

# OPERATION: FROG<sup>®</sup>

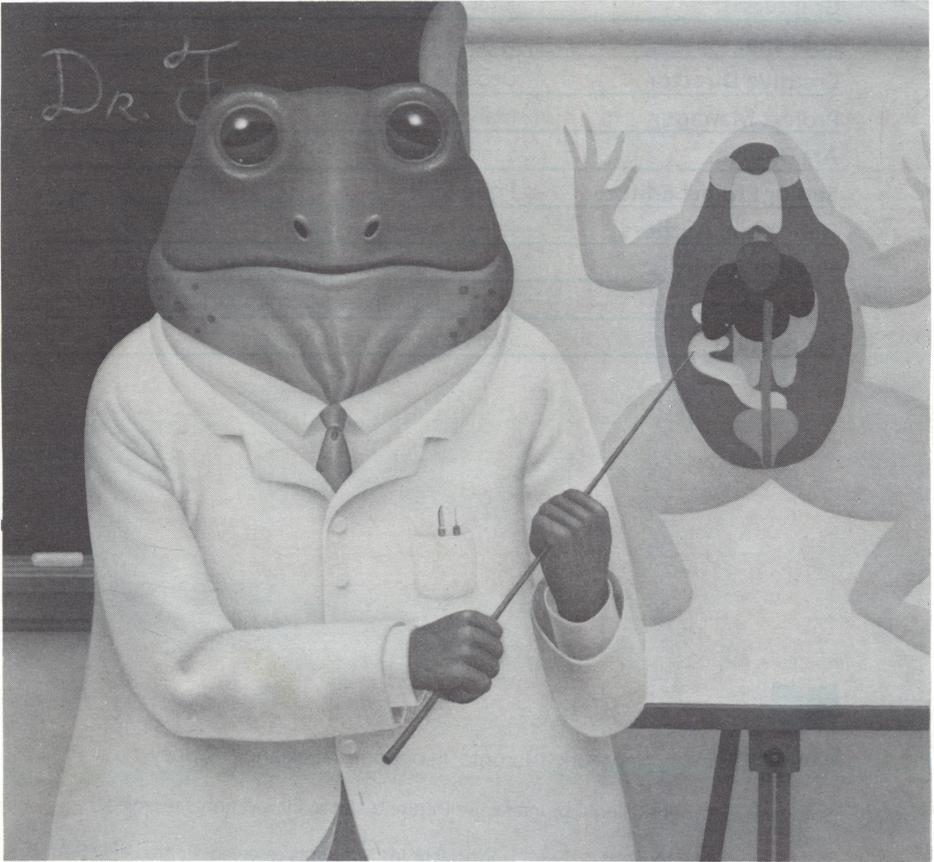
*A Leap Forward in Science*



Apple<sup>®</sup> II Plus, IIe,  
IIc, 64K. Optional:  
Joystick or AppleMouse

**Ages 9-16**

# OPERATION: FROG<sup>®</sup>



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<b>Software Design Team</b>	Interactive Picture Systems, Inc.
<b>Design</b>	John Mack
<b>Producer</b>	Susan Rubin
<b>Program</b>	Sanford Kay, Jimmy Snyder, Jon Wolfe
<b>Commodore Conversion</b>	David Holmes
<b>Animation</b>	Bob Svihovec
<b>Graphics</b>	John Mack
<b>Publisher</b>	Scholastic Inc.
<b>Creative Director</b>	Deborah Kovacs
<b>Project Manager</b>	Maryellen Kohn
<b>Art Director</b>	Sandi Young
<b>Senior Project Editor</b>	Philip Miller
<b>Handbook Authors</b>	Philip Miller/John Mack
<b>Science Advisors</b>	Arthur Goldhamer, PhD/Susan Isenberg
<b>Art Production</b>	Dennis Niswander/Malcolm Kirton
<b>Production</b>	Lydia Buechler/Kirin Nielsen



**Scholastic Inc.** New York Toronto London Auckland Sydney

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# INTRODUCTION

## What is Operation: Frog?

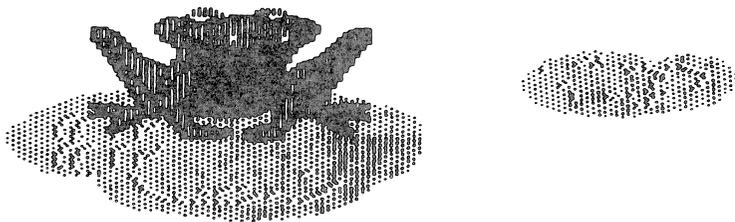
*Operation: Frog* is a computer program that turns your micro-computer into something new—a science simulation tool. Using this tool, you become a scientist of the future, investigating frog biology through an easy-to-learn dissection on your computer screen.

The *Operation: Frog* simulation gives you all the instruments you need: surgical scissors, a probe, forceps, and a magnifying lens. Prompts and hints help guide you through the program, and you can call up extra assistance by pressing the special help key.

*Operation: Frog* is divided into two stages: dissecting the frog and reconstructing the frog. In the dissection stage, you use the computer to probe and snip body organs, to remove organs to the examination tray, and to investigate frog body systems close-up. In the reconstruction stage, you use the computer to put the dissected frog back together.

It's exciting and challenging—like a biology puzzle. And while you're having fun with *Operation: Frog*, you'll be learning important information about frogs, biology, and laboratory methods.

In the rest of this handbook, you'll find all the information you need to get started. You'll also find a glossary that explains many of the scientific and computer terms used in the program, and a list of amazing frog facts.



## ***Is it Real?***

*Operation: Frog* is a computer simulation. This means that, although it is based on realistic scientific procedures, there are some differences between *Operation: Frog* and an actual dissection. For example, in the *Operation: Frog* dissection, you don't work with all of the frog's body parts—only the main organs in the head and torso areas. Here are some other differences:

- In *Operation: Frog*, the frog's skin automatically disappears at the beginning of the dissection, revealing the main body organs. In a real dissection, you would need to snip and remove both the skin and the underlying abdominal muscles.
- A real frog has dozens of different bones and muscles—too many to show on your computer screen. That's why *Operation: Frogs* does not include any bones, and why it includes only one sample muscle.
- In *Operation: Frog*, the body organs are colored to make them easier to find. Don't be surprised if the colors you see inside a real frog are different. Also, with real frogs, the size and exact location of the organs may differ from one frog to the next.
- Through computer graphics, *Operation: Frog* gives you the chance to see how several different body organs work in a live frog—a chance you wouldn't get in an actual dissection.

*Operation: Frog* also gives you one other opportunity that you wouldn't get in a real dissection—the chance to put the dissected frog back together. This reconstruction phase adds extra level of learning, and a special scoring feature adds an extra level of challenge.

## **Frogs and Science**

Frogs and famous scientists go back a long way together. As early as the sixteenth century, Leonardo da Vinci was dissecting frogs to learn more about the way the human body worked. In the seventeenth century, William Harvey's study of frog hearts led to some important insights into the workings of the human heart. Anton van Leeuwenhook, another seventeenth-century scientist, discovered capillaries (small blood vessels) while peering at a tadpole through a device he had just invented—the microscope. In the eighteenth century, Luigi Galvani's experiments with frogs led to his discovery that nerve impulses are actually a form of electricity. Today, frogs continue to be the subjects of many important experiments and studies.

But why do frogs get all this special attention? First, frogs are found in almost every part of the world, and they are fairly easy to grow and care for. Second, and even more important, frogs and humans share many of the same organs and body systems. For example, both frogs and humans are vertebrates—life forms that have backbones and internal skeletons. By studying frogs, we can often gain insights into the ways that our own bodies work. Scientists also study many other animals, including mice, rats, and rabbits.

Frogs are members of the class of animals known as “amphibia.” Amphibia and “amphibian” are a combination of two ancient Greek words meaning “double life.” True to their name, frogs and other amphibia lead two lives—one on land, and one in the water.

Scientists usually study either the Leopard frog (*Rana pipiens*) or the larger American bullfrog (*Rana catesbiana*). In *Operation: Frog*, you'll be dissecting and reconstructing a computer simulation of *Rana catesbiana*. More specifically, you'll be dissecting a *male bullfrog*. However, when you dissect and examine the organs of the urogenital system, you'll see detailed drawings of both the male and female organs.

## **Definitions**

As you move through *Operation: Frog*, you'll probably come across words and terms that are new to you. Don't worry. Many of the terms used in the program are defined in the glossary at the back of this handbook.

There is, however, one set of terms you should get straight before you start *Operation: Frog*. When the program refers to right or left, it means the frog's right or left, not yours. For example, if the computer tells you to snip the right lung, it actually means the lung that is closest to the left edge of the screen, on the frog's right side.

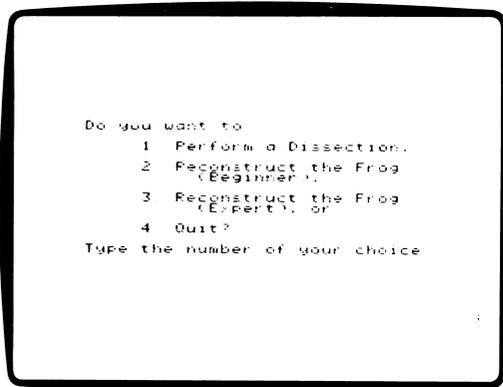
# GETTING STARTED

## Loading the Program

For instructions on loading the program into your computer, see the reference card that came with your *Operation: Frog* package.

## The Main Menu

Once the program loads, the opening animation scene will run. Then you'll see the main menu:



The main menu allows you to choose between performing a dissection (the dissection stage) or reconstructing the frog at the beginner or expert level (the reconstruction stage). You can also choose to quit the program.

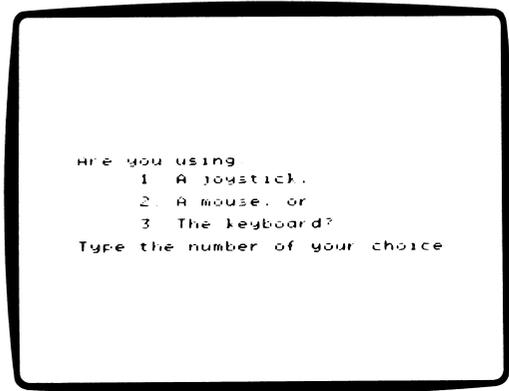
If this is your first time using *Operation: Frog*, you will probably want to choose "Perform a Dissection." To make your choice, follow the instructions at the bottom of the screen. Once you make a selection, the computer will ask you to confirm your choice. It will also give you a chance to go back and change your mind.

If you choose to "Quit," you will leave the program, and your computer will be available for other uses.

If you choose "Perform a Dissection" or either of the two "Reconstruct the Frog" options, the program will move to the screens shown below.

### **Selecting a Controller**

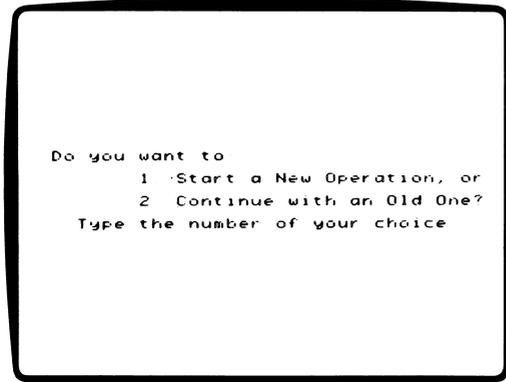
On some computers, the program will pause at a screen that asks you to indicate which type of controller you are using. On all computers, you will have the option of joystick or keyboard control. If you are using an Apple® computer, you also have the option of using the Applemouse™.



To make your choice, follow the instructions at the bottom of the screen. For more information on using the keyboard, joystick, or Applemouse™, see the reference card included with your *Operation: Frog* package.

### **Selecting a Starting Point**

If you choose "Perform a Dissection" or "Reconstruct the Frog" from the main menu, the computer will ask if you want to start the dissection or reconstruction from the beginning ("Start a New Operation") or from the point where you left off earlier ("Continue with an Old One").



If this is your first time through *Operation: Frog*, you should select the first choice and start from the beginning.

If you select the second choice ("Continue with an Old One"), the computer will display some extra instructions. Follow these instructions to retrieve the work you started earlier. For more details about saving and retrieving your work, see pages 30-31.

### **Next Steps**

If you have chosen "Start a New Operation," what you see next will depend on whether you selected "Perform a Dissection" or one of the two "Reconstruct the Frog" options from the main menu.

Again, for first-time users, it's best to begin with the "Perform a Dissection" option, especially since the next section of this handbook includes a step-by-step introduction to the dissection simulation. If you've chosen to begin with the dissection stage, read the next section now. If you've decided to start with either the beginner or expert level of "Reconstruct the Frog," read "Reconstructing the Frog" on page 24.

## **DISSECTING THE FROG**

This section of the handbook explains how to perform the *Operation: Frog* dissection. Your goal in the dissection is simple: to remove the frog's body organs to the examination tray, where you can study them more closely. To remove and examine the organs, you'll need to use the correct instruments in the correct order. You'll also need to know which organs you can remove at which times.

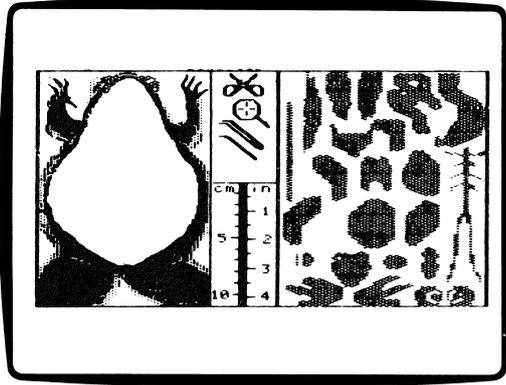
On the pages that follow, you'll find explanations of the different *Operation: Frog* instruments, instructions for using the instruments, and information on removing and examining organs. To help you get started, you'll also find a step-by-step introduction to the dissection.

### **Getting to the Dissection**

To get to the dissection part of the *Operation: Frog* program, follow the instructions listed under "Getting Started" (page 9). When the computer asks you whether you want to do a dissection or a reconstruction, choose "Perform a Dissection."

## **The Dissection Screen**

Once you've followed all the instructions described in "Getting Started," the computer will display the dissection screen.



The dissection screen is divided into three separate areas: the frog area, the instrument area, and the examination tray.

The frog area occupies the left side of your computer screen. This is the area in which you will probe, snip, pick up, and examine the frog's internal organs.

The instrument tray is located in the center of the screen. It is divided into two separate sections: the instrument area and the ruler area. The instrument area houses the simulated laboratory instruments that you will use to probe, snip, pick up, and examine the frog's organs. The ruler area contains a measuring stick marked in inches and centimeters. You can use this ruler to measure organs as you remove them. Since the ruler is drawn to the same scale as the frog, your final measurements will be close to those a scientist would record during the dissection of a real bullfrog.

The examination area is on the right side of the screen. This is where you place an organ after you remove it from the frog. Notice that the examination tray includes an outlined area for each organ. Once you've deposited an organ in its correct place on the tray, you can use the magnifying lens to examine it in more detail.

Somewhere on the dissection screen, you'll also see a small hand. This is the cursor. For more information about the cursor, read the "Using the Instruments" section on page 14.

## Using the Instruments

The simulated laboratory instruments used in *Operation: Frog* are described in the boxes below. Like real laboratory instruments, each of the *Operation: Frog* instruments has a special function to perform. In addition, some of the *Operation Frog* instruments will work only during the dissection, and some will work in only one area of the screen.

### Instrument Grid

Icon	Instrument	What You Use It For		Where You Use It
		During the Dissection	During the Reconstruction	
	Probe	Revealing an organ's snipping points. Revealing an organ's name (in the examination tray)	Revealing an organ's name	In the frog area (only during the dissection) and in the examination tray
	Dissecting scissors	Cutting an organ at its snipping points	—	Only in the frog area
	Forceps	Picking up and moving organs	Picking up and moving organs	In the frog area and the examination tray
	Magnifying lens	Examining an organ and its body system close-up	Examining an organ and its body system close-up	Only in the examination tray

### ***Picking up an Instrument***

Picking up one of the simulated instruments is easy. Using the joystick, mouse, or keyboard controls, move the cursor to the instrument that you would like to select. Then press the joystick button, mouse button, or **SPACE BAR**. You should hear a click or a beep. When you do, the cursor will disappear, and the instrument you selected will be under your control.

### ***Moving and Using an Instrument***

Once you've picked up an instrument, moving it and using it is just as easy. First, use the joystick, mouse, or keyboard controls to move the instrument to an organ. Then press the button or **SPACE BAR**. When you do, you'll hear a sound indicating that the instrument has performed its job. For example, if you move the scissors to an organ and press the joystick button, mouse button, or **SPACE BAR**, you should hear a signal to indicate that the scissors have snipped the organ. If you don't hear the signal, try moving the instrument slightly and pressing the button or **SPACE BAR** again.

### ***Returning an Instrument to the Tray***

Once you have finished using an instrument, you'll need to put it back in the instrument tray. To do this, use the joystick, mouse, or keyboard controls to move it back to the tray. Then press the button or **SPACE BAR**. You'll hear a signal, and the cursor will reappear. When it does, you are free to choose another instrument.

## **Removing Organs From the Frog**

Once you know how to pick up and use the instruments, you're ready to begin the actual dissection. If you'd like some help getting started, see the "Step-by-Step Dissection Guide" on page 20.

### **Selecting an Organ to Remove**

Once the computer removes the frog's skin and abdominal muscles, you're ready to begin removing organs. Before you can start, you'll need to decide which organ to snip and remove first. There are two rules to keep in mind.

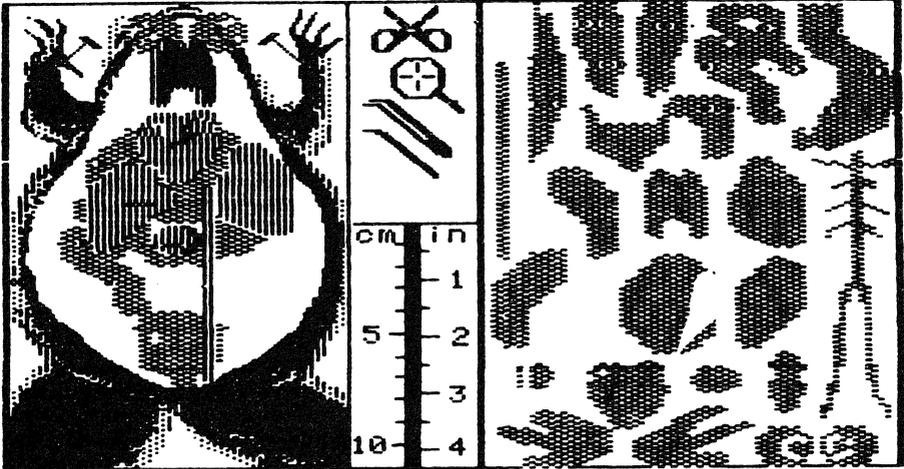
- The organs appear in three layers: the top (ventral) layer, the middle layer, and the bottom (dorsal) layer. You must remove all the organs from the top layer before you can begin removing organs from the middle layer, and you must remove all of the organs from the middle layer before you can begin removing organs from the bottom layer.

When you first cut open the frog, you'll see the top layer of organs completely drawn in. Underneath, you'll see the middle layer in outline form. (See the diagram on page 17.) Once you remove the top layer, the computer will draw complete graphics for the middle layer, and the bottom layer will appear in outline form.

- Even within layers, you must remove the top organs first. For example, although the stomach and lungs are both located in the middle layer of organs, the lungs rest on top of part of the stomach. Therefore, you must remove the lungs before you can remove the stomach. In this example, the lungs would be an available organ when you first began dissecting the middle layer, and the stomach would become available once you removed the lungs.

In a real dissection, you would follow very similar rules. You would remove most of the top (ventral) organs first, and then you would remove the organs located underneath.

Discovering which organs to remove at which times is an important part of the learning in a real dissection and in *Operation: Frog*.



### ***Five-Step Guide for Removing an Organ***

Once you've selected an available organ to remove, follow these five simple steps:

1. Use the probe to find the organ's snipping point.
2. Use the scissors to cut the organ at the snipping point.
3. Use the forceps to pick up the snipped organ.
4. Move the organ to the outlined area in the examination tray.
5. Drop the organ into its outlined area.

The steps are the same for removing each organ. Remember that an organ must be available before you can remove it.

## **Getting Help**

Any time you're not sure which organ to remove next, or any time you're confused about your next move, press the **H** key for help. Once you do, a help message will appear on the screen. The message will say something like "Snip the Spleen."

Although a help message will always suggest a correct next move, it will not indicate all of the moves open to you. For example, if a help message tells you "Snip the Heart," you may also be able to snip the tongue, since two or more organs may be available at one time. With practice, you'll learn what choices and options are available at different points in the program.

To make a help message disappear, move the joystick or mouse, or press the keyboard controls. When the message disappears, you'll be ready to make your next move.

## ***Examining an Organ***

When an organ is in the examination tray, you can use the magnifying lens to examine it more closely. To examine an organ, follow these three steps:

1. Pick up the magnifying lens. (If you don't remember how, look back to the "Using the Instruments" section on page 14.)
2. Move the magnifying lens over the organ you would like to examine.
3. Press the joystick button, mouse button, or **SPACE BAR**.

On some computers, you will see a message that tells you "Flip the Disk and Press Return." Remove the disk from the drive, turn it over, replace it in the drive, close the door, and press **RETURN**.

The screen will switch to one of the following (depending on the organ you're examining):

- An animation (motion) sequence that shows how an organ works; or
- A diagram that shows how the organ fits into one of the frog's body systems.

Once you've studied the diagram or animation sequence, press the button or **SPACE BAR** again. When you do, the screen will switch to a "frog file" — a text page that gives you more information about the organ or body system that you've been examining. At the bottom of the page, you'll see "SPACE BAR/MORE" and "RETURN/OPERATE." To examine more frog file pages, press the **SPACE BAR**. Keep pressing the **SPACE BAR**, and you'll arrive at the diagram or animation sequence again.

When you're finished with the examination, press the **RETURN** key. Be sure to follow any instructions that appear on the screen. The computer will restore the dissection or reconstruction, and you'll be ready to continue from the point where you left off.

## **Step-by-Step Dissection Guide**

By this point, you're probably ready to try the dissection for yourself. If you're feeling confident, go back to "Getting Started" and jump right in. If you'd like some extra instructions, read the step-by-step guide that follows. It will take you through the opening stages of the *Operation: Frog* dissection, and introduce you to many of the program's features.

- 1.** Load *Operation: Frog* into your computer. For loading instructions, see "Getting Started" (page 9).
- 2.** When the computer asks you to choose between performing a dissection or reconstructing the frog, choose "Perform a Dissection."
- 3.** When the computer asks you whether you want to start with a new operation or continue with an old one, choose "Start a New Operation."
- 4.** Once you've answered all of the computer's questions, you'll see the *Operation: Frog* dissection screen. The frog's skin and abdominal muscles will disappear, revealing the organs underneath. At this point, test to make sure you can move the cursor using the keyboard controls, joystick, or mouse.
- 5.** Now that you can see the body organs, you're ready to begin removing them. Start by pressing the **H** key. The message area will display the name of an available organ, and the computer will suggest that you snip it. Remember, you can only remove organs that are available, and only certain organs are available at any time. Whenever you need help, press **H**.
- 6.** For this demonstration, let's start by removing one of the organs available at this point — the heart. The heart is the reddish-orange organ located near the center of the frog's body, just below the head. Begin by picking up the probe from the instrument tray, moving it to the heart, and pressing the **SPACE BAR**, mouse button, or joystick button. This will reveal the snipping point for the heart. For more information on picking up and using the instruments, see page 14.

7. Once you've located the snipping point, return the probe to the instrument tray and release it. Pick up the scissors, move them to the heart, and cut at the snipping point. When you've finished snipping, return the scissors to the instrument tray, replace them, and pick up the forceps.
8. Move the forceps to the snipped heart, and press the **SPACE BAR** or button to pick it up.
9. Carry the heart to the examination tray, and drop it in its outlined storage area. If the heart won't drop, you are probably trying to put it in the wrong area.
10. Once you've placed the heart in the correct location on the examination tray, return the forceps to the instrument tray.
11. Pick up the magnifying lens, move it to the heart, and press the **SPACE BAR**, mouse button, or joystick button.
12. Follow any instructions that appear on the screen. Once you do, you'll see an animation sequence that shows the heart's pumping cycle.
13. Once you've studied the heart animation, press the **SPACE BAR** or button to see frog file explanations of the heart and the circulatory system. Keep pressing the **SPACE BAR** or button, and you'll come back to the beginning of the heart animation.
14. When you're ready to return to the dissection screen, press the **RETURN** key. Follow any instructions that appear on the screen.
15. Back at the dissection screen, pick up and use the probe to find the snipping point for the frog's tongue — the light-colored organ in the mouth.
16. Repeat step 6-11. This time, instead of working with the heart, you'll be snipping, removing, and examining the tongue.
17. Once you've placed the tongue in the examination tray and moved the magnifying lens over it, you'll see a diagram of the internal features of the mouth. (On some computers, the program may tell you to flip the disk first.)

**18.** After you study the diagram, press the **SPACE BAR**, joystick button, or mouse button for more information. Keep pressing the **SPACE BAR** or button, and you'll come back to the diagram.

**19.** When you're ready to return to the dissection screen, press **RETURN**. Be sure to follow any instructions that appear.

**20.** When the dissection screen reappears, return the magnifying lens to the instrument tray.

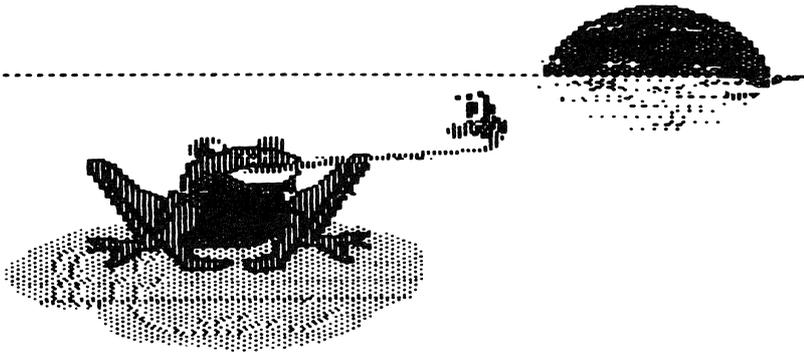
From this point, you're on your own. Try probing, snipping, picking up, removing, and examining another organ. Then keep going. Remember, whenever you need help, you can press **H**. For more help, look back through the "Performing a Dissection" section of this handbook. When you finish the dissection, get ready for your next big challenge: reconstructing the frog.

## **Completing a Dissection**

The dissection ends when you remove the last organ and put it on the examination tray. At that point, the computer will congratulate you for successfully completing the dissection stage of *Operation: Frog*.

Although completing the dissection is your final goal, don't be in too much of a hurry. Spend some time exploring the features and functions of *Operation: Frog*, and be sure to study and examine each of the organs. This extra experience will come in handy when you face an even tougher challenge—reconstructing the dissected frog.

After the computer signals that you've completed the dissection, it will return you to the dissection screen. Once the screen reappears, you can use the magnifying lens to examine more organs. When you finish, press the **Q** key. This will end the dissection and bring you back to the main menu. From there, you can choose to try the dissection again, to try to reconstruct the frog, or to quit the program.



## **RECONSTRUCTING THE FROG**

This section of the handbook explains the reconstruction stage — the puzzle portion of *Operation: Frog*. In the reconstruction, the frog starts with all of its organs removed. Your goal is to put the frog back together again. When you've replaced the last organ, you'll receive a final score. The fewer tries it takes you to replace the organs, the higher your score.

The reconstruction features two levels: beginner and expert. On the beginner level, you are free to use the help **(H)** key whenever you like. On the expert level, you will lose points from your final score each time you ask for help. You will also lose points each time you try to replace an incorrect organ.

As you will soon discover, the reconstruction stage can be very challenging, even on the beginner level. If you're just starting out, it's best to practice with the *Operation: Frog* dissection first. That way, you'll start the reconstruction knowing what the different organs are, where the organs are located in the frog, and how the different instruments work.

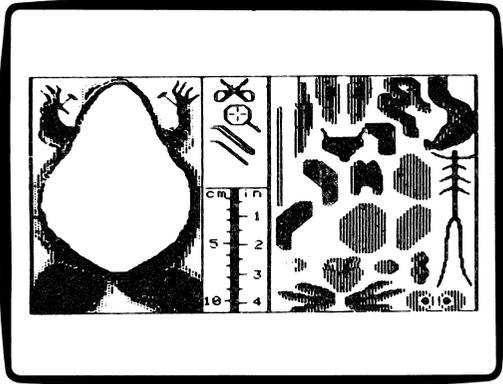
### **Getting to the Reconstruction**

To get to the reconstruction part of the *Operation: Frog* program, follow the steps listed under "Getting Started" (page 9). This time, when the computer asks you to choose between the dissection or the reconstruction, be sure to select either "Reconstruct the Frog (Beginner)" or "Reconstruct the Frog (Expert)."

Remember, on the expert level, you lose points each time you use the **(H)** key or try to replace an incorrect organ. As a result, you'll probably want to start on the beginner level. Then, when you've had some practice, you can try the expert level.

## **The Reconstruction Screen**

Once you've followed all the instructions described in "Getting Started," the computer will display the reconstruction screen.



As you can see, the reconstruction screen is very similar to the dissection screen. (See page 13.) Both screens are divided into the same three areas: the frog area, the instrument area, and the examination area.

You will also notice one major difference between the dissection and reconstruction screens. In the dissection, the organs start off inside the frog, and you must use the simulated instruments to remove them to the examination tray. In the reconstruction, the organs start off in the examination tray, and you must use the instruments to return them to their proper place inside the frog.

### **Using the Instruments in Reconstruction**

If you've tried the *Operation: Frog* dissection, you already know how to pick up, move, and use the simulated instruments. For instructions, see pages 14 and 15.

As the grid on page 14 shows, you do not use the scissors during the reconstruction stage. The organs will be snipped and waiting in the examination tray. Also, during the reconstruction, the probe will work only in the examination tray, where you can use it to reveal an organ's name.

## ***Replacing Organs***

### ***Selecting Organs and Rebuilding Layers***

The reconstruction begins with all of the organs in the examination tray. Using the forceps, you must pick up the organs and place them back in the frog, one organ at a time. Before you can start, you'll need to decide which organ to pick up and replace first.

There are two rules to keep in mind:

- Each organ fits into one of three layers of organs: the top (ventral) layer, the middle layer, and the bottom (dorsal) layer. In the reconstruction, you must replace all of the organs in the bottom layer before you can begin replacing organs in the middle layer. Once you have replaced all of the organs in the middle layer, you can start filling in the top (ventral) layer.

As you've probably noticed, you work with the same three layers of organs in the dissection stage, only in reverse. In the dissection, you start with the top layer of organs and work down to the bottom layer. In the reconstruction, you start with the bottom layer and work up.

- Within layers, you must replace the underlying organs first. For example, although the spinal cord and kidneys are both members of the bottom (dorsal) layer of organs, the spinal cord is located underneath the kidneys. Therefore, you must replace the spinal cord before you can replace the kidneys. In this example, the spinal cord would be an available organ when you first begin the reconstruction, and the kidneys would become available after you replaced the spinal cord.

When you've replaced all of the organs in the bottom layer, the organ graphics for the middle layer will appear. When they do, you'll see that the bottom layer of organs is displayed in outline form. Use the outlines of the underlying organs as guidelines to help you position the organs of the middle layer.

When you finish filling in the middle layer, the computer will reset the organ graphics in the frog area again. Once the graphics reappear, you'll see the organs of the middle layer displayed in outline form. That's the signal for you to begin replacing the organs of the top layer.

### ***Three-Step Guide for Replacing an Organ***

Once you've selected an organ to place back in the frog, follow these three simple steps:

1. Use the forceps to pick up the organ.
2. Move the organ to its proper location inside the frog.
3. To release the organ, press the **SPACE BAR**, joystick button, or mouse button.

If the organ won't drop into the frog, check to make sure you're trying to place it in the correct location. Try moving the organ slightly and pressing the **SPACE BAR**, joystick button, or mouse button again. If it still won't drop, the organ may not be part of the layer you are trying to reconstruct, or you may have to replace one or two other organs first.

## ***Getting Help***

There are three ways to get hints and helpful information in the reconstruction stage: pressing the **H** key, probing an organ, or examining an organ.

### ***The Help (H) Key***

If you press **H**, the computer will help you out by recommending a next move, just as it does when you press **H** during the dissection. In the reconstruction stage, the help messages say things like "Liver May Be Replaced" or "Incorrect Organ — Pick Another." Remember, although the help messages will always suggest a correct move, there may be other, equally correct moves that you can make.

### ***Probing Organs***

During the reconstruction, there may be times when you can't remember which organ is which. When this happens, you can reveal an organ's name by probing it. Here's how you do it:

1. Move the probe to the organ that you want to identify. The organ must be located in the examination tray.
2. Press the **SPACE BAR**, joystick button, or mouse button.

Once you complete these simple steps, the organ's name will appear at the bottom of the screen.

### ***Examining Organs***

If you're having trouble remembering how the different body parts fit together, it might help to examine the system diagram or animation sequence available for each organ. For more information, see the "Examining an Organ" section on page 29.

### ***Effect on Scoring***

At the main menu screen, the computer asks you to choose between the beginner level or the expert level. If you select the beginner level, you are free to use the help key whenever you like. If you select the expert level, you'll lose points from your final score each time you press (**H**) for help. On the expert level, you will also lose points for trying to replace the wrong organ.

## ***Examining an Organ***

While an organ is in the examination tray, you can use the magnifying lens to examine it more closely, just as you can during the dissection stage. When you examine an organ, you'll see one of the following:

- an animation (motion) sequence that shows how the organ works; or
- a diagram that shows how the organ fits into one of the frog's body systems.

From the diagram or animation sequence, you can switch to frog file text pages that explain the organ and its function in more detail.

For instructions on using the magnifying lens to examine an organ, see page 19.

## ***Completing the Reconstruction***

The reconstruction ends when you replace the last organ. At that point, you will have successfully rebuilt all three layers of organs, and there will be no organs left in the examination tray.

Once you replace the last organ, the computer will congratulate you and display your final score. To reward you for a job well done, the computer will also give you a special surprise.

After the surprise, the computer will bring you back to the main menu. From there, you can choose to quit the program, to try the dissection, or to try the reconstruction again.

Each time that you try the reconstruction, your score should improve. With practice, you may even reach a score of 100 — the highest score possible.

## **SAVING AND RETRIEVING AN UNFINISHED DISSECTION OR RECONSTRUCTION**

With *Operation: Frog*, you never need to worry about having enough time to finish dissecting or reconstructing the frog. At any time, you can stop the dissection or reconstruction, save the operations you've completed so far, and come back to continue later. You don't need an extra disk to save your work. Just follow the directions below.

### ***Saving a Dissection or Reconstruction***

To save an unfinished dissection or reconstruction, follow these steps:

1. Press the **Q** key.
2. The computer will display a special set of characters. This is the code that you will need to retrieve your saved work. Be sure to copy the code down. If you are working on the reconstruction, the computer will also display a score for the work you've completed.
3. Follow the rest of the computer's instructions. You will end up back at the main menu.
4. To quit the program, choose "Quit" from the menu.
5. For instructions on starting a new dissection or reconstruction, see "Getting Started" on page 9.

Once you've saved your work, be sure to keep the code you've written down in a safe place. You will need it when you come back to retrieve your saved dissection or reconstruction.

## ***Retrieving a Saved Dissection or Reconstruction***

Before you can continue working on a saved dissection or reconstruction, you'll need to retrieve it. Follow these instructions:

- 1.** Follow the "Getting Started" steps that begin on page 9.
- 2.** When you arrive at the main menu, the computer will ask you to choose between "Perform a Dissection" or "Reconstruct the Frog." If you are retrieving a dissection, choose "Perform a Dissection." If you are retrieving a reconstruction, choose "Reconstruct the Frog." Be sure to choose the correct reconstruction level: Beginner or Expert.
- 3.** The computer will ask you to choose between "Start a New Operation" or "Continue with an Old One." Tell it that you want to continue with an old (saved) operation.
- 4.** The computer will ask you to type in the code for your saved work (the code that you copied down when you saved the dissection or reconstruction). Follow this instruction and any others that appear on the screen.
- 5.** Once you have followed the computer's instructions, the dissection or reconstruction screen will appear. When it does, you'll be ready to continue from the point where you left off.

## **AMAZING FROG FACTS**



### ***Frogs, Frogs Everywhere***

With the exception of Antarctica and a few Pacific islands, frogs inhabit every area on earth — even regions inside the Arctic Circle. But don't look for frogs in the ocean. Although some frogs can tolerate semi-brackish water, none can live in salt water.

### ***Deadly Frogs of the Amazon***

Many types of frogs are mildly toxic to touch, but none is quite so deadly as the poisonous "dart" or "arrow" frog of the South American rain forests. All twenty varieties of this frog keep their skins moist with a paralyzing nerve poison. These small, deadly amphibians are brightly-colored, to warn away animals who might otherwise mistake them for a tasty meal. Local hunters take advantage of the poisonous amphibians by dipping the tips of their darts and arrows in a specially-brewed mixture of the frog toxin. A shot of the poisoned arrow that just grazes the skin is enough to paralyze even a full-grown monkey!

### ***Back-Up Breathing System***

Like humans, adult frogs take in oxygen through their lungs. But frogs also have a second, back-up breathing system. Air passes through the frog's thin skin and into blood traveling in veins near the surface. The veins carry the blood to the heart, which pumps it to other areas of the frog's body. Frogs can even exhale through their skins, sending carbon dioxide back into the surrounding air.

By the time a frog is fully grown, it is used to dealing with different sorts of breathing systems. As newly-hatched tadpoles, frogs breathe like fish, taking oxygen from water that passes over a pair of exposed feathery gills. In just a few days, skin covers the outside surface of the gills. At this point, the tadpole takes in oxygen-carrying water through its mouth, passing the water over the gills to breathe. As the tadpole grows, the gills disappear into its body, and the frog develops the "double system" described above.

### ***The Incredible Shrinking Frog***

The island of Trinidad is home to an unusual and aptly named frog. As a tadpole, this frog reaches an astounding 1 foot in length. But by the time it “grows” to adulthood, the frog rarely measures over 1 and ½ inches. Its name? The “paradoxical frog” of Trinidad.

### ***Frozen Frogs***

Some frogs can be frozen nearly solid and still survive. As part of their hibernation cycle, at least three species of ground-dwelling frogs produce glycerol, a kind of natural antifreeze. Glycerol protects the frog’s muscles and organs from damage during super-cold winter months, even when the ground is frozen solid.

### ***Frogs Don’t Drink***

Frogs do not lap, slurp, or guzzle water. In fact, they don’t drink water at all. Instead, frogs absorb all the water they need through their thin, porous skins.

### ***Alligators for Lunch?***

North American bullfrogs grow to be as big and heavy as standard-sized telephones. In fact, some adult bullfrogs are big enough to catch and eat baby alligators and full-grown birds. In contrast, the smallest North American frog — the Least Grassfrog — is less than an inch long when it reaches adulthood.

### ***Fresh Frog Skins***

A frog’s skin serves as a camouflage device, an organ of the respiratory (breathing) system, and a toxic defense against predators. To keep their skin in top shape, frogs regularly shed the thin outer layer for a new, fresh layer of growth. Green tree frogs shed their skin every day, and bullfrogs shed every other day. Not ones to waste anything, most frogs also eat the old layer of skin, which provides them with a nourishing meal.

### ***Frogs in Space***

In 1970, as part of a scientific experiment, a pair of frogs orbited the earth on board a spacecraft specially designed for them. Sensors attached to the frogs’ inner ears recorded information about the effects that long-term weightlessness has on balance.

### **Getting the Jump on Humans**

Many frogs can jump as far as 20 times their body length. If humans could do the same, a six-foot-tall man or woman would be able to long-jump 120 feet — more than one-third the length of a football field!

### **Nimble-Fingered Frogs**

Most frogs catch bugs and insects by flipping their long, sticky tongues over and out. But some primitive frogs have no tongues. They hunt by sweeping their long fingers through the muck at the bottom of ponds. This stirs up small animals, which the frog spots, grabs, and swallows.

### **Swallowed Alive**

By swallowing her eggs, the two-inch *Rheobatrachus silus* of Australia guarantees the safety of her offspring. After the eggs hatch, the youngsters go through the tadpole stage inside their mother's stomach. Eight weeks later, the mother vomits a brood of fully-formed young, each one no larger than a fly.

### **Sticky Frogs**

Many tree-dwelling frogs make their own glue. Tiny glands on the frogs' toes secrete a thin, sticky substance that helps them cling to tree trunks, glass, and walls. With the help of this natural glue, tree frogs can even hang upside down from overhanging branches.

## **LABORATORY WORKSHEETS**

This section of the *Operation: Frog* handbook includes two types of laboratory worksheets: the Dissection/Reconstruction Record and the System Drawings Worksheets.

Use the Dissection/Reconstruction Record to record the organs that you remove or replace, the measurements (in centimeters and inches) of each organ, and your notes and observations. Be sure to list the organs in the order that you remove or replace them, so you can use the record as a guide when you return to try again.

The System Drawings Worksheets include illustrations of the different body systems that you study in *Operation: Frog*. As you will discover, these are the same system drawings that you see when you examine organs. But there is one important difference: On the System Drawing Worksheets, the labels for the individual organs that make up the system have been left out. Your job is to fill in the blanks.

Keep the *Operation: Frog* worksheets handy as you work with the program. Use them to help organize your dissections and reconstructions, and to review information about the frog's body systems.

# ***Dissection/Reconstruction Record***

Name \_\_\_\_\_ Date \_\_\_\_\_

Check one: Dissection \_\_\_\_\_ Reconstruction \_\_\_\_\_

Time Started \_\_\_\_\_ Time Ended \_\_\_\_\_

ORGAN REMOVED OR REPLACED	MEASURE- MENTS (CM/INCHES)	NOTES/OBSERVATIONS
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
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17.		
18.		
19.		
20.		
21.		
22.		
23.		

# Dissection/Reconstruction Record

Name \_\_\_\_\_ Date \_\_\_\_\_

Check one: Dissection \_\_\_\_\_ Reconstruction \_\_\_\_\_

Time Started \_\_\_\_\_ Time Ended \_\_\_\_\_

ORGAN REMOVED OR REPLACED	MEASURE- MENTS (CM/INCHES)	NOTES/OBSERVATIONS
1.		
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22.		
23.		

# **Dissection/Reconstruction Record**

Name \_\_\_\_\_ Date \_\_\_\_\_

Check one: Dissection \_\_\_\_\_ Reconstruction \_\_\_\_\_

Time Started \_\_\_\_\_ Time Ended \_\_\_\_\_

ORGAN REMOVED OR REPLACED	MEASURE- MENTS (CM/INCHES)	NOTES/OBSERVATIONS
1.		
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21.		
22.		
23.		

# **Dissection/Reconstruction Record**

Name \_\_\_\_\_ Date \_\_\_\_\_

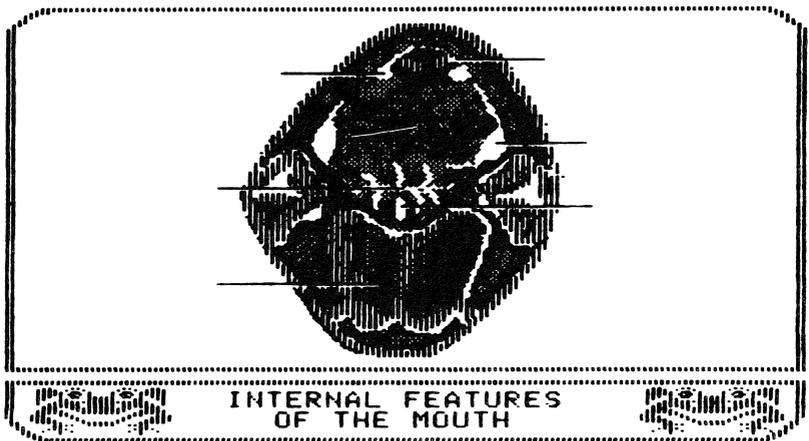
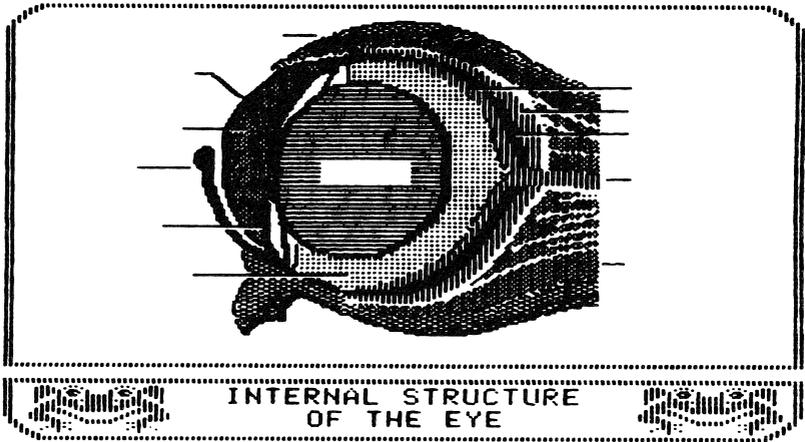
Check one: Dissection \_\_\_\_\_ Reconstruction \_\_\_\_\_

Time Started \_\_\_\_\_ Time Ended \_\_\_\_\_

ORGAN REMOVED OR REPLACED	MEASURE- MENTS (CM/INCHES)	NOTES/OBSERVATIONS
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____
15. _____	_____	_____
16. _____	_____	_____
17. _____	_____	_____
18. _____	_____	_____
19. _____	_____	_____
20. _____	_____	_____
21. _____	_____	_____
22. _____	_____	_____
23. _____	_____	_____

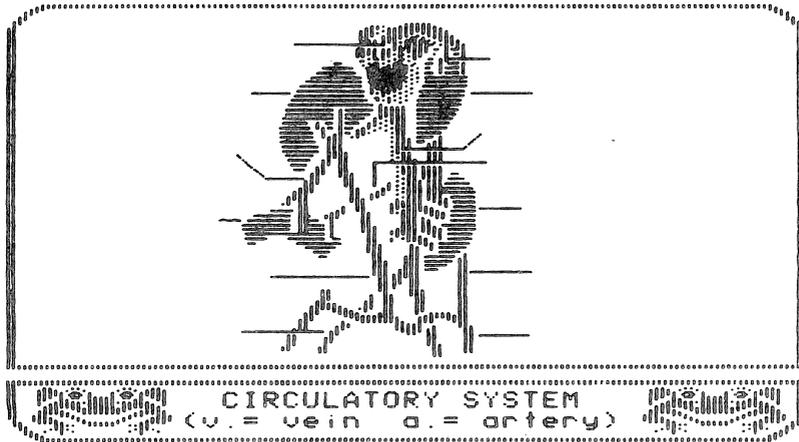
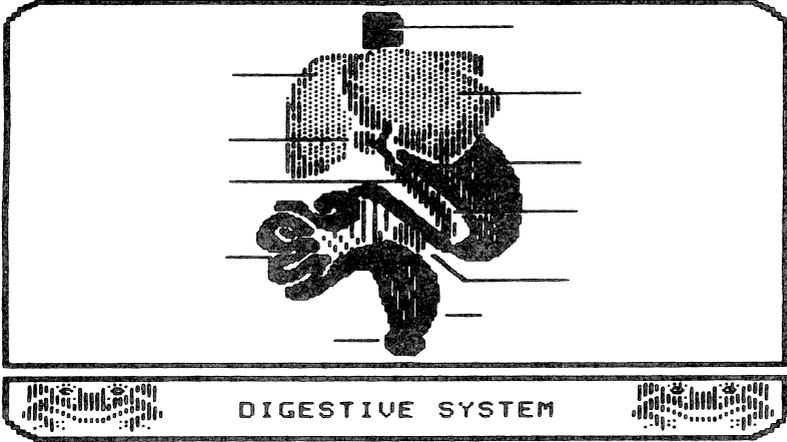
## System Drawing Worksheet #1

The lines in the drawings point to the organs that make up the body system. Your job is to fill in the correct name for each organ. For more information, use *Operation: Frog* to examine one of the organs as you perform a dissection or reconstruction.



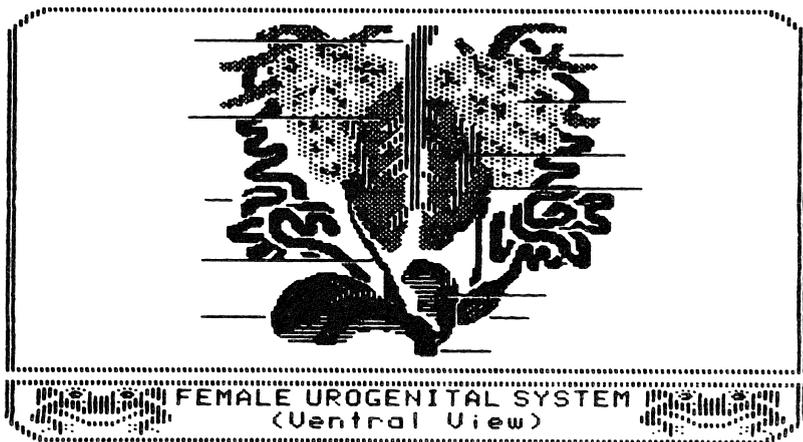
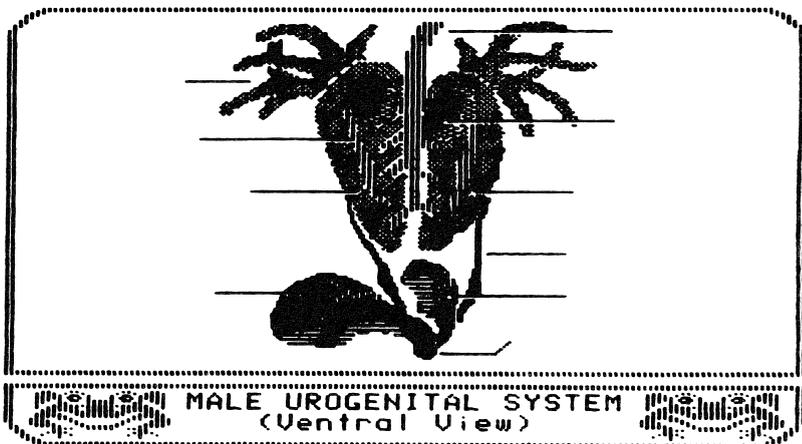
## System Drawing Worksheet #2

The lines in the drawings point to the organs that make up the body system. Your job is to fill in the correct name for each organ. For more information, use *Operation: Frog* to examine one of the organs as you perform a dissection or reconstruction.



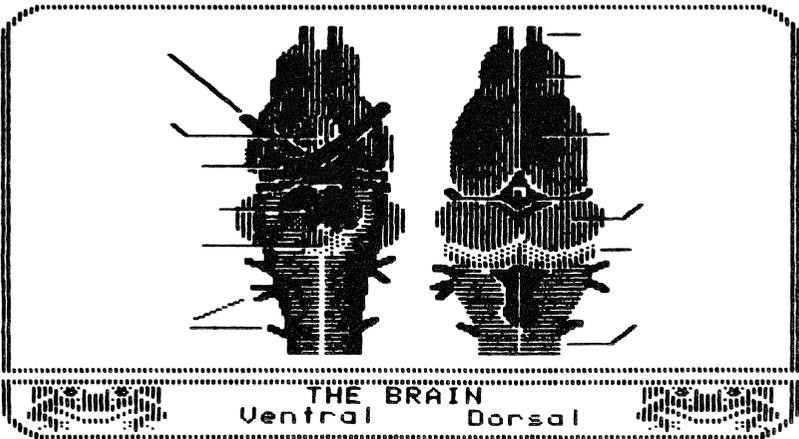
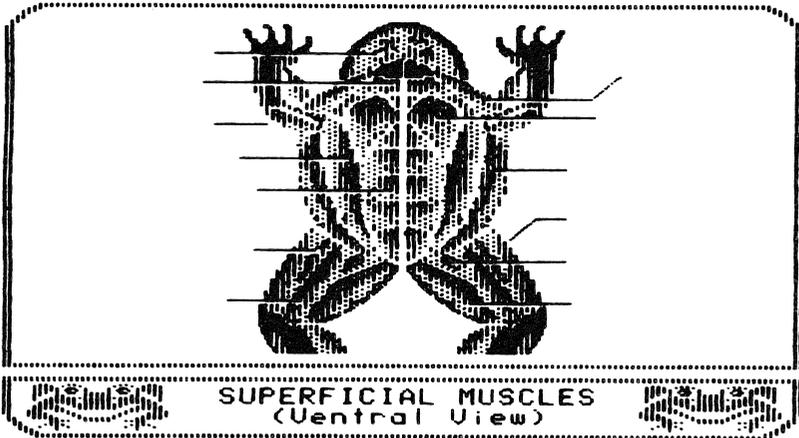
### **System Drawing Worksheet #3**

The lines in the drawings point to the organs that make up the body system. Your job is to fill in the correct name for each organ. For more information, use *Operation: Frog* to examine one of the organs as you perform a dissection or reconstruction.



## System Drawing Worksheet #4

The lines in the drawings point to the organs that make up the body system. Your job is to fill in the correct name for each organ. For more information, use *Operation: Frog* to examine one of the organs as you perform a dissection or reconstruction.



## **GLOSSARY**

**AMPHIBIAN**—A cold-blooded animal that has a backbone, a three-chambered heart, and skin that is not covered with hair, scales, or feathers. Many amphibians hatch in water but live their adult lives on land. Frogs and toads are amphibians.

**ANIMATION**—A computer graphic that shows an object or scene in motion. In *Operation: Frog*, animation sequences show how a body organ or system works.

**ANTERIOR**—Toward the front or head end of an organism.  
Compare to *posterior*.

**ARTERY**—A blood vessel that carries blood from the heart to other parts of the body. Compare to vein.

**BIOLOGY**—The science of living things. Biologists study both plants and animals.

**CENTIMETER (cm)**—A unit of length in the metric system that equals 1/100 of a meter (approximately 3/8 of an inch).

**CENTRAL NERVOUS SYSTEM**—The body parts that work together to control the movement and reflexes of an organism. The frog's central nervous system includes the brain and spinal cord.

**CIRCULATORY SYSTEM**—The parts of an organism that work together to pump, or circulate, blood through the body. The frog's circulatory system includes the heart, the spleen, and the veins and arteries.

**CURSOR**—In *Operation: Frog*, the green arrow that you use to pick up instruments from the instrument tray. To pick up an instrument, move the green arrow to the instrument and press the joystick button, mouse button, or **SPACE BAR**.

**DATA DISK**—A computer disk used for saving and storing information. In *Operation: Frog*, you must have a data disk to store partially finished dissections and reconstructions. For information on preparing data disks, see the *Operation: Frog* reference card.

**DIGESTIVE SYSTEM**—The parts of an organism that work together to digest and absorb food. The frog's digestive system includes the gullet, stomach, small intestine, and colon.

**DISSECTION**—The process of cutting and removing parts of a plant or animal to study the parts more closely.

**DORSAL**—Toward the back or backbone. In *Operation: Frog*, a body part that is “dorsal to” another organ is underneath the organ. A “dorsal view” of an organ shows what the organ looks like from the back (underneath) side. Compare to *ventral*.

**FORCEPS**—In *Operation: Frog*, tweezers that you use to pick up and carry snipped organs.

**MEDIAL**—In or toward the middle.

**MENU**—A listing of the features and choices available in a computer program. In *Operation: Frog*, the main menu allows you to choose between dissecting or reconstructing the frog.

**ORGAN**—A body part that performs a specific job or function in a plant or animal.

**PINS**—In *Operation: Frog*, two small instruments that you use to pin and hold the frog’s forelimbs at the beginning of the dissection.

**POSTERIOR**—Toward the rear or tail end of an organism. Compare to *anterior*.

**PROBE**—In *Operation: Frog*, an instrument that you use to determine an organ’s name or its snipping points.

**PULMONARY RESPIRATORY SYSTEM**—The parts of the body that work together to bring oxygen into the body (inhalation) and to send carbon dioxide and other gases out (exhalation). The frog’s pulmonary respiratory system includes the lungs, glottis, and bronchi.

**SCISSORS**—In *Operation: Frog*, the instrument that you use to cut an organ at its snipping points. In the dissection, an organ must be snipped with the scissors before you can remove it with the forceps.

**SIMULATION**—A computer model of a real process or situation. *Operation: Frog* includes a computer simulation (model) of a frog dissection. By using the model, you can learn what it’s like to dissect a frog.

**SYSTEM**—A group of organs that work together to perform an important function. See *central nervous system*, *circulatory system*, *digestive system*, *pulmonary respiratory system*, and *urogenital system*.

**UROGENITAL SYSTEM**—The body parts involved in reproduction and the excretion of waste matter.

**VEIN**—A blood vessel that returns blood to the heart from other parts of the body. Compare to *artery*.

**VENTRAL**—Toward the front or belly side. In *Operation: Frog*, a body part that is “ventral to” another organ is above that organ. Compare to *dorsal*.

**VERTEBRATE**—An animal that has a backbone. Amphibians (including frogs), reptiles, fish, birds, and mammals are all vertebrates.

## **FROG RESOURCES**

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- Gibbons, Whit. *Their Blood Runs Cold*. University, AL: University of Alabama Press, 1983.
- Lane, Margaret. *The Frog*. New York: The Dial Press, 1981.
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- Simon, Hilda. *Frogs and Toads of the World*. New York: Harper and Row, Inc., 1975.
- Thompson, Gerald, et al. *The Pond*. Cambridge: The MIT Press, 1984.
- Zappler, George and Lisbeth. *Amphibians as Pets*. New York: Doubleday & Co., 1973.

### **Magazine and Journal Articles**

- "Birth Through the Mouth." *Science Digest*, October 1981, pp. 29.
- Howard, Richard D. "Big Bullfrogs in a Little Pond." *Natural History*, April 1979, pp. 31-36.
- Jacobson, Susan Kay. "Frog Feats." *International Wildlife*, May/June 1984, pp. 12-16.
- Middleton, Harry. "Peeper: The First Frog of Spring." *National Wildlife*, April/May 1983, pp. 19.
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- Schmid, William D. "Survival of Frogs in Low Temperature." *Science*, Vol. 215, 5 February 1982, pp. 697-698.
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- Wilder, Rachel. "Flying Frogs." *Science Digest*, October 1981, pp. 29.

# **Operation: Frog**<sup>TM</sup> **Reference Card**

## **Equipment You Need**

1. Apple® II Plus (64K), IIe, IIc
2. TV or monitor
3. Disk drive
4. Joystick or AppleMouse (optional)

Apple is a registered trademark of Apple Computer, Inc.

## **Disk Loading Instructions**

1. Your computer should be turned off.
2. If you are using a joystick or mouse, connect it to the correct port on the back of your computer.
3. Carefully slide the disk into the disk drive. Hold the disk by the label as you insert it, and make sure the label side is facing up. Then close the disk drive door.
4. Turn on your computer, and turn on your TV or monitor. The disk drive will make some whirring and clicking sounds. In a few seconds, the program titles and opening will run, and you'll see the *Operation: Frog* menu.
5. For instructions on using *Operation: Frog*, see the rest of this reference card and the *Operation: Frog* handbook.

## **Important Information**

### **Using the Keyboard Controls to Move the Cursor**

If you don't have a joystick or mouse, you'll need to use the keyboard controls to move the cursor and any *Operation: Frog* instruments that you pick up. Here are the controls you use:

- On an Apple II Plus with 64K: Press the **I**, **J**, **K**, and **M** keys.
- On an Apple IIe or IIc: Press the ← → ↓ ↑ keys.
- Moving diagonally: On the Apple II Plus, IIe, and IIc, you can also move the cursor diagonally by pressing the **U**, **O**, **N**, and **,** keys.

### **Picking Up and Releasing an Instrument**

To pick up an *Operation: Frog* instrument, move the cursor to the instrument and press the joystick button, mouse button, or **SPACE BAR**. To release the instrument, return it to the instrument tray and press the button or **SPACE BAR** again.

### **Examining an Organ**

Once an organ is in the examination tray, you can use the magnifying lens to study it more closely. Move the magnifying lens over the organ, and press the **SPACE BAR** or button. The computer will tell you to turn the disk over to side 2. Once you do, press any key to display a system diagram. To return to the dissection or reconstruction screen, press **RETURN**. A message will tell you to turn the disk back to side 1. Turn the disk and press **RETURN** to continue.

## Getting Help

Whenever you need help during a dissection or reconstruction, press the **H** key. Once you do, the computer will display a help message. *Warning:* If you are reconstructing the frog at the expert level, pressing **H** will take points from your final score.

## Jumping Directly to the Main Menu

To jump over the opening frog cartoon, press **RETURN** when the program titles appear.

## Quitting the Program

To quit the program, press the **Q** key. If you are in the middle of a dissection or reconstruction, the computer will give you a chance to save your work. For more information on saving and retrieving your work, see pages 30 and 31 of the *Operation: Frog* handbook.

## Instrument Grid

Icon	Instrument	What You Use It For		Where You Use It
		During the Dissection	During the Reconstruction	
	Probe	Revealing an organ's snipping points. Revealing an organ's name (in the examination tray)	Revealing an organ's name	In the frog area (only during the dissection) and in the examination tray.
	Dissecting scissors	Cutting an organ at its snipping points	—	Only in the frog area
	Forceps	Picking up and moving organs	Picking up and moving organs	In the frog area and the examination tray
	Magnifying lens	Examining an organ and its body system close-up	Examining an organ and its body system close-up	Only in the examination tray



# OPERATION: FROG<sup>®</sup>

## ***Dissect a frog on your home computer!***

Now you can participate in every major step of a frog dissection, on your home computer! Select the proper instruments — surgical scissors, probe, forceps, and magnifying glass. Probe and snip body organs, remove them to the examination tray, and investigate frog body parts and systems. You can even observe how these body systems function in a living frog.

But the experience doesn't end there! Now it's time to reconstruct the frog. And when you are done, see the frog come to life! The Macintosh and MS-DOS versions also include an on-line reference tool that enables you to point and click to identify organs, and a comparative anatomy option to compare frog and human anatomy. It's a fun leap forward to a better understanding of biology and anatomy!

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