Teacher's Instructions for the SimpleGene program

The SimpleGene program contains 10 exercises. As the name implies, the program deals with the simplest level of genetics. It starts by defining the life cycle, then moves on to the assignment of gene and characters, gene segregation and genetic ratios.

The program concludes with two exercises on the description of genetic ratios in families with more than one child. Although the concept here is not a particularly difficult one, it takes time for many students to assimilate the distinction between the different possible outcomes for a single child family and the different possible multiple-child families.

The program contains the facility for suppressing these last two exercises if this concept is beyond the scope of the class. In the introductory screen, click on the 'hand', while holding down the 'Alt' key (Windows) or the 'Apple/Command' key (Macintosh). This action only works for the site licence version of the program. It allows you to either include or leave out the last two exercises.

Order of exercises

The 10 exercises in the program are ordered logically. The student can proceed through the exercises by clicking on an arrow which appears at the bottom right corner of the screen when any exercise is complete. However the program has the flexibility to cope with cases where not all exercises are done at one time or where students wish to return to previous exercises. It includes the facility to jump from any exercise to any other using menu commands. Exercises can also be repeated.
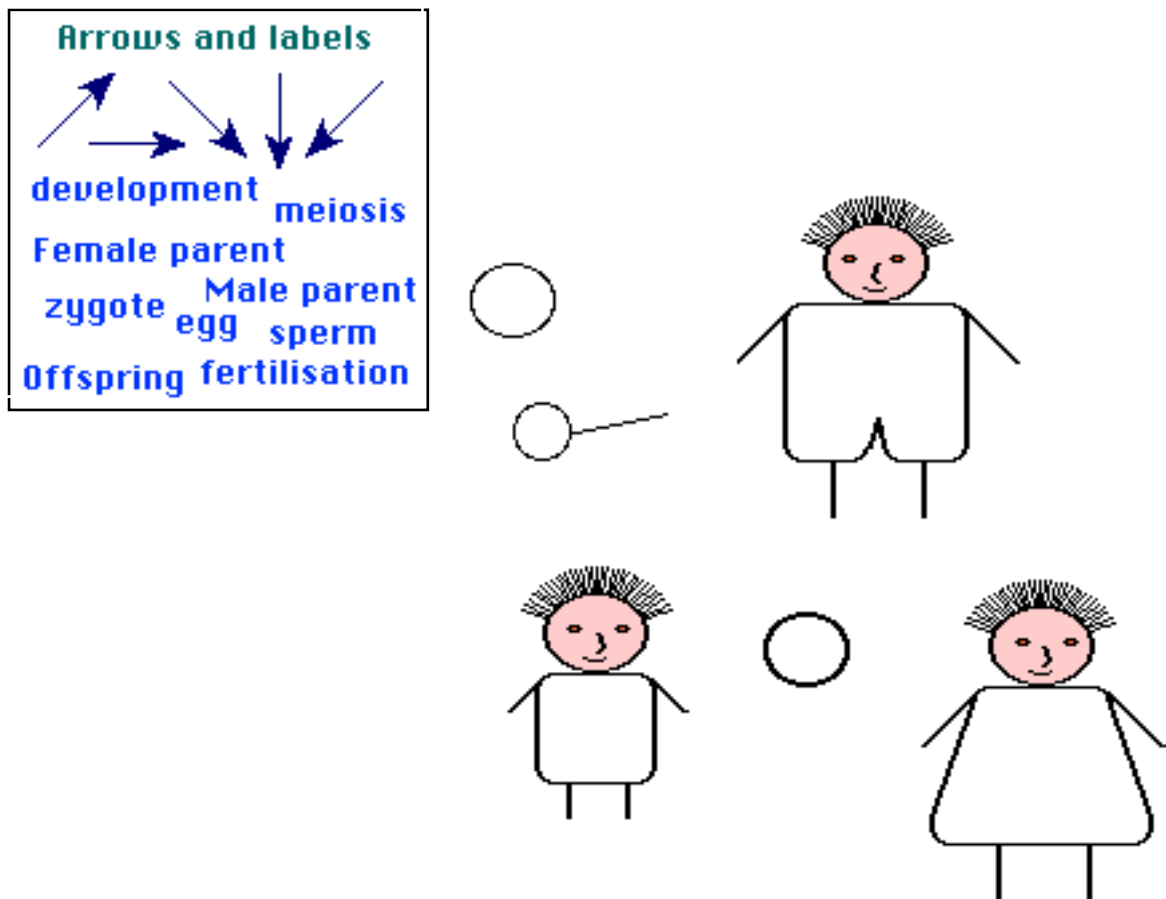
Marking the exercises

The SimpleGene program includes a simple marking scheme. Each time the student makes a wrong choice, the program adds 1 to the overall error count. When the last exercise has been completed, the total number of exercises completed and the total error count are displayed. The student can also, at any stage, see which exercises have been completed from the **List of exercises** item of the **Exercises** menu.
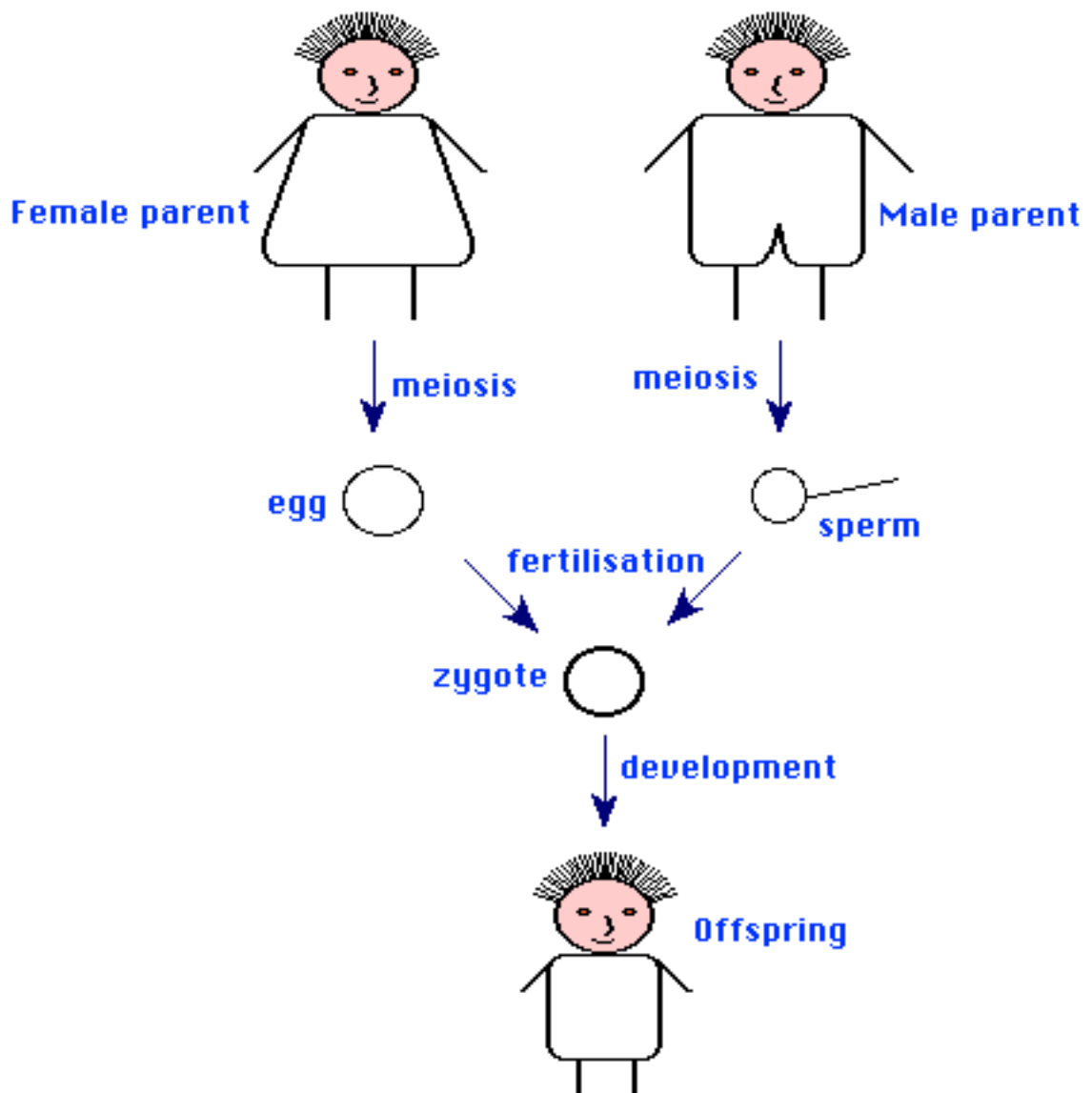
Listing of individual exercises

Exercise 1

The student is required to draw up a picture of a simplified life cycle, and label all the items and stages in the process. The initial screen looks something like the following. The box at left contains a template of arrows and labels.
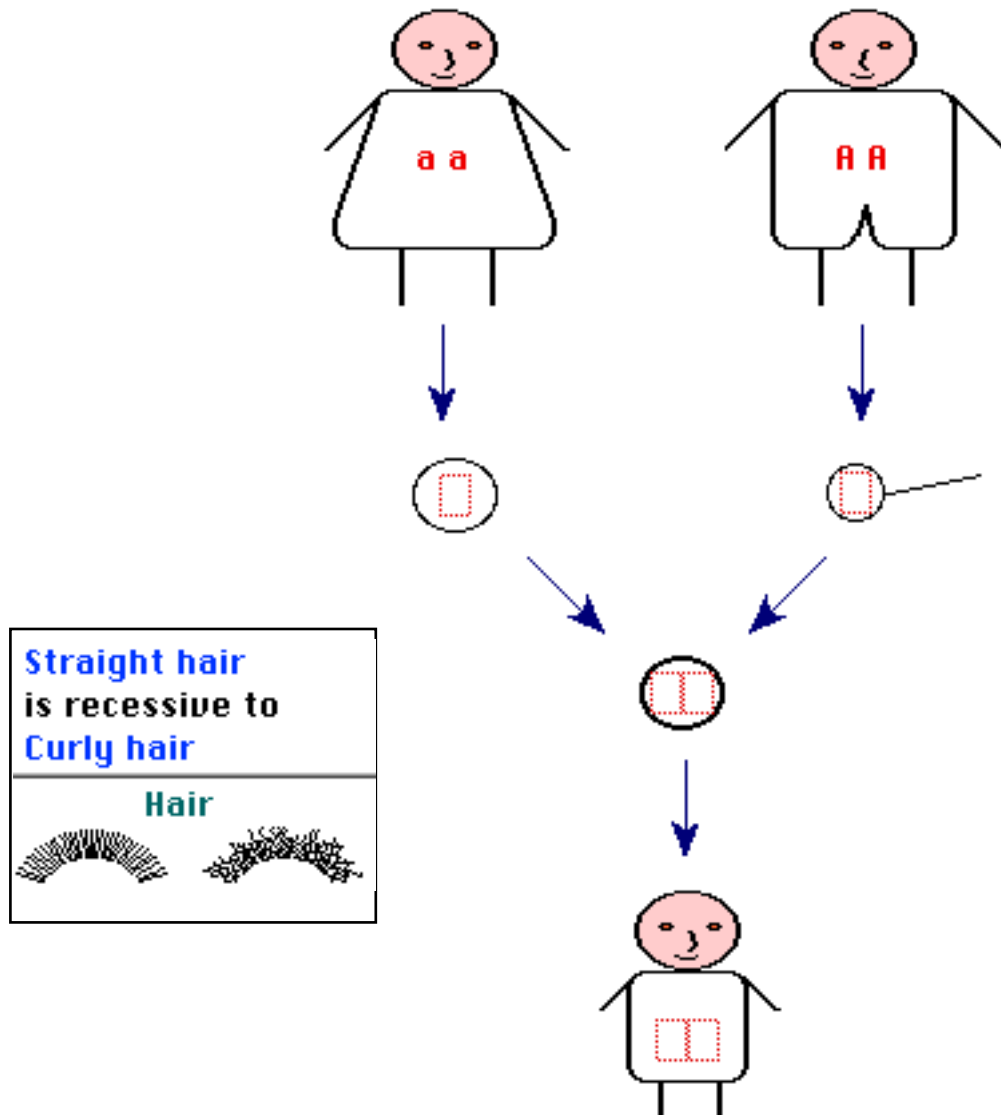

Although this is the first example, it is in some respects the hardest since it may not be obvious to the student what is the 'correct answer'. The program therefore supplies special instructions in this case, which also help to introduce the notion of dragging objects around the screen. The program is also willing to provide a hint on the placement of objects, and will provide additional information if mistakes are made. It would like the student to produce a diagram such as that shown below. There are, however, other variants which are marked as correct. The program checks to see that each pair of objects is connected by an arrow, and does not require that the particular arrows shown below be used. See Exercise 3 for another example of a valid diagram.

There is some flexibility in the placement of labels. For example, a single 'fertilisation' label suffices for both arrows in the figure, but two labels could be used. The 'zygote' label in the above diagram could be associated with either the zygote or with the fertilisation arrow. If each object and arrow is labelled and the correct number of labels is used then the program will mark the above placement as correct, but if other mistakes have been made then the program may become confused about what is intended.

Exercise 2

Genes and characters are introduced in this example. The dominance relationships are announced by the program. Genes must be dragged from parents to the gametes and then to the zygote and offspring. Characters are dragged from the template to both parents and offspring.

When genes are dragged from the gamete into the zygote their placement is fixed by the program. The gene from the female goes on the left and the gene from the male on the right.. In going from zygote to the offspring, either gene can go into either slot. If the resultant genotype is the heterozygote, then the program asks for the genes to be placed in the order Aa rather than aA. If the student puts the genes in the latter order then the program reverses them and puts a note on the screen to that effect.

Exercise 3

This exercise is a repeat of the previous exercise, except that the dominance relationships have to be inferred from the parent genotypes and phenotypes.

Eyes

Exercise 4

This exercise combines all aspects of the previous three exercises. A life cycle diagram must be constructed, with labels, and all genes and characters put into place.
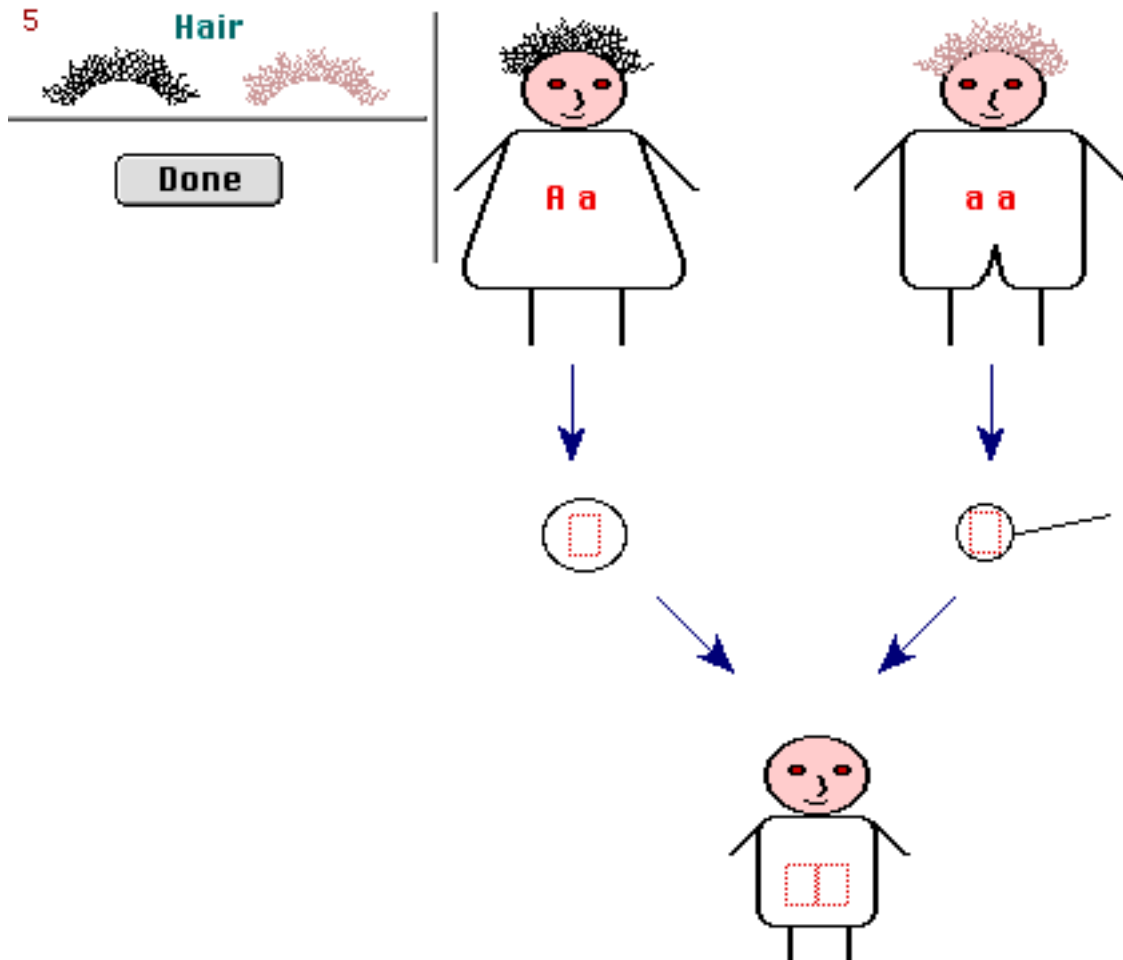

There are three variable characters - hair colour (it looks better on the screen than in black-and-swhite), hair curling, and eye colour. Only one of these characters is allowed to be variable. The invariant characters may be of either type. The dominance relationships shown in the bottom box need to reflect the chosen phenotypes. Any genotypes are permissible, provided that they do not lead to the same phenotypes in all three individuals. The simplest choice is to follow the pattern of the previous examples with the two parents being opposite homozygotes.
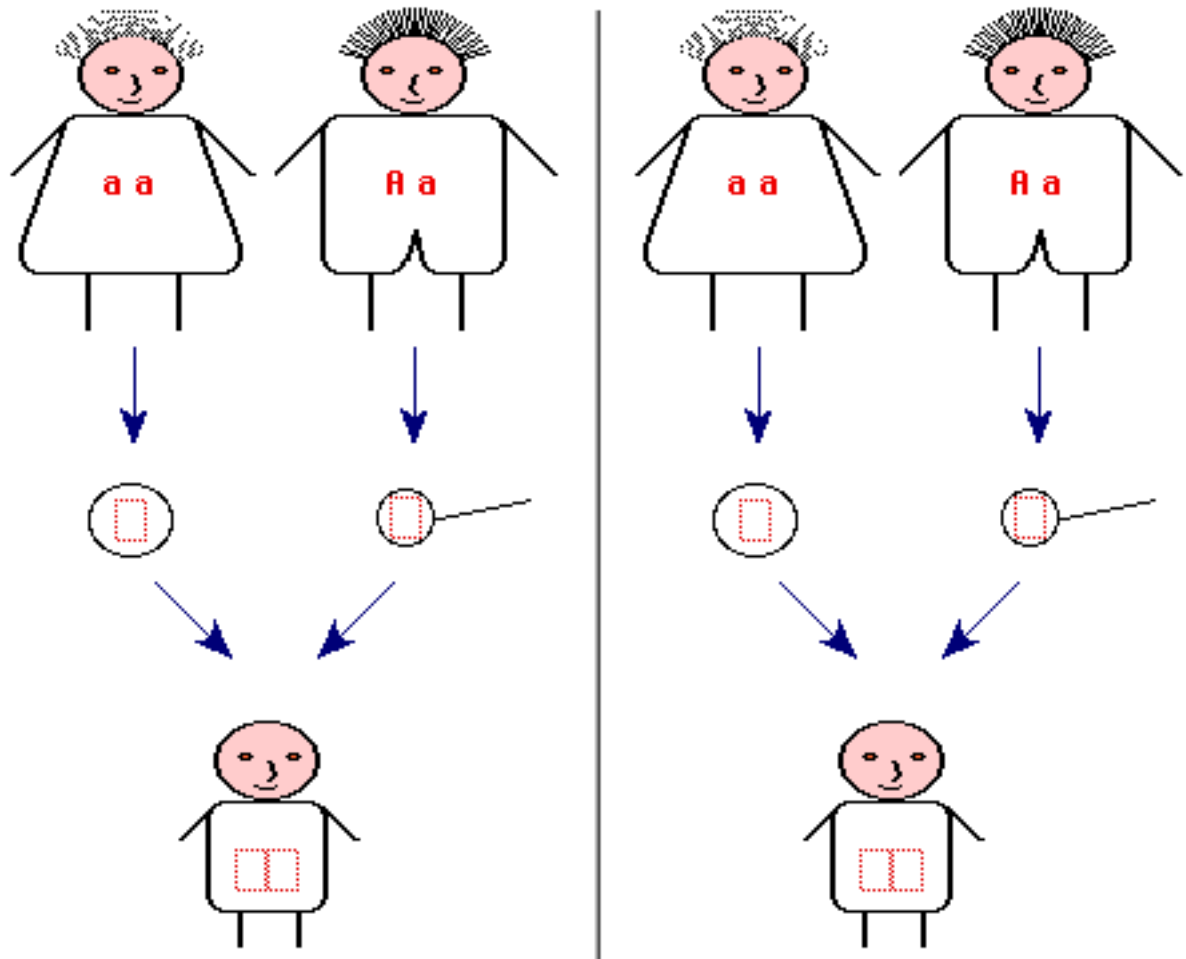
Exercise 5

The concept of gene segregation is introduced very gently in this example. The student simply needs to nominate one or other gene in the gamete of the heterozygous parent.

There are two other changes in this example. The life cycle is simplified by omitting the zygote stage. Secondly, the program automatically places the genes into the offspring once the gametes have been chosen. This more accurately reflects the idea that the offspring genotype is determined by the selection of genes for the gametes. All examples following the present one include this automation.
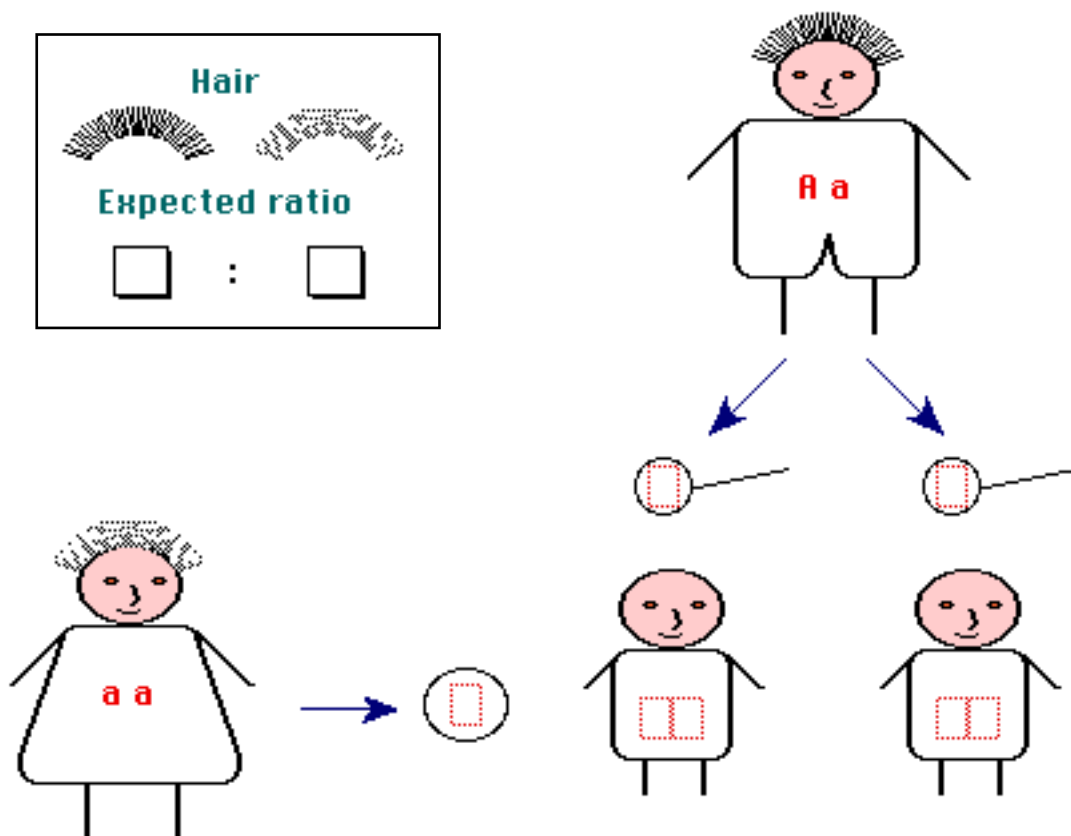
Exercise 6

This diagram extends the segregation concept by requiring the student to make different offspring phenotypes in the two families. Although not shown in the diagram, the missing phenotypes must as usual be filled in from a template.
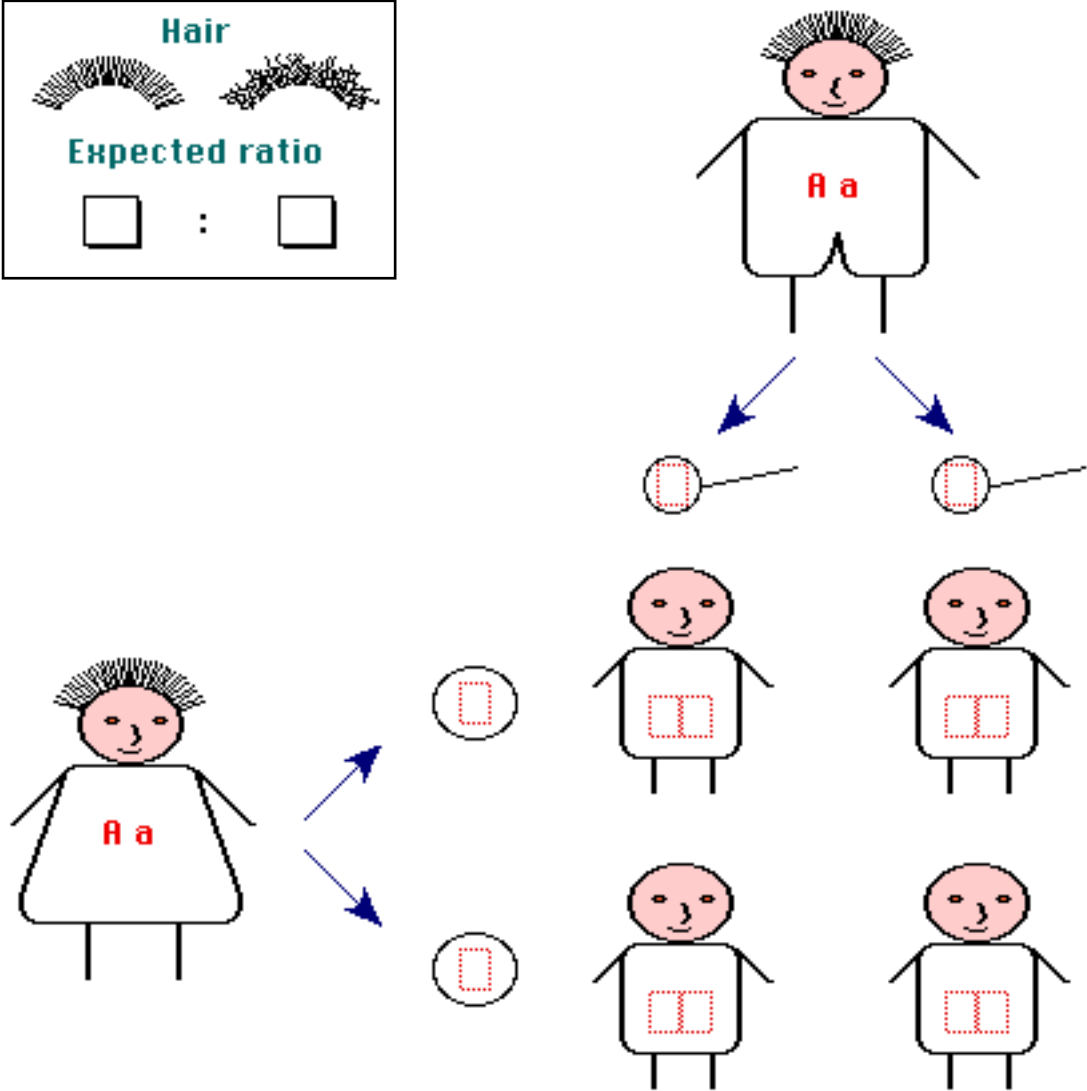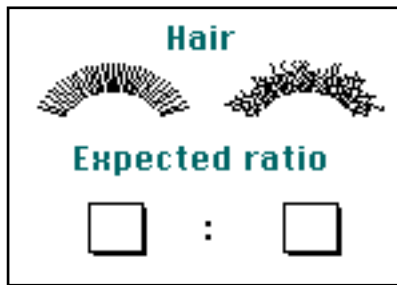
Exercise 7

This exercise is identical to the previous exercise, except in the way the individuals are depicted. The exercise attempts to show the student, by comparison of diagrams of Exercises 6 and 7, what is intended when the simplified diagram is used.

The idea of a genetic ratio is also formally introduced in this example. The student is expected to enter the ratio by means of pull down menus in the boxes.
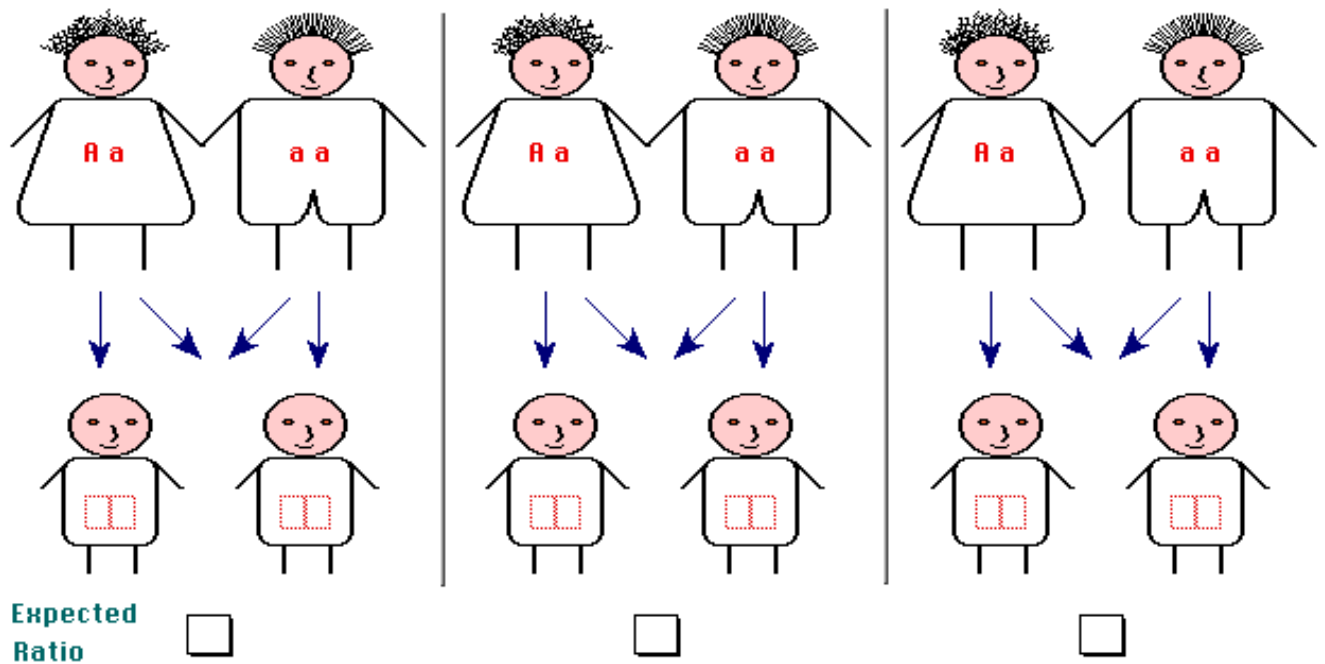
Exercise 8

The equivalent exercise for a heterozygote intercross leading to a 3 : 1 ratio.

Exercise 9

The concept of ratios in a multiple-child family is introduced. The genes and characters are the same as those of the previous exercises. In addition to filling in the possible family types, the student is asked to fill in the expected ratio of the three types. The program gives a clue if the first attempt is incorrect.

Exercise 10

This exercise extends the multiple-child family concept to 3- and 4-child families, using multiple choice questions. Although the calculation is not an elementary one, the possible answers are restricted so as to make it obvious which is the correct choice. This example is followed by a screen which explains the relationship between the expected ratio and the observed ratio in small families.

1. In families with 3 children in which the parents are Aa and aa , there will be:

   ○ 3 equally likely families: Aa Aa Aa   Aa Aa aa   Aa aa aa

   ○ 4 different types of families: Aa Aa Aa   Aa Aa aa   Aa aa aa   aa aa aa
      in the ratio: 1   3   3   1

   ○ 1.5 children of genotype Aa and 1.5 children of genotype aa

2. In families with 4 children in which the parents are Aa and aa , there will be:

   ○ 5 different types of families: Aa Aa Aa Aa   Aa Aa Aa aa   Aa Aa aa aa   Aa aa aa aa   aa aa aa aa
      in the ratio: 1   4   6   4   1

   ○ 2 children of genotype Aa and 2 children of genotype aa

   ○ 4 equally likely families: Aa Aa Aa aa   Aa aa Aa aa   Aa aa aa aa   aa aa aa aa