Use of a Genetic Marker Stock to Identify the Chromosomal Location of a Mutant Gene. (1/2002)

In order to identify the chromosomal location of a new mutant gene, it is convenient to use a genetically defined genetic marker stock which has genetic markers on each pair of chromosomes. We will demonstrate this technique using the "Curly over Plum (2): Dichaete over Stubble (3)" balanced marker stock. The dominant markers, Curly (Cy) and Plum (Pm) are located on chromosome #2, and the dominant markers Dichaete (D) and Stubble (Sb) are located on chromosome #3. Each of these genes is lethal in homozygous condition, and since these genes are accompanied by inversions, there is no crossing over between the pairs of genes which are on the same chromosome. Therefore this stock breeds true. Its correct genotype is: [Cy Pm+/Cy+ Pm; D Sb+/D+ Sb]. This stock is useful for determining the chromosomal location of new mutant genes. We will use a "vestigial wings (vg)" strain to represent our "unknown" new mutant stock, following the format shown in the Carolina Drosophila Manual (pp. 24-25).

1. Cross virgin vestigial females to balanced marker stock males. Obtain the F_1. If only F_1 males show the mutation (vestigial), it is a X–linked recessive. If all of the F_1 flies show the mutation, it is dominant (go to step #2). If none of the F_1 flies show the mutation, it is due to an autosomal recessive gene (go to step #3).

2. Dominant. Mate wild–type females with F_1 males of one of the four phenotypes: Cy;D, Cy;Sb, Pm;D, or Pm;Sb. For this mating choose the phenotype which least interacts with the expression of the mutation. Examine the offspring. An X–linked dominant will appear only in females. A chromosome #2 dominant mutant will not appear with Curly or Plum. A chromosome #3 dominant mutant will not appear with Dichaete or Stubble. A chromosome #4 dominant mutant will show independent assortment with both of the two dominant marker genes.

3. Autosomal recessive. Mate virgin females of the mutant strain with F_1 males of one of the four phenotypes produced in step #1: Cy;D, Cy;Sb, Pm;D, or Pm;Sb. For this mating choose the phenotype which least interacts with the expression of the mutation. Examine the offspring. A chromosome #2 recessive will not appear with Curly or Plum. A chromosome #3 recessive will not appear with Dichaete or Stubble. A chromosome #4 recessive will show independent assortment with both of the two marker genes.

Description of mutant stocks:

Curly - curly wings, homozygous lethal
Plum - purplish eyes, homozygous lethal
Dichaete - winds divergent, homozygous lethal
Stubble - bristles short and thick, homozygous lethal
" vestigial wings" - short wings
Note that since vestigial is a wing mutation, you will not want to use either Curley or Dichaete tester mutant stocks.

Diagram the crosses for each of the possible types of inheritance as indicated above, showing the expected results. Convince yourself that the instructions work, and show them to me. Do the appropriate crosses. Analyze your results and hand in a written report.