

# *Drosophila melanogaster*

We normally focus on people in this column, but this issue we are looking at an organism that has played a succession of key roles in developments in biological science over the last 100 years – the fruit fly, *Drosophila melanogaster*.

You have probably seen fruit flies – they are the tiny yellowish flies that rise up when you disturb rotten fruit. You may even have been fortunate enough to have used fruit flies to track simple patterns of inheritance in breeding experiments in biology lessons.

In hot weather, the life cycle of the fruit fly (see Figure 1) may take only 7 to 8 days and the adult lays 700 to 800 eggs in its 20- to 30-day life span. Once the eggs hatch, the maggot-shaped larva burrows into the fruit. Oblong pupae with a forked breathing tube at one end occur wherever larvae are found.

It has proved relatively easy to recreate optimum conditions for fruit flies in laboratories and to maintain them in captivity under controlled conditions from one generation to the next (see Box 1).

## Useful flies

*Drosophila* has a long history as a model for genetic study. Research began on the fruit fly over 100 years ago when the biologist Thomas Hunt Morgan discovered a mutant fly with white eyes (see Box 2) rather than the normal red eyes. *Drosophila* quickly became one of the most important organisms used in genetics research, not only in terms of patterns of inheritance at the level of the chromosome and the gene, but later on at the molecular level, in terms of DNA and protein structure and function. It has also proved useful in looking to see how a complex organism develops from a relatively simple fertilised egg.

In 2000, the *Drosophila* genome was sequenced – it is reckoned that 61% of known human disease genes have a recognisable match in the genetic code of fruit flies, and 50% of the amino acid sequences in fly proteins have mammalian matches.

Researchers have found that many aspects of the biochemistry of fruit flies and humans are similar. Because of this, fruit flies have become a useful tool in

Genetic research. A biologist holds a milk bottle in which normal and mutant fruit flies of the species *Drosophila melanogaster* are raised

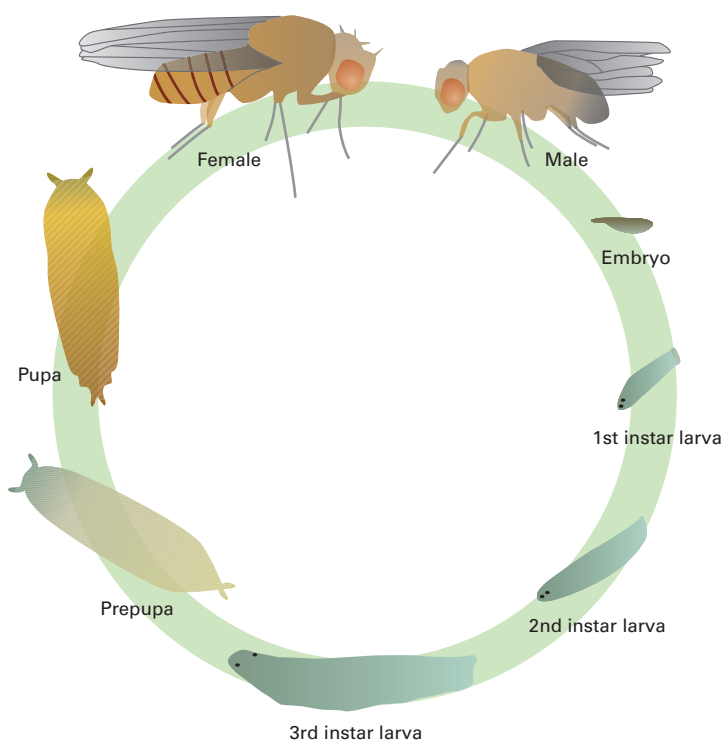


Figure 1 The life cycle of *Drosophila melanogaster*



**Left:** A normal and a mutant fruit fly. The fly on the left, with the red compound eyes, is the wild type. The fly on the right is a mutant type. It has white eyes, shorter wings than the normal fly, and the bristles on its face and body are distorted and forked

### Box 1 Culturing and counting *Drosophila*

Fruit flies are obtained easily from the wild and companies stock a variety of different mutants. It is not difficult to keep *Drosophila*. They can be kept in large numbers in small jars, with some food and a cotton wool stopper. The cotton wool prevents them from escaping while allowing air movement. They can be fed with a mixture of dried yeast, sugar and cornmeal, thickened with agar.

At 25°C it takes *Drosophila* only 10 days to go from egg to adult. The life cycle can be completed within 2 weeks. The resulting large populations make statistical analysis easy and reliable.

*Drosophila* can be anaesthetised, using a stream of carbon dioxide, to count and sort different types under a microscope. They recover rapidly. The males and females are different in appearance.

Over time, more and more mutants have been found or created. In the days of classical genetic studies these differed in appearance. Nowadays mutants may have differences that are revealed only through biochemistry, with individual genes affected — so called ‘knockout’ flies. For breeding experiments, virgin males and females are often obtained by separating the sexes as soon as they hatch, though they can be separated later because virgins are physically distinct from mature adults.

studying human diseases caused by defective genes, including Parkinson’s, Huntington’s, Alzheimer’s, diabetes and cancer (see pages 1–3).

### Conclusion

The story of the fruit fly is an interesting one. The more people found out about the organism, the easier it became to work with. As a result, more

### Box 2 Thomas Morgan and *Drosophila*

Thomas Morgan and three of his students were interested in what we would today call **classical genetics**. By doing controlled crosses with different mutants, they were able to show that certain groups of genes were linked together. The number of linkage maps produced tied in with the number of chromosomes, helping to identify chromosomes as carriers of hereditary material.

In 1915, Morgan and his students summarised their work in a book, *The Mechanism of Mendelian Heredity*. Morgan was awarded the Nobel prize for medicine in 1933 ‘for his discoveries concerning the role played by the chromosome in heredity’.

Morgan and his colleagues also discovered how gender was inherited in fruit flies. By coincidence, the same system occurs in humans, involving X and Y chromosomes. The white-eyed flies showed sex-linked inheritance. The eye colour gene is located on the X chromosome, with no matching position on the Y chromosome. If a *recessive* white-eyed allele occurs on the X chromosome, a male fly has white eyes. For females (XX), one chromosome may carry the red-eyed *dominant* allele.

In 1995 Ed Lewis, Christiane Nusslein-Volhard and Eric Wieschaus were awarded the Nobel prize in medicine/physiology ‘for their discoveries concerning the genetic control of early embryonic development’, using *Drosophila*.

researchers were attracted to it and more techniques and deeper levels of understanding were developed. Today, *Drosophila* is found in laboratories around the world and is the subject of intensive study by a large research community of several thousand scientists.

**Nigel Collins** teaches biology and is an editor of CATALYST.

The *Drosophila* genome is about 165 million bases and contains an estimated 14 000 genes. The human genome is about 3000 million base pairs and involves an estimated 30 000 genes.

- If you have a safe place to set up a plastic container out of doors with some overripe fruit — it will need to be in summertime — look out for fruit flies.

- Read more about Thomas Morgan and the other Nobel prizewinners at: [http://nobelprize.org/nobel\\_prizes/medicine/laureates/](http://nobelprize.org/nobel_prizes/medicine/laureates/)

- Find out more about *Drosophila* at [www.ceolas.org/fly/intro.html](http://www.ceolas.org/fly/intro.html)