How-To-Do-It

An Inquiry Activity for Genetics Using Chromosome Mapping

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Have you been looking for interesting and inquiry-oriented activities to develop basic concepts in genetics? Genetics can be one of the most difficult areas in biology for getting students involved in solving problems, because most standard heredity experiments for students take relatively long periods of time. The following lesson can easily be done in one class period and will likely captivate the students because of its mystery-like format. This activity can be used successfully either as an introduction to genetics for students who enjoy challenges, or as a review for students who have already studied some Mendelian genetics and sex determination. The concepts to be developed, the objective, and the student activity are described below. Only the Activity section and figure 1 are to be given to the students initially. After the students carry out the activity, the Objectives and Concepts could be shared with them as reinforcement and summary.

There are no special materials required except the simulated chromosome maps (figure 1). These "photomicrographs" are actually cut from the labels of Campbell's soup cans. As you know, the thickness and sequence of the bands on the labels are codes for numbers which are in turn read by an optical scanner at the checkstand and interpreted as price and reorder data. The numerical values of each label are actually printed right next to the band. Different soups of the same brand will generally have close to the same number on the label. If you plan to illustrate only one trait, it is ideal to have most (but not all) of the lines match up so the students can locate the "gene locus" of the trait in question on the simulated chromosome map. You will need to make sure that the sequence of numbers is the same on all labels that you plan to use to represent the same chromosome. The numbers on the two labels used to represent the different X chromosomes in this example are 51000 11251 and 51000 12351 respectively. (Note that the map for one of the chromosomes of Fly E has been inverted to make this activity a little more puzzling.)

Concepts

1. Banding patterns on chromosomes can identify the locations of certain genes.
2. Fruit fly males have one X chromosome and females have two.
3. White eyes in fruit flies are recessive to red eyes.
4. The ratio of offspring in a cross between a heterozygous red-eyed female and a white-eyed male is one red-eyed male to one red-eyed female to one white-eyed male to one white-eyed female.
5. Only the X chromosome, but not the Y chromosome, carries genes for eye color in the fruit fly.

Objectives

Upon an examination of banding patterns on a chromosome "map" of

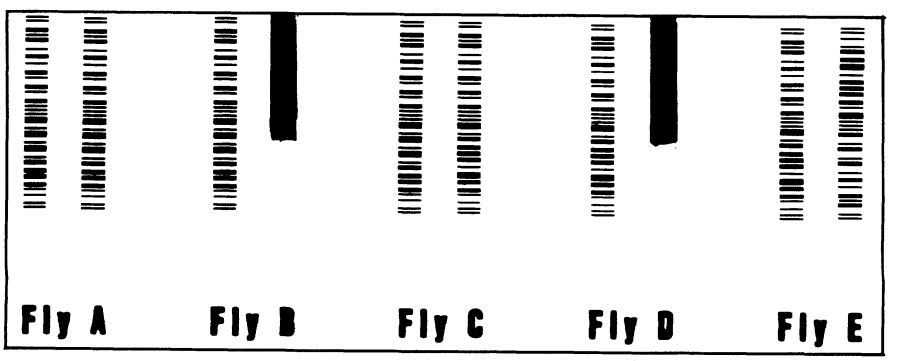

FIGURE 1. Sex chromosome maps of five different fruit flies.

male and female fruit flies, the student will:

1. Hypothesize the location of certain genes.
2. Determine the sex of each of the samples.
3. Hypothesize the eye color phenotype and genotype of given samples.
4. Hypothesize a ratio of possible fruit fly offspring for eye color and sex.

Activity: "The Fruit Fly Chromosome Mystery"

Below are the sex chromosome maps of five different fruit flies. The X chromosome contains the gene for eye color. The red-eye gene is the allele to the white-eye gene and is dominant over the white-eye gene. The Y chromosome contains no genes. Fly D has white eyes. The gross structure of the sex chromosomes in the fruit fly is similar to that of humans. Your task is to unravel the following mysteries:

1. Where is the location for eye color on the chromosome map?
2. What is the sex and eye color of each individual?
3. What are the genotypes for sex and eye color for each individual?
4. What is the ratio of possible offspring between Fly C and Fly D?

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often-fatal form of pneumonia caused by the protozoan, *Pneumocystis carinii*. Other forms of GRID involve autoimmune diseases such as lupus and various cancers including Burkitt's lymphoma, cancers of the tongue and anus, and Kaposi's sarcoma, a malignancy of the immune system. Kaposi's sarcoma is particularly alarming because it is rapid-developing and frequently fatal.

No one is sure what causes GRID or why it has suddenly appeared now. Most, though not all, cases have been among homosexual males who had a large number of sexual partners and who used sexual stimulants such as amyl nitrite as well as illicit drugs. Though some suspect that nitrites are involved, the evidence isn't overwhelming. Others think the immunosuppression and cancers are linked to infection with cytomegalovirus. Some even feel the semen itself may be responsible since it can be a potent immunosuppressive if it gets into the bloodstream. Finally, over-the-counter cortisone creams used for skin irritations may suppress immunity because membranes of the anus and genitals readily absorb the cortisone. This last explanation would account for the sudden appearance of GRID because these creams have only become available recently. Some physicians don't think GRID is a new disease at all, but one that is just being more readily identified.