**Homework # 4 – Linkage**

Plant Breeding & Genetics, PBG430 & PBG530

**Due Monday, Feb. 20, in class, as hard copy.**

1. Three genetic loci are linked together on the same chromosome in the order A, B, and C. Double cross-overs mean that the recombination frequency between A and C is less than the sum of the recombination frequencies between A and B and B and C. Double cross-overs can also involve 2, 3 and 4 strands (see slide 18 of the Linkage lecture). Fill in the boxes below with bivalents for the results of meiosis for an F1 plant heterozygous at all three loci (AaBbCc) produced from a cross between one parent AABBCC and the other aabbcc and show the different gametes than can be produced form 2, 3 and 4 strand double cross-over. In each case, one cross-over is between A and B and the other between B and C. To help visualization, use a straight line for the A B C parental homolog and a squiggly line for the a b c homolog.

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| Type of Cross-Over | Drawing of the bivalent showing cross-overs for all three locibcaBCAbcaBCA | Drawing of 4 gametes produced and the resulting allele combinations, indicating whether they are parental or recombinant |
| 2 strand double |  | bcabCABcaBCA |
| 3 strand double | bcaBCAbcaBCAbcaBCAbcaBCA | bcaBCAbcaBCA |
| 4 strand double |  | bcaBCAbcaBCA |

1. The figure below shows graphical genotypes for random inbred lines 46 to 70 derived from a cross between diploid inbred parents in columns and their genotypes at 36 marker loci in rows. The column marker ‘Position’ gives the location of each marker in centiMorgans (cM) on a genetic map. Genotypes coded ‘a’ and highlighted in red are all derived from one parent and genotypes coded ‘b’ and highlighted in green are derived from the other parent.



* 1. Look at individual number 48. Identify any pairs of loci where a cross-over might have occurred
	2. Look at individual number 47. How many cross-overs do you think have taken place to produce this graphical genotype?
	3. On average, a cross-over is expected to occur once every 100 centimorgans. Do you think the result you observed in b is normal?
	4. Double cross-overs are not expected to occur within map distances of less than 10 centimorgans. Look at marker 510 (mlo\_4H). How many double-cross-over events do you observe for just this one marker from the graphical geneotypes?
	5. mlo\_4H is a disease resistance locus and was scored as either resistant or susceptible to provide a genotypic scoring. Disease occurrence can be sporadic; what do you conclude about the phenotypic scores for this marker?