NAME _____

DATE _____

Two-Point Linkage with *Drosophila*

Most dihybrid crosses studied in introductory genetics activities use gene loci that are on separate chromosomes. What if the gene loci are on the same chromosome? How might that change the inheritance pattern of the two genes? In this activity you will study the offspring of a cross of female flies having yellow bodies and white eyes with wild-type males (gray bodies and red eyes).

A slash (/) is used to indicate that alleles and gene loci are on homologous chromosomes:

A/A one gene locus

A/A, B/B two gene loci, not linked

A B/A B two gene loci, linked

In the case of *Drosophila*, gene loci on the X chromosome often do not have corresponding loci on the male's Y chromosome. Phenotypes resulting from the actions of these genes are sex-linked because their inheritance is linked to the X chromosome. If gene loci A and B are linked on the X chromosome, then a male is hemizygous: A B/Y^0.

Assume that the alleles for yellow and white are recessive to the wild-type alleles. Choose symbols for the alleles that you will use in your following work.

_____ allele for yellow body

_____ allele for gray body

_____ allele for white eye

_____ allele for red eye

Assume that the loci for yellow and white are not linked.

P_1 Female, yellow body, white eyes × P_2 Male, gray body, red eyes

_____ × _____

F_1 genotype _____ F_1 phenotype _____

Assume that the loci for yellow and white are linked.

P_1 Female, yellow body, white eyes × P_2 Male, gray body, red eyes

_____ × _____

F_1 genotype _____ F_1 phenotype _____

Making a comparison

You will need a culture of F_1 flies, a FlyNap® kit, and an empty vial with plug for anesthetizing the flies. **Set the F_1 culture vial on a pad of paper. Tap the vial against the pad to knock the flies down.** Remove the plug from the vial and invert the empty anesthetizing vial over the mouth of the F_1 culture. While holding both vials mouth-to-mouth, invert them and tap the bottom of the anesthetizing vial against the pad of paper to knock flies from the F_1 culture into the anesthetizing vial. Plug both vials. Insert the wand into the FlyNap® solution. Rub the wand against the inner mouth of the bottle to remove excess solution. Cap the FlyNap bottle. Use fingers to push back the plug of the anesthetizing vial until you can insert the wand. Wait until the flies have fallen to the bottom of the vial (about 2 minutes). Remove the plug and dump the anesthetized flies onto an index card. Place the card on the stage of a stereomicroscope and sort the flies by sex and phenotype. Record the results below.

Do your results show linkage or non-linkage? Explain.

What additional assumption(s) must you make to explain the results you observed in the F_1?

Using your new assumptions, diagram and explain this cross:

P_1 Female, yellow body, white eyes × P_2 Male, gray body, red eyes

F_1 genotype _____ F_1 phenotype _____

What would be the expected F_2 of this cross? Show a Punnett square or branching diagram of the cross and give the phenotypes and their ratios of the F_2.

_____ × _____

If there is crossing-over between the gene loci for body and eye color, what new genotype and phenotype combinations will be produced in the F_2? Notice that crossovers will occur only in the female.

Set up the cross to produce the F_2. When the F_2 flies begin emerging, anesthetize them, sort them by sex, and score their phenotypes. Discard these flies in the morgue. Do not return them to the culture vial. Do this each day for 3–5 consecutive days. Total all counts for all lab groups and record the results below.

Do your results show that crossing-over has occurred? If so, use your data to calculate the linkage distance as the percentage of recombinants.

Map distance = total recombinants/total flies counted × 100 = _____

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