Biology 113 Closed Book Take-Home Exam #1 – Information

There is no time limit on this test, though I have tried to design one that you should be able to complete within 3 hours. There are 6 pages in this test, including this cover sheet and the data gallery. You are <u>not allowed to look at someone else's test, use your notes, old tests, the internet, any books, nor are you allowed to discuss the test with anyone</u> until all exams are turned in no later than **9:30 am on Monday Sept. 17**. If you turn in your exam late, you will lose a letter grade for each day you are late. The **answers to the questions must be typed in this Word file** unless you are asked to draw on a separate page, or you want to use scratch paper. If you do not write your answers in the appropriate location, I may not find them. Tell me where to look if you put your answer at the back of your test. Submit a hard copy to be graded.

I have provided you with a "Data Gallery" in the form of figures and tables. To choose a figure in support of your answer, simply state Figure #x. Do not assume how many of the data images you will use, or not use. **Simply choosing the data is not sufficient support for your answer. You must explain the significance of the data and how they support your answer.** *I have given you word limits so be concise.*

-3 pts if you do not follow this direction.
Please do not write or type your name on any page other than this cover page.
Staple all your pages (INCLUDING THE TEST PAGES) together when finished with the exam.

Name (please type):

Read the pledge and sign if you can do so with honor:

_____

On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete?

Lab blended with lecture Questions:
4 pts.
1) While you were sleeping, the oligo fairy snuck into the lab and change the concentrations of your oligos and the annealing buffer. The new concentrations are 40X annealing buffer and 150 µM oligos. You want the final volume to be 20 µL and the final concentrations to be 1X buffer and 5 µM oligos. Fill in the table below to produce the protocol you would need to follow prior to boiling your oligos.

reagent	Volume (give units)

4 pts.
2) Take the sequence below and submit it to the Oligator web site to produce the DNA you would need to use GGA for cloning the DNA control element into the plasmid shown to the right:
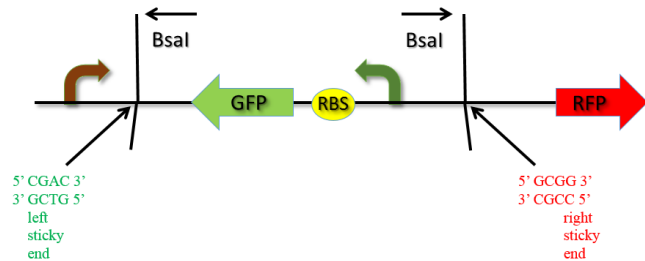
ATGGCCTTGCTTACAAAACCGAGGTCTCACTGGACATCACCTCCCACAACGAAG

Past your DNA below this line and label the 5' end_____

2 pts.
3) Did you find any surprises in the DNA for question #2? Support your answer with data. Limit your answer to a maximum of 25 words.

Textbook Questions:
11 pts.
4) DNA is the heritable material, or is it???
a) Look at figure 24 in the data gallery. How did Griffith know that the mice in the fourth column of data died due to the S-factor rather than directly from S cells that were injected into the mice? Support your answer with data. Limit your answer to a maximum of 35 words.

b) Look at the data in figures 7 and 21 in the data gallery. Which one supports the role of epigenetics by correlation and which one by causation? Support your answer using the data in these two figures. Limit your answer to a maximum of 40 words.

c) In the space provided here, draw the only nucleotide triphosphate that is unique to RNA. You may use a single letter to represent the base. Write very neatly and label all the atoms and number the carbons correctly.

12 pts.
5) Building proteins from genetic information.
a) Compile experimental results from two figures in the data gallery to make the argument that mRNA are the molecules that determine which proteins will be made. Limit your answer to a maximum of 35 words.

b) Translate this synthetic ORF into protein. Use the single letter code for amino acids and type them below the sequence shown here.

UUUAACCCGGG**AUG**GCUUUAUGUCAGCUGAUG**UAA**GGCAGGGCG 3'

Answer here →

18 pts.
6) Cells are control freaks!
a) What is the function of $lacO^+$? Support your answer with data. Limit your answer to a maximum of 25 words.

b) How are some cells able to respond to steroids whereas others are not? Support your answer with data. Limit your answer to a maximum of 35 words.

c) How do proteins know where to bind within a promoter? Support your answer with data. Limit your answer to a maximum of 30 words.

12 pts.
7) Biological information is not always as simple as we first think it will be.
a) Use only BLAST2 to align these two sequences: NM_001101.4 and AY582799.1

Which sequence is the mRNA and which one is the gene? How do you know? Limit your answer to a maximum of 20 words.

b) How many introns and how many exons are in this gene? Support your answer with a screenshot of your data. Limit your answer to a maximum of 25 words.

12 pts.
8) Dogs produce puppies, cats produce kittens…. There is a rare and recessive trait that instead of having hairs in their nostrils, some people have small feathers. This gene is located on chromosome 13. Answer the following questions. Show your work for a chance at partial credit.
a) What is the probability of a couple having a daughter who is a carrier or a son with the feathery nostrils if the mother has feathery nostrils and the father's father had feathery nostrils but the father does not?

b) As it turns out, another very rare trait exists, but it is caused by a dominant allele. Some folks are born with a tiny unicorn that is often removed at birth so you may not have ever seen one. Consider this couple: father had his unicorn removed at birth and his father had feathery nostrils; the mother has feathery nostrils and she did not have a unicorn but her mother did. What is the probability of this couple having a son with a unicorn from one pregnancy and a daughter with feathery nostrils one year later?

12 pts.
9) Tiny cells are important too.
a) What two physical components contribute to the timing of bacterial cell division by binary fission? Support your answer with two figures from the data gallery. Limit your answer to a maximum of 35 words.

b) The cells in figure 22 of the gallery appear to have regulated population growth rates. Use a different figure to describe the growth rate of individual *E. coli* cells. Limit your answer to a maximum of 30 words.

13 pts.
10) Why don't we call these processes your-tosis and our-tosis?
a) On a separate piece of paper, draw a picture of a diploid cell that has two different chromosomes (A is big and B small) during each of the phases of mitosis. Label neatly.

b) Synthesize meiotic recombination and the laws of independent assortment and segregation to explain the randomness that Mendel first noticed in figure 11 in the data gallery. Limit your answer to a maximum of 35 words.
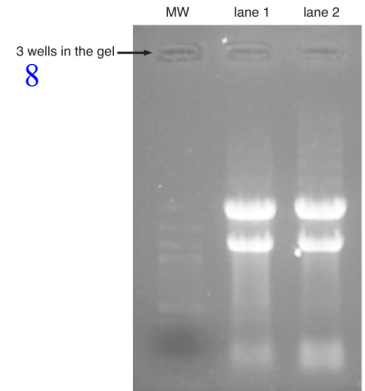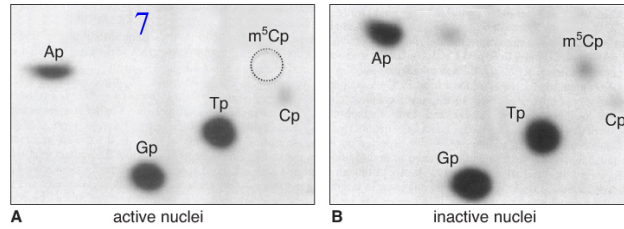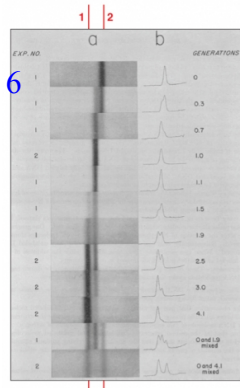
Data Gallery

1

2

3
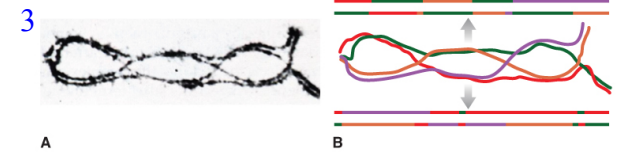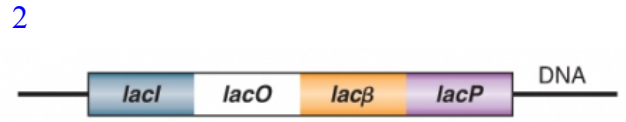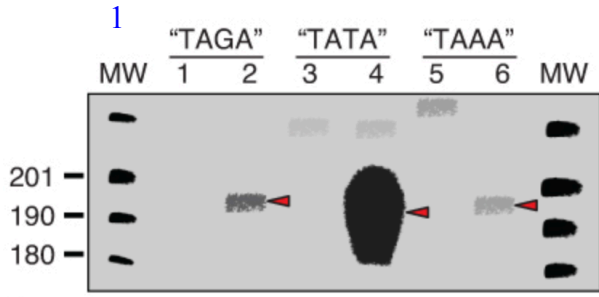
4

sample source	extracellular	intracellular
^{35}S-Protein Figure 1.8	~80%	~20%
^{32}P-DNA Figure 1.8	~30%	~70%
^{35}S-Protein refined experiment	~99%	~1%
^{32}P-DNA refined experiment	~30%	~70%

5

promoter length	doubling time	drug resistant
29 bp	no growth	none
78 bp	5 hours	none
113 bp	5 hours	none
155 bp	3 hours	yes
320 bp	3 hours	yes

6

7

A active nuclei   B inactive nuclei

8

9

position #	1	2	3	4	5	6	7
A	−6.64	1.84	−6.64	0.84	1.26	−6.64	−0.72
C	−6.64	−6.64	−0.37	−6.64	−6.64	−6.64	−6.64
G	−0.37	−6.64	−6.64	1.18	−0.37	−6.64	1.92
T	1.57	−6.64	1.57	−6.64	−0.72	1.84	−6.64

10

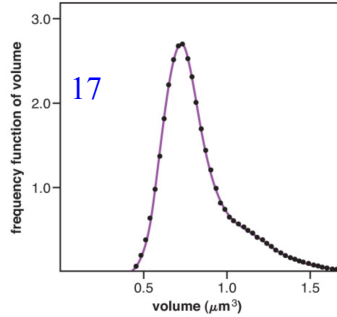| sample source	extracellular	intracellular
^{35}S-Protein Figure 1.8	~80%	~20%
^{32}P-DNA Figure 1.8	~30%	~70%
^{35}S-Protein refined experiment	~99%	~1%
^{32}P-DNA refined experiment	~30%	~70%

11

plant number	smooth pea	wrinkled pea	plant number	yellow pea	green pea
1	45	12	1	25	11
2	27	8	2	32	7
3	24	7	3	14	5
4	19	10	4	70	27
5	32	11	5	24	13
6	26	6	6	20	6
7	88	24	7	32	13
8	22	10	8	44	9
9	28	6	9	50	14
10	25	7	10	44	18
totals	336	101	totals	355	123

12
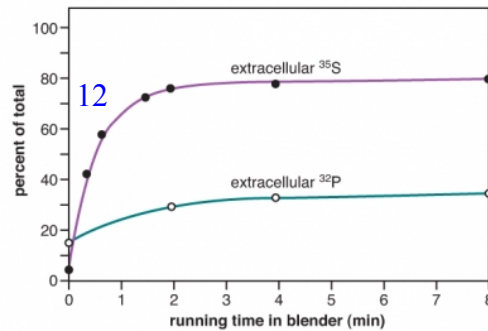
13

	second base in codon			
	U	**C**	**A**	**G**
U	UUU phe F UUC phe F UUA leu L UUG leu L	UCU ser S UCC ser S UCA ser S UCG ser S	UAU tyr Y UAC tyr Y UAA stop UAG stop	UGU cys C UGC cys C UGA stop UGG trp W
C	CUU leu L CUC leu L CUA leu L CUG leu L	CCU pro P CCC pro P CCA pro P CCG pro P	CAU his H CAC his H CAA gln Q CAG gln Q	CGU arg R CGC arg R CGA arg R CGG arg R
A	AUU ile I AUC ile I AUA ile I AUG met M	ACU thr T ACC thr T ACA thr T ACG thr T	AAU asn N AAC asn N AAA lys K AAG lys K	AGU ser S AGC ser S AGA arg R AGG arg R
G	GUU val V GUC val V GUA val V GUG val V	GCU ala A GCC ala A GCA ala A GCG ala A	GAU asp D GAC asp D GAA glu E GAG glu E	GGU gly G GGC gly G GGA gly G GGG gly G

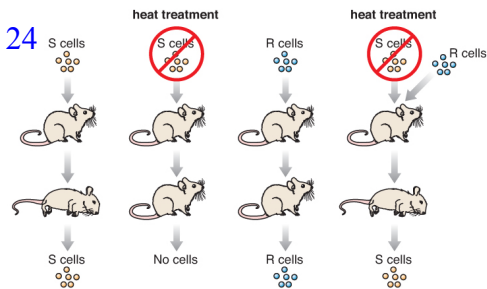(first base in codon)

14
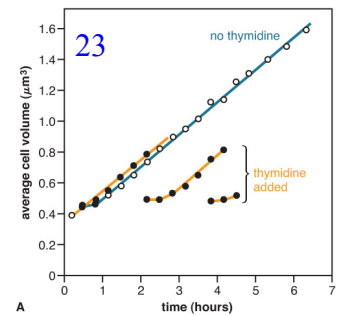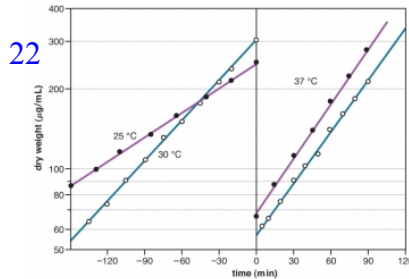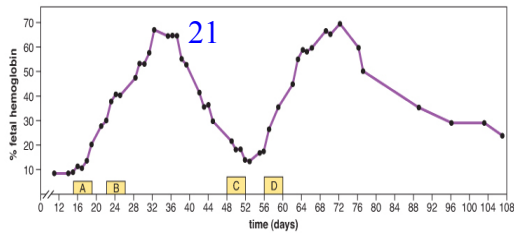
15

16

17

18

19

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V-T7    5´...TAAACACGGTACGATGTACCACATGAAACGACAGTGAGTC... 3´
V-fd    5´...GCTTCTGACTATAATAGACAGGGTAAAGACCTGATTTTTG... 3´
V-SV40  5´...ATTGCAGCTTATAATGGTTACAAATAAAGCAATAGCA...... 3´
V-1     5´...ACTGGCGGTGATACTGAGCACATCAGCAGGACGCACTGAC... 3´
B-tRNA  5´...GTCATTTGATATGATGCGCCCCGCTTCCCGATAAGGAGC ... 3´
B-Lac   5´...TCCGGCTCGTATGTTGTGTGGAATTGTGAGCGGATAACAA... 3´
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20

genotype	− lactose	+ lactose
I^+ O^+ β^+ P^+	1	100
I^- O^+ β^+ P^+	100	100
I^+ O^+ β^+ P^+ / I^+ O^+ β^+ P^+	1	240
I^D O^+ β^+ P^+	1	1
I^D O^+ β^+ P^+ / I^+ O^+ β^+ P^+	1	2
I^+ O^- β^+ P^+	<1	<1
I^+ O^- β^+ P^+ / I^+ O^+ β^+ P^+	1	100

21

22

23

24

25

TBP		+		+	+	+
TFIIB		+	+		+	+
PAR 74		+	+	+		+
RNA pol		+	+	+	+	

promoter alone

6