

CircuSoft gMouse v2

Developer's Guide

P. Daniel Tyréus

Copyright 2004

CircuSoft Instrumentation LLC

Contents

Preface	1
1 Introduction	3
Resource Sharing	3
Where to Find More Help	3
2 File Structure	5
3 Database Structure	7
Mouse Structure	7
Breeding Structure	8
Screening Structure	8
4 Simple Customizations	11
User-Defined Fields	11
Changing the Field Type	11
Creating a Calculation	11
Mouse Table	12
Auto-Numbering	12
Current Status	13
5 Custom Reports	15

Creating an External Reports File 15

Example: Mouse Strain Report 16

Example: Litters Grouped By Strain 17

Setting Up the Reports File 18

Creating the Report 18

Creating an Interface 19

6 Creating an External Module 21

Histology Module Walkthrough 21

Create the Database Structure 21

Linking to the gMouse Database 22

Creating Layouts 23

Summary 25

Preface

This is the gMouse 2 Developer's Guide, a developer's companion to the gMouse 2 User's Guide. The Developer's Guide is designed for advanced gMouse users who wish to make customizations to their database or to construct external modules. The average user does not need to read this to use gMouse effectively.

CircuSoft encourages end-user development using gMouse 2. However, we also understand that it is not necessarily easy, despite our efforts to provide enough information and examples in this guide. We encourage you to post questions on the developer's forums on the CircuSoft web site. These posts will be answered by the technical support staff.

This document assumes you are using gMouse v2.2 or later. Earlier version of gMouse may be slightly different.

1 Introduction

CircuSoft gMouse is probably the most customizable mouse database you can buy, for several reasons. First, developers have full access to the database file that contains all the tables, relationships, and data. Second, gMouse 2 is written using FileMaker 7, a relatively simple to use, graphical database application that almost any developer can learn. Finally, gMouse 2 is modular in its design, allowing developers to easily create add-ons that handle additional data types (*e.g.* experimental data for mice), perform new tasks, or contain custom reporting features. The end result is that users can take a relatively inexpensive, off-the-shelf produce and tailor it to exactly meet their immediate and future needs without paying expensive customization fees or wondering if their system will become obsolete as the needs of the lab change.

The types of customizations that can be performed on gMouse range from simple field modifications to advanced external module designs. While most of the modifications discussed in this guide can be done by anyone who is proficient with average desktop applications, some work is best handled by developers or IT professionals. While every effort is made in this guide to assist you in performing customizations safely, CircuSoft cannot be responsible for damage done to your database while attempting development work. *We strongly suggest that you back up your entire database to a remote location before attempting any type of customization.*

Completed versions of some of the more complex examples are available as file downloads from the CircuSoft web site. These files can be found in the modules section. These files are excellent reference points or can be used as templates for developing new modules.

Resource Sharing

As software developers, we at CircuSoft have benefitted many times from generous programmers sharing code resources with others over the Internet. As such, we encourage gMouse developers to share solutions they have developed with others who might benefit from your efforts. If you create a module that performs a useful task, generates an interesting report, or stores types of data that other labs may be interested in using, please let us know. We would be more than happy to post the module on our web site for others to download and give you the credit you deserve.

Where to Find More Help

The developers at CircuSoft are delighted to see users customizing the software by developing modules. We do also understand that there are a lot of places where things can

4 Chapter 1 Introduction

go wrong and that most users will require some assistance along the way. We offer consulting services at the rate of \$60/hour (or on a set-fee basis) for developer assistance or custom design. We cannot provide free one on one email or phone technical support to developers. However, we encourage developers to post questions on the developer's forums on the CircuSoft web site. These posts will be answered as best as possible by the technical support staff.

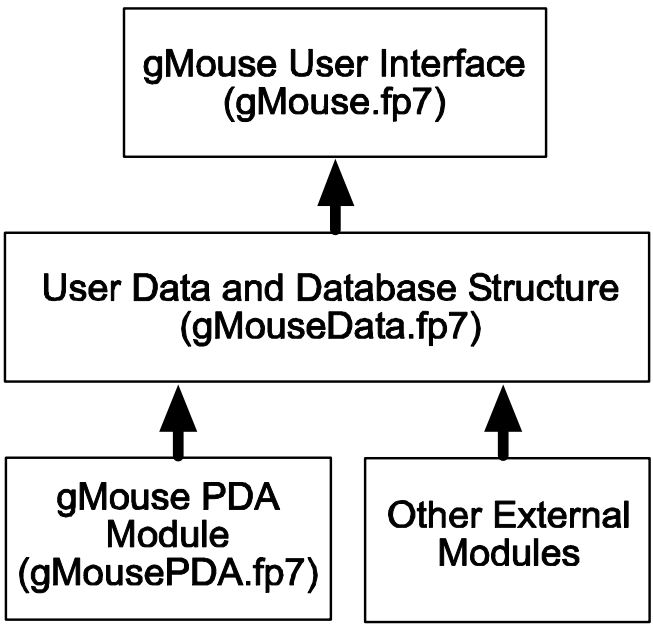
2 File Structure

In order to make gMouse as flexible and extensible as possible, during development the application was broken up into multiple FileMaker files. The primary structure of the gMouse database consists of two files. The first file, gMouse.fp7, is the gMouse user interface. This file contains the layouts that you see when you open gMouse as well as the scripts that power user interaction with the database. End-user developers do not have access to anything inside this file. The second file, gMouseData.fp7, contains all the tables, fields, and data. End-user developers have full access to everything inside this file.

If you are reading this guide, then you are probably interested in why gMouse was developed in this way. The design of CircuSoft gMouse 2 takes advantage of a powerful capability of FileMaker 7 that was not possible in earlier versions, separation of data and logic. This is a common design heuristic used in most high-level programming languages, but FileMaker has not provided the tools to use this technique before the release of FileMaker 7. To understand why this is important, it is easiest to consider the alternative. Consider a database solution distributed in a single file containing all the scripts, layouts, tables, and data. A user fills the database with important data and customizes it as he or she desires. During that time, the company comes out with a new feature involving new scripts and layouts. How can the existing user benefit from the new features? One option is to get the newest copy of the database file and to import all the data from the old file to the new one. Then the user must remake the custom modifications to the new file. This is very inconvenient for the user. The other option is for the company to try to modify the existing user's file so that it incorporates the new features. This is time consuming and error-prone for the company.

Enter separation of data and logic. To add a new feature to gMouse 2, the CircuSoft developers can make the necessary modifications to the logic and layouts in the gMouse.fp7 file. Then users can upgrade easily and smoothly just by downloading a new copy of the gMouse.fp7 file. The gMouse file automatically accesses the data in the existing gMouseData.fp7 file. Since the gMouseData.fp7 file was not modified or upgraded, there is no import or other hassle required for the end user.

The other implication of this design method for end-user developers is that it makes creation of external modules that access the data in the primary database much easier. An example of such a module is the gMousePDA.fp7 file. External modules will be discussed in more detail in the following chapters.



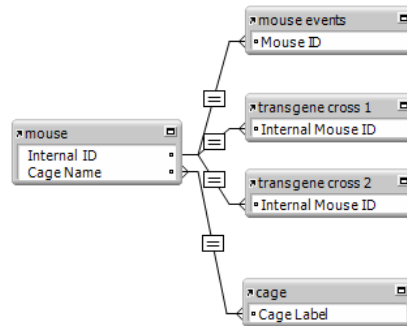
1.Symbolic representation of the gMouse database file structure. The primary structure consists of the gMouse.fp7 and gMouseData.fp7 files. External modules such as gMousePDA.fp7 link directly to the gMouseData file.

3 Database Structure

The CircuSoft gMouse database consists of about 17 different tables, but the three most important are the Mouse, Litter, and Breeding table. CircuSoft gMouse is a mouse-centric database. This means that the Mouse table is the primary table in the database, and almost every other table has a direct or indirect relationship to the Mouse table. It is possible to view the entire database structure by opening the gMouseData.fp7 file in FileMaker and clicking on File | Define | Database... However, the following sections break the database up into more manageable chunks.

Mouse Structure

The mouse table defines a record for each mouse in the colony and stores fields such as strain, date of birth, and coat color. Each mouse record has a unique internal identifying number, known as the Internal ID. The Internal ID is a serial number that is completely independent of the user-specified Mouse ID. Several mice can have the same Mouse ID, but every record has a unique Internal ID to maintain database integrity.



2.Direct Mouse table relationships. The Mouse table has direct links to the Events, Transgene Crosses, and Cages tables.

The Internal ID defines the relationship of each mouse record to all related records in other tables. Therefore, this number should not be modified once it is defined. Figure 2 shows how the Mouse table is linked to four other tables. Each mouse record can be related to one or more events and transgene labels via its Internal ID. For instance, if an event record has a Mouse ID that is the same as a mouse record Internal ID, those records are related. Many event records can have the same Mouse ID, indicating multiple events

for one mouse. Each mouse can also be linked to a cage record via the Cage Name. In this case, many mouse records can have the same Cage Name, indicating multiple mice in the same cage.

Breeding Structure

In the breeding section of the gMouse database, each mouse record can be linked in multiple ways (directly and indirectly) to a breeding record. The Breeding table has an Internal Breeding ID that is analogous to the Mouse Internal ID. Each breeding record is linked directly to an instance of the Breeder table (shown as mother and father in Figure 3). The Breeder table is a bridge between the Mouse table and the Breeding table. Each breeding record can have one or more breeder records linked via the Internal Breeding ID. In other words, each breeder with a Breeding ID field matching the Internal Breeding ID of a breeding record is either a mother or father in that breeding. To distinguish between the two, a breeder record with the Mouse ID matching the Father ID of the breeding record is a father in the breeding. A breeder record with the Mouse ID not matching the Father ID is a mother. This allows for multiple female mice (mothers) but only one male (father) in each breeding.

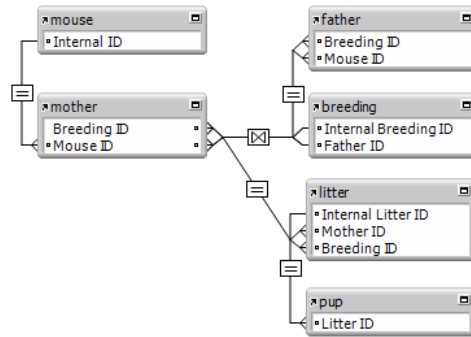
Each breeder record is also linked back to a mouse record via the Internal ID. This is so that the breeding record can access the underlying mouse record data via the breeder record. This is shown as the Mother to Mouse relationship in Figure 3. So why not use a mouse record directly instead of going through the Breeding table? For instance, why not put a Breeding ID field in the Mouse table? Well, a mouse can be involved in more than one breeding during its life. If we created a new breeding, we would have to overwrite the contents of the Breeding ID field in the mouse record to link it to the new breeding. This would destroy the link to the old breeding. The solution is to use the Breeder table as a bridge and to create new breeder records for each new breeding. This means a mouse can be involved in any number of breedings without losing any information. This is a handy trick to remember when developing modules for gMouse.

Also as shown in Figure 3, each female breeder can be linked to a litter record. Each breeder can have multiple litters. Each breeding can have multiple breeders. The end result is that a breeding is related to all litters produced by mothers only while in that breeding. The same mouse could have produced litters while in another breeding that will not show up in the first breeding. Finally, each litter can have any number of pups. Each pup has a one to one direct relationship with a mouse record via the Internal ID (not shown) and a one to one indirect relationship to the mouse record of its mother (shown).

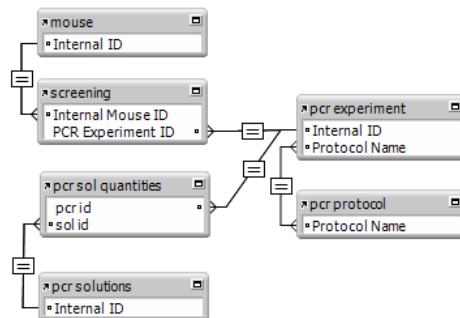
Screening Structure

In the PCR or screening section of gMouse, each mouse record can be linked to multiple screening results. The primary tables in this section are the PCR Experiment table and the PCR Protocol table. Each PCR Experiment is based on a single PCR Protocol via the Protocol Name. A single PCR Protocol record can be the basis of a large number

of PCR Experiment records. Every PCR Experiment has a unique Internal ID. A mouse record is related to one or more PCR Experiment records via the Screening table bridge, which connects the Internal ID of a mouse record to the Internal ID's of one ore more a unique PCR Experiments.



3. Structure of the gMouse breeding relationships.



4. Structure of the gMouse screening (PCR) module.

4 Simple Customizations

There are a number of fairly simple changes you can make to the gMouseData.fp7 file directly to change the behaviour of the database. This chapter covers three such possibilities.

User-Defined Fields

The gMouse User's Guide covered how to use the user-defined fields that appear on the mouse layout. However, it is possible to further tailor these fields for your needs. For instance, by default user-defined 1 holds text, user-defined 2 holds a calculation, and user-defined 3 holds a date. If, for example, user-defined 1 is redefined to hold a protocol number, the field type might be more appropriately defined as a number than text. In this way, sorting by the protocol number will sort the mice numerically rather than by the text representation of the number.

Changing the Field Type

The following steps show how to change the user-defined 1 field type:

1. Open the gMouseData.fp7 file and log in as Admin.
2. Click on File | Define | Database... and select the Fields tab and the mouse table.
3. Scroll down and select the field User1.
4. Under type, select Number.
5. Click the Change button.

Note: The Cage Name field is also a text field. If you only store numbers in this field, you may want to change the field type to number for sorting purposes.

Creating a Calculation

The user-defined 2 field is defined as a calculation, but by default that calculation is empty. For this example, we will assume that user-defined 3 is being used to hold the date that a mouse was transferred out of the colony. We are going to define user-defined 2 as a calculation that determines the mouse's age when transferred out of the colony.

1. Open the gMouseData.fp7 file and log in as Admin.

2. Click on File | Define | Database... and select the Fields tab and the mouse table.
3. Scroll down and select the field User2.
4. Click on the Options... button.
5. In the dialog, replace "User Calculation" with the text: User3 - Date of Birth.
6. Change the Calculation result to Number. Press OK.

If you navigate back to the mouse layout, you will see that entering any date in the user-defined 3 field automatically causes user-defined 2 to recalculate the age when transferred out.

Mouse Table

A simple but powerful customization of gMouse is to change the fields that appear in the Mouse Table View. The Mouse Table View can be brought up by clicking the Mouse Table link from the mouse layout. Clicking this link actually brings up a layout in the gMouseData file. Therefore, you have full access to modify it. The following steps allow you to modify the mouse table layout.

1. Open the gMouseData.fp7 file and log in as Admin.
2. While in browse mode, select the Mouse Table layout. This is how the layout currently appears.
3. To modify the layout, enter Layout mode. You can now insert or remove fields from the layout or change the data entry characteristics.

Note: You can also change the size and position of the column headers in the table layout by dragging and dropping while in Browse mode.

Auto-Numbering

With gMouse, you can modify the default values assigned to new mouse, litter, or breeding records. This can be an extremely powerful way to implement a custom numbering scheme while keeping data entry to a minimum. To activate the Auto-Numbering feature, select the appropriate Settings... from the Admin tab of the Home layout. You must choose to use the External auto-numbering script in the gMouseData file.

Every mouse, litter, and breeding record created in gMouse is assigned an internal, sequential serial ID number that cannot be changed. The default auto-number system then assigns this value to the modifiable ID (*e.g.* Mouse ID Number, Litter Name, Breeding Name). However, any numbering scheme is possible. The following example changes

the mouse auto-number script so that it assigns a Prefix based on the Strain and an ID Number based on the birthdate.

1. Open the gMouseData.fp7 file and log in as Admin.
2. From the FileMaker menu, select Scripts | Script Maker...
3. Select Auto-Number mouse and click Edit...
4. In the loop, select the line that sets the Mouse ID Number. Click Specify... to change the calculated result.
5. Change "mouse::Internal ID" to "Day(mouse::Date of Birth)". Press OK.
6. In the loop, select the line that sets the Mouse ID Prefix. Click Specify... to change the calculated result.
7. Change ""A"" to "Left(mouse::Strain; 1)". Press OK.
8. Exit the script maker and create a new mouse to test.

Current Status

By default, the Current Status field displays Assigned when a mouse has the Investigator field filled. This is designed to indicate that a mouse is assigned to an investigator and not available for other uses. This may not make sense for all labs, so some users may want to eliminate the Assigned status. The following instructions show how to do this.

1. Open the gMouseData.fp7 file and log in as Admin.
2. Click on File | Define | Database... and select the Fields tab and the mouse table.
3. Scroll down and select the field Current Status.
4. Click on the Options... button.
5. The existing calculation text reads: Case (not IsEmpty (Date of Death) ; "Deceased" ; IsEmpty (Weaning Date) ; "Unweaned"; Active Father + Active Mother > 0; "Breeding"; not IsEmpty (Investigator); "Assigned" ; "Available"). To remove the Assigned status, remove the section <<not IsEmpty (Investigator); "Assigned" ;>> so that the calculation reads: Case (not IsEmpty (Date of Death) ; "Deceased" ; IsEmpty (Weaning Date) ; "Unweaned"; Active Father + Active Mother > 0; "Breeding"; "Available")
6. Press OK to exit.

5 Custom Reports

Another easy and powerful way to customize gMouse is to create custom reports to automatically generate specific to your lab's needs. Since it is almost impossible to predict how every user wants his or her mouse colony data grouped and sorted, gMouse's modular design provides a powerful framework for creating an unlimited number of user-designed reports. Creating a custom report requires very little previous FileMaker experience. The remainder of this section will guide you through two examples.

CircuSoft gMouse database administrators have full access to the gMouseData.fp7 file. The gMouseData file has several example reports and scripts already designed in. A simple way to get started if you only desire small changes to existing reports is to modify the gMouseData file directly. However, changes to the gMouseData file are permanent. If you destroy the file or the database structure it cannot easily be recovered. For small changes by experienced developers, this is unlikely to be a problem. To be on the safe side, though, this guide will show you how to create custom reports in a new, external file to reduce the risk of damaging your database. The examples discussed in this chapter are available in the Reports.fp7 file, free for download from the CircuSoft web site.

Creating an External Reports File

To create an external reports file, open FileMaker 7 Pro and create a new file in your gMouse directory. Call the file Reports.fp7. To create custom reports from data in the main gMouse database, you must link the Reports file to the pertinent tables in gMouse.

1. With the Reports file open in FileMaker, click on File | Define | File References...
2. Click the New... button to create a new reference. Add the gMouseData.fp7 file and click OK in all the dialogs.
3. Now we must link in the necessary tables from the gMouseData file. Click File | Define | Database to bring up the database definition dialog for the Reports file.
4. Click on Relationships. There will likely be an empty Reports table that was automatically generated when you created the file. We do not need this for now, but there is no harm in leaving it.
5. From the bottom left of the dialog, click the green plus sign button to add a table. Under File: select gMouseData instead of Current File.
6. Select the Mouse table and click OK. We will add more tables later, but this is all we need for now.

Example: Mouse Strain Report

In this example, we will create a report that displays all currently living mice, grouped by strain and sorted by cages. This examples assumes you have created the external Reports file from the previous section.

1. Open the Reports file and go to Layout Mode.
2. Click Layouts | New Layout/Report...
3. Select to show records from Mouse and call the layout "Report: Mice by Strain/Cage." Select a Columnar list/report and press Next>.
4. Select Report with grouped data. Then select to include subtotals and grand total. Press Next>.
5. In this screen, we add the fields we want in the report, but it is possible to add or remove fields later. Move the Mouse ID, Gender, Age, Cage Name, Investigator, and Strain to the Layout Fields column. Press Next>.
6. To group the mice by strain, move the Strain field to the Report Categories column. Click Next>.
7. In the Sort Records screen, the Strain field will already appear in the Sort Order with a lock next to it. This shows that the mice will be grouped by strain. Within each strain group, we also want to sort by cage. With that in mind, add the Cage Name field to the Sort Order so that it appears under Strain. Press Next>.
8. In the subtotal field, we want to tell the report to calculate the number of mice in each strain group. Under Summary Field: click the Specify... button.
9. Scroll down the field list until you find the Number of Mice field. It should be the only field not grayed out. Press OK.
10. Click the Add Subtotal button to the Number of Mice subtotal to the list. Click Next>.
11. In the same way, add the Number of Mice grand total. Click Next>.
12. If this report will be printed, select an easy theme such as High contrast white print. Press Next>.
13. Select the current date for the top right and page number for the bottom center. Press Next>.
14. Choose to create a script and click Next>.
15. Select to view in Preview Mode and press Finish.

Chances are in preview mode that the report will not look quite the way you want or will not fit nicely on a page. Change to layout mode, move the fields around or adjust the size

of the text so that the report fits on a page when printed (as seen in preview mode). You can also add or remove fields from each section of the report, but this could dramatically effect the way the report behaves. See the FileMaker manual for more information on report sections.

One noticeable thing about the report is that it shows all mice in the database, whether they are living or have been dead for years. Most likely, you will only want to see living mice in the report. Reports work on the current found set. To change the current found set to only include living mice, we need to make a change to the automatically generated script.

1. Click on Scripts | Script Maker...
2. Select the report script, and press Edit...
3. Find the Show All Records script step under Found Sets on the left. Add this step to the script by clicking the >> Move >> button.
4. Drag the Show All Records step until it appears immediately under the first Go to Layout step.
5. Add the Perform Find script step directly below the Show All Records step.
6. Select the Perform Find [] step and click the Specify... button.
7. In the Specify Find Requests dialog, Click on New...
8. By Action:, select Omit Records.
9. Under Omit records when:, scroll down to select the Current Status field.
10. Under Criteria:, add the text "Deceased" without quotes. Click the Add button.
11. Click OK until you have exited out of all the dialogs.

To test the report, click on the Reports menu. The Report: Mice by Strain/Cage script should be listed next to the number 1. Click on this script to generate the report. Now, any time you want to run this report, open the Reports file and click on the Report: Mice by Strain/Cage script.

Example: Litters Grouped By Strain

In this next example, we will create a second report that shows all litters produced within a date range and group them by the strain of the mother. We will also create a simple interface that will allow you to specify the date range for use in the report. This example assumes that the previous example has already been completed and uses the Reports file from above. A completed version of the Reports file you will be creating is available from the CircuSoft web page for reference.

Setting Up the Reports File

Since this report will utilize litter information, we need to add more linked tables to the Reports file.

1. Open the Reports file, and click File | Define | Database.
2. From the Relationships tab, add a copy of the Litter and Breeding table from the gMouseData file.
3. Drag the Mother ID field from the Litter table so that it creates a relationship with the Internal ID from the Mouse table.
4. Drag the Breeding ID field from the Litter table so that it creates a relationship with the Internal Breeding ID from the Breeding table.
5. Press OK to exit this dialog.

Creating the Report

Creating this report will follow many of the same steps as for creating the mouse report above.

1. Open the Reports file and go to Layout Mode.
2. Click Layouts | New Layout/Report...
3. Select to show records from Litter and call the layout "Report: Litters by Strain." Select a Columnar list/report and press Next>.
4. Select Report with grouped data without subtotals and grand totals. Press Next>.
5. Add the Litter Name, Litter DOB, and Number of Pups from the Litter table.
6. Add Mouse ID and Strain from the mouse table. Since there is a relationship between the Mother ID of the Litter table and the Internal ID of the mouse table, the Mouse ID and Strain reported will be the Mouse ID and Strain of the mother.
7. Finally, add the Breeding ID from the Breeding table. This is the label of the breeding from which the litter was produced. Click Next>.
8. To group the litters by the strain of the mother, move the mouse::Strain field to the Report Categories column.
9. To additionally group by breeding, also move the breeding::Breeding ID to the Report Categories column. Click Next>.
10. Add the Litter DOB to the Sort Order. Press Next>.
11. If this report will be printed, select an easy theme such as High contrast white print. Press Next>.

12. Select the current date for the top right and page number for the bottom center. Press Next>.
13. Choose to create a script and click Next>.
14. Select to view in Preview Mode and press Finish.

Note: The litter report does not have subtotals and grand totals because there are no summary fields defined in the Litters table. To create a report with totals, you must first define a summary field in the Litter table by editing the table in the gMouseData file.

Creating an Interface

To test the report, click on the Report: Litters by Strain link under the Scripts menu. Currently our report shows all litters ever produced in the database. This may be what you want in some cases, but as the database grows, this may become unwieldy. Would it not be better to be able to designate a date range interactively each time the report is run? To do this, we need to create a simple report interface.

1. Open the Reports file, and click File | Define | Database.
2. In the Fields tab, select the Reports table. Type Litter Date Range into the Field Name and click the Create button.
3. Select the newly-created Litter Date Range field and click the Options... button.
4. Under the storage tab, click to Use global storage. Press OK twice to exit.
5. From the Layouts menu, click New Layout/Report...
6. Choose to Show records from: Reports, call the layout Litter Reports UI, and select Standard Form. Press Next>.
7. Move the Litter Date Range to the Layout Fields and press Next>.
8. Select a Theme and press Finish.
9. In layout mode, select Insert | Button.
10. Select Perform Script under control. Press Specify... and select Report: Litters by Strain. Press OK to exit back to the layout.
11. Type Run Report into the button text. Move the new button to below the Litter Date Range field on the layout.
12. Click Scripts | Scripts Maker... and select to edit the Report: Litters By Strain script.
13. Under the first Go to Layout step, insert a Enter Find Mode step. Deselect the Pause option.

14. Under the Enter Find Mode step, insert a Set Field step. Use the Specify... button so that the litter::Litter DOB gets set to the Reports::Litter Date Range. The scripts step should appear like "Set Field [litter::Litter DOB; Reports::Litter Date Range]".
15. Under the Set Field step, insert a Perform Find step. Press OK to exit.

To test this new user interface, enter browse mode. Type a date range into the Litter Date Range field. An example of valid date ranges would be to type ">1/1/04" or "1/1/03..12/31/03". Press the Run Report button to generate the report.

6 Creating an External Module

Histology Module Walkthrough

This section provides step by step instructions for creating a custom external module that will interact with the main gMouse database records. You can download the file containing the completed version of this example database from the CircuSoft website. This tutorial assumes a working knowledge of FileMaker 7.

Field Name	Type
Record ID	Number, Auto-Enter Serial
Mouse ID	Text
Experiment Label	Text
Tissues Collected	Text
Experiment Date	Date
Date Sectioned	Date
Date Embedded	Date
Embedding Material	Text
Fixative	Text
Sample Location	Text
Unstained Slide Location	Text
Stained Slide Location	Text

1.Histology Fields

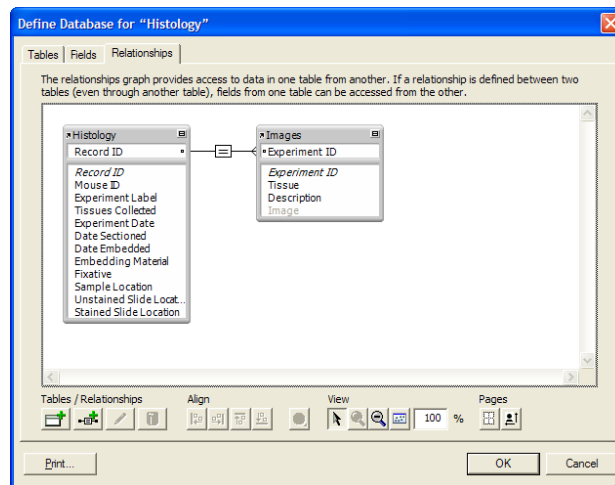
Create the Database Structure

1. Open FileMaker 7 and create a new, blank database. Save the database as Histology.fp7 in the same directory as your gMouseData file.
2. In the Define Database dialog that appears automatically, create two tables, Histology and Images.
3. In the Histology table, create the fields shown in Table 1.
4. In the Images table, create the fields shown in Table 2.
5. Click on the Relationships tab. Create a relation between the Histology table Record ID and the Images table Experiment ID. This allows you to link an unlimited number

of images to each histology record. When you are done, the database map should look like Figure 5. Press OK to close the dialog.

Field Name	Type
Experiment ID	Number
Tissue	Text
Description	Text
Image	Container

2.Images Fields



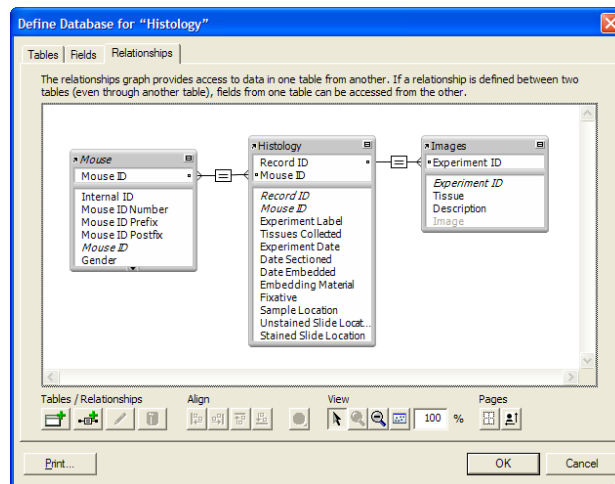
5.Histology database structure

Linking to the gMouse Database

Now that the basic database structure is created, we need to link the experimental histology records to mice in the main gMouse database.

1. With the Histology file open in FileMaker, select File | Define | File References.
2. Click on New... to add a file reference to gMouseData.fp7. Press OK to exit.
3. Now go to File | Define | Database... and click on the Relationships tab again.
4. From the lower left corner of the dialog, click the green plus sign button to add a table.
5. In the Specify Table dialog, select the gMouseData file instead of the Current File. This brings up a list of all the tables in the gMouseData file.

6. Select the mouse table, name the table Mouse, and press OK to add a link to the gMouseData mouse table.
7. Create a relationship between the Mouse ID in the Mouse table and the Mouse ID in the Histology table. This links each histology record to a mouse record. When you are done, your database map should look like Figure 6.



6.Histology database structure linked to the gMouse mouse table.

Creating Layouts

With the database structure intact, it is time to create layouts that will display the records in a useful manner. The finished layouts shown in Histology.fp7 are available for download from the CircuSoft website. Any layout in FileMaker can show one primary record type and all its related records. This walkthrough will cover the creation of three layouts: one mouse-centric and one experiment-centric.

Creating a Mouse-Centric Layout

A mouse-centric layout shows the records from the mouse table. Since each mouse record can have one or more related experiment records from the histology table, the mouse-centric layout can also display linked experimental records for each mouse record on the layout. In this layout example, the records from the histology table will be displayed in a portal.

1. Switch to Layout mode.
2. From the Layout menu, click New Layout/Report... Name the new layout Mice, use a Standard Form, and select to show records from the Mouse table.

3. Add Mouse ID, Gender, Transline, Strain, and Current Status from the available fields in the Mouse table. Click Next and then Finish.
4. Next we will add a portal to display related experiment records for each mouse record. While in Layout mode, select Insert | Portal... Choose to show records from the Histology table. Press OK.
5. Chose to add the Experiment Label and Experiment Date fields.
6. Switch to Browse mode and select View | Show As List to display all the mouse records in your database. Since there are no experimental records yet, all of the portals will be empty.
7. To automatically create a new experimental record related to the current mouse record simply by typing into the portal, click on Define | Database... and go to the Relationships tab (Figure 6).
8. Double click on the relationship between the Mouse and Histology table. For the Histology table, check the box to allow creation of records via this relationship. Press OK to ext.
9. In Browse mode click on the first portal row for a mouse record. Enter a valid date. This creates a new Histology record linked to that mouse.

Creating an Experiment-Centric Layout

An experiment-centric layout shows all the records from the Histology table. Since each Histology record can have one or more related Image records, the experiment-centric layout can also display linked image records for each experiment record.

1. Switch to Layout mode and create a new layout named Experiments showing records from the Histology table.
2. Add all the fields from the Histology table except for the Internal Record ID. The Internal Record ID is automatically generated and should not be changed.
3. Also add the Gender, Strain, Transline, Age, and Current Status fields from the related Mouse table. Click Next and the Finish.
4. Add a portal to the Images table and add the Tissue, Description, and Image fields to the portal.
5. From the Relationships tab of the database definition, check the box to allow creation of records in the Images table via the Histology table relationship.
6. Select Browse mode to view the record you created previously from the Mouse layout. The record should show a date and the linked mouse information.

Navigating Between Layouts

When viewing an experimental record in the Experiments layout, it might be convenient

to navigate to the related mouse record and view all the other experimental records linked to that mouse. Similarly, clicking on a experiment from the portal on the Mouse layout should bring up that experiment. This functionality can be created using the related navigation features of FileMaker.

1. Switch to Layout mode and select the Experiments layout.
2. From the FileMaker menu, select Insert | Button...
3. In the Specify Button dialog, select Go to Related Record.
4. Click Specify... under options, choose get related record from Mouse and show using the Mice layout.
5. Press OK to place the button, and type "View Mouse" as the button text.
6. Enter Browse mode and click the View Mouse button to bring up the related mouse record.
7. Since each mouse can have one or more related experiment records, it would also be useful to navigate directly to the selected experiment record layout. Switch to layout mode and select the Experiment Label field in the portal.
8. Right click on the selected Experiment Label field and select Specify Button...
9. Under Navigation, select Go to Related Record.
10. Click on the Specify... button and select to show the Histology record on the Experiments layout.
11. Press OK, enter Browse mode, and click the Experiment Label link to navigate to the related experiment record.

Summary

This completes the walkthrough for creating a simple external module. In this walkthrough you created external tables, linked the tables to the gMouse database, created layouts, and implemented related navigation. That is a great start! The best way to learn how to make more sophisticated modules is just to experiment. Use the Histology module you just created as a starting place. You never have to worry about destroying the structure of your primary gMouse database, because you are never modifying the gMouseData file directly. However, you can inadvertently overwrite data in the gMouseData file from an external module, so it might be a good idea not to develop using your sensitive data. Instead, make a copy of your gMouseData file, move it to a new directory, and practice there until you are comfortable with your abilities.