

Name _____

Student ID _____

Midterm 2, Biology 2020, Kropf 2004

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Student ID _____

1. RNA vs DNA (5 pts)

The table below compares DNA and RNA. Fill in the open boxes, being complete and specific

Compare:	DNA	RNA
Pyrimidines	<i>C,T</i>	<i>C,U</i>
Purines	<i>A,G</i>	<i>A,G</i>
3-D structure	<i>Double Helix</i>	<i>Single Stranded</i>
Name the bond between complimentary bases	<i>H-Bond</i>	<i>H-Bond</i>
Monosaccharide	<i>Deoxyribose</i>	<i>Ribose</i>

2. Keeping track of energy during glycolysis and respiration (7.5 pts)

Fill in the blanks with the **NET** number of molecules of each energy intermediate (or CO₂) produced **PER GLUCOSE** during the following steps of glycolysis and respiration

	ATP	NADH	FADH ₂	GTP	CO ₂
Glycolysis	<u> 2 </u>	<u> 2 </u>	<u> 0 </u>	<u> 0 </u>	<u> 0 </u>
Pyruvate Dehydrogenase Link	<u> 0 </u>	<u> 2 </u>	<u> 0 </u>	<u> 0 </u>	<u> 2 </u>
Citric Acid Cycle	<u> 0 </u>	<u> 6 </u>	<u> 2 </u>	<u> 2 </u>	<u> 4 </u>

3. Global CO₂ cycle (4 pts)

A. What is the net effect of photosynthesis and respiration on the global CO₂ cycle?

No net effect or slight decrease

B. Explain the greenhouse effect in terms of chemical bonds and energy absorption.

C=O bonds of COO absorbs IR radiation thus heating the atmosphere

Name _____

Student ID _____

4. Matching (5.5 pts)

Some letter may be used more than once or not at all, some blanks may have more than one letter.

___c___ Helicase

___f___ pol III

___h___ DNA ligase

___i___ pol I

___d___ single stranded binding proteins

___l_f_i___ prokaryotic RNA polymerase

___j_e___ DNA polymerase

___g___ sliding clamp

___a___ heterochromatin

___k___ termination

A. X chromosome inactivation

B. Synthesizes nucleic acid 3' to 5'

C. opens DNA helix

D. Prevents DNA strands from reannealing

E. Conducts proofreading

F. Synthesizes tRNA

G. Holds polymerase on double helix

H. Seals nick in DNA strand during repair

I. Synthesizes rRNA

J. Requires a primer

K. Hairpin loop

L. Sigma subunit

5. Translation (1.5 pts)

Following initiation, translation is nearly identical in prokaryotes and eukaryotes with the tRNA

with bound polypeptide residing in the ___p___ site , an uncharged tRNA in the ___e___ site and

a charged tRNA in the ___a___ site.

6. Partytime (5 pts)

You go to a sorority party and meet someone who can hold their breath and get drunk. She seems to have acquired a metabolic pathway not normally found in humans. **What pathway is it and what organism normally uses this pathway? What is the purpose of this pathway in that organism?** Be specific.

anaerobic fermentation

yeast

regain NAD⁺ to keep glycolysis going

Name _____

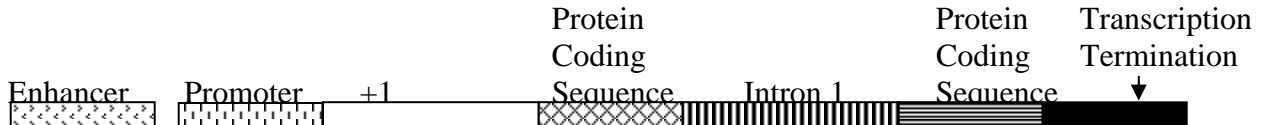
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	C	A	A			Appropriate tRNA anticodon
	5					

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

9. Eukaryotic Gene Organization (6 pts)

The following rectangles with pattern represent parts of a eukaryotic gene. **Use only the boxes and patterns in your drawings.**



A. Draw the initial mRNA transcript before processing.

see biology bldg for answer

B. Draw the fully processed mRNA in the cytoplasm

see biology bldg for answer

C. Draw the protein product

see biology bldg for answer

10. RNA (4 pts)

1. Compare the RNA produced during DNA replication to the RNA produced during transcription. Your answer should include the name of the enzyme used and its potential longevity.

DNA replication

RNA primer
DNA primase
short lived

Transcription

mRNA, rRNA, tRNA
RNA polymerase
longer-lived

Name _____

Student ID _____

11. Brown Fat (6 pts)

1. Most newborns mammals, including human infants, have a special type of fat tissue called brown fat, in which a naturally occurring uncoupling protein called thermogenin is present in the inner mitochondrial membrane. This protein uncouples ATP synthesis from the electron transport chain by creating an H^+ channel in the membrane.

a) What happens to the energy stored in the electrochemical gradient?

lost as heat

b) What happens to the amount of glucose consumed in these cells containing thermogenin?

increased consumption

c) Some adult mammals also have brown fat. Would you expect to find more brown fat tissue and more thermogenin in a hibernating bear or in a physically active bear? Explain your reasoning.

hibernating bear

12. Energetics of translation (5 pts)

A. How many high-energy bond equivalents are consumed during charging and elongation to add one amino acid to a growing peptide chain?

4 high energy bonds

B. At which steps are the high-energy bonds consumed? Be specific and briefly explain the step.

-attaching aa to tRNA (2Pi)

-placing tRNA into A site of ribosome (1Pi)

-ribosomal movement (1Pi)

Name _____

Student ID _____

13. Protein synthesis (6 pts)

A strain of yeast produces proteins with a high degree of inaccuracy. Individual molecules of a particular protein isolated from this yeast have the following variations in the first 11 amino acids, as compared with the sequence of the same protein isolated from normal yeast cells:

Data:

<i>Normal sequence</i>	Met	Thr	Ala	Ile	Val	Ser	Asn	Thr	Gln	Ile	Lys
<i>Mutant yeast strain</i>	Met	Ala	Ala	Ile	Val	Ser	Asn	Thr	Gln	Ile	Lys
	Met	Thr	Ala	Ile	Val	Ser	Asn	His	Gln	Ile	Lys
	Met	Thr	Ala	Ile	Val	Ser	Asn	Thr	Gln	Ile	Lys
	Met	Ile	Ala	Ile	Val	Ser	Asn	Ile	Gln	Ile	Lys
	Met	Met	Ala	Ile	Val	Ser	Asn	Thr	Gln	Ile	Lys
	Met	Thr	Ala	Ile	Val	Ser	Asn	Ser	Gln	Ile	Lys

What is the likely cause of this variation in protein sequence? Select from among the following 5 choices; **circle the correct answer and explain your reasoning.**

- A mutation in the DNA coding for the protein
- A mutation in the threonine-tRNA synthetase that decreases its ability to distinguish between different tRNA molecules.
- C**. A mutation in the threonine-tRNA synthetase that decreases its ability to distinguish between threonine and other amino acids

Thr-tRNA synthetase is binding to the right codon, but aa for the Thr-tRNA is randomly different. Therefore it is the “C” mutation in the Thr-tRNA syn. that isn’t correctly distinguishing aa.

Name _____

Student ID _____

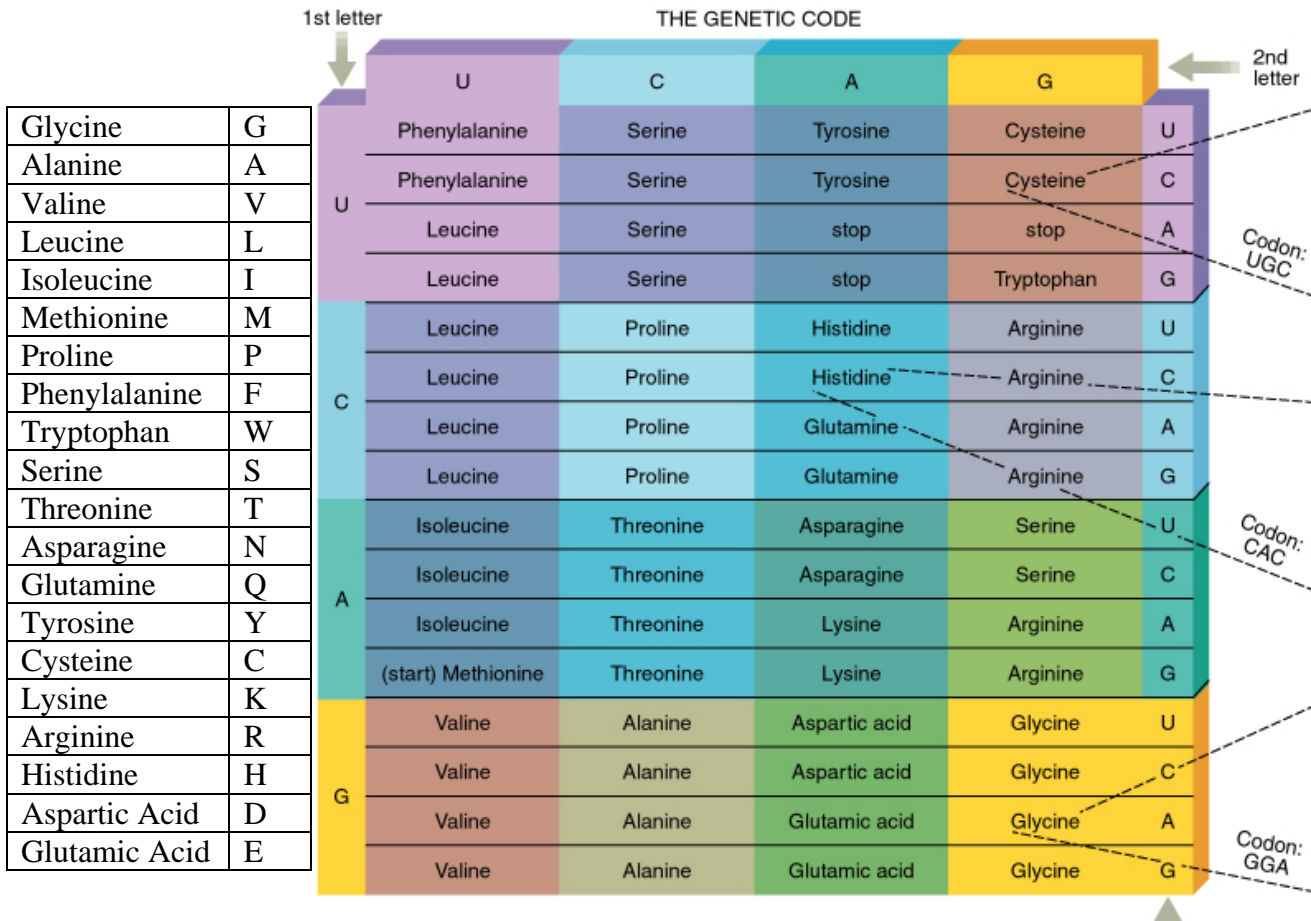
14. DNA packaging (4 pts)

Histone deacetylase remodels euchromatin by changing the structure of the nucleosome allowing expression of specific genes in humans. Expression of these genes is also essential in E.coli (bacterium). Do you think expression of these genes in E.coli is dependent on histone deacetylase? Why or why not?

No, there are no histones in proks. Therefore proks are not dependent on histone of eacetylase.

Name _____

Student ID _____



15. Genetic Code (8 pts)

Analyze the following mRNA sequence to answer A and B below.

...GGCCAGGCAUAGAGCAUAGCCAAAUUGAAGUGAUG...

A. How many possible protein products are there?

3

B. Which of the possible protein products is most likely to be found **in the middle** of a polypeptide? **Why?** Use the genetic code (above, right) to translate the mRNA into protein found in the middle of a polypeptide. Use the **one-letter** amino acid abbreviations (above left.)

ARHRALAKFEVM

C. Using the genetic code, what amino acid does the anticodon 5'CAU3' code for?

MET

Name _____

Student ID _____

16. TCA cycle (5.5 pts)

Draw the citric acid cycle showing the **intermediates, acetyl CoA** and **all CO₂**. (You need not show energy consumed or released.)

See biology bldg.

17. Polypeptide coding (5 pts)

Both prokaryotes and eukaryotes can make different polypeptides from one mRNA, but the mechanisms by which this is done are quite different. Compare and contrast the eukaryotic and prokaryotic mechanisms.

Proks: polycistronic mRNA

Euks: Alternative splicing

18. Trp Operon (5 pts)

Name _____

Student ID _____

You have isolated a mutation that affects the trp operon and you know the mutation is within the operon itself. You have collected the following data:

TRP OPERON GENE “E” EXPRESSION LEVEL

	Wild Type	Mutant A
+ Tryptophan	5	2
- Tryptophan	1000	2

A. In what region of the operon do you think the mutation resides? Explain your reasoning.

Promoter RNA polymerase has reduced binding.

TRP repressor binding site (operator) Repressor binds operator more strongly in mutant.

19. RNA Splicing: fill in the blanks (4 pts)

Splicing of mRNA in _____ euks _____ (proks or euks) involves binding of the snRNP named U1 to the ___5’___ end of the intron and snRNP named ___U2 to the nucleotide ___A___ in the intron. The mRNA then forms a loop and a transesterification reaction cuts the mRNA at the ___3’___ end of the intron. Following a second transesterification reaction the intron is removed in the form of a ___Lariat. The exons are joined and the two nucleotides on either side of the junction site are ___AG___ and ___G___.

Name _____

Student ID _____

SCORES

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

15. _____

17. _____

18. _____

19. _____

TOTAL _____