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 7 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. 20. **EXAMS ARE DUE BY 9:30 am ON MONDAY SEPTEMBER 20**. If you turn in your exam late, then you lose a letter grade for each day you are late. You may use a calculator and/or ruler. 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. You may move these from the last two pages and incorporate them into your answers. Do not assume how many of the data images you will use, or not use. Simply placing data near your answer is not sufficient support for your answer. You must explain how 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. They are worth 2 points each. Indicate your answers by underlining your choice.

-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: You must show your work to be eligible for partial credit.

12 pts.

1) Tell me how to make these solutions with the information provided.

a) Make 35 μL of a solution that is 25 mM NaCl if you are given a stock solution of 350 mM NaCl.

b) Make 175 mL of a solution that is 0.15 M NaCl and 2% v/v ethanol if you are provided with 95% ethanol stock (molecular weight of 46) and dry NaCl with a molecular weight of 58.5.

c) Make 250 mL of a 13% v/v coffee solution if you bought a 100% *grande* coffee from Summit but you don't want to stay awake all night by drinking the coffee straight.

Lecture Questions:

5 pts.

2) In 4 sentences or less, explain what is wrong with this statement: "I can prove that I was not abducted by aliens."

12 pts.

3) Draw a picture of two strands of DNA with each strand of DNA two nucleotides long. Include the atomic details of the sugars. You do not need to draw the atomic details of the bases, but your drawing should include enough detail to roughly show how we know which bases bind to each other. You can draw this in Word, or draw it by hand on a blank piece of paper and attach it to the end of your exam.

8 pts.

4) To what end does DNA polymerase add the next nucleotide? Support your answer with data but your answer cannot be longer than 3 sentences.

8 pts.

5)

a) Describe the relative rates of RNA production in active cells. Support your answer with data but your answer cannot be longer than 3 sentences.

b) What does tRNA do? Support your answer with data but your answer cannot be longer than 3 sentences.

7 pts.

6) How did investigators know β-galactosidase was induced over time when lactose was present? Support your answer with data but your answer cannot be longer than 3 sentences.

10 pts.

7)

a)Are promoter sequences specific? Support your answer with data but your answer cannot be longer than 3 sentences.

b) Is the information in promoters linear or discontinuous? Support your answer with data but your answer cannot be longer than 3 sentences.

12 pts.

8) Distinguish what happens to the genetic information inside growing dog skin cells and the production of a fertile dog egg. Your answer should be a numbered list (1-6) that includes 6 major differences.

1.
2.
3.
4.
5.
6.

12 pts.

9)

a) What evidence supports randomness in eukaryotic reproduction? Support your answer with data but your answer cannot be longer than 2 sentences.

b) Calculate the probability of a couple having a boy with a recessive genetic disease if the father smoked and was heterozygous at this locus. The mother exercised regularly and she did not have the disease, but her mother had the disease. You must show your work to be eligible for partial credit.

c) What evidence led to the interpretation of dominant and recessive alleles? Support your answer with data but your answer cannot be longer than 3 sentences.

"Quick Recall" Questions for 2 points each

Electronically underline the correct answer.

QR1 Because of the anti-parallel nature of DNA,

a) one strand has an exposed 3' carbon on both ends, and the other strand has an exposed 5' carbon on both ends
b) DNA polymerization proceeds in opposite directions on the two template strands
c) synthesis of the leading strand during replication always ends with an exposed 3' carbon on the last nucleotide.
d) all of the above.
e) only answers (b) and (c) are correct.

QR2 Consider a genetic character with two possible alleles, one dominant and one recessive. When a pair of heterozygotes mate and produce many progeny,

a) you expect the two phenotypes to occur in equal numbers in the progeny.
b) you expect progeny genotypes to be in a 3:1 ratio.
c) you expect recessive traits to be apparent in 75% of the progeny.
d) you expect progeny genotypes to be in a 1:2:1 ratio.
e) none of the above.

QR3 In protein translation,

a) the ribosome consumes ATP every time a new amino acid is added.
b) energy is brought with each amino acid to the ribosome, which produces ADP as waste.
c) a protein polymerase covalently connects three amino acids into codons.
d) a signal moves across a membrane when a ligand binds to its receptor.
e) answers (a) and (b) are correct.
f) none of the above.

QR4 Mitosis

a) includes cell division.
b) includes one round of DNA replication and two rounds of chromosome division.
c) results in diploid cells.
d) results in haploid cells.
e) is prone to crossing over (recombination).
f) none of the above.

QR5 DNA mutations

a) may convert a recessive allele into a dominant allele.
b) may convert a dominant allele into a recessive allele.
c) may not have any effect on the gene's function.
d) are difficult to define since no two individuals have identical DNA.
e) all of the statements above are true.
f) none of the statements above are true.

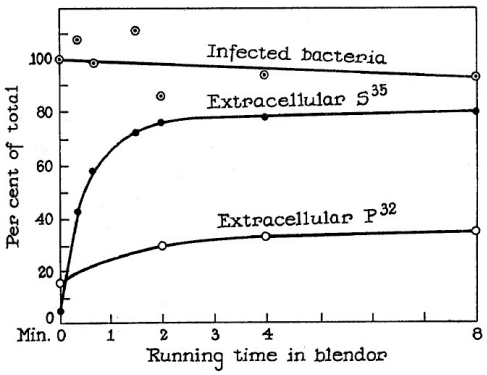
QR6 Alleles can be dominant or recessive. Which statement is true?

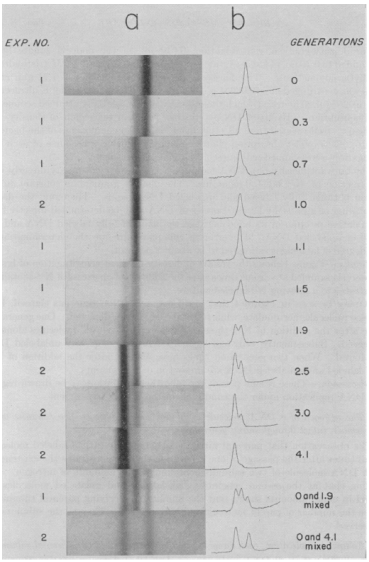
a) You cannot predict if a new allele is dominant or recessive by looking at the DNA sequence.
b) Unlike recessive alleles, dominant alleles must be inherited from the previous generation.
c) Recessive phenotypes are more common in girls than boys because girls have two X chromosomes.
d) Some dominant phenotypes can skip a generation if they are on the Y chromosome.
e) None of these statements are true.

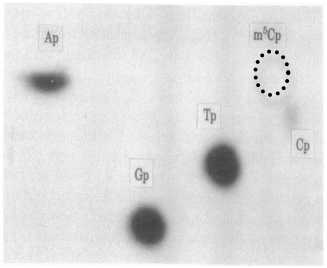
QR7 In order for a eukaryotic gene to be transcribed, the gene

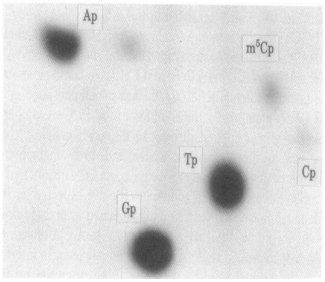
a) must have at least one transcription factor bind to its promoter.
b) must contain at least one intron and two exons.
c) must be methylated on at least some of its cytosines.
d) cannot be linked to a mutant dominant allele.
e) cannot be longer than 100,000 base pairs in length.
f) only a and b are correct.
g) none of the statements above are correct.

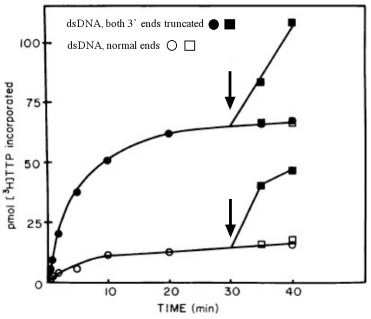
Data Gallery

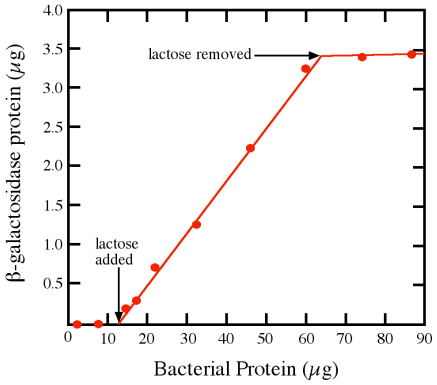


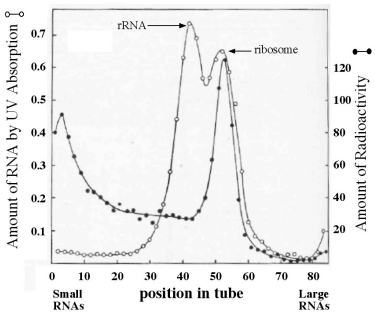


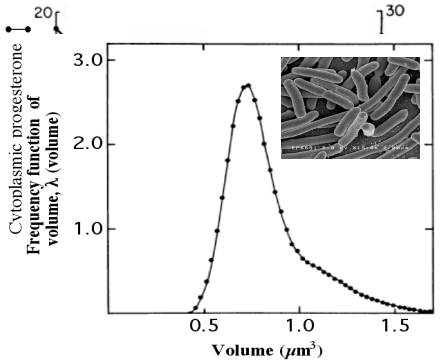


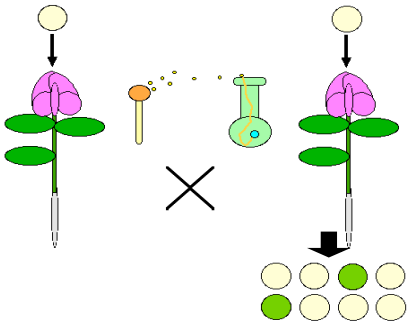


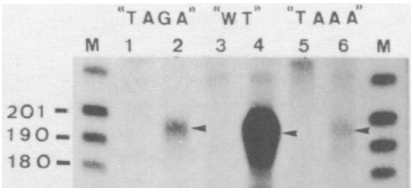


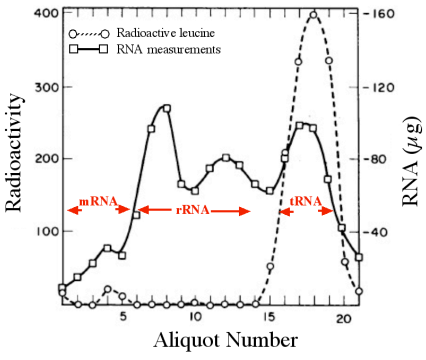


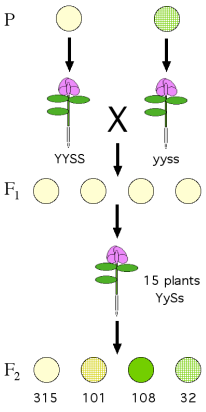












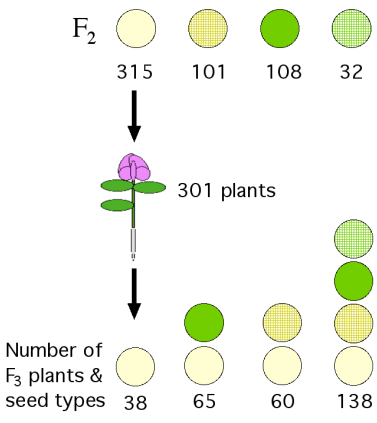


Table 1.3 Demonstration of radioactive viruses (by percent total radioactivity) behaving like normal viruses.

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

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**

	DNA polymerase I		DNA polymerase II	
Ions (conc. in mM)	DNA length	Error rate	DNA length	Error rate
Mg^{2+} alone (1.0)	65	1 in 10,800	513	1 in 41,000
Mg^{2+} & Ni^{2+} (1.0 & 1.0)	27	1 in 1,500	93	1 in 5,030
Mg^{2+} & Ni^{2+} (1.0 & 2.0)	6	1 in 330	37	1 in 1,850
Mg^{2+} alone (1.0)	66	1 in 11,000	596	1 in 41,100
Mg^{2+} & Cd^{2+} (1.0 & 0.1)	34	1 in 900	125	1 in 7,810
Mg^{2+} & Cd^{2+} (1.0 & 0.2)	50	1 in 90	76	1 in 5,070
Mg^{2+} alone (1.0)	83	1 in 11,070	572	1 in 40,900
Mg^{2+} & Ca^{2+} (1.0 & 0.6)	36	1 in 4,240	124	1 in 7,520
Mg^{2+} & Ca^{2+} (1.0 & 1.0)	25	1 in 3,570	88	1 in 5,500
Mg^{2+} & Ca^{2+} (1.0 & 2.5)	12	1 in 1,850	32	1 in 3,760

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

	% 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

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

Table 2.3 Growth data from deletion mapping in Figure 2.20.

Deletion	- His Growth	+ AT Growth
+6	none	none
+4	none	none
+2	none	none
-29	none	none
-60	9	none
-78	5	none
-90	4	none
-92	5	none
-113	5	none
-155	3	Yes
-185	3	Yes
-205	3	Yes
-220	3	Yes
-250	3	Yes
-300	3	Yes
WT	3	Yes

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 μm³ and divided in half	2*0.1*50	+10
Equals new # of cells after 10 seconds		106

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**

Cause of Death	Lifetime Odds (USA)
Any accident	1 in 36
Motor vehicle accident	1 in 81
Firearm	1 in 202
Poisoning	1 in 344
Falling object (excluding objects from space)	1 in 4,873
Drowning in bathtub	1 in 10,455
Suffocation by plastic bag	1 in 130,498

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