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 2 hours. There are 6 pages in this test plus 2 PPT files, 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 **2:20 am on Monday 21 Sept**. If you email 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.

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.
Include all your pages (INCLUDING any extra ones) when finished with the exam.

Name (please type):

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

_____

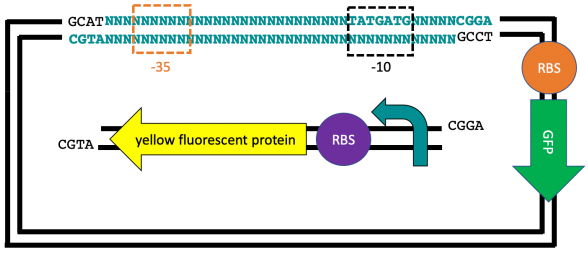
On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete? _____

lab blended with textbook questions:

10 pts.

1) Open the PPT file named "Exam 1 Q1.pptx". You will see a fictitious plasmid that has already been cut by a type IIs restriction enzyme. I want you to move the insert out of the plasmid by dragging it to the bottom of the slide. Then I want you to type a promoter that will lead to transcription of GFP. Replace the teal letters inside the plasmid so that your letters will be the right size and font. Then drag your new promoter into the right location. Label the -10 and -35 regions using the dashed boxes provided for you. If there are DNA bases whose sequence you are unsure of, you may type `N` to indicate "any DNA base". Take a screenshot of your final drawing and insert it here.



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

sticky ends = 2 pts each (4 pts total)
-10 sequence = 2 pts
-10 position = 2 pts
-35 position = 2 pts

Textbook questions

23 pts.

2)

a) A guy I went to high school with does not "believe" how DNA is replicated. He thinks Meselson and Stahl were fake scientists. Use the data in figure #8 to disprove the competing hypotheses about how DNA is replicated. To get full credit, you must take a screen shot of **only 1 row** from the figure for each hypothesis you disprove. Your answer should consist of 1. the name of the hypothesis, 2. the screenshot, and 3. how the data disprove the hypothesis. For number 3, you are limited to 35 words for each one.

8pts each

1. conservative

2. 

3. only one band, 50% heavy/light instead of predicted 2 bands, all heave & all light

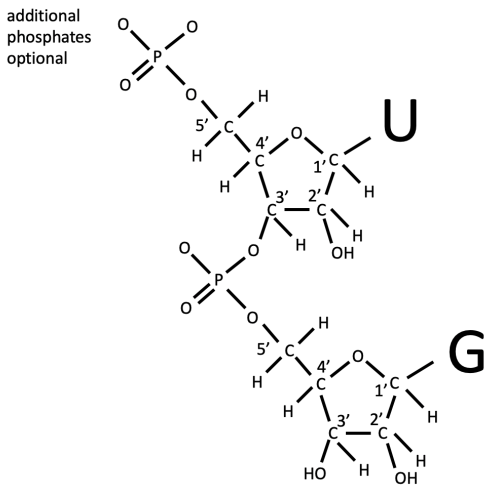
1. mosaic

2. 

3. two bands instead of predicted 1 band that was 75% light, 25% heavy.

b) Draw two RNA nucleotides properly connected to each other. You do not have to draw the atoms of the bases – you may write a single letter to represent the base. The 5' base must be the base only found in RNA and the 3' base must be capable of 3 hydrogen bonds.

5 pts
Bases and order
structures



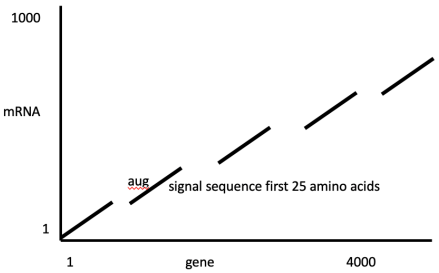
16 pts.

3)

a) Draw a dot plot that aligns a gene and an mRNA that meets the criteria below as best you can. Label the axes and include numbers on both axes.

- gene is 4000 base pairs long
- mRNA is 1000 bases long
- gene contains 4 introns
- the protein is secreted

3 pts each



b) Translate this ORF:

5′ UUUAAACAGAUGGCCAGUAAGUAAGAUAUUUAU 3′

M A S K

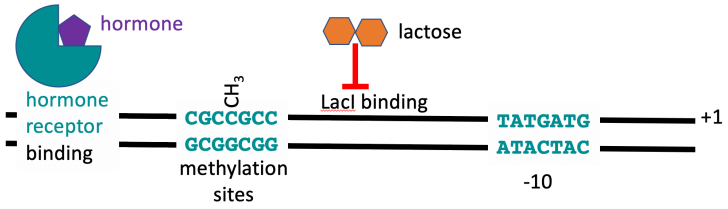
4 PTS

15 pts.

4)

Draw one picture of one promoter that meets all these criteria. Then support each element of your drawing with data and text that is limited to 35 words each. 2 pts each, + 5 for drawing

1. transcription is regulated by a hormone #13 – binds cytoplasm, moves nucleus
2. transcription is repressed by a protein #20 row: 5 lac I^D in diploid
3. a sugar eliminates repression #17 or 20 row: 1 lactose induces gene
4. the -10 sequence matches a consensus sequence for *E. coli* #9 position weight matrix
5. the gene can be epigenetically silenced #21 or #7 methylation of promoter



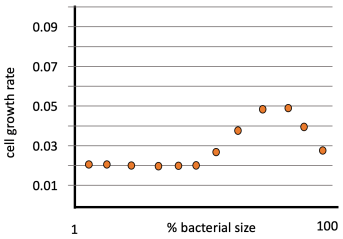
18 pts.

5)

a) Sexual reproduction generates the diversity we see around us and the diversity that makes the world a better place. Provide a numbered list of sources of variation generated through sexual reproduction that we have studied in Chapters 1 - 3. For each source, provide a one sentence explanation of no more than 25 words. 4 pts each = 12

1. Random gametes fusing
2. Prophase I recombination
3. Independent assortment and segregation

b) Use the associated PPT file to generate a graph showing how *E. coli* cells grow. Take a screenshot of your graph and insert it here for grading.



Goes up late 4 pts

Then down 1 pts

18 pts.

6) Please provide the answers to these genetics questions. For partial credit, you must show your work either here or on a separate page in this Word file.

6 points per section

As you know, I liked to breed and sell animals to raise money when I was in high school. This time, I happened upon a rare breed of dog that had a unicorn! This recessive allele (*) was on the X chromosome. I mated a unicorn male with a wildtype female. All 4 male puppies had unicorns and half of the 8 females also had unicorns.

a) What were the parents' genotypes? Mom: X*X Dad: X*Y

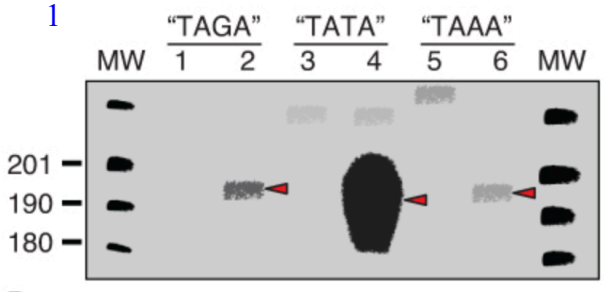
b) If you knew the mother was going to give birth to 12 puppies, what numbers would you have predicted for each of the possible phenotypes?

6 male puppies, 3 with unicorns; plus 6 females, 3 with unicorns

c) I used to breed racing turtles that were known throughout Arkansas as the fastest turtles. Little did I know, this racing capacity was encoded in two genes on separate chromosomes. The fast allele for one gene encoded for thin shells (t) and the other fast allele encoded for long legs (L). If I mated two turtles that were heterozygous for both genes, how many racing fast turtles would I expect from 100 offspring (round to the nearest whole number)? TtLl x TtLl → 19 expected

Data Gallery

1



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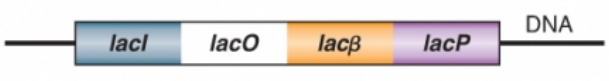

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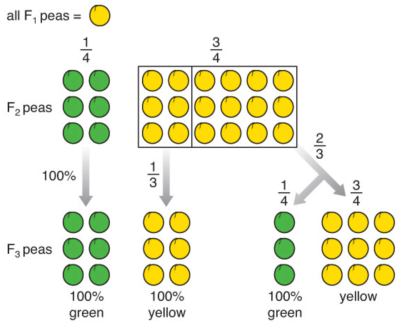
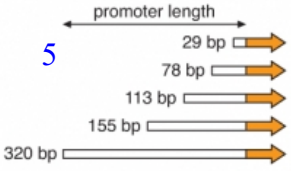


4

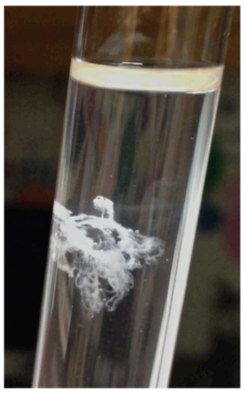
generation	wrinkled peas	smooth peas
P	5 true-breeding wrinkled plants	5 true-breeding smooth plants
F_1	0 wrinkled peas	281 smooth peas
F_1	0 plants from wrinkled peas	self-cross 253 plants from F_1 smooth peas
F_2	1,850 wrinkled peas	5,474 smooth peas

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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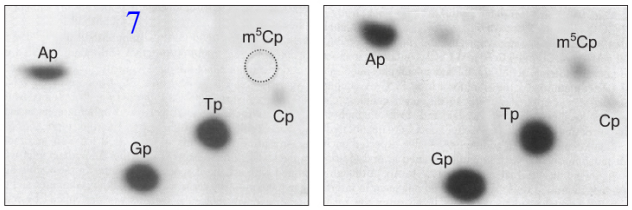

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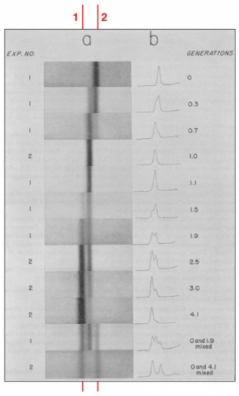

9

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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

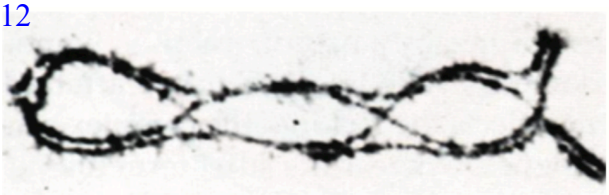
10

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%

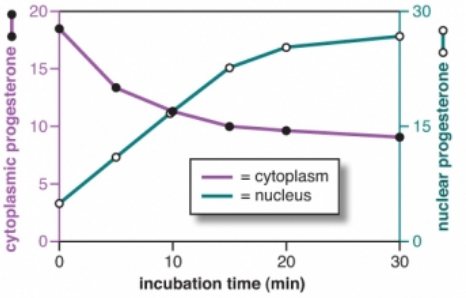
11

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



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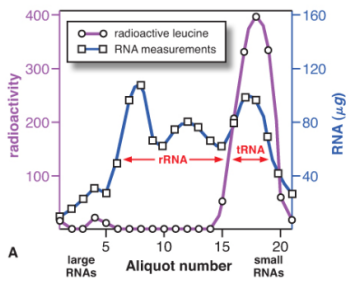

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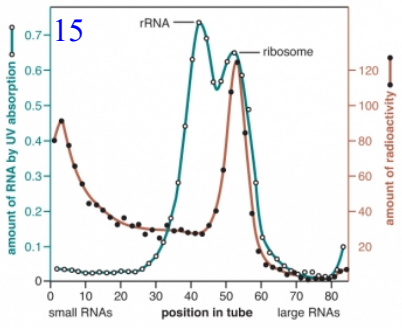

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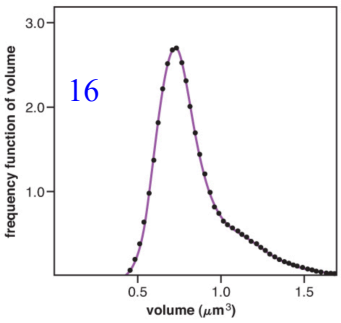
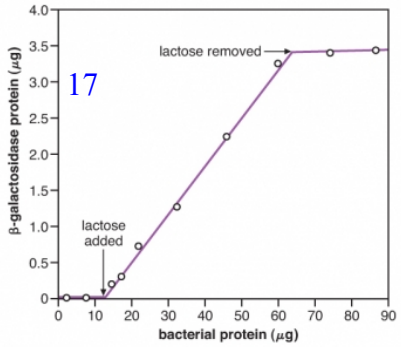


17



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

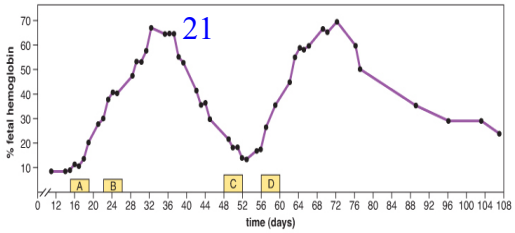
19

```
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′
```

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



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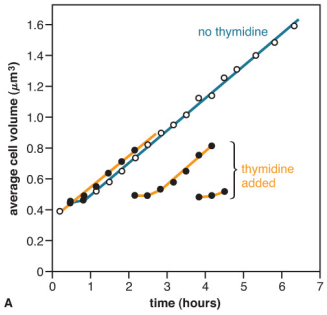

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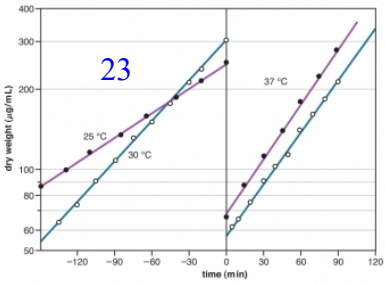

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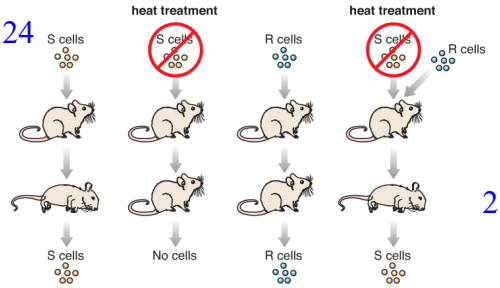

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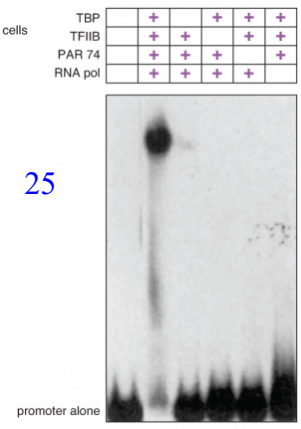

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