A SEX-LINKED CROSS MODEL

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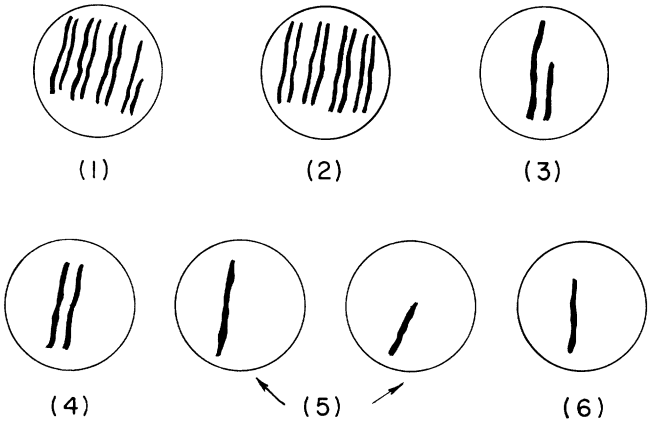
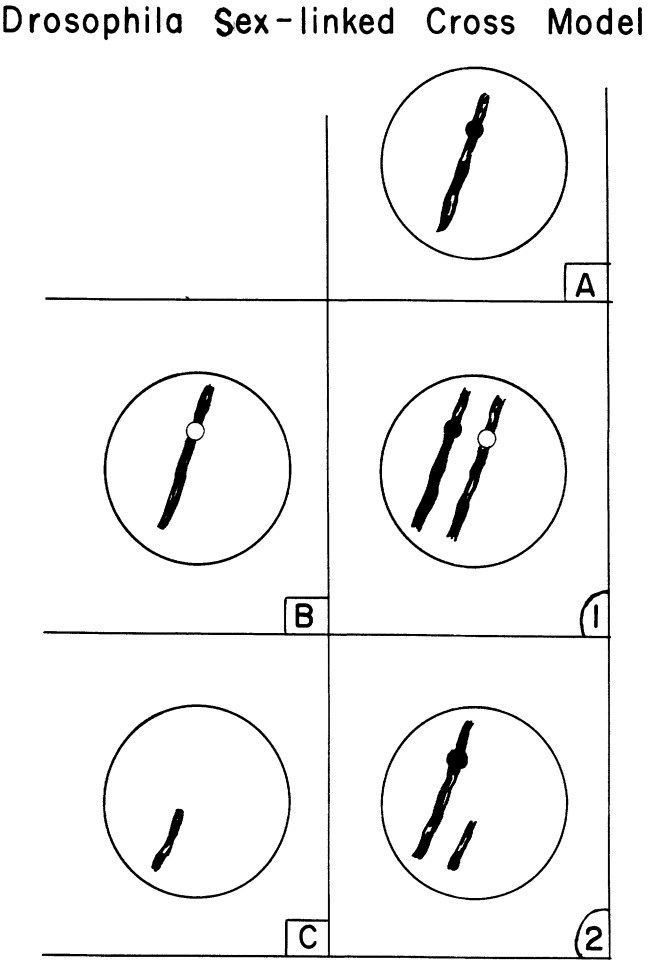
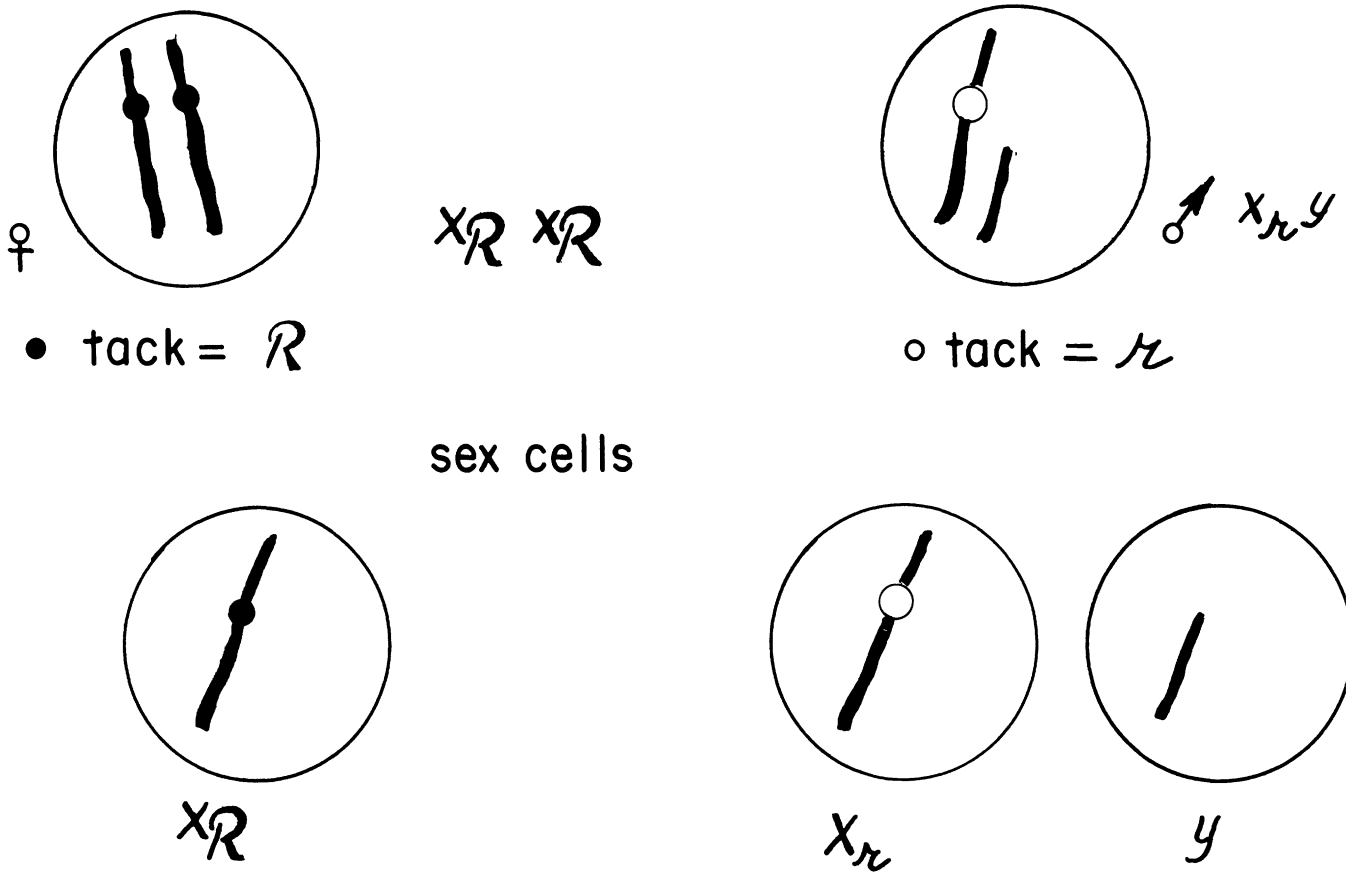
Biology students in an introductory survey course who completed a laboratory session with the Punnett square sex-linked cross model possessed a better understanding, as determined through discussion periods and a unit examination of the follow-up laboratory exercise in Drosophila matings. This model helped the beginning biology student to visualize results obtained by the mating of red and white-eyed fruit flies. It also helped the student to trace sex and eye color in resulting offspring.

Materials Needed for the Model

1) Licorice strips 6" long represent all chromosomes except the Y chromosome
2) Licorice strips 3" long represent the Y chromosome only
3) The cell nucleus is represented by a circular disc 9" in diameter and cut from material similar to manila folders. The contrast of a dark-colored licorice on a light-colored disc, thick enough to







support the licorice strips when lifted, is desirable. The cytoplasm is not represented.

4) White eye is controlled by a recessive allele r. Use a white tack to represent this recessive allele.
5) The normal red eye color is controlled by a dominant allele R. Use a red tack to represent this dominant allele.
6) Use string and tape to construct a Punnett square on the lab table for the F_1 and F_2 crosses.

Preliminary Exercise

Directions for students: Show chromosome arrangements for these situations:

1) A male somatic cell of Drosophila
2) A female somatic cell of Drosophila
3) A male somatic cell of Drosophila with the autosomes removed
4) A female somatic cell of Drosophila with the autosomes removed
5) Construct the two types of mature male sex cells minus the autosomes
6) Construct the mature female sex cell minus the autosomes

Answers for preliminary exercises in Fig. 1.

The students should next place the sex cells in the blocks of Punnett square and complete the offspring possibilities by one of two methods.

Method One: Slide one nucleus (disc), under the other, and pair the single chromosomes from each nucleus on one double disc (Fig. 2)

Method Two: Construct the offspring possibilities from spare licorice and discs. Leave the sex cells intact. Place the offspring possibilities in the ap-

propriate block in the Punnett square. (Fig. 3) *The Drosophila Genetic Problem: A* homozygous red-eyed female is crossed with a white-eyed male.

The student should remove all autosomes for this sex-linked cross and construct these models. (Fig. 4)

Further Applications of This Model

1) The F_1 flies of the cross illustrated in methods one and two can be mated to show the 3:1 phenotypic ratio of a monohybrid cross where dominance is present. In the F_2 cross the student discovers that all fruit flies showing the recessive phenotypes are males.

2) The teacher can use red and white tacks where necessary and follow the preliminary exercise to help the student visualize the meaning of these terms: homozygous dominant and recessive, heterozygous, haploid, diploid, Y chromosome, sex-linked cross, and autosomes.

3) Nondisjunction, the failure of homozygous chromosomes to separate during cell division, is a factor contributing to Klinefelter and Turner's syndrome.

4) Markers may be used for tracing maternal and paternal Drosophila chromosomes through the F_1 and F_2 generation. Possible markers are red licorice instead of black licorice for maternal chromosomes, or smooth licorice instead of corrugated licorice for maternal chromosomes, or even etchings put in maternal chromosomes.

The Conduct of the Laboratory

The preliminary exercise as presented in this article was conducted with mimeographed sheets, on which were drawn empty nuclear circles. After each student constructed the correct chromosome model, he then sketched the chromosome arrangement on his mimeographed sheet under the appropriate label. A second mimeographed sheet set for the F_1 and F_2 crosses was passed out. Empty nuclear circles for parental genotype and sex cells as well as Punnett squares were drawn on this mimeographed set. Students constructed the licorice models and then sketched the chromosome arrangements on their mimeographed sheets.

String was taped on the lab table in the shape of a Punnett square for the completion of the F_1 and F_2 crosses. Licorice models on nuclear discs were placed in the blocks of the Punnett square. Sketches were then made on the mimeographed sheets. Concluding this laboratory exercise was a completed genetic cross with the letters X, Y, R and r substituted for licorice and tacks.

Markers may be used for tracing the maternal and paternal Drosophila chromosomes through the F_1 and F_2 generation. Possible markers are:

1) red licorice instead of black licorice for maternal chromosomes,
2) smooth licorice instead of corrugated licorice for maternal chromosomes,
3) etchings put in the maternal chromosomes.

The crosses illustrated in the article, "Sex Differences in Cells," by Ursula Mittwoch, *Scientific American,* July 1963, can be duplicated by this model.

WATER DISTILLING KIT

True to the prediction of two scientists who thought up the idea, a survival kit has been placed on the market for those who might venture onto the desert or become stranded along a beach and run short of water. It is called *Sun Still* and is manufactured by Harbor Scientific, P. O. Box 2129, Costa Mesa, California.

The *Sun Still* is a practical implementation of the discovery of the simple method of producing pure water from the earth's moisture by Drs. Cornelius van Bavel and Ray Jackson of the U. S. Department of Agriculture's Water Conservation laboratory, Tempe, Arizona.

They found that almost all soil contains enough water to sustain life if you know how to obtain it. All that is needed is a bright sun, a hole in the ground and a piece of clear plastic. The heat of the sun passes through the plastic and is absorbed by the soil. This causes evaporation of the water present in the now warmer soil which in turn condenses on the cooler plastic. The droplets thus formed run down the properly positioned plastic into a waiting container.

From a well selected desert site, this method can produce an average of a quart of water a day from a conical shaped hole about 40" across. The output may roughly double if sliced, moisture laden cactus is placed in the hole.

Tests along the seashore show that a water still placed just above the high tide mark will produce a supply equal to the best given in the desert.

In areas where there is little or no moisture in the soil, the *Sun Still* can purify body wastes or polluted water. It also effectively purifies water contaminated by radioactivity.

Harbor Scientific envisions that the *Sun Still* will be an invaluable aid to rock hounds, campers, prospectors, and other desert travelers, as well as pilots and boaters who may become stranded. It may well be a matter of life or death to them all.

The *Sun Still* is currently being used as a science demonstration in schools and as an educational survival technique for various youth groups.