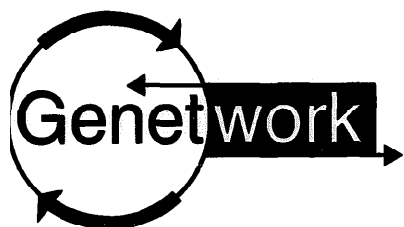


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FlyBase: a virtual *Drosophila* cornucopia

Less than ten years ago there was only a single source of information that compiled all our knowledge on the fruitfly: *Genetic Variations of Drosophila melanogaster*, affectionately known as 'The Redbook', written by Dan Lindsley and Ed Grell¹. One of us (H.B.) clearly remembers complaining to his former advisor for several years (1983–1985) that *The Redbook* was really out of date and that there was an urgent need for an updated version. First, relief came at the end of 1985 with *Genes from A–K* by Lindsley and Zimm², rapidly followed by a series of useful *Drosophila*

Information Service publications, culminating in Ashburner's *Drosophila Genetic Maps*³ and *The New Redbook*⁴. The plethora of organized knowledge that is now available on the fly is flabbergasting, and the speed by which it is updated is remarkable and very laudable. Here, we discuss how to access FlyBase⁵, what is available, and comment on some of the useful and less useful aspects of the database. Interested readers who want to know more about the history of FlyBase and those who are involved are referred to Ashburner and Drysdale⁶.

FlyBase is a comprehensive database, which contains information on genetics, molecular and cell biology of *Drosophila melanogaster*. The database is expanding daily as new information is added on, for example, stock lists, bibliographical references, genes and alleles, cloned regions. As of September 1995, FlyBase contained information on 25 000 alleles and 9000 genes, distilled from over 73 000 publications. This information can be browsed in many different ways and can be accessed through the WWW, ftp, Gopher and GopherMail (see Box 1). Once in Flybase the reader will find an extensive list of information as well as a list of the search tools that can be used to access these data.

The continuous stream of information, published as well as unpublished (the latter is mainly generated by the genome projects and the stock centers), that must be entered in the database presents a major challenge for the FlyBase project. Efficient data entry is quintessential as approximately 3000 publications appear yearly on *Drosophila*. Data generated and curated by the European and Berkeley *Drosophila* Genome Projects are also integrated into the database. The data of the Berkeley *Drosophila* Genome Project (BDGP) are so far only partially available in FlyBase, though all Berkeley data are available on CD-ROM, which is produced jointly by the BDGP and FlyBase under the name *Encyclopaedia of Drosophila*. This is a database program derived from ACeDB, the *Caenorhabditis elegans* database, which contains much of the bibliographic and genetic data, as well as the BDGP data, of FlyBase. This complicates matters at the present time as, for example, not all the mapped P-elements and clones shown on the CD-ROM are available in FlyBase, necessitating double searches. It should be noted, however, that it is the goal of the BDGP and FlyBase to have all the information now available on CD-ROM integrated in FlyBase in the near future. A welcome move!

Box 1. FlyBase access via the Internet

World Wide Web: <http://morgan.harvard.edu/>
 Gopher and anonymous FTP: flybase.bio.indiana.edu
 GopherMail (access Gopher data via email): Send the message 'help' to:
flybase-gopher@flybase.bio.indiana.edu

Note: For those without Internet access, the *Encyclopaedia of Drosophila* CD-ROM (Macintosh compatible only) can be ordered by calling 1 617 495 2906. The *Encyclopaedia of Drosophila* is also available for Unix platforms by FTP (see <http://morgan.harvard.edu/Readme-eofd.html>).

The types of data that can be retrieved from FlyBase can be subdivided into two main classes: those that are of a 'scientific' nature and those that facilitate our work but are of a 'general' nature (e.g. addresses and telephone numbers of coworkers). The most useful 'scientific' features are CytoSearch, SymbolSearch and the Graphic maps for browsing data by cytological/genetic location. Here we briefly describe their main features.

CytoSearch is particularly useful as most Drosophilists who isolate a new mutation (e.g. *P*-element induced mutations) or clone, carry out cytological mapping at first. The cytological mapping position provides an entry point as it permits us to find all the genes, clones, rearrangements and transposons in the cytogenetic interval of interest. One can then click on a specific gene and immediately obtain detailed reports that contain, for example, a short description of the phenotype associated with each published allele, genetic information, sequence information, references. In general, the information is very accurate and up-to-date. However, occasionally some information is absent or inaccurate. It is, therefore, recommended that individual investigators regularly check the presented information about the genes that they study and help the curators by pointing out omissions and inaccuracies. This can be conveniently done by clicking flybase-updates@morgan.harvard.edu on the main menu and commenting on the problems.

SymbolSearch permits searching of the database via symbols, for example, the abbreviations of genes (not the full name), symbols used for rearrangements like inversions and deficiencies, but not yet *P*-elements. This function is quite valuable as it provides a very rapid way to identify when and where a gene or rearrangement was published and if it is available from

the Indiana Stock Center. Unfortunately, the stocks of the Mid-America Stock Center (Bowling Green) and Umea (Sweden) are not integrated at this point and require a separate search. By clicking the appropriate icons one can also order the stocks available from the Indiana Stock Center, a very convenient tool indeed!

The cream of the crop are the Graphic maps for browsing data by cytological or genetic location. The user can browse the genome by cytological location and click on a particular subdivision and request data on, for example, genes, clones and rearrangements, but not yet transposable elements. The manner of presenting data is very similar to the way the data are presented in the *Encyclopaedia of Drosophila* CD-ROM. The Graphic maps are particularly useful as the display shows all the available data in a comprehensive manner. This tool is probably one of the easiest and most efficient ways of accessing FlyBase.

Other FlyBase tools, which we use daily, include retrieving the address,

telephone, fax and email directory of *Drosophila* workers from FlyBase at IUBio. Teachers will also be interested in *Drosophila* images, because one can view early *Drosophila* development through a series of SEM pictures. We strongly recommend that every *Drosophila* researcher or teacher who has not yet browsed FlyBase do so rapidly. FlyBase has become indispensable for every *Drosophila* researcher!

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The Dictionary of Cell Biology

<http://www.mblab.gla.ac.uk/~julian/Dict.html>

The Dictionary, originally published by Academic Press in 1989, was conceived in Glasgow as a teaching aid for undergraduate courses in Cell and Molecular Biology. The second edition, published in 1995, was greatly expanded to include nearly 6000 entries. However, contemporary biology is advancing at such a rate that it is hard even to keep pace with new entries as they arise. The electronic version allows use of *The Dictionary* to be logged, so that we have advance warning of new terms that are not yet covered, and can also solicit revisions and new entries directly from the users. The electronic version has evolved to provide features not found on the paper version; cross references are now live hypertext links and there are external links to relevant entries in databases, such as FlyBase, Online Mendelian Inheritance in Man, Prosite and scop. Conversely, the vagaries of the Internet mean that we are hoping that regular users will still find it quicker and more helpful to have the paper version! This is a rather bold experiment, which might be terminated if the sales of the second edition slump; but unless this happens, the electronic version of *The Dictionary* will remain freely available as a service to the academic community. Contributed by Julian Dow, Division of Molecular Genetics, Institute of Biomedical and Life Sciences, University of Glasgow, Glasgow, UK G11 6NU (gbaa02@udcf.gla.ac.uk).