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 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 until all exams are turned in no later than **8:30 am on Monday Sept. 18**. 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 print):

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

_____

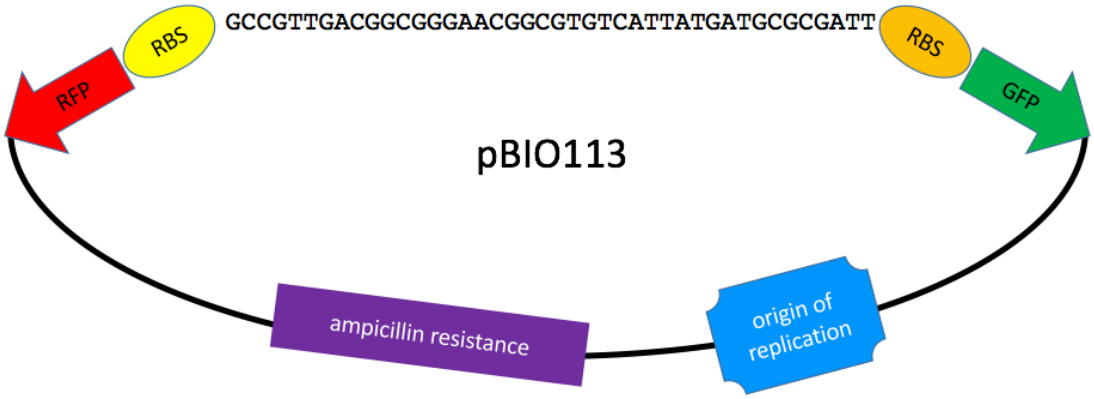
On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete?

Lab blended with lecture Questions:

6 pts.

1) Some *E. coli* cells were transformed with the plasmid below and all of the colonies were red when grown on antibiotic plates. Hand-label approximately where the -10 and -35 DNA would be for this particular plasmid. Make sure to draw and label boxes around the DNA, and make sure they about the right sizes. Please write neatly so I can read your labels.



4 pts.

2) When you produced the double-stranded DNA for cloning into your plasmid, what will prevent the DNA from ligating backwards into your plasmid so that transcription goes in the wrong direction? *Answer Limit: 30 words.*

Lecture Questions:

11 pts.

3) Here are some questions about one of the most amazing molecules on the planet.

a) From the Data Gallery, choose THE most compelling data demonstrating that DNA is the heritable material. Use the data to justify why the experiment was so compelling. *Answer Limit: 30 words.*

b) Draw a picture of the DNA banding pattern Meselson and Stahl would have gotten after 3 rounds of replication with ^{14}N **IF** the mosaic model for DNA replication was the correct one. Use the centrifuge tube I have provided here, and use labels to clarify what you have drawn.

12 pts.

4) On the lines provided here to represent dsDNA and mRNA, please label the following parts: introns, promoter, start codon, +1 base, 4 small exons, signal sequence, RBS, stop codon, end of mRNA, ORF, upstream, and downstream. Be sure to keep their relative positions and sizes in mind when drawing shapes to represent each part. Write neatly!

gene

mRNA

18 pts.

5) Some questions about Central Dogma.

a) Go to Figure 23 and use a mathematical argument to show that the *lacβ* gene was induced by the sugar lactose. Use the time points near 30 and 60 μg in your argument. Show your mathematical work for full credit. *Answer Limit: 40 words.*

b) Look at Figures 12 and 20 that examine the sequences of promoters. How could the investigators who generated Figure 12 have benefitted from careful examination of the data in Figure 20 and disproven their own hypothesis without conducting experiment 12 in the first place? *Answer Limit: 40 words.*

c) Integrate the data from Figures 5 and 17, and then draw a picture of what the dsDNA promoter in Figure 5 physically would look like immediately before transcription begins.

12 pts.

6) Would you believe the movie *Lost in Translation* was about college students who never took introductory biology?

a) Translate the ORF below using the genetic code provided in the Data Gallery. Use the single letter code for amino acids.

AAATACTAGATGGCCAAAGAAATGGAGTGATATCT

Answer here:

b) How do ribosomes know which proteins to make at any given time? Support your answer with data. *Answer Limit: 40 words.*

c) Which type of RNA molecules are likely to persist the longest inside cells? Support your answer with data. *Answer Limit: 40 words.*

16 pts.

7) Now it is time to apply some of Mendel's insight to some rare cases of genetic oddities.

a) A heterozygous man has an upside down nose such that he risks drowning if he walks in the rain. His wife has a normal nose. If they reproduce and have two children, what is the probability that they will have a boy with a normal nose and then a girl who risks drowning in the rain?

b) There is a rare bird that can produce a single horn like a unicorn but it must be homozygous to do so. This same species of bird can exhibit a glow-in-the-dark phenotype only if its genotype is homozygous. These two genes are on separate autosomes. How many glow-in-the-dark, non-unicorn birds would you expect to see in a clutch of 20 babies if two carrier birds mated? Show your work for a chance at partial credit.

c) Generate an allele key and then list all the genotypes that could produce a glow-in-the-dark, non-unicorn bird:

-

d) A very rare allele carried on the X chromosome can lead to transparent ears on rabbits. If a male with transparent ears mated with a female carrier, how many babies would be female and have transparent ears if the litter size is 12 bunnies? Show your work for a chance at partial credit.

12 pts.

8) Chapter 3

a) How does a bacterial cell know when it is ready to reproduce? Support your answer with data. *Answer Limit: 40 words.*

b) Describe the growth rate of bacteria as revealed in Figure 25. *Answer Limit: 40 words.*

c) List three contributing factors that can explain the data in Figure 11. Support two of your factors with data. *Answer Limit: 30 words per factor.*

1.

2.

3.

9 pts.

9) You are almost done now. Just one more question.

a) List two mechanisms that temporarily prevent a gene from being transcribed. Support both mechanisms with data. *Answer Limit: 30 words per mechanism.*

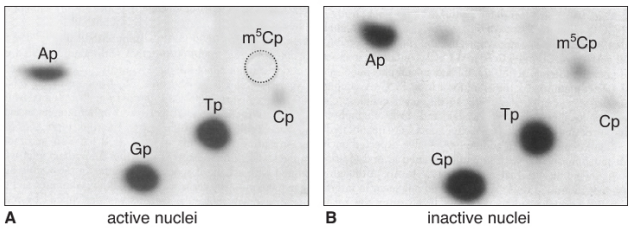
1.

2.

b) Do you predict this sequence `GATACTG` would be part of a good promoter? Support your answer with data. *Answer Limit: 20 words.*

Data Gallery

1



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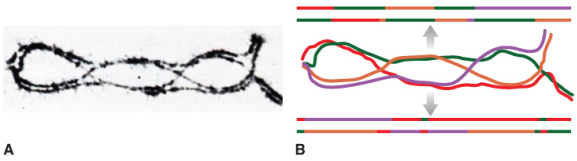

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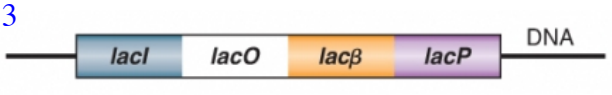
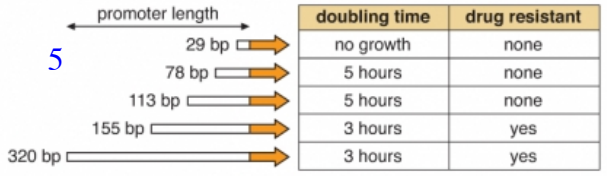


4

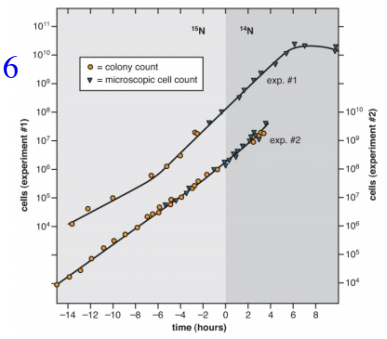
sample source	extracellular	intracellular
^{35}S-Protein Figure 1.8	~80%	~20%
^{32}P-DNA Figure 1.8	~30%	~70%
^{35}S-Protein refined experiment	~99%	~1%
^{32}P-DNA refined experiment	~30%	~70%

5



doubling time	drug resistant
no growth	none
5 hours	none
5 hours	none
3 hours	yes
3 hours	yes

6



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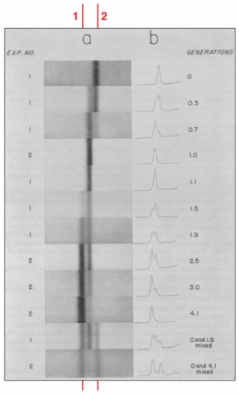

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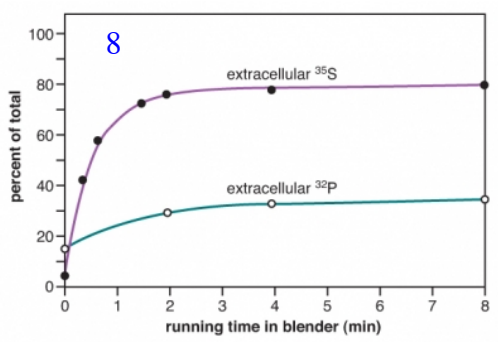

9

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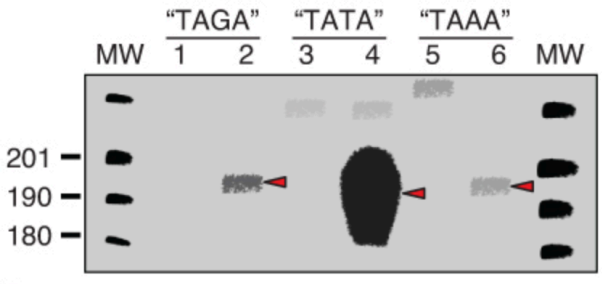
10

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

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



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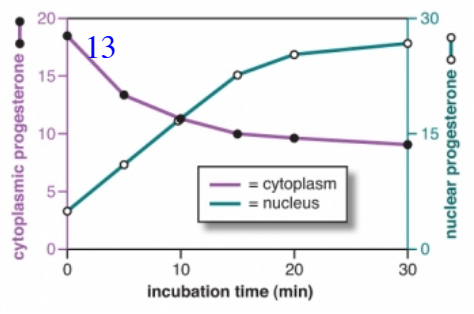

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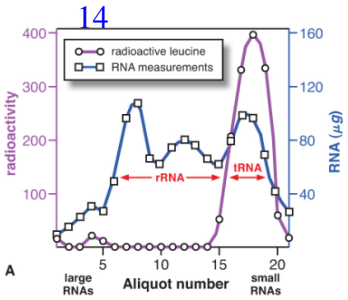

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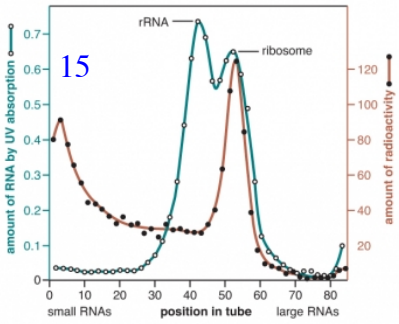

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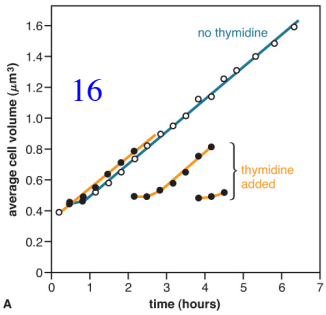

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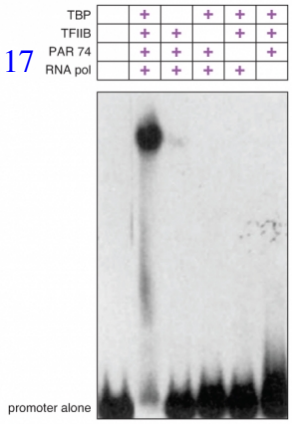

18

second base in codon

first 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

19

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

20

```
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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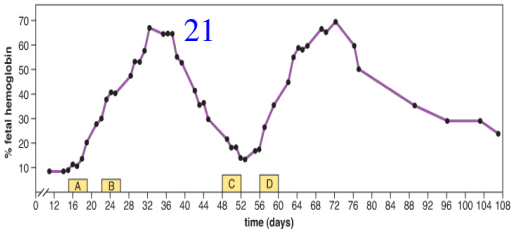
21



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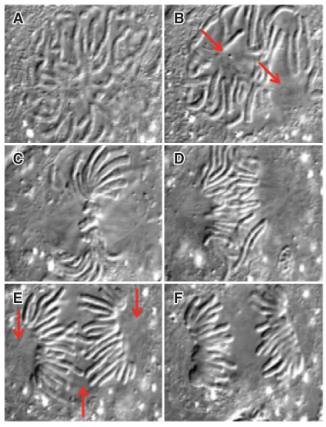

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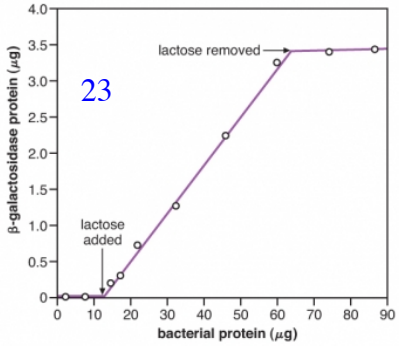

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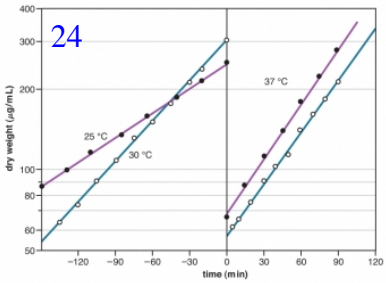

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