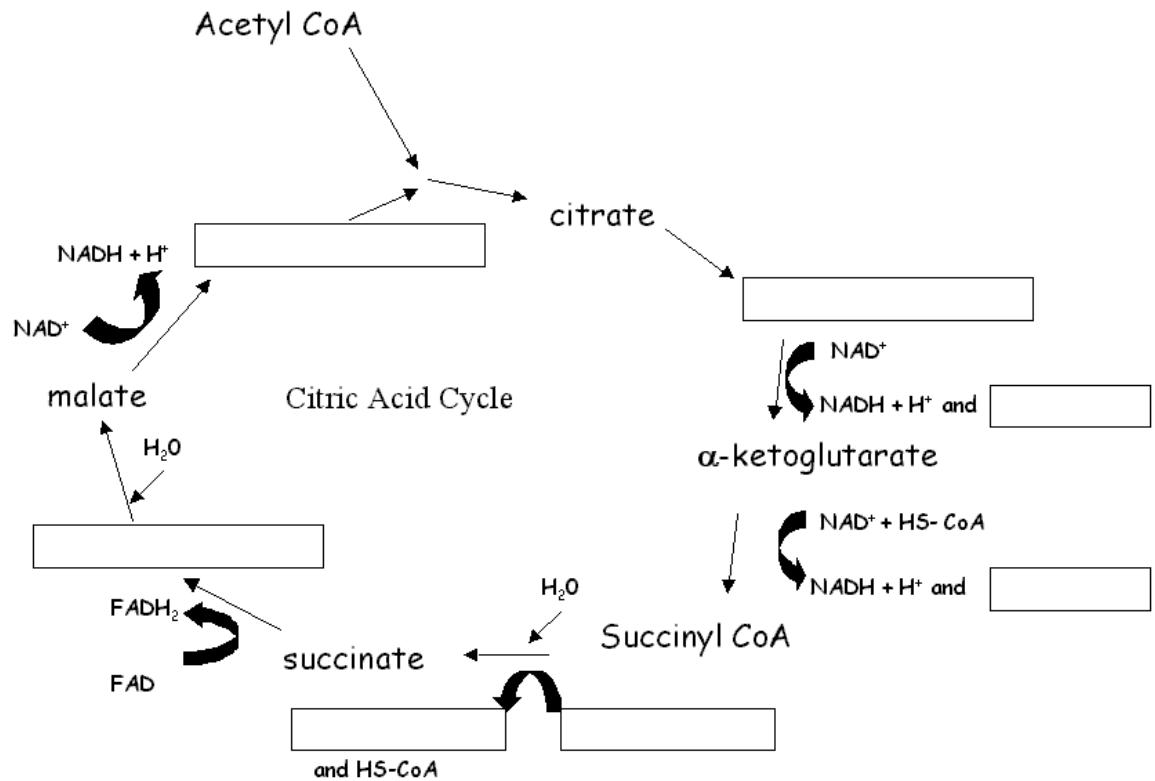
E. (1 pt) Mutation in RNA polymerase. No transcription, off

Not done this year!

12. (4 pts) During β oxidation _____ are catabolized in a cyclic pathway. Each turn of the cycle produces _____ which feeds directly into the _____ cycle, and the chain length of the starting molecule is decreased by _____ carbons.

13. Citric acid cycle (7 pts). Fill in all boxes with the name of the molecule.

SEE PANEL 13-2



14. (3 pts) Why are the ends of the chromosome difficult to replicate? Hint, think about the mechanism of replication. Three or four sentences.
 NOT COVERED THIS YEAR, BUT DUE TO NEED FOR PRIMER, CAN'T EASILY REPLICATE VERY END SEQUENCES

15. (6 pts) tRNA translates the sequences of ribonucleotides in mRNA into the sequence of amino acids in proteins. tRNA binds both the large and small subunit of the ribosome. The two most important regions of the tRNA are the acceptor stem at the 3' end of the molecule, and the anticodon loop.

16. (4 pts) You are working on a project that requires you to clone a gene coding for protein so you can isolate the protein for study. You try to purify the protein from the bacteria containing the plasmid, but you find that the protein expressed by the bacteria is extremely short (only a few amino acids). You then sequence the gene that was cloned into the bacteria and find that an extra base was added at the +12 position at the 5' end of the gene. Explain why the short protein is produced. (Three or four sentences)

frameshift mutation leading to creation of a stop codon

17. (6 pts) Match the terms, each blank has only one correct answer

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- A. Prokaryotes
- B. Eukaryotes (ignore mitochondria and chloroplasts)
- C. Both Prokaryotes and Eukaryotes

___C___ contains leading and lagging strand during DNA replication

___A___ -35 and -10 sequences in the promoter are involved in binding RNA polymerase

___B___ chromosome is linear, double stranded DNA

___B___ contains enhancer sequences

___C___ UGA is a stop codon

___A___ transcription and translation occur in the same compartment

___B___ alternative splicing

___A___ during initiation, mRNA binds to the small ribosomal subunit prior to tRNA binding

___B___ initiator tRNA binds to the small ribosomal subunit prior to mRNA binding

___B___ contains snRNP

___A___ sigma subunit

___B___ TFIID

18. (4 pts) Fill in each blank with a number (1, 2, 3 etc)

The energy stored in NADH molecules produced during the citric acid cycle is used to make ATP. NADH donates 2 electron(s) to the electron transport chain, and as the electron(s) move down the chain 10 H⁺ are moved outward across the inner mitochondrial membrane. If we assume that 4 H⁺ must flow across membranes to make one ATP molecule, it is possible to make 32 ATP(s) from one NADH molecule.

19. (3 pts) State three differences between DNA and RNA. One sentence each.
RNA is single stranded, has base U and 2' OH

20. (4 pts) Plasmids used in cloning have specific DNA sequences designed into them to facilitate cloning. Give the names and function of two such sequences in a typical cloning plasmid. One sentence each.

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Restriction sites for cutting plamid open
Gene coding for antibiotic resistance

21. (2 pts) What would happen to transcription if you inject 3' deoxyadenosine into the nucleus of a eukaryotic cell? Explain your answer in 1 sentence.

Stop, can't extend chain because have to bond through the 3'OH