

ScienceLabDatabase: A Computer Program to Organize a Molecular Biology Laboratory

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ABSTRACT

A description of a novel laboratory management software is provided. ScienceLabDatabase (SLD) offers a useful platform to organize a molecular biology research laboratory. The program manages stocks of biological samples, including plasmids, antibodies and cell lines, laboratory protocols and addresses, and it includes an easy ordering and funds managing system. Preformed data sheet templates help to store and maintain valuable information on samples or reagents and to facilitate the transfer of accurate information between researchers. Password protection regulates access, and simple button functions allow the use of this system without prior database knowledge. SLD is based on FileMaker Pro Version 4.0, which allows easy customization and import of preexisting data from other applications. The SLD program was successfully tested in several independent research groups and proved a useful tool to efficiently organize a molecular biology laboratory.

INTRODUCTION

The handling of rapidly increasing amounts of data poses a considerable problem in different areas of industry and academia. However, the development of database software greatly improves data management for a variety of applications, which increases efficiency of daily routines and significantly reduces cost. Today, relational databases help to organize material stocks, streamline purchasing and handle information. They are therefore widespread platforms to organize and

maintain any form of business enterprise. However, maximum efficiency is only achieved when the specific needs of a customer are met. Surprisingly, to our knowledge, no available commercial program has been designed to manage a small-to-medium scale molecular biology research laboratory. Current alternatives seem to be listing information in a spreadsheet program, such as Excel[®], or collecting data in printed form.

A scientific research laboratory does not greatly differ from any commercial business in that it needs to control costs and to manage information and material. In our own laboratories, we were increasingly struggling to keep up with the management of plasmid clones, antibody stocks, cell lines, etc., and we spent a considerable amount of time filling out data sheets and searching for lost samples. Furthermore, it is not only important to be able to track down valuable samples in an overflowing freezer, but it is equally important to have adequate and reliable documentation to share with colleagues or to use for patenting purposes. The costs of constructing a customized database have been relatively prohibitive and many require, once established, full-time administrators and programmers. However, the release of FileMaker Pro Version 4.0 enabled the development of an affordable and customized database solution. FileMaker Pro 4.0 offers both power and flexibility—a database can be maintained on either a PC or Macintosh[®]-based computer system and can be accessed by either system over a network. Furthermore, database files are compatible across computer platforms, and customized record entry forms can be created easily with little computing knowledge. Using FileMaker Pro 4.0, we initiated the development of the ScienceLabDatabase (SLD), and we hope that it will find interest in a wide community. Since SLD was developed by molecular biologists, it incorporates in-depth knowledge of a research laboratory and accounts for the specific everyday laboratory routine, its personnel, equipment and frequently used labware. In addition, to organize stocks of valuable biological material or consumables, SLD features an easy ordering system and provides a complete overview of expenses and grants. It furthermore serves as a database to store addresses and to accumulate experimental protocols.

Together, SLD offers an affordable and easy-to-install database system, and it offers an efficient and user-friendly way to organize a molecular biology laboratory.

MATERIALS AND METHODS

ScienceLabDatabase is a FileMaker Pro 4.0 (Claris Corporation, Santa Clara, CA, USA) based program and is used on Macintosh computers (Apple Computer, Cupertino, CA, USA) or on a standard PC. ScienceLabDatabaseMac and ScienceLabDatabasePC are available as programs using FileMaker Pro 4.0 or as stand-alone programs, which do not require FileMaker Pro 4.0. The stand-alone program does not allow the user to customize the software or change passwords, and the program cannot be accessed simultaneously by multiple users over a network. A minimum of 36 Mbyte random-access memory (RAM) and a 4 Gbyte hard drive are recommended (depending on the planned size of the database). The programs run on all systems released following Macintosh System 6.0 (Apple Computer) or Windows 95® (Microsoft, Redmond, WA, USA). See Availability for information about obtaining the programs.

DISCUSSION

SLD is a hierarchically organized relational database for the use in molecular biology research laboratories. It is divided into several sub-databases (Figure 1) and helps to manage data concerning common biological samples (plasmids, antibodies,

primers etc.), general administrative data (ordering, inventory) and addresses. A separate section is devoted to laboratory protocols. Password protection is included to recognize different user categories before entering the program's home page. Currently, three password tiers have been set: (i) administrator, (ii) laboratory scientist and (iii) guest. Each of these tiers contain different permissions regarding data entry, editing and viewing. Additional features such as grant and cost controls are only accessible to the administrator or respective group leader, whose password recognition permits the user to modify the current program (not in stand-alone version) or to change passwords, if necessary. The different databases are activated through buttons, and additional help functions provide useful information on each subject. Furthermore, since SLD can import data from Excel spreadsheets (Microsoft), a preexisting database is quickly converted.

Database Entry

This section describes the procedure to enter a plasmid into the plasmid database. This process is identical for all the other databases such as antibodies, cell lines and so on. New entries are made on preformed data sheets (exemplified by the plasmid data sheet in Figure 2), and a numbering system allocates a new identification (ID) number to each entry. To ensure that each item is unmistakably recognized, the ID number will not be reused even after deleting an old entry. Each data sheet is designed to contain most of the commonly used information, and we have found that this system encouraged users to enter complete data. However, since SLD is constructed with FileMaker Pro 4.0 software, additional entry fields or modification of existing SLD forms can be easily customized to suit specific needs (not in stand-alone version).

The plasmid entry form contains useful cross-links. Similarly, other sub-databases are cross-linked if they contain complementary information; for example, entries from the **Users** and the **Suppliers** databases appear in all other databases in pull-down menus in the *Made by* and *Supplier* field. The **DNA Analysis** button starts up a preferred program, such as DNAstrider or DNAsis® (Hitachi Software Engineering America, San Bruno, CA, USA), and copies the contents of the *Sequence* field into the DNA program for further manipulation, such as restriction digest maps. A link to a program of your choice is easily established (described in the **Help** function in SLD). Because each field can hold up to 65000 characters, the entire DNA sequence information can be stored. The plasmid map can be made with a simple drawing program that automatically starts by pressing the **Draw Map** button. Complete maps that are created by more sophisticated programs can be simply copied and pasted into the *Map* field. FileMaker Pro 4.0 can import a variety of Macintosh and PC graphic formats, making it simple to insert scanned or internet-downloaded maps.

All the important information for a particular plasmid is displayed in a data sheet using the *browse* mode, whereas an overview of all plasmids is found in a list display. The power of an electronic database usually resides in its *sort* and *find* features. Every database can be sorted according to any feature, such as date, name, etc.. With a *find* option, a particular

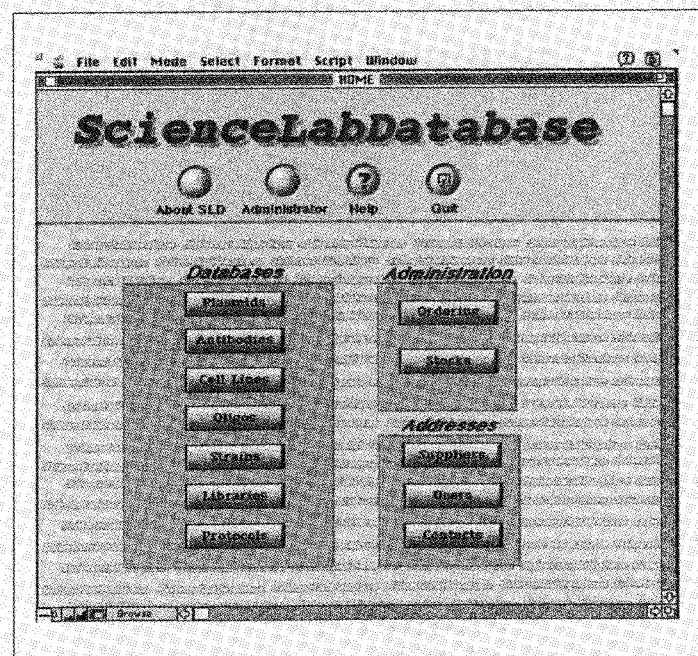


Figure 1. Home page of the SLD. A screen shot of the home page shows the different sub-databases, which are activated by clicking on the individual database buttons. General information and explanations on the use of the different databases is accessible with the **Help** button.

entry or a group of entries containing a common feature can be rapidly picked out. So far, the entry of a record into the plasmid entry form has been described. Many of these described features can also be found in **Antibodies**, **Oligos**, **Cell Lines**, **Strains**, **Libraries** and **Protocols**. A particular advantage of the SLD lies in its capability to organize sample storage. Items are currently stored in standard polypropylene freezer boxes using a 10 × 10 space format (e.g., Nunc®; Nalge Nunc International). Although different box formats are not featured here, these could be easily customized. After entering data, for example into the **Plasmid** database, the sample is manually allocated to a specific freezer and box. The **Box it** command is used to open a graphical display of the chosen box, and the sample is entered (Figure 2). All boxes can be viewed in the **Stocks** database, which is a virtual representation of the laboratory freezers. Furthermore, to

identify a sample in the box, simply clicking on it and then pressing the **MENU** button takes you to the original entry in the correct database.

Ordering

The ordering of reagents or equipment is an almost daily routine in most laboratories. However, we have found that it is often difficult to control outgoing and incoming orders and to maintain an overview of available reagents to avoid redundancies or erroneous orders. Furthermore, looking up addresses or phone numbers of suppliers, especially for frequent reorders, can be unnecessarily time-consuming. Several aspects of a regular ordering process, including supplier addresses, details of the purchase, etc. are combined in a preformed order data sheet in SLD (Figure 3). A **ReOrder** button allows

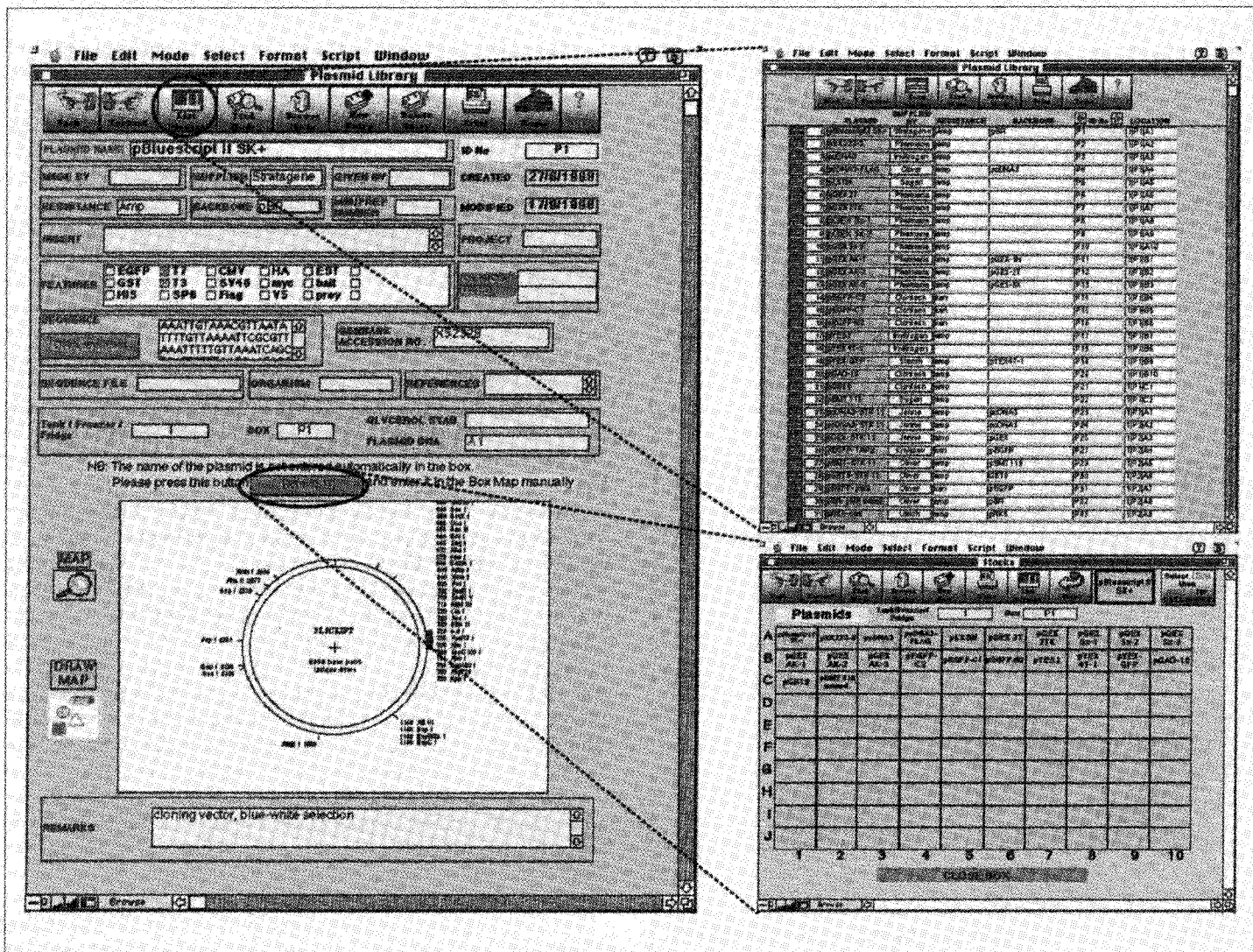


Figure 2. Preformed data entry sheet of the **Plasmid** sub-database. The screen shot of the **Plasmid** database displays the data entry form in the *browse* mode (left). The entry of the pBlueScript® plasmid illustrates the information that can be stored. Buttons are used to open a DNA analysis program or a **Draw map** program. The **List Display** button is circled. This button displays lists of all plasmids entered, indicating their name, the person that made or provided the plasmid, the resistance, the unique identification number and the location (top right). The circled **Box it** button opens the stocks database (bottom right). The name of the plasmid indicated on the top right is transferred to its precise location in this virtual box with a **Drag&Drop** function.

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the instant creation of a new order form from a previously used order. In addition, all orders can be allocated to a particular grant or money source, so that an instant balance of the accounts on a monthly or yearly basis can be viewed. A specific search feature also enables the user to view expenditure according to, for example, supplier or user. The expenditure information is again only available to the individual with the administrator permission. The **Ordering** database program incorporates all received orders and provides an accurate overview of all available reagents. Thus, redundancies of orders and reagents can be effectively eliminated.

Administrative Functions and Address Books

After SLD has been opened with the administrator's password, all program features, such as layouts, passwords and so on can be changed (not in the stand-alone version). Also, sev-

eral additional features are available in the program. Clicking of the **Administrator** icon in the home page (Figure 1) opens a dialogue that allows the definition of projects that will appear as pull-down menus in the various database sheets. In addition, this page allows the entry of fund names and the amount of money allocated to a particular grant. Clicking on *Expenditure* in the order menu results in a sub-menu that gives a weekly, monthly or yearly expenditure report. With the administrator's password, new members of the laboratory can be added, including their user names, phone numbers and addresses. This user name will appear in all data sheets as a pull-down list under **Made By** or **Ordered By**. Finally, only the administrator can delete entries by pushing the **Delete Entry** button. In contrast, the laboratory scientist password allows entries of supplier and contact names, which are used to store information about vendors and fellow scientists, respectively, providing reagents.

Ordering & Inventory

File Edit Mode Select Format Script Window

Home Expenditure List Find Browse Delete Order New Order Print Help

Order Information

Ordered by: Jörg

Supplier: Sigma-Aldrich

Grant Name: NIH 256497

Source: Grant Department Misc.

Status: Ordered Received

Expenditure ReOrder

New Supplier

Int. Order No.: 12356

Order ID: 4

Order Created: 30/11/1999

Order Modified: 4/2/1999

Repeat Order:

Product No.	Amount	Item	Cost	Total
A34567	1	Microtubes	444.00	444.00
			Total Sum	444.00

Browse

Figure 3. Preformed ordering data sheet. The preformed data sheet is used to place an order and to allocate the purchase to a particular fund and grant name. A balance of accounts is easily acquired with the **Expenditure** button. Frequent orders are simplified using a repeat order status. The **ReOrder** button creates a new order form from a previously used entry bearing a repeat order status.

SUMMARY

We describe some of the central features of ScienceLab-Database, molecular biology laboratory management software specifically developed by molecular biologists using FileMaker Pro 4.0. This database meets the specific needs of a small-to-medium scale research laboratory and will greatly help to organize stocks of valuable reagents, to store and maintain information on those items and to simplify ordering processes. Furthermore, as all orders can be allocated to different grants and funds, a group leader maintains an overview over all reagents and consumables in the laboratory and has instant access to the balance of a project's money sources and how they were used. The power and flexibility of FileMaker Pro 4.0 with the SLD does not limit itself to one laboratory. Because of its networking potential and its cross-platform capability, this database could be initialized on an institute level.

We have successfully introduced the SLD management system in our own laboratories and found that it greatly facilitates many aspects of our daily routines. Furthermore, since it is very easy to use, it is appreciated by our laboratory members as an easy information retrieval system. Based on our own experience, it is thus conceivable that ScienceLabDatabase could become a widespread laboratory management program.

AVAILABILITY

The ScienceLabDatabase is made available at a reasonable fee. For further information, visit the authors' home page (<http://www.neuro.mpg.de/stamm.htm>).

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red AND white	must find both words
red OR white	must find either word
red AND (white or blue)	must find "red and one of the other words
red*	any word which starts with "red", such as "redress"
red?	any word which has "red" and one character, such as "redo"
red	any word in which "red" appears, such as "sacred"
red AND NOT white	"red" must be found without "white"
red THEN white	"white" must be the next word after "red"
red NEAR white	"red" must occur within 8 words of "white"
red NEAR 3 white	"red" must occur within 3 words of "white"

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