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Experimental and simulated evolutions in teaching population genetics: An approach through computer assisted instruction.

The purpose of this paper is to describe an educational process in which students are able to get a concrete approach to theoretical models of population genetics using both computer simulation and laboratory experiment on Drosophila populations.

Teaching is divided into three steps:

1°) Students analyse the evolution of the allelic frequencies of different genes by studying in cages Drosophila melanogaster populations in various environments. For each generation, allelic frequencies are estimated on flies hatching from egg samples put on a rich nutrient medium to avoid competition. Two cases are generally observed: elimination of one of the alleles or maintenance of the two forms. After 15 generations complementary experiments provide estimations of the selective values for each genotype.

2°) Simultaneously students learn an elementary programing language (OPE 1970) and write programs using classic recurrent formulae in population genetics; application of the Hardy Weinberg law, sex linked genes, two pairs of genes, selfing, sib mating, gene mutation and selection. These simulations allow students to weigh the relative influence of each factor introduced in these mathematical models.

3°) With the selective values observed experimentally each student conducts a simulated experiment based on the elementary constant fitness selective model.

Generally this theoretical evolution does not fit the experimental data well, so students discuss the obtained results criticizing precision of estimated fitness values and validity of the elementary model. New simulated experiments are performed using a linear frequency dependent selective model in which the rare types are at an advantage. The student's program changes the parameters' values to build families of theoretical evolution which are then compared and discussed with the observed evolutions.

The same educational process is carried on for the study of small populations: 1) experimental studies on genetic drift at the laboratory with Drosophila melanogaster; 2) program writing on random numbers and Monte-Carlo simulation model; 3) comparison between observed and expected data and discussion with classic experiments of Wright and Kerr, and Buri.

This constant feed-back between laboratory and computer simulated experiments helps students to avoid a purely speculative manipulation of the mathematical models in population genetics.

COMPUTER ASSISTED INSTRUCTION. The experiment of the Faculty of Science in Paris. Technical report Conference of use of Computer in Higher Education Center for Education research and Innovation. OECD 1970.

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An alternative to ether.

Although diethyl ether is traditionally used for anaesthetising Drosophila in genetics experiments, it is highly inflammable and subject to possible abuse. It is therefore a serious potential hazard in teaching laboratories. Chloroform is a possible alternative anaesthetic but it has both acute and chronic toxic effects. We have found that methylene chloride (dichloromethane) is a cheap and adequate non-inflammable substitute for ether. Methylene chloride is ten times less toxic than chloroform and, unlike the latter, it appears not to generate chronic ill effects, although of course it is still necessary to ensure that, as with ether or chloroform, the laboratory in which it is used is adequately ventilated.

For anaesthetic purposes one may use methylene chloride in exactly the same way as ether. The length of time that the flies need to be left in the vapor and the time taken for recovery are similar to those for ether. However, the behaviour of the flies while anaesthetised is rather different. Initially the wings of the flies may be held vertically above the body, i.e., they may appear to be "over-etherised", but this effect is temporary. The flies also tend to twitch in a way which may be slightly disconcerting to Drosophila workers who are used to handling etherised flies. Although this twitching might possibly detract from the use of methylene chloride for some experiments, e.g., those involving bristle counting, we have in general found no difficulty in training students to use it for work involving the mutants