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ABSTRACT

This report summarizes activities related to the development, field testing, evaluation, and marketing of the "Scientists at Work" program which combines computer assisted instruction with database tools to aid cognitively impaired middle and early high school children in learning and applying thinking skills to science. The brief report reviews demonstrations and promotions of the project as well as the marketing plan and results of contacts with various commercial publishers. The program requires a Macintosh computer, a hypercard, and an external disk drive. It combines visual, sound, and textual information within a life science problem-solving context utilizing an embedded interactive coach. Most of the document consists of appendixes including the "Scientists at Work" print materials (the Users' Guide and the Teaching Guide with lesson plans), team activities for the nine lessons, a description of the Interactive Advisor, a report of field testing (indicating a lack of statistically significant quantitative findings but encouraging results in the qualitative dimension), sample requests for the program and videotape, a news release on teaching thinking skills with databases, and a brief report on the feasibility of converting the program to the Personal Computer environment. (DB)

SCIENTISTS AT WORK

FINAL REPORT

EDUCATION TURNKEY SYSTEMS Inc

256 NORTH WASHINGTON STREET
FALLS CHURCH, VIRGINIA 22046

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FINAL REPORT

Prepared for:

U. S. Department of Education

Under Grant No. G008730293

EDUCATION TURNKEY SYSTEMS inc

256 NORTH WASHINGTON STREET
FALLS CHURCH, VIRGINIA 22046

September 29, 1989

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I. INTRODUCTION

The purpose of this report is to summarize the major activities related to the development, field-test, evaluation, and marketing of the *Scientists at Work* program which combines computer-assisted instruction with data base tools to aid cognitively impaired children in learning and applying thinking skills in science.

The project's objectives included:

- Objective 1: Develop a CAI program that combines the power, open-endedness, and flexibility of general purpose data base tools with the guidance and direction of an interactive "coach". This objective was met in September 1988 prior to field-testing; a final product consisting of a general User Guide, Lesson Plans, Teacher Guide, Student Handouts, overhead transparencies, an 18-minute videotape, and the seven disc Macintosh HyperCard program was delivered and demonstrated to ED/OSEP on December 15. Subsequently, a refined version was developed for preview by potential software publishers and distributors. Print documentation is included in Appendix A. A paper describing the interactive Advisor is included in B.

- Objective 2: Demonstrate the effectiveness of the program in classroom settings through a field-test with teachers and students representative of the target audience, including cognitively impaired and learning disabled students. The field-test was initiated in ten classrooms involving 408 students and five teachers beginning in September 1988 through February 1989. The initial field-test occurred during September-December 1988 in the following Virginia schools: Fairfax County Public Schools, Falls Church City Schools, and Prince William County Public Schools. Based on refinements to the program, one of the devlopers also field-tested the program in one school in the Lansing, Michigan area, which was associated with development activities undertaken at Michigan State University. The results of the field-tests/evaluations are included in Appendix C.

- Objective 3: Develop a plan for demonstrating, promoting, and marketing the package.

The remainder of this report summarizes the activities conducted thus far and those planned for the immediate future.

II. *SCIENTISTS AT WORK* DEMONSTRATIONS/PROMOTIONS

The primary objectives of the promotion/demonstration activities regarding the *Scientists at Work* program were:

- to make practitioners, primarily special education teachers, aware of the *Scientists at Work* program and to obtain comment and feedback from them;
- to demonstrate the capabilities of the *Scientists at Work* program and the approach to teaching information processing skills to key members of the special education technology R&D community and other researchers and developers interested in alternative learning methods for cognitively impaired children; and
- to orient potential publishers, distributors, and vendors to the *Scientists at Work* program.

To accomplish these objectives, a number of major activities were undertaken, including:

- numerous demonstrations and presentations at key meetings, conferences, etc.
- development of a broadcast-quality, 18-minute videotape, produced by the Fairfax County Public Schools, Division of Instructional Technology and Media; and
- preparation and publication of articles for journals and interested parties.

Below we summarize the major promotional activities which have taken place thus far in this project.

A. Special Education Technology Project Director's Meeting (June 1988)

The initial version of *Scientists at Work* was demonstrated to OSEP Project Directors during the annual meeting. In addition, several publishers in attendance (e.g., Apple, IBM, Educational Activities) also viewed the program and provided feedback. Publishers had some concern about where *Scientists at Work* would fit in the curriculum and the lack of structure.

B. TAM Conference (December 1988)

The *Scientists at Work* program was officially announced and presented to approximately 50 attendees during a special session at the TAM Conference in Reno. In addition to high interest among developers, several publishers (e.g., DLM) expressed some interest in marketing the package. A large number of Apple staff in attendance reaffirmed their interest in promoting the program, including the production of 200 copies of the videotape and program, which would be shared equally among Apple staff (particularly ETCs) and the project team for subsequent distribution for cost.

C. Education Technology Center (December 1988)

The *Scientists at Work* program was demonstrated to the Project Director and other ED staff at the Technology Center. The Center subsequently requested and was sent a copy of the program for demonstrations.

D. Florida Instructional Computing Conference (January 1998)

The videotape was presented to MECC and Sunburst during the FICC. In addition, other attendees who expressed interest in the program were also shown the videotape. Both MECC and Sunburst were sent copies for their review.

E. Maryland Instructional Computing Conference (March 1989)

Approximately ten publishers attended a special video presentation of *Scientists at Work* during the MICC, including several TAM members (who were primarily interested in development), IBM, Apple, Vantage, DLM, and MACRO, among others.

F. Software Publishers Association Conference (May 1989)

During this conference, videotape presentations of *Scientists at Work* were made to several publishers, including Davidson & Associates and The Learning Company.

G. National Education Computing Conference (June 1989)

A panel session, involving the field-test evaluator and one of the lead field-test teachers, presented the field-test results as well as a video segment of *Scientists at Work*. A surprisingly large number of European attendees were at this session. Several attendees commented on the field-test findings and the nature of the program, particularly the functions of the interactive coach.

H. International Federation of Information Processing Societies Working Group (June 1989)

The *Scientists at Work* program was demonstrated to approximately 20 attendees from different countries during the Reykjavik, Iceland conference. It was also demonstrated to the IBM contingent from Belgium.

Other presentations of *Scientists at Work* were made by members of the project team during the Colorado Technology in Education Conference, an ASTD Special Interest Group meeting focusing on computer-based training, at Columbia Teachers College, and at Technical Education Research Centers (TERCs) in Cambridge.

In addition to formal presentations, the *Scientists at Work* videotape has been included in the following television broadcasts: (1) a Midlands Star School broadcast in April; (2) the School Vision Program, broadcast by PBS in May 1989; and (3) numerous broadcasts on the Fairfax County (Virginia) Learring Channel in July 1989.

In addition to presentations and demonstrations, *Scientists at Work* developer Dr. Beverly Hunter, President of Targeted Learning Corporation, has prepared three papers on *Scientists at Work*, including:

- "*Scientists at Work* in the HyperCard Environment", to be published by The Computing Teacher (ICCE);

- "Collaborative Learning in the HyperMedia Environment", a paper for the World Conference on Computing in Education (1990 in Australia); and

- "Scientific Inquiry in HyperText: *Scientists at Work* in the Classroom", to be submitted.

Copies of the program have been provided to selected researchers and publishers in the United States and Europe.

In addition, project evaluator Dr. Charles White distributes the NECC paper, including field-test results, upon request.

As a result of the above promotional activities, a variety of individuals from different sectors have requested copies of the program and/or videotape. These range from such teacher education universities as Harvard Graduate School of Education to software evaluation centers and model technology schools (see Appendix D).

No immediate plans for additional promotion and demonstrations to potential users are planned for a variety of reasons. First, we are still awaiting a final decision by Apple for a joint promotional venture, whereby Apple will produce approximately 200 copies of the videotape and program for internal distribution for demonstration purposes and to provide the project team an equal amount for distribution to key members of the R&D community and others. The agreement with Apple Computer has not been finalized for a number of reasons, including: (a) a lack of specific focus within Apple Computer for this type of program (more than 11 individuals at Apple have requested copies or otherwise have been involved in this process); (b) several recent reorganizations within Apple corporate in Cupertino and the decentralization of all promotional activities to Apple's six regional offices; and (c) the apparent new priority direction for Apple's promotion of the Macintosh within education (i.e., desk-top publishing as opposed to middle-school level instruction). Several options are available if Apple's commitment is not obtained in the immediate future, as described in the marketing section which follows.

III. MARKETING PLAN

In this section of our report we summarize major marketing and distribution activities, primarily discussions with software publishers, for marketing the *Scientists at Work* program and the videotape. A royalty arrangement has been negotiated with the Fairfax County (Virginia) Public Schools for sale of the videotape. The proposed royalty for the program, to be divided among the three groups, is approximately 12 percent. We have suggested that publishers make the program available for less than $100 and that the tape be priced at $79 or less.

Below we summarize the nature of negotiations and discussions with major publishers.

A. Sunburst Communications

Discussions were held with both the President and Vice President of Marketing for Sunburst during the FICC, NECC, and SPA Conference. While Sunburst was initially very interested in the program, after a detailed review of the *Scientists at Work* they declined to market the product in its current form. They felt that the cost of the Macintosh and hard disc drive currently required for the program would be difficult for schools to justify for this program. As an alternative, they suggested that the *Scientists at Work* animal data base be converted to CD-ROM, thereby reducing the requirement for an external hard disc drive. This alternative is being assessed by the development team.

B. The Learning Company

The Director of Development Dr. David Ruben, who has developed several software products under grants from ED/OSEP, was very interested in the program but felt that the company's current thrust will remain basically at the elementary level and, hence, the program would not at this time be appropriate because of the middle/early high school level target audience. He indicated they might be interested in another version of the program, but not under the HyperCard environment with a hard disc. Such a program would be in C language. This alternative is not being pursued.

C. Scholastic

Scholastic has reviewed the videotape but expressed some concern about the marketability of any data base programs in the current market. They also expressed concern about the high cost of the Macintosh hard disc/HyperCard environment.

D. Claris Corporation

The Director of Education Marketing at Claris felt that the program was very exciting; however, she also felt it did not fit into the current line of Macintosh products, which are basically tool applications rather than the use of data bases, to provide instruction. If their current direction changes, they will contact us.

E. Developmental Learning Materials

The Director of Software Marketing for DLM, which has distributed a number of OSEP-funded product development efforts, felt that the level for *Scientists at Work* was slightly higher than their current K-6 target market. They also expressed concern about the current low level equipment base of Macintosh computers used for instructional purposes at the junior high level.

F. Davidson & Associates

Several meetings were held with the key staff at Davidson, including the President, during the SPA Conference, FICC, and NECC to discuss the possibility of their marketing *Scientists at Work*. Davidson was not initially interested because of the lack of Macintosh software line. Recent interest has been kindled because of their serious consideration of a new product line, which is Macintosh based. Discussions with Davidson continue.

G. MECC

On three occasions members of the project team met with the President, Vice President, and Product Development staff from MECC to discuss their marketing of *Scientists at Work*. MECC staff expressed consensus regarding the high quality of the product and the need for such a product in schools. Also they felt it would complement their planned Macintosh line of software. They expressed some concern over: (1) the relatively small base of Macintosh computers equipped with an external hard disc drive in middle school science programs; and (2) several changes which would have to be made to facilitate incorporation into the curriculum. Negotiations with MECC were continuing nicely until recently, when the state legislature mandated that MECC be sold. As a result, MECC indicated that at this time they could not seriously consider taking on the *Scientists at Work* product.

Given the recent situation at MECC and its inability to move on *Scientists at Work* at present, it would appear that several options exist worth exploring.

We will continue to contact new publishers and/or those previously contacted to assess their general level of interest. One such possibility is the ICCE, which recently announced a new line of courseware, entitled Teaching Thinking Skills with Databases (see Appendix E). Since this program focuses on grades four through eight, *Scientists at Work* may be considered a nice supplemental product. However, this will likely be the first HyperCard-based product from ICCE. Dave Moursand, Executive Director of ICE was very interested and has been sent a copy of the *Scientists at Work* program and materials. We recently contacted Broderbund, who expressed interest in marketing the product, a copy of which has been sent for their review.

We could seriously consider modifying the program to improve its marketability, particularly lowering the price of the Macintosh platform. One such way would be to convert the data base to CD-ROM, which Sunburst has suggested. Dr. Beverly Hunter is pursuing this alternative in terms of cost and level of effort with both Apple and Sunburst.

We could pursue the possibility of converting the program from HyperText to LinkWay, which IBM announced one year ago. During the NECC, it announced three new cards which basically convert the PS/25 to a videodisc capability without full motion; however, it appears that IBM will announce a capability to provide full motion video through digitized, compressed, converted tapes. IBM has offered to pay $15,000 for delivery of 600 converted *Scientists at Work* programs which execute on LinkWay. We are currently assessing the time and effort for such conversion; a preliminary assessment is included in Appendix F.

Since the above alternatives are not mutually exclusive, we will continue pursuing each, with the highest priority being placed on the first alternative. According to high level Apple officials, while the Macintosh base is still growing, it is still not great enough at the middle school level for instructional purposes to encourage major publishers/distributors to add Macintosh programs to their lines. Given anticipated growth in the installed base over the next six months and the anticipated price reduction of the Macintosh, the relevant base for the target population should have almost doubled, after which time new interest into the Macintosh software distribution arena can be expected. Hence, while pursuing the above publishers, we will also be contacting additional publishers who are entering, for the first time, the Macintosh education software market.

APPENDIX A

SCIENTISTS AT WORK Print Materials

Scientists at Work

Beta Version

Users' Guide

Preface

This Users' Guide describes the Beta version of *Scientists at Work* as of January 1989. This Guide, and the program, are for limited distribution under a Beta test agreement. The Guide has not been edited in final form for publication, and may contain information that does not correspond with the current version of the program.

Scientists at Work was developed and tested with support of a grant from the U.S. Department of Education, Office of Special Education Programs, to Education TURNKEY Systems, Charles Blaschke, Project Director. Barbara Bowen, Director of Apple Computer's External Research, provided Macintosh equipment for developing and testing the program.

Technical Director and designer of the program is Beverly Hunter, Targeted Learning Corporation in Amissville, Virginia. Richard McLeod, Michigan State University provided science education direction and collaborated in design of the data base tools. Kris Morrissey and Jim Harding, Naturalist of the Michigan State University Museum provided the animals data and project ideas. Glenn McPherson wrote the Hypertalk scripts and contributed to the design of the data base tools.. Cameron Wood drew the animal pictures. Charles White, George Mason University, is the external evaluator and is responsible for the field test. Judith Wilson, Director of the Microcomputer Information Coordination Center at the University of Kansas, provided advice on special education requirements for the program.

Teachers participating in the field test in the fall of 1988 include Rita Johnson, Jeanne Meadows and Mike Lester of Fairfax County Virginia; Brian Gibbs of Prince William County Virginia; and Nancy Mattran of Falls Church Virginia. Students who contributed in-depth testing and evaluation of the program during the summer of 1988 include Chris Sisson, Joe Berger, and Jeffrey Mason.

Beverly Hunter is the author of this User's Guide. Her address is Targeted Learning Corporation, Rt. 1 Box 190, Amissville, VA 22002.

Table of Contents

1. Introduction

Scientists at Work is a computer program designed to help students in grades 7 to 12 develop and apply skills in scientific inquiry and information handling. *Scientists at Work* provides students and teachers with projects, a set of tools for working with information, a collection of visual, sound, numeric and textual information about animals, a structured notebook for planning and recording results of experiments, and an Advisor to assist in learning scientific methods and information-handling skills.

What you need
Scientists at Work works on the Macintosh™ Plus, Macintosh SE and Macintosh II. Minimum 1 megabyte memory and a hard disk are required. A printer is highly recommended. You need Macintosh System version 6.0 or higher, and Hypercard version 1.2 or higher.

About this guide
This Users' Guide is organized in five sections. This section introduces the program. Section 2, Getting Started is a short tutorial for those who like to jump right in and try a sample learning activity. Section 3 shows how the program is organized. Section 4 provides a reference on how to use the program. Section 5 is a quick reference guide you may place beside the computer for your students. Appendix A tells how to install the program. A separate Teaching Guide with student worksheets accompanies this Guide.

Instructional purposes

Scientists at Work is an innovative approach to helping students learn science, specifically life science, while at the same time developing many of the problem solving and information-handling skills educators consider vital.

While using *Scientists at Work*, students develop understanding of <u>concepts</u> such as hibernation, parental care of young, body heat source (commonly considered as cold blooded and warm blooded animals), longevity of animals, and the food chain. They develop this understanding while investigating <u>problems</u> relating to each concept. *Scientists at Work* provides the tools to help students successfully solve a range of problems focused around the concepts so that their understanding of the concept is not a superficial reiteration of facts, but includes generalizations, exceptions, and inferences about the exceptions.

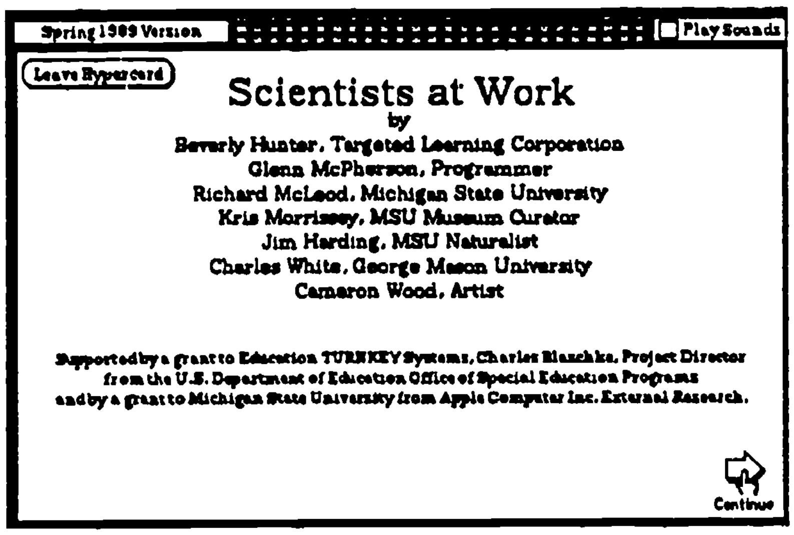
To begin understanding the capabilities of *Scientists at Work*, you can work through the introductory exploration provided in the next few pages. This may take from fifteen to 30 minutes, depending on how much time you want to spend exploring. If you get sidetracked in your exploration of the program, that's fine. You can always click the Home button and begin again.

2. Getting Started

This step-by-step tutorial will help you get going quickly in an introductory experience with the program.

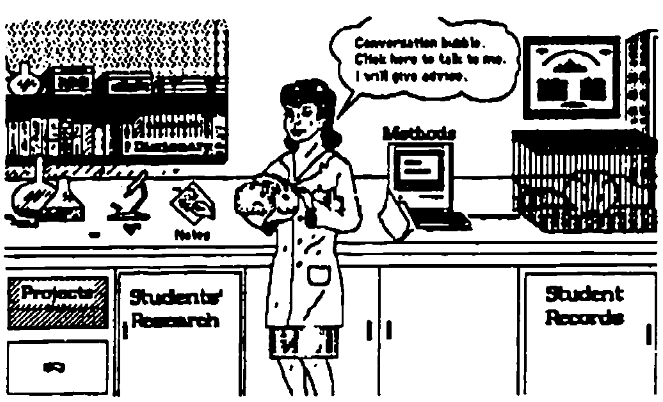
1. Sign on to the program under your own name.

Follow the instructions in Appendix A sections A, B, C, and D.to install the program on your hard disk, register your own user name on the program, and then sign on under your own name. After you do this, you should be at the Nature Center Entrance, which looks like this:



2. Visit the Science Advisor.

At the Nature Center Entrance, go to the Advisor's Office by clicking the Science Advisor door.



Advisor's Office

3. Click the Advisor's Conversation Bubble.

If this is your first time using the program and you have signed on under your own name, the Advisor at this point will suggest that you click the rabbit in her hand. Do so.

4. Continue exploring, following the Advisor's advice.

The Advisor button looks like this:  . Click her anytime you are ready for more advice about what to explore. Then do whatever she suggests. When she tells you to "Pull down the OPTIONS..." that means to click the mouse on the OPTIONS and hold down the mouse button as you drag down the options list. You might have to practice that a couple times.

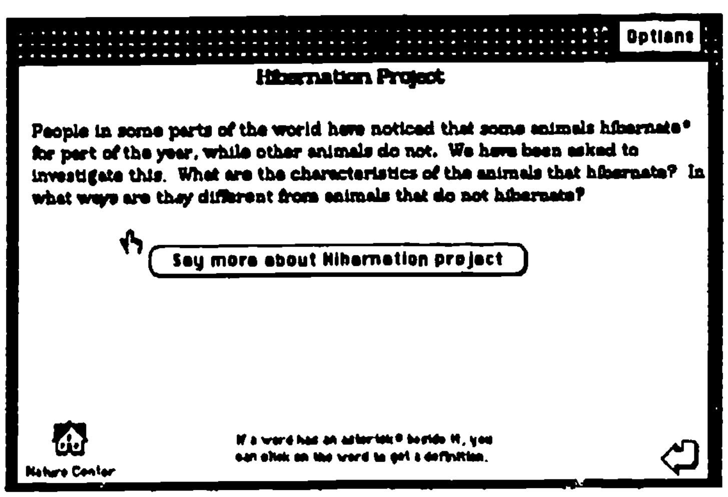
As you explore, the Advisor is keeping track of your progress. When you have explored all of the parts of Scientists at Work that you were asked to look at, the Advisor will permit you to sign up for a Hibernation project.

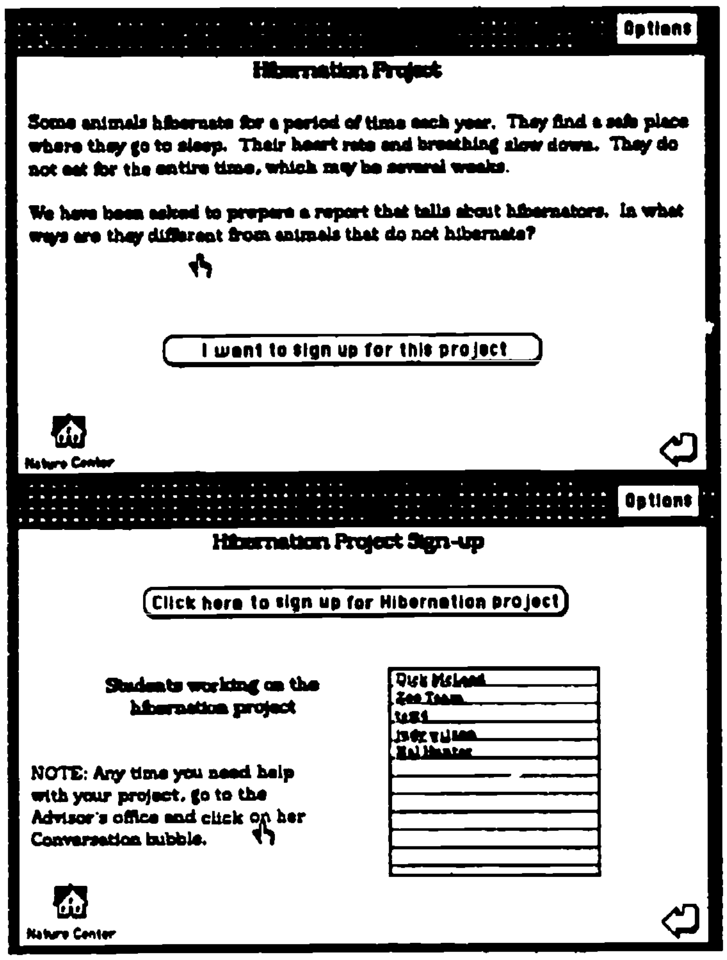
5. When the Advisor says you are ready, choose the Hibernation project.

After you have completed your exploration, the Advisor will tell you that you are ready to sign up for a research project. When you get the screen that shows the projects, click the "Hibernation" project button.

6. Sign up for the Hibernation project.

After you click Hibernation you will see the following screen. Continue reading through the screens that describe the Hibernation project.

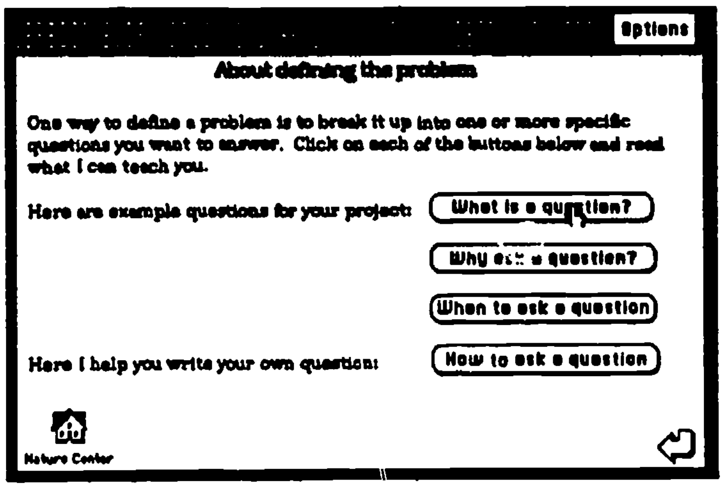


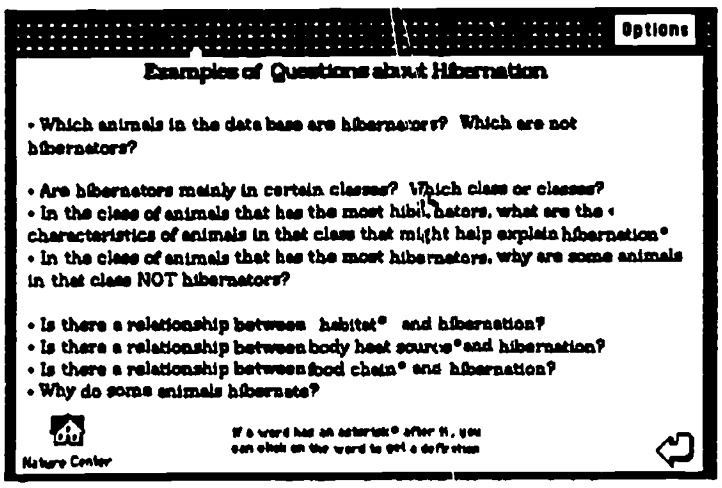


Finally, click to sign up for the hibernation project. Notice that your name is added to the list of students working on the project.

7. Get the Advisor's help in getting started with your project.

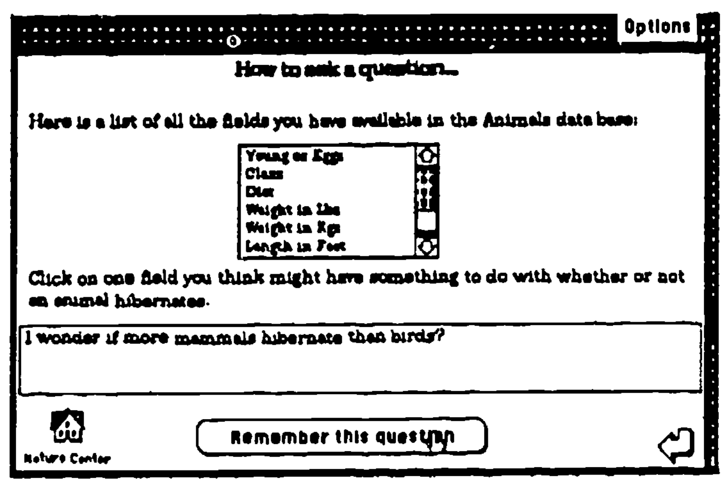
To experience the Advisor's help in scientific methods, click the Advisor button. At her office, click her conversation bubble. She says she will help you write a research question. The next screen looks like the screen below and offers various kinds of help on defining the research problem and developing questions. Look at all of them by clicking on each button in turn. Anytime you want to get back to the previous screen, click the Return arrow ⏎.





Notice as you pursue various avenues that the information is directly relevant to <u>your Hibernation project</u>. If you had chosen a different project, the examples would have pertained to that project.

Next, click HOW TO ASK A QUESTION. Notice the instructional tools that are provided to help you build a reasonable question. Click the word "class" in the scrolling list. Then type the question "I wonder if more mammals than birds are hibernaters." When you click "Remember this question", your question is copied to your notebook and the data base automatically.

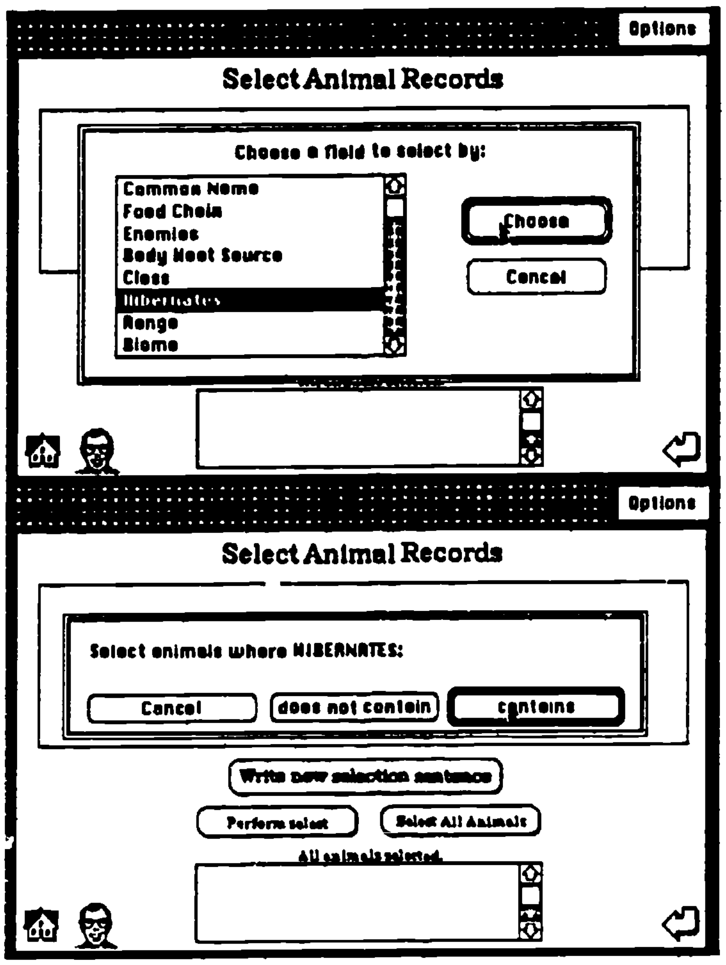


8. Plan what information will help answer your question.

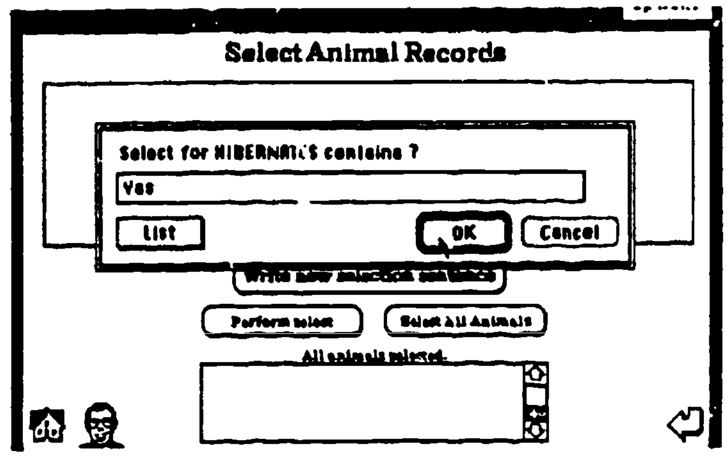
Go to the Animal Data Base by pulling down the Options menu and clicking "Animal Data". Since this is just a quick introduction, you probably don't know enough yet to be able to make a plan for getting the information you need. So, here is the plan: you will <u>select</u> a set of animals that will help to answer your question. Remember, we want to know whether hibernation is related to Class and we were wondering whether more reptiles hibernate than do birds. We are going to use the Select tool to select only those animals that do hibernate. Then we will make a bar chart of the hibernators, showing what Classes they are in. This will show us if any birds hibernate and which classes have the most hibernators.

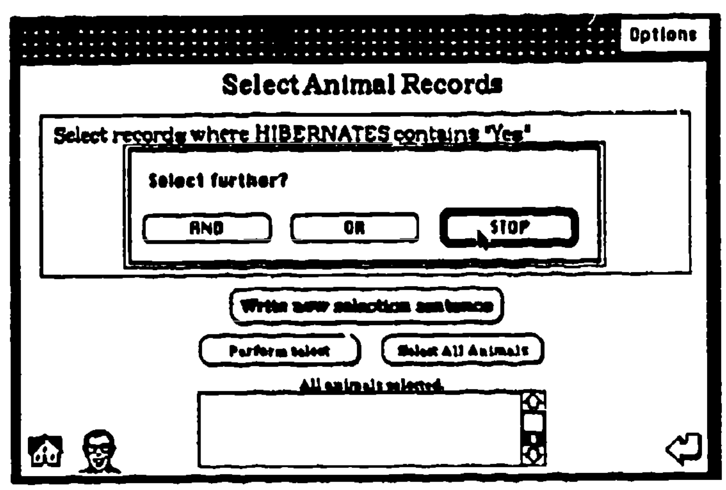
9. Select animal records where the field Hibernates contains "Yes".

In the Animal Data Base, choose SELECT from the pull down OPTIONS menu, and proceed through screens like the following.



When LIST is displayed, click it and it will display the choices. You need only highlight your choice and it will be typed into the box for you. Try it by selecting "YES."





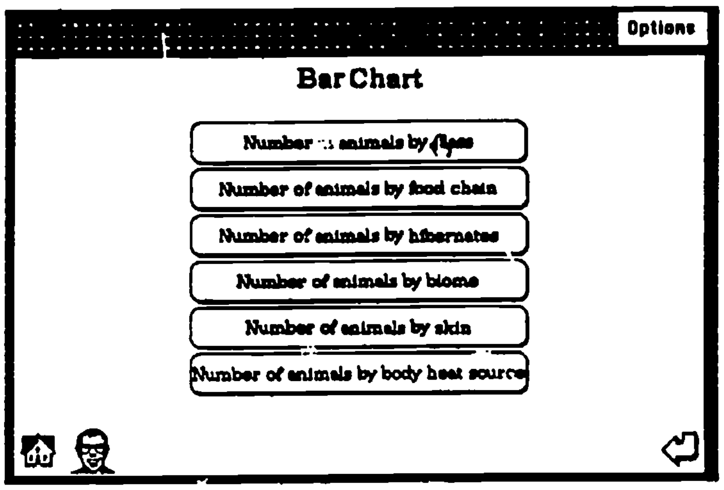
After you have created your selection sentence, the program will ask "Do it?" . Choose to do so by clicking "Yes".. The selection process will take about one minute. Once the animals are selected, you will see a scrolling box with all of the selected animals listed.

Now return to Animal Data by clicking the Return arrow. You will see your selection sentence displayed and you will be looking at data for only those animals that hibernate. This process of selecting is a very important process in science. The selection process is one way of controlling variables. By selecting only those animals that hibernate, you are controlling the variable, HIBERNATES, to one value, YES.

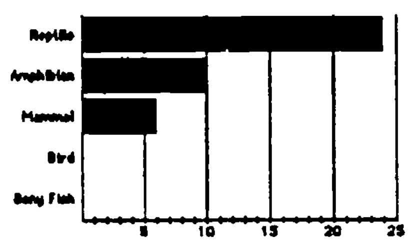
10. Chart the selected data.

To answer your research question, you could, of course, look at each selected record and see what class of animal it is. However this would take a long time. There is a much quicker way.

Now you are going to produce a bar chart that will help to organize and summarize the data that was selected. Pull down the OPTIONS menu and choose Graph. Select Bar Chart. Now you are faced with the following screen of choices.



Since our interest is in which <u>class</u> of animals is most likely to hibernate, choose NUMBER OF ANIMALS BY CLASS. This will take a moment or two and will yield the following graph. Isn't that easy to interpret?



11. Copy your chart to your notebook by doing the following.

Choose "notes" from the Options menu.

Go to the "Graphs" section of your notebook.

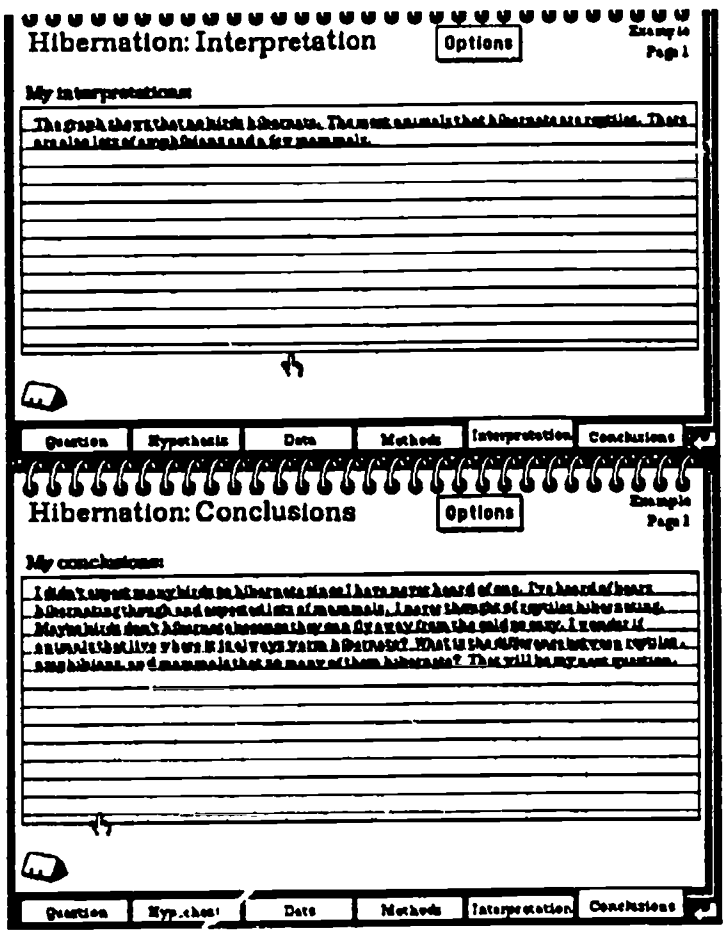
Pull down the options menu and click "Paste graph onto this page."

12. Interpret your data and draw conclusions

Interpreting your bar chart is straightforward, since it clearly shows that more reptiles than birds are hibernators and in fact <u>no</u> birds in this data base are hibernators. This clearly begins to answer your research question (more clearly than is often the case!).

Now, *why* are no birds hibernators? What does this say about hibernation? Most likely, you will begin to think of other interesting research questions at this point. What characteristics of animals lead them to hibernate? Does it have anything to do with where they live? And notice, in your bar chart, that many reptiles are hibernators? What is the characteristic of reptiles that you would associate with hibernation? By asking questions such as this, you can begin to draw conclusions based on your research.

The student can turn to his notebook, one to which we have admittedly transferred relatively little information, and, looking at their questions, hypotheses, data, graphs, etc., write their interpretation and conclusions. A sample is shown below.



The entire Project notebook can be printed and turned in as a finished report, or made available to the teacher for analysis on screen. It may be that you would prefer to view the report on screen first and suggest other information to be included prior to printing. For example, you might ask the students to include a list of the animals that hibernate so that you can analyze them more easily.

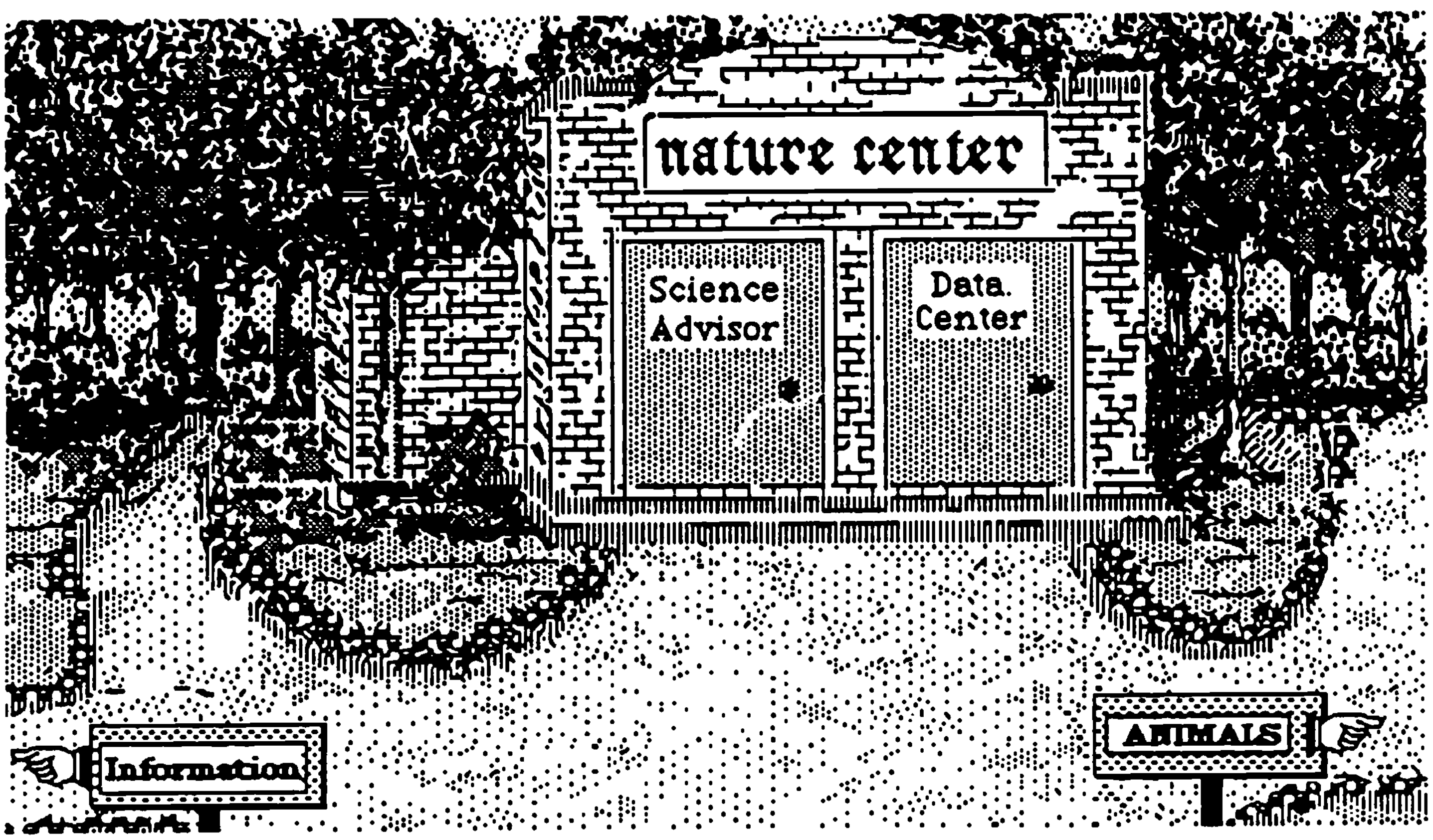
As your students raise new questions and think of other things to add to their notebooks, their reports will become increasingly rich. *Scientists at Work* encourages students to explore, keep notes, organize data, analyze data, come to conclusions, and make another hypothesis!. This is what science is all about.

13. To end your introduction, click the  Nature Center button. At the Nature Center Entrance, click "QUIT."

3. How *Scientists at Work* is Organized

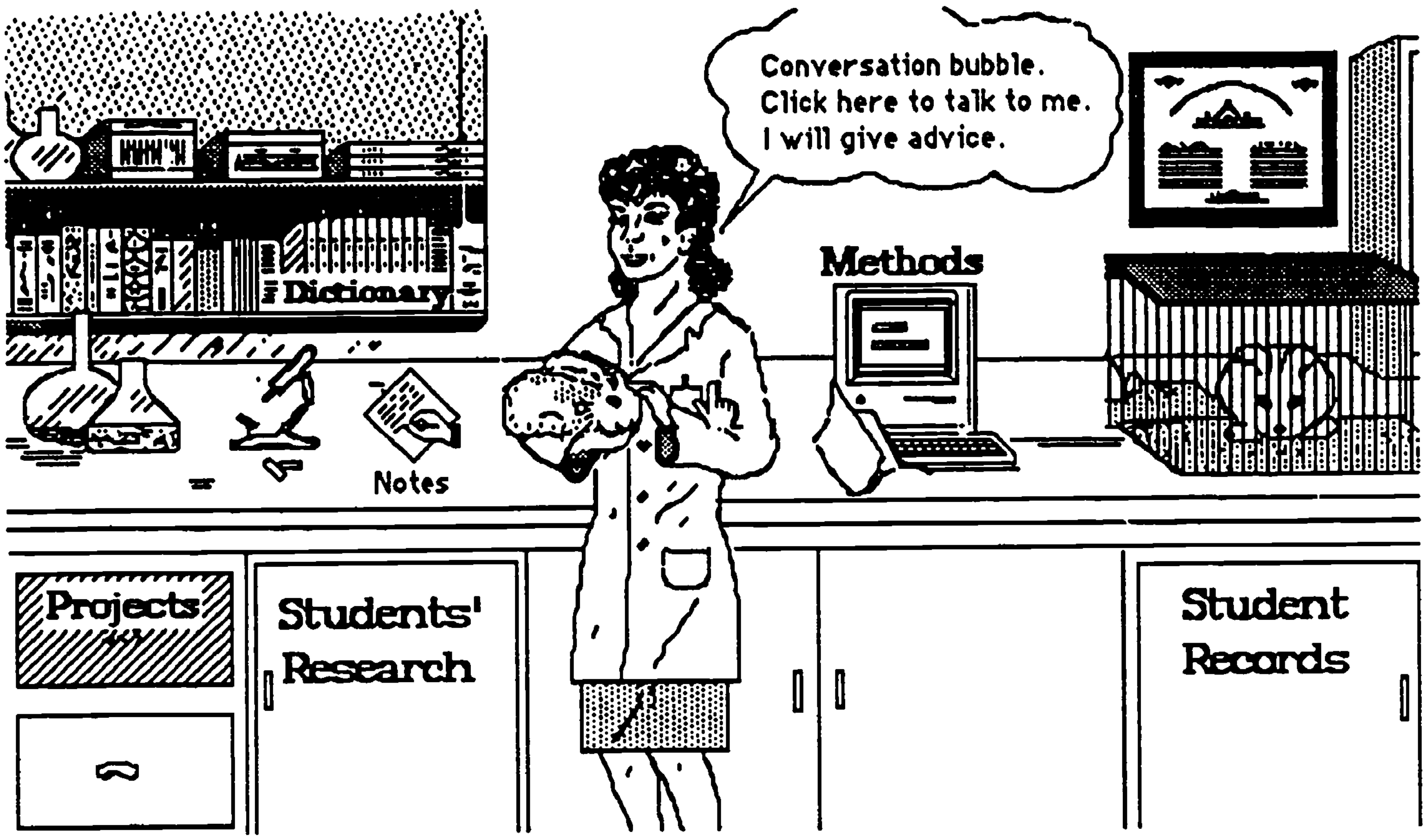
In *Scientists at Work* students are working as research assistants in a Nature Center. All information and tools in this program are contained in the Nature Center. This section explains the main components of the Nature Center.

Nature Center Entrance. After you sign on to the program, you go to the Nature Center Entrance. Here is the entrance to the Nature Center:



Science Advisor

The Science Advisor is in charge of the research projects in the Nature Center, and provides advice and guidance on how to conduct the projects. This picture shows the Advisor's Office:



Projects
The Advisor has several research projects to be conducted. Students working in teams choose a project to work on. Here is an example project description:

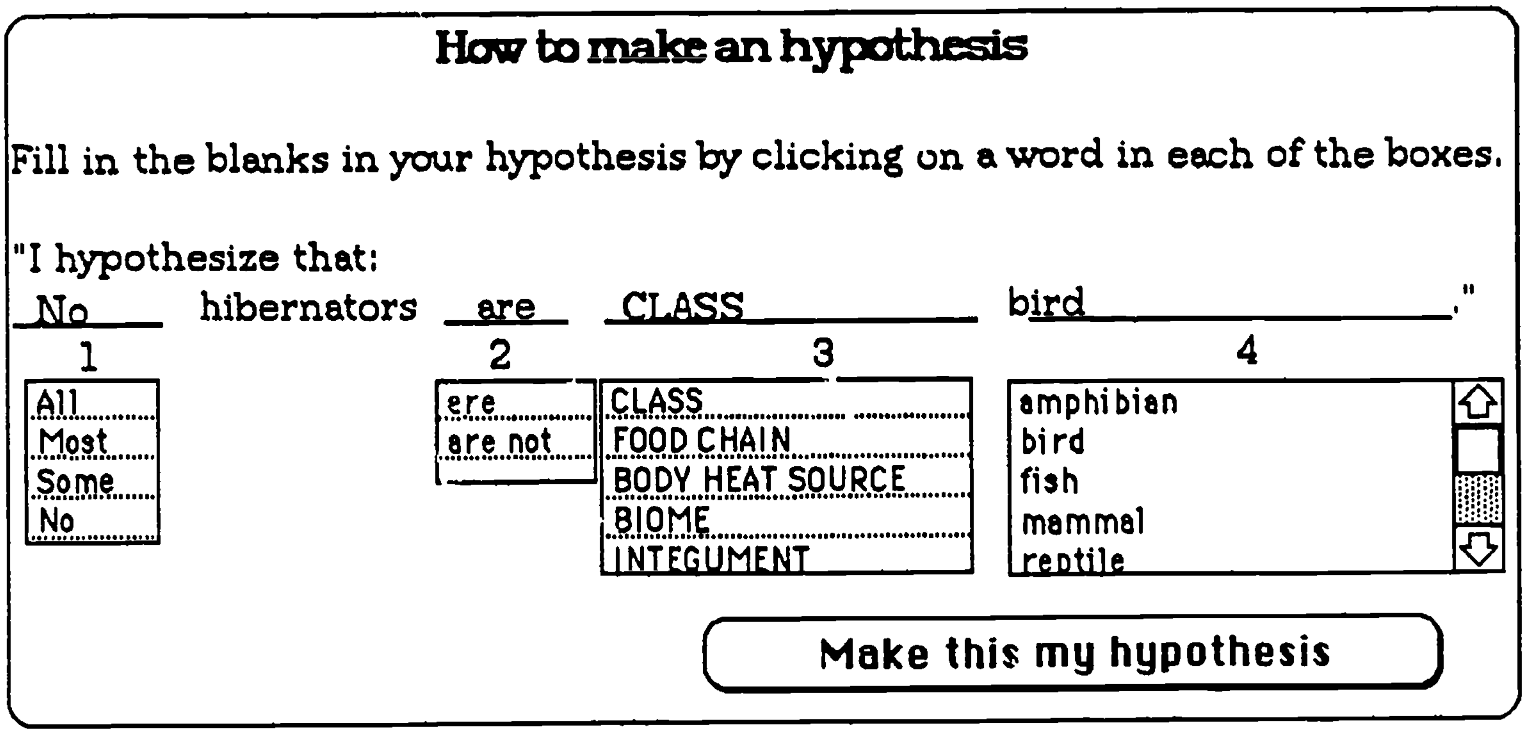
Habitat Exhibit Project

A local zoo has asked us to prepare large poster exhibits showing animals in their habitat* and biome*. They want an exhibit for a habitat for each major biome, that shows the type of vegetation for that habitat and biome, the type of food available, and pictures of animals that live there.

Say more about the Habitat Exhibit project

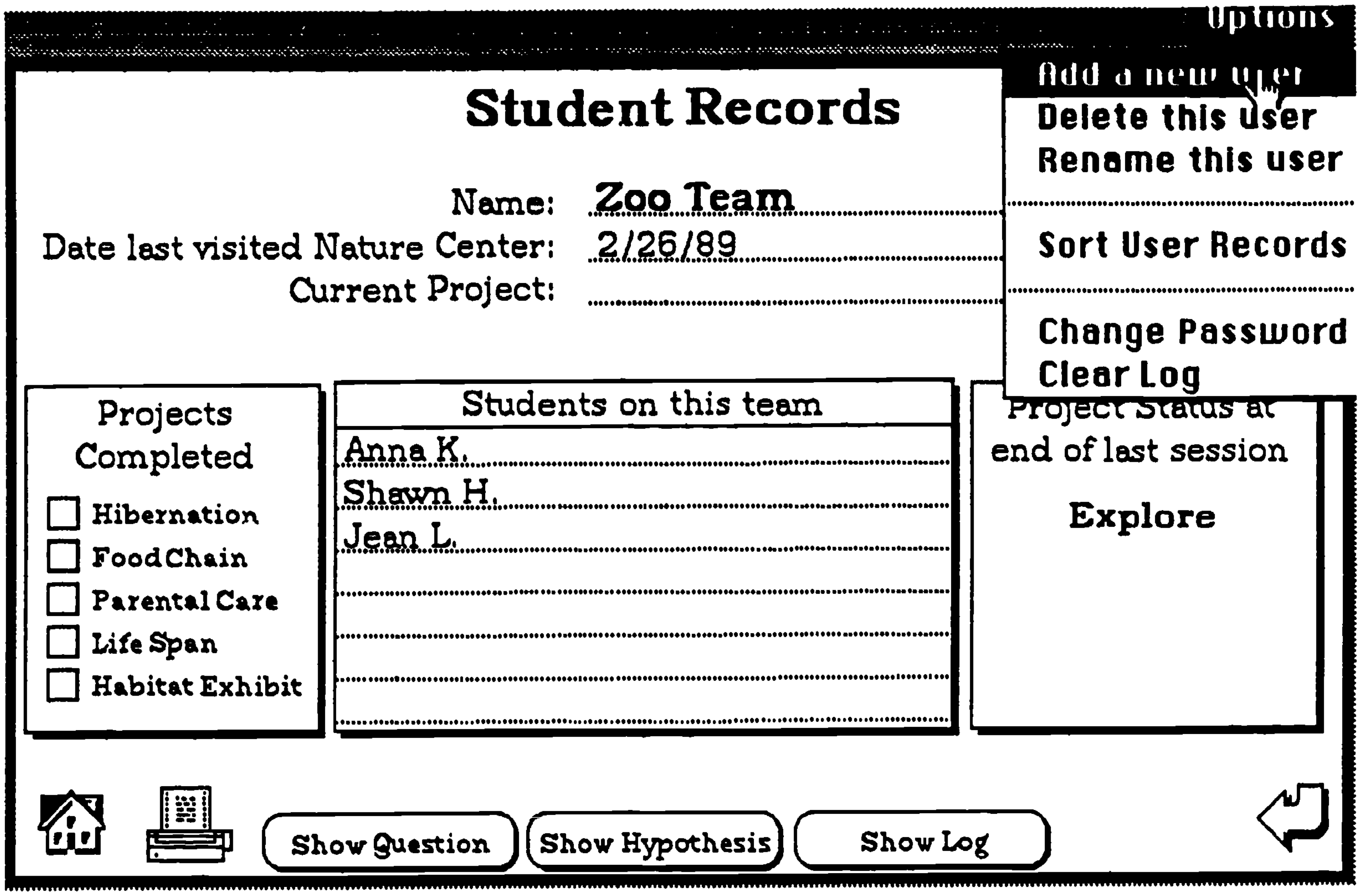
I want to sign up for this project

Methods
The Advisor also provides guidance on methods to use in doing research. Here is an example of the Advisor's guidance:



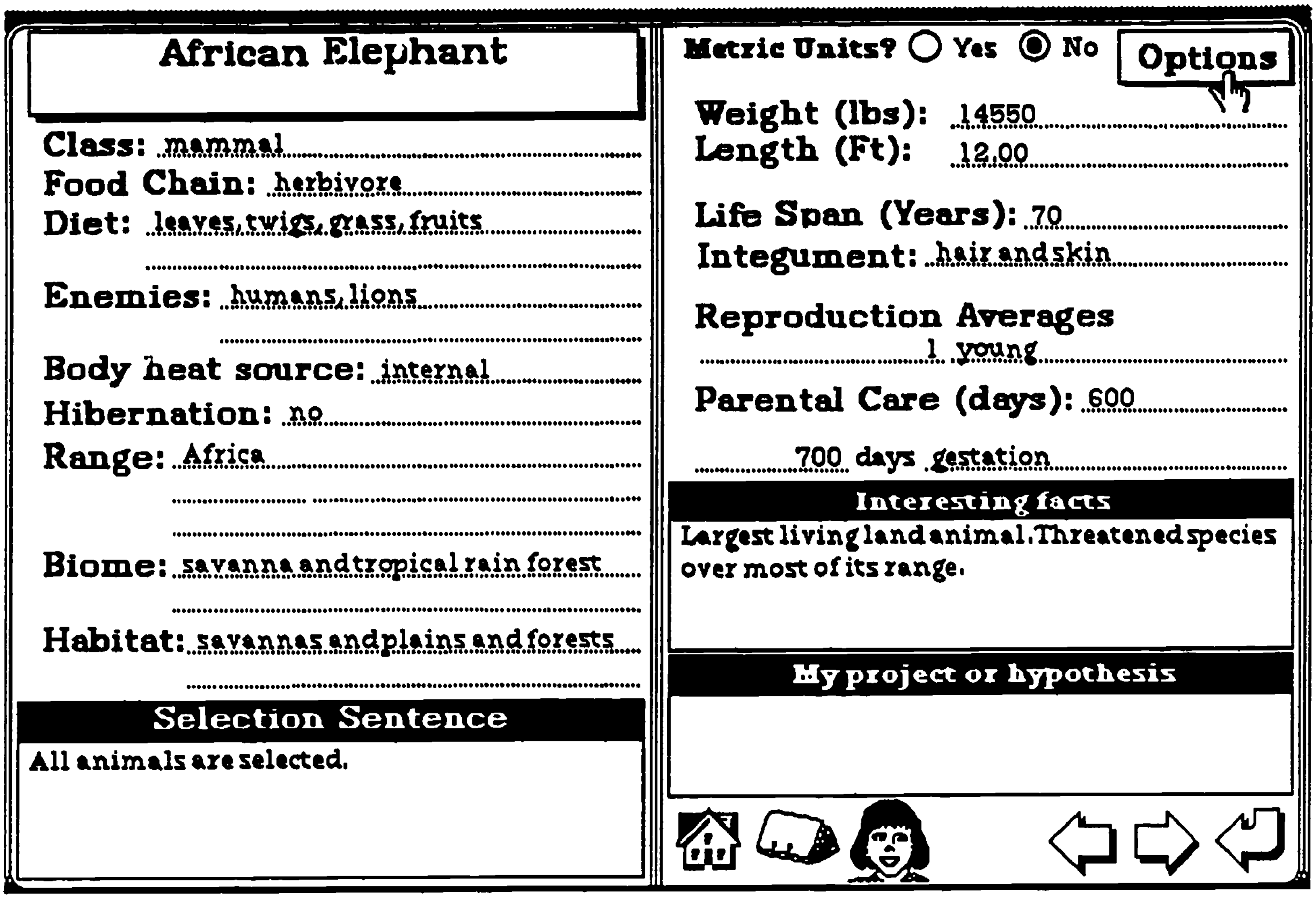
Student Records

The Advisor maintains student records to keep track of what project the student is working on and the status of the work. Here is an example student record with the Options menu pulled down:



Animal Data Base

The Animal data base contains data on 170 vertebrates, including mammals, fish, reptiles, amphibians and birds. Here is an example record for one animal:

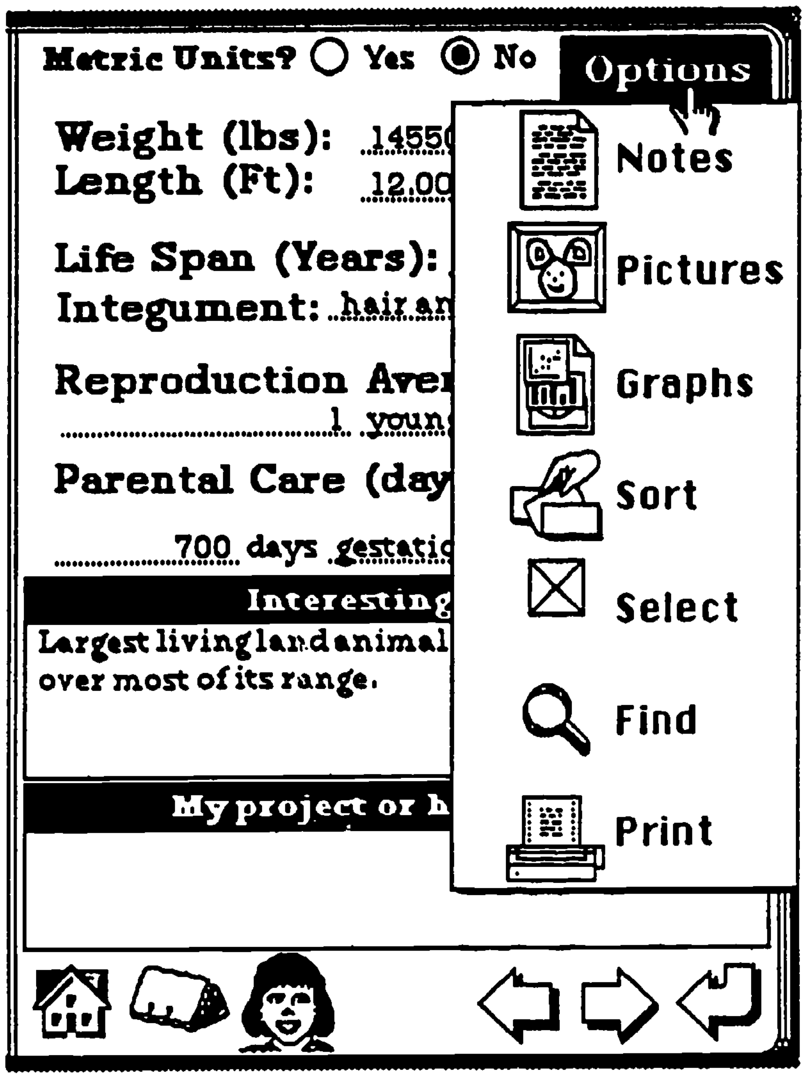


Animals were selected for inclusion in the data base, based on the following factors:

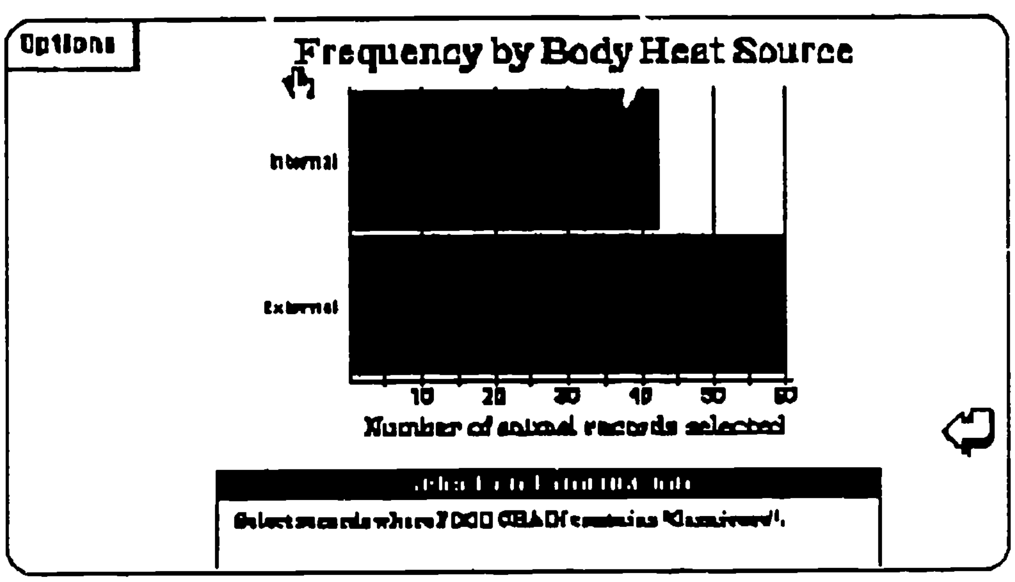
- coverage of North American vertebrates
- representation of the variables included in the data base
- vertebrates of special interest to students, irrespective of location

Data Base Tools

The animal data base contains tools for analyzing data. These were designed to be easy for young scientists to use. They include tools for finding, selecting, sorting, graphing, charting and printing data.

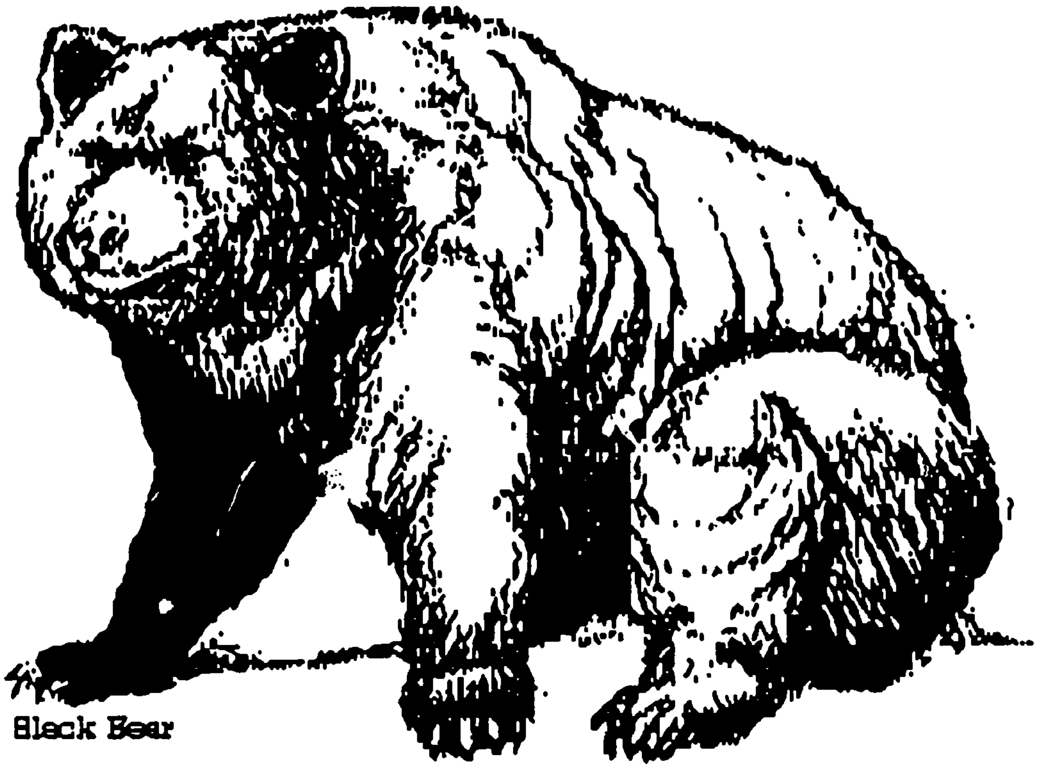


Here is an example bar chart:



Animal pictures and sounds

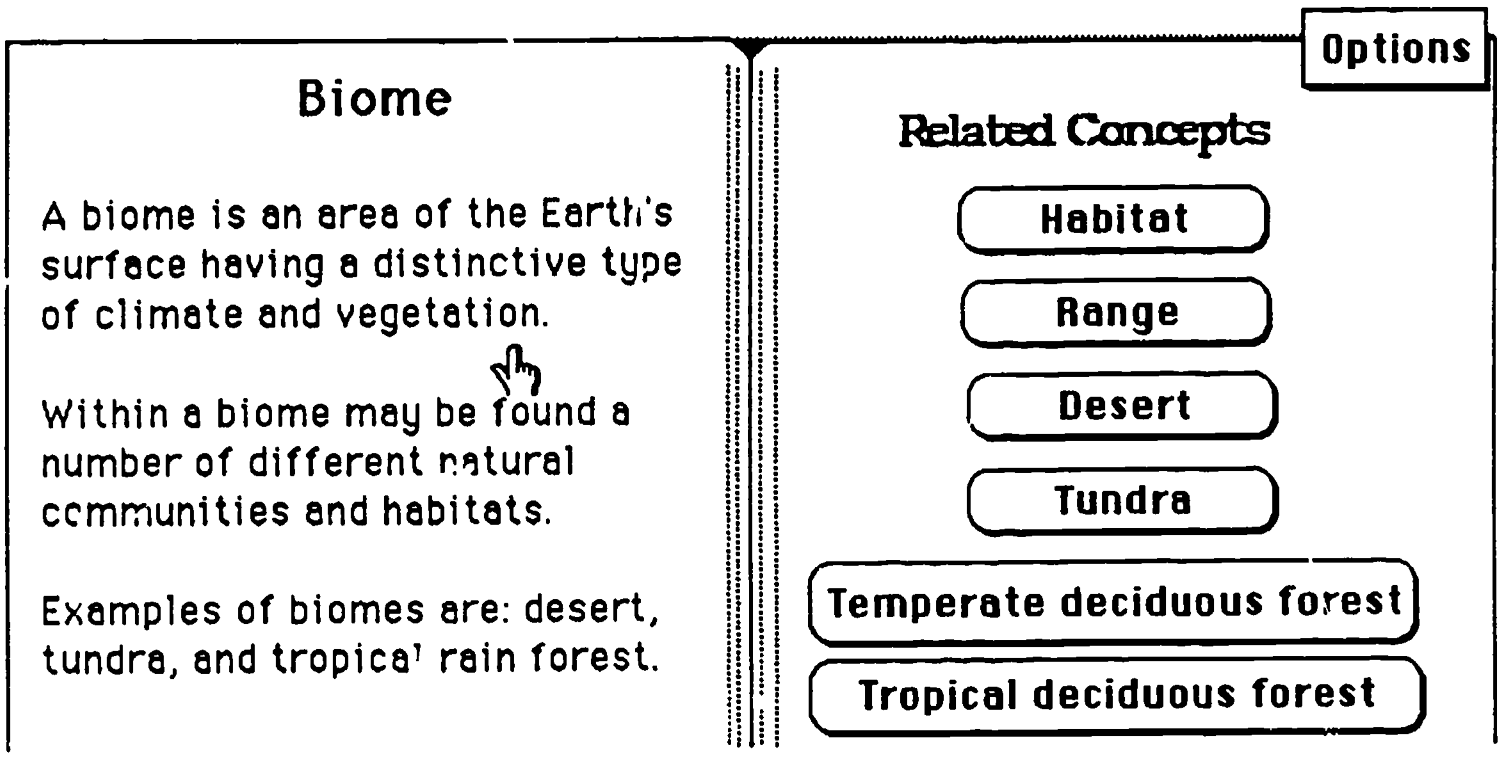
Each animal in the data base has a corresponding picture. Here is an example picture:



Animal Sounds. Some animal pictures also have a sound button. Clicking on the button plays a sound the animal makes.

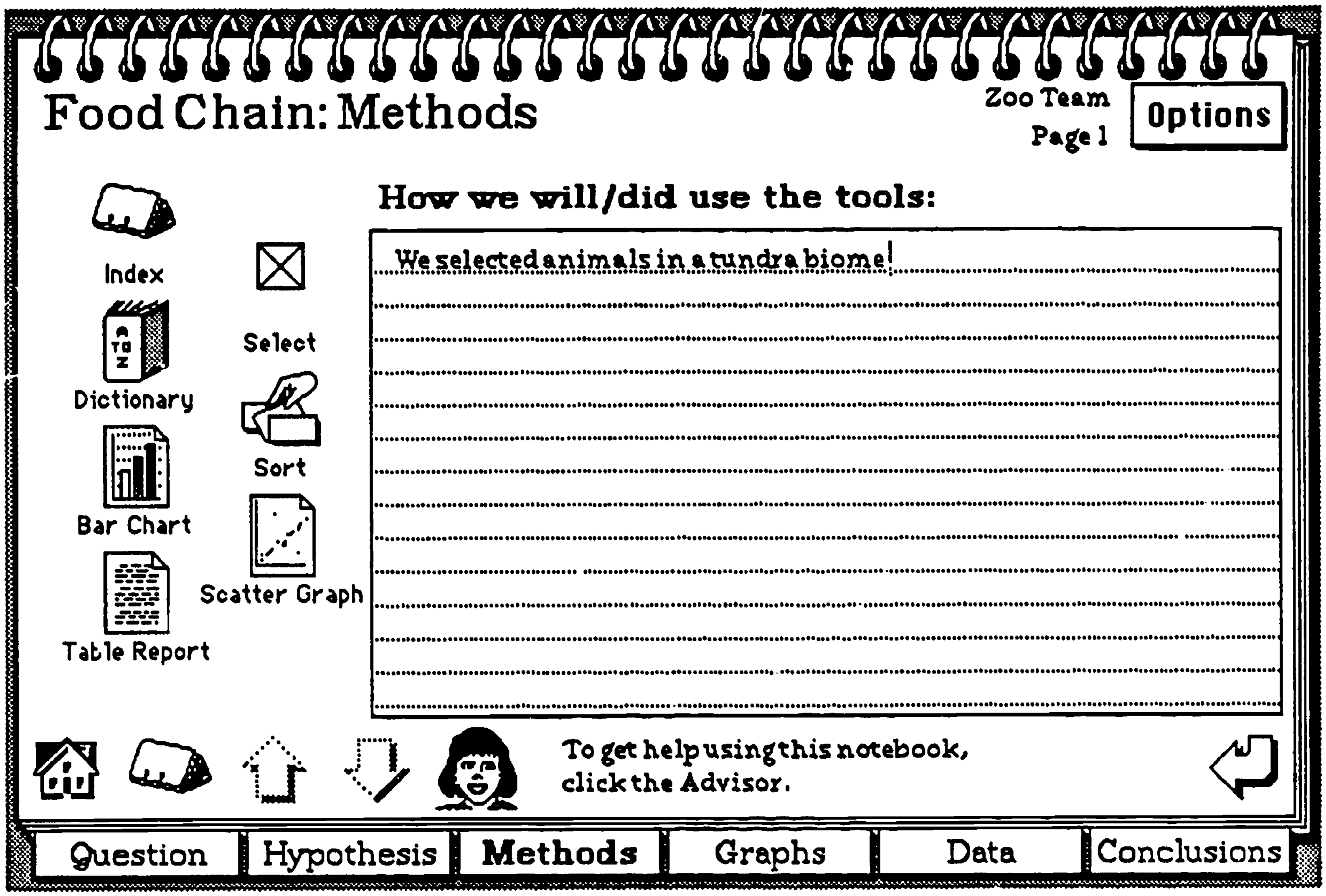
Animals Dictionary

The Animals Dictionary contains definitions of all the terms used in the Animals Data Base. plus definitions and concepts used in scientific inquiry. Here is a sample Dictionary page:



Notebook

Each user has a personal notebook, structured to help plan and conduct his or her project. Here is an example Notebook page:


Food Chain: Methods
Zoo Team
Page 1
Options
Index
Select
Dictionary
Sort
Bar Chart
Scatter Graph
Table Report
How we will/did use the tools:
We selected animals in a tundra biome
To get help using this notebook, click the Advisor.
Question
Hypothesis
Methods
Graphs
Data
Conclusions

4. Using *Scientists at Work*

This section provides a reference guide for using the program. The best way to learn to use *Scientists at Work* is to explore it on the computer. In *Scientists at Work* as in any Macintosh program, the way you tell the program what to do is by the "point and click" method. That is, you use the mouse to point the cursor at certain places on the screen and click the mouse button.

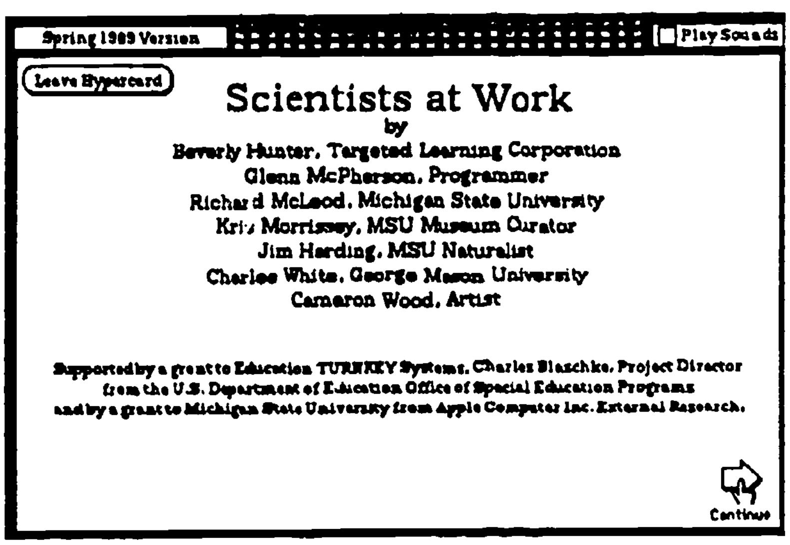
Installing *Scientists at Work* on your Macintosh

Before you can use the program you must install it on your hard disk, following the instructions provided in Appendix A. It is important to following these instructions exactly. The person who installs the program should know how to copy files and folders on the Macintosh desktop.

Starting Up the Program

To start up the *Scientists at Work* program:

1. From the Macintosh desktop, double click the *Scientists at Work* folder to see the list of files in the folder.
2. Double click the "Home" file. The *Scientists at Work* opening credits screen will appear.



Signing on to the Nature Center

<u>To sign on to the program you need to be a registered teacher or student. See section below on "Registering Teachers and Students".</u>

If you are a registered teacher, do the following to sign on to the program:

1. At the opening credits screen, click the "continue" arrow on the lower right-hand corner.
2. Type the first few letters of your name when asked.
3. Click the "OK" button. A message box will ask "Are you (your name)?"
4. If the name is correct, click "Yes". If the name is not correct, click "No" and start over.
5. Type your password when asked. Click "OK". The Nature Center entrance will appear.

If you can't remember your password, you will have to sign on under a name for which you do know the password. Then use the procedures given in the section on Registering Students and Teachers to change your password.

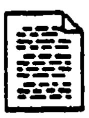
If you are a registered student, follow the procedure above except you don't need a password.

Navigation: Moving Around

To move around in the Nature Center you "point and click" at buttons. For example, at the Nature Center Entrance the buttons are the doors to "Science Advisor" and "Data Center", the sign pointing to "Information", the sign pointing to "Animals", the "Quit" button, and the "Return" arrow.

Navigation buttons. The following are the main buttons used for navigation throughout the program:

Symbol	**Name**	**Takes you..**
	Return Arrow	..back to wherever you just came from.
	Next Arrow	..to the next animal in the data base.
	Previous Arrow	..to the previous animal in the data base.
	Science Advisor	..to the Advisor

	Nature Center	.. to the Nature Center entrance
	Data Base	.. to the Animals data base
	Picture	.. to the Animal pictures
	Dictionary	.. to the Animal Dictionary
	Index	...to the index for the Animals Dictionary or Animals Data Base.
	Notes	.. to your personal notebook

Options

Using Pull-down Options Menus

OPTIONS is a pull-down menu containing a variety of options. The particular options available depends on what part of the Nature Center you are working in. To choose an option, click the Options button and hold down the mouse button. Drag the mouse to the option you want. It will be highlighted. Then release the mouse button.

If you are a registered teacher, do the following to sign on to the program:

1. At the opening credits screen, click the "continue" arrow on the lower right-hand corner.
2. Type the first few letters of your name when asked.
3. Click the "OK" button. A message box will ask "Are you (your name)?"
4. If the name is correct, click "Yes". If the name is not correct, click "No" and start over.
5. Type your password when asked. Click "OK". The Nature Center entrance will appear.

If you can't remember your password, you will have to sign on under a name for which you do know the password. Then use the procedures given in the section on Registering Students and Teachers to change your password.

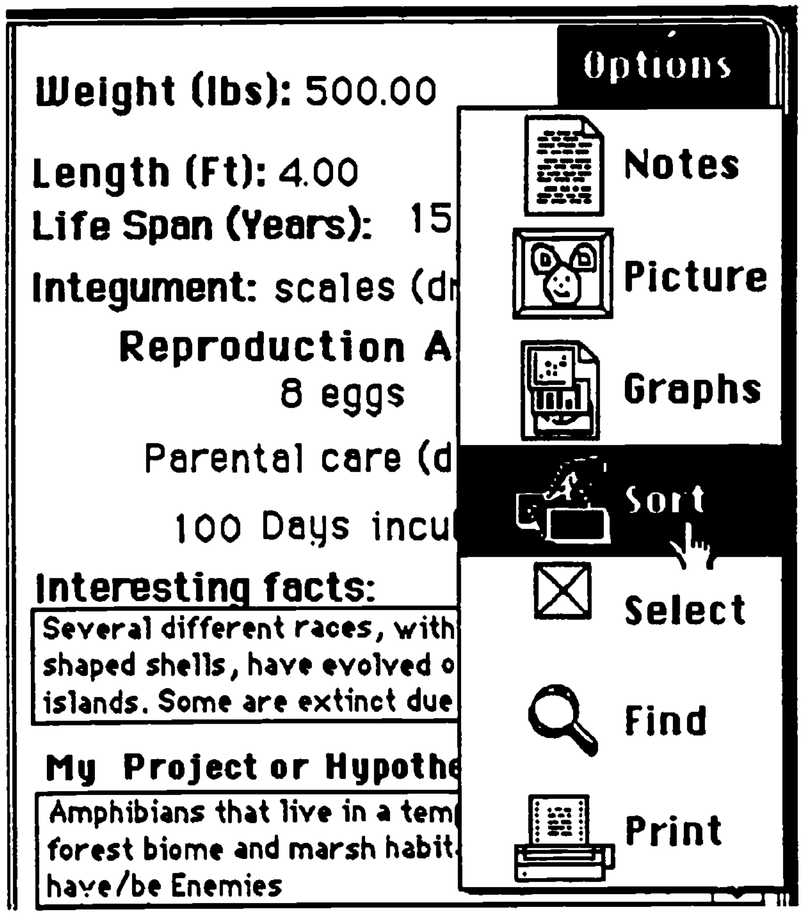
If you are a registered student, follow the procedure above except you don't need a password.

Navigation: Moving Around

To move around in the Nature Center you "point and click" at buttons. For example, at the Nature Center Entrance the buttons are the doors to "Science Advisor" and "Data Center", the sign pointing to "Information", the sign pointing to "Animals", the "Quit" button, and the "Return" arrow.

Navigation buttons. The following are the main buttons used for navigation throughout the program:

Symbol	**Name**	**Takes you..**
	Return Arrow	..back to wherever you just came from.
	Next Arrow	..to the next animal in the data base.
	Previous Arrow	..to the previous animal in the data base.
	Science Advisor	..to the Advisor



Registering New Students and Teachers

In the Student Records you can register students, student teams, and teachers onto the program. Teachers can view all student and teacher records, change names, and change passwords.

Procedure for registering a new student, student team or teacher. To register an individual student, student team or teacher, follow this procedure:

1. Start up the program
2. Sign on to the program. If you are not already a registered user, sign on using the name "Bev" and the password "Bev".
3. From the Nature Center Entrance, click the Advisor's Office door.
4. In the Advisor's Office, click "Student Records".
5. Click the Options menu and drag the pointer to "Add a new user."
6. Click "Teacher" or "Student", whichever you want to add.
7. Follow instructions to type the name (and password if you are registering a teacher).

If your students are working in teams (which is recommended) you should use their team name to register them. You can list the students on the team in the record.

Using the program after registering your name. If you have just registered yourself or another person who wants to use the program right now, go back to the *Scientists at Work* opening credits screen (by pressing the "Return" arrow as many times as necessary). Then sign on under your own name.

Deleting students or teachers. To delete a student, student team or teacher, first get that person's record on the screen. Do this by paging through the student records using the "Next" arrow. Then pull down the Options menu and click "Delete User".

Changing names and passwords. To change the name or password of a student, student team or teacher, first get that person's record on the screen. Do this by paging through the records using the "Next" arrow. Then pull down the Options menu and click "Change name" or "Change password."

Using the student information. Teachers and researchers can use the student records information in several ways, to monitor their students' progress.

Printing an individual student record. To print an individual student (team) record, get that team's record on your screen. Click the printer button (insert printer icon here). When the message says "Print what?", click "Screen."

Printing a report on all the students. To print out a list of information about all your students, click the printer button. When the message says "Print what?", click "Report." The report generator screen will appear. Choose the fields you want printed for each student record. (See "Setting up a Table Report" on page xx of this User Guide.)

Viewing a question, hypothesis, or log. At the bottom of each user record are buttons for viewing the user's research question, hypothesis, and log. The research question or hypothesis is automatically stored here when the user is working with the Advisor on setting up a research question or hypothesis. The "log" is a record of the past actions of the user (30 K is stored; when this is used up, the program automatically erases it and begins over).

Quitting the Program (Leaving the Nature Center)

When you have finished your session in the Nature Center, it is <u>important</u> that you Quit the program in an orderly way. <u>This is important.</u> By pressing the QUIT button you tell the Advisor to update your record with information about the work you have done during your session. If you do not quit properly, the Advisor will not keep track of your progress.

Wherever you are in the program at the time you want to quit, click the Nature Center button . This will take you to the Nature Center entrance. Then click the "Quit" button. This will take the program to the opening credits screen where another person can sign on.

Using the Animals Data Base

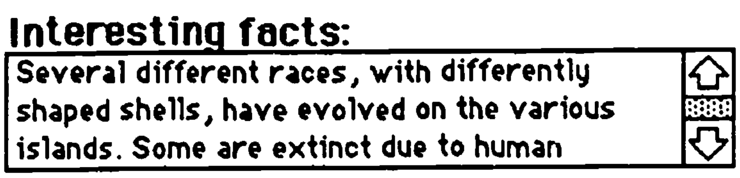
You can go to the Animals data base by clicking on the Data Center door from the Nature Center entrance, or by choosing "Animals Data" from an Options menu.

Animal records. Each screen (record) in the data base contains data on one animal. An animal record is shown on page xx above.

Field names. Words shown in bold and followed by a colon, such as **Class:** and **Life Span (Years):** are called "field names." To see the definition of a field name, click the name. After you have read the definition, return to the data base by clicking the Return arrow. You should return back to the same animal record you were looking at.

Metric units. Weight and length of the animal are available in both metric and non-metric units. Click the box beside "Y" or "N" to get Metric units yes or no.

Scrolling fields. A scrolling field is enclosed in a box and has little up and down arrows to the right of the box, like this:



If there is more information in the scrolling field than will fit in its box, you can scroll up and down through the text with the by holding the mouse on the little up and down arrows and pressing on the mouse button.

My project or hypothesis field. This field, on the lower right of the data base screen, is used by the Advisor to remind you of your current project, question or hypothesis. This field will be empty until you choose a project, write a research question with the Advisor's methods computer section on "How to write a question". or write an hypothesis.

Current selection field. The field on the lower left hand side of the data base record shows the selection sentence for the current selection of animals. If this field is blank it means that all records are currently selected.

 **Looking at pictures.** To see the picture for the animal described on the data base screen, choose the "Picture" button on the Options menu. To get back from the picture to the data for the same animal, either press the Return arrow or choose the Animals data button on the Options Menu.

Using Data Base Tools

The data base tools enable you to <u>locate</u> particular animal records using an index, <u>find</u> specific words in the data base, <u>select</u> groups of animal records, <u>sort</u> records, <u>graph</u> data in the form of bar charts or scatter graphs, and <u>print</u> a screen or a tabular report.

 **Locating an animal record in the index.**

Sometimes you want to look at the record for a particular animal. An easy way to do this is to use the Index. The Index lists all the currently selected animals in the data base.

Index procedure. To find a particular animal record, do the following:

1. From the Animals data base, click the index button. The Index of selected animal records will appear.
2. Scroll through the list until you find the animal name you are looking for.
3. Click the animal name. You will go to the animal record.

If the animal name you are looking for is not listed in the Index, it may be because it is not a currently selected animal. See the section below on "Selecting Animal Records."

 **Finding a word or phrase**

Sometimes you want to find a particular name or word in the data base. For example, you might want to find the word "snake", wherever it might appear. (NOTE: If you know what field you want the word to appear in, you probably should be using "Select" instead of "Find".)

Find procedure. To find a particular word or phrase in the data base, do the following:

1. Choose "Find" from the Options menu. A Find box will appear.
2. Type the word, part of word, or phrase you want to find. Click "OK".

3. If the program finds the word you are looking for, you will see it enclosed in a box on the screen.
4. To see the next instance (if any) of your word in the data base, click the **Find** button on the lower right of the screen.
5. Continue pressing Find button until you have seen all instances of your word in the data base that you want to see.
6. To find a different word or part of word in the data base, choose "Find" again from the Options menu and repeat the above procedure.

Selecting Animal Records.

Select is a very important tool, one you use frequently in your work with the data base. Use Select to choose groups of animal records to work with for particular projects, to answer questions, to test hypotheses, to make graphs and charts.

Selection sentences. The program helps you build a selection sentence that tells what field to select by, and what the contents of the [illegible] should be. For example, to select all reptiles you would "Select records where CLASS contains Reptile." If you wanted to select just the reptiles that live in a deciduous forest biome, you would further select Biome contains "deciduous forest."

Selection criteria. For fields that contain numeric data, such as weight, length, parental care, gestation or number of young, you specify the criteria for selection using "equals", "greater than", "greater than or equal to", "less than", "less than or equal to", or "not equal to." For example, to select all animals weighing more than 500 pounds your selection sentence would read: "Select records where WEIGHT IN LBS > 500."

Selection procedure. To select animal records, follow this procedure in the data base:

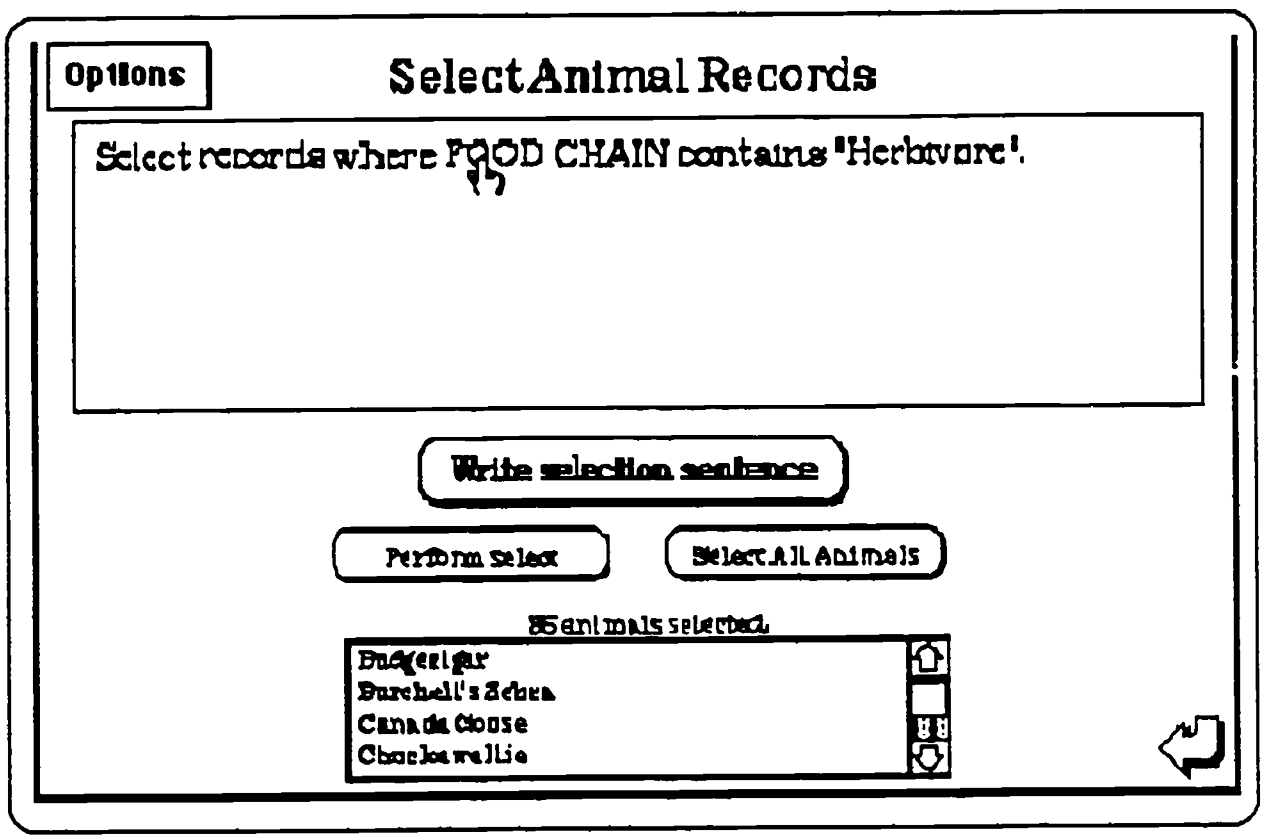
1. Choose the Select button in the Options menu.
2. Click "Write new selection sentence."
3. A list of the fields in the data base appears. Scroll through the list until you find the field you want to select on. Click that field name, then click "Choose."
4. A message box appears, asking what operator you want to use. For fields containing text, the choices are "Contains" and "Does not contain." For numeric fields, the choices are =, >, <, and so forth. Click the operator you want.
5. A message box appears, asking what you want the field to contain (or be compared to, in the case of numeric data). For text fields, there is a pull-down **List** of what the field could contain. Pull down the list and click the contents you are looking for. If the word you

want the selected field to contain is <u>not</u> in the list, you can just type it.

If your field is numeric, type in the number you want. For example, to select animals where WEIGHT IN LBS. is greater than 500, type "500." Then click "OK".

7. A message box appears, asking if you want to select further. Click "AND", "OR" or "STOP".
8. A message box asks if you want to "Do it?" Read your selection sentence and see whether it says what you want it to say. If it does, click "YES". If it does not, click "NO" and start over.
9. The program begins selecting animals. Wait while the beach ball turns.

After selecting. When the selection process is completed, your screen looks like this:



Number of animals selected. Notice the scrolling window at the bottom of the screen. The number of animals selected shows above the window, and you can scroll through the list of animals selected

Graphing the selected data. You can have a graph drawn from your selected data by clicking on the Graph button in the Options pull-down menu.

Viewing selected animals in the data base. After making your selection you may want to look at the records for the selected animals. To return to the data base and look at the data records for your selected animals, click either the Return arrow or the name of one of the selected animals. Only the records you have selected now appear in the data base. Your selection sentence appears in the lower left hand corner of each data base record, to remind you of your selection.

Undoing a selection (Selecting ALL animals). Usually, you will continue working with your selected records for awhile. If you want to work with all of the records in the data base instead of just selected ones, choose the Select tool again and click "Select All Animals"

Sorting Records.

Often you want to put the animal records in some order or sequence. For example, if you are studying the life spans of animals, you might want to order the animals by life span. If you sort them in descending order by life span, the longest-lived animals will be at the beginning of the data base and the shortest-lived will be at the end.

Levels of sorting. You can have up to three levels of sorting, although you will usually just want one level. The following is an example report printed after sorting on three levels. First, records were sorted by CLASS. Within class they are sorted by FOOD CHAIN. Within food chain they are sorted by WEIGHT IN LBS.

Common Name	Class	Food Chain	Weight in Lbs.
Surinam Toad	amphibian	carnivore	0.18
Bull Frog	amphibian	carnivore	1.00
Hellbender	amphibian	carnivore	2.00
Mudpuppy	amphibian	herbivore	0.22
Eastern Newt	amphibian	omnivore	0.01
Yellow Warbler	bird	carnivore	0.04
Eastern Kingbird	bird	carnivore	0.10
Great Blue Heron	bird	carnivore	6.00
Budgerigar	bird	herbivore	0.06
Domestic Chicken	bird	herbivore	7.00

Sorting procedure. To sort animal records, follow this procedure in the data base:

1. Choose the Sort button in the Options menu.
2. Click "Write sort sentence."
3. A list of the fields in the data base appears. Scroll through the list until you find the field you want to sort on. Click that field name.

4. Click "Ascending" or "Descending", whichever you want.
5. A message box appears, asking whether you want to sort within the first sort. Usually you will click "No." .
8. A message box asks if you want to "Perform selection?" Read your selection sentence and see whether it says what you want it to say. If it does, click "YES". If it does not, click "NO" and start over.
9. The program begins sorting animal records. Wait while the beach ball turns.

Viewing records after sorting. After your records have been sorted, you can return to the data base by clicking on the Return arrow. Now when you go through the records they will be in the sorted order.

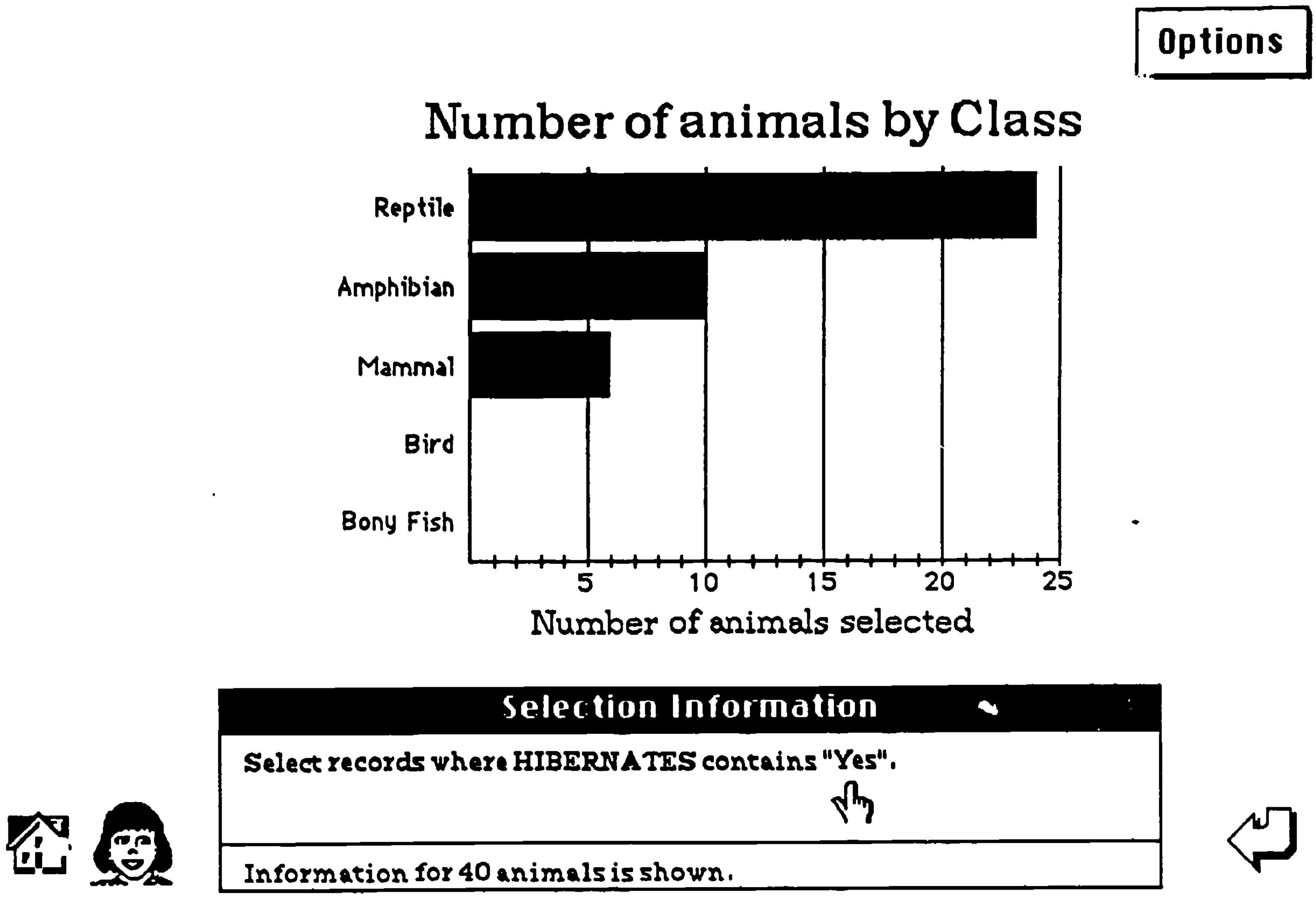
Making a table report after sorting. You may want to print a table report listing selected fields from your sorted records. The data will be listed in the sorted order on your table report. You can do this by choosing the Print option from the pull-down Options menu.

Graphing Data

You can make two kinds of graphs -- bar charts and scattergrams. Use bar charts to find number of animals by category, such as number of animals by biome. Use scattergrams to look for relationships between two numeric variables, such as relationship between life span and weight.

Use graphing in combination with selecting. For example, you might first select all hibernators. Then make a bar chart showing number of hibernators by biome.

Bar charts. Here is an example bar chart produced by the program:



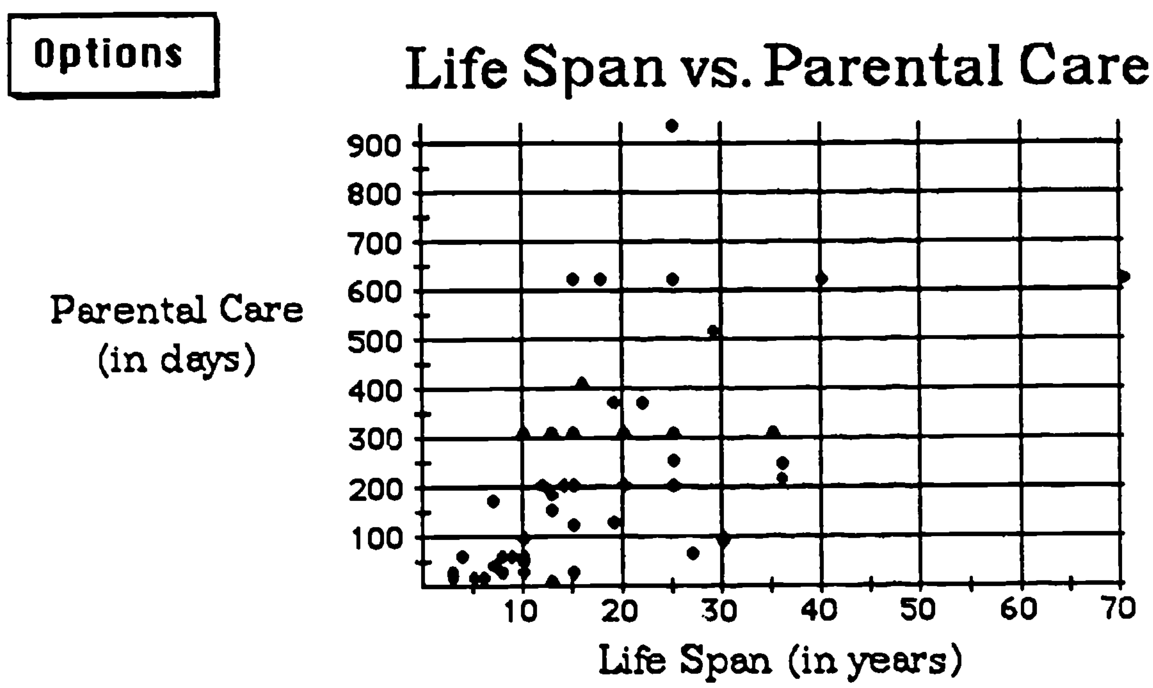
You can make similar charts by food chain, hiberation, biome, skin, body heat source. (These are the fields that have a predefined set of categories in them.)

Bar chart procedure. To make a bar chart, first select the records you want included in the data for your chart, using the select tool. Then follow this procedure:

1. Choose the Graph button in the Options menu.
2. Click "Bar Chart."
3. A list of the available bar charts appears.. Click the chart you want.
4. The program begins gathering the data for the chart. Wait while the beach ball turns.

Copying the chart to your notebook. When your chart is complete, you can copy it to your notebook. Simply go to the Data section of your notebook. Pull down the Options menu. Click "Paste graph onto this page". If you need a new page to paste your graph on, choose "New page" before pasting.

Scattergrams.
You can use scattergrams to test your hypotheses about relationships between two characteristics of animals. For example, in a study of animal life spans, you might hypothesize that "the longer an animal lives, the longer it cares for its young.." Here is a sample scattergram produced by the program to test that hypothesis:



Each dot on the graph represents one animal. Notice that, in general, as the life span increases the parental care in days increases.

Scattergram Procedure. First, use the Select tool to select the animals you want included in your scattergram. Then follow this procedure:

1. Click the "Graphs" button in the Options menu.. The graphs screen appears.
2. Click "Scatter Graph." The x-axis and y-axis choices appear.
3. Click the field you want to use for your x-axis value. (Only numeric fields can be used in a scatter graph.)
4. Click the field you want for your y-axis value.
5. Click "Make Graph." Then wait while the program gathers the data for your graph. After awhile the graph will appear.

Interpreting the scattergram. In making a scattergram you are testing an hypothesis about relationships, such as "The longer an animal lives, the longer it cares for its young." You can see in the above graph that this hypothesis is, in general, true for the animal data used in making the graph.

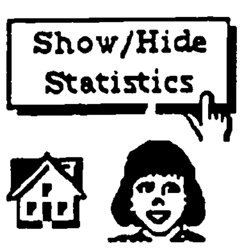
On the graph screen is some additional information to help you interpret your graph:

Selection information. The animals selected for the graph are described in the lower left hand box on the graph screen. It looks like this:

Selection Information
Select records where CLASS contains "mammal".
Information for 53 animals is shown.

Note that the above graph is based on selecting mammals.

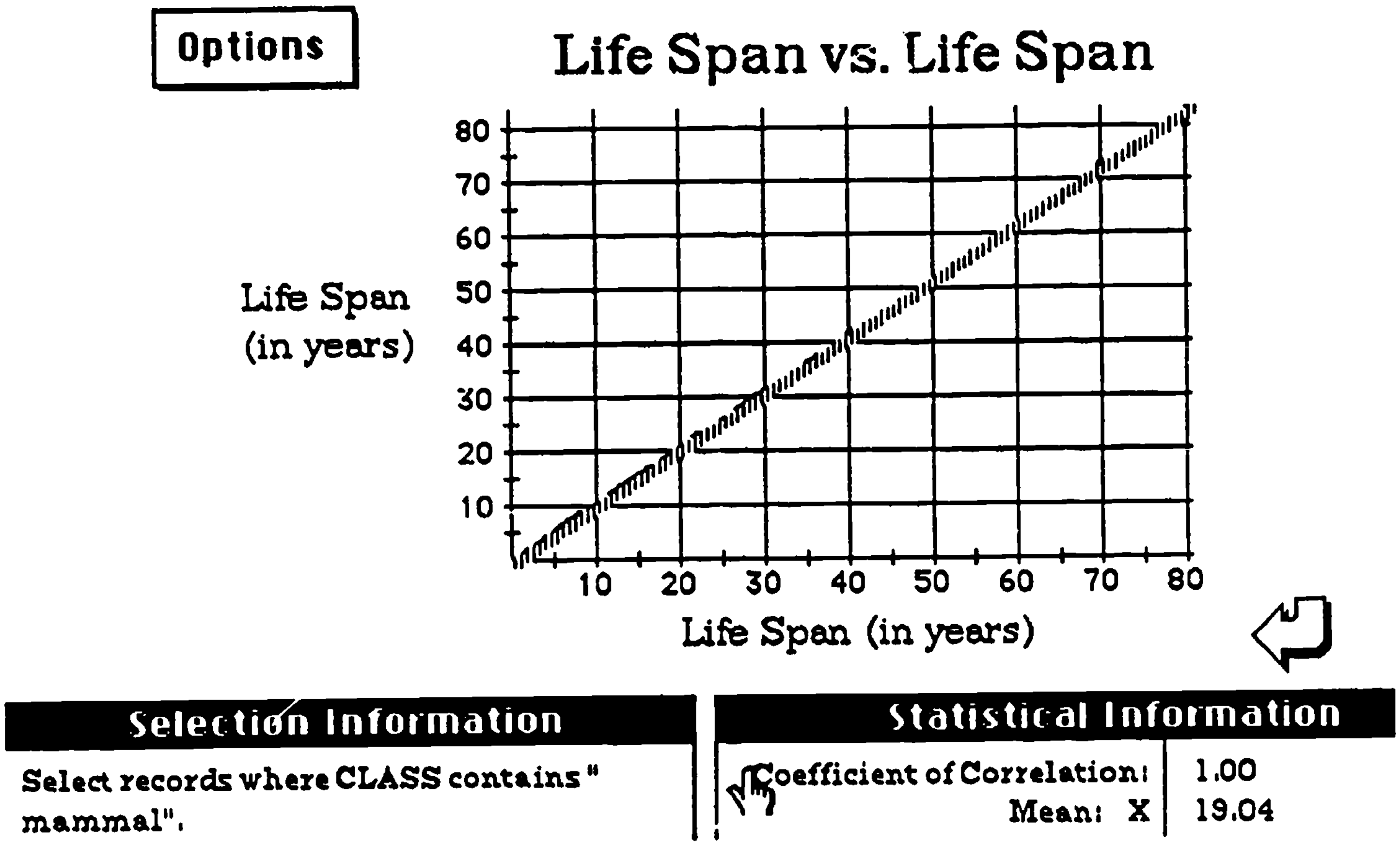
Statistical information. The "Show/Hide Statistics" box on the graph screen reveals statistical information about your graph data. You can make use of this information even if you have not studied statistics. Notice the Coefficient of Correlation in the Statistical Information box below. If there were a perfect relationship between the two variables being graphed, the coefficient of correlation would be 1.0. For example, if it were 100% the case that an animal A that lives longer than animal B always cares for its young longer than animal B, then the relationship would be perfectly correlated. But of course it is not that way in nature. Your coefficient of correlation will always be less than 1.0. In general, the higher the coefficent of correlation, the better the relationship you are getting in your graph.



Statistical Information	
Coefficient of Correlation:	1.00
Mean: X, Y	22.07, 22.07
Standard Deviation: X, Y	21.10, 21.10
Regression Equation:	y = 0.00 + 1.00x

Regression line.

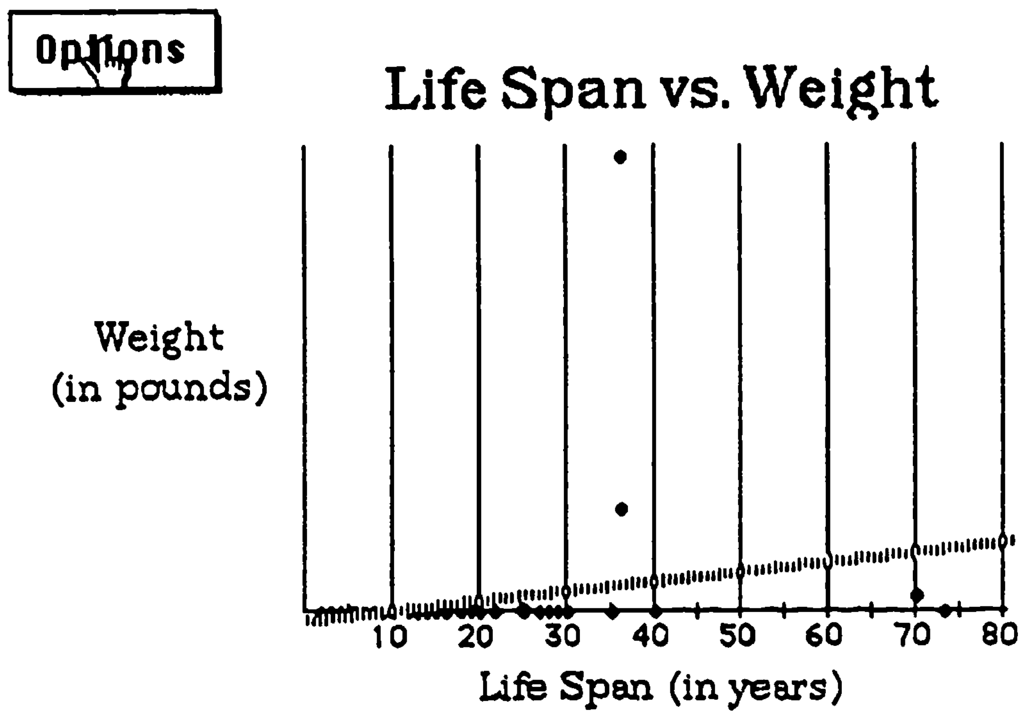
If the relationship between the variables were perfect, the dots would fall in a straight line, like this:



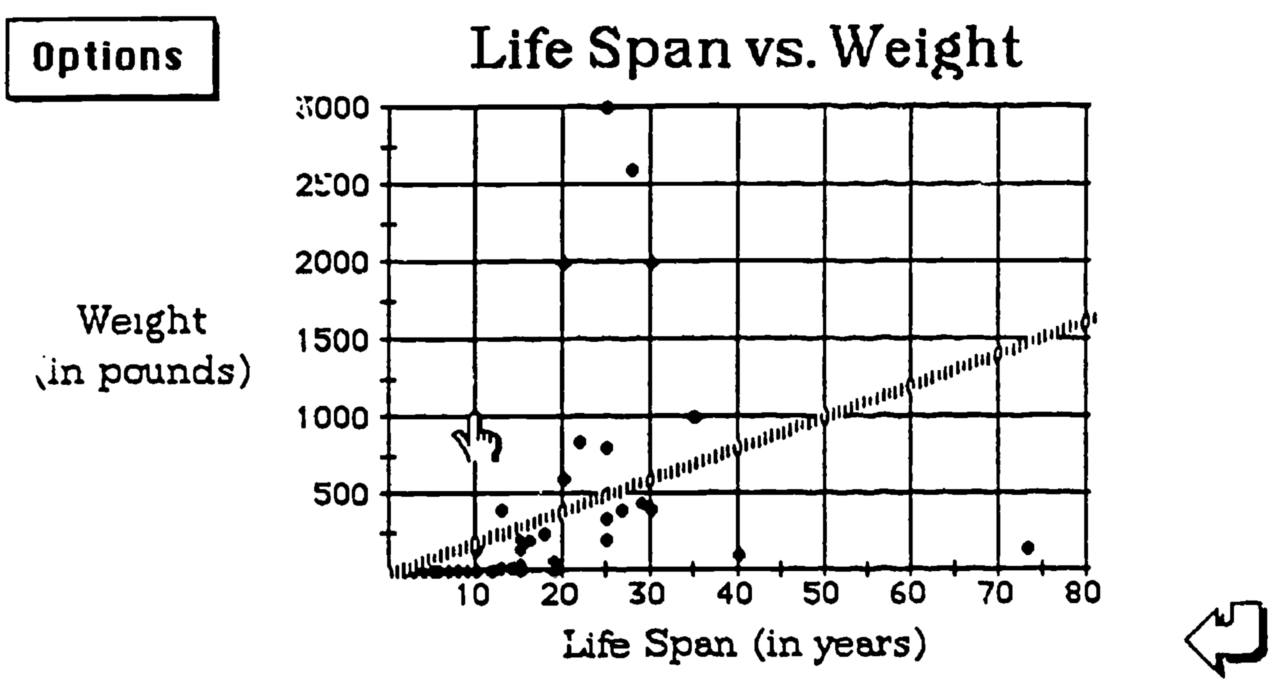
The program draws a line, called a regression line, that shows the direction of the relationship. The closer the data dots are to that line, the stronger the relationship is.

To have the program draw a regression line on your graph, click "Draw Regression Line" at the time you choose your x-axis and Y-axis.

The data dots in your scattergrams will not be on a perfect line like the graph above.. Here is a scattergram of life span vs weight. Notice one dot way at the top. This animal weighs so much that the computer could not even show the weight scale numbers on the y axis. As a result, all the other animal dots look like they are near zero weight in comparison.



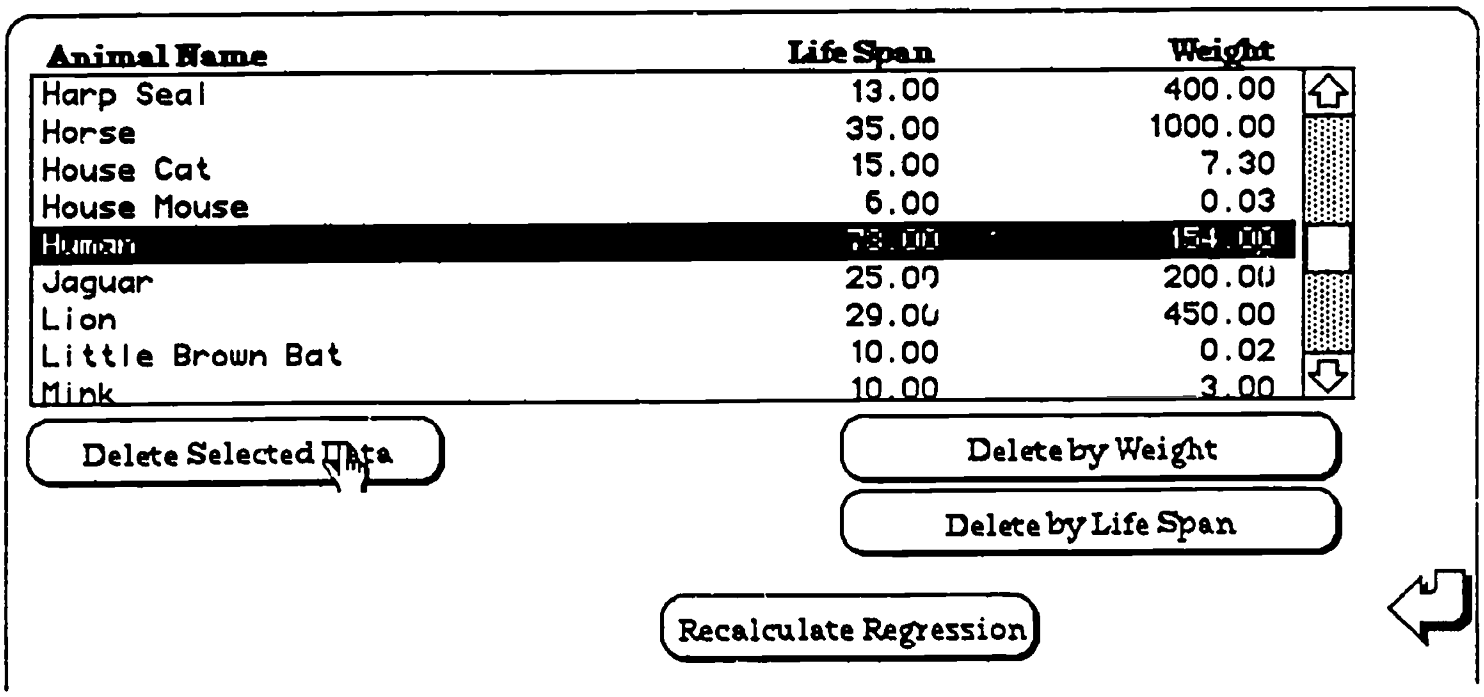
If we delete all animals weighing more than 3,000 pounds, our graph becomes more readable:



Notice, hov ever, that there are still many data dots that are far away from the regression line. You might want to know which animals are represented by those dots. The program gives you an easy way of finding out, called "Look at Data".

Look at data. The program gives you some tools for looking at the data points from your graph, deleting selected data, and then redrawing from the graph. While you are looking at your graph on the screen, choose the "Look at Data" option on the pull-down Options menu. You can scroll through the list of data items graphed, and find data points that lie far away from the regression line. For example, the human lives an unusually long time -- 73 years.

Delete data. We might want to see what the graph looks like without the human data in it. To do this, just click Human, as shown below. Then click the "Delete Selected Data" button.



Animal Name	Life Span	Weight
Harp Seal	13.00	400.00
Horse	35.00	1000.00
House Cat	15.00	7.30
House Mouse	6.00	0.03
Human	73.00	154.00
Jaguar	25.00	200.00
Lion	29.00	450.00
Little Brown Bat	10.00	0.02
Mink	10.00	3.00

After you delete selected data you can ask the program to "Recalculate Regression".

Redrawing the scattergram. By clicking on the Return Arrow you can look at the redrawn graph.

Copying a scattergram to your notebook. When your graph is complete, you can copy it to your notebook. Simply go to the Data section of your notebook. Pull down the Options menu. Click "Paste graph onto this page". If you need a new page to paste your graph on, choose "New page" before pasting.

Printing

In order to print, of course, you need to have a printer connected to your Macintosh. You can print out any screen in the Nature Center, including

Advisor screens, dictionary screens, notebook screens, animal pictures, or animal records. In addition, you can print selected data from the animal records in a tabular reports.

Printing a single screen. To print the screen you are looking at, check to see that your printer is turned on and the paper is properly positioned in the printer. Then choose the Print button on the pull-down Options menu. Click "Print Card" in the message box that appears.

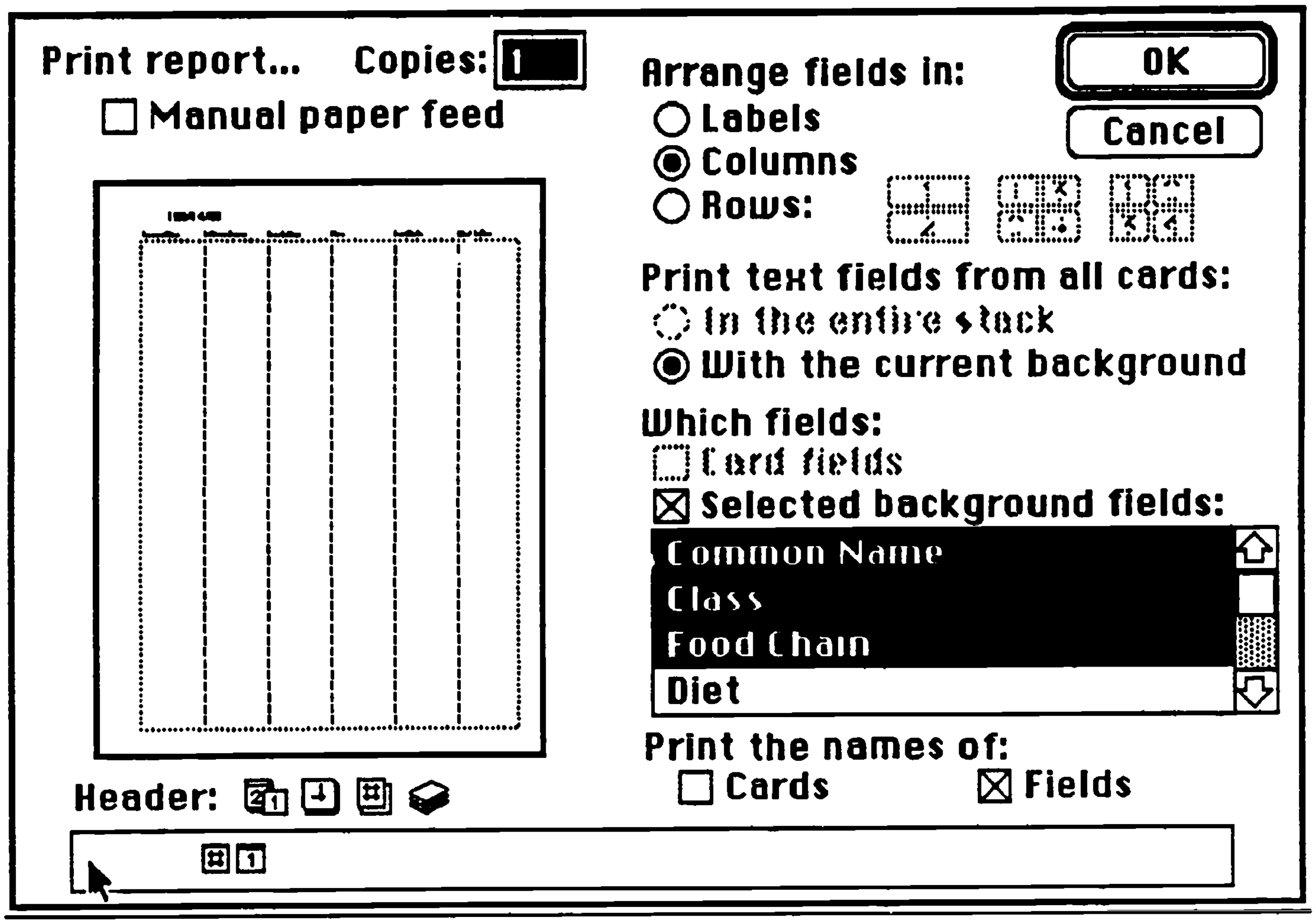
Table reports. Table reports are in columns, like this:

Common Name	Class	Food Chain	Weight in Lbs.
Surinam Toad	amphibian	carnivore	0.18
Bull Frog	amphibian	carnivore	1.00
Hellbender	amphibian	carnivore	2.00
Mudpuppy	amphibian	herbivore	0.22
Eastern Newt	amphibian	omnivore	0.01
Yellow Warbler	bird	carnivore	0.04
Eastern Kingbird	bird	carnivore	0.10
Great Blue Heron	bird	carnivore	6.00
Budgerigar	bird	herbivore	0.06
Domestic Chicken	bird	herbivore	7.00

Before printing a table report, do the following:

1. Sort the Animals data base in the order you want the information to appear in your report. For example if you are studying life spans of animals, you probably want to sort the records by life span within class.
2. Decide what fields you want to include in the columns of the report, and in what order. It's a good idea to make a paper sketch of the column (field) headings you want.
3. Decide what title you want to put on the report.

Setting up a table report is quite easy to do, although the screen for doing it looks complicated.



To print a table report, your screen should be set up like the figure above. Notice that "Columns" is selected and"Copies" is "1".

Selecting fields (columns) for the report. You need to choose the fields (columns) to be printed. To select a field, click its name. To select more than one field, Hold down the shift key as you click each name. The columns will appear on your report in the order in which you select the field names. The selected field names are highlighted. If you change your mind and want to deselect a field, hold the shift key while you click its name.

Making a header On the bottom of the report setup page you can type a heading which will appear on each page of the report.

Printing the report._When the report is set up the way you want it, check to make sure the printer is on and the paper is properly positioned. Click "OK" at the top right.

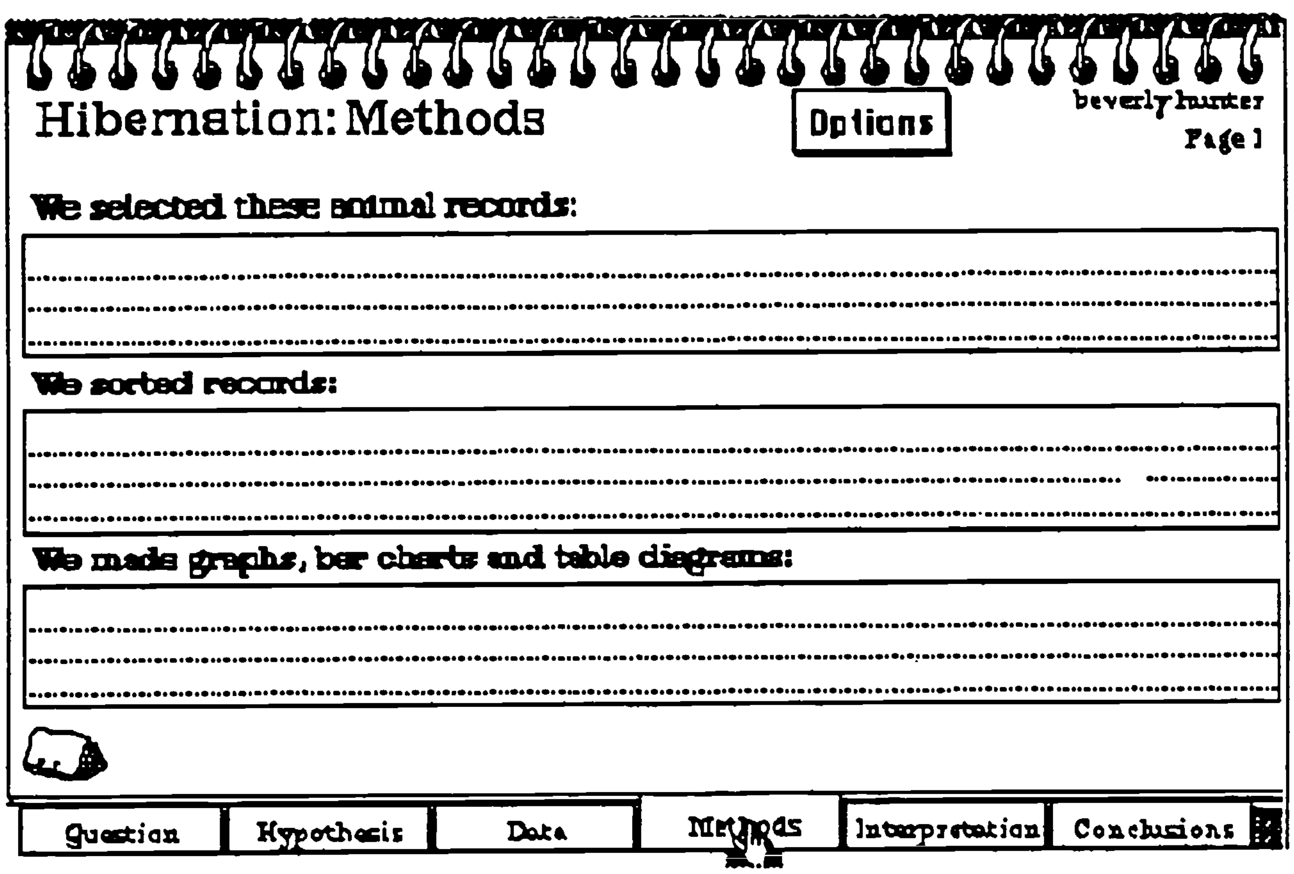
Using Your Notebook

When a student or teacher is registered to use the Nature Center, the program automatiacally creates a notebook for that person. The notebook is organized to help you plan and report on your research projects. You should use your notebook every time you make a decision about your project, get an idea about it, observe some data, make an interpretation, or write conclusions about your project.

Project Notebooks. There is a separate notebook for each of the five major projects, plus a general notebook. If you are working on one of the five projects, use the corresponding notebook. If you are working on some other project, use the "General Notes".

Notebook sections. Each project notebook has six sections: Question, Hypothesis, Data, Methods, Interpretation, and Conclusions. These correspond to sections in a science report. Thus when you have filled in a notebook you have written your report!

Here is the Methods section of the Notebook:



Notebook procedures.

After you have signed up for a Project, you will automatically be using the Notebook for that Project.

1. From any place in the Nature Center (Advisor, Animals data, etc.), click the Notebook button in the Options menu.
2. You will see the first page of your project notebook on the screen. (If you have not signed up for a project, you will go to General Notes.)

3. Click the tab button at the bottom of the notebook to go to the section of the notebook you want to write in.
4. Place your cursor where you want to type. Begin typing.
5. If you need an additional page in this section to write on, pull down the options menu and click "New Page."
6. To leave the Notebook, click the Return button. This should take you back to whence you came.

Pasting information into your Notebook.

Sometimes when you are reading the Advisor's advice or looking at a definition in the Animals dictionary or doing other work in the Nature Center, you would like to copy a piece of information into your notebook. This is very easy to do. Here is the procedure:

1. Click the paragraph or word you want to copy. You will hear a voice say "Copied!"
2. Using the Notebook button, go to the section of your notebook where you want to paste the information.
3. Click the cursor on your screen where you want the information to be pasted.
4. Hold down the Command key (to the left of the space bar) and press the letter V. Your information will be pasted into your notebook.

You can copy just about anything from anywhere in the Nature Center, except pictures. You can copy a graph, a field in the data base, a screen from the Advisor, a list of selected records, a selection sentence, a sort sentence, and so forth. If you try to copy something that can't be copied, you will know it because you won't hear the little voice say "copied."

To paste a graph or chart to your notebook, you don't need to click the graph. Just go to the Data section of your Notebook and choose "Paste graph onto this page."

Printing your notebook. You can print one page, one section, or your entire project notebook. Just choose "Print" from the Options menu and then click your choice.

Using the Animals Dictionary

The Animals Dictionary contains definitions of words and phrases about animals. There are two main ways to get to the dictionary. One is to choose the Dictionary button in the Options pull-down menu. Another is to click a special word somewhere in the program. These special words are explained below.

Using the Dictionary Index. One way to go to the Dictionary is by choosing the Dictionary button in the Options pull-down menu.

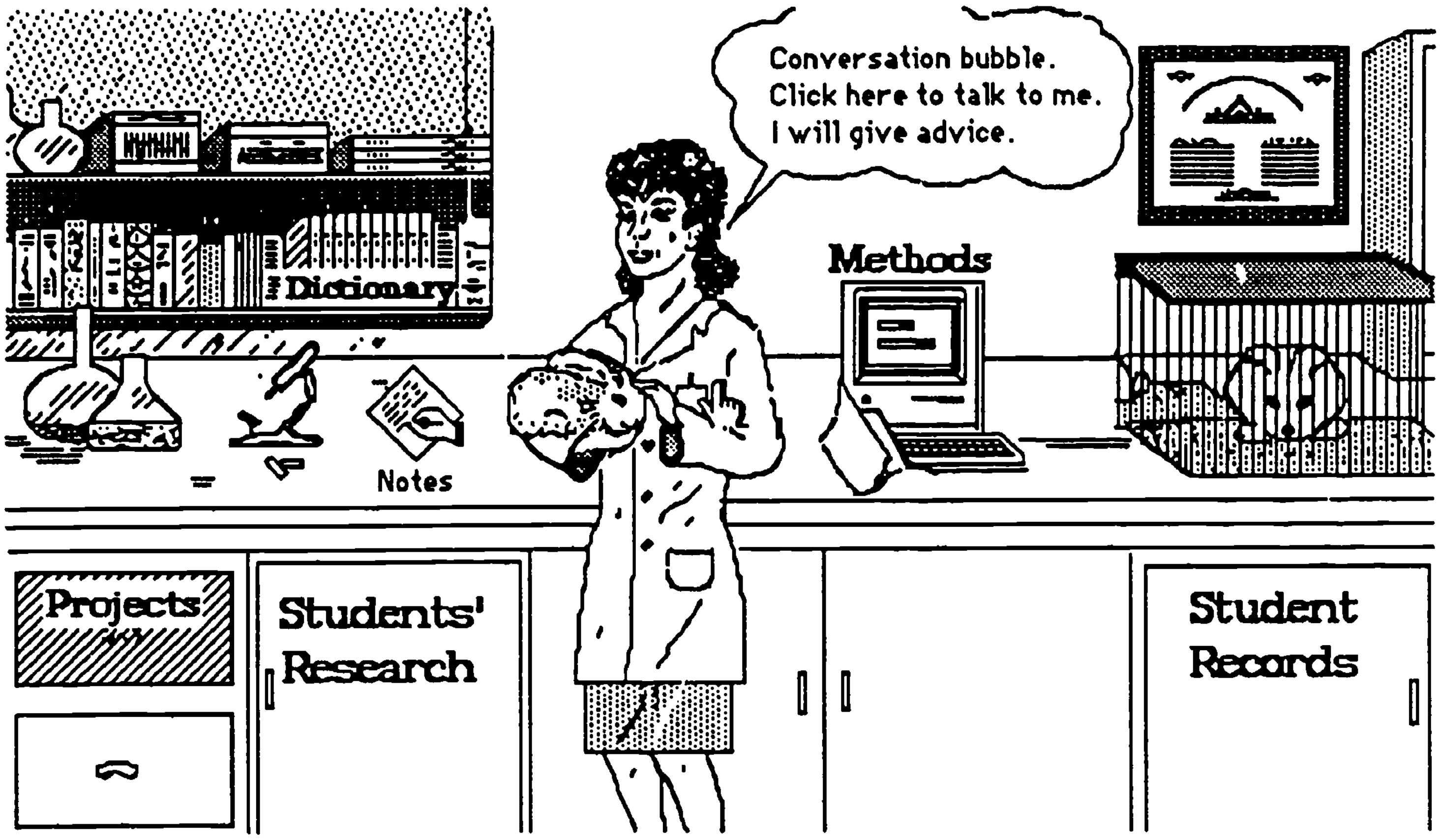
This takes you to the first page of the Dictionary. There you can click the Index button to get a list of all the words in the dictionary. Click the word you want to look up. After looking at the definition in the dictionary, return to the data base by clicking the Return arrow.

Clicking on data base field names. In the animals data base, you can click a field name (a word in bold followed by a colon, such as **Biome:**). After looking at the definition in the dictionary, return to the data base by clicking the Return arrow.

Clicking on words with an asterisk*. When you are reading about projects or methods, you will find that some words have an asterisk* behind them. You can get a definition of such a word by simply clicking on it.

Working with the Science Advisor

The Science Advisor is in charge of the research at the Nature Center. She has research projects that need to be accomplished. She supervises the work of the student assistants, and keeps records of their progress. She advises the students on methods for doing research and working with data. This is her office:



You can click anything in the Advisor's office, including the rabbit in her hand.

Getting to the Advisor. From anywhere in the Nature Center, you can go to the Advisor by clicking on the Advisor button. 

Getting Advisor's Advice on what to do next. At any time, you can click the Advisor button and seek advice on what to do next in your research. The Advisor is familiar with the work you have been doing, and will give advice based on your progress so far. Here is the procedure:

1. Click the Advisor button. She may "pop up" with a suggestion. If not, she will take you to her office.

2. Click the Advisor's Conversation Bubble.
3. The Advisor will give you a suggestion. If the suggestion seems useful, do what she suggests.

If the Advisor's suggestion does not tell you what you need to know, try using the Methods computer on the Advisor's desk.

Choosing a Project. By clicking on the Projects file cabinet you can read about the current research projects at the Nature Center. Click on the project you want to read about, and read the screens describing the project. To sign up for the project, click the button "I want to sign up for this project." Your student record (or teacher record if you are a teacher) will be updated to show which project you are working on. The Advisor will also put the name of your project into your notebook. Any time you go to your notebook after you have signed up for a project, you will automatically go to the notebook corresponding to your project.

Getting Advice on Science Methods and Data Base Methods. Click the computer in the Advisor's office to get advice and instruction on methods for doing your research. If you have signed up for a project, the advice you get will often be tailored specifically to that project.

Advice is available on two kinds of methods: Science research methods and Data Base methods. Science research methods take you step by step through a process of scientific inquiry from defining a problem to writing your conclusions. Data base methods tell you why, when and how to use data base tools such as selecting, sorting and graphing.

After you have signed up for a research project, you should continue going back to the Advisor button. She will give you instruction on asking research questions.

Looking at other students' research. The Advisor is building a collection of students' research projects. If you want to see what another student has done, click the "Students' Research" cabinet in the Advisor's office.

Looking at Student Records. When a student clicks on the Student Records cabinet in the Advisor's office, that student's record appears. When a teacher clicks on the Student Records cabinet, he or she can look at all the student records by pressing the "Next" and "Previous" arrows. You can look at the student's current question or hypothesis by clicking on the corresponding buttons in the student records. While in the Student Records, the teacher can add new students or delete students, change student name or password. (See section above on Registering a Student or Teacher.).

Either students or teachers can look at the current "Question" or "Hypothesis" for a student by clicking on those buttons at the bottom of the student record.

Printing student records. To print a student record, click the Print button.

Scientists at Work

Teaching Guide

December 13, 1988

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Contents

Introduction

This teaching guide was tested by teachers participating in the fall 1988 classroom test of *Scientists at Work.* Students are in seventh grade Life Science and Environmental Science classes.

Instructional Goals. The instructional goals in the learning activities outlined here are in six main categories:

- skills, knowledge, and an attitude of inquiry in scientific method and problem solving
- skills in working with information and using information in the scientific process.
- knowledge about animals and related concepts such as class, food chains, habitat and biome, body heat source, hibernation.
- understanding concepts related to food chains and food webs, including herbivores, carnivores and omnivores; predator-

prey relationships; animal communities and their habitats and biomes; producers and consumers; flow of energy in a food web; ways of visually depicting relationships in food web.

- skills in note-taking and organizing one's work
- skills in collaboration and teamwork

Classroom management. The lessons take place in ten 48-minute classe periods. Each day's lesson (with one or two exceptions) is divided into three activities: teacher lecture and whole class discussion (approximately 8 minutes); teamwork at desk (approximately 20 minutes); teamwork at computer (approximately 20 minutes). The timing of the activities assumes four computers per class of approximately 25 students.

Organizing and managing teams. Students will work in teams of three (or four depending on class size). If you have teams or lab groups that have been working together before, it's best to continue with those groups. If you are planning new groups, please do your best to ensure that they are heterogeneous groupings. Learning-disabled, special ed, or low ability students should be carefully combined with other students in groups. In a team of four, tnere should be one high-ability, two middle-ability, and one lower ability or special needs student.

All members of the team should contribute to team discussions and decisions. Within a team, students choose roles. Students exchange roles after two or three lessons, so that each student has the opportunity to participate in all ways in the work of the team. Roles for lessons 1-3 are:

Team leader - reports to teacher, keeps project on schedule, keeps all team members on task. Makes sure each team member is performing their assigned role for the day. Makes sure team is using the correct handout material for the activity, and turns in completed work to teacher.

Computer Operator - operates the computer, makes sure team signs on and quits properly. Makes sure printer has paper loaded in it.

Team Reader - reads screens and team handout materials out loud to the team. Makes sure each team member has understood what is read.

Team Recorder - writes the team's answers to questions on team handouts; takes notes for the team when they want a paper note about something on the screen. Makes sure all team notes, printouts, and handout materials are kept in the team folder.

In lessons 4-6 different roles are needed. The teams may have a **Team Leader**; a **Naturalist** who decides what animals are needed for their food web; a **computer operator** who obtains the needed data and pictures and printouts from the computer; and an **Exhibitor** who arranges the material on the team's poster.

Registering the Teams on the Computer. Prior to the first lesson, the teacher should plan the composition of teams and assign team names. Project staff will register them on the computer they will be using. It will be necessary for teams to use the same computer for every lesson.

Computer Stations. Each computer station should have the following:

- desk space for teams to have their papers
- chairs for all team members
- Quick Reference Guide to *Scientists at Work*
- A sign that tells which teams use this computer and how to type your team name or number.

Each of the nine lesson plans includes
Objectives
Teacher overhead transparencies & lecture notes (8 min.)
Team handouts
At-computer activity (20 min)
Teacher notes for at-computer activity.
At-desk activity (20 min)
Teacher notes for at-desk activity.

Assessing Student Progress
The At-Desk activities are fairly easy to assess because you can look at the team's written responses to the questions. The team will need to be on task most of the time in order to complete these handouts. The team's folder should contain all the handouts as well as the printouts and notes the team makes. Reviewing these folders is also a way of monitoring progress.

Work on the computer can be monitored by observing the teams as they work on the computer. As you go around to the computer, check for the following, and comment to the team:

- Is each team member performing their role for the day?

• Is the team using the correct at-computer worksheet for the day?
• Is the team using the Advisor?

Also, you can sign on using a teacher name and look at all the Student Records on the computer. The student records tell what state of learning the team has reached. At the end of each lesson, they should be at a specified state of learning. The states are, in sequence: Explore, Choose Project, Make Hypothesis, Test Hypothesis, Interpret Data, and Conclusions/Report. (The Advisor updates their student records when they press the QUIT button. If they don't QUIT properly, their progress for the day is lost.)

Lesson 1: Exploring the Nature Center

Science begins with curiosity and exploration. In this lesson, encourage students to explore and make their own discoveries. They will make discoveries about animals, about animal concepts, and about how the program works. They will begin learning to work cooperatively as a team, and perform their assigned team roles.

Objectives

• Learn to find your way around in the Scientists at Work program:

Sign on:

Animal pictures: Click on Animals sign in the Nature Center Entrance

Animal data base: Click on Animal data door in Nature Center Entrance, or choose "Animal Data" from the Options menu in the Animal pictures

Index: Lists all selected animals in data base. Click an animal name to go to its record.

Advisor: Click on Science Advisor's Door in Nature Center Entrance, or click Advisor button anywhere in the program.

Return arrow: to go back where you came from.

Right arrow: to see the next animal picture or data record.

Pull-down Options Menu: Click and drag the pointer.

Quit: From Nature Center Entrance, click "Quit"

• Become familiar with the "feel" of the mouse and the need to click just once.

• Work cooperatively as a team, and carry out a role within the team.
• Learn to use the correct pages of the Team Activities book for the day's lesson.

Materials, student handouts

For each team, Lesson 1 Team Handouts for At-Desk Activity.
For each computer: Lesson 1 Computer Activity. Team Handout.
For teacher lecture, transparencies 1-6.

Teacher Lecture/Demonstration

- Introduce the idea that students will be working for the next couple of weeks as research assistants in a Nature Center. They will work in teams conducting research on topics concerning animals. They will learn many skills involved in doing science research and in using computer data bases. Today they will form teams and learn how to explore the Nature Center on the computer.
- Transparency 1: show the opening screen of Scientists at Work. When you go to the computer to start your work, this is the screen you should see.
- Transparency 2 .Explain how to sign on to the program, using your assigned team name. Make sure everyone knows their team name.
- Transparency 3: Nature Center Entrance. Invite students to guess what they might see if they click on certain places in the Nature Center. Illustrate clicking on the "Animals" sign. Anything you can click on in the program is called a "button". The Animals sign is an example of a button. YOU CLICK ONCE ON A BUTTON.
- Transparency 4: Animal picture. Invite students to guess what the Return button does.
  Point out the Options menu, which is shown in the pulled-down position. Explain how to drag the options menu down by holding down the mouse button. Here, we choose the Animal data option. This takes us to the data for the animal we are looking at.
- Transparency 5: Elephant record in Animal data base. There is one record for each animal in the data base. For today, see how much you can discover about the kinds of information on a data base record.

- Emphasize that students are exploring the program, and that they should try out any buttons they wish, look at whatever animals they want, enjoy the discoveries.

Advisor: Point out the Advisor button on any screen. • Transparency 6: Advisor's office. The Advisor is always available to assist students in their research. Students should click on anything in the Advisor's office to see what kinds of help and advice are available. Point out the Advisor's Conversation Bubble. •

- Whatever transparency you have up, should have the Nature Center button (the little house) on it. Point this out to the students. When their turn at the computer is up or the class period is over, they must go to the Nature Center Entrance to QUIT.
- Transparency 3 - Nature Center Entrance. Point out the QUIT button. It is most important that the team QUIT the program properly by pressing the QUIT button.
- Make the following point: there is a lot to discover in the Nature Center, and they will not have time at the computer today to discover everything about the program. The Team Handout for the At-Desk activity is very important, because it will teach them many important skills in using the program. They will need these skills in order to do their research on the computer.

- Form the research teams and assign team names. Ask the students to please assign roles within the team for today. They can change roles tomorrow if they don't like the roles they try out today.
- Emphasize the importance of the Team READER, both at-desk and at-computer. Also the Team RECORDER.
- Hand out team booklets and team folders. Point out that the At-Computer activity says "At Computer" at the top, and the At-Desk activity says "At Desk" at the top.
- Tell students about computer schedules.
- Teams working at Desk should divide up tasks on the team and COMPLETE the At-Desk activity in the handout materials. (it is nine pages long). They may refer to the Quick Guide at desk to find out the answers to the questions.

At-desk (Off-computer) Activities

- Fill in Team Members worksheet.
- Answer questions in At-Desk Activity handout for Lesson 1.

TEACHER NOTES: The at-desk activity is just as important as the at-computer activity in terms of learning to use the program. If tear·· have difficulty answering some of the questions, sugges. that the team leader borrow one of the Quick Guides that is beside one of the computers. They can look up answers to the questions in the Quick Guide if they can't figure them out on their own.

When teams switch positions from at-computer to at-desk, it is important for them to get on task quickly with the at-desk activity.

Some teams will have difficulties assigning roles. It may be reassuring to remind them that they can take turns on different days with different roles. However, it is important that they assign the roles for the day and carry the roles out responsibly. The team cannot function unless all roles are performed.

At-computer Activities

- Sign on to Scientists at Work using team name.
- Explore: Animal pictures; Animal data base; Animals dictionary; Notes; Options Menu.
- Explore Advisor's office.
- Make careful obs^rvations of what happens when you click certain places. Discover something to tell the class about. Fill in Team Discoveries on the At-Computer handout..
- Quit properly.

TEACHER NOTES: Do whatever you can to make the sign-on procedure go quickly.

It wo ' be a good idea to go around to each computer station anc ..ow the team how to use the mouse properly. One light tap on the mouse button should be enough. They may get impatient waiting for something to happen, but it only adds confusion if they press the mouse button repeatedly. This results in their going to unexpected places, because the computer remembers every mouseclick and executes all of them.

When students are first learning to use the Index, you may need to show them how to scroll through the list of animals by pressing the mouse pointer on the tiny arrow on the scroll box.

Encourage the students to explore anything and everything they can think of in the program. But like all good scientists, they must be observant. They must observe what they did and what the result was. Otherwise, they won't learn or remember much about how to use the program. The "What we did" -- "What happened" worksheet in the At-Computer handout should help reinforce this idea.

Since this is their first time using this program, they should immediately get in the habit of ACTUALLY READING what is on the screen. Obviously they don't need to read out loud every word on a data base record. But screens such as Dictionary screens and Advisor screens have sentences on them need to be read if they are to be useful to the students. The Team READER needs to get in the habit of reading out loud the screens to the team.

Check to make sure that each member of the team is performing a role.

Student State at the end of this activity should be "Explore".

Wrap-up

- Computer operators click "QUIT" button to properly Quit for their team.

Lesson 2: Finding Information about Animals

In this lesson, students begin to develop understanding of the information available to them in the nature center, and how to locate the information they need. They should begin to distinguish among the kinds of information sources available: the Animals Dictionary for definitions; the Animal Data Base for facts; the Animal Pictures for pictures and sounds, and the Science Advisor for research methods and assignments. They will learn to use tools such as the data base index and the Select tool to perform simple information retrieval tasks such as locating a particular animal or selecting a collection of animals, and the Print tool for getting hardcopy of a screen. They will begin to recognize the classes of animal included in the data base and the meanings of terms used. These are all prerequisite skills and understandings to doing their research.

Objectives

• Learn to use some of the basic information tools in the Nature Center:
Index: Locate the record for a Moose.
Dictionary: Click on "**Biome:**" in Animals data base to learn what Biome means.
Select: records where class contains "reptile"
Print the picture of one animal of your choice.
Advisor: she suggests next exploration you need to try
• Become comfortable with Macintosh interface conventions such ask clicking "OK" after a message appears, clicking on a word to get a definition, clicking on a name in an Index to go to that animal's record, clicking "Choose" when appropriate.
• Begin to understand terminology related to different kinds of information: "Data base", "Record", "Field name", "Animal Dictionary":
• By browsing through the Animals data base, identify the 6 classes of animal that are included in the Animals data base.
• Use the Animals Dictionary to become familiar with meaning of terms used in the Animal data base: "Biome:", "Class:" "Enemies"

Class Management

Because it is so important for all students to get these basic skills and understandings, each individual student will complete an At-Desk handout today, rather than working on a team handout. Students within a team should be encouraged to discuss the answers to the questions on the handout, but each child should write the answers.

Materials, student handouts

For each STUDENT, Lesson 2 Team Handouts for At-Desk Activity.
For each computer team: Lesson 2 Computer Activity. Team Handout.
For teacher lecture, transparencies 5-19.

Teacher Lecture/Demonstration

• Invite students to share their discoveries from yesterday.

- Have students talk about their discoveries in the Advisor's office. Did the Advisor give them suggestions about what to explore? At the computer today, they should use the Advisor quite often. Any time they are not sure what to do next, they should click on the Advisor button. Make sure they know what that is.

- See if they can identify the various kinds of information available to them in the Nature Center:
  - Pictures of animals
  - Sounds of some of the animals animals
  - Facts for each animal, such as its diet, its enemies, where it lives, etc. The facts are in the Animal Data Base. Each animal has a record in the data base.
  - Definitions of words such as "Biome" and "Class". Definitions are in the Animals Dictionary.
  - Advice from the Science Advisor on how to learn and how to conduct science research.

- Transparency 5: Animal data. Explain that information about one animal is on one screen, called a "record" in the data base. They will be using this data in their research. So it is important to observe what kinds of information are in the data base. Point out some field names such as **Class:** and **Biome:** Field names are in bold letters. To find out what a field name means, you click on the name to see its dictionary definition. (e.g. click **Class**).
- Transparency 7: Animals Dictionary page for **Class.** Whenever a team has such information on their screen, it is important for the Team Reader to read the screen out loud to the team. Point out the Return Arrow which will take them back to the animal data they were looking at.
- Transparency 5: Animal data. How many teams used the Index yesterday to locate.an animal? Point out the Index button. (It looks like a little Rolodex file).
- Transparency 8: Index to Animal data. Point out the little arrow used to scroll through the list. Click the name of the animal you want to go to.
- Introduce the very powerful Select tool. Perhaps make an analogy with selecting from the class of students, all those who have "piano" as their Musical Instrument. Musical

instrument could be the name of a field in a data base about students. "Piano" could be one of the entries in that field (so could "Drums", "Voice", "Guitar", etc.)

- Transparency 9: Anaconda record. Notice what Class the Anaconda is (reptile).
- Transparency 10: Anaconda with Select option highlighted. Suppose we wanted to look at information for all the reptiles in the data base. In which field does it tell you whether an animal is a reptile? (Class)
- We can tell the computer to select, out of all the animals in the data base, just the reptiles. Point out the Select option on Options menu.
- Transparency 11- selection screen. Click "Write new selection sentence." A selection sentence will tell the computer the rules for what animal records we want to Select.The computer program helps us to create the sentence we need.
- Transparency 12 - Scroll through the list of field names and click on the one you want to select on -- e.g. Class, because we want to select all the animals that are **Class:** "reptile".
- Transparency 13 - select animals where Class **contains.** What does "contains" mean? Your locker contains books, clothes, etc. This room contains desks, people, etc. A field in a data base contains letters and words.
- Transparency 14: The computer gives you a list of words that the Class field can contain. You scroll down through the list with your mouse pointer till you get to the word you want. We want "reptile". After we click on "reptile", the computer will wait for us to click OK.

- Transparency 15. Select further? In later classes we will do more complex selections, like selecting reptiles that live in certain biomes and have certain enemies. For now, just STOP with the sentence the way it looks.
- Transparency 16. (Do It?) The computer gives us a chance to look at our selection sentence and see whether it says what we want it to say. If it does, we tell the computer to go ahead and Perform the Selection, by clicking "Yes".
- Transparency 17. After a few seconds the computer shows you how many animals were selected (38), and shows you a list of them. You can scroll through the list by clicking the little down arrow. Notice our Selection sentence is still at

the top of the screen, so we are reminded of what rules we used to select these animals.

- .. Transparency 18: To look at the record for one of those animals, click on its name. Here, we are clicking on the Snapping Turtle. After we do that, we will see the record for the snapping turtle (not shown in the transparency).
- The selection we made, of reptiles, will stay selected until we make a different selection. As you browse through the data base using the right arrow, you will see only selected animals' records. Transparency 19: Notice, for example, that anytime you use the Index after selecting, the Index only shows the selected animals.

- Emphasize the importance of the Team READER at-computer, as well as all roles.
- Hand out team handouts for Lesson 2 and team folders.
- Tell students about computer schedules.
- Students working at Desk should COMPLETE the At-Desk activity in the handout materials.

At-desk (Off-computer) Activities

- Each student working at desk will complete the handout for Lesson 2. Discuss the items in the handout with your team mates.

TEACHER NOTES: The at-desk activity is just as important as the at-computer activity in terms of learning to use the program. If students have difficulty answering some of the questions, suggest they discuss the question with their team mates. When teams switch positions from at-computer to at-desk, it is important for them to get on task quickly with the at-desk activity.

On-computer Activities

- Locate an animal using the Index.
- Use Select tool to select all reptiles.
- Use Select tool to select animals who have "Wolves" as enemies.

- Learn Select concepts from Advisor. Do other explorations the Advisor suggests.
- Learn from the Animals Dictionary the meaning of "Biome", "Food Chain", "Class", "Habitat", "Range".
- Print the picture of one animal..
- Quit properly.

TEACHER NOTES:

They should get in the habit of ACTUALLY READING what is on the screen. Screens such as Dictionary screens and Advisor screens have sentences on them need to be read if they are to be useful to the students. When they read, they need to also read the words on the Buttons. The Team READER needs to get in the habit of reading out loud the screens to the team. The Team Leader should make sure all members of the team are performing their roles.

Some teams will have difficulties assigning roles. It may be reassuring to remind them that they can take turns on different days with different roles. However, it is important that they assign the roles for the day and carry the roles out responsibly. The team cannot function unless all roles are performed.

Student State after Quitting from this activity should be "Explore"

Wrap-up

- Computer operators click "QUIT" button to properly Quit for their team.
- Students who did not complete the At-Desk assignment might be assigned to complete it as homework.

Lesson 3: Where in the World are the Animals?

The purpose of today's activity is to have the students become familiar with some characteristics of the animals in the Animal data base, and with tools for learning about those characteristics. They will need both the understanding of the data and the skill in using the tools in order to do their work with food chains effectively. Specifically, they will begin to get an understanding of the various Biomes in which the animals live, and the number of animals available in the biomes. They will use two main tools to develop this familiarity with the data: Select and Bar Chart.

Objectives

- Learn to use some of the basic information tools in the Nature Center:

Select: records where Biome contains "savanna"

Bar Chart: various biome bar charts give a "feel" for the number of animals in the data base.

Advisor: she suggests next exploration you need to try

- Become comfortable with terminology related to where various animals live: biome, range, habitat; deciduous forest, savanna, etc.
- Begin to understand concepts that will be needed in making food web, such as the various places that different communities of animals live in.
- Use the Animals Dictionary to become familiar with meaning of terms used in the Animal data base: "Biome:", "savanna", "deciduous forest", "tropical rain forest", etc.

Class Management

Each team will complete an At-Desk handout. Students within a team should be encouraged to discuss the answers to the questions on the handout, and have the Team Recorder write the answers.

Materials, student handouts

For each team, Lesson 3 Team Handouts for At-Desk Activity.
For each computer team: Lesson 3 Computer Activity. Team Handout.
For teacher lecture, transparencies 5-19.

Teacher Lecture/Demonstration

- Invite students to share their discoveries from yesterday.

- Have students talk about their discoveries in the Advisor's office. Did the Advisor give them suggestions about what to explore? At the computer today, they should use the Advisor quite often. Any time they are not sure what to do next, they should click on the Advisor button. Make sure they know what that is.

- Transparency 5: Elephant record. Point out the Biome field. Where does an elephant live? Discuss the fact that we can describe where he lives in terms of biome, range, and habitat. Remind students that they looked up the definition of Biome in the ANimals Dictionary. Biome is characterized by a type of vegetation or water in the case of fish.

- What other animals might live in the same Biome as the elephant? How might we find out? Student should be reminded of yesterday's lesson on using the Select tool.
- Transparency 20: choose field Biome to select by
- Transparency 21: pull down the list and choose "savanna"
- Transparency 22: 10 animals are selected. This tells us that our Animal data base contains information on only ten animals that live in a savanna biome. We can look at the records for any of those animals if we like.
- Now how could we find out how many animals live in the other biomes? We could go on selecting all the animals in each biome to find out. But there is a quicker way. We can make a bar chart of ALL the animals by biome.
- Transparency 23: First, let's get all the animals back again by telling the computer to Select all.
- Transparency 24: Then choose the Option Graph from the options menu.
- Transparency 25: We are given a choice of bar chart or scatter graph. We will choose bar chart.
- Transparency 26: We choose to chart number of animals by biome.
- Transparency 27: Now we can see ALL the animals by biome. In which biome do most of the animals in this data base live?
  How many animals in total are included in the chart?
  How many animals does the chart show for savanna?

- If we wanted to study just the fish in our data base, we could select records where biome contains fish.
- Transparency 28: When we do that, we see we have 22 fish selected.
- Now we can make another bar chart by biome, but this time just for the selected animals (the fish)
- Transparency 29: bar chart by fish.
  In which biome do most of the fish live?
  Do students know the difference between fresh water and marine biomes?

- Emphasize the importance of the Team READER at-computer. Also the Team RECORDER.

• Hand out team handouts for Lesson 3 and team folders.

• Tell students about computer schedules.

• Students working at Desk should COMPLETE the At-Desk activity in the handout materials.

At-desk (Off-computer) Activities

• Each team working at desk will complete the handout for Lesson 3.

TEACHER NOTES: The at-desk activity is just as important as the at-computer activity in terms of learning to use the program. When teams switch positions from at-computer to at-desk, it is important for them to get on task quickly with the at-desk activity.

On-computer Activities

• Find out how many animals in the Animal data base live in a tropical rain forest biome.
• Use Select tool to select all mamm ı ..
• Use bar chart to find out how many mammals live in each biome.
• Learn Bar Chart concepts from Advisor. Do other explorations the Advisor suggests.
• Learn from the Animals Dictionary the meaning of "Biome", "marine", "Habitat", "Range".
• Quit properly.

TEACHER NOTES:
They should get in the habit of ACTUALLY READING what is on the screen. The Team READER needs to get in the habit of reading out loud the screens to the team.
As you go around to the teams at computer and at desk, remind students that all roles must be performed.
Please make sure students at computer are using the ADVISOR.

Student State after Quitting from this activity should be "Project Sign Up"

Wrap-up

- Computer operators click "QUIT" button to properly Quit for their team.
- Students who did not complete the At-Desk assignment might be assigned to complete it as homework.

Lesson 4: Beginning the Food Chains Project

In this lesson, students begin working with the concept of food chains and food webs. They begin to see how they can use the data available to them to enrich their understanding of the food chain concept. They will learn to take advantage of tools and resources such as the data base index, the Animals Dictionary, Select, and bar chart to help them flesh out their understanding. They may also begin to get some insights into the limitations of the data base, and how to work with those. These are all steps that scientists go through as they begin to formulate their research projects.

Objectives

- Learn to use features of the Scientists at Work program:
  - Projects: read the project description and sign up for the Food Chains project
  - Animals Dictionary: Food chain; carnivore; omnivore; herbivore; diet; enemies
  - Animal Data Base Index.
  - Print a screen (data for their chosen animal)
  - Select

- Recognize meaning of terms : "Food Chain" "Food Web"; "Herbivore"; "Carnivore"; "Omnivore"; "Diet"; "Enemies"; "Predators"; "Prey".
- Classify animals as herbivores, carnivores or omnivores.
- Recognize that an animal may have an "Enemy" listed in its data base record but that enemy animal may not have the first animal listed in its "Diet", and understand reasons why this may be the case.

Learn to use Advisor to help you with your project.

Materials, student handouts

Concept paper for Food Chain/Food Web (Lesson 4 At-Desk Handout)

At-computer activity guide (Lesson 4 At-Computer Handout).

Transparencies 5, 30-31 for teacher.

Posted on the wall, food web posters that other students have made in the past, to serve as examples of the kinds of posters your students might make.

Teacher Lecture/Demonstration

- Introduce today's lesson by reviewing briefly what your students have learned previously about food chains and food webs.
- Introduce the idea of using the Animals data base to do research on food webs and food chains. They will be creating a poster of a food web and using the Animal data base to get the information they need in order to make a food web. Show students two or three sample posters other classes have made, and comment on them.

(NOTE: You may want your students to make either a simple food chain or a food web, depending on their level of development of these concepts.)

- Transparency 30: Projects opening screen. (How the students get to this screen depends on whether they are Advisor users or not. Advisor-using students get there through the Advisor's office, non-Advisor students get there through the "Student Research" door in the Nature Center Entrance.
- After they choose "Food Chain", the Team Reader should read out loud to the team the project description, so the team will know what the assignment is all about. They might also decide to print out the screen that tells the assignment. When they are on the computer, teams should sign up for the Food Chains Project.
- Transparency 31: Example of a partial food web for a tundra community. Invite students to discuss and interpret the information in the web, identify specific food chains in the web, etc.
- Through lecture or class discussion, make the following points about the food web:
  - In order to make a food web, we can begin by choosing a particular animal we want to start with. We could start at the top of the web, at the bottom, or somewhere in the middle.
  - The animal(s) at the very bottom of the web will always be herbivore.

- There are likely to be animals in the food web (in the real world) that are not in our Animals data base. As they have discovered, most of the animals are for North America. Thus, North American animals are easier to create a food web for.
- All the animals in a food web live in the same biome and range.

- The students will have three days in which to complete their posters. During this project, they should have the following team roles:
  - **Team Leader**, who makes sure each person in the team is performing their role, that the correct worksheets are being used, that the project is on schedule. The Team Leader can also serve the role of Team READER.
  - **Naturalist** who makes final decisions about what animals are needed for their food web (after discussing with all team members). The Naturalist can also be the TEam Recorder, keeping a record of decisions made by the team and the information used to make the decisions.
  - **Computer operator** who obtains the needed data and pictures and printouts from the computer
  - **Exhibitor** who arranges the material on the team's poster.
- To begin your research, each team will choose an animal or biome to study.

The Advisor will help you start your project and will give you help all the way through.. • Transparency 6 - Advisor's Office. Click on her conversation bubble.

- Transparency 5: What data fields will you want to look at to help you with your food web? (the Diet, Enemies, Food Chain and Biome of the animal you are studying). Since you will need this information later at your desk, you should print the screen that has your animal data on it. Does everyone know how to print a screen?

At-desk Activities

Read Food Chain/Food Web Concept Paper in the Lesson 4 At Desk Handout and answer the questions. Also read teacher's assigned supplemental readings on biomes and food webs from textbook or other material. These may be completed as homework if there is not enough time in class.
The team should choose an animal and biome to study if you have not yet done so.

TEACHER NOTES: Teams working at desk need to understand the terms and concepts explained in the handout, such as "carnivore", "predator", "enemy", etc. if they are to be able to do their work on the food web with understanding.
As you go around to the teams working at desk, make sure all team members are participating in the completion of the handout.

At-computer Activities

Read the Project description;
Sign up for Food Chains project

Use Advisor to help you with the project. Anytime you don't know what to do, click on Advisor's conversation bubble.

As a team, choose an animal to begin your study.
Find the animal in the data base by using the Index.
Make notes as to its Diet, Biome, Range and Enemies.
Get needed printouts and paper notes to use at desk.

TEACHER NOTES: Today it is especially important for the children to READ the screens they see if they are going to be able to use the computer productively.
As you monitor their work, make sure that:

Teams are using the Advisor FREQUENTLY.

- Team READER is actually reading the screens aloud.
- All team members have assigned roles for the project.

Problems to expect:

- Advisor-using teams may find the Advisor won't let them sign up for the project because they have not completed all their explorations. Reassure them that this is ok, just complete the explorations the Advisor tells them to do. Tell them to keep going back to the Advisor to check on their progress.
- Non-advisor teams may be totally confused, because they do not read the Project screens that tell them what

the project is about. Suggest they print out the instructions in the Project stack, where it tells them what the project is.
• Please resist the temptation to serve as the "Advisor" to nonAdvisor classes.

Student State in the student records at the end of this activity should be "Choose Project".

Wrap-Up

Teams should keep their printouts, handouts and notes in their team folders for use in next class.

Lesson 5: Creating a Food Web Diagram

Students should begin to discover that they need to make inferences from the data in order to create a realistic food web. The ability to select a relevant set of information from a large data base and make inferences from the data is a very powerful capability in our information-rich world. More advanced students may begin to gain insights into the limitations of the data, and see how they can make useful inferences from the information available to them.

Objectives

- Locate information from the Animal data base to assist in creating a drawing of a food web.
- Use the following kinds of information about animals in creating the food web: food chain; diet; enemies (predators); biome; range.
- Identify limitations of the Animals data base, such as animals and kinds of animals that are not included in the data base.
- Make inferences based on available data -- such as the kinds of fish eaten by a predator living in a particular biome and range.
- Depict predator-prey relationships in a drawing of a food web.

Use Advisor's Data Base Methods to learn about Selecting data.

TEACHER NOTE: This activity will take two days. Teams will likely vary in the amount of information they are able to locate and place on their food chains or webs. For a web, they should be able to include at least two herbivores, the plants they eat, and two carnivores or omnivores in their food web drawing. The more animals they identify as candidates for inclusion in the food web, the more issues they will confront in terms of making inferences, identifying missing data, and checking for proper biome for their particular food community.

Some teachers want their students to include raw materials such as sunshine and water, and decomposers in their food webs. You will need to clarify for the students what you want included.

Materials, student handouts

Team Handouts for Lesson 5.

If possible, large piece of poster paper for teams to draw their food webs; magazines they can cut pictures out of; crayons for coloring pictures they print out of the computer; scissors; glue.

Teacher Lecture/Demonstration

- Invite teams to tell the class what animal their team is studying and where it lives.
- Teams should by now know where their animal lives, what is in the diet of their selected animal, and what its enemies are. Invite students to suggest what the next step would be in gathering the information they need to complete their food web. There are several approaches they could take, for example:

  - Locate the record for each animal listed in its diet, and find out what the diet and enemies are for those animals.
  - Locate the record for each animal listed as an enemy, and find out what the diet and enemies are for those animals.

  Each time they take one of these information-gathering steps, they will find out a little more about the food web for the community they are creating.
- Remind students of the powerful Select tool as a way of getting information for their food web.
- If you feel they need a refresher on how to use Select, try the following:
- Transparency 32. Notice what is in the diet of a hare.

- Now, how can we find all the animals that have hares in their diets? Point out the Select option on Options menu.
- Transparency 33- selection screen. Click "Write new selection sentence." A selection sentence will tell the computer the rules for what animal records we want to Select.
- Transparency 34 - Scroll through the list of fields and click on the one you want to select on -- e.g. Diet, because we want to select (or choose) all the animals having hares in their diets. Transparency 35 - select Diet contains "hares". Then click OK.
- Transparency 36 - 3 animals selected, Bobcat and Gray Wolf and Snowy Owl. Notice our Selection sentence at the top of the screen.
- .. To look at the record for one of those animals, click on its name.

- How might we use the Select tool to help us get information for our food web? Some possibilities:
  - Select all the animals that live in the same Biome as their animal, and decide whether they should be included in the food web.
  - Select all the animals that have their animal listed in the Diet field.
  - Select all the animals that have their animal listed in the Enemies field.

The Advisor's Methods Computer teaches you more about selecting data. Transparency 37: Advisor's Data Base Methods. Transparency 38: About selecting records.

- Tell students when their food web project is due. They will exhibit them and report to the class on the food web and how they got the information.

At-desk Activities

Review the notes and printouts you have made, and decide what animals to place in your food web.
Draw as much of the food web as you can, based on the information you have gathered so far.
Decide what additional information you will need in order to make the food web more complete.
Keep track of the methods you use to identify animals for your food web, so you can explain these to the class.

TEACHER NOTES: Teams that print only pictures of animals will have a hard time at-desk planning their food webs. If this

is happening, remind them to print data base record for each animal picture they print.
Don't allow any students to take materials home; they will be the ones to be absent on a crucial day and the team will be left without materials.

At-computer Activities

Advisor.will take you step by step through the activity. Click on her conversation bubble in her office.

Select animals in the data base that might be in your food web. Make notes as to the Diet, Biome, Range and Enemies of the selected animals. Make printouts you need for your poster. Decide whether the selected animals should be in your food web.

TEACHER NOTES:

Please remind classes to go back to the Advisor frequently.

If it seems appropriate for the students at the time, point out ways they can begin to look critically at the data. For example, in the case of the selection of animals having hares in the diet, when we look at the Bobcat record we find that its range is most of the United States southern Canada and Mexico. It is not in a tundra biome. Therefore, even though "hares" are in its diet, it is not likely to be the Arctic Hare that is in its diet.

Certain biomes present more difficulties than others. In a marine biome, students will need to use all possible clues carefully in order to decide which fish might eat other fish (e.g. size, habitat in addition to biome and range).

Student State at the end of this activity should be Choose Project.

Wrap-Up

Teams should keep their food web and notes in Team folders to use in the next lesson. They will display their food webs for the whole class in Lesson 6.

Lesson 6: Exhibiting Food Webs and Asking Questions

One of the most effective ways to consolidate our learnings is to communicate them to others. In this lesson, students will have the opportunity to share the methods and results of their research with their classmates, and to evaluate the research of the other teams. In this activity, they have much in common with the research scientist who presents her work at a professional conference.

Teams will have the opportunity to display their work to other teams and describe the methods they used to get the information for their food webs. Thus far, students have been working with relatively concrete ideas and data -- specific animals that are in their food webs. Now they are challenged to look for patterns and generalizations in the data. Students will try to see patterns in the food webs they have developed so far. Let's leave it to a later lesson to discover when the generalizations do and don't hold up.

Objectives

- Communicate team's results and methods orally and in writing.
- Develop a generalization about food chains.
- Write the generalization in the form of a question.
- Develop proficiency in use of features of the Scientists at Work program:
  Notebook: use Questions section.

Use Advisor's Science Methods to help write a question about food chains.

Materials

Food web posters and information the teams have developed.
Individual student at-desk handouts for Lesson 6.

Classroom Management:

A possible way to manage this activity is to have half the teams presenting their work to each other, while the other teams are working on the computer. Then reverse the procedure. This means that each student will get an opportunity to learn from the food web work of half the teams. If this seems to confusing for your classroom, you may need to defer the at-computer part of this lesson until tomorrow, and have the whole class participate together in the food web presentations.

Teacher Lecture/Demonstration

The following discussion might be conducted twice: once for half the teams and then again for the other half. Teams not involved in the discussion will work at the computer.

For the teams that are not working at the computer:

- Hand out the at-desk worksheet for each student. Explain that they must listen carefully to the other team's presentations, and ask questions of the team if they don't understand something. They should choose two of the presentations (other than their own) to write about on their worksheet. This assignment is important, and they should plan to turn in their completed worksheet to the teacher at the end of the period.
- Give the teams about 5 minutes to decide how they will present their project to the class; who will say what, etc. All members of the team should participate in the presentation. They should explain their food web, its biome, and describe the methods they used to get the information. (For example, "We selected all the animals that live in a marine biome and an Atlantic Ocean Range. Then we looked at the diet and enemies of each animal.") Teams should tell how they used the Advisor to help with their project. They may describe any difficulties they had in doing the project, such as data they needed that is not in the data base. They may describe the roles of the various team members and how they worked together on this project.
- Invite one team to hold up their team's food web on the board and make a 3-5-minute presentation. Other members of the class should be invited to ask questions.
- After all the presentations are made:
- Teams should be seated together and have their food webs and printouts of animal data in front of them as you raise questions for them to think about. The object of this discussion will be to try to get the students to make some general observations about their food webs.

- For each of the presentations, ask the students to make general observations about the food webs. For example, "It seems to me that the carnivores are larger than the herbivores." or "It seems to me that the herbivores have the most enemies."
- Invite students to generate their own questions such as the following:

  What classes of animal are in your food web? Why are some classes of animal not present in the food web community you are working on?
  What class of animal are the herbivores in your food web?
  Are the herbivores larger or smaller than the carnivores?
  Do some animals have more enemy species than others?
  Why do these animals have so many enemies?
  Are fish mainly herbivores or carnivores?
  - Do small herbivores have more young than large herbivores?.
  - Do most carnivorous birds eat insects?
  - Are most reptiles carnivores?
  - Do rabbits have more enemies than wolves?
  - Why are there are not many herbivores in the desert?
  - How many of the carnivores eat insects?

At-Computer teams:

The Advisor will help your team to think about food chain questions.

Today your team will begin at the computer doing its research on food chains and food webs. You will make up questions about food webs, based on what you have learned as you were drawing your example food web.

At-desk Activities

Each student will complete the At-Desk handout for Lesson 6, and participate in presenting their team's work.

TEACHER NOTES: This Lesson 6 worksheet is a good product to use in evaluating student progress, along with their team food web poster and presentation.

At-computer Activities

Use Advisor's Methods Computer to learn about defining the food web problem and to generate their Question. They should tell the Advisor to "Remember my question".

Write a question about food webs in your computer Notebook.
Select animals in the data base that might help to answer your question.
Make notes as to the Diet, Biome, Range and Enemies of the selected animals, or print their records.
Use your Notebook to make notes about your question.
Student State at the end of this activity should be Answer Question.

TEACHER NOTES: Depending on size of class and how efficiently your students work, you may want to defer the at-computer part of today's lesson to tomorrow.

Lesson 7: Getting Answers to Food Web Questions

One of the most creative tasks of a scientist is to invent a method for getting answers to questions. The scientist is always constrained by available data and tools for manipulating that data. In this lesson, students apply the selection and bar chart tools, and see how they might (or might not!) help them in answering their questions.

Objectives

- Develop proficiency in use of features of the Scientists at Work program:

  Notebook: use Methods and Data and Interpretation sections. Paste "copied" data into Interpretation section. Paste charts into Data section.
  Select.: use two or more criteria for selection.
  Bar chart
  Print: print Methods and Data sections of notebook.

- Plan a method for answering a question.
- Get answers to questions, using data from the Animals data base.

• Use Advisor's Science Methods to help plan a method for getting answers to questions. • Use Advisor's Data Base Methods to learn about bar charts.

Teacher Lecture/Demonstration

- Each team should now have a question about food chains and food webs. Have some team leaders tell what their team's question is. You may want to help them sharpen up their question if it doesn't sound answerable from the data.
- Choose one of the team's questions, or use an example such as "Are most reptiles carnivores?." Invite class to discuss what sort of evidence would be needed to convince someone that they had an answer to the question.
- We will need to decide on a method for answering our question. First, think about what animal records we want to work with. Do we want data from ALL the animals? No, because it is only animals in the Class "Reptile" that we are

interested in for this question. What data base tool can we use to just work with the reptiles? We can SELECT records where Class contains "Reptile."

- Once we have selected all the reptiles, how can we find out whether most of them are carnivores? We could look at the record for each reptile in the data base, but that would take a long time and would be boring. We have a data base tool that makes it easy to see HOW MANY animal records are in each category, such as Food Chain. This is the Bar Chart tool.
- Transparency 39: Bar chart showing reptiles by food chain. Does this chart answer the question about whether reptiles are carnivores? Have students discuss interpretation of the bar chart.
- It's very easy to make a bar chart. Transparency 40: after selecting the reptiles (notice there were 38 selected), choose Graphs from the Options menu.
- Transparency 41: choose type of graph. We want a bar chart.
- Transparency 42: tell what you want the chart to show. We choose <u>Food Chain</u> for our question about the carnivores.
- Transparency 39: the bar chart appears on the screen. Notice that below the bar chart it tells what animals were selected to create this bar chart. It is important to pay attention to this when interpreting the bar chart. The chart would look quite different if it were Mammals that we had selected, wouldn't it?
- After you have looked at your bar chart, you may decide to Print it or you can copy it and paste it into your Notebook.
- For some kinds of questions, bar charts are a very easy way to get some information to help answer the question. You must be sure to Select the records you want before making the chart.

Tell teams when they are using computer, to use Advisor's Data Base Methods to learn more about bar charts.

- Transparency 43: Methods section of Notebook. As we have been discussing, the Method we use to answer a question is a very important part of a scientific research project. In the Methods section of the Notebook we write our plan for answering a question or testing an hypothesis. Because you are just starting to learn how to do research, you may not be able to think of the "best" way to answer your question. You may have to try several different methods. Each time you try a new method, write about it in your notebook

- Explain that the Team's computer Notebook, when completed and printed, will be a complete science report for the team.

- Use Advisor's Science Methods to help you learn about methods for answering questions.

- After you get some data that helps to answer your question, you need to put the data into the Data section or the Interpretation section of your notebook. You can paste a bar chart into the Graphs section, or you can type information in the Interpretation section. To paste a bar chart or graph into your Notebook, first make the chart using the graph tool in the ANimal data base. Then go to the Graph section of your Notebook. Pull down the Options menu and click the choice that says "Paste graph onto this page." You can paste more than one graph by make a new page in the Graphs section of your Notebook.

Also, you can click on some data in the data base and if it says "Copied!" you can then go to the notebook and paste it in the Data section. You paste data by clicking the mouse pointer where you want the data copied, then hold down the command key while you press the v key.

At-desk Activities

Complete Lesson 7 At-Desk handout, to practice:
- selecting data to answer a question
- choosing a bar chart to answer a question
- deciding methods to answer a question

TEACHER NOTE: Again, students may need to be reminded that the concepts they are learning in the handout are very important. They will not be able to do their research productively unless they understand the ideas in the worksheets.

At-computer Activities

Use Advisor's Science Methods to learn about answering questions.

In the Methods section of your computer Notebook, write the method you will use to answer your question. (If necessary, change the question in the Question section of your notebook, or write a different question).

In the Animal data base, Select the records you need to answer your question.

If appropriate for your question, make a bar chart. If not appropriate, look at the selected records and find out the data you need.

Use Advisor's Data Base Methods to learn about making and interpreting Bar Charts.

Make printouts of data or charts, or paste them in the Data section of your Notebook.

If you have more time on the computer, think of another way to answer your question, and write about that method in your notebook.

Student State at the end of this activity should be either Answer Question or Make Hypothesis.

TEACHER NOTES: It is quite likely that students will write ques.:ons for which it is difficult to get the answers from the data base. They may not have all the skills needed to get the answers, depending on the type of question they ask.

Two of the tools they have not yet learned about, are Sort and Print Report. If their question can't be answered using a bar chart or other method they have learned, suggest they try cut sort and report. Advisor classes can go to the Advisor's Methods computer and learn what the advisor has to teach about these.

A good way to teach students how to do things like pasting a graph into the notebook, is to go around to the teams at computer and show them (rather than trying to explain to whole class).

Lesson 8: Writing and Testing Hypotheses

Today we introduce the idea of an hypothesis as a testable prediction or guess. The Animals data base provides students with a variety of tools as well as data for formulating and testing an hypothesis. The challenge for them now is to choose the appropriate tools and data to test their hypothesis.

Objectives

- Understand the concept of an hypothesis ; a testable guess or prediction.
- Write an hypothesis concerning food chains or food webs.

- Plan appropriate methods for testing hypothesis and write these in your notebook.
- Select data relevant to an hypothesis.
- Organize selected data by sorting or creating a bar chart.
- Use Advisor's Science Methods to help write an hypothesis about your project.

Teacher Lecture/Demonstration

- Invite discussion of any problems or questions the teams have had in getting data to answer their research questions.
- Discuss with the class the idea of a scientific hypothesis. Scientists begin a research study or experiment by making an hypothesis as to what they think the outcome of the experiment will be. An hypothesis is similar to a question, except that you make a prediction as to what you think the answer will be. Here are some examples of hypotheses about food chains:

- Rabbits have more enemies than wolves.
- There are not many herbivores in the desert.
- Most reptiles are carnivores.
- Small herbivores have more young than large herbivores.

- Now that the teams have had experience using the Animal data base to answer questions, it should be fairly easy for them to think of a research hypothesis that can be tested using the data base.

- Introduce the idea of getting evidence to support an hypothesis. Using one of the examples above, have students suggest what kind of evidence would be needed to prove or disprove the hypothesis. What data would convince someone that your hypothesis is true (or false)? We can use the Animal data base to get evidence to prove or disprove our hypothesis.

- Emphasize that the important thing in making hypotheses is NOT to make a hypothesis that is necessarily true, but rather to make an hypothesis that is testable. In science, we learn a great deal from testing hypotheses that turn out to be false.

- Another key idea here, is that often the data we get are not adequate to support or disprove our hypothesis. The data may simply lead us to a different hypothesis.

- Depending on time available for class discussion, you might introduce the idea of controlling variables in the testing of an hypothesis. Most commonly, generalizations do not hold up across classes of animal. Thus the most commonly controlled variable will be Class. The way to control the variable is to SELECT just the animals in the class you are studying, such as mammal.

At-desk Activities

Teams that have their at-desk activity before their on-computer activity, will will use their notes and printouts from their work on research questions, to help them formulate an hypothesis and a method for testing their hypothesis.

Teams that have their at-desk activity after their on-computer activity, will analyze the data they have obtained. They will decide whether the data supports their hypothesis, and whether they need additional data.

At-computer Activities

- Generate an hypothesis and put it in your Notebook.

Use Advisor's science methods to help you write an hypothesis. Tell Advisor to remember your hypothesis.

- Write in your notebook the method you will use to test your hypothesis.
- Obtain data by selecting, sorting, making bar chart or table report.
- Print out notebook sections, data, and any other materials team will need at desk to make interpretations and draw conclusions.

Go to the Advisor's Methods Computer and get advice on methods for testing your hypothesis.

Student state at end of this activity: Interpretations/Conclusions.

Lesson 9: Interpreting data and drawing conclusions

Do my data support my hypothesis? Students can apply many of their previous learnings and experiences to answer this question. Often their data will be ambiguous, and will at best suggest other questions for research. In this experience, students have much in common with working scientists.

Objectives

- Develop proficiency in use of features of the Scientists at Work program:

  Notebook: use Data, Interpretations and Conclusions sections.
  Print: print whole notebook.

- Decide whether data supports or denies hypothesis.
- Identify additional data needed to confirm or deny hypothesis.
- .Revise hypothesis based upon findings.
- Draw conclusions based on evidence and method of testing.

• Use Advisor's Science Methods to help interpret findings and draw conclusions.

Teacher Lecture/Demonstration

- Each team should by now have collected some data related to their hypothesis. Now the challenge is to interpret the data and draw conclusions. They will need to decide whether the data tends to support or deny the hypothesis, and think of reasons why the data does or does not support the hypothesis.
- Invite one team leader to describe to the class their team's hypothesis and the data they have identified. Ask other class members (not on the team involved) to say whether they think the data supports or denies the hypothesis and why. Some possibilities which you might point out include:

.- the data are not relevant to the hypothesis. What data would be relevant?
- the team has not collected enough evidence to say whether the hypothesis is supported or not. What additional data is needed from the data base?
- the Animals data base does not contain the information needed to test this hypothesis. What additional data would be needed?
- the data are not organized in a way that enable us to interpret them. How should they be organized?
- the data tend to support (or deny) the hypothesis, but some additional information would be needed in order for us to be more certain. What additional data would we need and where could we get it?
- there is disagreement about whether the data support or deny the hypothesis, because some terms in the hypothesis (such as "larger than" or "more than") are not clearly defined. How might we define them to make the hypothesis testable?

- Work through another example from the teams if time permits.
- Explain that the Team's Notebook, when completed and printed, will be a complete science report for the team. These reports, along with the food webs the team drew, will become a product which the teacher will evaluate.
- Point out that they may not have clear answers when they make their conclusions. In fact it is more likely that they will have discovered more new questions to study. This is usually the case in scientific research. Usually when we do one experiment it helps us to see new questions which leads to new experiments, and so forth.

At-desk Activities

If the team has not yet had its turn on the computer, the team should examine carefully the data they got yesterday and try to interpret it. Does the data tend to support their hypothesis or not? What additional data are needed?

If the team has already had their turn on the computer, they should organize their printouts and hand write any additional explanations to complete the report.

At-computer Activities

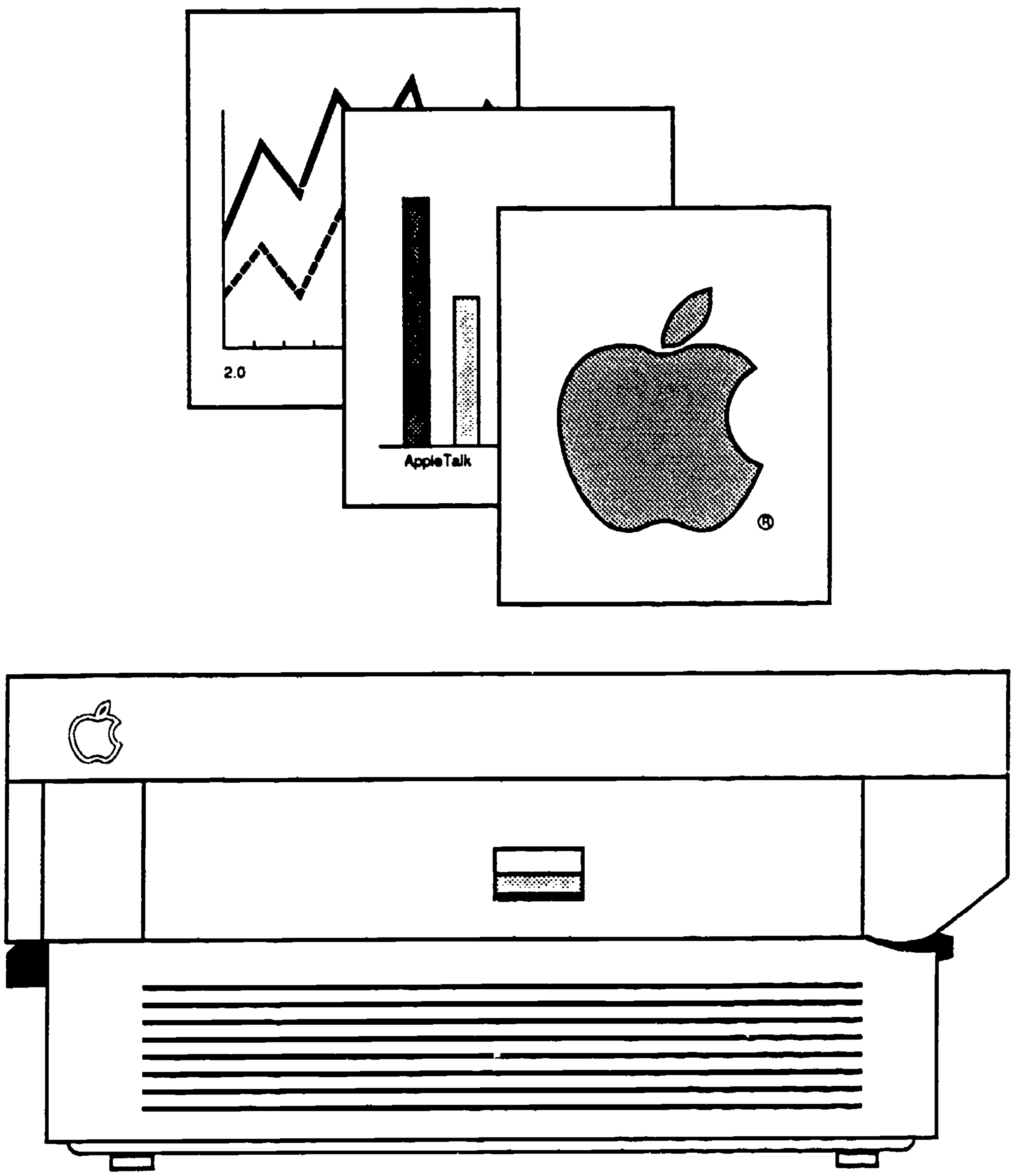
Print or paste to Notebook any additional data or charts needed.

Write interpretations and conclusions sections of notebook.

Print whole notebook.

• Use Advisor's Science Methods to help interpret findings and draw conclusions.

LaserWriter



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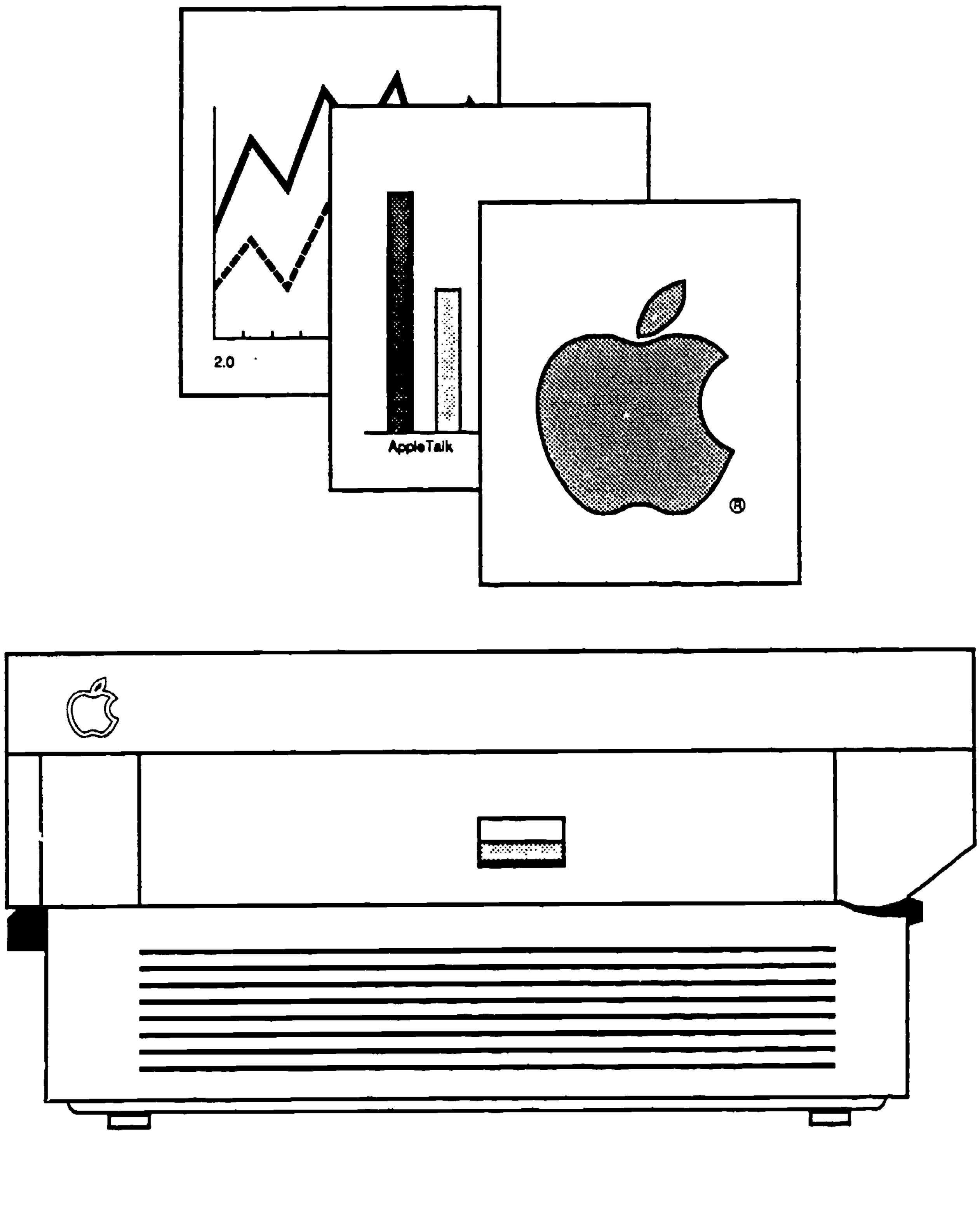
LaserWriter



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Scientists

at

Work

TEAM ACTIVITIES

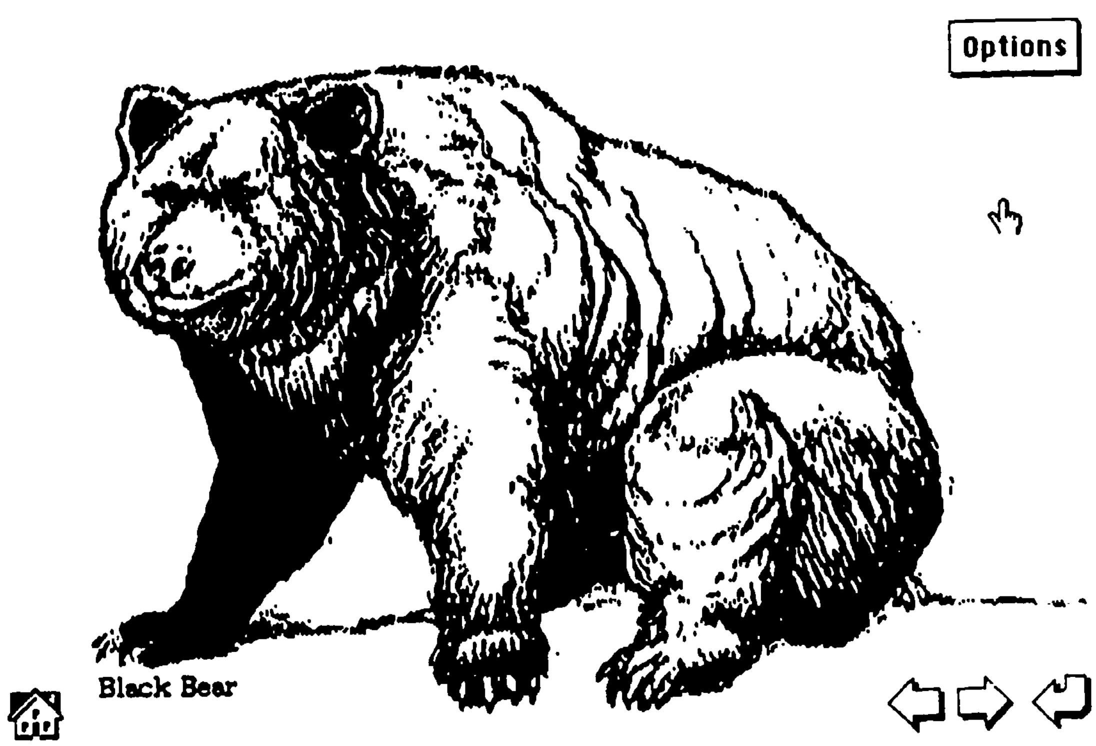


TABLE OF CONTENTS

Scientists at Work
Lesson 1
At-Desk Activity

Team Name or Number: ____________________

Decide with your team the roles of team members. Write the name of the member of your team who will be in charge of each of the following tasks (at least for today)..

Team Leader: Keeps the team on task and on schedule. Delivers team products to the teacher. Makes sure all members of the team are performing their roles.
Name of team leader: ______________________________

Computer Operator: Operates the computer. Learns how to use the computer program. Makes sure the team signs on and quits the program properly. Uses Reference Guide to find out how to use features of the program.
Name of computer operator: ______________________________

Team Recorder: Writes on the team's handouts and worksheets, based on ideas and information the team develops.
Name of recorder: ______________________________

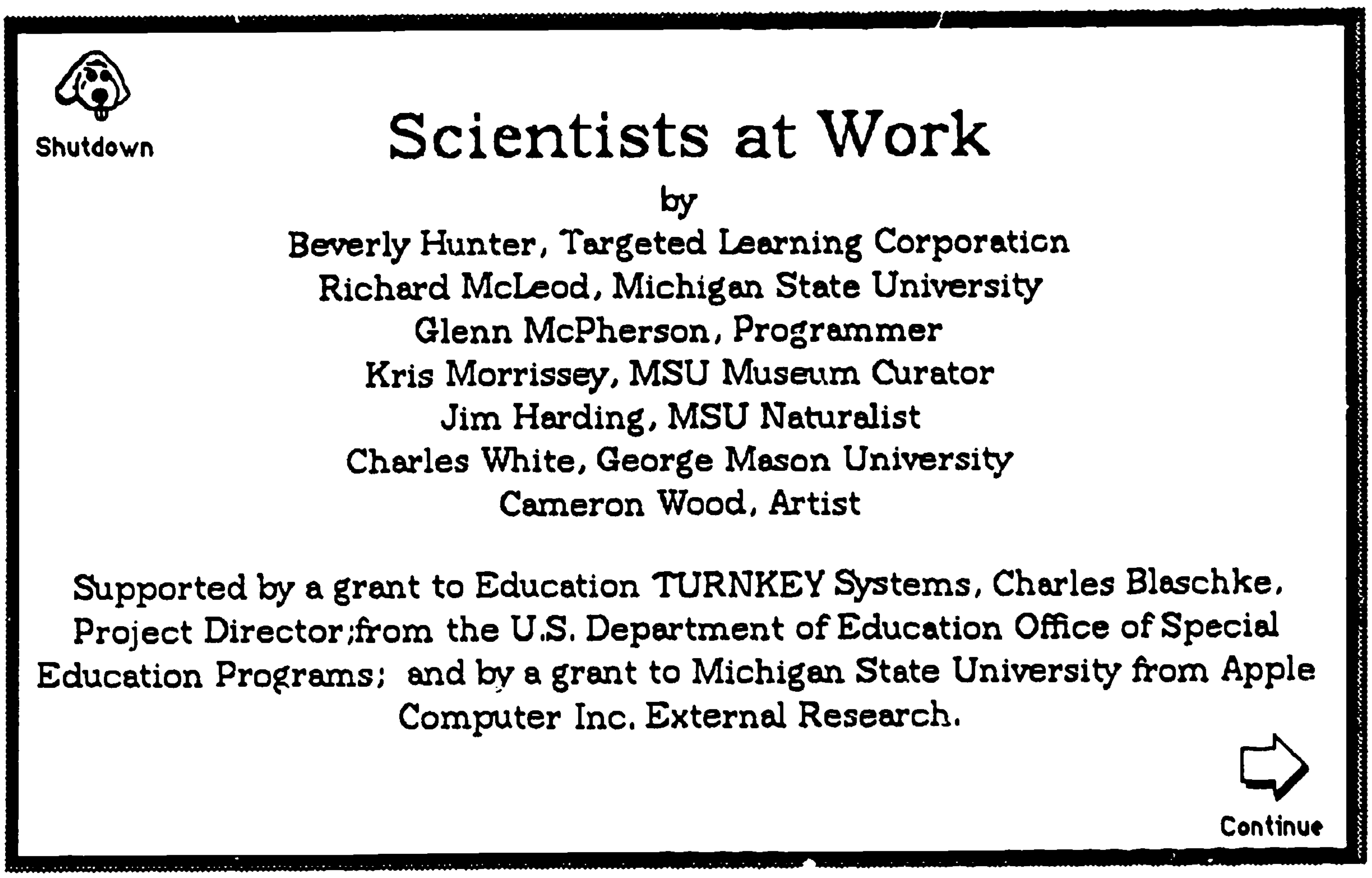
Team Reader: Reads out loud to the team when there is a paper handout to read or a computer screen to read. Makes sure that all team members have heard what the reader has read.
Name of reader: ______________________________

> NOTE: Your teacher may suggest that team members take turns playing different roles on different days. If there are only two persons on your team, then each person will have two roles.

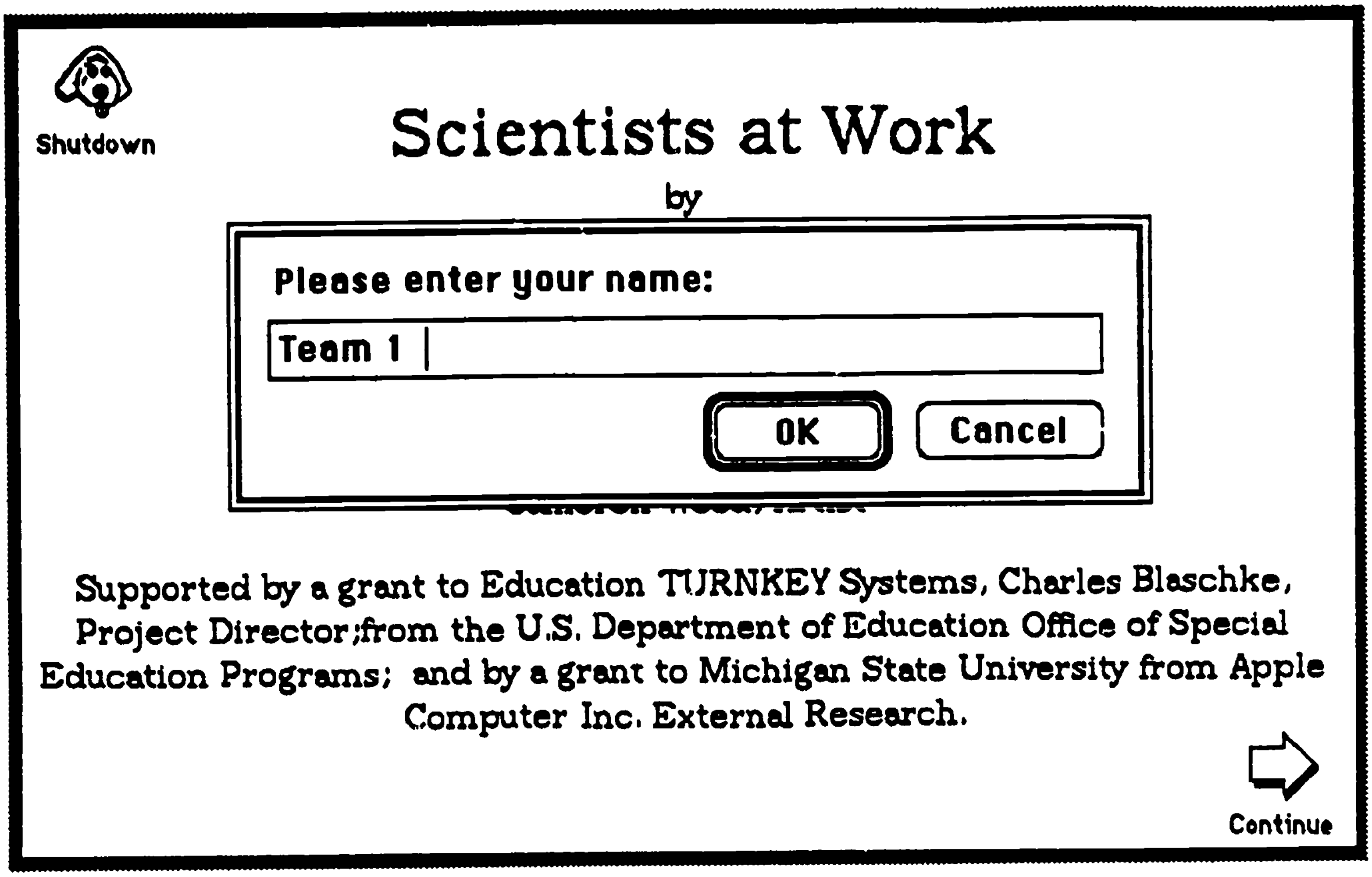
Scientists at Work
At-desk Activity
Lesson 1

Team Name: ______________________________

Looking at the paper screens from *Scientists at Work* can help you learn how to use the program. Being able to use the program quickly and easily will be very helpful when you are doing your research on the computer.

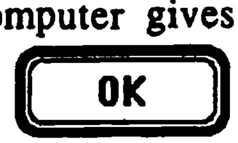


You want to sign on to the program. Circle the place you should click.

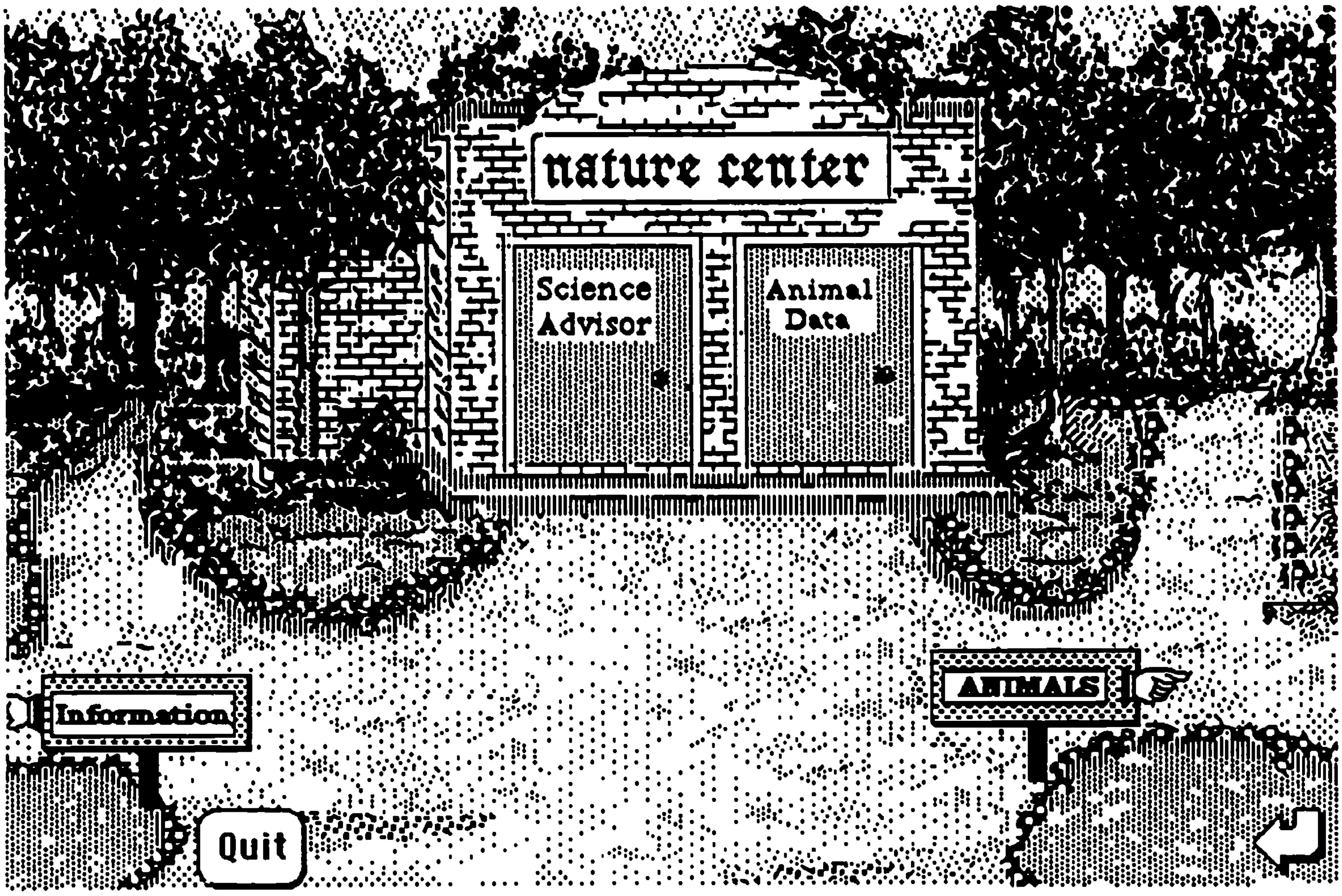


You have typed your team name or number. Where do you click now? Circle the place.

NOTE: Any time the computer gives you a message that has



you need to click OK before you can continue working.

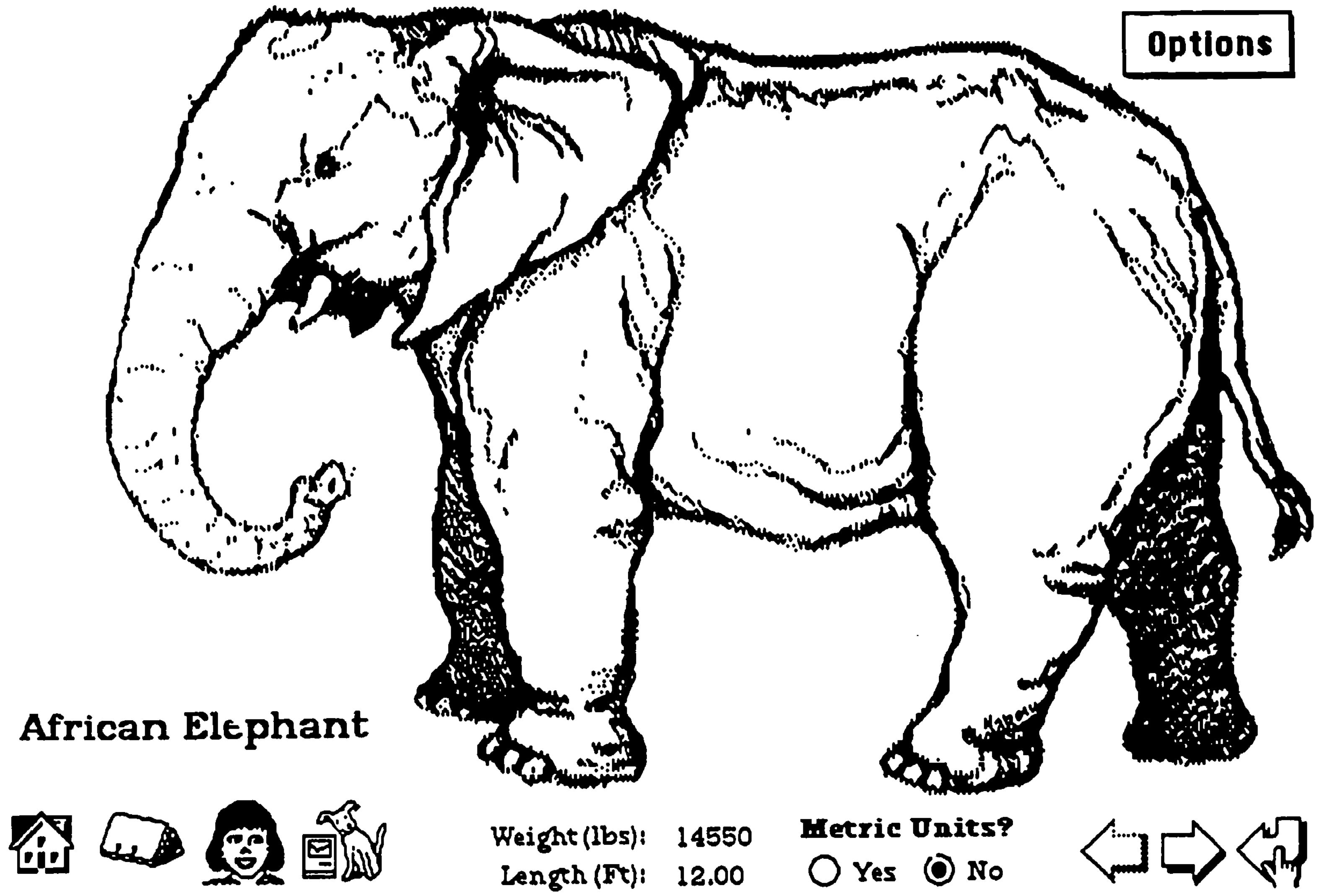


A. You want to see the animals. Where do you click? Write the letter A on the place.

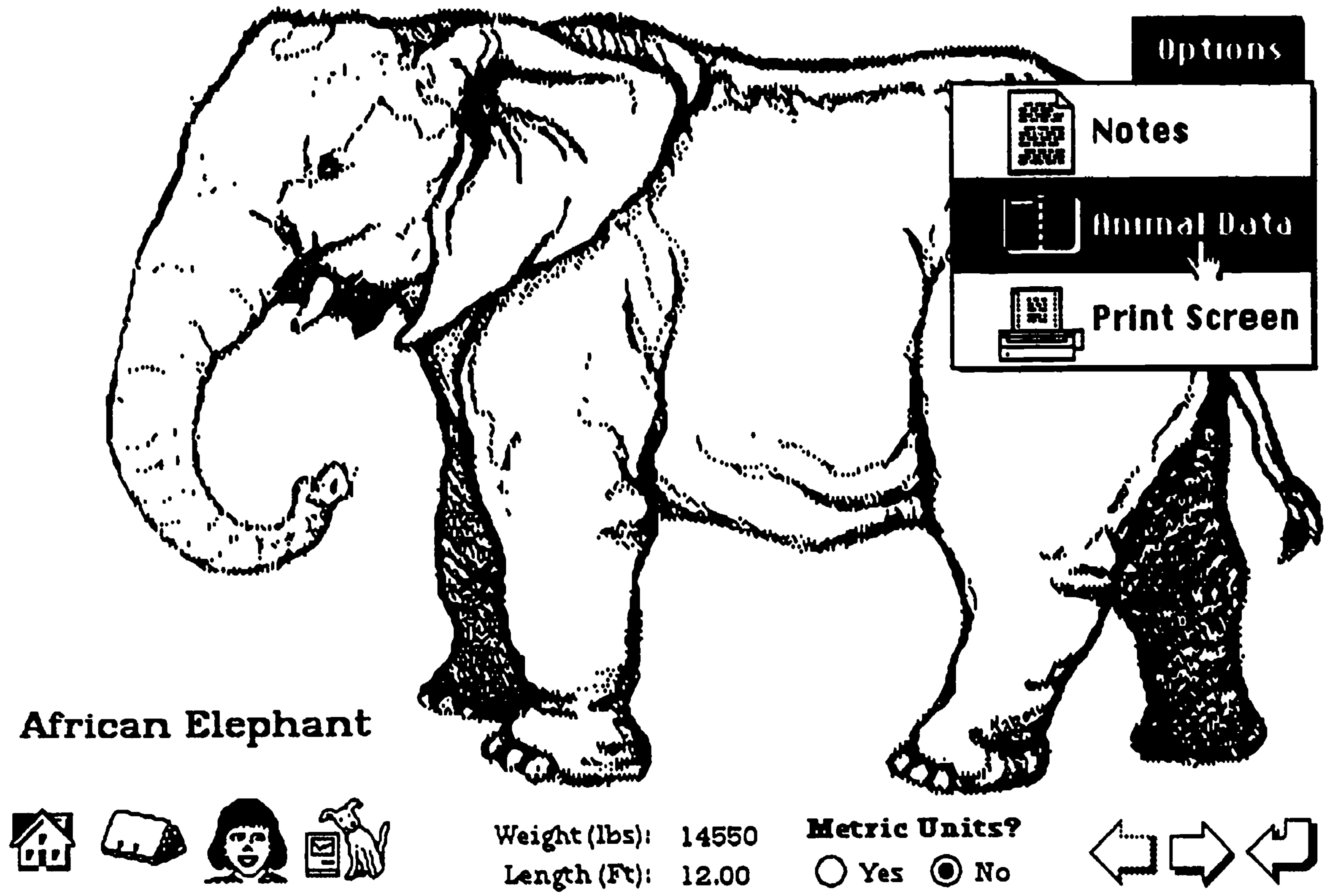
B. You want to visit the Science Advisor. Where do you click? Write the letter B on the place.

C. Your team's time at the computer is over. Where do you click? Write the letter C on the place.

(5)



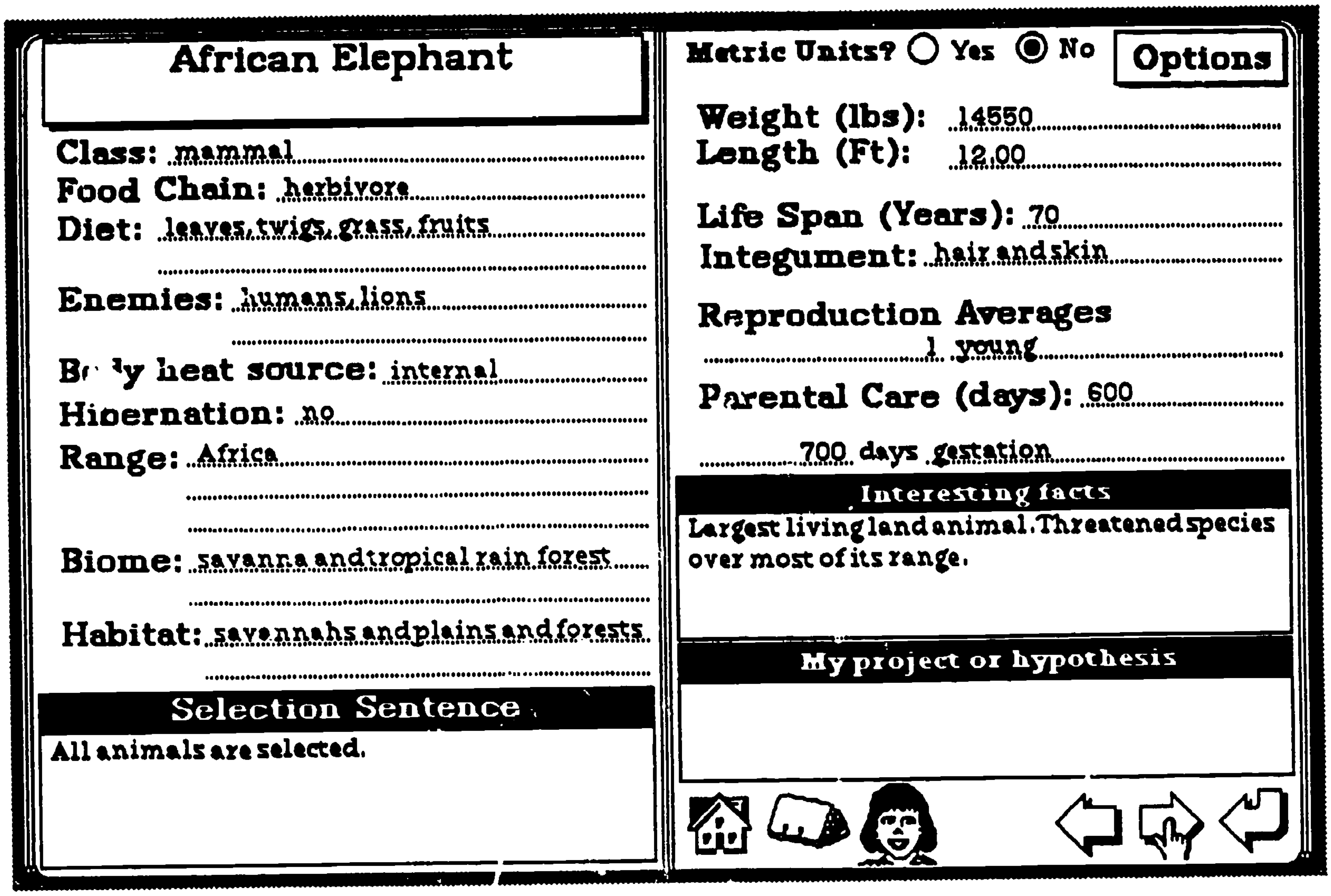
A. You want to hear the elephant. Where do you click?
B. You want to see the next animal. Where do you click?
C. You want to visit the Advisor. Where do you click?
D. You click on the Return Arrow  What happens?



A. You want to learn about the habitat of the elephant. Where do you click?

B. Your time at the computer is over. Where do you click?

C. You want to see the next animal picture. Where do you click?



African Elephant

Class: mammal
Food Chain: herbivore
Diet: leaves, twigs, grass, fruits
Enemies: humans, lions
Body heat source: internal
Hibernation: no
Range: Africa
Biome: savanna and tropical rain forest
Habitat: savannahs and plains and forests

Selection Sentence

All animals are selected.

Metric Units? Yes No | Options

Weight (lbs): 14550
Length (Ft): 12.00
Life Span (Years): 70
Integument: hair and skin
Reproduction Averages
1 young
Parental Care (days): 600
700 days gestation

Interesting facts

Largest living land animal. Threatened species over most of its range.

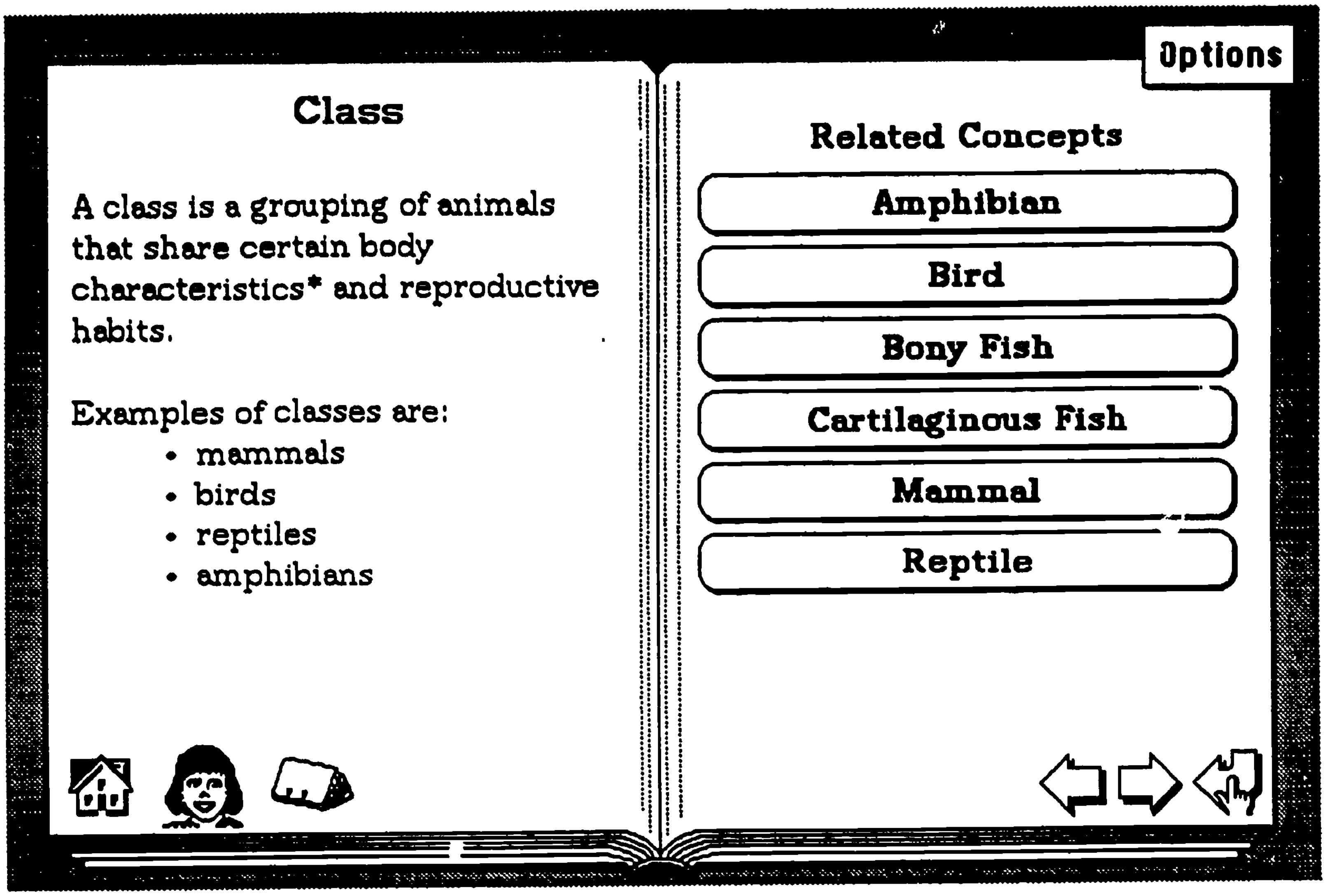
My project or hypothesis

This is the record for the African Elephant in the Animal Data base. Notice that for each animal there are many different fields of data. For example, Class: is a field in the record. All the words shown in bold printing are Field names. For example, Diet: is a field name. You can see a definition of a field by clicking on its name.

A. You would like to know what Class: means. Where do you click?

This is called the Index button. The index will show you a list of all the animals in the Animal Data Base.

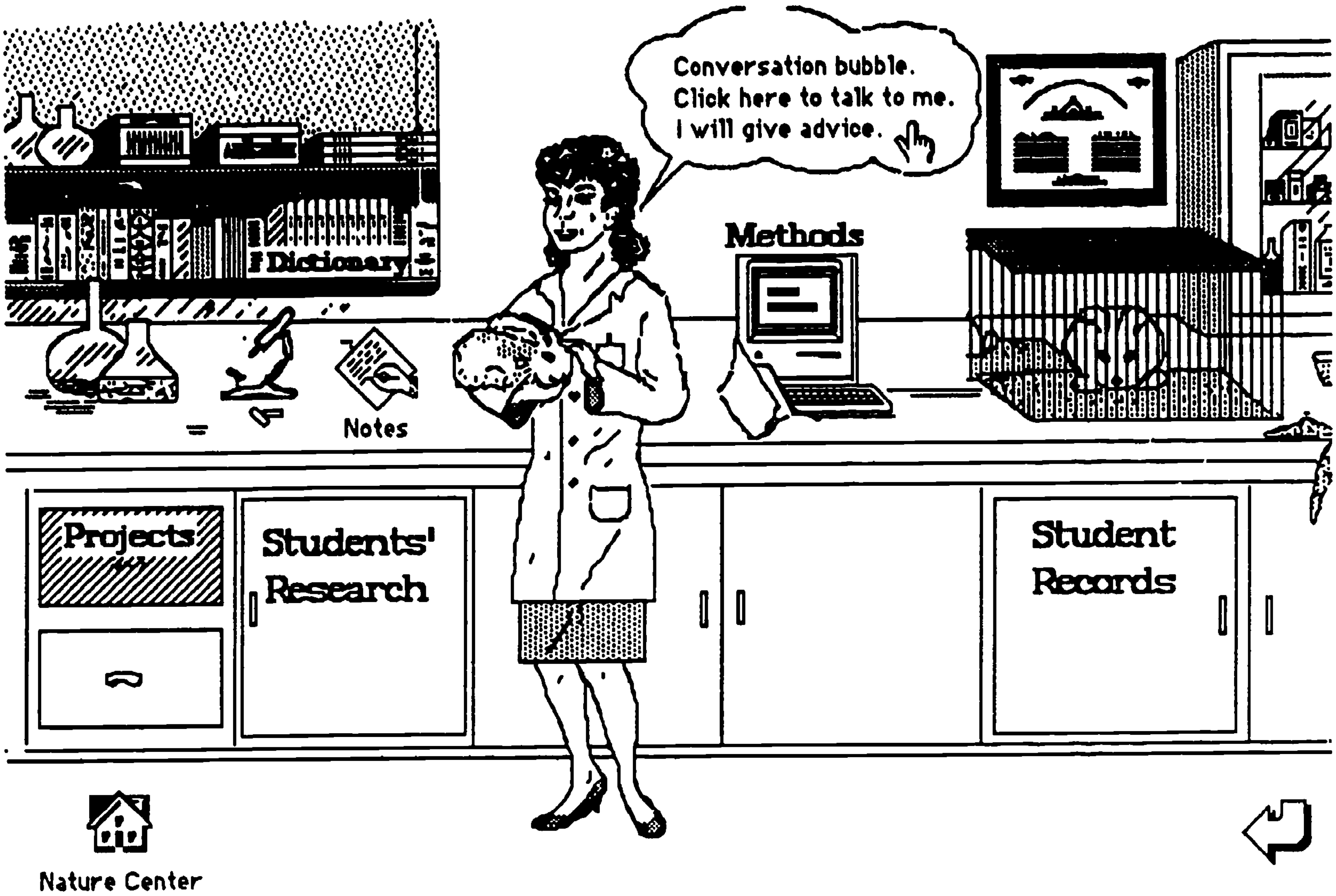
B. You want to see a list of all the animals in the data base. Where do you click?



Here is a screen in the Animals Dictionary. It is very helpful to you when you do not know what a word means. Use it often. You probably got here by clicking the word "Class" in the Animal Data Base.

Notice you can click on other words, like "Amphibian" to get more definitions of words you need to learn.

A. You want to visit the Advisor. Where do you click?
B. You want to go back to the Animals Data. Where do you click?
C. Your team's time on the computer is over. Where do you click?



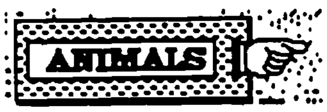
A. You want the Advisor to give advice on what to do next? Where do you click?
B. You want to know what the Advisor is holding in her hand? Where do you click?
C. Your team's time on the computer is over. Where do you click?

Scientists at Work
At-Computer Activity
Lesson 1

Team Name or number:________________________________

Explore the Nature Center. As you go to different places, pay attention to what you did and what happened when you did it. Your team's Recorder will write down four of the interesting things that your team observes during your explorations.

What we clicked | **What happened**



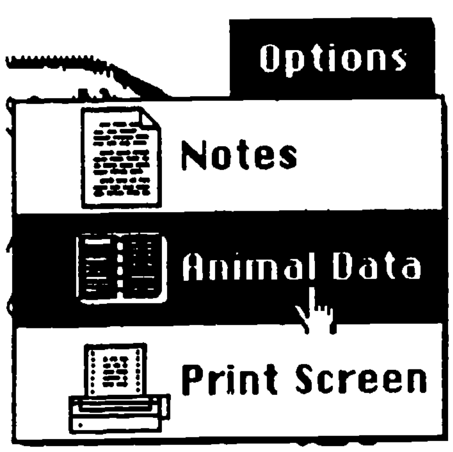
____

elephant roared

____

____

(drag-click) ________________________________



____


Science
Advisor


Quit

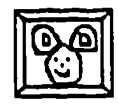
Scientists at Work
At-Desk Activity
Lesson 2: Finding Information

Student Name: ____________________________ Period: ____________

Discuss the ideas and questions in this handout with your team members. Write your own answers to the questions on this handout.

Different kinds of information in the Nature Center.

The Nature Center contains several different kinds of information:

Kind of Information	Where
• Pictures of animals	Animal pictures 
• Sounds for some animals	Animal pictures
• Facts about animals	Animal Data base 
• Definitions of words	Animals Dictionary 
• Advice on doing research	Science Advisor 

For each of the following questions, tell <u>where you go</u> in the Nature Center to find the answer. The first one is done for you:

1. Is a Robin a meat-eater or a plant-eater? _*Animal Data base*___
2. What is the Select option used for? ____________________________
3. What does a Beaver look like? ____________________________
4. What Biome does the Gray Tree Frog live in? ________________
5. What is a deciduous forest biome? ____________________________
6. What animals live in a tundra biome? ________________________
7. What research projects can I work on? ________________________

Understanding the Animal Data Base

African Elephant

Class: mammal
Food Chain: herbivore
Diet: leaves, twigs, grass, fruits
Enemies: humans, lions
Body heat source: internal
Hibernation: no
Range: Africa
Biome: savanna and tropical rain forest
Habitat: savannahs and plains and forests

Selection Sentence

All animals are selected.

Metric Units? ○ Yes ◉ No **Options**

Weight (lbs): 14550
Length (Ft): 12.00
Life Span (Years): 70
Integument: hair and skin
Reproduction Averages 1 young
Parental Care (days): 600
700 days gestation

Interesting facts

Largest living land animal. Threatened species over most of its range.

My project or hypothesis

This is the data base record for the African Elephant. Practice interpreting the data base by answering the following questions:

8. What is the name of the field that tells whether the elephant is a meat-eater or a plant-eater? ____________________
9. What is the name of the field that tells whether the animal is cold-blooded or warm-blooded? ________________________
10. What is the name of the field that tells the continent on which the animal lives? ______________________________
11. About how long does an elephant live? ___________
12. In this animal record, does the field **Biome:** contain "Deciduous forest"? ________________
13. Look at **Enemies:** humans, lions
    What does the field contain? __________
    What is the field name? _________
    If you were looking at a data base record for a Dolphin, what might this field contain? ____________________________

Tools for finding information

There is information on 170 animals in the Animal data base. It would be difficult to use all this information if we didn't have **tools** for finding and organizing the information. Some of the tools are:


Index. It shows a list of all the selected animals in the Animals data base or pictures. Another Index shows a list of all the words in the Animals Dictionary. By using the Index, you can just click on the word or animal you want information on, and you will go directly to that information.

Options

The Options menu contains many tools. In the Animal Pictures, one option is to go to ANimal Data. In the ANimal Data base, one option is to go to the Picture. Today you'll learn to use two more of the options: Select and Print.


Print

For each of the following situations, tell which tool you use to get the information you need. The first one is done for you:

14. You are looking at the picture of a Beaver on your screen and you want to know what does a Beaver eat. __*Options Menu - Animal Data*

15. You are looking at the data base record for a Beaver, and you want to save the information to work on later at your desk.

____

16. You are looking at the data base record for a Beaver, and you want to know whether a beaver is bigger than a Weasel. __________

____

17. You are looking at the data base record for a Beaver, and you want find out what other animals live in the same habitat as the beaver. ____

____

Scientists at Work
At-Computer Activity
Lesson 2: Finding Information

1. Go to the Science Advisor's office and click on her Conversation Bubble. Your Team Reader will read the messages to the team. Do the things the Advisor suggests to help you explore the Nature Center.

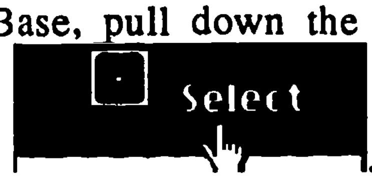
Any time you are not sure what to do, click on the Advisor button or go visit her in her office.

2. Go to the Animal Data base and use the Index  to locate the record for any snake you wish. What snake did you look at?

____

3. Learn how to Select certain animal records in the Animal Data base. You will practice by selecting the reptiles.

Follow these steps:

a. In the Animal Data Base, pull down the Options menu and choose the Select Option 

.

b. Click **Make new selection sentence**.

c. Choose the field **Class.**

d. Click **contains**.

e. Pull down the **List** and click "reptile". Then click **OK**.

f. When the program asks "Do It?" click **Yes**.

g. Wait while the program searches through the data base, looking for the records where Class contains reptile.

How many animals were selected? __________

4. Click on the name of one of the selected reptiles, to look at the data for that reptile. Print the data base record for one of the reptiles you selected.

5. In the Animal Data Base, click the field name **Biome:** to see the Animals Dictionary Definition of Biome.
Give one example of a Biome: ____________________

6. See if there is anything else the Advisor would like you to explore.

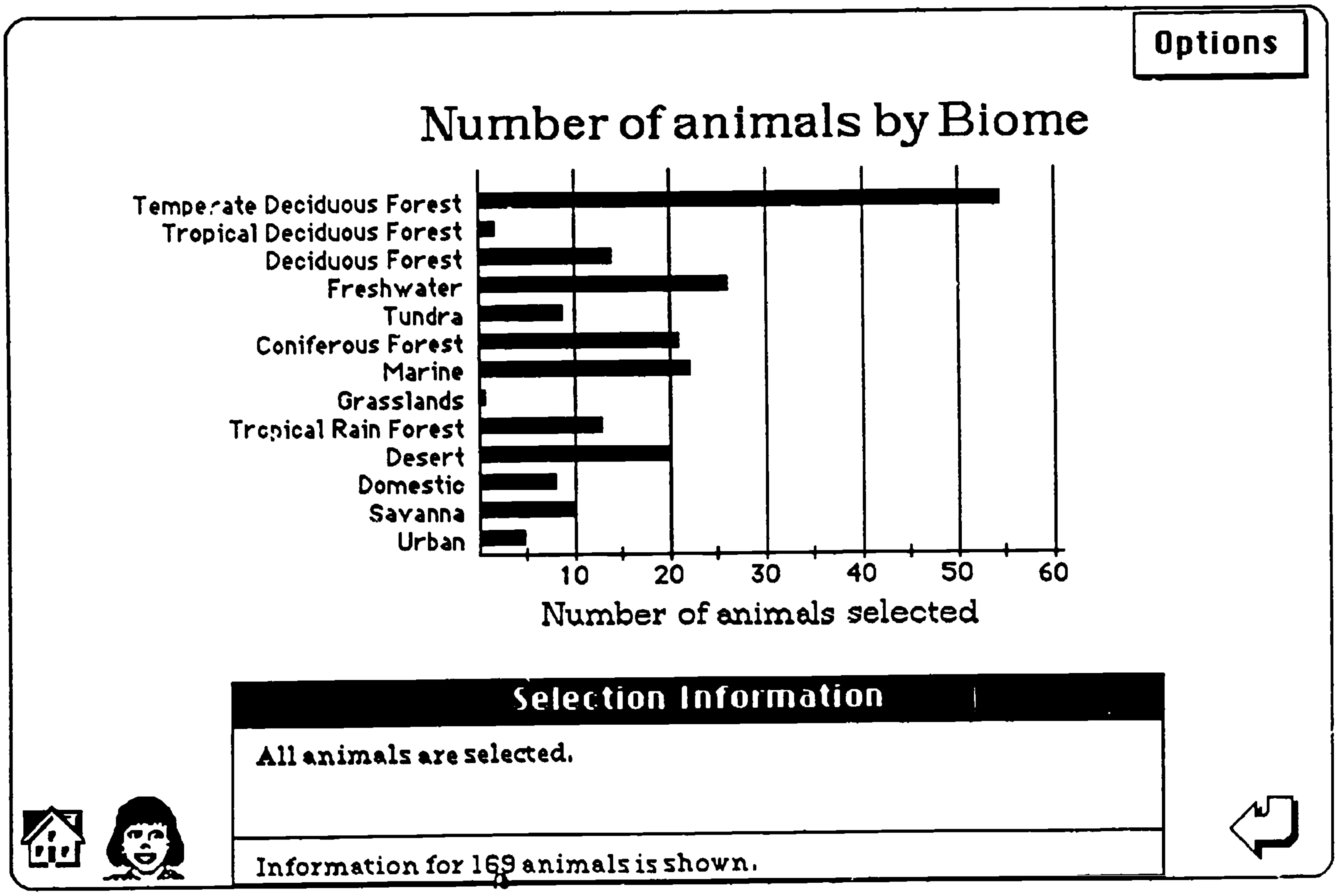
7. When your time at the computer is over, your team Computer Operator will make sure you QUIT properly.

Your Team Leader will make sure your handouts and printouts are placed in your Team Folder.

Scientists at Work
Lesson 3
At-Desk Activity
Where in the World are the Animals?

Team Name: ____________________

A. The *Scientists at Work* computer program made the following bar chart, using information from all the animals in the Animal data base:



Use the information on this screen to answer the following questions:

1. How many animals are represented in the bar chart? ________

2. The largest number of animals in our Animals data base live in which biome?

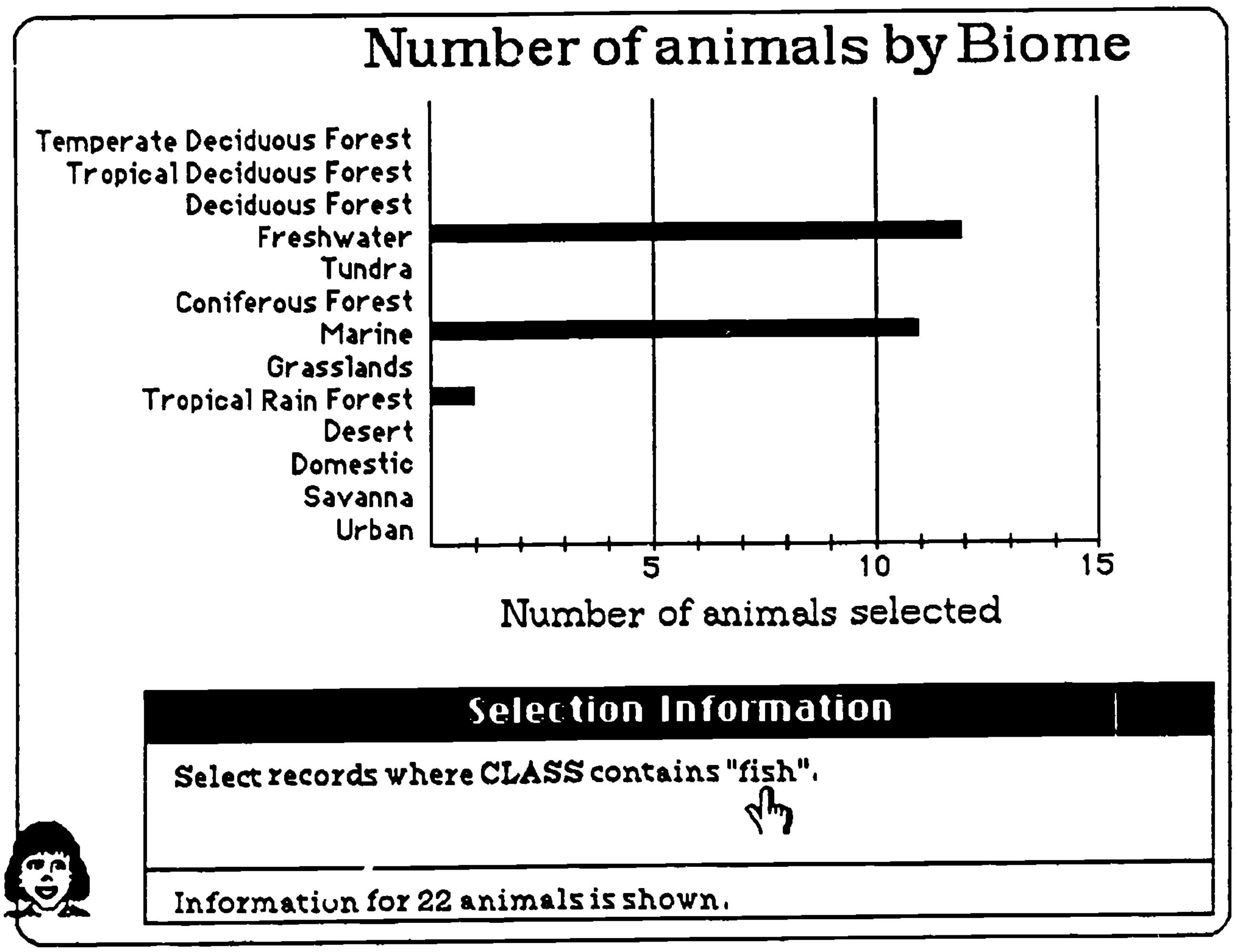
____

3. How many animals from our data base live in a tropical rain forest? _____

4. If you wanted to study animals that live in the Tundra, how many would you find information about in the Animals Data base? ____________

5. What does the bar chart tell you concerning how many fish are in the data base? ____

B. Some students were studying fish, and they wanted to know how many fish from the Animal Data Base live in the ocean. First, they used the SELECT tool to select all the animal records where CLASS contains "fish." Then, they made a bar chart. It looks like this:



Answer the following questions by looking at the information on the screen above.

6. Why are there no animals shown for the temperate deciduous forest?

____

7. What class of animals is represented on the bar chart? __________

8. Suppose you were studying animals that live in the ocean. According to the bar chart, how many animals in the data base would you have information to look at? __________

9. What does the chart tell you about the number of fish species that live in North American rivers? __________________________

C. The *Scientists at Work* program will make bar charts based on the following data fields: **Class, Food Chain, Hibernates, Biome, Skin, and Body Heat Source.**

10. Which chart would you make, if you wanted to know whether there are more mammals or reptiles in the data base? ____________

11. You want to know whether the data base has any plant-eaters that live in the desert. One way to find out is to first Select records where **Food Chain** contains "herbivore". Then make a bar chart of the herbivores by **Biome.** Can you think of another way to find the answer?

____

____

13. Do you think I could use Select to find the herbivores that live in the desert? What do you think the selection sentence would be? ________________

______________________________________ ____________________

Scientists at Work
Lesson 3: Where in the World are the Animals?
At-Computer Activity

Team: ______________________________

Visit the Advisor. Click her conversation bubble. Follow her advice.

- Use the Select tool to find out how many animals in the data base live in a tropical rain forest.
  How many? ____________

- Use the Select tool in the Animal Data base to select records where CLASS contains mammal.
___How many mammals were selected? ________

- Learn about Bar Charts from the Advisor. Your team reader will read the screens out loud to the team.

- Make a bar chart that shows how many mammals live in each biome. How many mammals live in a marine biome? ________.

- Learn from the Animals Dictionary what Class, Biome, Habitat, and Range mean. Print the dictionary pages for Biome, Habitat and Range and put these in your Team folder for reference.

Visit the Advisor before you quit. See if she has any more assignments for you. When she says you are ready to sign up for a Project, you are ready for tomorrow's work.

Scientists at Work
At-desk Activity
Lesson 4: Food Chain/Food Web Concepts

Team Name: ____________________

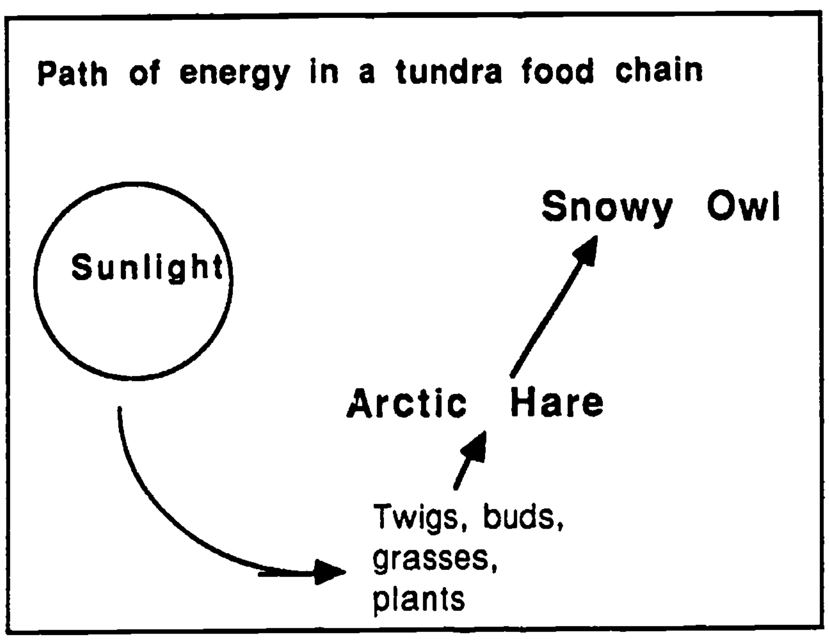
Take turns being Team Reader for this activity. All members of the team should help answer the questions. The Team Recorder should write the team's answers on this worksheet.

Why learn about food chains and food webs?

- All animals get energy from the food they eat.
- Plants produce the energy for animals. Plants use the energy from our sun to produce food in a form animals can eat.
- A food chain is one path by which energy passes between living things.
- A food web is a diagram showing the interrelationships among many food chains in a community of plants and animals.

Clearly, food chains and food webs are a matter of life and death for living things on our planet! If anything happens to break a food chain, many living things will die. Therefore it is very important for all humans to understand food chains and food webs.

What is a Food Chain?



The Arctic Hare eats twigs, buds and grasses. It consumes energy from the plants. When the Arctic Hare is eaten by a Snowy Owl, the energy moves up the chain from the plant, to the hare and then to the owl. This path from the plant to the animal to another animal is called a food chain.

Look at the direction of the arrows on the food chain diagram. The arrows in the diagram show energy moving from plants to animals to other animals. Why does the arrow point to the Snowy Owl? ____________________

All living things need energy. Plants use sunlight, air and water to make their own food. They are called producers of energy. Animals get their energy from the food they eat. They are called consumers of energy. When an animal eats a green plant, energy travels from the plant (a producer) to the animal (a consumer).
Is the Arctic Hare a consumer or a producer of energy? ____________
Where does the hare get its energy? ________________________

Can you think of an example of a food chain from your experience with acquariums or terrariums or your own pets or farm?

Herbivores, Carnivores, and Omnivores
When scientists study food chains, it helps to classify the animals according to their placement on the food chain. Animals that get their food directly from the producers (the green plants) are called herbivores. These animals are often referred to simply as plant-eaters.
Which one of the animals in the food chain diagram above is a herbivore?

____

Animals that get their food by eating another animal are called carnivores. These animals are often referred to simply as meat-eaters. They may eat other carnivores or they may eat herbivores.
Which animal in the food chain diagram above is a Carnivore?

Where do you think omnivores get their food? ________________
(HINT: "omni" means "all")

Predators and their Prey
When an animal is a meat-eater, the animals that it hunts are referred to as its "prey" and the meat-eater is called a "predator". In the animals database. you can learn what animals eat a particular animal by looking in the field called "enemies." "Enemies" and "predators" are almost the same thing. The difference is that humans are enemies but not predators because they kill many animals that they don't eat.
Can you think of examples of humans killing animals for reasons other than eating? --

What is a Food Web?
A food web is similiar to a food chain but is more complex and shows the relationships between an animal and *many or all* of its food sources and *many or all* of its enemies. The diagram above of a food chain, shows that

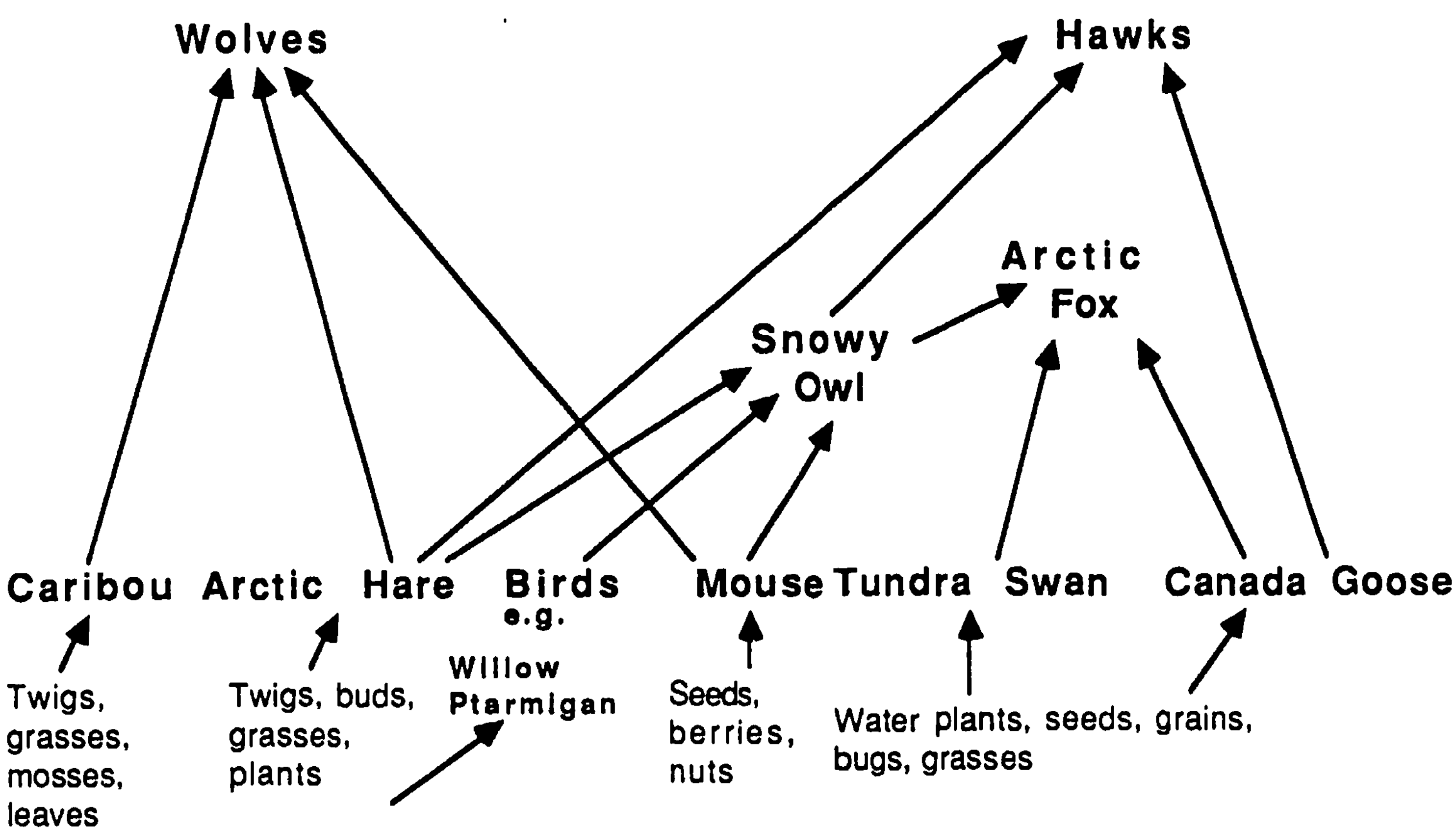
snowy owls eat arctic hares. But snowy owls eat more than just hares. If you looked in the animal data base record for a Snowy Owl, you would see that the "diet" of the snowy owl includes rodents, rabbits, hares and birds.

Just like humans, the diet of animals is varied. You might prefer pizza for dinner but if you don't have any, you might eat a salad instead. An animal must eat what ever foods are available at the time that it is hungry. If one source of food is not available, it looks for something else.

If you looked up the Arctic Hare in the Animal data base, you would see that it is not only the snowy owl that preys on the hare. Wolves, arctic foxes, hawks, eagles, and humans are all enemies of the hare. All of these animals are competing with the Snowy Owl for the hares.

Look at the diagram below of a food web.

Part of a Food Web for the Tundra Biome



Can you identify the carnivores and the herbivores in the food web shown above? Write their names here.

Herbivore	**Carnivore**
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________

_____________________ ______________________

What does the hawk eat? ____________________________
What does the hare eat? ______________________________
Which animals in the tundra food web are predators?

____
Which are prey?______________________________________
Which carnivore is the prey of another carnivore?______________

Studying food webs helps us understand the relationships between animals and their sources of energy. All of these animals are dependent on each other. If the plants and grasses are damaged, the herbivores may soon starve or move off to other areas. Then the carnivores no longer have a source of food and will also move or starve.

How the Animal Data base helps you create a food web.

Each animal record in the animal data base contains the following fields of information. Circle the fields that contain information you can use to help you create a food web.

Name of animal; Class: Food Chain: Diet: Enemies: Body heat source: Hibernation: Range: Biome: Habitat: Weight: Length: Life Span: Integument: Reproduction Averages: Parental Care: Interesting Facts:

Can you think of a reason to find out the Biome and Range of an animal when you are getting information for your food web?

____

Example: We were working on a food web for animals that live in the tundra biome. We look at the record for Canada Goose, which lives in the tundra. and find that "foxes" are included as enemies. We then discover there is a record in the data base for a Red Fox. Here is part of that record:

Red Fox

Class: mammal
Food Chain: omnivore
Diet: mice, rabbits, chipmunks, birds, snakes, frogs, berries, fruits
Enemies: bobcats, lynx, coyotes, dogs, bears, eagles, humans
Body heat source: internal
Hibernation: no
Range: North America: most of United States and Canada except deep south.
Biome: deciduous forest (temperate) and coniferous forest
Habitat: open woodlands, farmlands

In the tundra, is the Red Fox an enemy of the Canada Goose? _________

Which field of information in the data base tells you this? ______________

Then how do we know the <u>Arctic</u> Fox (not the Red Fox) is an enemy of the Canada Goose in the tundra? When we looked at the record for Arctic Hare, we discovered one of the hare's enemies is <u>Arctic Fox</u>. That's how we found out that there is an Arctic Fox in the tundra.

This example shows that <u>each animal record you study will help you understand a little more about the food web you are creating</u>.

What animal is your team going to begin studying in order to create a food web? ____________

Do you know where it lives (what Biome and Range)? ______ ______

Do you know yet whether it is a carnivore, herbivore or omnivore? ___

Do you know yet whether the animal you want to study is in the Animal data base? ______

Scientists at Work
At-Computer Activity
Lesson 4

Your Team Reader will read the screens out loud to the team.

1. Go to the Projects drawer in the Advisor's office. Read about the Food Chain project. <u>This will take several screens.</u>

2. Sign up for the Food Chain project by clicking on the button that says "I want to sign up for this project".

3. On the signup screen there is a button to get help with the food chain project. Use the help. The Advisor will help you get started with your Food Web.

Any time you don't know what to do, go to the Advisor's office and click on her Conversation Bubble.

4. Keep your handouts and printouts in your team folder to use when working at your desk.

The Team Computer Operator will make sure you QUIT properly.

Scientists at Work
At-Desk Activity
Lesson 5: Creating Your Food Web

1. Review your notes and printouts and decide which animals to include in your food web.

2. Draw as much of your food web as you can on your poster. Paste pictures of animals and plants on your poster. Include data base infoımation about the animals.

3. You should have at least four animals in your food web.

4. Keep track of the methods you used to identify anima's. You will report on your methods to the class when you present your food web poster.

Scientists at Work
At-Computer Activity
Lesson 5: Creating Your Food Web

The Science Advisor will help you gather information for your food web. Visit the Advisor several times during your session at the computer.

Print out pictures and data base records for the animals you will include in your food web.

You can make a list here of the animals you <u>might</u> include:

____
____
____
____
____
____
____
____
____
____

Scientists at Work
At-Desk Activity
Lesson 6: Asking questions about food webs

Your name: ______________________

Listen carefully to the other teams as they present their food webs (or food chains) to the class. Ask them questions if you don't understand their food webs. Choose two of the teams' food webs to write about on this paper.

Name of project team: ______________________

•What biome does their food web (or food chain) live in?

____

•What parts of the world (Range) does their food web live in?

____

•What is the name of one carnivore in their food web?____________

• How many carnivores are in their food web? ________________

•Who are the plant-eaters? ______________________________

•What kinds of plant material do they eat?

____

•Which animal in their food web probably has the most enemies?

____

•What class is that animal? ______________________

•Write one of the methods they used to help them decide which animals to put in their food web. (for example, "They used the Select tool to select animals in a marine biome." or "They started with an Eastern Chipmunk and found out who its enemies are.")

____

____

•What is one interesting thing you learned from their presentation?

____

____

• Does this food web help you think of a general question about food chains, food webs, carnivores, or herbivores? Write the question:

____

____

____

Name of project team: ______________________

•What biome does their food web (or food chain) live in?

____

•What parts of the world (Range) does their food web live in?

____

•What is the name of one carnivore in their food web?__________

• How many carnivores are in their food web? ______________

•Who are the plant-eaters? ______________________________

•What kinds of plant material do they eat?

____

•Which animal in their food web probably has the most enemies?

____

•What class is that animal? ____________________________

•Write one of the <u>methods</u> they used to help them decide which animals to put in their food web. (for <u>example</u>, "They used the Select tool to select animals in a marine biome." or "They started with an Eastern Chipmunk and found out who its enemies are.")

____

____

•What is one interesting thing you learned from their presentation?

____

____

• Does this food web help you think of a general question about food chains, food webs, carnivores, or herbivores? Write the question:

____

____

____

Scientists at Work
At-Computer Activity
Lesson 6

Team ______________________

• Let the **Science Advisor** guide you through this activity. Begin by going to the Science Advisor's office and clicking her Conversation Bubble.

(If Advisor does not know that you finished your food web, she will give you a chance to tell her so by giving you a button that says "We finished our food web.")

• Learn from the Advisor about asking questions, why we ask questions, how to ask questions. Your Team READER will read the information out loud to the team.

• The Advisor will help you create a question about animals in Food Chains. Tell the Advisor to Remember your question.

• Use the Question section of your Notebook on the computer to make notes about your question. (You get to your Notebook by choosing "Notes" in the Options Menu.)

If you want to change your question, just type the new question after the old one in the Notes. TO TYPE NOTES, JUST CLICK THE MOUSE WHERE YOU WANT TO WRITE. THEN START TYPING. TO ERASE, PRESS THE "DELETE" OR "BACKSPACE" KEY.

• The Advisor will teach you about methods for answering questions.

• Go to the Methods section of your Notebook and write about how you will get information to answer your question.

Scientists at Work
At-desk Activity
Lesson 7: Getting Answers to Food Web Questions

Name: ____________________

This lesson helps you learn how to use a data base to answer questions about animals. You will use this skill when you are doing your research in the Nature Center.

1. You can find answers to many questions about Food Chains and Food Webs by using the information in the Animal Data base.

For example, one team want to know "Are most birds carnivores?" Here is how they answered their question using the Animal Data base:

a. First, they went to the Animal data.in the Nature Center.
b. They used Select in the Options menu to Select all the records where CLASS contains "bird".

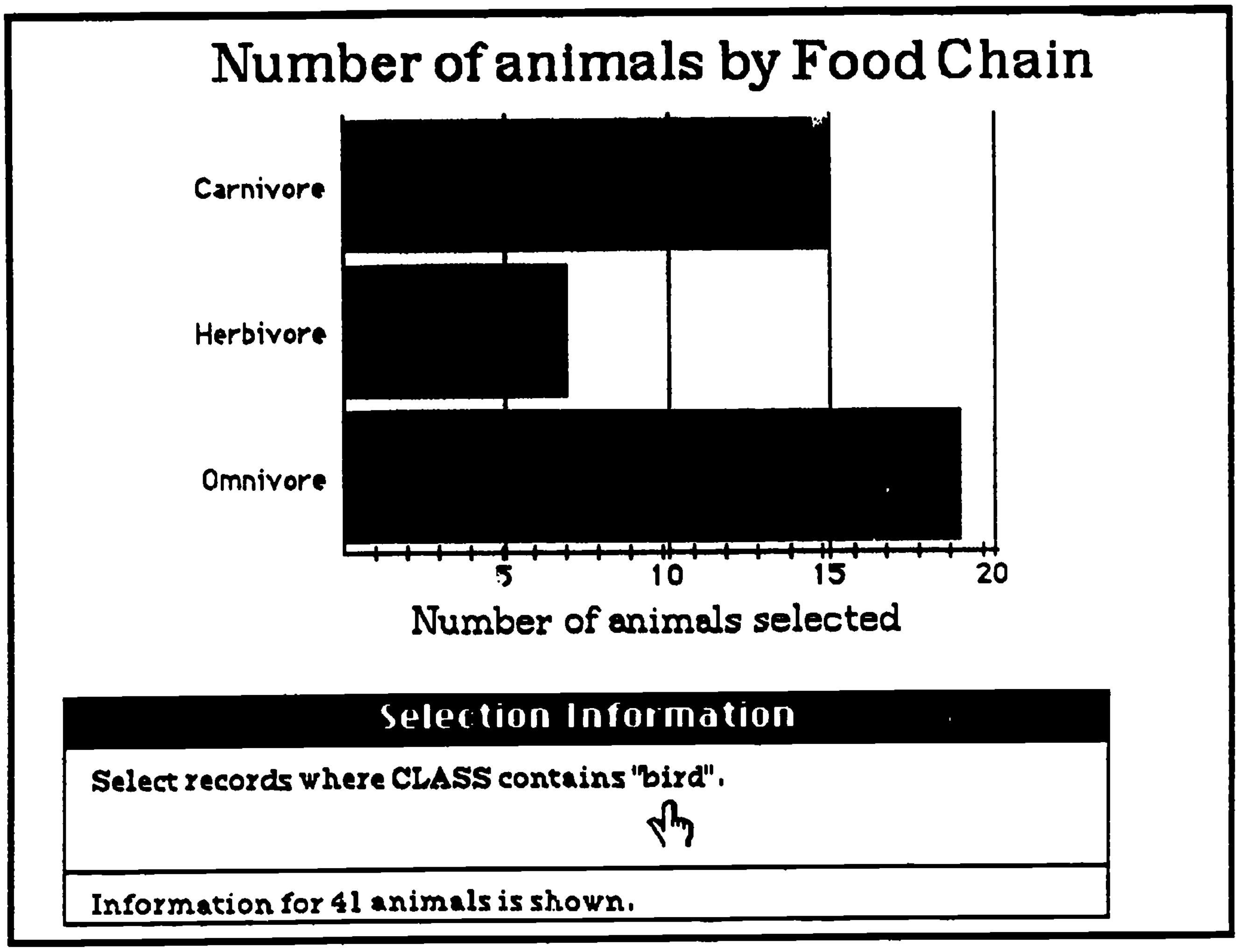
Why did they select the birds in the data base?

____

____

____

c. They used Graph in the Options menu to make a bar chart that shows number of selected animals by Food Chain. It looked like this:



d. They read and interpreted the bar chart.

According to the screen above, how many birds are in the Animal data base? ________

How many of these birds are Carnivores? ______________

Does this bar chart tell you the answer to the question "Are most birds carnivores"? ____________

What answer does it tell you?

____

2. There are several different ways you could use the Animal data base to answer the question "Do any mammals eat frogs?" Here is one way:

a. In the Animal Data, use Select to write a Selection sentence that says: **Select records where DIET contains "frogs" and CLASS contains "mammal".** b. The following animals are then selected by the computer: Mink Raccoon Red Fox River Otter

Does this information enable you answer the question "Do any mammals eat frogs?" __________

What do you think the answer is, based on the selection from the Animal data base?

____

____

3. The Animals data base has answers to many questions about food chains, but it does not have <u>all</u> the answers! Look at a printout of one of the animal data base records. Tell why each of the following questions can NOT be answered by the information in the data base:

"Do carnivores run faster than herbivores?"

____

____

"Are carnivores more likely to migrate than herbivores?"

____

____

4. Some students want to study a food web that includes crickets, crayfish and snails. Why isn't the Animal Data base helpful to them?

____

____

5. When you study food webs, you might think of many different questions.

> Here are a few questions some students started asking:
>
> • Are most birds carnivores?
> • Do any mammals eat frogs?
> • In the desert, what do herbivores eat?
> • Are meat-eaters usually larger than plant-eaters?

Write your team's research question about food chains or food webs

____

____

____

Do you think the Animal data base contains the information you need in order to answer your question? ________

If the Animal data base does contain the information you need, think about how you can find that information in the data base.

Will you use the Animals Dictionary? ________ If so, what words will you look up in the dictionary? ______________________

Will you use the Index? ______ If so, what animal will you look for in the Index? ______________________

Will you use Select? _____ If so, what will your selection sentence be?

____

____

Will you make a bar chart? _________ If so, which chart will you make (by Class, Food Chain, Body heat source, Hibernation, Biome, Skin)? ____

Scientists at Work
At-Computer Activity
Lesson 7: Answering Research Questions

Today you will practice using the Animal Data to help you get answers to your own research questions. You may find that you have to try several different methods before you get the data you really need. Or you may want to change the question as you go along.

1. Use the Science Advisor to learn about methods for answering questions.

2. In the Methods section of your Notebook on the computer, write the method you will use to answer your research question. (If necessary, change the question in the Question section of your notebook. You can do this by simply typing the new question right after the old one).

3. In the Animal data base, use the Select tool to select the records you need to answer your question.

4. Use Advisor's Methods computer, Data Base Methods, to learn about making and interpreting Bar Charts.

5. If appropriate for your question, make a bar chart. If not appropriate, look at the selected records and find out the data you need.

6. Make printouts of data or charts, or paste charts into the Data section of your Notebook. To paste your bar chart into your Notebook, follow these steps:
   a. Make your bar chart in the Animal Data.
   b. Go to the Data section of your Notebook.
   c. Pull down the Options menu and click "Paste graph onto this page."
   d. Wait while the computer pastes your graph or chart.

7. If you have more time on the computer, think of another way to answer your question, and write about that method in your Notebook.

8. Print out your Notebook sections "Question" and "Methods" and "Data" so you will have them to refer to when you are working at your desk.

Scientists at Work
At-Desk Activity
Lesson 8

Team Name: ________________________

1) Think about this hypothesis: "Most carnivorous birds eat insects." What is a "carnivorous bird"? ________________________

One way to test this hypothesis would be to use the Select tool in the data base, to select all records where **Food Chain** contains "Carnivore" AND **Class** contains "Bird". Then look one-by-one at each of the selected birds to see whether it has insects in the Diet. You could make a count of how many do and how many do not have insects in the Diet.

What might be another way to test this same hypothesis?

____

____

____

2. Think about this hypothesis: "Birds that eat insects are usually omnivores." What records could you select to help you test that hypothesis?

____

____

3. Think about this hypothesis: "Most amphibians are plant-eaters." What animal records would you select from the data base to test this hypothesis?

____

____

____

4. Suppose you want to know whether more amphibians are carnivores, herbivores or omnivores. After you select records where Class contains "amphibian", which bar chart would you make -- number of animals by Class, by Food Chain, by Hibernates, by Biome, by Skin, or by Body Heat Source?

____

5. What is your team's hypothesis about food chains and food webs?

6. To test your team's hypothesis, what animal records will (or did) you select?

7. After you have selected the records, what will you do with them?
Some possibilities include: • Look at each of the selected records to find out whether it supports the hypothesis (NOTE that this might take a long time, depending on how many are selected). • Make a bar chart of the selected data. • Sort the selected records and then look at each of them. • Print a report that includes all the fields you will need in order to decide whether your hypothesis is true or false.

8. One team hypothesized that "Most reptiles that live in a tropical rain forest are plant-eaters." How would you test their hypothesis using the Animal Data base?

Scientists at Work
At-Computer Activity
Lesson 8: Writing Hypotheses

• Click on the Advisor's Conversation Bubble to see what she advises you to do next in your project.

If you have not yet written an hypothesis concerning food webs, she will probably ask you to do so now. The Advisor will help you write an hypothesis. Tell the Advisor to "Remember this hypothesis".

• Use the Advisor to learn about testing hypotheses.

• In the Methods section of your notepad, write the method you will use to test your hypothesis.

• In the Animals data base, Select (using the Select tool) the records you need to test your hypothesis.

• Look at the records you have selected to find out whether your hypothesis is true or false. You might make a bar chart or you might look at each selected record to see what the facts are.

• If you have more time on the computer, think of another way to test your hypothesis and write that method in your Notepad.

• Print out any information your team will need to use at your desk, to decide whether the data support your hypothesis.

Scientists at Work
At-Desk Activity
Lesson 9: Interpreting Data and Drawing Conclusions

1. Look carefully at the data and printouts your team has gotten so far. Do the data tend to support your hypothesis? Why or why not?

2. Can you draw any conclusions from your data yet? If not what additional data do you need?

3. What additional information would need to be added to the Animal Data base in order for you to test your hypothesis adequately?

Lesson 9 At Desk Team Handout

Scientists at Work
At-Computer Activity
Lesson 9: Interpreting data and Drawing Conclusions

• Use the Advisor's Science Methods to learn about interpreting data and drawing conclusions.

• In the Data, Interpretations, and Conclusions sections of your Notepad, add any additional data and ideas you need for your project.

• Print your whole Notepad.

Scientists at Work
Appendix A
February 1989
Instructions for installing the program.

It is important that you follow these instructions exactly, in order to install the program correctly. The program will not run correctly if you do not follow these instructions.

A. Preliminaries

1. Check your hard disk to make sure you are using the latest version of the operating system and Finder (6.0.2 as of this writing). Be sure you do not have more than one system and finder on your hard disk. If you are using Imagewriter II's, be sure you have the Imagewriter I&II driver in your system folder.

2. Check to be sure you are using the latest version of Hypercard (at least version 1.2.1).

3. Create a folder called *Scientists at Work.*

4. Put Hypercard program into the Scientists at Work folder.

5. Check your Control Panel to make sure your sound is turned up as loud as it will go.

B. Loading the program onto your hard disk.

There are seven floppy disks for the program.

1. Copy all the files from all 7 floppies into your Scientists at Work folder.

2. Double-click the file called "Pictures (SIT)" to unstuff the file. This will take awhile.

3. Set the startup so that Hypercard will automatically boot itself. To do this, from the desktop, click the Hypercard program icon once, to highlight it. Then use the Special menu to Set Startup to Hypercard and Finder only. If you do this correctly, the students will never see the Desktop. DO NOT USE MULTIFINDER.

4. As extra insurance to avoid having users trashing stacks, arrange the Desktop screen so that the Home icon is the only thing visible in the Scientists at Work folder window. If there is any problem with auto booting of the program, all they need do is double-click the Home icon.

C. Finishing the installation.

1. Double click the HOME stack in your Scientists at Work folder.

2. To complete the installation of the sound resources, click the large button called "Finish installation". This will take awhile.

3. When "installation complete" message appears, you are ready to register your own name into the system.

D. Registering your own name.

It's important for you to register and sign on under your own name. The program will not work correctly for you unless you follow these instructions.

1. Click the "continue" arrow on the lower right of the opening screen.

2. Type the name "Bev".

3. Click "OK" when the program asks if you are Beverly Hunter.

4. Type "bev" when asked for your password. Click OK. The Nature Center entrance will appear.

5. Go to the advisor's office by clicking on the Science Advisor door.

6. Go to Student Records by clicking on Student Records cabinet.

7. Pull down the Options menu and click "Register new user"

8. Click "teacher" in response to the message box.

9. Type your name in response to the message box about the user's name.

10. Type a password in response to request for password. Click OK.

11. Click the return arrow to go back to the Advisor's office.

12. Click "Nature Center" to go back to Nature Center Entrance.

13. Click Quit from the Nature Center Entrance. This will take you back to the Opening Screen.

14. From the Opening Screen, click "continue" arrow and sign on under your own name which you just registered.

E. Registering teams of students.

1. Choose which computer will be used for which teams.

2. Sign on to the program under a teacher name and go to the Student Records in the Advisor's office.

3. Pull down the Options menu and choose "Register New User" option.

4. Choose "Register Student".

5. Type the name or number of the team. Usually this will be, for example, "Team 1-2" for first period, team 2.

6. Continue registering students for that machine until all are registered.

7. As a check on your work, print a Report listing all the team names you have registered.

F. Printing team status.

Some teachers like to print out the status of each team at the end of each day. To do this, sign on under a teacher's name and go to the Student Records.

1. Use the Print Report function.
2. Choose the following fields to print, holding down the shift key as you click the fields to be printed:
   - Team name
   - Project status
   - State
   - Statelist

3. Print the report.

G. Shutting down the computer.

To shut down the computer for the day, do the following:

1. Get to the opening screen of Scientists at Work (credits page).

2. Click "Quit Hypercard"

3. At the desktop, pull down the "Special" menu and click "Shut Down".

4. Turn off the computer.

H. Troubleshooting

• The spinning beachball in the program tells you the computer is busy doing whatever you asked it to. However, if the beachball continues spinning endlessly for a minute or more, the computer is "hung up." To solve this, hold down the command key and press period. This will interrupt whatever the computer was trying to do.

• When a team presses the QUIT button at the end of their time on the computer, the program updates their student record. If the team does not QUIT properly, then the next time they sign on the Advisor won't know what they did before. Or, another team may come up and start using the program without signing on. In any such case, the messages they get from the Advisor won't make much sense. Teams must QUIT and sign on properly to make the Advisor work correctly.

• If your printer does not work with the program, you probably have not installed the correct printer driver, or else you have not set up the Chooser correctly. For an Imagewriter II, you must have the Imagewriter I & II driver in your System folder (not the old Imagewriter driver).. And, you must Choose that printer in the Chooser in the Apple menu.

• If the sounds do not work on your computer, check to make sure that you:
- have followed the installation instructions exactly
- are NOT using MultiFinder
- ARE using Hypercard 1.2.1 or higher
- have at least 1 megabyte of internal memory.

Hypercard 1.2.2 is reputed to have better sound handling, but we don't yet have it as of this writing. Use it if you possibly can.

APPENDIX B

INTERACTIVE ADVISOR

Scientists at Work -- An interactive advisor for science inquiry and information-handling skills

Beverly Hunter
Director of Research
Targeted Learning Corporation
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(703) 937-5500

Scientists at Work provides an open-ended environment for science inquiry and problem-solving activities. The underlying pedagogical assumption is a *constructivist* one, in which the learner constructs his new knowledge by applying his existing knowledge to new problems. He is aided in his work by having access to information and tools for manipulating that information.

Scientists at Work was developed by Beverly Hunter of Targeted Learning Corporation, Dick McLeod of Michigan State University, and programmer Glenn McPherson. Charles White of George Mason University is directing the external evaluation of the field test. The project is supported by grants from the U.S. Department of Education Office of Special Education Programs and Apple External Research.

This paper describes the following:

1) our motivation for experimenting with an interactive advisor in the context of this tool-using learning environment
2) characteristics of the design of the advisor
3) some of the design issues we encountered

I) Motivation for the interactive advisor

As I stated at the outset, our approach in Scientists at Work is to have students engaged in science inquiry activities. They use the computer as a tool as they explore a visual/sound/text data base, create their own research questions, use various tools to locate and manipulate information to help them answer their questions, and to organize information in a way they need it to communicate with others. The students work in teams, each student playing a defined role within the team.

Overhead 1 shows the overall structure of this program. Overhead 2 shows the opening screen, which is the entrance to the Nature Center. Students are playing the roles of research assistants at the Nature

Center. Overhead 3 shows one of the animals in the Nature Center. Overhead 4 shows the same picture with the Options menu pulled down. Overhead 5 shows the data for the same animal. If you click on one of the field names, such as **Class**, you get the dictionary entry for that word as shown in overhead 6. Overhead 7 shows animal data with the options menu pulled down to the **Select** tool. As shown in Overhead 8, students can easily select a subset of the data base to work with, such as the set of animals that live in a savanna biome. Overheads 9 and 10 illustrate use of the graphing and charting tools. Each user has his own electronic notebook for recording his research. This notebook is structured to help the researcher organize his work. Overhead 11 shows the **Methods** section of the notebook.

To give you a concrete idea of this learning environment, I will show a five-minute segment of a video of the children working with *Sscientists at Work.*. The video takes place in a seventh grade environmental science classroom at a junior high school in Fairfax County, Virginia. This is one of five schools in northern Virginia taking part in this classroom-based research involving over 600 students in the fall of 1988. The classes includes students from a wide range of abilities, including children with a variety of special needs.

Several characteristics of the classroom environment in which students are working with such rich information base:

- Since there are eight teams of students in the classroom, the teacher cannot be aware at any given time of what particular problems a team may be having in their work
- students may have difficulties learning how to work effectively and collaboratively as a team
- complex interaction of content knowledge, concepts, and skills in inquiry
- the wide variety of different kinds of difficulties students encounter as they attempt to define and solve their own problems in this complex environment

The reasons we believe an interactive advisor is needed in this learning environment are:

1) Since we want the students to be working in a fairly open-ended inquiry, each student or team will be working on a different

research question or hypothesis. It is not possible for the teacher to be familiar with the issues that any one team is encountering at any particular moment in the classroom.

2) Also, because of the complexity of the information environment the students are working in, they encounter a wide variety of different kinds of conceptual and procedural difficulties.
3) Students of all ages have many different weaknesses in information-handling and inquiry concepts and skills. It is not possible in the context of a science class or a social studies class to remediate all these weaknesses in a series of lessons.

II. Design of the Advisor

The metaphor of an interactive *advisor* is similar to that of a computer *coach* (e.g. see Burton & Brown 1982; Brazier & Beishuizen 1986). In our conception of an Advisor, the learner is in complete control of the system and the learner decides when to ask the Advisor for assistance.

The Science Advisor visual metaphor

The "Science Advisor" in *Scientists at Work* is represented visually as a person at the Nature Center who is in charge of the research projects at the center and who is available to advise on how to conduct the research. Her office is shown in figure 1.

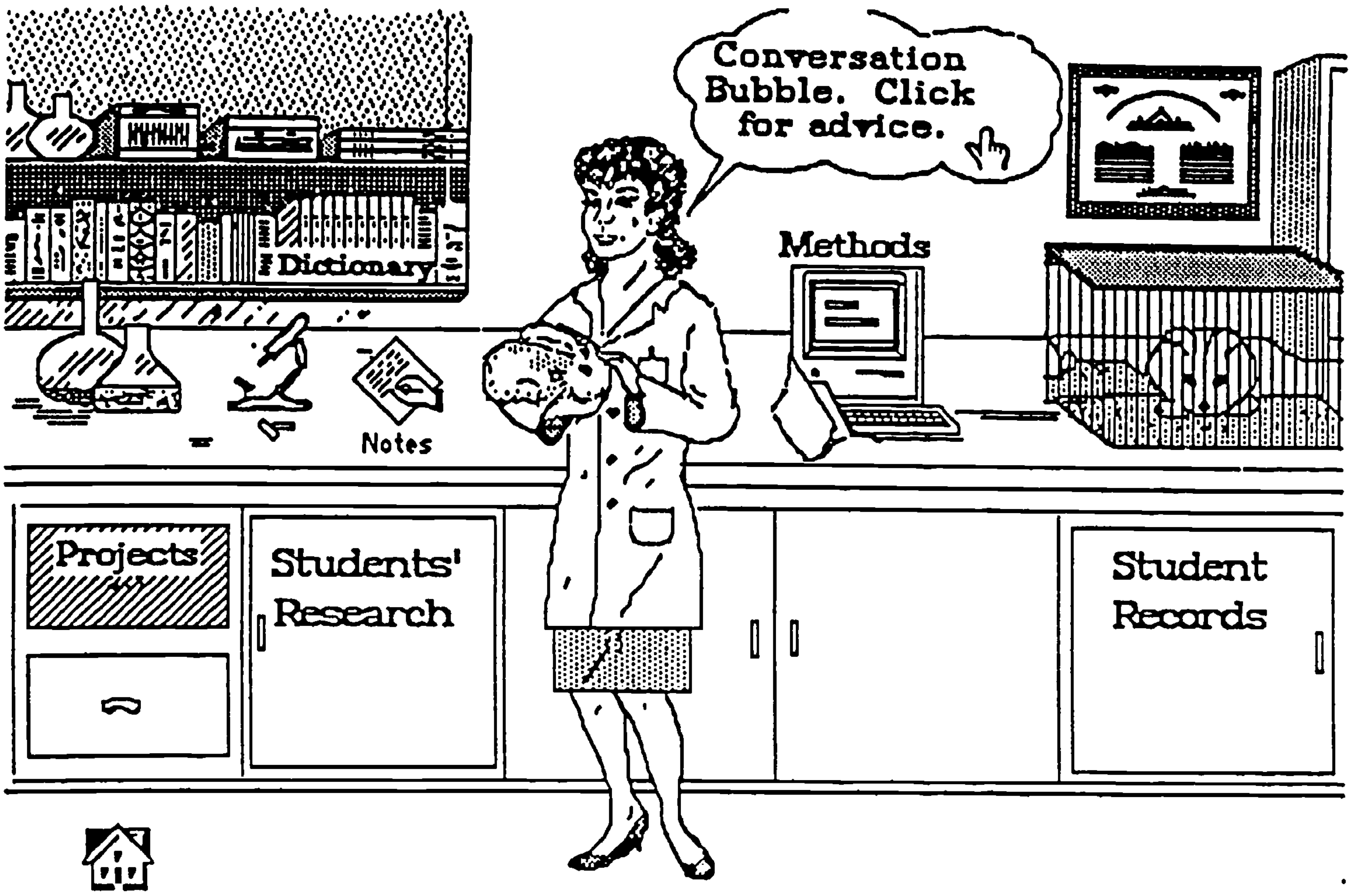


Figure 1: Advisor's Office

Computer coaches are usually described in five components: the Expert, the Student module, the Tutor, the Interaction module, and the Monitor. (Brazier & Beishuizen 1986). We will describe the functions of the *Scientists at Work* advisor in these terms. (See overhead

The Expert
The Expert component of the Science Advisor knows a general paradigm for science inquiry using data bases, which includes the following major steps:

- exploring the data base
- taking ownership of a problem or project
- formulating and answering questions related to the project
- formulating an hypothesis
- testing the hypothesis
- interpreting the data
- drawing conclusions
- writing a report

The Expert also has knowledge of five different research projects that can be pursued using the data base available. A project is a broad, ambiguous statement of an area of research that needs to be investigated. Within a project there are many possible research questions and hypotheses the learner can formulate. The Expert knows many examples of questions and hypotheses within each of these project areas.

Overhead 13 shows the project titles. Overheads 14 and 15 show the introduction to two of the projects.

The student module

The student module maintains a profile of the learner, including the stage of inquiry he is in, what actions he has taken in this stage, what project he is working on, what his question or hypothesis is. Overhead 16 shows a student record.

The tutor

The tutoring function of the Advisor has four levels:

- at the "Conversation" level, the Advisor will suggest the next task the learner should undertake in his research, or the next step his should take within a task. For example, in the Exploration stage of students' research, the Advisor may suggest that the learner try out the Index to the animal pictures by locating the polar bear in the index. (Overhead 17.) At other stages in the learner's work, the advisor may provide advice specific to the project the learner is working on (Overhead 18).
- at the "Job Aid" level, the Advisor provides the learner with various cues throughout the system to remind him of his own current project, research question, or hypothesis. (Overhead 19.)
- at the "Help" level, the Advisor provides assistance in using a particular tool or feature of the system, such as providing an explanation of how to use the electronic notebook (Overhead 20).
- at the "Reference" level, the Advisor provides procedures, definitions of terms, examples, and explanations of concepts related to both science inquiry and the subject domain (Overheads 21-23).

The tutor only gives advice when asked by the learner. There is one exception to this rule: the tutor does not permit the learner to sign up for a research project until he has explored seven main places or tools in the Nature Center.

The Interaction module

The interaction module maintains the communication facilities between the user and the system. In *Scientists at Work*, the interaction is implemented in the "point and click" interface conventions of a hypertext or hypermedia development environment. For example, when the learner wishes to ask the Science Advisor for advice, he clicks on her icon button, which looks like figure 2:

Figure 2: Advisor Icon

At the Conversation level, the Advisor both speaks to the learner in voice and gives a printed message on the screen. Figure 3 shows an example message.

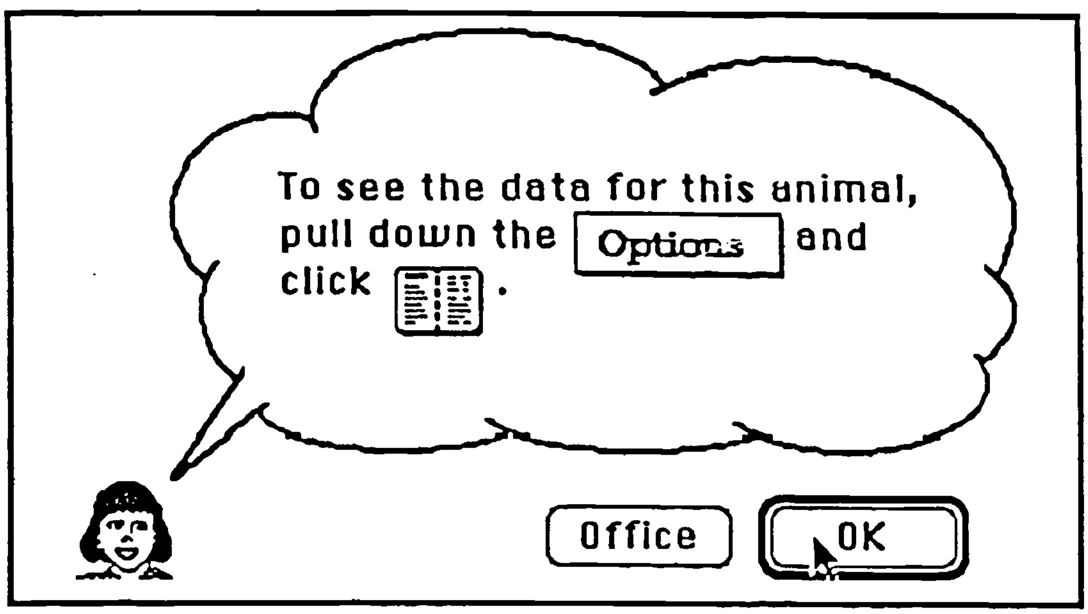


Figure 3: Example Advisor Conversation

At the Job Aid, Help and Reference levels, she displays information in text or pictorial form.

The Monitor

The monitor function records the learner's actions, compares the learner's actions with the Expert module's expectations for science inquiry in the learner's particular project, and decides what Tutorial message to provide when the learner next invokes the advisor.

III. Issues and problems

Problems encountered in design and implementation of the Science Advisor may be grouped in five main categories corresponding to the components described above.

Issues related to the Expert

The Expertise in the Advisor covers three broad skill and knowledge domains: science inquiry methods, information-handling skills, and the research projects related to the animal data base. Because we want to allow for a broad range of creativity and individuality on the part of the learner, the Expert's knowledge is correspondingly abstract. For example, there are no "wrong" hypotheses a learner can make within a given project. It is theoretically possible to build far more expertise into the Advisor than we have done so far, but this will require an extensive knowledge engineering effort which the current project did not have resources to support.

Issues related to the Student module.

A major deficiency of the SAW Advisor is that the Student module lacks information about the student's intentions, plans and strategies. Lacking information on the learner's plans, the Tutor's advice is often irrelevant, in the learner's mind, to what he wants to do. A second weakness is that although the Student module contains information about the learner's current project, research question, and research hypothesis, the Advisor takes advantage of this information in much more limited ways than are theoretically possible.

Issues related to the Tutor

There are two major and related problems that must be solved by a computer coach. They are: 1) when to interrupt the student's problem solving activity, and 2) what to say once it has been interrupted. (Burton & Brown, 1982).)

As described earlier, the Tutor (with one exception) provides advice, help and reference information only upon the learner's request. Thus it is possible for the learner to work for long periods of time without any Advisor interaction. The consequence is that by the time the learner does consult the Advisor, the learner has diverged so greatly from the Expert that too wide a gap has developed. The Tutor may then want to tutor the learner on a topic which the learner should have learned about much earlier in his project. This is quite annoying to the learner, who is focussed on solving a problem or accomplishing a particular task and does not want to be instructed on something he perceives as irrelevant at the moment.

Issues related to the Interaction-Interface

Most of our attention in the design of our Science Advisor has focussed on issues related to the user interface and the method of interaction between the learner and the Advisor. As indicated earlier, the interaction is implemented in HyperCard. HyperCard is an implementation of the generic concept called hypertext or hypermedia. As such it suffers from the difficulty common to all hypertext, which is that the user can easily get "lost" in the large information space available. (Conklin, 1987). There are many options available to the learner at any given time, and the learner does not always understand which of these will most efficiently get him to where he wants to go. A related problem is in the design of the "buttons" which are the places on the screen which the user "clicks" to go to the next set of information. Some of the buttons are icons, such as the Advisor icon shown above. Others are short phrases enclosed in a standard "button" shape, such as that shown in figure 4:

How to ask a question

Figure 4: Example text button

Although we used a variety of techniques for standardizing the "look and feel" of the buttons, learners often either do not understand them or do not attend to them in the intended manner.

Another interface issue relates to the use of voice (sound) output versus text. Many students state a strong preference for hearing the Advisor's conversation rather than reading it. However there are at present severe constraints on the amount of voice it is practical to store on disk. In our system, each second of sound requires 11K bytes of storage.

A further interface issue involves the need for an Advisor to demonstrate certain information-handling procedures rather than simply explaining them. Within the resources of the current project we were not able to create programmed demonstrations of procedures for performing information-handling tasks such as selecting a subset of data or making a graph. Thus the Tutor could only provide a list of steps for performing the procedure, much as one would find in a printed user manual. The learner would have to print out the list of steps and then attempt to follow the printed list of steps.

A much broader interface issue and probably much more important, has to do with the metaphor we use of a human advisor. Naturally, students have many implicit assumptions, expectations, of a human advisor. They are frequently frustrated because, of course, our machine advisor is NOT human even though she has some human-like qualities (she looks like a human, has a human voice). Steve Weyer, Apple Corporation's Director of the artificial intelligence group, thinks we would avoid a lot of problems by taking the human metaphor away from the advisor function. One alternative is to make the advisor less formal, more like a cartoon character with robot-sounding voice. Another is to make the advisor functions more like an elaborate help system.

Issues related to the Monitor

The Monitor issues derive from our policy of not letting the Advisor intervene except when invited to by the learner. This policy extends not just to the use of the Advisor, but also to the way in which the learner interacts with the Advisor. For example, the Advisor is capable of assisting the learner in formulating his own research question, and remembering what the learner's question was. However, the Advisor does not in any way "force" the learner to use this assistance. If the learner does not use the assistance, then the Advisor does not know a) whether the learner has formulated a research question or b) what his question is. About half of the monitoring of the learner takes place during Advisor interactions, while the other information about the learner is gleaned from his interactions with the data base. If the learner does not choose to cooperate with the Advisor, either by not calling on her or by not interacting with her in a way the Monitor can understand, then Student module and the Expert module become so divergent that the Tutor's advice is too far from the learner's current thought processes.

Summary

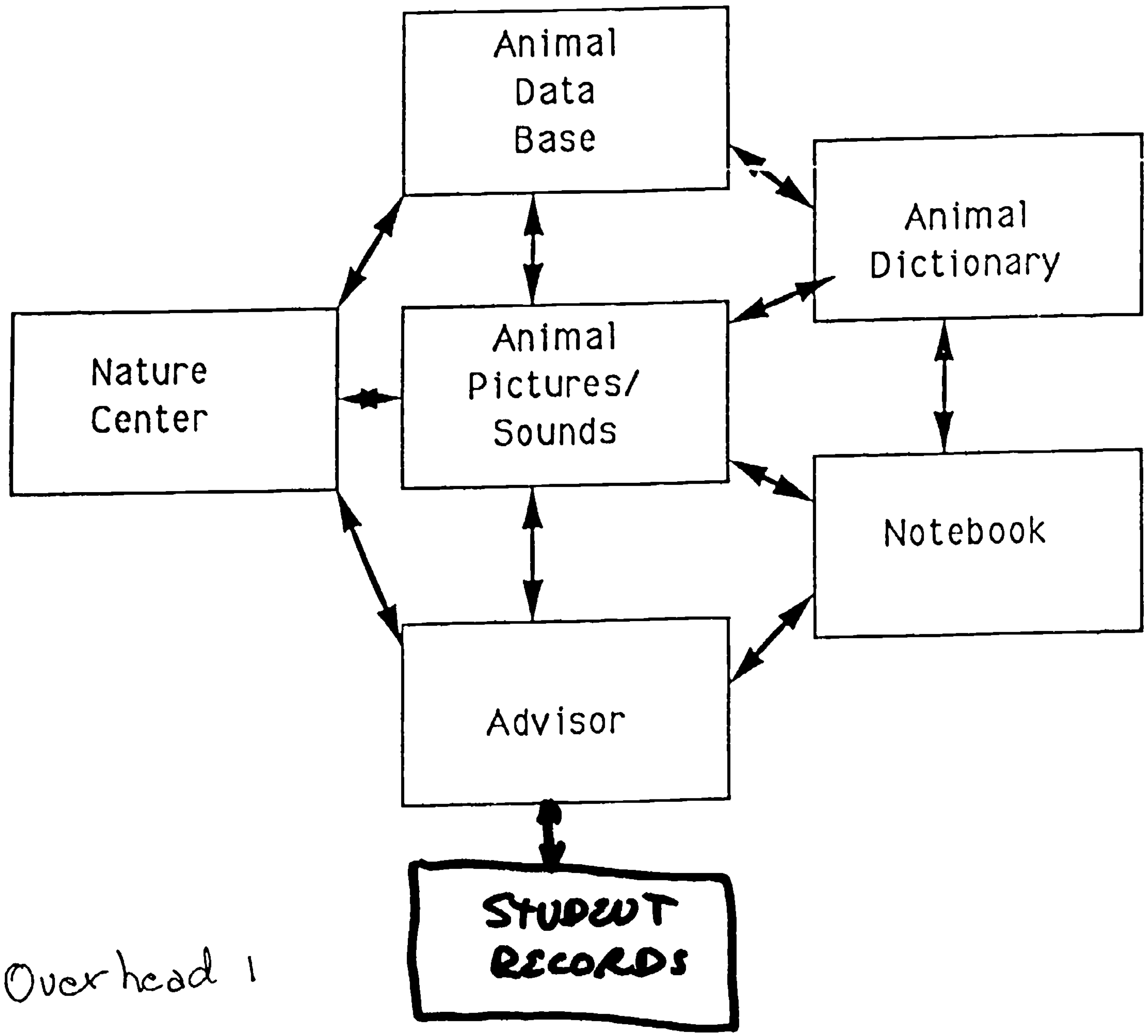
If students are to be able to take advantage of large multimedia data bases to develop and apply skills in information handling and inquiry, they will need a great deal of assistance and instruction. It is not possible for the classroom teacher to provide the specific help a student or team may need at any given moment in the students' work. Some kind of interactive assistance will be necessary. This project takes a beginning step in the direction of designing, implementing and testing a range of advisor features and functions. Much more research and development needs to be done before the advisor has the needed intelligence and appropriate interface to serve diverse student needs in a particular inquiry and subject matter context.

References:

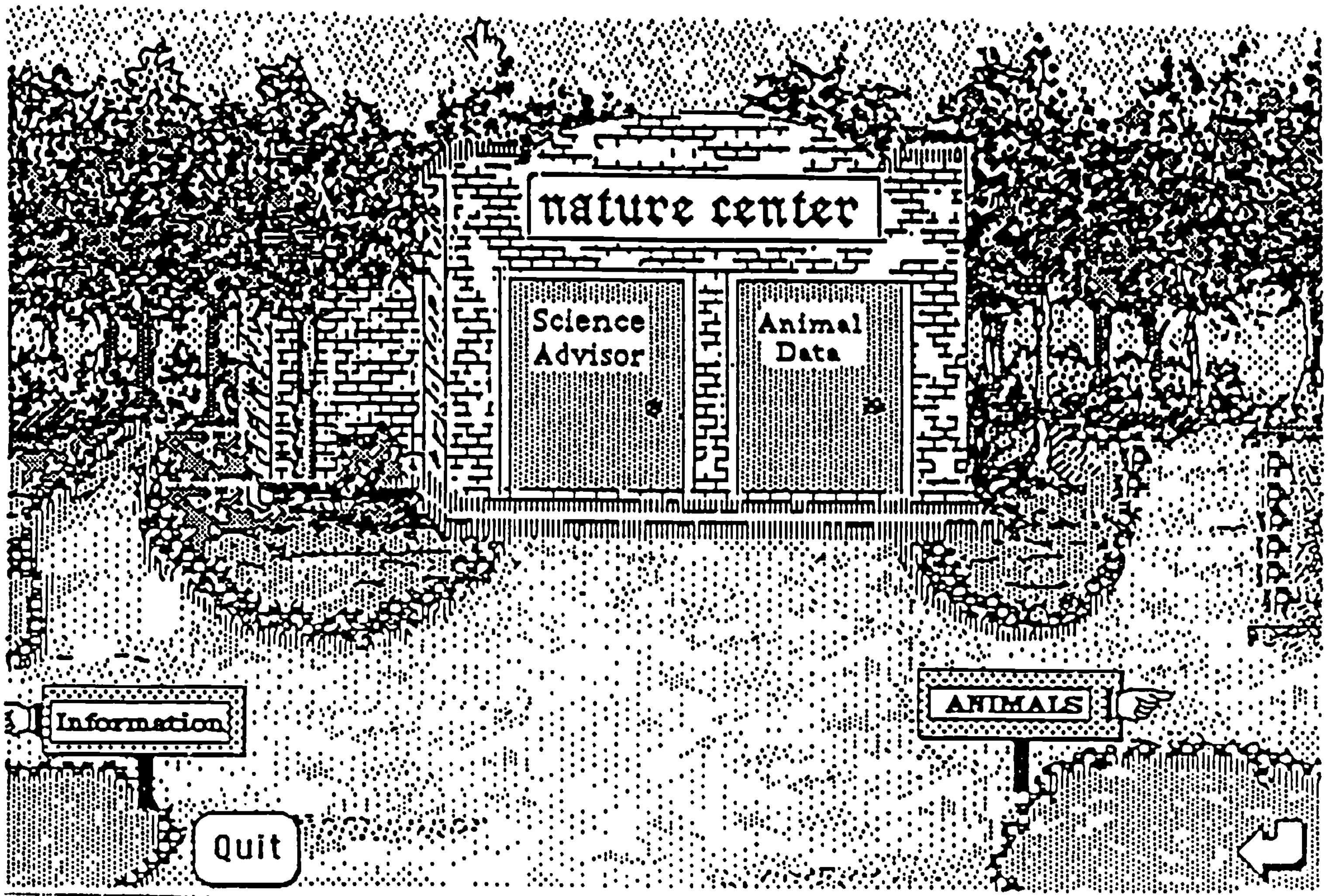
Beishuizen, J. CIR: a computer coach for information retrieval. In J. Moonen & T. Plomp (Eds.), *EURIT86: Developments in Educational Software and Courseware* (pp. 21-27). Oxford: Pergamon Press 1987.

Burton, R. R. & Brown, J.. An investigation of computer coaching for informal learning activities. in Sleeman & Brown (eds) *Intelligent Tutoring Systems.* Academic Press 1982.

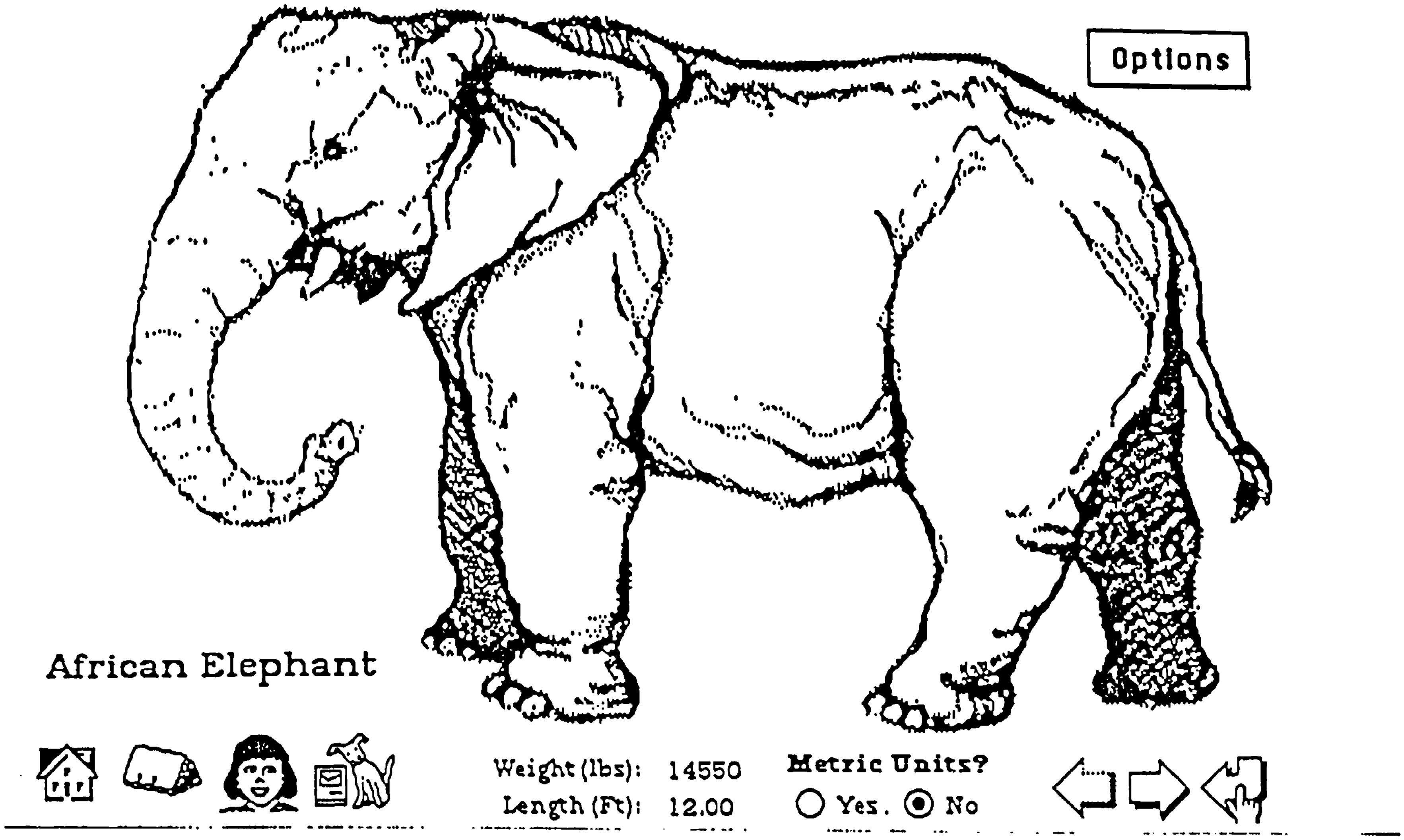
Conklin, Jeff. A survey ot hypertext. *MCC Technical Report No. STP-356-36.* Software Technology Program, MCC, 9390 Researach Blvd. Austin, TX 78759. October 1986.


Animal Data Base
Animal Dictionary
Nature Center
Animal Pictures/ Sounds
Notebook
Advisor
STUDENT RECORDS

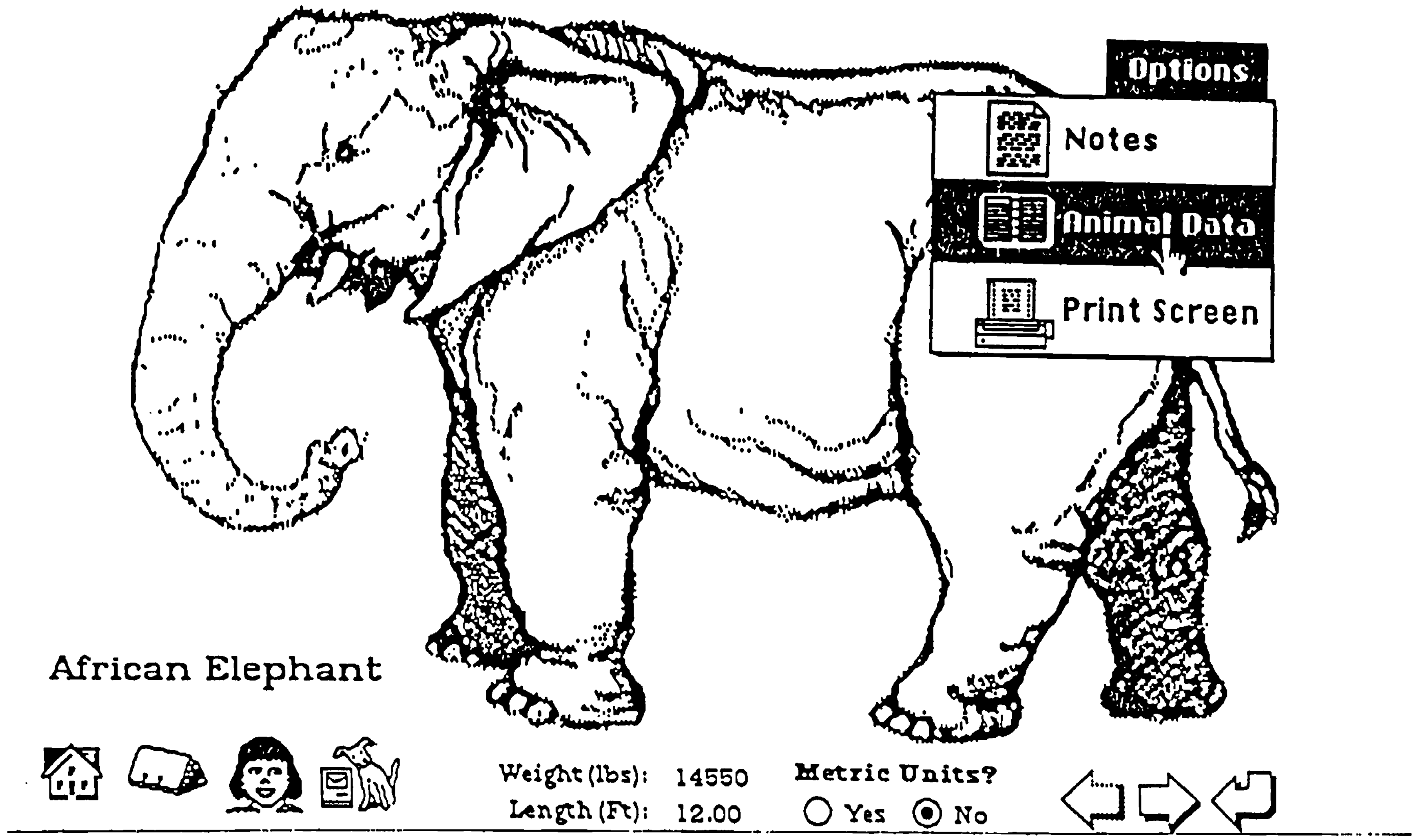
Overhead 1


nature center
Science
Advisor
Animal
Data
Information
ANIMALS
Quit

OVERHEAD 2


Options
African Elephant
Weight (lbs): 14550
Length (Ft): 12.00
Metric Units?
Yes. No

OVERHEAD 3


Options
Notes
Animal Data
Print Screen
African Elephant
Weight (lbs): 14550
Length (Ft): 12.00
Metric Units?
Yes
No

OVERHEAD 4

African Elephant

Class: mammal

Food Chain: herbivore

Diet: leaves, twigs, grass, fruits

Enemies: humans, lions

Body heat source: internal

Hibernation: no

Range: Africa

Biome: savanna and tropical rain forest

Habitat: savannahs and plains and forests

Selection Sentence

All animals are selected.

Metric Units? ○ Yes ◉ No — Options

Weight (lbs): 14550

Length (Ft): 12.00

Life Span (Years): 70

Integument: hair and skin

Reproduction Averages

1 young

Parental Care (days): 600

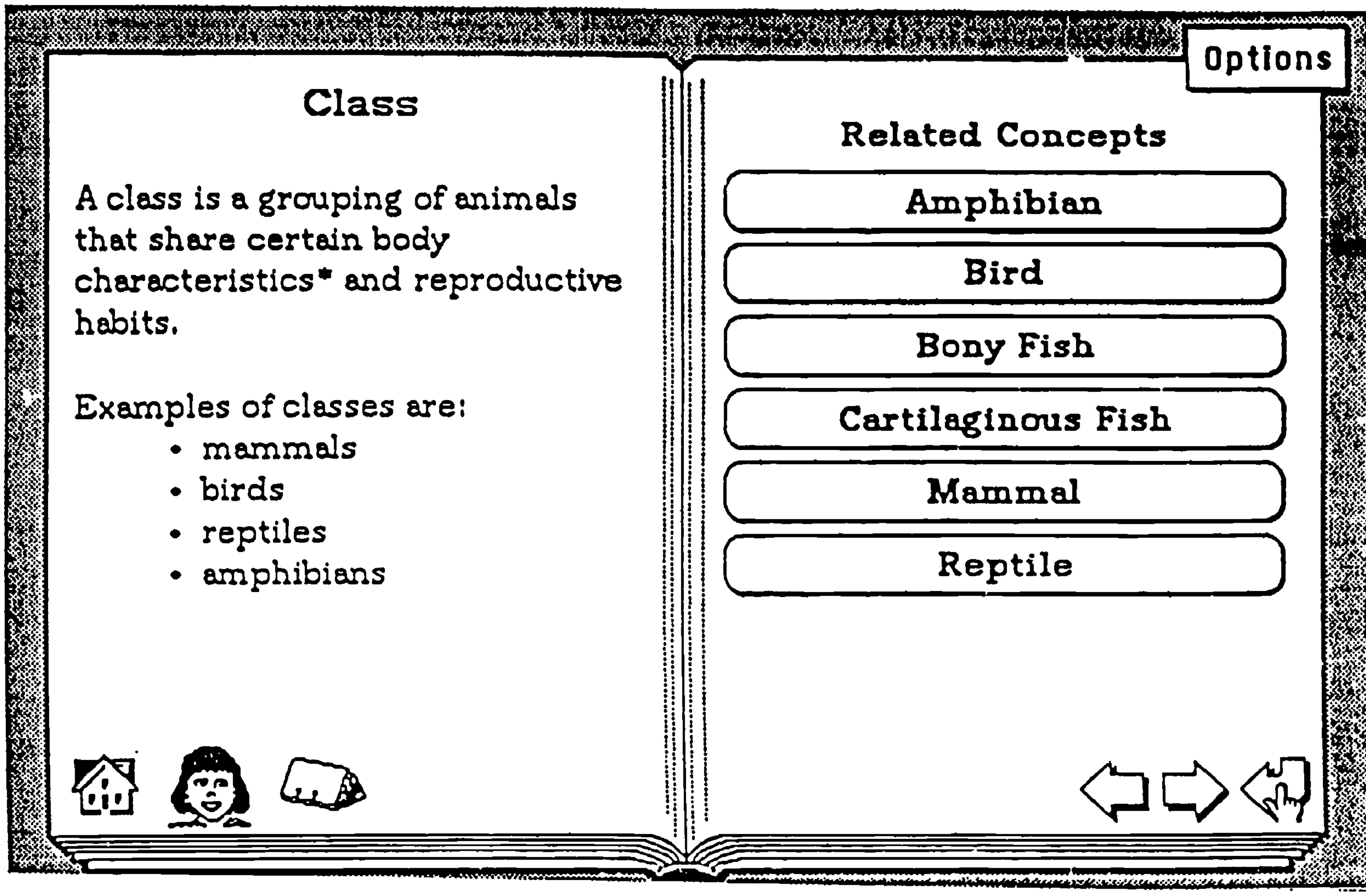
700 days gestation

Interesting facts

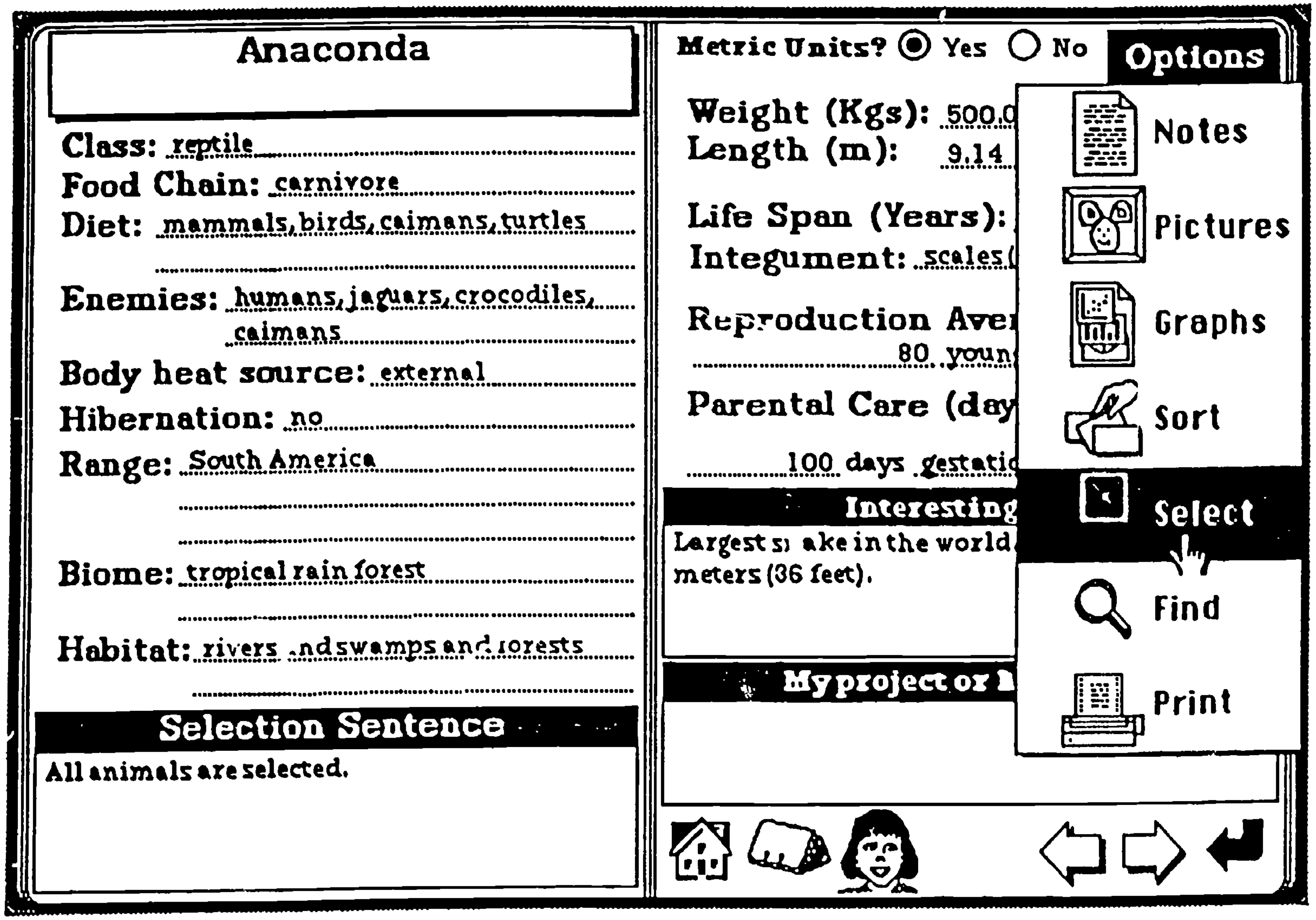
Largest living land animal. Threatened species over most of its range.

My project or hypothesis

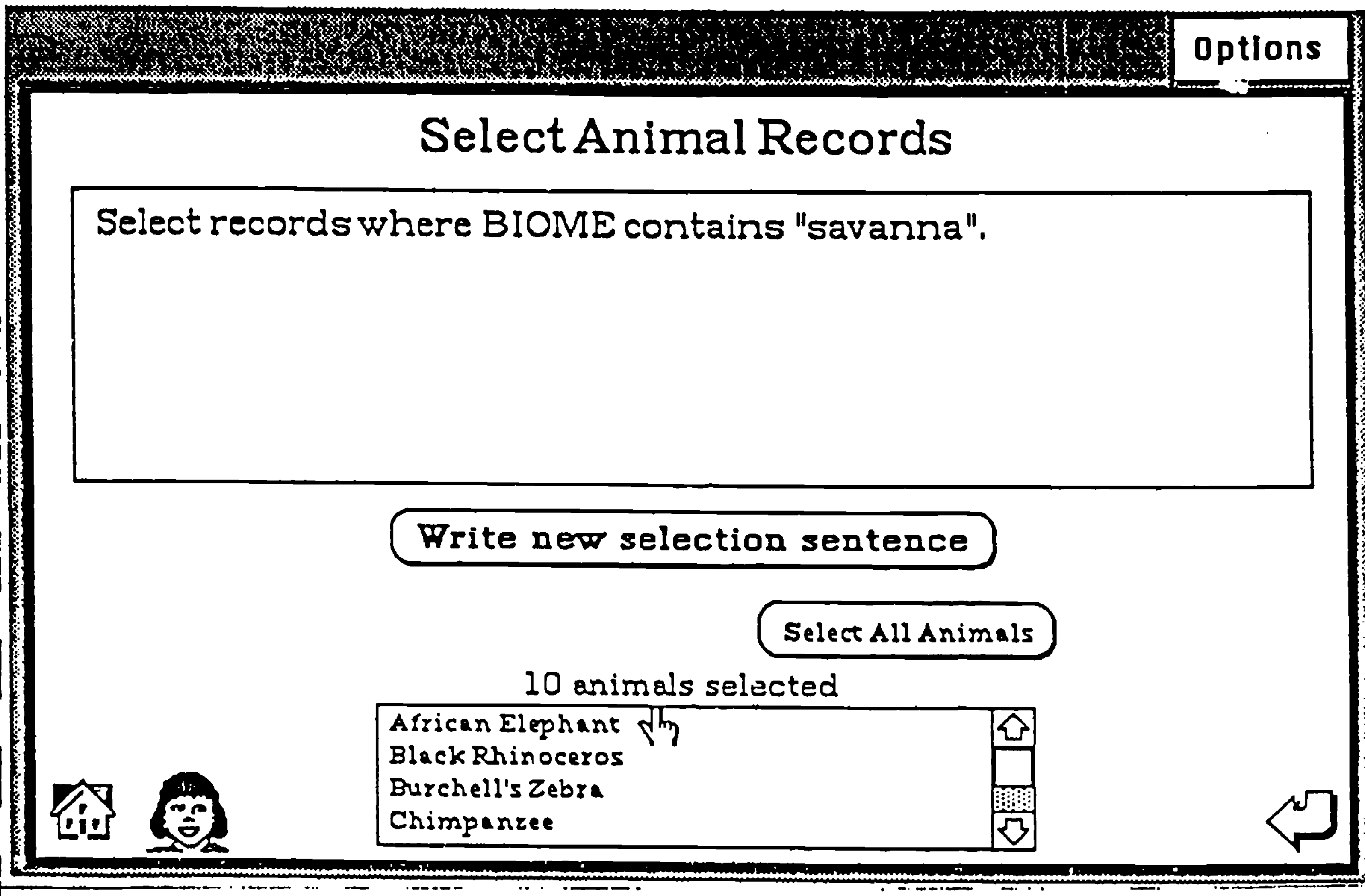
OVERHEAD 5


Options
Class
A class is a grouping of animals that share certain body characteristics* and reproductive habits.
Examples of classes are:
• mammals
• birds
• reptiles
• amphibians
Related Concepts
Amphibian
Bird
Bony Fish
Cartilaginous Fish
Mammal
Reptile

OVERHEAD 6

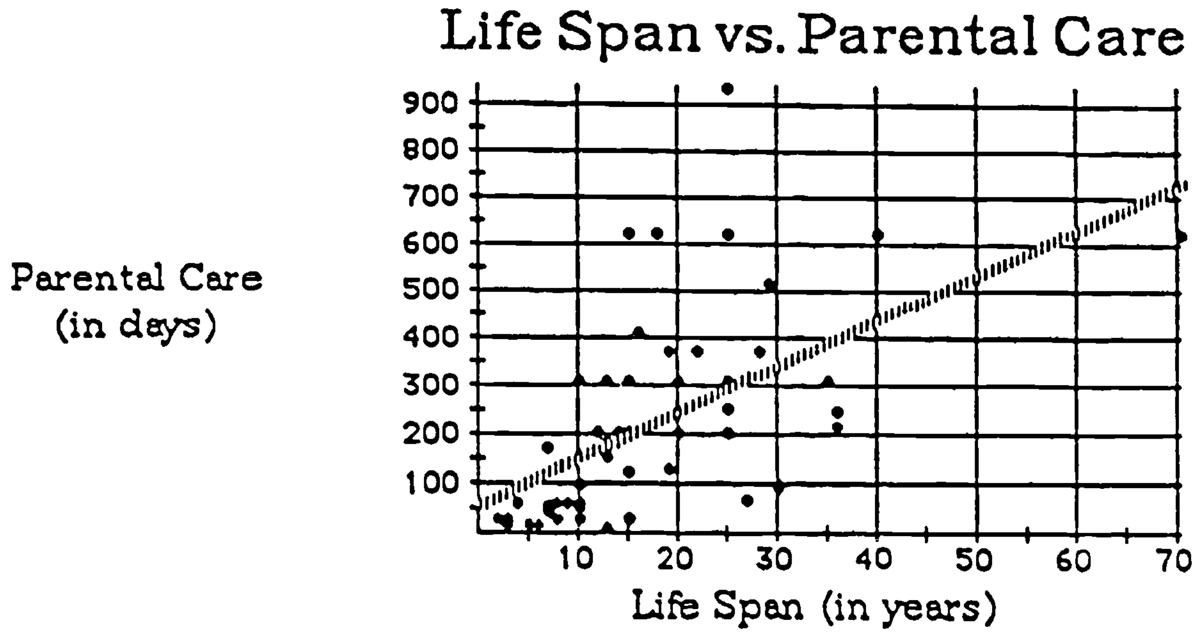

Anaconda
Class: reptile
Food Chain: carnivore
Diet: mammals, birds, caimans, turtles
Enemies: humans, jaguars, crocodiles, caimans
Body heat source: external
Hibernation: no
Range: South America
Biome: tropical rain forest
Habitat: rivers and swamps and forests
Selection Sentence
All animals are selected.
Metric Units? Yes No
Options
Weight (Kgs): 500.0
Length (m): 9.14
Life Span (Years):
Integument: scales
Reproduction Ave
80 youn
Parental Care (day
100 days gestatic
Interesting
Largest snake in the world
meters (36 feet).
My project or
Notes
Pictures
Graphs
Sort
Select
Find
Print

OVERHEAD 7


Options
Select Animal Records
Select records where BIOME contains "savanna".
Write new selection sentence
Select All Animals
10 animals selected
African Elephant
Black Rhinoceros
Burchell's Zebra
Chimpanzee

OVERHEAD 8

Options



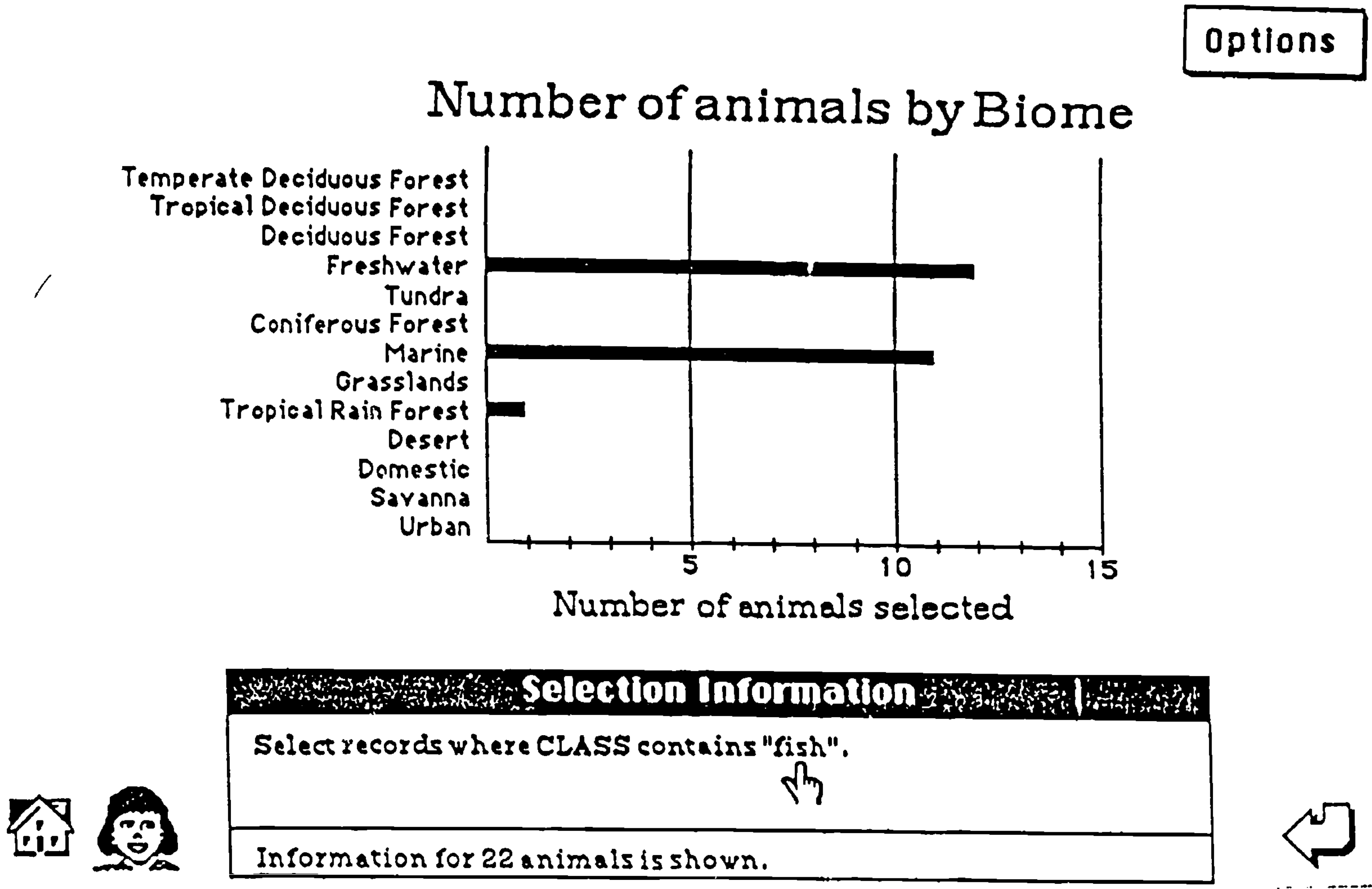
Show/Hide Statistics

Selection Information

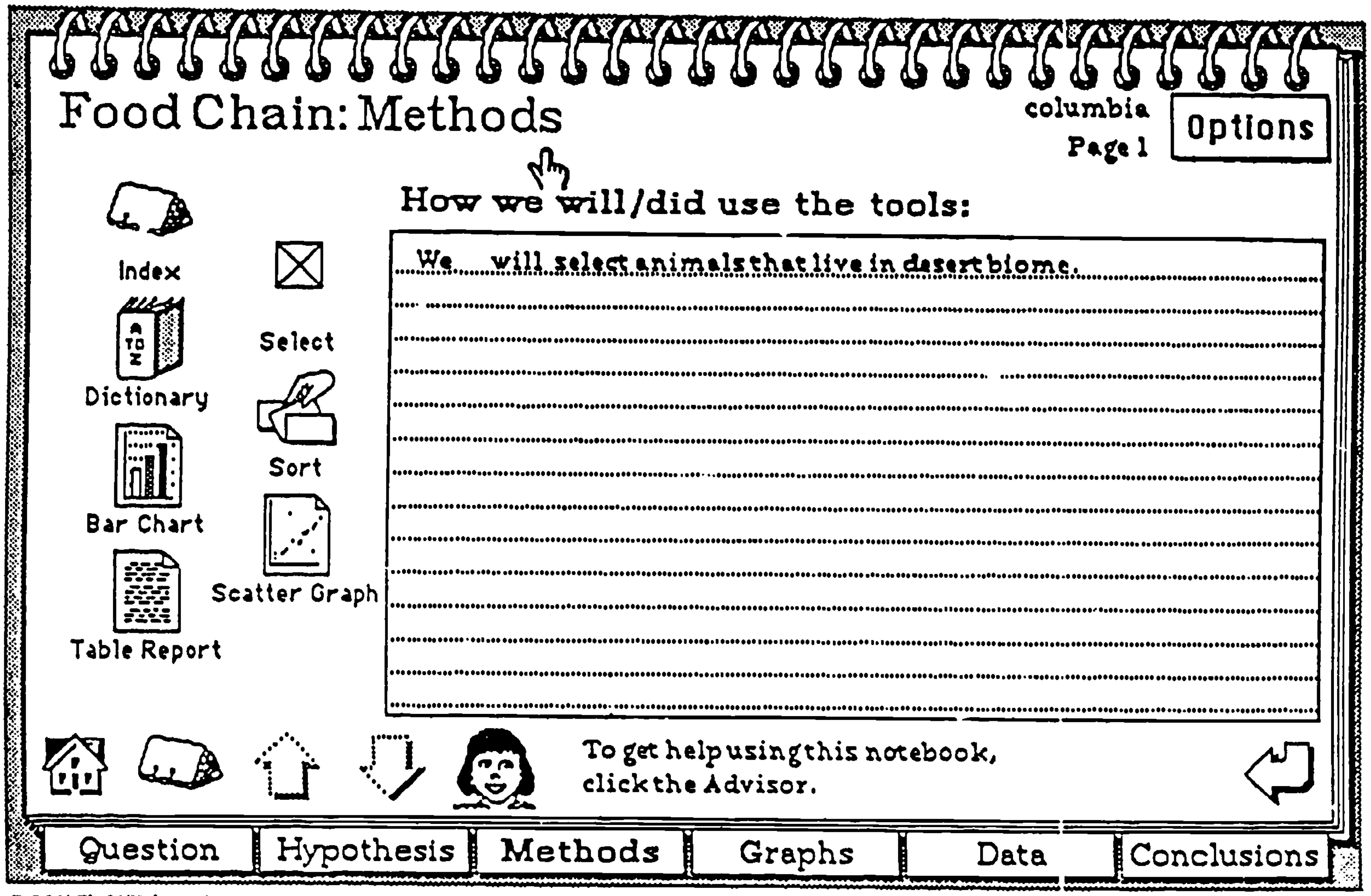
Select records where CLASS contains "mammal".

Information for 55 animals is shown.

OVERHEAD 9


Options
Number of animals by Biome
Temperate Deciduous Forest
Tropical Deciduous Forest
Deciduous Forest
Freshwater
Tundra
Coniferous Forest
Marine
Grasslands
Tropical Rain Forest
Desert
Domestic
Savanna
Urban
5
10
15
Number of animals selected
Selection Information
Select records where CLASS contains "fish".
Information for 22 animals is shown.

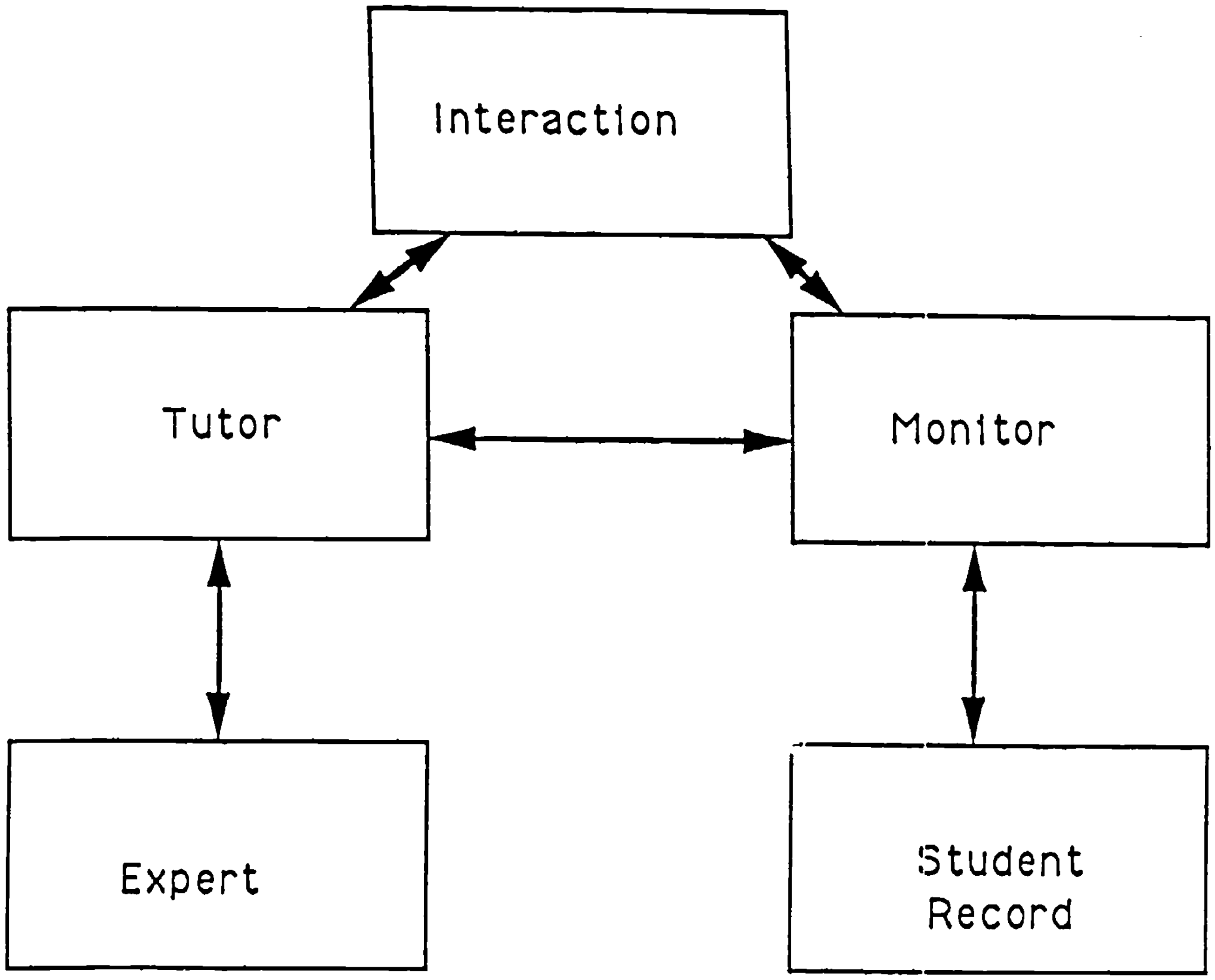
OVERHEAD 10



Food Chain: Methods
columbia
Page 1
Options
How we will/did use the tools:
We will select animals that live in desert biome.
Index
Select
Dictionary
Sort
Bar Chart
Scatter Graph
Table Report
To get help using this notebook, click the Advisor.
Question
Hypothesis
Methods
Graphs
Data
Conclusions

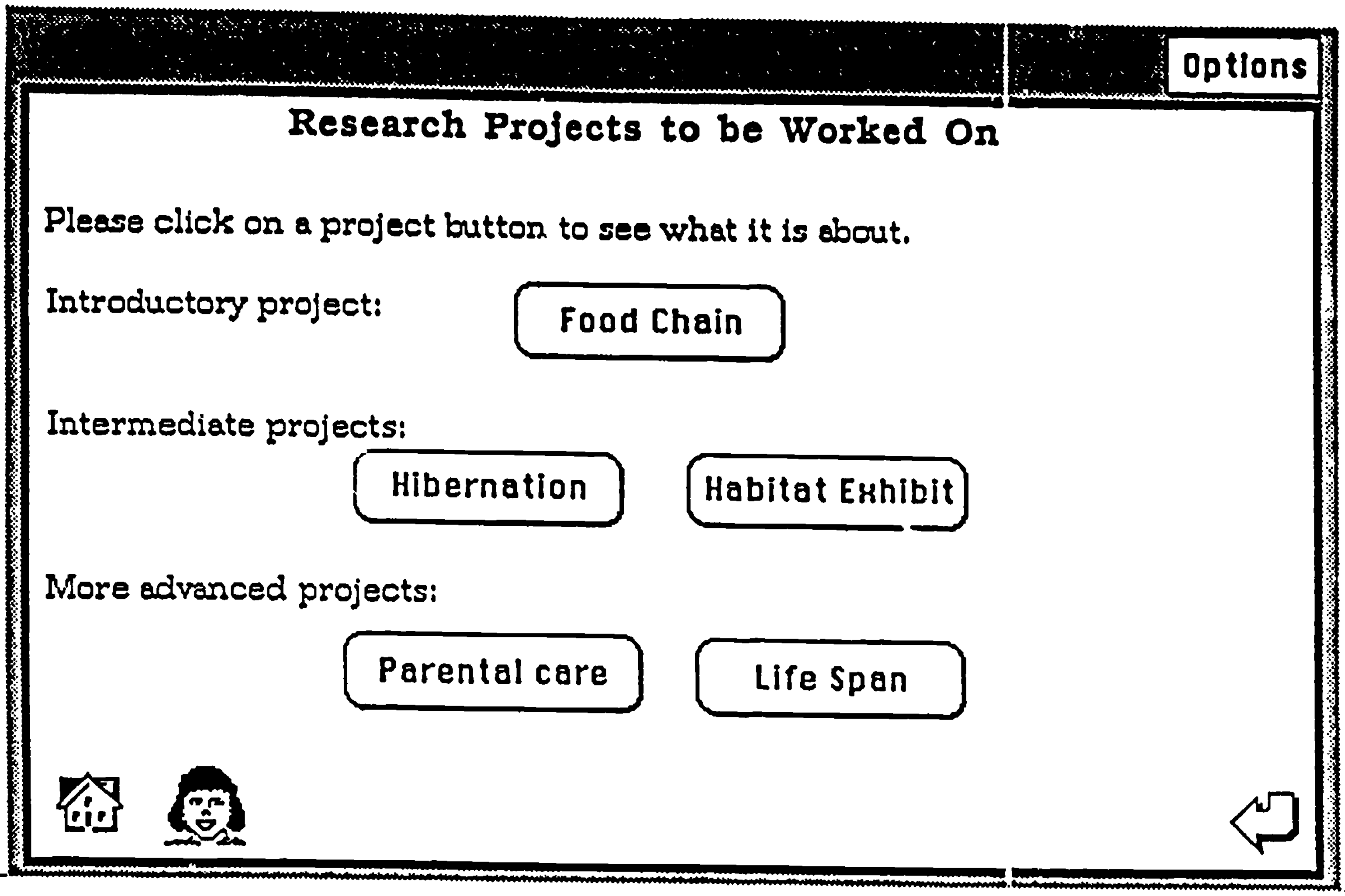
OVERHEAD 11

Functions of the Interactive Advisor



OVERHEAD 12

12


Options
Research Projects to be Worked On
Please click on a project button to see what it is about.
Introductory project:
Food Chain
Intermediate projects:
Hibernation
Habitat Exhibit
More advanced projects:
Parental care
Life Span

OVERHEAD 13

Options

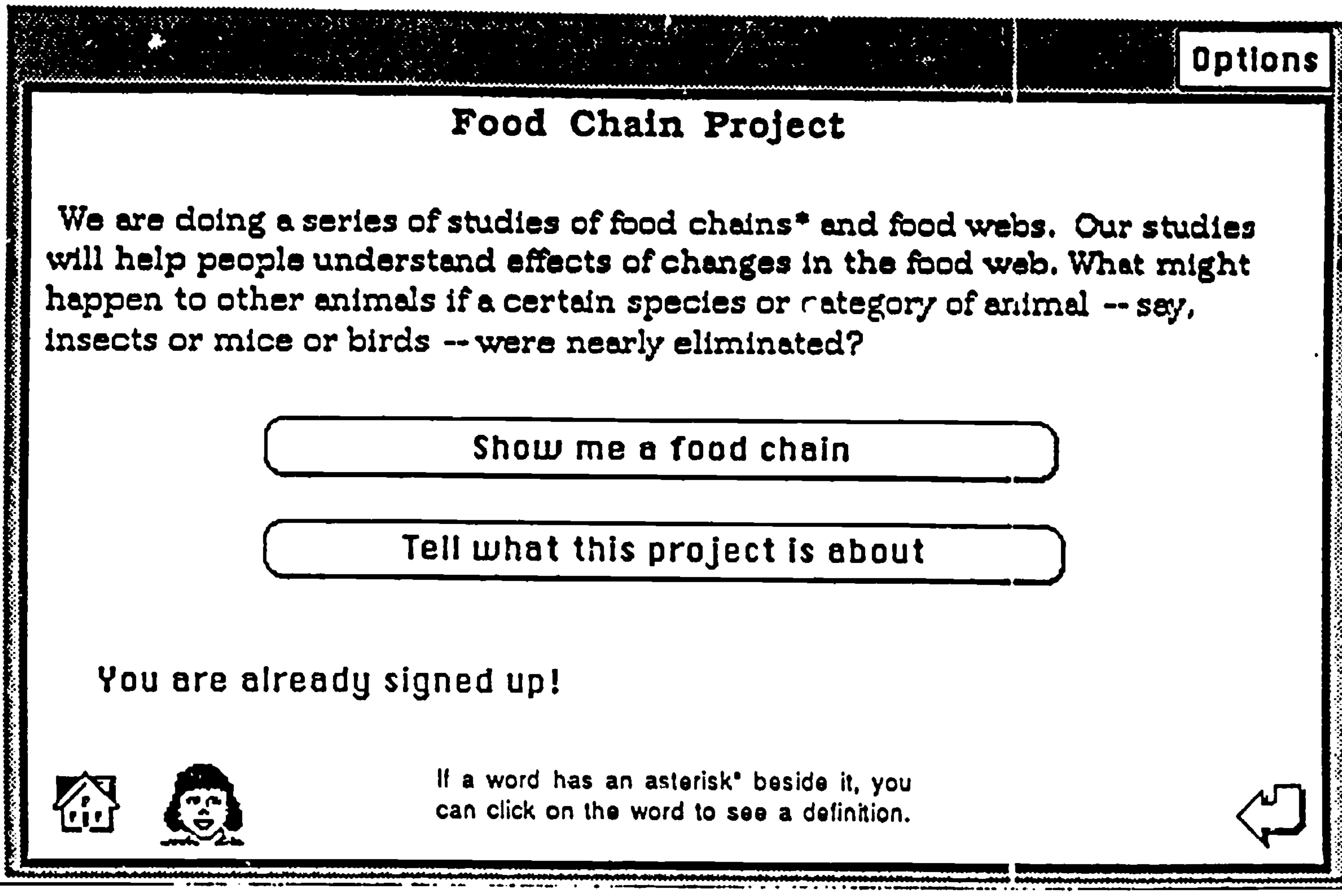
Parental Care Project

How long does an animal care for its young? People from several zoos are planning to return certain animals to their natural habitats after they are old enough to survive on their own.
They need to know more about length of parental care* of different animals. Is there a relationship between length of parental care and other characteristics such as life span, number of young, position in the food chain?

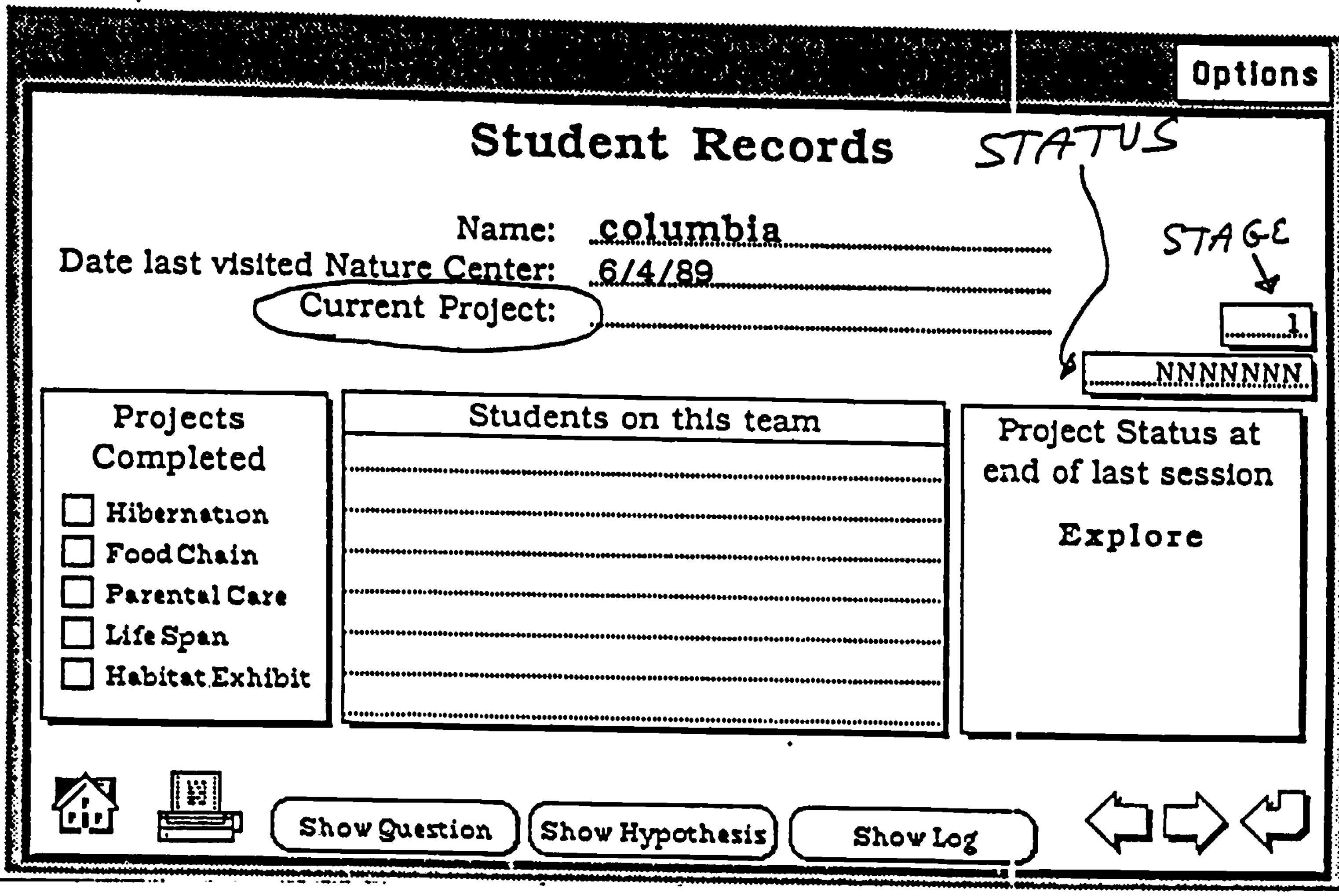
Say more about the Parental Care project

If a word has an asterisk * beside it, you can click on the word to see a definition.

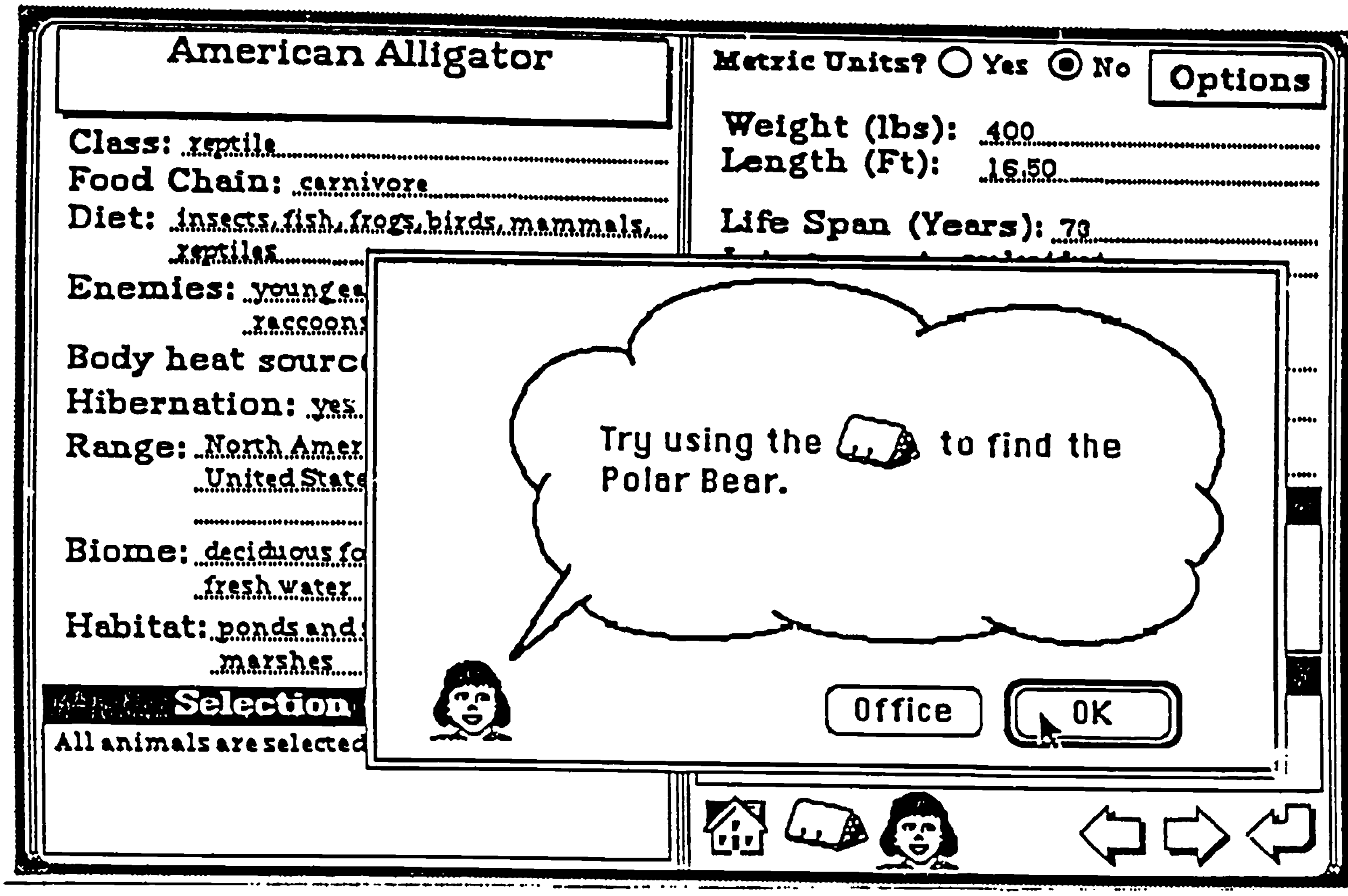
OVERHEAD 14


Options
Food Chain Project
We are doing a series of studies of food chains* and food webs. Our studies will help people understand effects of changes in the food web. What might happen to other animals if a certain species or category of animal -- say, insects or mice or birds -- were nearly eliminated?
Show me a food chain
Tell what this project is about
You are already signed up!
If a word has an asterisk* beside it, you can click on the word to see a definition.

OVERHEAD 15


Options
Student Records
STATUS
Name: columbia
Date last visited Nature Center: 6/4/89
Current Project:
STAGE
1
NNNNNNN
Projects Completed
Hibernation
Food Chain
Parental Care
Life Span
Habitat Exhibit
Students on this team
Project Status at end of last session
Explore
Show Question
Show Hypothesis
Show Log

OVERHEAD 16


American Alligator
Class: reptile
Food Chain: carnivore
Diet: insects, fish, frogs, birds, mammals, reptiles
Enemies:
Body heat sourc
Hibernation: yes
Range: North Amer
United State
Biome: deciduous fo
fresh water
Habitat: ponds and
marshes
Selection
All animals are selected
Metric Units? Yes No
Options
Weight (lbs): 400
Length (Ft): 16.50
Life Span (Years): 73
Try using the to find the Polar Bear.
Office
OK

OVERHEAD 17

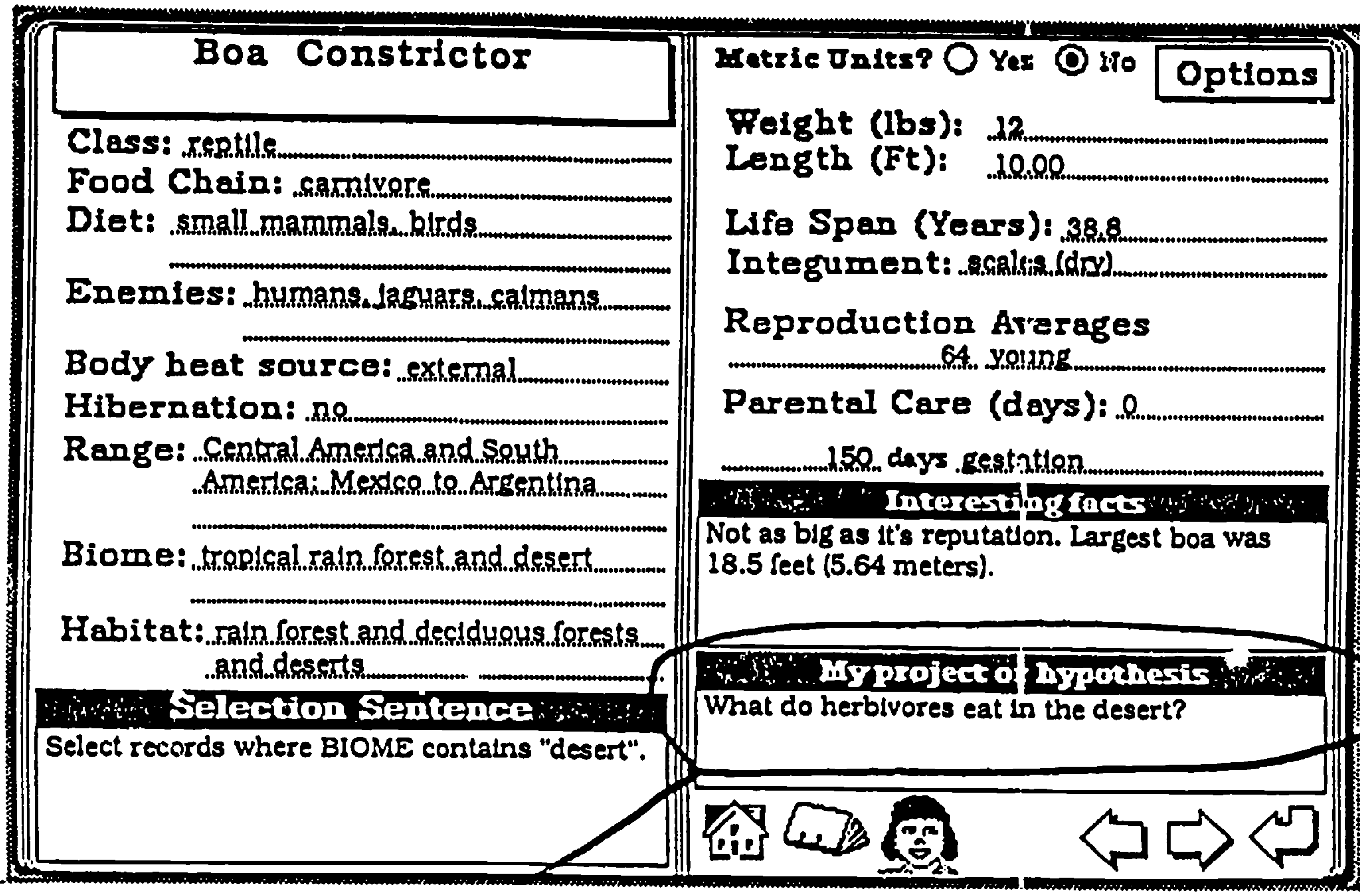
Options

Example Questions about Food Chains and Food Webs

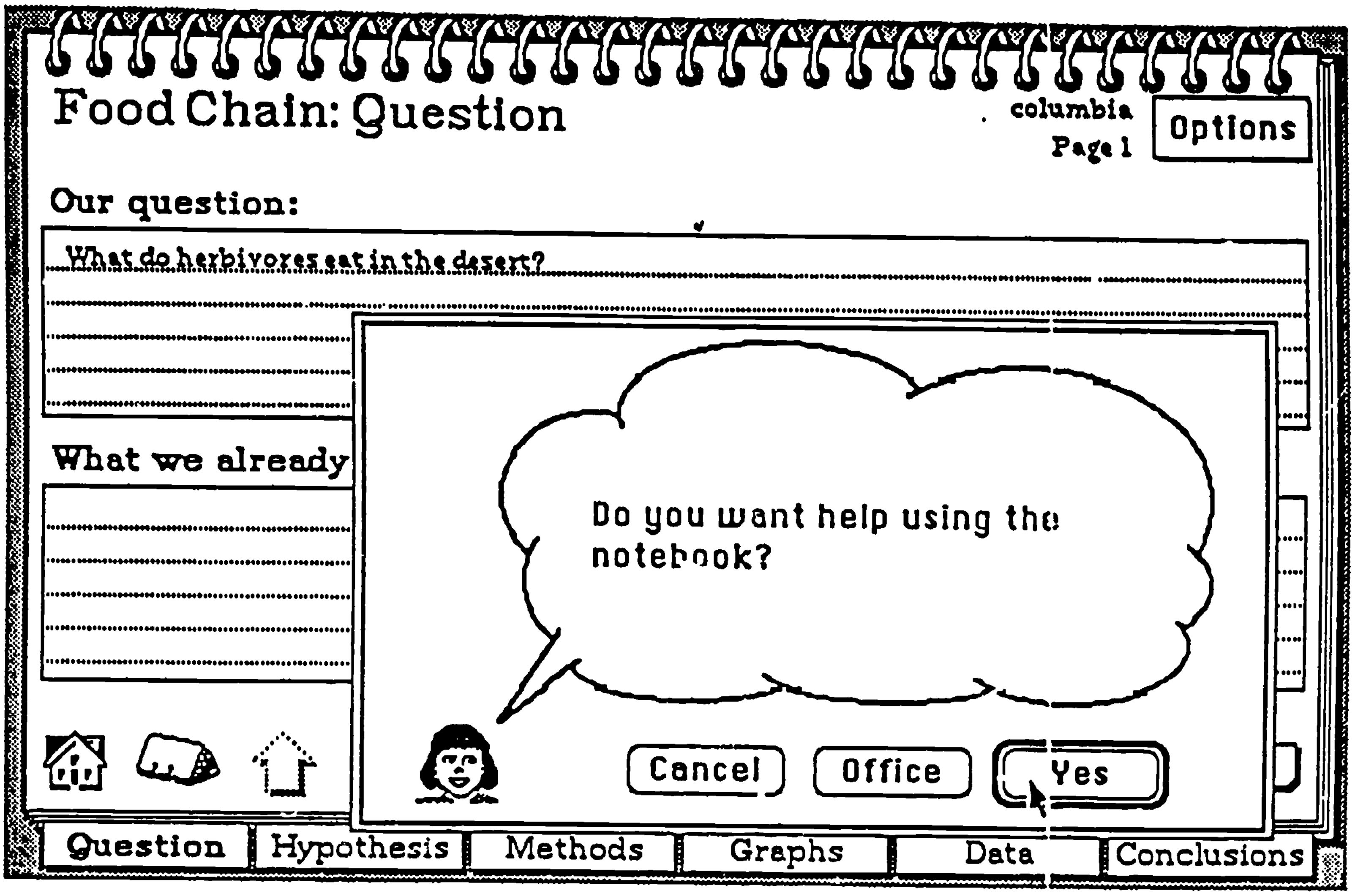
You may use these examples to help you make up your own question:
Which class of animals in our data base has the most herbivores?
Which class of animals in our data base has the most animals that eat insects?
Do herbivores live longer than carnivores?
How many animal species are eaten by snakes?
Are the fish in our data base mainly herbivores or carnivores? Why?
Are the amphibians in our data base mainly herbivores or carnivores? Why?
What is in the diet of a mouse?
What animals have "mouse" (or "mice") in their diet?
How many of our carnivores eat crustaceans? How can we find out whether the crustaceans are herbivores or carnivores?
If all insects were poisoned by pesticides, what would be the effect on the food chain?

To go back where you came from, click the Return Arrow.

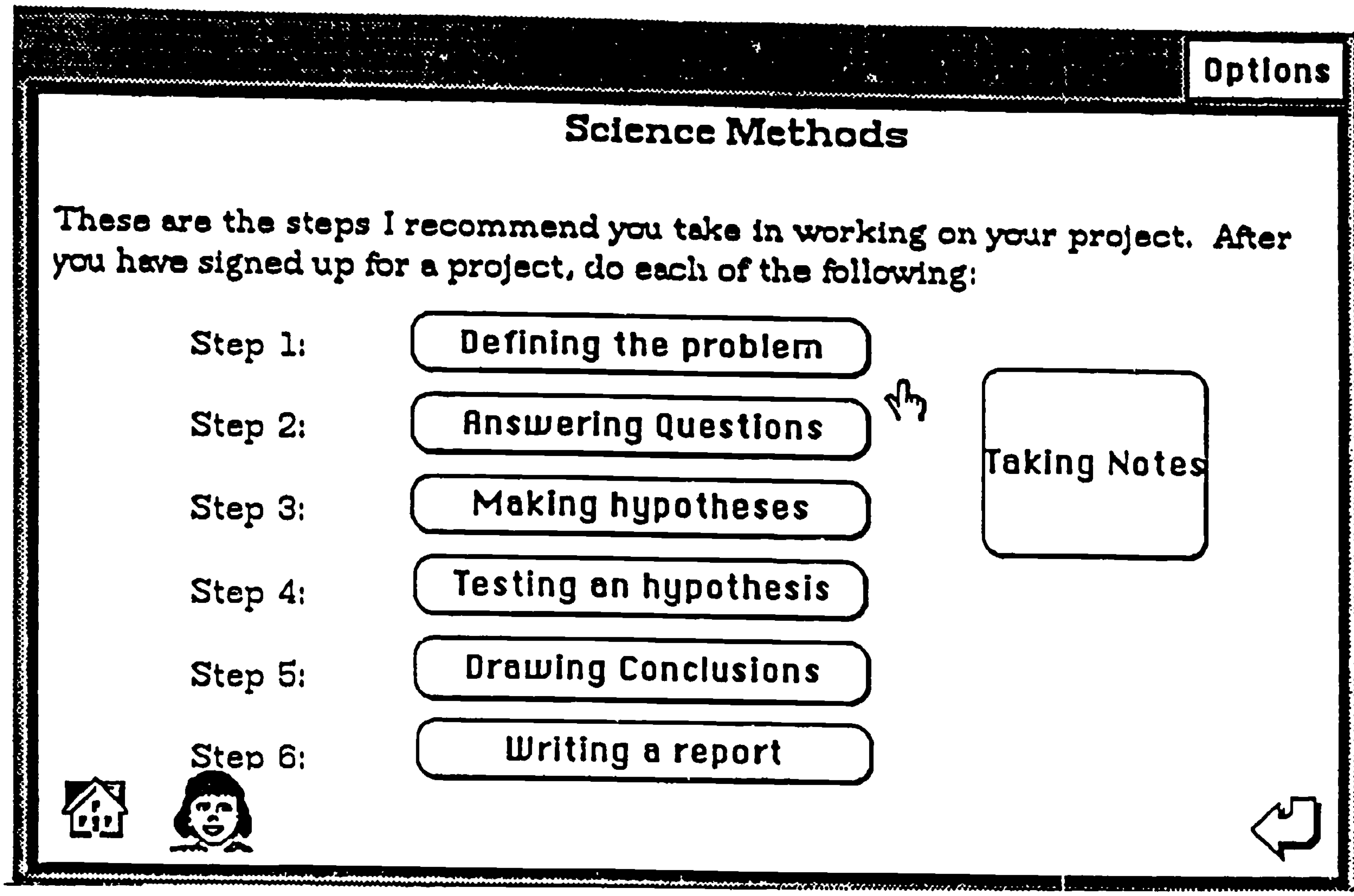
OVERHEAD 18


Boa Constrictor
Class: reptile
Food Chain: carnivore
Diet: small mammals, birds
Enemies: humans, jaguars, caimans
Body heat source: external
Hibernation: no
Range: Central America and South America; Mexico to Argentina
Biome: tropical rain forest and desert
Habitat: rain forest and deciduous forests and deserts
Selection Sentence
Select records where BIOME contains "desert".
Metric Units? Yes No
Options
Weight (lbs): 12
Length (Ft): 10.00
Life Span (Years): 38.8
Integument: scales (dry)
Reproduction Averages
64 young
Parental Care (days): 0
150 days gestation
Interesting facts
Not as big as it's reputation. Largest boa was 18.5 feet (5.64 meters).
My project or hypothesis
What do herbivores eat in the desert?

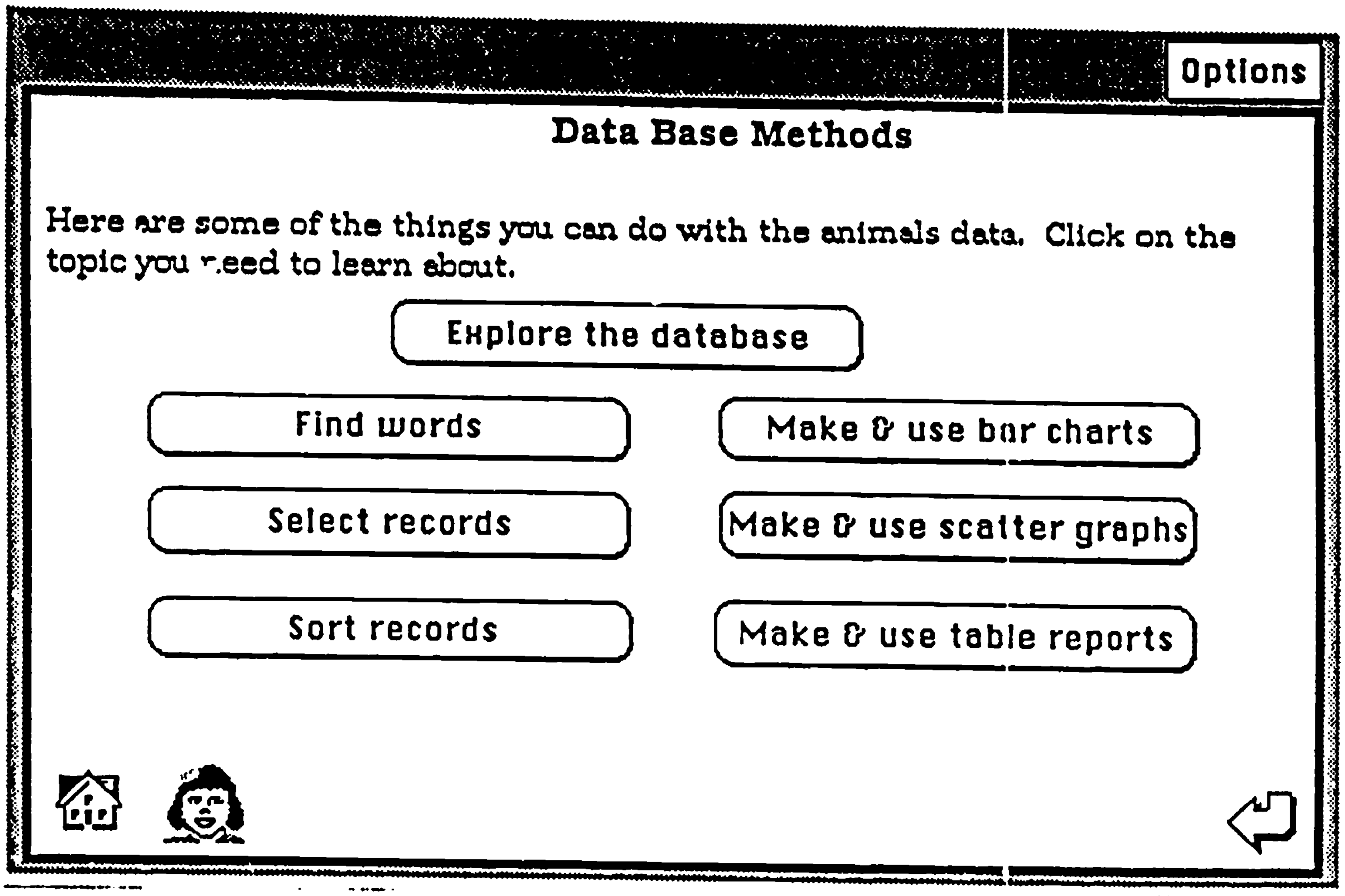
OVERHEAD 19


Food Chain: Question
columbia
Page 1
Options
Our question:
What do herbivores eat in the desert?
What we already
Do you want help using the notebook?
Cancel
Office
Yes
Question
Hypothesis
Methods
Graphs
Data
Conclusions

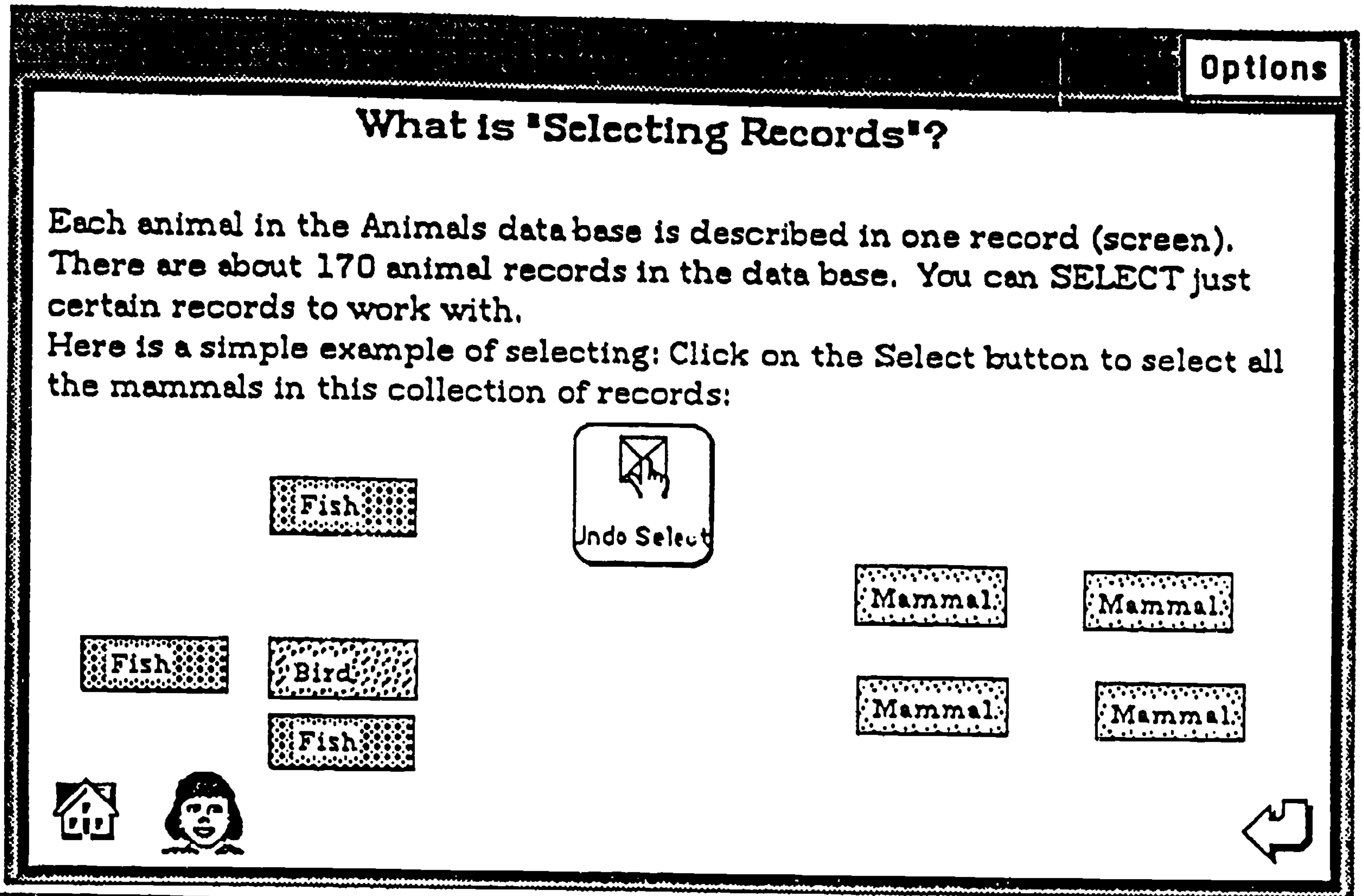
OVERHEAD 20


Options
Science Methods
These are the steps I recommend you take in working on your project. After you have signed up for a project, do each of the following:
Step 1: Defining the problem
Step 2: Answering Questions
Step 3: Making hypotheses
Step 4: Testing an hypothesis
Step 5: Drawing Conclusions
Step 6: Writing a report
Taking Notes

OVERHEAD 21


Options
Data Base Methods
Here are some of the things you can do with the animals data. Click on the topic you need to learn about.
Explore the database
Find words
Select records
Sort records
Make & use bar charts
Make & use scatter graphs
Make & use table reports

OVERHEAD 22


Options
What is "Selecting Records"?
Each animal in the Animals data base is described in one record (screen). There are about 170 animal records in the data base. You can SELECT just certain records to work with.
Here is a simple example of selecting: Click on the Select button to select all the mammals in this collection of records:
Fish
Undo Select
Mammal
Mammal
Fish
Bird
Mammal
Mammal
Fish

OVERHEAD 23

APPENDIX C

FIELD-TEST: REPORT OF FINDINGS

FIELD TEST OF THE HYPERTEXT PRODUCT
"SCIENTISTS AT WORK":
A REPORT OF FINDINGS

Charles S. White, Director
Center for Interactive Educational Technology
George Mason University
Fairfax, VA 22030

OVERVIEW

In the *Scientists At Work* project, we have developed a computer program to help middle school and high school children develop and apply science inquiry skills within the context of life science content. The Macintosh-based database program features an interactive coach to help learners define problems, formulate hypotheses, design experiments, gather and organize data, recognize patterns and relationships in data, apply data to solutions of problems, and recognize limitations in the data and in their own inquiry methods. The importance of these skills and the challenges faced in developing them have been underscored in recent educational literature.

The project has been carried out through a $137,249 grant from the U.S. Department of Education (#86.086S - "Improving Technology Software"), with support from Apple Computer Corporation. The development project team included Charles Blaschke (Education TURNKEY Systems), Beverly Hunter (Targeted Learning Corporation), Richard McLeod (Michigan State University), and Charles S. White (George Mason University). Dr. White led the project evaluation effort and performed the role of primary researcher for the *Scientists At Work* project.

Testing the program for technical soundness and instructional utility and effectiveness was carried out initially through one-on-one student interaction within a laboratory setting, followed by a classroom-based field test. What is described in the paper are preliminary results from this field test.

We have been interested in gauging the contribution of an interactive adviser to the development of problem-solving skills, since this distinguishes *Scientists At Work* from curriculum database products currently available. To seek some information in this regard, we applied a pretest-posttest design as the basis for the experimental component of the field test. Each project teacher involved two pairs of intact classes who followed essentially identical science curricula. Observational data collected during the treatment period augmented our understanding of the program's effectiveness, although these data have not been completely analyzed at this writing.

Beyond the cognitive effects of the adviser, we were also interested in students attitudes toward computer use and toward problem solving. On the one hand, the attitudes students bring to computer use and to problem solving may have an effect on information processing skill development (Davis, 1973; Salomon, 1983). On the other hand, we wished to examine whether interaction with ***Scientists At Work*** had a positive impact on these attitudes.

BACKGROUND AND INTRODUCTION

The primary purpose of this research project was to ascertain whether students' ability to process database information within a life science problem-solving context is enhanced when an embedded interactive coach is provided. At the core of this purpose was the following question: Can an interactive coaching system boost the power of databases to support information skill development? A growing literature on databases, information-processing skill development, and interactive coaches informed the development of the research reported here.

Databases and Information-Processing Skills

Considerable attention has been focused of late on the development of thinking skills among pre-college students. According to Perkins, "recognition of the contemporary problems of knowledge glut and knowledge obsolescence has in part inspired the current attention to the development of students' thinking" (Perkins, 1986, p. 4). The cluster of behaviors involved in locating, gathering, organizing and evaluating information figures prominently in prescriptions for developing thinking skills throughout the curriculum. With the entry of the microcomputer into schools, advocates of computer-based education have speculated on the potential power of the technology to developing thinking and information-processing skills (Mandinach and Linn, 1986; Clements, 1986).

Claims made for the potential effectiveness of database software in helping to develop information-processing skills as they serve problem solving have appeared frequently in the education literature (Hunter, 1985; Lockheed, Gulovsen, and Morrison, 1985; Lockheed, Gulovsen, and Morse, 1985; Lockheed and Mandinach, 1986; White, 1988). Dissatisfaction with pre-college computer literacy curricula that placed heavy emphasis on programming has also been responsible for increased interest in applications software like databases. Evidence is beginning to appear that database use does enhance information-processing skills associated with problem solving (White, 1987)[1], and this study provided an opportunity to further explore this apparent effect.

[1]White (1987) contains an extensive review of the relevant literature.

within the broader category of human/computer interfaces, but few studies have focused on the impact of different interfaces on information skills. Researchers in the Netherlands (Brazier and Beishuizen, 1986, 1987; Brazier and Trimp, 1988) have explored differences in information retrieval ability between a menu-driven versus a command-driven database system, finding that the latter yielded greater retrieval efficiency, particularly for novices. In a study particularly relevant to this project, Beishuizen (1986) examined directly the use of software-resident coaching in information retrieval. He found positive gains in retrieval efficiency using the coach, especially when students struggled with weakly-structured data. The proposed study will gauge the impact of interactive coaching on an array of information-processing skills, including information relevance identification, information sufficiency identification, and information organization efficiency.

Hypotheses and Questions

The study associated with the *Scientists At Work* field test endeavored to test following research hypotheses:

1. Compared to students in a control group, students who manipulate a database program with an interactive coach will demonstrate greater skill in processing information: specifically, in identifying data relevant and sufficient to solve given problems and in interpreting graphs relating to given problems.
2. Compared to students in a control group, students who manipulate a database program with an interactive coach will display more posit attitudes toward computer use and problem solving.

3. Students who come to a computerized database task with positive attitudes about computer use and about problem solving will demonstrate greater skill in processing information (as defined in Hypothesis #1) than students with poor attitudes toward computer use and problem solving, regardless of treatment level.

While the quantitative methods described below target these hypotheses directly, we employed largely qualitative methods to address a number of questions relevant to the product's features and their effects:

1. Is the coach sufficiently directive without undermining student independence? How frequently do students consult with the coach? How useful was the consultation? When during their inquiry efforts do students tend to consult the coach?
2. How much time do the various program features absorb? Are these time requirements reasonable in light of the time constraints typical of the classroom? Do some features, because of their time requirements, interfere with student inquiry and problem solving?
3. At what points do students need teacher intervention? At those points, what is the nature of those interventions?
4. How easy was the program to use, with respect to: the interface, navigation techniques, inquiry support tools, the notepad, and the dictionary?
5. What program features were most used/least used? Why?

As noted earlier, much of the qualitative data is yet to be analyzed, although we were able to develop some tentative impressions relative to these five questions. Subsequent sections of this paper describe the manner in which we gathered and analyzed data relevant to the hypotheses stated above.

RESEARCH DESIGN AND METHODOLOGY

The Experiment

Design

The experimental component of the field test employed intact classes, and each participating teacher involved at least one pair of his or her classes.[2] For each teacher, classes were randomly assigned to one of the two treatment levels. This reflects a randomized block design with classes assigned to treatment levels randomly within blocks represented by individual teachers, and with students nested within teachers and treatments. Pretest/posttest data were collected and the study used analysis of covariance, with pretests serving as covariates, to measure differences by treatment level.

Treatments

Two treatments were applied, both of which were based on a common set of materials and software. Treatment Level 1 used the *Scientists At Work* program in its entirety during the two-week treatment period, along with ancillary print materials developed for the field test.[3] Treatment Level 2 was identical to level 1 with the excep-

[2]For planning convenience, and to maximize the instructional benefits, participating teachers used the product with all of their classes if they wished.

[3]Lesson materials were developed by Beverly Hunter in collaboration with participating teachers to ensure maximum curriculum fit.

tion of the coach feature, which was disabled for this treatment. Each of the classes used four Macintosh SE computers and four printers for the duration of the project.

Observation

As mandated by the U.S. Department of Education grant, this project sought information about specific features of the *Scientists At Work product, as one would typically collect in a product field test. We believed that observation was more likely to enlighten this aspect of the project, so we utilized more "naturalistic" (Guba, 1978) methods to assist us in addressing questions enumerated earlier.*

The collection of observational data was facilitated by the use of two trained observers per classroom for the duration of the treatment period. Observers drawn from upper-level undergraduate teacher education majors at George Mason University were selected and trained by Dr. White as part of a three-credit Independent Study course developed expressly for this project. Data were collected using a checklist/frequency protocol and anecdotal notes were kept by observers.

Limitations

As is frequently the case when conducting classroom-based research which places a high premium on ecological validity, the results must be interpreted cautiously, for a number of reasons. First, while at least one study with a two-week treatment period did demonstrate significant differences in treatment levels, 10 class sessions of instruction is a limited timeframe for effects to become apparent. Second, we will have mostly anecdotal data regarding the benefits of databases per se, since there will be no "true" control group; that is, a group that does not use the computer program at all. We felt it more reasonable to allow teachers to use the product for all their classes, both to maximize the possible benefits and to minimize the planning problems.

A third limitation involved treatment contamination caused by teachers performing as their own controls. However, since we anticipated that the coaching feature would provide instantly accessible student assistance, contamination would still be limited by the teacher's ability to provide such instantaneous assistance. Finally, non-random sample selection clouds external validity a bit, although we believe that participating students spanned the full range of academic ability and were otherwise typical in other relevant respects. Additional limitations will be discussed later in the paper.

RESEARCH INSTRUMENTS

Experimental Instruments

Three paper-and-pencil instruments were used in this study, each of which has undergone validity and reliability testing.

Information-Processing Scale (IPS)

The purpose of the IPS is to measure students' ability (1) to recognize sufficient information to solve a given problem, (2) to recognize whether the information they are presented is relevant to a given problem, and (3) to interpret graphs relevant to a given problem. Measurement was accomplished using the 18-item IPS, which contains items representative of the three skills and which served as the primary dependent measure used to test the hypotheses.

The first two parts of the IPS scale listed above were developed as part of an earlier study (White, 1987). At that time, content and construct validity were assessed by a panel of six professionals consisting of four university faculty and two advanced doctoral students with expertise in instructional design and cognitive psychology. Several rounds of evaluation and revision produced the current version of IPS. Construct validity using factor analysis indicated that IPS should be used as a unidimensional scale for analysis purposes, and this approach will be applied in the current study. With respect to reliability of the 1987 IPS, a Kuder-Richardson-20 coefficient of .66 was obtained on a sample of 843 7th-11th graders. Administration and completion of the original IPS took approximately 45 minutes.

The results of previous IPS use by White suggested that the wording and problem complexity needed to be reduced in order to produce higher mean scores and reliabilities. The IPS version appearing in the Appendix represents the outcome of that revision, and is the version administered in this study.

Computer Attitude Scale (CAS)

The Computer Attitude Scale was developed by White (1987) and expanded on the attitude portion of the Computer Literacy Assessment designed by the Minnesota Educational Computing Consortium (1979). CAS is a 50-item Likert scale tapping two dimensions: attitudes toward personal computer use and attitudes about the social impact of computers. CAS validation procedures in the 1987 study included content validity assessment through a panel of experts, construct validity through factor analysis (which confirmed the desired dimensions), and a Cronbach standardized alpha coefficient of .91 (n = 813). CAS takes approximately 25 minutes to complete, but was administered to only half the sample to reduce the overall time devoted to data collection. A copy of CAS may be found in the Appendix.

Problem-Solving Attitudes Scale (PSAS)

This 22-item Likert scale is a two-dimensional instrument designed by White (1987) based on a scale developed by Carey (1958). One dimension taps respondents' personal like or dislike of problem solving, while the other measures their attitudes toward activities in which problem solving figures prominently (e.g., programming and puzzles). Content and construct validity were assessed in a manner similar to that described for the CAS and the results were favorable. A Cronbach alpha reliability of .83 (n = 843) was obtained by White in the 1987 study. PSAS administration and completion time is approximately 15 minutes, but was administered to the other half the sample only to reduce the overall time devoted to data collection. See the Appendix for a copy of the PSAS.

Observational Instruments (Protocols)

The Appendix also contains the observational instrument that was used in this project. The protocol provided frequency data on the use of particular program features. Pairs of observers sat in close to student groups in the Advisor treatment and recorded check marks corresponding to features currently under use by students every 30 seconds for 15 minutes, the typical duration of on-computer time for any group. Observers also recorded relevant anecdotes during the class sessions, and were debriefed after each session by Dr. White or his graduate assistant. Row and column totals were generated for each team.

SAMPLING AND DATA COLLECTION

The Sample

The *Scientists At Work* field test involved five teacher volunteers, each of whom contributed two pairs of classes in the study (20 classes in all). A total of 408 students were involved in the field test; however, due to a combination of logistical problems and needed materials revision, students from one of the five teachers were excluded from the analysis (84 students). An additional 13 students were excluded due to excessive missing data (more than half of the attitude scale items or 25% of the dependent measure items missing). Statistics reported below are based on a sample size of 311, all 7th grade life science or environmental science students in 16 classes (8 experimental and 8 control). As stated earlier, randomization was limited to intact classes being assigned to treatment levels within teacher pairs.

Based on teachers report, the student sample spanned a fairly broad range of abilities, allowing us to observe how the program performs with varying student populations. Teachers were asked to indicate which students have been identified as special needs or learning disabled, as well as those judged by the teacher as of low ability, in order to conduct separate analysis on that subsample. Students so identified totaled 50, or 16% of the sample.

Data Collection

Phase I: Coding

To ensure that pretest and posttest data from individual students remained intact throughout the study, participating teachers supplied the researcher with identification numbers to be printed at the top of each instrument. Teachers retained a master list that links student names to ID numbers and insured that each student completed four identically-coded instruments (two at the pretest phase and two at posttest). The researcher did not have access to the master list, thus preserving student anonymity.

Phase II: Pretest (1.5 class sessions)

The researcher produced the necessary copies of the measurement instruments with student ID numbers affixed to the top of each instrument. Prior to the treatment period, participating teachers will devoted half a class session to the attitude scale administration, distributing and then collecting researcher-provided instruments, and pencils. The same procedure was followed for the one-class session needed to complete the IPS. The project's graduate assistant was available to assist teachers in administering the pretests, and conveyed the completed instruments to the researcher for analysis.

Phase III: Observation (10 class sessions)

Two observers were present throughout the treatment period in classes identified as Advisor classes, observing groups of students as they worked on assigned problems with the help of the project software. Observers were instructed to remain as unobtrusive as possible. The researcher worked also with participating teachers to obtain their reflections about the use of Scientists At Work.

Phase IV: Posttest (1.5 class sessions)

The same procedure used to collect pre-test data was applied to post-test data collection.

DATA ANALYSIS

Experimental Data Analysis

Responses from the three paper-and-pencil instruments were entered into the mainframe computer at George Mason University for statistical analysis. Visual inspection of formatted raw data printouts helped locate and correct data entry errors prior to analysis.

Analysis of covariance was the statistical procedure of choice in this study, since it allowed the researcher to control for differences in baseline performance across classes and thereby to get a clearer picture of group differences accounted for by the treatments themselves. Using the pretest IPS score as a covariate, an analysis of covariance (with IPS as the dependent variable) was run on the data to test Hypothesis #1 (see above). Using each of the pretest attitude scores as covariates, analyses of covariance (with CAS and PSAS as dependent variables) tested Hypothesis #2. Finally, IPS pretest scores were coupled in turn with CAS and PSAS pretest scores as covariates to test Hypothesis #3, again using IPS as the dependent variable.

Observational Data Analysis

Checklist/Frequency Data

Frequency counts of program features used were compiled from the observational protocols. Frequencies alone allowed us to draw some inferences about how students approach problem-solving tasks. For example, frequent use of the SORT feature may be indicative of attempts to discover more useful organizations of data for a given problem solution. Use of the program's graphing capabilities may reflect varying abilities to interpret information that has been summarized visually.

Anecdotal Records

At the conclusion of each observation session, observers individually clarified or extended their anecdotal records for purposes of later recall. Debriefing sessions were conducted by the project graduate student and by the researcher in order (1) to amplify the written anecdotal record, (2) to record and clarify discrepancies within and across observers, and (3) to pursue in greater depth information relating in particular to Questions 1 through 4 listed in an earlier section. As is typically the case in naturalistic inquiry, we anticipated discovering patterns in the anecdotal record that will both help focus observations during the treatment period and identify trends that would clarify and explain the results of the statistical analysis.

QUANTITATIVE RESULTS

Instrument Reliabilities

A series of Kuder-Richardson-40 measures were obtained for the IPS scale used in this field test. In order to boost scale reliability to the maximum, three items were removed prior to statistical analysis, and the resulting 17-item scale achieved a reliability of .74, an improvement over previous iterations of the scale.

For both attitude scales, all items were retained after analysis used to generate Cronbach alpha reliabilities. The CAS scores exhibited a reliability of .95, while PSAS scores reached an alpha reliability of .86.

Intercorrelation of Measures

Figure 1 below displays post-test statistics for the key measures used in the study. The results of correlational analysis indicate that there is no relationship between student scores in problem solving and those of the IPS scale. While there is a significant correlation between attitude and IPS, the relationship is modest. For this reason, the use of either CAS or PSAS as covariates is contra-indicated.

	Intercorrelations					
Scale	*IPS*	*CAS*	*PSAS*	*Mean (Possible)*	*SD*	*n*
IPS	1.00	.24*	.04	8.69 (17)	3.47	311
CAS	.24*	1.00	-.20*	161.83 (250)	22.77	155
PSAS	.04	-.20*	1.00	69.51 (110)	9.02	156

*p = .000

Figure 1. Intercorrelations and Summary Statistics: Post-test

Also displayed in the above figure are mean scores for the three measures. The mean score for the IPS overall was 8.69 out of a possible 17, or 51.1% correct. While low for traditional grading purposes, a mean slightly above 50% is most desirable for statistical purposes. Inspection of the mean attitude scores reveals mildly positive attitudes toward computers and problem solving at the conclusion of the field test; on the five-point scale used, the means translate to 3.24 and 3.16, respectively.

Treatment Effects

A series of analyses of variance and covariance were performed on the data to test the three hypotheses stated at the outset. None of these analyses yielded statistically-significant results, including teacher and treatment-by-teacher interaction effects. The statistical analysis was unable to find any significant difference in information processing skill or attitudes between treatments. Figure 2 displays summary information about the IPS results for the pretest and post-test, broken down by treatment.

Scale	*Mean*	*SD*	*n*
PRE-IPS			
Overall	8.65	3.20	311
Advisor	8.88	3.18	147
No Advisor	8.44	3.22	164
POST-IPS			
Overall	8.69	3.54	311
Advisor	9.01	3.69	147
No Advisor	8.40	3.39	164

Figure 2. IPS Pretest/Post-test Results, by Treatment

Overall, students improved in performance on the IPS scale from pretest to post-test, but test sensitivity could explain such improvement. While not statistically significant when simple T-test procedures were applied, improvement in student scores for the Advisor treatment classes measured 1.5%, but the performance of their Non-advisor counterparts actually declined by 0.5%.

Similar analysis was performed for the low-ability subsample, whose scores on the IPS scale were significantly lower than their peers for both the pretest and post-test (pretest: $F = 25.815$ [1,309], $p = .000$; post-test: $F = 39.200$ [1,309], $p = .000$). Figure 3 summarizes low-ability student performance in comparison to average and above average students.

	Avg/High Ability			*Low Ability*		
Scale	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*
PRE-IPS						
Overall	9.04	3.11	261	6.62*	2.94	50
Advisor	9.38	3.01	122	6.48	2.93	25
No Advisor	8.74	3.17	139	6.76	3.00	25
POST-IPS						
Overall	9.21	3.47	261	5.98*	2.59	50
Advisor	9.65	3.57	122	5.92	2.55	25
No Advisor	8.82	3.33	139	6.04	2.68	25

*$p = .000$

Figure 3. IPS Pretest/Post-test Results, by Ability and Treatment

Removing the low-ability students, we see that the remaining subsample showed a 1.88% improvement of score between pre- and post-test, and that the experimental treatment group's (Advisor) improvement was greater than the control group's (No Advisor), with percentage gains of 2.88% and 0.92% respectively. Note also that, among low-ability students, the decline in performance between pre- and post-test was greater for the No Advisor groups than for the Advisor groups (-10.65% versus -8.64%).[4]

Aside from the effects of general ability on differences in IPS scores, which were not assessed in this study, a differential in attitudes toward problem solving was apparent between low-ability and other students. Differences in PSAS scores are presented in Figure 4 below.

Figure 4 also reveals an unexpected result: among average and high ability students, attitudes toward problem solving declined between the pretest and post-test ($t = 2.60$, df = 128, $p = .01$). Moreover, the downward turn occurs only for these students who are in the experimental (Advisor) group ($t = 2.68$, df = 54, $p = .01$).

The change in problem-solving attitudes uncovered above suggested that further analysis of computer attitudes should be conducted, the results of which are presented in Figure 5.

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[4]T test results failed to find any statistically-different pre-to-post differences for either treatment or ability level.

	Avg/High Ability			Low Ability		
Scale	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*
PRE-PSAS						
Overall	75.06	12.10	129	69.92[a]	7.73	25
Advisor	74.98	12.71	55	69.93	7.37	14
No Advisor	75.12	11.70	74	69.91	8.54	11
POST-PSAS						
Overall	73.09[b]	11.81	129	67.76[a]	8.78	25
Advisor	71.67[b]	10.36	55	68.07	7.77	14
No Advisor	74.15	12.75	74	67.36	10.30	11

[a]Difference between ability groups on pre- or post-test is significant at $p < .05$
[b]Pre/post difference within ability group is significant at $p < .05$.
Figure 4. PSAS Pretest/Post-test Results, by Ability and Treatment

	Avg/High Ability			Low Ability		
Scale	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*
PRE-CAS						
Overall	175.56	24.82	132	175.96	25.01	25
Advisor	177.10	24.23	67	182.27	17.37	11
No Advisor	173.97	25.51	65	171.00	29.37	14
POST-CAS						
Overall	173.39	27.50	132	167.48[a]	24.44	25
Advisor	173.81	25.89	67	174.27	13.65	11
No Advisor	172.95	29.26	65	162.14[a]	29.84	14

[a]Pre/post difference within ability group is significant at $p < .05$.
Figure 5. CAS Pretest/Post-test Results, by Ability and Treatment

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The differences between ability groups with respect to computer attitudes was not statistically significant. Within ability groups, only the low-ability group displayed a decline in attitudes toward computers ($t = 2.71$, df = 24, $p = .01$), and this occurred only for the control (No Advisor) group ($t = 2.53$, df = 13, $p = .025$).

OBSERVATIONAL RESULTS

Analysis of the qualitative data paints a strikingly more positive picture than portrayed by the statistical results reported above. Figure 6 below summarizes the mean percentage of time during which students used particular features or engaged in listed behaviors within each 15-minute observation session. The commentary that follows is based on those data.

Features Used

The values presented in Figure 6 represent aggregate feature use for all Advisor groups observed, across all lessons within the two-week treatment. From this information, we can see that students sought the advisor's "counsel" fairly frequently: 3½ minutes of each 15-minute session, on average. Some of this advice centered on database and scientific methods, which students investigated for an average of 17 and 13 percent (2½ and 2 minutes) of each session, respectively. More will be said later about the performance of the interactive advisor.

Observers reported a wide range of use, by feature, depending on the particular lessons students were completing. Early lessons promoted student exploration of features, but students tended to access those they found particularly intriguing. Of these, the PICTURE and SOUND features predominated. Later, as students were preparing their reports, the PRINT CARDS and notepad features led the way.

Among the inquiry support tools, the SELECT feature was most heavily used; on average, students invoked that feature 13 percent of time during each session, with that time span increasing from early to later lessons. Other such features were less frequently used, including FIND and SORT. The graphing tools were generally under-utilized, for two reasons; first, only later lessons required the generation of charts and graphs, and second, students were reaching a saturation point with respect to learning additional features during the second week of the treatment period.

In the course of debriefing project teachers and observers, some insights regarding the programs ease of use were developed. Generally, students found ***SAW***'s interface very approachable, a circumstance for which the Macintosh environment is most responsible. To the extent students had difficulty drawing maximum benefit from the program, the source of difficulty was the program's richness. Navigation was easy, but there was much to navigate. The inquiry tools were friendly, but perhaps too much so; their directiveness was instructive but time-consuming. The consensus of both teachers and observers was that the duration of the treatment was too brief to fully exercise many of the program's most powerful features.

Social Interaction, Time-on-Task, and Student Enthusiasm

Observers reported a high level of social interaction and time-on-task among all students in the project, regardless of treatment level. As indicated in Figure 6, for more than three-quarters of the time throughout the project, students were interacting with members of their group on issues and tasks related directly to the project (as opposed to idle conversation).

FEATURE	*MEAN % OF SESSION TIME USED*	*FEATURE*	*MEAN % OF SESSION TIME USED*
Animals Data Base	63.0	View animal record	17.0
Index	10.0	Options Menu	2.0
FIND	0.5	SELECT	13.0
SORT	7.0	BAR CHART	1.0
SCATTERGRAM	0.4	PRINT CARD	27.0
PRINT REPORT	17.5	PICTURE	20.0
SOUND	10.0	Dictionary	0.8
Program Notepad	23.0	Advisor's Office	23.0
Conversation Bubble	10.0	Science Methods	13.0
Data Base Methods	17.0	Projects	7.0
Nature Center	8.5	Quick Reference Guide	10.0
BEHAVIOR	*MEAN % OF SESSION TIME USED*	*BEHAVIOR*	*MEAN % OF SESSION TIME USED*
Team Interaction	77.0	Take Notes on Paper	30.0
Teacher/Classmate Assistance	11.5	Students in Group on Task	87.0

This is a percentage of group members, not of time.

Figure 6. Percentage of On-Computer Session for Specific Features and Behaviors, Advisor Groups Only

Related to our measure of social interaction is time-on-task, and the data support the view that student groups persisted in tasks throughout their time at the computer, with very little "drop out" by uninvolved students. Surely the novelty of the treatments contributed importantly to this result, but the ease with which the program manipulated data and presented multiple representations of the data also contributed to student perseverance and positive affect. The observations surrounding time-on-task and student enthusiasm, as well as highly laudatory teacher comments, contrast sharply with what one might conclude from the quantitative analysis presented earlier.

The Performance of the Interactive Coach[5]

Throughout the project, students in the experimental treatment accessed the advisor a bit less than a quarter of the time while at the computer. For a number of reasons, however, the benefit of an interactive advisor was not reflected in performance of the kind of information processing tasks required in problem solving, given the results of our quantitative analysis described earlier. A number of issues and problems encountered in the design and implementation of the advisor may have contributed to its checkered performance.

Advisor Expertise

The expertise in the Advisor covered three broad skill and knowledge domains: science inquiry, information-handling skills, and the research projects related to the animal database. In the interests of maximum student creativity and individuality, the expertise of the Advisor was fairly general. For example, there were no "wrong" hypotheses a learning might propose for a given project. For this reason, students may have found the advisor less helpful than they had hoped. It is theoretically possible to build far more expertise into the advisor, but this was beyond the scope of the current project.

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[5]This section is drawn from "*Scientists At Work* - An Interactive Advisor for Science Inquiry and Information-Handling Skills," a paper prepared by Beverly Hunter for the National Educational Computing Conference in Boston, Massachusetts, June 1989.

Knowledge of Student Progress

A major deficiency of the Advisor was that it lacked information about the students' intentions, plans, and strategies. Lacking planning information, the Advisor's recommendations were not always directly relevant to students' needs. Moreover, while the program maintained information about students' current project, research questions, and research hypothesis, the Advisor takes advantage of this information in much more limited ways than are theoretically possible.

Advisor Intervention

Common to all computer coaches are two fundamental questions that must be resolved; first, when to interrupt the student's problem-solving activity and, second, what to say once it has interrupted (Burton & Brown, 1982). In the case of ***Scientists At Work***, the Advisor (with one exceptions) provides advice, help, and reference information only upon the learner's request. Thus it was possible for groups to work for long periods of time without any Advisor interaction. The consequence was that by the time the students consulted the Advisor, the group had diverged so greatly from the Advisor's expertise that too wide a gap would develop. At this point, the Advisor would attempt to tutor the group on a topic which the students should have learned much earlier in their project. This was quite annoying to some students, who were focussed on solving a problem or accomplishing a particular task and did not want to be instructed on something they perceived as irrelevant at the moment.

Quality of Interaction and the Interface

Most of the design attention in the project focussed on issues relating to the user interface and the method of interaction between the students and the Advisor. As indicated at the outset of this report, the interaction was implemented in HyperCard. HyperCard is an implementation of the generic concept called hypertext or hypermedia. As such, it suffered from the difficulty common to all hypertext, which is that the user could easily get "lost" in the large information space available (Conklin, 1987). There were many options available to the students at any given time, and students did not always understand which of these options would most efficiently move them to where they wanted to go. One consequence of this was the need to provide a significant amount of structure outside of the program in the form of detailed worksheets.

Related to this was the design of "buttons," which are the places on the screen that the user "clicks" to go to the next set of information. Although a variety of techniques were used to standardize the "look and feel" of the buttons, observers reported that students frequently did nr . understand or attend to the buttons in the manner intended by the designers.

Sound as an element of the user interface raised another set of concerns. Many students stated a strong preference for *hearing* the Advisor's conversation rather than reading it. However, there are at present severe constraints on the amount of voice one can store on a disk. In the system on which this project was constructed, each second of sound required 11K bytes of storage.

A further interface issue involved the need for an Advisor to *demonstrate* certain information-handling procedures rather than simply explaining them. Within the development resources of this project, the designers were not able to create programmed demonstrations of procedures for performing information-handling tasks such as selecting a subset of data or making a graph. Thus, the Advisor could only provide a list of steps for performing the procedure, similar to that found in a printed user manual.

A final interface issue, and one of broader import, relates to the metaphor of a human advisor. Naturally, students have many implicit assumptions and expectations of a human advisor. A substantial number of students were frustrated because, of course, the advisor provided in the project is NOT human, even though it has some human-like qualities (voice, appearance). One alternative is to remove the metaphor from the advisor function altogether. Perhaps one might make the Advisor less formal, and more like a cartoon character for which students have not developed high expectations. Alternatively, the advisor function could resemble more an elaborate help system than an advisor.

DISCUSSION

The lack of statistically significant results in the qualitative dimension of this project, in contrast to the encouraging results from the qualitative dimension, demands some reflection of issues that can inform future studies.

Explaining Non-Significant Results

Measurement and Design Issues

Statistical analysis was unable to discover significant effects in information-processing skills attributable to the presence or absence of an interactive advisor. A number of factors may be responsible for this outcome. First, the IPS scale may not be sufficiently sensitive to measure genuine treatment effects. While several iterations of the IPS instrument have achieved more highly reliable scores, a KR-20 of .77 is still below what would wish for an aptitude measure. Aside from reliability, there are several nagging validity issues about the IPS. Although half of the test focuses on a content domain very close to in which the students were engaged during the treatment, the transfer from a computer program to a paper-and-pencil measure may be too great. Moreover, each IPS question can be seen as demanding a cluster of skills and subskills that should be the real targets for analysis. On the otherhand, of course, the questions enjoy important external validity value, replicating the kind of information tasks people are increasingly confronted with.

Beyond measurement limitations, the absence of significant quantitative results might be traceable to the research design itself. First, the duration of the treatment may have been insufficient for the information skills of interest to be affected enough to be measurable even by the most sensitive instrument. In an earlier study, White (1987) employed a treatment period comparable to the one used in this study, and was able to find statistically-significant results. However, the environment provided for student inquiry in this instance was far richer than in the earlier study, requiring more time to reach sufficient facility to achieve results. This point is corroborated by comments of several project teachers and their students that they felt somewhat rushed in learning to use the various inquiry support tools and in carrying out necessary lesson assignments. In the press of time, one can see how the potential benefits of an advisor can be submerged beneath a complex web of tools and capabilities.

Interesting, Non-Significant Trends

In the absence of statistically significant treatment effects, we can speculate about what *might* have been found had the deficiencies discussion above been eliminated, based on the *non-significant* changes in mean scores across treatments and ability levels. First, the mean IPS scores for the overall experimental treatment (Advisor) did change positively between pretest and post-test, while No Advisor mean scores moved lower. This is what one would expect if the Advisor treatment was manifesting its desired effect.

Second, when the sample is broken down by ability group, one finds gains for both treatments among average and high ability students, and declines for both treatments among low ability students. The latter may be explained by a level of frustration experienced by these students in grappling with a rich database designed to maximize independence, when in fact these students required a great deal more structure in interacting with the program. On the positive side, however, the IPS gain for average and high ability students was highest for the Advisor treatment, and the IPS decline for low ability students was least for the No Advisor treatment.

Explaining Significant Attitudinal Differences

Three differences among students with respect to attitudes emerged from the data analysis. First, one finds that low ability students' attitudes toward problem solving were significantly lower that those for average and high ability students. This may coincide with the former's lower IPS mean scores as well. While most people find some problem solving fairly taxing, it is not surprising to find that lower ability students find problem solving particularly difficult and, as a result, unpleasant. Working with ***Scientists At Work*** did not produce significantly more negative feelings toward problem solving for these students, although the means fall in that direction.

A second, and rather surprising, finding was the decline in attitudes toward problem solving among average and high ability students between the pretest and post-test. Moreover, this decline occurred within the Advisor treatment group, where one would expect the assistance of the advisor to make the problem-solving tasks less onerous and, thus, more pleasant. It could be that this subsample had higher expectations for the problem-solving expertise of the Advisor that were met during the treatment. This, combined with the frustration of learning a complex program in such a limited time, may be partly responsible for the decline.

Finally, low ability students' attitudes toward computers declined from pretest to post-test, among the No Advisor treatment group in particular. Without the benefit of the Advisor, these students may have lost faith in the computer's ability to aid them in their work, producing a decline in affect toward the technology. On the otherhand, however, means for both attitude scales declined between pre- and post-testing, although not significantly.

Implications for Further Research, Development, and Practice

Our knowledge of how students tackle problems requiring the manipulation of significant amounts of information, and how one might design an interactive coach to assist in that manipulation, has been significantly advanced through this study. Among the points that we believe must guide future research and development are the following three. First, the duration of the treatment must be substantially expanded, perhaps to a full school year. While history and maturation will both cast their shadow on the results, there is little prospect of producing genuine improvement in information-processing skills without several opportunities to engage in prolonged interaction with software of this kind. Extending treatment periods obviously will impose new demands on researchers and schools, but the position that quick interventions can produce meaningful results is being discredited at almost every turn, and is now roundly criticized by the varied constituencies involved in the public schools.

A second issue for further examination is that of measurement. Standardized tests have generally failed to measure the kinds of skills in which schools and the public are now interested in emphasizing. Problem-solving and information-processing skills are by nature difficult to conceptualize adequately, and to operationalize convincingly. More work needs to be done to refine the IPS instrument, and to produce more measures that tap significant skills.

Finally, future interactive coaches must display greater intelligence than the one developed for *Scientists At Work*. Among the enhancements must be the capability to provide much more structure to users who require it, while allowing other students to bypass tutorial elements they do not need. From an instructional standpoint, the advisor also ought to be able to demonstrate database and scientific methods, not just describe them. This is simply sound pedagogy, suggesting that the best result will be derived from development teams consisting of experienced classroom teachers well-versed in problem solving, skilled instructional designers and developers, imaginative evaluators, and talented programmers.

When asked what they liked most about *Scientists At Work*, teachers rarely mentioned the interactive coach per se. What captured their enthusiasm was the program's ability to involved students with significant research experiences, within an informationally-rich environment. The teachers recognized that successful problem solving in such an environment is most likely to prepare students to confront an increasingly information-glutted culture. The teachers want computer technology needs to amplify the impact of their teaching, and so they also recognize the considerable potential of an interactive coach. These are the circumstances, and the needs, that will drive future research and development in the realm of interactive coaches for effective information handling.

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APPENDIX

1. Information-Processing Scale (IPS) Instrument
2. Computer Attitude Scale (CAS) Instrument
3. Problem Solving Attitude Scale (PSAS) Instrument
4. Observation Protocol

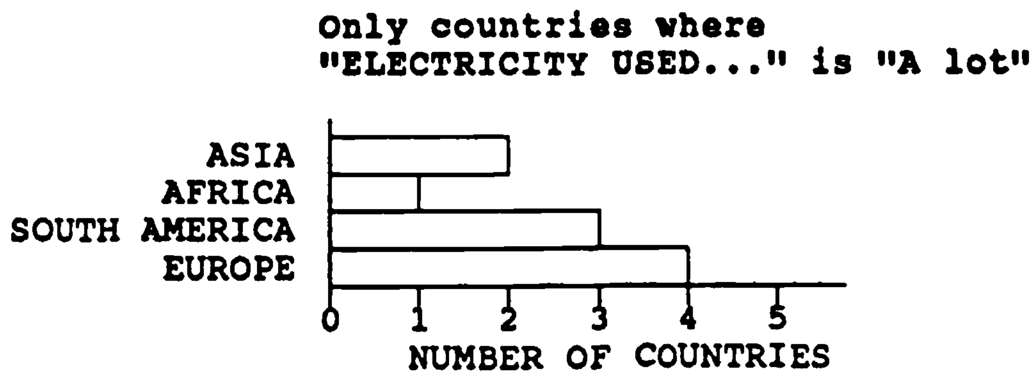
Number ____________

FORM NUMBER 1

Instructions: CAREFULLY REMOVE the WHITE reference sheet from the back of this handout and put it on your desk.
USE THE REFERENCE SHEET to help you answer each question on the WHITE pages that follow in this handout.
CIRCLE ONLY ONE ANSWER FOR EACH QUESTION, the one you think is the BEST answer.

READ THIS BEFORE YOU BEGIN:

For the next 10 questions, make believe that I've given you a stack of index cards with information about 52 countries around the world (13 each in Africa, Asia, Europe, and South America). Each country card has 9 information categories, such as NAME OF COUNTRY and REGION OF THE WORLD. The categories appear on the country index card shown on the WHITE reference sheet.



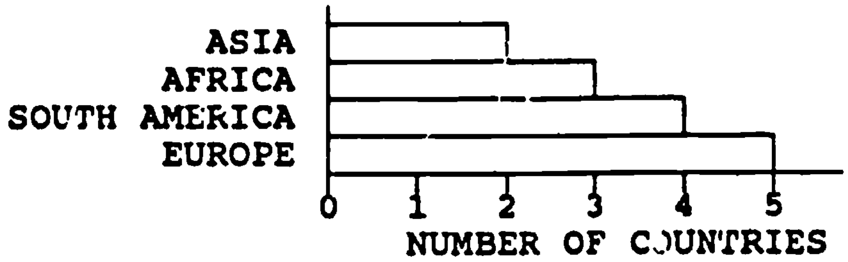
Look at the chart above. It was made using the information about the 52 countries, based on the stack of cards I just described.

Based on the CHART above, all of the following statements are true EXCEPT for which one: (CIRCLE a, b, c, OR d)

a. Africa has the fewest countries that use a lot of electricity.
b. Europeans use more electricity per person than any of the other regions.
c. Asia and Africa added together have more countries that use lot of electricity than Europe.
d. If the world lost all its electricity, people living in Europe would probably be most affected, compared to people in the other regions.

Refer to the 9 categories of information about countries on the **WHITE** reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the country index cards.

Only countries where
"OIL USED..." is "A lot"

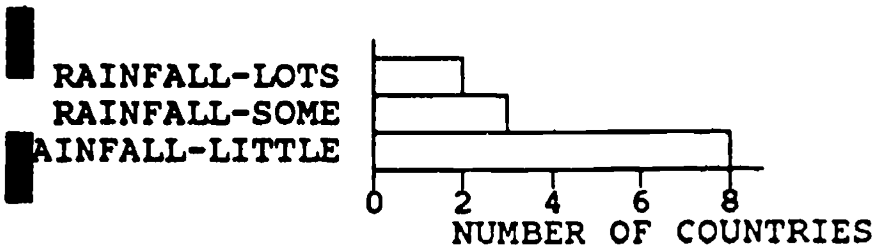


Look at the chart above. It was made using the information about the 52 countries, based on the stack of cards I described on page 1.

According to the CHART above, which <u>one</u> of the following statements is true? (CIRCLE a, b, c, OR d)

a. There are more countries located in South America than there are in Africa.
b. Asia has the fewest countries that depend heavily on oil, compared to the other regions.
c. Countries in North America use more oil per person per year than countries in the other regions.
d. Europe has twice as many countries that use a lot of oil than Africa has.

Only countries where
"REGION OF THE WORLD" is "Africa"



3. Look at the chart above. It was made using the information about 52 countries, based on the stack of cards I described on page 1.

According to the CHART above, which <u>one</u> of the following statements is true? (CIRCLE a, b, c, OR d)

a. More than half of the countries in Africa get little rainfall.
b. As a region, African countries get less rain than countries in other regions.
c. Most countries in Africa get some or lots of rainfall.
d. More than half of the countries in the world get little rainfall.

Refer to the 9 categories of information about countries on the WHITE reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the country index cards.

Only countries where "REGION" is "Asia"

Country	Oil Used per Person
China	Not much
S. Korea	Some
N. Korea	Some
Japan	A lot
Thailand	Not much
Mongolia	Not much
Philippines	Not much
India	Some
Burma	Not much
Nepal	Not much
Laos	Some
Cambodia	Not much
Turkey	Not much

Only countries where "REGION" is "Europe"

Country	Oil Used Per Person
England	A lot
France	A lot
W. Germany	A lot
E. Germany	A lot
Spain	Some
Italy	A lot
Ireland	Some
Denmark	A lot
Switzerland	A lot
Portugal	Some
Belgium	A lot
Greece	A lot
Poland	A lot

4. Look at the two lists of information above. One lists only Asian countries, and the other lists countries in Europe.

Based on the lists above, which one of the following statements is BEST SUPPORTED by the lists? **(CIRCLE a, b, c, OR d)**

a. If the world's oil dried up, Asia would be hurt more than Europe.
b. European countries must waste more oil than Asian countries do.
c. Japan is as dependent on oil as countries in Europe.
d. Europe must be colder than Asia.

5. Let's say you want to find some information just about South America. Which one of the 9 categories of information on the country index cards would be MOST HELPFUL to you?
(CIRCLE a, b, c, OR d)

a. REGION OF THE WORLD
b. NAME OF COUNTRY
c. AVERAGE ANNUAL FAMILY INCOME
d. SOUTH AMERICA

Refer to the **9** categories of information about countries on the **WHITE** reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the country index cards.

Looking at the country index card, you can see that you would have enough information to find out whether **3** of the statements below are true or not for the 52 countries.

For which one of the following statements do you NOT have enough information to check if it is true or not? **(CIRCLE a, b, c, OR d)**

a. Countries that produce a lot of oil also are the biggest users of oil.
b. In general, the countries that produce the most oil per person are located in Asia.
c. Most European countries have to import (buy) oil from other countries.
d. Countries use oil mostly to produce electricity.

7 Let's say you want to find some information about cold countries.
Which one of the 9 categories of information on the country index cards would be MOST HELPFUL to you? **(CIRCLE a, b, c, OR d)**

a. REGION OF THE WORLD
b. CLIMATE
c. OIL PRODUCED PER PERSON PER YEAR
d. RAINFALL

8 For only one of the following statements would you have enough information from the country index cards to see if it is true or not for the 52 countries. Which statement is it? **(CIRCLE a, b, c, OR d)**

a. Countries that produce a lot of oil don't need to rely on nuclear power plants for electricity.
b. In general, the countries that produce the most oil per person are located in North America.
c. Countries use oil mostly to produce plastics and related materials.
d. Most South American countries have to buy oil from other countries.

9 If you want to find information about the amount of rain that falls in Asia, which one pair of the 9 information categories would be MOST HELPFUL to you in finding that information? **(CIRCLE a, b, c, OR d)**

a. REGION OF THE WORLD and RAINFALL
b. NAME OF COUNTRY and RAINFALL
c. REGION OF THE WORLD and CLIMATE
d. REGION OF THE WORLD and NAME OF COUNTRY

Refer to the 9 categories of information about countries on the WHITE reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the country index cards.

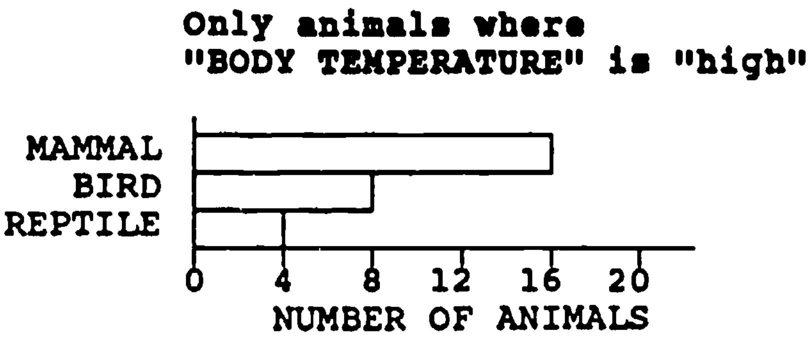
10. There is only one statement below for which you would have enough information to check its accuracy, using the 52 country index cards. Which statement is it? (CIRCLE a, b, c, OR d)

a. Countries whose average temperature is less than 45° F have the least number of air conditioners per 1,000 people.
b. Family incomes are higher in countries that produce a lot of oil, compared to countries where not much oil is produced.
c. Countries that produce a lot of oil attract oil workers from surrounding countries.
d. European families save a higher percentage of their income than South American families do.

Instructions: **CAREFULLY REMOVE** the **BUFF** reference sheet from the back of this handout and put it on your desk.
USE THE REFERENCE SHEET to help you answer each question on the **BUFF** pages that follow in this handout.
CIRCLE ONLY ONE ANSWER FOR EACH QUESTION, the one you think is the **BEST** answer.

READ THIS BEFORE YOUR BEGIN:

For the last 10 questions, make believe that I've given you a stack of index cards with different information -- this time the cards are about 60 animals (20 animals each of mammals, birds, and reptiles). Each animal card has 8 information categories, such as NAME OF ANIMALS and TYPE OF ANIMAL. The categories appear on the animal index card shown on the BUFF reference sheet.



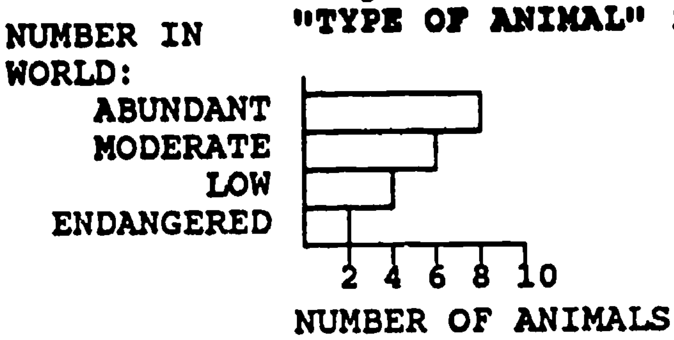
1 Look at the chart above. It was made using the information about the 60 animals in the categories I just described.

Based on the CHART above, all of the following statements are true, EXCEPT for which one? (CIRCLE a, b, c, OR d)

a. More mammals have high body temperature than any of the other types of animals.
b. The fewest animals with high body temperatures are reptiles.
c. There are fewer mammals with high body temperatures than birds and reptiles added together.
d. Scientists looking for animals with low body temperatures should start by looking for reptiles.

Refer to the 8 categories of information about animals on the BUFF reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the animal index cards.

Only animals where "TYPE OF ANIMAL" is "mammal"



Look at the chart above. It was made using the information about the 60 animals, based on the stack of cards I described on the previous page.

According to the CHART above, which one of the following statements is true? (CIRCLE a, b, c, OR d)

a. There are fewer mammals that are endangered than either reptiles or birds.
b. Most mammals are either endangered or low in number
c. Less than half of the world's animals are abundant in number.
d. Less than half of the mammals are abundant.

Only animals where "MIGRATE" is "yes"

ANIMAL	FOOD EATEN
ROBIN	BOTH
BUFFALO	VEGETATION ONLY
LONGHORN SHEEP	VEGETATION ONLY
LION	ANIMALS ONLY
EAGLE	ANIMALS ONLY

Only animals where "MIGRATE" is "no"

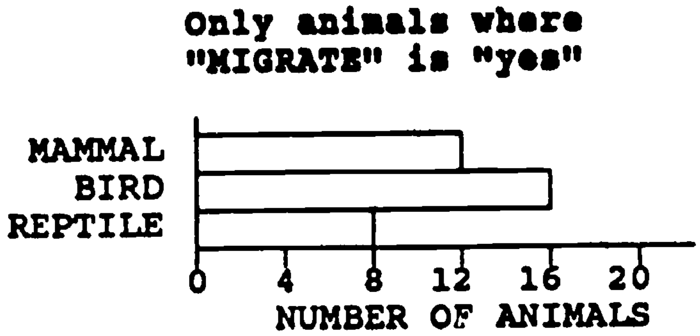
ANIMAL	FOOD EATEN
BEAR	BOTH
MOUSE	BOTH
HUMAN	BOTH
MOOSE	VEGETATION ONLY
OWL	BOTH

Look at the two lists of information above (not all the animals are listed). One lists only animals that migrate, and the other lists animals that do not migrate.

Based on the lists above, which of the following statements is BEST SUPPORTED by the lists? (CIRCLE a, b, c, OR d)

a. Animals that eat both vegetation and animals are most likely to migrate with the seasons.
b. Animals who migrate, travel south in winter and north in summer.
c. Animals that eat a wider variety of food do not need to migrate to find year-round food.
d. Humans don't migrate with the seasons because they live in houses.

Refer to the 8 categories of information about animals on the BUFF reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the animal index cards.



14. Look at the chart above. It was made using the information about the 60 animals, based on the stack of cards I described earlier.

According to the CHART above, which <u>one</u> of the following statements is true? (CIRCLE a, b, c, OR d)

a. Insects do more migrating than any other kind of animal.
b. Birds are more likely to travel a lot during their lives, in comparison to the other types of animals.
c. Birds outnumber reptiles in the world by 2 to 1.
d. A large percentage of reptiles migrate than the percentage of mammals that migrate.

15. Let's say you want to find some information about the effects of pollution on animals.

Which <u>one</u> of the 8 categories of information on the animal index cards would be <u>MOST HELPFUL</u> to you in finding this information? (CIRCLE a, b, c, OR d)

a. LEADING CAUSE OF DEATH
b. TYPE OF ANIMAL
c. FOOD IT EATS
d. NUMBER IN WORLD

16. You would <u>have enough information</u> to check the accuracy of <u>only one</u> of the statements below, using the 60 animal index cards I have described. For which <u>one</u> statement do you <u>have enough information</u>? (CIRCLE a, b, c, OR d)

a. Animals with fast heart rates eat more food than animals with slow heart rates.
b. Water pollution is more dangerous to animals than other kinds of pollution.
c. Migrating animals die more from the weather than any other cause.
d. Animals that eat only vegetation don't get sick as often as animals that eat just other animals or both vegetation and other animals.

Refer to the 8 categories of information about animals on the BUFF reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the animal index cards.

17. Looking at the animal index card, you can see that you would have enough information to find out whether 3 of the statements below are true or not for the 60 animals.

For which one of the following statements do you NOT have enough information to check if it is true or not? **(CIRCLE a, b, c, OR d)**

a. Animals that are abundant in the world are more likely to die from old age than from any other cause.
b. Animals that don't migrate are more abundant than animals that do migrate.
c. Animals with low body temperatures are more likely to die from the weather than from any other cause.
d. Animals with fast heart rates run away from other animals better than animals with slow heart rates.

18. Let's say that you want to find information about the eating habits of reptiles.

Which one pair of the 8 information categories would be MOST HELPFUL to you finding the information you need? **(CIRCLE a, b, c, OR d)**

a. NAME OF ANIMAL and FOOD IT EATS
b. TYPE OF ANIMAL and FOOD IT EATS
c. TYPE OF ANIMAL and MIGRATE
d. TYPE OF ANIMAL and NAME OF ANIMAL

19. Looking at the animal index card, you can see that you would have enough information to find out whether 3 of the statements below are true or not for the 60 animals.

For which one of the following statements do you NOT have enough information to check if it is true or not? **(CIRCLE a, b, c, OR d)**

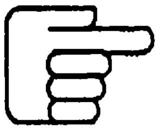
a. Reptiles are more likely to have low body temperatures than other animals.
b. Compared to other animals, large animals tend to die of old age more than any other cause.
c. Weather is more likely to kill reptiles than other kinds of animals.
d. The world's most abundant animals tend to die more from being hunted than from any other cause.

Refer to the 8 categories of information about animals on the BUFF reference sheet. (REMEMBER: you can only use information that would appear in the categories listed on the animal index cards.

20. Let's say you want to find information only about birds.

Which one of the 8 categories of information would be MOST HELPFUL to you finding the information you are looking for?
(CIRCLE a, b, c, OR d)

a. NAME OF ANIMAL
b. MIGRATE
c. BIRD
d. TYPE OF ANIMAL



USE THIS SHEET

TO HELP YOU ANSWER THE QUESTIONS

ON THE BUFF PAGES.

1. **NAME OF ANIMAL:**
2. **TYPE OF ANIMAL:** (either mammal or bird or reptile)
3. **BODY TEMPERATURE:** (either high or average or low)
4. **HEART RATE:** (either fast or average or slow)
5. **MIGRATE:** (either yes or no)
6. **NUMBER IN WORLD:** (either abundant or moderate or low or endangered)
7. **LEADING CAUSE OF DEATH:** (either pollution or hunting or weather or old age or animals other than humans)
8. **FOOD IT EATS:** (either vegetation only or animals only or both)

ANIMAL INDEX CARDS

USE THIS SHEET

TO HELP YOU ANSWER THE QUESTIONS

ON THE WHITE PAGES.

1. **NAME OF COUNTRY:** (13 countries per region. Total = 52 countries)

2. **REGION OF THE WORLD:** (either Africa or Asia or Europe or S. America)

3. **CLIMATE:** (either hot or warm or cold)

4. **RAINFALL:** (either lots or some or little)

5. **ELECTRICITY USED PER PERSON PER YEAR:** (either alot or some or not much)

6. **OIL USED PER PERSON PER YEAR:** (either alot or some or not much)

7. **OIL PRODUCED PER PERSON PER YEAR:** (either alot or some or not much)

8. **AIR CONDITIONERS PER 1,000 PEOPLE:** (either alot or some or not many)

9. **AVERAGE ANNUAL FAMILY INCOME:** (either high or moderate or low)

COUNTRY INDEX CARDS

Number ____________

SCALE 1

Instructions: Please circle the number for each item that best reflects your opinion or feelings. Be sure to respond to all the items, and to circle ONLY ONE NUMBER for each item.

1=strongly disagree	2=disagree	3=uncertain	4=agree	5=strongly agree

1.	If I had my own computer, I'd use it to help with my homework.	1	2	3	4	5
2.	It is easier to correct a computer programming error than most people think.	1	2	3	4	5
3.	Learning how to program a computer is fun.	1	2	[illegible]	4	5
4.	Someday, a computer is going to start a war by accident.	1	2	3	4	5
5.	It takes a good math mind to really use computers.	1	2	3	4	5
6.	Computers create more problems than they solve.	1	2	3	4	5
7.	I can never get as much time at a computer as I'd like.	1	2	3	4	5
8.	In a few years, all the interest in computers will die out.	1	2	3	4	5
9.	I like working with computers.	1	2	3	4	5
10.	If I had my way, I'd ban all computers.	1	2	3	4	5
11.	I would spend most of the school day at a computer if I could.	1	2	3	4	5
12.	Sometimes, I get really impatient with people who aren't "computer literate."	1	2	3	4	5
13.	I don't understand why a lot of people are so interested in computers.	1	2	3	4	5
14.	It wouldn't bother me if I found out that the government had information about me in one of its big computers.	1	2	3	4	5
15.	Computers can help students raise their test scores.	1	2	3	4	5

1=strongly disagree	2=disagree	3=uncertain	4=agree	5=strongly agree

16.	Most videogames aren't as exciting as people say they are.	1	2	3	4	5
17.	People who spend all their time at a computer are wasting a lot of good time.	1	2	3	4	5
18.	I'm not the kind of person who would work well with a computer.	1	2	3	4	5
19.	I can't picture myself making a living someday with a computer.	1	2	3	4	5
20.	Computers will never live up to the claims people make about them.	1	2	3	4	5
21.	People who are afraid of computers are being silly.	1	2	3	4	5
22.	I have no interest in learning more about how to use a computer.	1	2	3	4	5
23.	Computers solve more problems than they create.	1	2	3	4	5
24.	Society wouldn't work very well these days without computers.	1	2	3	4	5
25.	Sometimes a computer can really mess things up.	1	2	3	4	5
26.	When people I know start talking about computers, I really feel out of place.	1	2	3	4	5
27.	I'd like to learn more about computer programming.	1	2	3	4	5
28.	If I had enough money, I'd probably spend a lot of time at a videogame arcade.	1	2	3	4	5
29.	People who say computers are a threat to society don't know what they're talking about.	1	2	3	4	5
30.	I'm smart enough to learn just about anything I want to know about computers.	1	2	3	4	5
31.	We would all be better off without computers.	1	2	3	4	5
32.	Computer scientists probably do interesting work.	1	2	3	4	5
33.	I think just about everybody ought to have his/her own computer.	1	2	3	4	5
34.	People are too quick to blame a computer for mistakes.	1	2	3	4	5
35.	I'm not interesting in taking computer classes.	1	2	3	4	5
36.	I think computers are great.	1	2	3	4	5

1=strongly disagree	2=disagree	3=uncertain	4=agree	5=strongly agree

37.	Computers in society give too many people too much information about other people.	1	2	3	4	5
38.	I really get tired of people who can't stop talking about computers.	1	2	3	4	5
39.	People get too upset about kids who use their own computer to break into another computer illegally.	1	2	3	4	5
40.	I think I'd like to work with computers after I get out of school.	1	2	3	4	5
41.	Someday computers are going to get out of control.	1	2	3	4	5
42.	Computers are so smart that sometimes they make me feel dumb.	1	2	3	4	5
43.	Computers are too complicated for me to use.	1	2	3	4	5
44.	If I had my way, every student in school would have his/her own computer.	1	2	3	4	5
45.	Someday I'll probably lose a job to a robot.	1	2	3	4	5
46.	Society is becoming too dependent on computers.	1	2	3	4	5
47.	If I tried using a computer, I'd probably break it.	1	2	3	4	5
48.	Students should be taught more about computers.	1	2	3	4	5
49.	I don't think I'm very good at using a computer.	1	2	3	4	5
50.	Computers will solve more problems in our world than most people can even imagine.	1	2	3	4	5

How much experience have you had working with a computer? (CHECK ONE)

A lot _____ Some _____ Not much _____ None _____

How much experience have you had with a Macintosh computer? (CHECK ONE)

A lot _____ Some _____ Not much _____ None _____

Do you have a computer at home? (CHECK ONE)

Yes _____ No _____

Number ____________________

SCALE 1

Instructions: Please circle the number for each item that best reflects your opinion or feelings. Be sure to respond to all the items, and to circle ONLY ONE NUMBER for each item.

1=strongly disagree	2=disagree	3=uncertain	4=agree	5=strongly agree

1.	I'd like to learn more about computer programming.	1	2	3	4	5
2.	I like to solve problems.	1	2	3	4	5
3.	I do well in math classes.	1	2	3	4	5
4.	Once I pick up a puzzle book, I find it hard to put it down.	1	2	3	4	5
5.	I think I would like figuring out programs that make the computer do what I want it to.	1	2	3	4	5
6.	When I was in elementary school, I liked arithmetic better than spelling.	1	2	3	4	5
7.	It is hard for me to concentrate on what I'm doing.	1	2	3	4	5
8.	My friends often ask me to help them solve puzzles or brain teasers.	1	2	3	4	5
9.	Getting a computer program to run the way I want it to would be an enjoyable challenge.	1	2	3	4	5
10.	I avoid games that involve a lot of thinking.	1	2	3	4	5
11.	I would rather watch a comedy program than a debate on television.	1	2	3	4	5
12.	Mathematics is one of my favorite subjects.	1	2	3	4	5
13.	When a problem arises that I can't immediately solve, I stick with it until I have a solution.	1	2	3	4	5
14.	I like to try new games.	1	2	3	4	5
15.	I find it helpful to count on my fingers when doing arithmetic.	1	2	3	4	5
16.	I'd rather play videogames than write my own videogame programs.	1	2	3	4	5

1=strongly disagree	2=disagree	3=uncertain	4=agree	5=strongly agree

17.	I like puzzles.	1	2	3	4	5
18.	Computer programming would be too frustrating.	1	2	3	4	5
19.	I am challenged by situations I can't immediately understand.	1	2	3	4	5
20.	I enjoy problem solving of many kinds.	1	2	3	4	5
21.	I am as good at solving problems as most of my friends are.	1	2	3	4	5
22.	I would enjoy learning how to program a computer.	1	2	3	4	5

How much experience have you had working with a computer? (CHECK ONE)

A lot _____ Some _____ Not much _____ None _____

How much exper'ence have you had with a Macintosh computer? (CHECK ONE)

A lot _____ Some _____ Not much _____ None _____

Do you have a computer at home? (CHECK ONE)

Yes _____ No _____

Scientists at Work Observation Protocol

Instructions to observers: Observe a team during its entire On-Computer activity session Make checkmarks in the boxes below to indicate # students on task and features of the program being used at each 30-second interval.

30-second interval:																													
# Students on task																													
Animals Data Base																													
View animal record																													
Index																													
Options Menu																													
FIND																													
SELECT																													
SORT																													
BAR CHART																													
SCATTERGRAM																													
PRINT CARD																													
PRINT REPORT																													
PICTURE																													
SOUND																													
Dictionary																													
Program Notepad																													
Advisor's Office																													
Conversation Bubble																													
Science Methods																													
Data Base Methods																													
Projects																													
[illegible]																													
Teacher/Classmate Assistance																													
Quick Guide Ref																													
Take Notes on paper																													
Team Interaction																													
Other(note on back)																													

Class Code ____________ Team Name ______________ Lesson ______________

Observer ____________ Session Mins. ______________ Date ______________

A P P E N D I X D

REQUESTS FOR PROGRAM/VIDEOTAPE

HARVARD UNIVERSITY
Graduate School of Education
Roy E. Larsen Hall, Appian Way
Cambridge, Massachusetts 02138

Laboratory of Human Development

May 25, 1989

Charles L. Blascke, President
Education TURNKEY Systems, Inc.
256 North Washington Street
Falls Church, Virginia 22046

Dear Mr. Blasche:

I read your "Scientists at Work" package with great interest. I would like to discuss and demonstrate your approach to using the computer for critical inquiry in science in my course "Learning as an Interactive Process" in the Fall 1989.

Please send me information about how I can order the software, user guide, starter lesson plans, and videotape. I will need these as soon as possible to plan for the Fall.

Thank you very much.

Sincerely,

Colette Daiute

Colette Daiute
Asscciate Professor

CD:ao

Room 7973218 1-March-89 19:35

From: X0284 Targeted Learning, B. Hunter

To: X0367 Ed Turnkey System, Charles Blaschke

Sub: sheldon fisher

Sheldon Fisher called me today, demanding a copy of Scientists at Work. Would you please handle his needs? I told him we would give him the user guide on disk along with the program. He can print it.

GEORGIA EDUCATIONAL TECHNOLOGY CENTER
1568 WILLINGHAM DRIVE
SUITE F-100
COLLEGE PARK, GEORGIA 30337

25 January 1989

Education TURNKEY Systems, Inc.
256 North Washington Street
ATTN: Charles L. Blaschke
Falls Church, VA 22046

Gentlemen,

A new NSEA site, the Georgia Educational Technology Center is attempting to get underway, would like to include your products in its activities. It is our understanding that you have made available certain products at no charge to organizations of our type. We currently have two McIntosh SE systems, and one Apple 2E. Please forward as many of these products as you allow.

Thank you very much for your support and assistance in the education of handicapped individuals in Georgia.

Bonnie W. Webb
Director, GETC

CUPERTINO•FREMONT
MODEL
TECHNOLOGY
SCHOOLS
PROJECT

January 18, 1989

Charles L. Blaschke
President
Education TURNKEY Systems, Inc.
256 North Washington Street
Falls Church, Virginia 22046

Dear Mr. Blaschke:

I am interested in receiving your video on "Scientists at Work", a Macintosh/Hypercard program. Please let me know how I may obtain this video. Any information may be sent to the address below. Thank you.

Sincerely,

Harvey Barnett
Director, Technology Support

HB:sca

10301 Vista Drive
Cupertino, CA 95014
(408) 252-3000 ext. 481
APPLELINK K1374

APPENDIX E

TEACHING THINKING SKILLS WITH DATABASES

News Release
For Immediate Release

Publishers of The Computing Teacher journal.

Teaching Thinking Skills With Databases

Eugene, OREGON -- January 3, 1989 --

The International Council for Computers in Education (ICCE) announces the availability of a new addition to its line of courseware: ***Teaching Thinking Skills With Databases***.

This new innovative program is a step-by step guide for Grades 4-8 , providing detailed instructions and ideas for teaching with databases in any subject area. The learning activities are sequenced in fifteen steps, progressing from lower order to higher order thinking skills. Each step is illustrated with scripted lesson plans on the 50 United States. The states serve as a model to be adapted towards any subject area.

The courseware has been extensively field tested and contains:

14 data files on disk

46 worksheet and transparency masters

All of these materials are ready to use in classroom applications.

Author Jim Watson holds a B.A. degree in history and elementary education from the University of Washington. He is currently a computer teacher/coordinator at the elementary level in Eugene, Oregon. ***Teaching Thinking Skills With Databases*** is an outgrowth and extension of the problem solving curriculum he authored for the Eugene School District.

Teaching Thinking Skills With Databases is laser-printed, and packaged in a three-ring binder. The package is available in two versions: *AppleWorks®* or *FrEdBase*. (*AppleWorks* or *FrEdBase* application software is required but not included.)

Purchase price of **$30.00** plus $3.50 shipping includes a school site license granting unlimited reproduction of print and disk materials throughout an entire school. Discounts are available to ICCE members and for multiple copy orders.

For more information contact: (503) 686-4414

The International Council for Computers in Education
Neal Strudler; Editor; Books and Courseware
Vincent Elizabeth Barnett; Marketing/Advertising Director

A P P E N D I X F

ASSESSMENT OF CONVERSION

August 23, 1989
A technical note for SigOMET Newsletter
From Beverly Hunter, Targeted Learning Corporation
Subject: HyperCard and LinkWay

I made a quick-and-dirty study of the feasibility of porting my HyperCard application *Scientists at Work* to a PC environment using LinkWay. After a few hours' investigation programmer Glenn McPherson and I decided this would not be a cost-effective effort. The following are the primary reasons for our decision:

1) Program structure. In our HyperCard application, we have eight stacks. We place our code at a variety of levels -- Home stack, external commands, stack, background, card, button, and field. This enables us to efficiently and systematically structure our code so that the script for a button contains only a command to execute a commonly-used routine that resides at the stack level. For example, a commonly-used routine examines the contents of a specified background field on the current card and link to that-named card in another stack. Or a routine might take the name of a user's current project, concatenate that with the contents of a field, and link to the resulting card name in another stack. In LinkWay, such routines would have to be repeated hundreds or thousands of times in various buttons since LinkWay scripts reside only in individual buttons and do not reference code located elsewhere.

2) External commands. Our external commands for our Hypercard application interact with the Hypercard scripts in a variety of ways. For example, the Hypercard script may pass an array to our external code to be sorted or graphed. Or our external command may instruct Hypercard to perform various operations such as pulling down menus, writing text into Hypercard fields. LinkWay's interaction with its external commands (user programs) is far more limited so we could not implement many of our application features through LinkWay.

3) Visuals. Our pictures are black and white drawings (about 200 in a stack). These would not be appropriate in a PC environment, where color is a major asset. Also, the drawings would not be able to be stored on the cards, and the stack would be too large for the LinkWay environment.

Our conclusion from this brief investigation was that we would need to design a hypermedia application from the outset to take into account the strengths and limitations of the PC and the hypermedia software enviroment for the PC.