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 7 pages in this test, including this cover sheet and the data gallery. You are not allowed to look at someone else's test, nor use your notes, old tests, the internet, any books, nor are you allowed to discuss the test with anyone until all exams are turned in no later than 9:30 am on Monday Sept. 22. **EXAMS ARE DUE BY 9:30 m ON MONDAY SEPTEMBER 22**. 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 within this test** unless you want to draw on a separate page. 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.

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. You do NOT need to move the figure on your test. 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 sentence 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 print):

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:

8 pts.

1) To the right is a position weight matrix. Below is a DNA sequence (**ACGTATA**) that may or may not be part of a promoter. Use the position weight matrix to determine if this is a promoter or not. To receive any credit, you MUST tell me how you reached your conclusion. *Answer Limit: 30 words*.

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

8 pts.

2) Here is a figure from lab and a potential promoter sequence (**GGGAACTGCACGTATAGGCTAGCAT**). Use the these data to determine what sequence you would send to the company to have them make the **top oligo** to use with GGA to functionally test if this is a promoter or not.

type your sequence here:
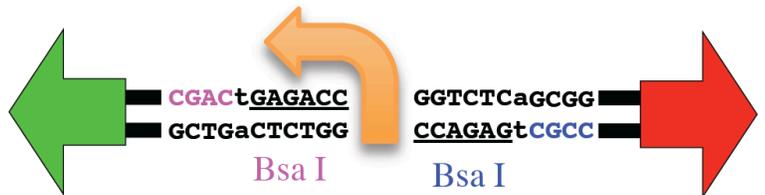
15 pts.

3) In the attached file Exam1_sequences.docx, I have two sequences for you: DNA derived from mRNA encoding over 100 amino acids, and a gene. These sequences come from the human genome, which means you carry two alleles very similar to what is in the file.

Use BLAST2 and ORF finder to analyze these two sequences and answer these questions:

a) How can you tell which sequence is the mRNA? *Answer Limit: 30 words*.

b) How many amino acids are encoded in the mRNA? *Answer Limit: 20 words*.

c) How many "start codons" are in this mRNA? Support your answer with data (a screen shot) *Answer Limit: 20 words*.

d) How many introns are in this gene? Support your answer with data (a screen shot) *Answer Limit: 20 words*.

e) What would you expect to see from this protein's amino acid sequence if the protein were purified from human tissue and you knew the protein were made on the rER? Support your answer by describing the posttranslational modification. *Answer Limit: 30 words*.

Lecture Questions:

9 pts.

5)

a) Draw a simplified diagram to show me what "anti-parallel" means for DNA. In your picture, be sure to label all the ends of your DNA. You do **NOT** need to diagram individual nucleotides.

b) Summarize the mathematical argument that protein was a better heritable material than DNA. *Answer Limit: 40 words.*

c) Choose 4 examples from the data gallery to disprove proteins are the heritable material. You must explain why each figure you chose contributes to the evidence. *Answer Limit: 30 words for each example.*

1.

2.

3.

4.

24 pts.

6)

a) Give two main reasons why Mendel was able to see inheritance patterns that his contemporaries were not. *Answer Limit: 40 words.*

There is a rare recessive trait called upside down nose (n) that can lead to drowning if a *nn* person goes out into the rain without a hat. There is very rare dominant trait that allows affected individuals to breath through their ears (E). Calculate the following scenarios.

b) What is the probability of a couple having a boy who can breath through his ears given none of his grandparents could and only his father can? Show your work to get full credit. *Answer Limit: 10 words.*

c) If the country's only ear breathing boy were part of a group of 10 men and 10 women (all unrelated) who colonized Mars, how many generations would it take before the ear breathers with at least one dominant allele were the majority of the total population? For this question, assume every couple reproduces and every couple has exactly 2 children per generation. Incest is forbidden on Mars. Support your answer using the rules of probability. Show your work to get full credit. *Answer Limit: 30 words.*

d) If a woman who could drown in the rain had children with a man whose father could drown in the rain but his mother was homozygous wild-type, what is the probability that one of their three children would be susceptible to drowning in the rain, but the other two would not be susceptible? Show your work to get full credit. *Answer Limit: 10 words.*

e) What is the probability of the following couple having a child with one mutant phenotype? Show your work to get full credit. *Answer Limit: 10 words.*

   father: *upside down nose, non-ear breather x* **mother**: *heterozygous wild-type nose, heterozygous ear breather*

f) The colors used in our book were chosen so that color blind people can distinguish the different colors. Red/green color blindness is a sex-linked trait that affects about 8% of men in the general population. How many students in Bio113 are likely to be red/green color blind (33 people: 13 male students, 1 male teacher, 19 female students)? Show your work to get full credit. *Answer Limit: 10 words.*

g) What is the probability of the following couple having a color blind son? Show your work to get full credit. *Answer Limit: 10 words.*

   father: color blind x mother: her father was color blind but she is not

h) What is the probability of this same couple having a color blind daughter? Show your work to get full credit. *Answer Limit: 10 words.*

14 pts.

7)

a) If a population of worms doubles every 24 hours, how could you determine whether a muscle protein was induced or not after exposure to heat? Support your answer with data. *Answer Limit: 30 words.*

b) Do *E. coli* cells in a growing population grow at a constant rate if the temperature is held steady? Support your answer with data. *Answer Limit: 30 words.*

c) Describe one form of information that bacteria use to determine when it is time to divide or not. Support your answer with data. *Answer Limit: 30 words.*

d) If you sampled 100 skin cells, how many would be going through mitosis and how many would have replicated their DNA but had not started mitosis yet? Support your answer with data. *Answer Limit: 20 words.*

12 pts.

8)

a) Explain how steroids can cause muscles to produce more protein. Support your answer with data. *Answer Limit: 30 words.*

b) Explain how steroids can cause negative side effects. Support your answer with data that you learned in class. *Answer Limit: 30 words.*

c) What type of molecule determines which cells are affected by steroids and which cells are not? Support your answer with data. *Answer Limit: 30 words.*

10 pts.

9)

a) Describe how repressors work. Support your answer with data. *Answer Limit: 30 words.*

b) List 3 mechanisms that contribute to the types of unexpected results Mendel found in data gallery figure 12.5. Don't limit your answer to monohybrid crosses. *Answer Limit: 30 words for each mechanism.*

1.

2.

3.

Data Gallery

1
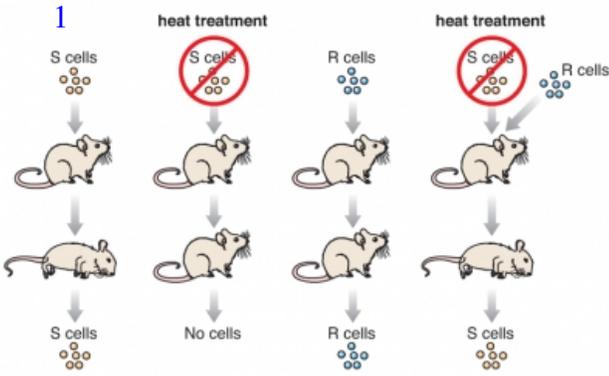
2

sample #	% nitrogen, N	% phosphorus, P	N/P ratio
37	14.21	8.57	1.66
38B	15.93	9.09	1.75
42	15.36	9.04	1.69
44	13.40	8.45	1.58
pure DNA	15.32	9.05	1.69

*from Avery, *et al.*, 1944. Table I.

3

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%

4

5

6

7

8
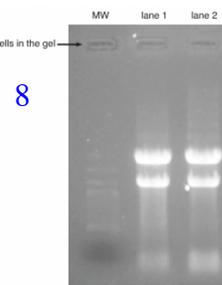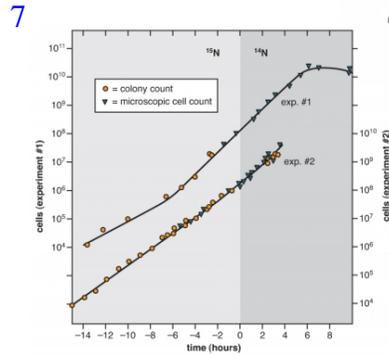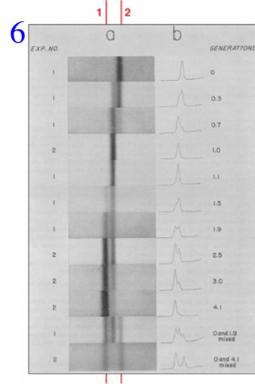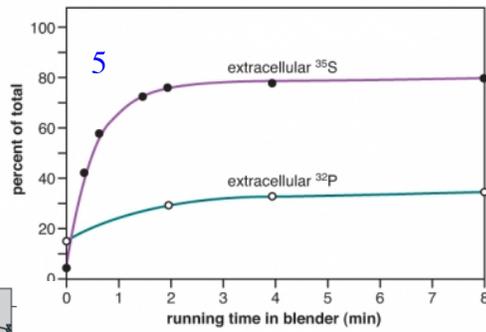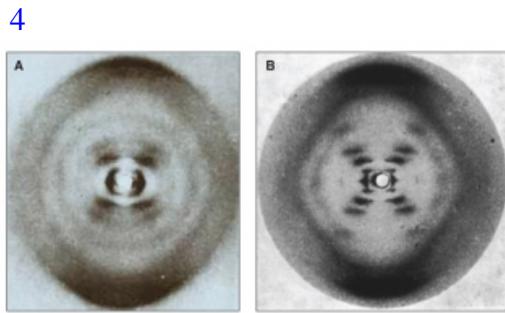
10

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´

11

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

12

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

12.5

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

13

14

15

16
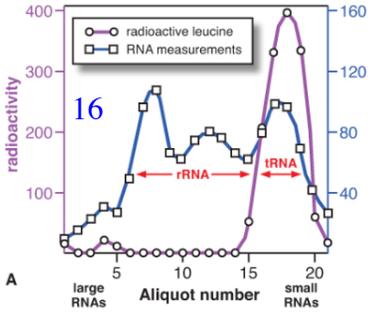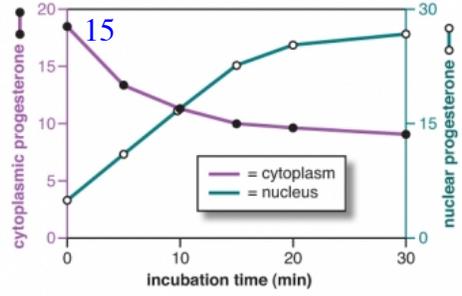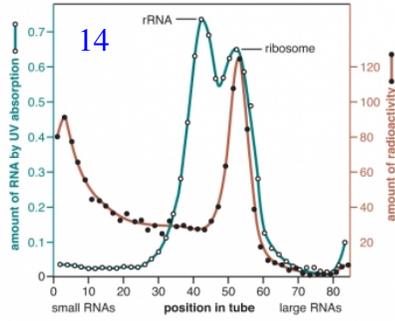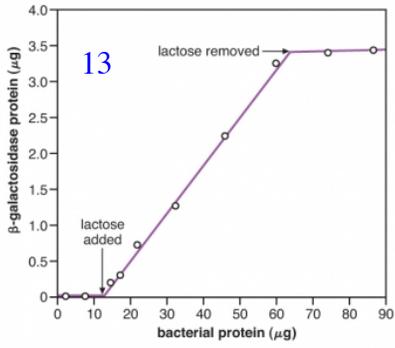
17

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

promoter alone

18

19
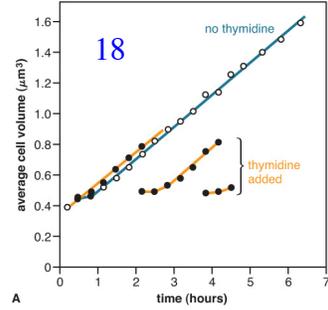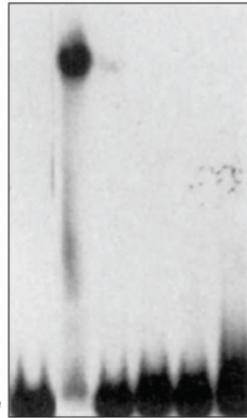
20 name	description	duration (hours)
G₁	growth and normal cellular functions	10
S	synthesis of DNA	8
G₂	growth and normal cellular functions	4
mitosis	separation of chromosomes	2

21

22

23

24

25