Fall 2001 Biology 111 Exam #2 – Classical Genetics

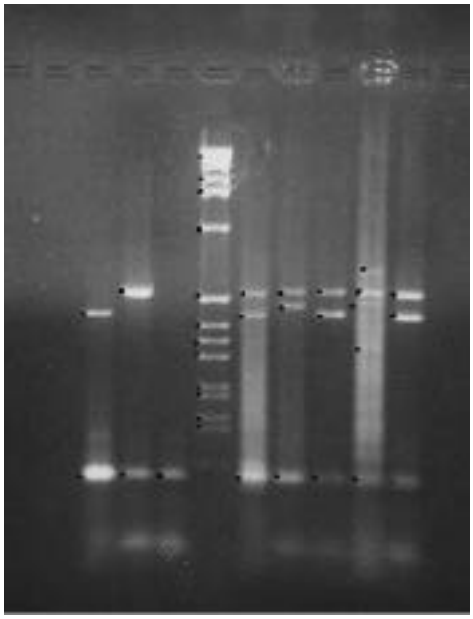
There is no time limit on this test, though I have tried to design one that you should be able to complete within 2.5 hours, except for typing. There are four pages for this test, including this cover sheet. You are not allowed to use your notes, old tests, the internet, or any books, nor are you allowed to discuss the test with anyone until all exams are turned in at 11:30 am on Monday October 8. **EXAMS ARE DUE AT CLASS TIME ON MONDAY OCTOBER 8**. 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:

How long did this exam take you to complete (excluding typing)?

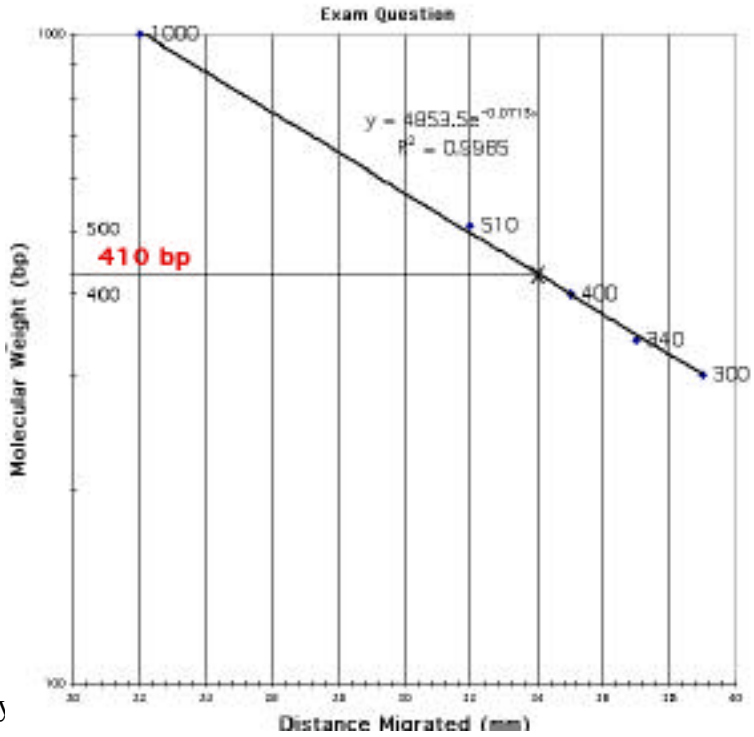
Lab Questions:
3 pts.
1) List the ingredients needed in order for a PCR mixture to work properly.
Taq DNA polymerase, dNTPs, template DNA, two primers.



7 pts.

2) Calculate the molecular weight of the band in the far left lane. To receive full credit, you must calculate your answer by using a graph that you must draw on the last page of this exam. A key to the molecular weight markers is on the last page.

MW	Distance
1000	22
510	32
400	35
340	37
300	39



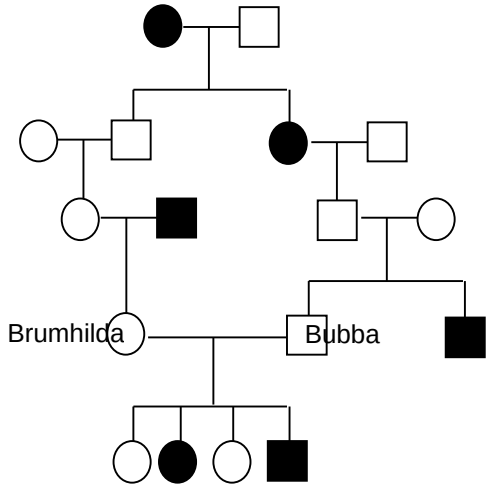
Unknown migrated 34 mm
Unknown is about 410 bp

Lecture Questions:

10 pts.

3) Draw a pedigree for the following family necessary to produce progeny.

Brumhilda married Bubba and they have four children – three girls and newborn boy. The boy and the middle girl have retinitis pigmentosa. Neither Brumhilda nor Bubba had the disease but Bubba's brother does. Bubba's father is a first cousin to one of Brumhilda's parents. Bubba's paternal grandmother had only one sibbling who was Brumhilda's maternal grandfather. Bubba's paternal grand mother had retinitis pigmentosa as did Brumhilda's father. Finally, the mother in the P generation also had retinitis pigmentosa.



8 pts.

4) Deduce the genotypes for the following individuals:

Key: R = dominant wild-type allele and r = recessive mutant allele

Brumhilda's husband = Rr

Brumhilda's father = rr

Bubba's paternal great grandmother = rr

Bubba's mother = Rr

4 pts.

5) During mitosis, sister chromatids separate. During what meiosis phase do sister chromatids separate?

anaphase II

8 pts.

6) What were the odds that Burmhilda and Bubba could have three girls and a boy when one girl and the boy had retinitis pigmentosa?

0.0264 or 2.64% chance

3 girls and 1 boy = 1/16 =0.0625

GGGB or GGBG or GBGG or BGGG = 4 possible combinations

D + wt + wt + D = 0.035

WDWD, WWDD

there are 3 combinations that would satisfy this situation

Odds of GGGB and disease + wt + wt + disease = 0.0625 x 0.035 = 0.0022

0.0022 times 4 combinations times 3 combinations = **0.0264 or 2.64% chance**

6 pts.

7) What specific genetic defect causes sickle cell disease?

A point mutation that was a base pair substitution. This lead to a missense mutation with valine substituted with a glutamic acid. This change in structure lead to an ability for hemoglobin to form crystals when in a low oxygen environment.

18 pts.

8) Below is the coding strand of a segment of DNA. Tell me the mRNA and also the amino acid sequences if the first DNA nucleotide is the start transcription site. Begin to translate when you see a start codon for methionine (Met). The genetic code is provided for you at the end of the test. For your protein sequence, you only need to supply the three letter code for the amino acids as are shown in the genetic code table.

3′ GGCAATACCCGGTCGAACTCTTTTTCACCATTGGATCCGGT 5′
5′ CCGUUAUGGGCCAGCUUGAGAAAAAGUGGUAACCUAGGCCA 3′(mRNA)
MetGlyGlnLeuGluLysLysTrp**stop**

8 pts.

9) Nonsense and missense mutations usually destroy a gene's ability to produce a functional protein. Explain why this is so.

With the incorrect amino acid sequence, the structure cannot be maintained and thus the function is also lost. A nonsense mutation would lead to a shortened protein since this mutation is caused by the production of a stop codon where an amino acid used to be. Missense mutations produce a protein where one or more amino acids have been substituted by other amino acids. This can alter the function of the protein if the mutation is in a critical part of the protein.

7 pts.

10) The Japanese woman who had a mutant SRY gene was sterile. Do you think she inherited this mutation or do you think it was a new mutation in her. Explain your answer.

This had to be a new mutation since both of her parents were fertile. She could not have gotten the mutation from her XY father since he was male. Her mother could not have been an XY female with the mutation since she was able to get pregnant.

12 pts.

11) Are these traits linked or are they unlinked? Support your answer by calculating the recombination frequency between the two loci regardless of your conclusion about linkage or no linkage.

Bulging nostrils is a dominant trait over aerodynamic nostrils.
Knee dimples is dominant over rounded knees.

A bunny with bulging nostrils and dimpled knees mated with another bunny that had aerodynamic nostrils and rounded knees. They produced 60 progeny with aerodynamic nostrils and rounded knees; 62 progeny with bulging nostrils and dimpled knees; 40 progeny with bulging nostrils and rounded knees; and 38 progeny with aerodynamic nostrils and dimpled knees.

These are linked and separated by 39 map units.

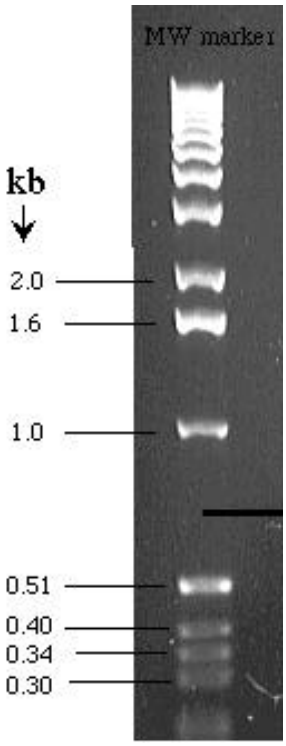
9 pts.

12) Define allele, gene and locus. Give a specific example for each term using a protein or trait we have studied this semester.

An allele is a form of a gene in the sense that one form can be dominant and the other recessive. For example, the wildtype allele for CF is dominant but the mutant version is recessive.

A gene is a segment of DNA that encodes a trait. One example is the gene that can cause CF when a person carries two mutant alleles.

A locus is a physical location on a chromosome where a particular segment of DNA is located. For example, in lab we determined our genotypes for the locus D1S80 which is located on chromosome number 1.



Courtesy Access Excellence Web Site:

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	STOP	STOP	A
	Leu	Ser	STOP	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G