

Supplemental Material

CBE—Life Sciences Education

Adams et al.

In-class problems for lecture 5 and readings

1. The LM and LN alleles at the MN blood-group locus show co-dominance. Give the expected genotypes and phenotypes and their ratios in progeny resulting from the following cross:

$$L^M L^N \times L^M L^N$$

2. Assume that long ear lobes in humans are an autosomal dominant trait that shows 30% penetrance. A person who is heterozygous for long ear lobes mates with a person who is homozygous for normal ear lobes. What is the probability that their first child will have long ear lobes?

3. Stem length is due to alleles at the L gene. A homozygous plant with long stems is crossed to a homozygous plant with short stems. All the F1 have intermediate length stems. When these F1 are crossed with each other, $\frac{1}{4}$ of the offspring have long stems, $\frac{1}{2}$ of the offspring have intermediate stems, and $\frac{1}{4}$ have short stems.

What is the genotype and phenotype of each of the parents, the F1 and the F2?

4. Four different alleles of a single gene in rabbits determine coat color. How many different genotypes are possible, when this locus alone is considered?

5. In a cross between two rabbits that are both heterozygous for coat color, one of them carrying the C-1 and C-2 alleles, and the other carrying the C-3 and C-4 alleles, what genotypes would be expected in the offspring?

6. In chickens, comb shape is determined by alleles at the R and P loci. The following genotypes cause the phenotypes shown:

R-P- walnut comb
R-pp rose comb
rrP- pea comb
rrpp single comb

What progeny and in what proportions, are expected from the following cross:

RrPp x rrpp

7. In a cross between two true-breeding plants, one with green leaves and one with yellow leaves, all the F1 had green leaves. Two F1 plants were crossed to each other and in the F2, 249 had green leaves and 16 had yellow leaves. Give the genotypes of all the plants in the parental, F1 and F2 generations.

8. Coat color in labradors is due to two genes, the E and the B genes. The ee gene causes dogs to be golden, regardless of the genotype at the B locus. If there is at least one dominant E allele present, dogs are chocolate if they are bb and black if they are B-

a. Is this an example of dominant or recessive epistasis?

b. In a cross between a golden female and a chocolate male, half the puppies were chocolate and half were golden. What are the genotypes of the parents and the offspring?

9. In a biochemical pathway where white pigment is converted to blue pigment by the dominant allele of the A gene, and blue pigment is converted to purple pigment by the dominant allele of the B gene, what are the expected genotypes and phenotypes from a cross of AaBb x AaBb?

In-class problems for lecture 11**Group #****Names:**

1. A series of two-point crosses, involving 7 genes (a-g), were carried out, and the following recombination frequencies were obtained. Place the seven genes into linkage groups (where a linkage group is any group of genes that are genetically linked to each other). Within each linkage group, determine the order of genes and the distances between them.

Genes	% recombination	Genes	% recombination
a-b	50	c-d	50
a-c	50	c-e	26
a-d	12	c-f	50
a-e	50	c-g	50
a-f	50	d-e	50
a-g	4	d-f	50
b-c	10	d-g	8
b-d	50	e-f	50
b-e	18	e-g	50
b-f	50	f-g	50
b-g	50		

2. A potato plant homozygous for the recessive alleles of three different genes (rrwwtt) that are linked on chromosome 3 is crossed to a plant that is homozygous for all three dominant alleles (RRWWTT). The resulting F1 are then crossed with a plant homozygous for the recessive alleles in a three-point testcross. The progeny from the test cross are:

rwT	87
RWt	94
RWT	3479
rwt	3478
RwT	1515
rWt	1531
rWT	292
<u>Rwt</u>	<u>280</u>
Total	10,756

a. Without calculating linkage, determine the order of the genes on the chromosome. Explain how you did it.

b. Now calculate the map distances between the genes

3. Three linked genes – the M,A and R genes- influence coat color in mice. A three – point testcross was performed, mating mice that were heterozygous for all three genes with mice that were homozygous recessive for all three genes. The following numbers of gametes were obtained:

arM	1
ARm	1
aRM	15
Arm	9
ARM	16
arm	36
aRm	76
<u>ArM</u>	<u>69</u>
Total	213

- what is the linkage between the three genes?
- what does this tell you about the order of the genes on the chromosome?
- which gametes came from a double-cross-over event?
- draw a diagram of the two chromosomes in the triply heterozygous mice used in the testcross, indicating which alleles were present, and in what order they were found, on each chromosome. Does your diagram support your conclusion in c about which gametes came from the double cross-over event?



Human Subject Informed Consent

Anonymous BIO240 Survey – Fall 2014 *(Please do NOT put your name on this sheet)*

Research Information Sheet

Dear Participant:

You are being invited to participate in a research study entitled ““What factors influence success in BIO240 (Genetics and Evolution)? ”. This study is being done by Dr. Alison Adams from Northern Arizona University.

The purpose of this research study is to determine what helps students to succeed in BIO240. If you agree to take part in this study, you will be asked to complete an in-class survey. The survey will ask you how you about yourself, how you study and how much time you spend on various aspects of the course (*e.g.*, taking lecture notes, working on assigned in-class worksheets, reading the text book, taking online quizzes). You will also be given open-ended questions for other comments. The survey should take less than 10 minutes and will be conducted during class time. To determine if there is any correlation between student success and type of student lecture notes, during class time students will also be asked randomly for a sample of their notes, which will be visually scanned by the instructor during class time, and categorized by type (*e.g.*, level of detail; handwritten or computer notes etc.).

You may not directly benefit from this research; however, we hope that your participation in the study will benefit the educational community, as it will provide scholarly information on factors affecting success of students taking Genetics and Evolution.

We believe there are no known risks associated with this research study; however, as with any research activity the risk of a breach of confidentiality is always possible. To the best of our ability your answers in this study will remain confidential. For example, data will be treated confidentially like all other class data, and no student identifiers will be used if the study is published. Electronic data will be stored on Dr. Adams’ computer until publication, at which time the data will be deleted.

Your participation in this study is completely voluntary and you can withdraw at any time. You are free to skip any question that you choose. If you choose not to participate it not affect your relationship with Northern Arizona University or result in any other penalty or less of benefits to which you are otherwise entitled. If you have questions about this project or if you have a research-related problem, you may contact the researcher, Alison Adams by phone (523-0393) or email (Alison.adams@nau.edu). If you have any questions concerning your rights as a research subject, you may contact Northern Arizona University IRB Office at irb@nau.edu or (928) 523-7288.

By submitting this survey, I affirm that I am over 18 years of age and agree that the information may be used for research purposes.



1. What is your current class standing by credit hours?

- Freshman
- Sophomore
- Junior
- Senior

2. For each of the following items, indicate how useful it is for your learning (from 5 = very useful to 1 = not useful at all):

	<u>Usefulness</u>							
	Not At All	1	2	Moderate	3	4	Very	5
a. Text book (Pierce)	1	2	3	4	5			
b. Online lecture	1	2	3	4	5			
c. In-Class worksheets/Discussion	1	2	3	4	5			
d. Pre- and post-class online quizzes	1	2	3	4	5			

3. For each of the following items, indicate on average how many hours per week you spent working on it:

	<u>hours/week</u>				
	0	0-2	2-4	4-6	>6
a. Text book	0	0-2	2-4	4-6	>6
b. Online lecture	0	0-2	2-4	4-6	>6
c. In-Class worksheets/Discussion	0	0-2	2-4	4-6	>6
d. Pre- and post-class online quizzes	0	0-2	2-4	4-6	>6

4. Which section are you in?

- 2.20-3.35 pm Mon, Wed
- 4-5.15 pm, Mon, Wed

5. If you are in the 2.20-3.35 section, skip this question.

If you are in the 4-5.15 pm section, which do you use for the online lecture?

- audio
- visual
- audio and visual

6. If you are in the 2.20-3.35 section, skip this question.

If you are in the 4-5.15 pm section, how do you take lecture notes?

- I take handwritten notes
- I take typed notes
- I print out the online lecture and add notes while I watch the lecture
- I print out the online lecture without adding notes while I watch the lecture
- I download the online lecture to my phone/computer without printing or taking any notes
- I did not watch the lecture or take notes
- other (explain)

7. If you are in the 4-5.15 pm section, skip this question.

If you are in the 2.20-3.35 pm section, how do you take lecture notes?



- I use a tape recorder
- I take handwritten notes
- I type notes onto my computer
- I do not take notes- I just listen without taking any notes
- other (explain)

8. Please indicate your level of agreement with the following statements (from 5 = strongly agree to 1 = strongly disagree):

	<u>Agreement</u>				
	Strongly Disagree		Neutral		Strongly Agree
<i>a. The material in this class is very interesting to me.</i>	1	2	3	4	5
<i>b. Genetics and Evolution is one of my favorite subjects.</i>	1	2	3	4	5
<i>c. The material presented in this class is relevant to my life.</i>	1	2	3	4	5
<i>c. The material presented in this class is relevant to my major/career.</i>	1	2	3	4	5
<i>d. I am willing to spend additional time reading about Genetics topics.</i>	1	2	3	4	5
<i>e. If I had a chance, I would like to do a research project in Genetics.</i>	1	2	3	4	5

9. If given a choice in course format, which do you prefer?
- Traditional in-class lecture
 - Flipped classroom (with online lecture instead of in-class lecture)
 - No preference

Explain: _____

10. If there were one thing that you could change about this course, what would it be?

11. How often did you go to the other section of BIO240?
- never
 - 1-5 times
 - 5-10 times
 - 10-20 times

12. What is your current grade in this class?
- A
 - B
 - C
 - D
 - F

Thank you for your participation!