Fall 2003 Biology 111 Exam #2 – Classical Genetics

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, except for typing. There are four pages for this test, including this cover sheet. You are not allowed to use your notes, old tests, the internet, or any books, nor are you allowed to discuss the test with anyone until all exams are turned in at 8:30 am on Friday October 10. **EXAMS ARE DUE AT CLASS TIME ON FRIDAY OCTOBER 10.** 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.

-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):

Write out the full pledge and sign:
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 (excluding typing)?

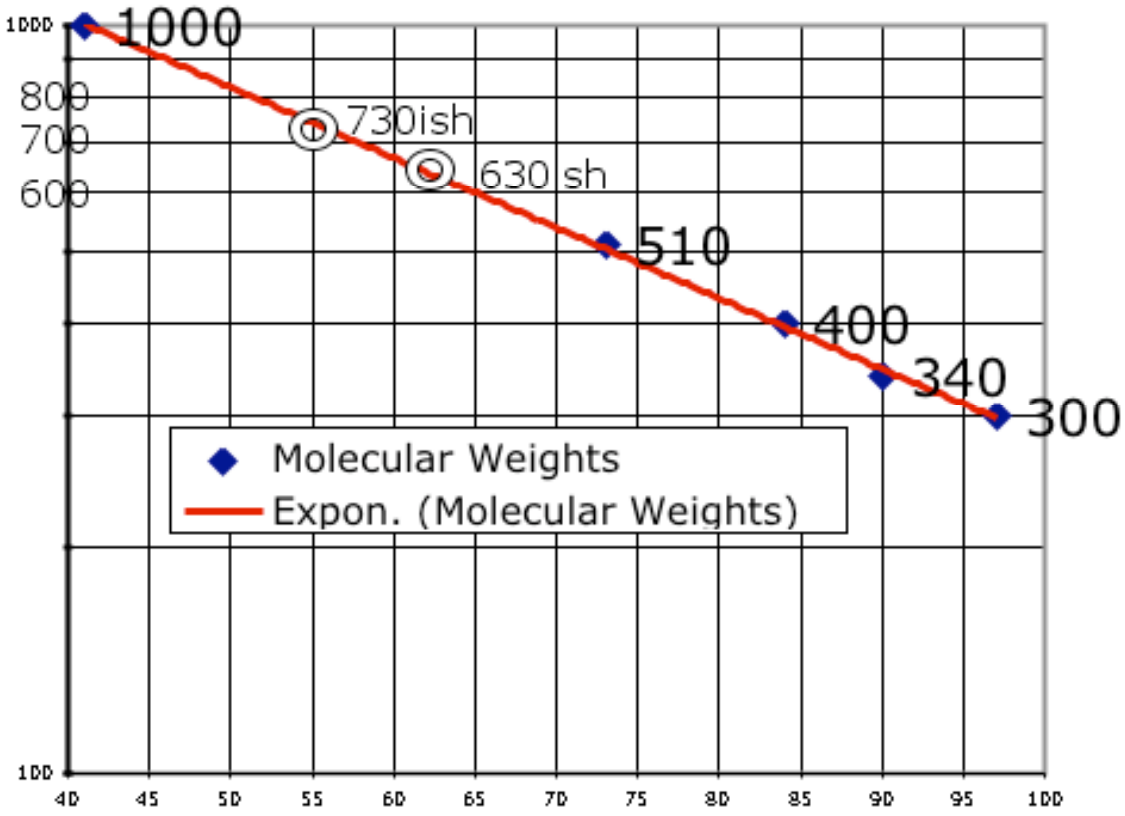
Lab Questions

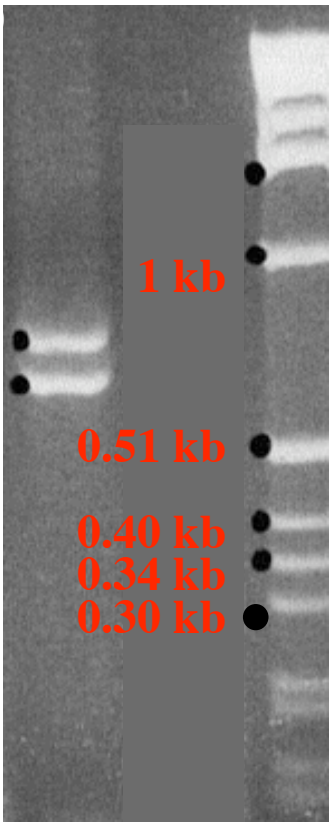
6 pts.

1) Calculate the molecular weights of the two bands marked by dots in the gel on the right.

Use this graph paper to receive full credit.

This has been scaled down for the key





4 pts.

2) If the basic PCR product is 350 bp and the VNTR consists of the repeated sequence GCAT, how many copies of this repeated sequence are in the two bands you measured?

95 repeats

70 repeats

Lecture Questions

12 pts.

3) Describe three examples of post-translational modification experienced by proteins.

glycosylation is the addition of sugars

disulfide bonds is the covalent bond formation between cysteines

trimming is the protease cutting of the original amino acid sequence to something shorter.

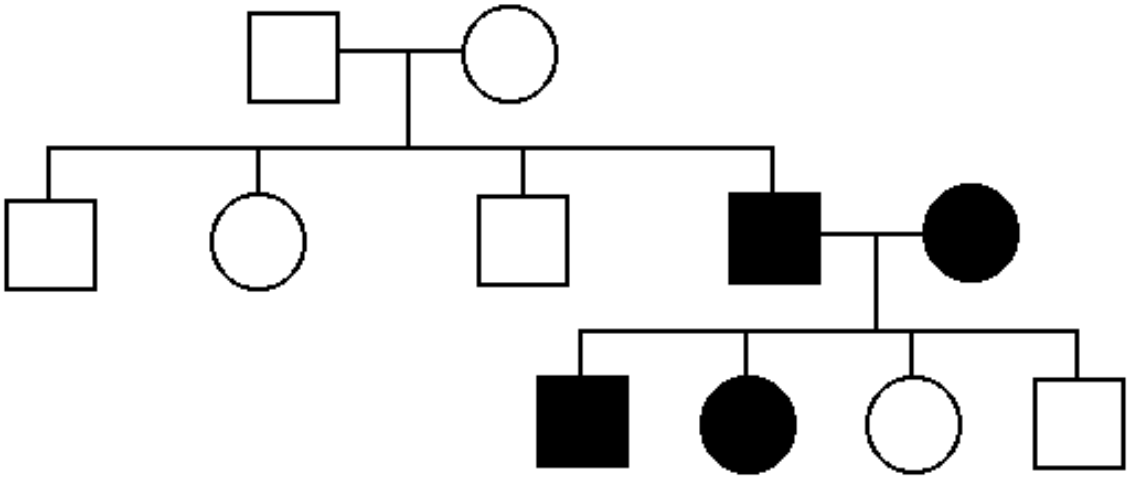
6 pts.

4) Describe a situation where a population has 60% penetrance for a bizarre phenotype (have fun with the phenotype you choose).

Penetrance is the degree to which a phenotype is shown in the population. 60% penetrance means that 60% of the people with the appropriate genotype display the phenotype.

8 pts.

5) Looking at the pedigree below, determine if this phenotype is dominant, recessive or incomplete dominant. To receive full credit, you must support your answer with data.



It must be dominant since the parents in the F1 generation produce wt offspring.

12 pts.

6) A pair of chameleons mated and produced 12 offspring with 3 horns and 4 with two horns.

3 horns is dominant and 2 horns is recessive: the parents must be heterozygous.

a. If they had one more baby, what are the odds that their next offspring will be a male with 2 horns?

1/2 male x 1/4 2 horns = 1/8 probability

b. In the next breeding season, what are the odds of them having two male babies with two horns and one female baby with three horns?

1 male with 2 horns = 1/2 * 1/4 = 1/8

1 female with 3 horns = 1/2 * 3/4 = 3/8

MMF = 1/8 * 1/8 * 3/8 = 3/512

OR MFM = 3/512

OR FMM= 3/512

Total Odds = 3(3/512) = 9/512

c. What are the odds of this couple producing three females with two horns each?

FFF = (1/2*1/4) * (1/2*1/4) *(1/2*1/4) = 1/512

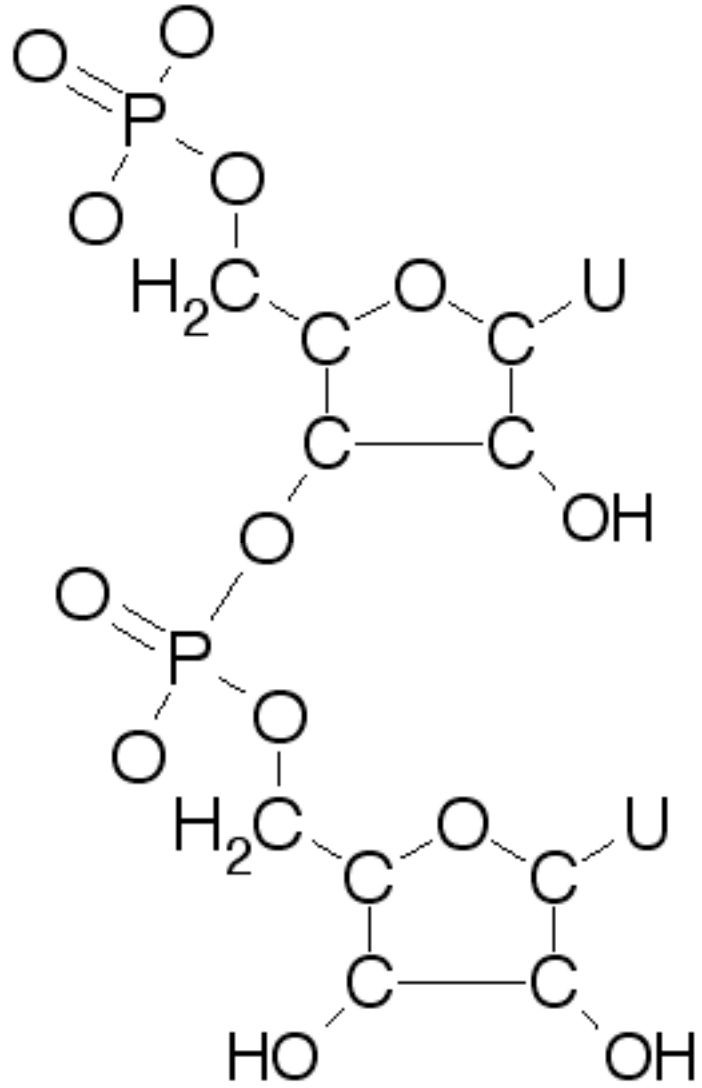
8 pts.

7) Explain why a black moth and a white moth could have gray offspring. To receive full credit, you must explain your answer using molecular terminology as well as Mendelian terminology.

This is an example of incomplete dominance where each allele (black and white) contribute to a blended phenotype in the heterozygous offspring.

10 pts.

8) On your own paper, draw a dinucleotide of RNA. For the bases, simply use one letter abbreviation that indicates it has to be RNA and not DNA. Your diagram must include the structures of all parts except the bases which can be represented by single letters.



6 pts.

9) Describe a change in DNA that may lead to a dominant allele but the DNA sequence of the gene is not altered.

Gene duplication or transposition could lead to over abundant RNA production and thus a dominant mutation.

6 pts.

10) Why do red blood cells take on the sickle shape in people who suffer from sickle cell disease.

The mutated □-globin alters the shape of the hemoglobin molecule when exposed to low oxygen. This altered shape allows the hemoglobin to produce crystals and thus deform the overall shape of the RBC. The change in shape was due to a missense mutation (6Glu-> Val).

8 pts.

11) Pick one protein used during transcription that could lead to a recessive disease if a person inherited two recessive alleles at this locus. Explain how this protein would result in a specific genetic disease.

Transcription factors not produced in a functional way could result in a recessive disease since the gene that normally would be transcribed by these transcription factors would not be transcribed any more.

6 pts.

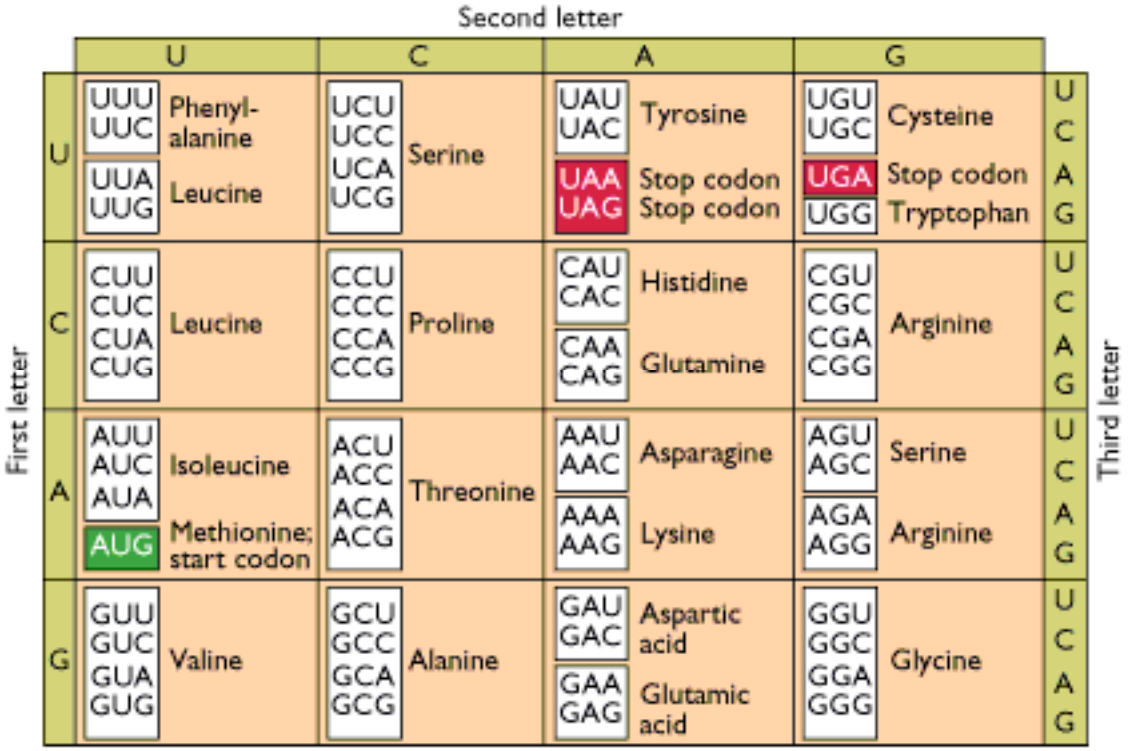
12) How are RFLPs related to the process of DNA fingerprinting?

RFLP are banding patterns that are due to DNA sequence which is highly variable in people. To DNA fingerprint, we want to test several RFLP loci to produce a banding pattern that is unlikely to match any other person. RFLPs are better at determining innocence than guilt.

8 pts.

13) Using this protein sequence, deduce an mRNA sequence (you only need to supply one of the many possible sequences). When you type your answer, be sure to group your letters in the appropriate reading frame with spaces between the codons.

Methionine,	Proline,	Lysine,	Glutamic Acid	Cysteine,	Tryptophan,	Histidine.	stop
AUG	CCU	AAA	GAA	UGU	UGG	CAU	UAG
	CCC	AAG	GAG	UGC		CAC	UAA
	CCA						UGA
	CCG						


Second letter
U
C
A
G
First letter
Third letter
U
UUU UUC Phenyl-alanine
UUA UUG Leucine
UCU UCC UCA UCG Serine
UAU UAC Tyrosine
UAA Stop codon
UAG Stop codon
UGU UGC Cysteine
UGA Stop codon
UGG Tryptophan
C
CUU CUC CUA CUG Leucine
CCU CCC CCA CCG Proline
CAU CAC Histidine
CAA CAG Glutamine
CGU CGC CGA CGG Arginine
A
AUU AUC AUA Isoleucine
AUG Methionine; start codon
ACU ACC ACA ACG Threonine
AAU AAC Asparagine
AAA AAG Lysine
AGU AGC Serine
AGA AGG Arginine
G
GUU GUC GUA GUG Valine
GCU GCC GCA GCG Alanine
GAU GAC Aspartic acid
GAA GAG Glutamic acid
GGU GGC GGA GGG Glycine