Biology 111 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 5 pages in this test, including this cover sheet. 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 9:30am on Monday Sept. 19. **EXAMS ARE DUE BY 9:30 am ON MONDAY SEPTEMBER 19**. If you turn in your exam late, then you lose a letter grade for each day you are late. The **answers to the questions must be typed on a separate sheet of paper** unless the question specifically says to write the answer in the space provided. If you do not write your answers in the appropriate location, I may not find them.

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.

There are 7 Quick Recall questions that are multiple choice. The questions are available only online so you will need internet access to take this exam. http://moodle.davidson.edu/moodle/

-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 Questions:

6 pts.

1) List the four major steps associated with the information experiment. List them in chronological order (first to last). Limit yourself to two sentences maximum for each step.

A. find promoter that could be regulated in a known way but not in Registry
B. order oligos that include sticky ends
C. ligate promoter into plasmid and transform into E. coli
D. measure cell density and fluorescence (fluor/density) and graph

4 pts.

2) Describe the new phenotype you will produce in the evolution experiment and how you will produce it in lab. Limit your answer to 3 sentences or less.

antibiotic resistance
Expose cells to sub-MIC concentrations and select for cells that survive. Continue as concentration of antibiotic gradually increases.

Lecture Questions:

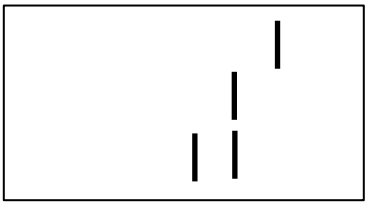
5 pts.

2) Describe three distinct experiments that lead biologists to conclude DNA was the heritable material. Restrict your answers to 2 sentences each.

A. Griffith and the R/S injections into rats
B. Avery's purification of "S factor" and N/P ratio
C. Hershey and Chase – ^{35}S and ^{32}P labeling of virus

12 pts.

3) In the 1950s, there were three competing models to explain how DNA could serve as a template for replication. Draw a picture of the data that disproved the two incorrect models. You must explain how these data actually disproved the two models. Limit yourself to no more than 2 simple diagrams and 4 sentences total (plus your labeled diagrams). You may draw your picture by hand and staple your drawing into your test answers, or use the Word drawing tools and include your drawing in the printed answers. Label your diagram so I know that you know what you are drawing a picture of.



all heavy DNA

after 1 round of replication
after 2 rounds of replication

round 1 disproved the duplication idea where the 2 old strands stayed together and the 2 new strands stayed together (2 bands should be present for this model to be true)

round 2 disproved the mosaic model which predicted all the DNA would be the same density and it would gradually get lighter. (1 band should be present for this model to be true)

8 pts.
4) Which RNA is responsible for telling the cell what proteins to make at any given time? Support your answer with data and your answer cannot be longer than 3 sentences.
mRNA
figure 4
radioactive viral DNA bond to ribosome but not rRNA

8 pts.
5)
a) What is the function of $lacO^+$? Support your answer with data but your answer cannot be longer than 2 sentences.
promoter
figure 20
last row – only works on adjacent DNA

b) What is the function of $lacI^+$? Support your answer with data but your answer cannot be longer than 2 sentences.
repressor
figure 20
3rd of 5th row

7 pts.
6) Determine if this sequence (`GACGATG`) is likely to be a promoter in *E. coli*. In order to receive full credit, you have to show/explain how you arrived at your conclusion.
yes, a promoter
used position weight matrix figure 19
summation much greater than 1

10 pts.
7) Is it possible for some promoters to be off unless activated by transcription factors? Support your answer with data but your answer cannot be longer than 2 sentences.
yes
figure 6
all or none binding, including RNA polymerase

12 pts.

8) Most biology majors think that *E. coli* grows at a constant rate as long as the temperature is held constant rate. Do you agree with most majors, or disagree? Support your answer with data but your answer cannot be longer than 2 sentences.

disagree

figure 7

not constant growth rate – faster as they get bigger – shoulder on right side of graph

12 pts.

9)

a) A pair of pink cats mated and produced a litter of five, non-identical purple cats. The next time these two cats mated, they produced 2 purple cats and 5 pink cats. What was the probability of these two cats producing 5 purple cats in one litter? 1/1024

b) What is the probability of the next cat born to this pair of cats being a pink male? 3/8

c) Create a list of four factors that produce diversity among the F_1 offspring of these P generation cats. State the factor and then describe it in one sentence (*e.g.* factor: Factor is a word.)

i. recombination

ii. random pairing of gametes

iii. law of ind. assortment

iv. law of segregation

DNA mutations or epigenetic factors also accepted

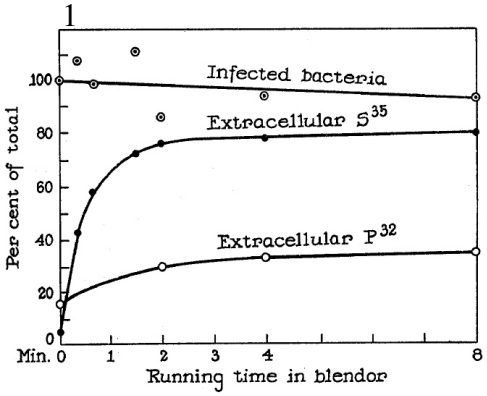
"Quick Recall" Questions for 2 points each

http://moodle.davidson.edu/moodle/

Dr. Campbell's Bio111 Exam #1 – Fall 2011

Data Gallery

1



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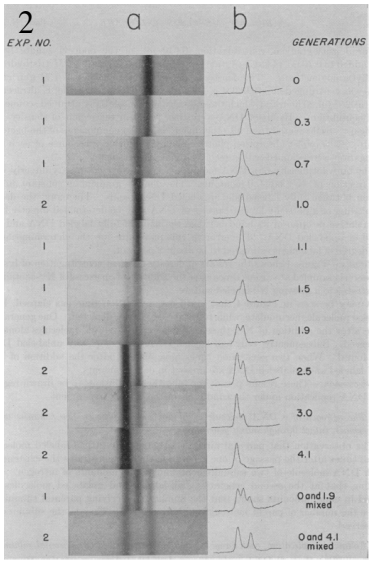

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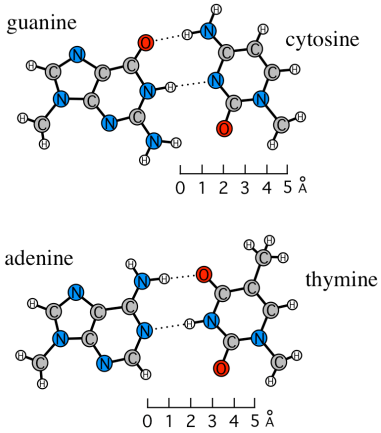

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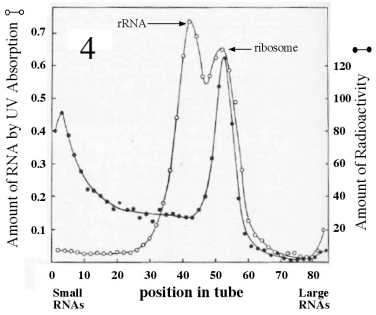

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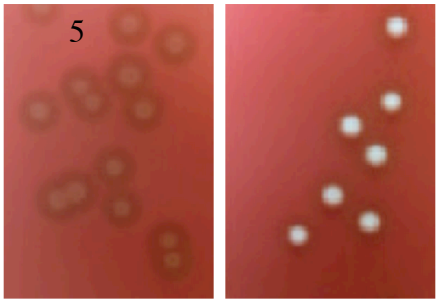

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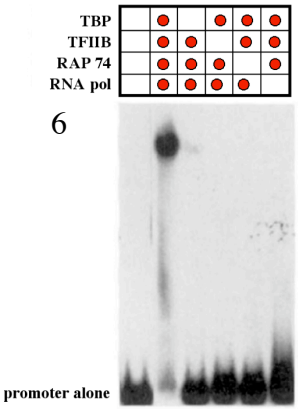

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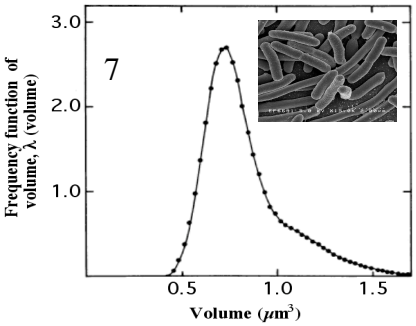

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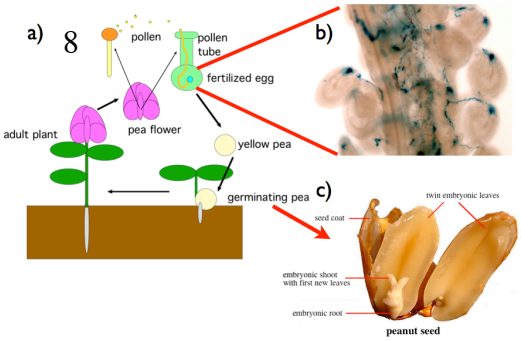

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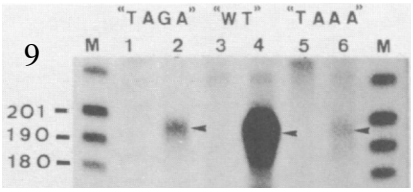

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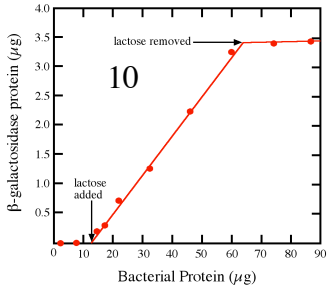

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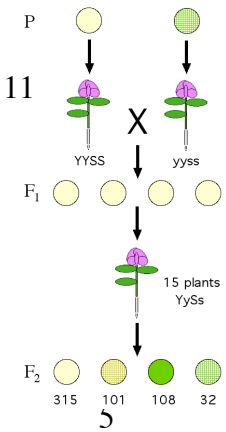

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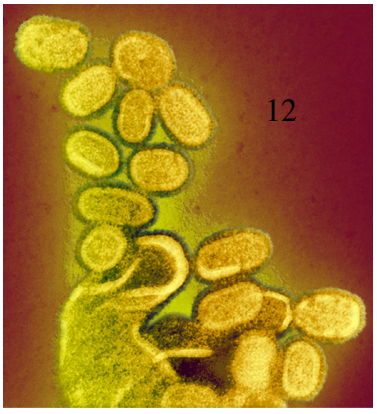

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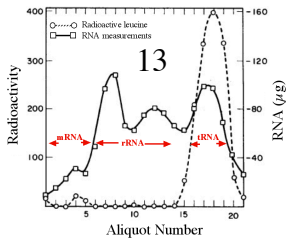

Table 1.3 Demonstration of radioactive viruses (by percent total radioactivity) behaving like normal viruses.

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Phage mixed with…	Phage labeled with…	Percent not remaining with bacterial pellet	
		After DNase	No DNase
Live *E. coli*	^{35}S	2	1
Live *E. coli*	^{32}P	8	7
E. coli heated before infection	^{35}S	15	11
E. coli heated before infection	^{32}P	76	13
E. coli heated after infection	^{35}S	12	14
E. coli heated after infection	^{32}P	66	23

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Cell volume 0.70 – 0.75		
Current # of cells in this volume category		100
Minus cells grown to larger volume category	100*0.08	- 8
Plus cells grown from smaller volume category	50*0.08	+ 4
Plus twice # cells that were 1.4 – 1.5 μm^3 and divided in half	2*0.1*50	+10
Equals new # of cells after 10 seconds		106

15

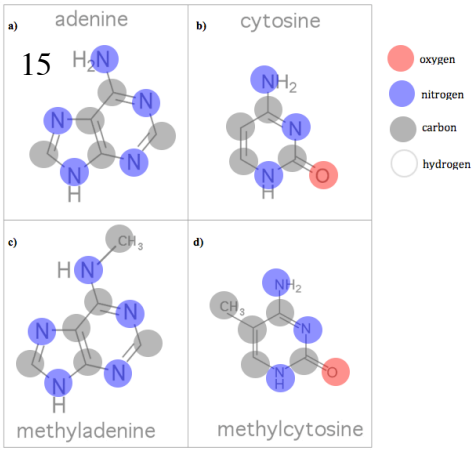

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Table 1.1 Comparison of four independent preparations of the transforming factor and purified DNA.

Sample #	% carbon, C	% hydrogen, H	% nitrogen, N	% phosphorus, P	N/P ratio
37	34.27	3.89	14.21	8.57	1.66
38B	no data	no data	15.93	9.09	1.75
42	35.50	3.76	15.36	9.04	1.69
44	no data	no data	13.40	8.45	1.58
Pure DNA	**34.20**	**3.21**	**15.32**	**9.05**	**1.69**

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Table 2.2 Amount of radioactive RNAs per milligram of total RNA.

Type of RNA	Radioactivity after 7 minutes	Radioactivity after 30 minutes
tRNA	8,620	12,400
rRNA (small)	1,260	2,660
rRNA (large)	714	2,160

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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

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	% β-galactosidase induction		% Permease induction	
Genotype	- lactose	+ lactose	- lactose	+ lactose
$I^+ O^+ \beta^+ P^+$	1	100	1	100
$I^- O^+ \beta^+ P^+$	100	100	90	90
$I^+ O^+ \beta^+ P^+ / I^+ O^+ \beta^+ P^+$	1	240	1	270
$I^D O^+ \beta^+ P^+$	1	1	1	1
$I^D O^+ \beta^+ P^+ / I^+ O^+ \beta^+ P^+$	1	2	1	3
$I^+ O^- \beta^+ P^+$	<1	<1	<1	<1
$I^+ O^- \beta^+ P^+ / I^+ O^+ \beta^+ P^+$	1	100	1	100

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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

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Time	Incorporation into long DNA polymers	
	pmoles ^{32}P primers	pmoles ^{3}H dNTPs
0 minutes	14.4	4.5
20 minutes	74.4	480.0
40 minutes	78.6	765.0
80 minutes	82.2	1062.0

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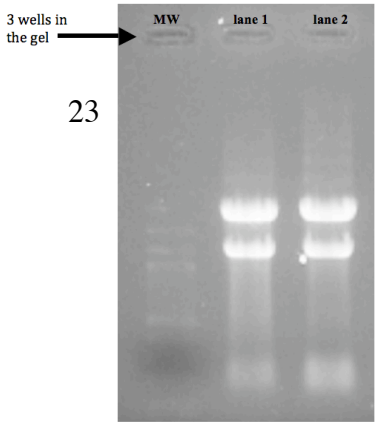

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Generation	Green Peas	Yellow Peas
P	5 true-breeding green plants	5 true-breeding yellow plants
F_1	0 green peas	273 yellow peas
F_1	0 plants from green peas	258 plants mature from F_1 yellow peas
F_2	2,001 green peas	6,022 yellow peas

25