1. Gene 1 has two possible alleles – a dominant \textbf{A} allele and a recessive \textit{a} allele. Gene 2 also has two possible alleles – a dominant \textbf{B} allele and a recessive \textit{b} allele. An individual with genotype \textbf{AA BB} is crossed with an individual with genotype \textit{aa bb} yielding dihybrid offspring with the genotype \textbf{Aa Bb}. One of the dihybrid individuals is test-crossed with an individual of genotype \textit{aa bb} yielding the following offspring:

- 155 \textit{Aa Bb}
- 43 \textit{Aa bb}
- 39 \textit{aa Bb}
- 163 \textit{aa bb}

a) Are these two genes linked? How do you know?

b) Diagram the chromosomes that contain these genetic loci for the dihybrid parent.

c) What percent of offspring inherited a recombinant chromosome? parental chromosome?

d) If the genes are linked, how many map units separate them?

2. In a particular plant species, single genes determine flower color and plant height and the genes are located on the same chromosome. A true-breeding plant that is tall with white flowers is crossed with a true-breeding plant that is short with red flowers. All of the offspring are tall and produce red flowers.

a) Determine which alleles for each gene are dominant vs recessive, and using your own symbols, indicate the genotypes of each true-breeding parent and the dihybrid offspring.

b) Diagram the chromosomes containing these genes for one of the dihybrid offspring.

c) Indicate what cross you would do to determine the distance in LMU between the two genes.

d) After carrying out the cross you indicated above, you get the offspring indicated below. Using these values, indicate the distance between these two genes in LMU.

- 9 tall with red flowers
- 7 short with white flowers
- 91 tall with white flowers
- 93 short with red flowers
3. A series of test crosses reveals that genes A, B, C and D are located on the same chromosome and are separated from each other by the indicated LMU. Construct a linkage map based on this information.

<table>
<thead>
<tr>
<th>gene pair</th>
<th>map distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and B</td>
<td>41 LMU</td>
</tr>
<tr>
<td>A and C</td>
<td>7 LMU</td>
</tr>
<tr>
<td>A and D</td>
<td>27 LMU</td>
</tr>
<tr>
<td>B and C</td>
<td>48 LMU</td>
</tr>
<tr>
<td>B and D</td>
<td>14 LMU</td>
</tr>
<tr>
<td>C and D</td>
<td>34 LMU</td>
</tr>
</tbody>
</table>

4. In *Drosophila*, normal (wild-type) eye color is red. A recessive allele for a particular autosomal gene results in a white eyes (*w*). A recessive allele for a different gene on the same chromosome results in curly wings (*cy*). The two genetic loci are 20 LMU apart. A true-breeding fly with white eyes and normal wings is crossed with a true breeding fly with red eyes and curly wings. All of the F₁ offspring have red eyes and normal wings. Indicate the probabilities of all possible phenotypes in the offspring of two F₁ dihybrid flies.