Instructions for the Meiosis program

The Meiosis program is divided into four parts.

(1) Mitosis vs. Meiosis
(2) Stages of Meiosis
(3) Chromosome assortment
(4) Crossingover

There is also a short introductory section. Each of the four parts has one screen associated with it. You will build up the screens yourself.

You need to go through these four parts in order. However there is a certain amount of flexibility in the running of the program:

(a) While you are working on any part, you can go back to the start of that part.

(b) Once you have moved on to the next part, you cannot modify the previous screen, but you can go back and look at it.

(c) In most operations, you can go back to where you started.

If you want to go back in the program and all else fails, you can always start again.

The Instruction Screen

Passage through the program is guided by the Instruction Screen, which 'floats' over the top of whatever screen you are working on. The instructions may get in your way at times, and you will need to move them out of the way. Move the mouse to the top part of the window, the title bar, hold the mouse button down and drag the window. You can slide it almost out of sight at the bottom of the main screen. You can also send the window away by going to the menu and clicking on **Hide Instructions** from the **Window** menu. If you do this, it will not reappear until you click on **Show Instructions**. You may be able to manage without the instructions in some stages, although eventually they will be needed when you come to answer questions.

You will see that the Instruction box usually has either a **Next** button or a **Done** button. The former means that you just have to read some information and then click to go onto the next instruction. The latter means that you have to do something, eg. move some chromosomes, answer a question etc, and you only click when you have finished doing this.

Dragging objects

This applies to names, which must be put into place in some exercises, and to chromosomes and chiasmata, which need to be put into position.

(1) If you drag an object from somewhere onto the screen and release the mouse button where there is not a valid 'slot' for it, then it will usually stay where it is.

(2) If you drag an object and release the mouse button near to an empty slot, the object will move into place.

(3) Once it is in a slot, you can move it out of the slot to elsewhere on the screen, although usually you need to move it a minimum distance.

(4) You can move an object straight from one slot to another. As previously, the new slot must be an empty one.

Try it out

You may find it easier to go through the program and work things out for yourself rather than trying to read the Help instructions. These instructions will probably make more sense once you have seen some of the screens and tried out the operations.

Stages of the program

(1) Mitosis vs. Meiosis

Only one operation is needed in this window. You will need to drag chromosomes such that the centromere is attached to a spindle attachment site. You will also need to put the names 'Mitosis' and 'Meiosis' in place. All chromosomes need to be put into a site to complete the screen. There is a lot of flexibility in which chromosome goes to which site.

(2) Stages of Meiosis

This screen will take you through the various stages. Most of the operations involve dragging chromosomes to a site on the Metaphase plate or dragging centromeres to the poles in Anaphase. Notice that in the latter operation you need to click specifically on the centromere of the chromosome.

(3) Chromosome assortment

This screen takes you through the process of distinguishing the different types of chromosome assortment. This screen differs from the previous screen in only showing the Metaphase stages, and you need to be careful that you see the correspondence between this screen and the previous one which shows all the stages.

(4) Crossingover

The final screen allows you to place crossovers (chiasmata) into the Metaphase chromosomes. Instructions for doing this are supplied with the chiasmata.

The importance of Prophase

In order to simulate processes on the screen, the Meiosis program takes some liberties with the stages of Meiosis. It requires you to pair chromosomes just prior to Metaphase. You should be aware that, in reality, chromosome pairing takes place in early Prophase. The chromosomes are extended and very difficult to visualise at this stage.

The same principle applies to crossingover. The program requires you to put crossovers in during Metaphase. In real life, the evidence indicates that crossingover occurs very early in Prophase, but that chiasmata only become visible when the chromosomes become distinguishable late in Prophase or early in Metaphase.

The chromosomes - a cautionary note

This simulation involves two chromosomes. One of these is a 'metacentric' and one is a slightly smaller 'telocentric'. There are also two colours, red and green, representing the chromosomes coming from the two different parents.

The colour difference may stand out more than the size/shape difference, and you might therefore be tempted to say that two green chromosomes, one metacentric and one telocentric, are more similar than a red and green metacentric. The truth is the opposite. The red and green are similar or indistinguishable in most genes, while the two green chromosomes will share almost no genes.

Why use the colour difference? The reason is that meiosis does two things:

(1) It ensures that all gametes get one copy of every gene.

(2) It 'mixes up' the genes contributed by the two parents.

The first of these functions is presumably more important, but it is also of less genetical interest. Everything gets the same. This program focuses on the second aspect, using colours to represent the chromosome differences.

Positioning chromosomes - a hint

There are two chromosomes in the simulation. In the meiosis screens there are two spindles, one on the left and one on the right. Either chromosome can go in either position. You may find it easier if you decide on one ordering and stick to this, although you are by no means obliged to do this.

It is not clear whether or not in real life particular chromosomes go to particular sites in the cell. The idea of a left- and right-side of a cell or nucleus is obviously an oversimplification.