

Teacher's Guide



The Digital Frog 2 is an updated version of The Digital Frog, an award-winning frog dissection and anatomy CD-ROM.

The Digital Frog 2 can be used as:

- preparation for a real dissection
- a replacement for, or alternative to, a real dissection
- follow-up material for a real dissection
- a teaching aid for both generalized and frog-specific anatomy and ecology
- a teaching aid for both generalized and frog-specific physiology
- an introduction to human anatomy

The CD is divided into three closely integrated sections:

Dissection leads students through a traditional frog dissection, including the body cavity organs, head structures, and leg muscles. Step-by-step instructions inform students which cuts to make. Students then make those cuts and identify the organs themselves, accompanied by full color, full screen videos showing the cuts and stages of the dissection. Full-screen detailed photographs follow each stage, letting students get close up views of the relevant organs.

Anatomy looks at the major systems within the frog, first at a system level, and then on an organ by organ basis. Anatomy includes the circulatory, respiratory, urogenital, immune, musculoskeletal, digestive, and control systems. Each organ is examined separately both and in context to the system as a whole, with particular attention paid to structure and function. As well, “Interacting Systems” examines each system’s role in relation to basic body functions such as feeding or mating. Where relevant, “Compare to Human” buttons highlight the differences between frog and human anatomy.

Ecology looks at frogs as living organisms within a larger environment. It includes biodiversity, behaviors such as hibernation, feeding, mating and vocalization, predators and prey, and external pressures and environmental concerns relating to frog populations.

Grade Levels

The Digital Frog 2 is designed primarily for students at the grade 10 level, but it appeals to a wide range of students and age groups. It also meets many curriculum objectives for both middle and secondary schools, and even for first year college and university zoology and general biology programs. The CD encourages students to learn by discovery, and can be explored at many different levels. Students can skim through, or get in-depth information on a wide range of topics covered in the program. Its multiple levels of detail and complete integrated dictionary allow students at a wide range of reading levels to understand the concepts and information. This workbook can provide additional structure to the students’ exploration of The Digital Frog 2.

What you get

The Digital Frog 2 CD-ROM

The CD-ROM contains the following modules:

- Dissection
- Anatomy
- Ecology
- An on-screen tour of how to navigate around the CD

Teacher and Student Workbooks

- **Teacher's Guide.** This includes the Teacher's Notes on how to use the CD, and copies of the student guide complete with answers and suggested sources for further information.
- **Student Workbook.** This helps structure exploring the CD, and is broken into sections corresponding to those found on the CD. The Student Workbook consists of single-sided "master pages," suitable for photocopying as needed.

The text files for both the Teacher and Student Workbooks are included on the Workbook CD as Microsoft Word 6 and Rich Text Format (RTF) files. They are also presented pre-formatted in Pagemaker 6.0 and PDF formats. For more information on using these files, see the "Customizing the Workbook" section below.

Learning Objectives for The Digital Frog 2

Dissection

- Describe the external structures of the frog
- Explain, with reference to the 3-dimensional aspects of frog anatomy, the need for a particular order of dissection in the body cavity
- Explain what structures need to be cut at each stage of the dissection
- Describe, and explain the reasons for, the appearance of the interior of the heart, the lungs, the stomach, the mouth, and the leg muscles

Circulatory

- Describe in general terms the function of the circulatory system, and the functions of the organs that comprise the circulatory system
- State the substances carried by the blood
- Trace the path, and explain the mechanics of blood flow through the blood vessels in the body
- Compare the structure and function of capillaries, arteries, and veins
- Compare the function of red blood cells and white blood cells
- Trace the path of blood flow through the heart

- Compare the structure and merits of 2, 3, and 4 chambered hearts, and compare amphibian to human hearts

Respiratory

- Describe in general terms the functions of the respiratory system, and the functions of the organs that comprise the respiratory system
- Distinguish between the terms respiration, gas exchange, and cellular respiration
- Identify and explain the differences between the three types of respiration in the frog, and where they occur in the body
- List the factors that are necessary for each type of respiration
- Explain the mechanics of pulmonary respiration
- Compare frog and human noses, mouths, and skin, with respect to their respiratory functions.

Urogenital

- Describe in general terms the functions of the excretory and reproductive systems, and the functions of the organs that comprise these systems
- Define homeostasis, and explain how the kidneys contribute to the maintenance of homeostasis
- Describe the structure of the kidney and nephron, explain how they work to remove waste materials, and compare frog kidneys to human kidneys
- Explain the differences between the male and female reproductive organs
- Compare the mechanics of mitosis and meiosis
- Explain the differences between internal (frog) and external (human) fertilization.

Control Systems (Nervous and Endocrine)

- Describe in general terms the functions of the nervous and endocrine systems, and the functions of the organs that comprise these systems
- Distinguish between the central nervous system and the peripheral nervous system, and explain the difference in functions of the two systems
- List and describe the functions of the sensory organs
- Explain the functions of the parts of the brain, and compare frog and human brains
- Explain the components and process of a reflex arc
- Describe the functions of the autonomic nervous system
- Describe the structure and function of a neuron
- Explain the mechanics of transmission of a signal between neurons
- Describe the possible reactions of a frog to visual sensory information
- Describe how the nervous and endocrine systems work together

Digestive

- Describe in general terms the functions of the digestive system, and the functions of the organs that comprise this system
- Explain how food moves through the digestive system, and describe what happens at each stage
- Describe the path of nutrients after being absorbed by the digestive tract
- List the different digestive secretions, and explain their function in the digestive system
- Compare the structure and function between frog and human mouths, small and large intestines, liver, and cloaca (colon), with respect to the digestive system

Musculoskeletal

- Describe in general terms the functions of the musculoskeletal system, and the functions of the organs that comprise this systems
- Describe and compare the structure and location of the three types of muscle and their functions
- Describe the placement and the function of the major skeletal groupings (axial and appendicular skeletons)
- Compare human and frog vertebral columns
- Describe the structure of bone tissue, and the functions of bones
- Explain the process of musculoskeletal interaction in the movement of the skeleton
- Describe the different types of bone joints
- Explain the roles of cartilage, ligaments, and tendons in the musculoskeletal system

Immune

- Describe in general terms the functions of the immune system, and the functions of the organs that comprise these systems
- Describe the non-specific and specific methods used by a frog to protect itself from foreign elements
- Describe the role and function of B-cells and T-cells

Interacting Systems

- Describe and define the role each of the frog's systems play in feeding, moving, and reproducing

Ecology

- Define what is a frog
- Describe a frog's niche, in terms of where it lives, its predators and its prey
- Define "cold blooded", and explain what impact it has on the life of a frog
- Explain each step of the lifecycle, including relevant changes to habitat and in food source
- Explain certain frog behaviors, such as vocalization, jumping, feeding, and mating
- Explain how and why frogs hibernate
- Identify and discuss some environmental pressures on frog populations

Installation instructions

Macintosh Standalone

Minimum System Requirements

LC II, 16Mhz 68030 (Power PC is ideal)
5 MB of available RAM
2 MB of hard disk space for QuickTime
2.5 MB hard disk space for The Digital Frog 2 application
CD-ROM drive
System 7.1, or later
Screen capable of displaying at least 640 x 480, 256 colors

Installation

The Digital Frog 2 requires QuickTime. We also recommend that you copy The Digital Frog 2 application from the CD to the hard drive. (You can run it directly from the CD, but it will run more slowly.)

If QuickTime 2.1.2 or later is not already installed:

1. Insert the disc into the CD-ROM drive.
2. Double click on the Digital Frog 2 CD-ROM icon to view the contents of the CD.
3. Double click on **QuickTime 3.0** folder.
4. Double click on **Install QuickTime**.
5. Follow the on-screen instructions to complete the QuickTime installation.

To install The Digital Frog 2:

1. Drag **The Digital Frog 2** icon from the CD to the hard drive.
2. Double click on the copied **The Digital Frog 2** icon to run the program.

Troubleshooting

If your Mac has less than 8 MB of RAM, you may need to turn off unnecessary extensions and reduce the application size to 5000 K. If you get message **Could not find QuickTimeLib** when you launch the program, you may be low on memory; reducing the application size will help.

To reduce the application size:

1. Click on **The Digital Frog 2** icon to select it.
2. Choose **Get Info** from the **File** menu.
3. Change the **Preferred Size** to 5000 K.

Minimum System Requirements

386/25 (Pentium or better is ideal)
8 MB available RAM (16 MB is recommended)
2 MB of hard disk space for QuickTime
2.5 MB hard disk space for The Digital Frog 2 application
CD-ROM drive
Windows 3.1x
VGA/SVGA displaying at least 640 x 480, 256 colors
Sound card recommended

Installation

Your computer must have a 16-bit version of QuickTime for windows installed (it's OK to have both 32-bit and 16 bit versions installed). We also recommend installing The Digital Frog 2 application (you can run it directly from the CD, but it will run more slowly).

If a 16-bit version of QuickTime for Windows is not installed (or you are not sure):

1. Insert the disc into your CD-ROM drive.
2. In **File Manager**, select your CD-ROM drive.
3. Open the **qtinstal** directory.
4. Double click on **qtinstal.exe**.
5. Follow the on-screen instructions to complete the installation.

To install The Digital Frog 2:

1. Insert the disc into your CD-ROM drive.
2. In **File Manager**, open the root directory of the CD.
3. Double click on **setup.exe**.
4. Follow the on-screen instructions to complete the installation.
5. Double click on **The Digital Frog 2** icon to start The Digital Frog 2.

Optimization Recommendations

- Disable all screen saver programs before running The Digital Frog 2, as most screen savers will force the program to quit.
- Close all other applications.
- If Microsoft Office is installed, turn off the Control Bar.

Troubleshooting

Error/problem	Possible reason	What to do
Please select the original FROG2.INI	The application wants to know where it can find the Media on the CD-ROM.	Make sure the CD is in the drive. Select your CD-ROM drive under “Drives:” and open the FROG2 directory. Double click on the FROG2.INI file here.
Could not find <c:\FROG2\media \INTRO\0101BKG. PIC>	The application could not find the media on the CD-ROM.	Run The Digital Frog 2 again, and when prompted, make sure you select the FROG2.INI file on the CD.
This program requires 16-bit QuickTime for Windows	The program requires a 16-bit version of QuickTime. QuickTime 3.0 will not work.	Follow the “If a 16-bit version of QuickTime for Windows is not installed” instructions on the previous page.
This display device does not support 640x480 pixels and 65536 or 256 colors!	The Digital Frog 2 requires that the color depth of the monitor be set to at least 8-bit (256 or thousands of colors), and at least a 640x480 resolution	Use the Windows Setup program to choose a video driver that supports this bit depth and resolution. If you have already tried this and are still getting an error, you will have to install the Microsoft SVGA 640x480 256-color driver included with Windows (also available on the CD-ROM, in the SVGA directory).
Some pictures show up surrounded by a colored box.	The Digital Frog 2 requires some images to be transparent. You will need to edit the FROG2.INI file, in the C:\FROG2 directory.	<ol style="list-style-type: none"> 1. Open the file FROG2.INI in a text editor 2. Change ;transparency=driver or bitmap to transparency=bitmap (Make sure that you remove the semicolon at the beginning of the line.)
General program crashes and/or General Protection Fault message	These problems are often a conflict between software programs installed on your machine.	Here are some things to try... <ul style="list-style-type: none"> • Make sure you have the latest version of 16-bit QuickTime installed. The version number can be obtained from the QuickTime control Panel. The version included on The Digital Frog 2 CD-ROM is 2.1.2.59. If the version that you have is earlier than this, make sure you update it. • Turn off video acceleration in your display control panel. This is usually found under “Control Panels: Display: Settings: Advanced Properties: Performance”. Drag the Acceleration slider from Full to None. • Ensure that you have the latest version of your video drivers. Check the web site of the manufacturer of your video card to download the latest driver. • Note: There have been some problems specifically with ATI Rage video drivers and QuickTime that have been fixed with the latest version of the ATI Rage drivers.)

Minimum System Requirements

386/25 (Pentium or better is ideal)
8 MB available RAM (16 MB is recommended)
2 MB of hard disk space for QuickTime
2.5 MB hard disk space for The Digital Frog 2 application
CD-ROM drive
Windows 95
VGA/SVGA displaying at least 640 x 480, 256 colors
Sound card recommended

Installation

The Digital Frog 2 requires a 16-bit version of QuickTime for Windows to be installed. (You can run The Digital Frog 2 directly from the CD, but it will run more slowly.)

If a 16-bit version of QuickTime for Windows is not installed:

1. Insert the disc into your CD-ROM drive.
2. Double click on **My Computer**, then the **Digital Frog CD** icon
3. Double click on the **Qtinstal** folder.
4. Double click on the **Setup.exe** file.
5. Follow the on-screen instructions to complete the installation.

To install The Digital Frog 2:

1. Insert the disc into your CD-ROM drive.
2. Double click on **My Computer**, then the **Digital Frog CD** icon
4. Double click on **Setup.exe**.
5. Click **OK** to accept the pathname in the **Copy to** window.
6. Follow the on-screen instructions to complete the installation.
7. Double click on **The Digital Frog 2** icon to start The Digital Frog 2.

Optimization Recommendations

- Disable all screen saver programs before running The Digital Frog 2, as most screen savers will force the program to quit.
- Close all other applications.
- If Microsoft Office is installed, turn off the Control Bar.

Troubleshooting

Error/problem	Possible reason	What to do
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Could not find <c:\FROG2\media \INTRO\0101BKG. PIC>	The application could not find the media on the CD-ROM.	Run The Digital Frog 2 again, and when prompted, make sure you select the FROG2.INI file on the CD.
This program requires 16-bit QuickTime for Windows	The program requires a 16-bit version of QuickTime. QuickTime 3.0 will not work.	Follow the “If a 16-bit version of QuickTime for Windows is not installed” instructions on the previous page.
This display device does not support 640x480 pixels and 65536 or 256 colors!	The Digital Frog 2 requires that the color depth of the monitor be set to at least 8-bit (256 or thousands of colors) and at least a 640x480 resolution	Use the Windows Setup program to choose a video driver that supports this bit depth and resolution. If you have already tried this and are still getting an error, you will have to install the Microsoft SVGA 640x480 256-color driver included with Windows (also available on the CD-ROM, in the SVGA directory).
Some pictures show up surrounded by a colored box.	The Digital Frog 2 requires some images to be transparent. You will need to edit the FROG2.INI file, in the C:\FROG2 directory.	<ol style="list-style-type: none"> 1. Open the file FROG2.INI in a text editor 2. Change ;transparency=driver or bitmap to transparency=bitmap (Make sure that you remove the semicolon at the beginning of the line.)
General program crashes and/or General Protection Fault message	These problems are often a conflict between software programs installed on your machine.	Here are some things to try... <ul style="list-style-type: none"> • Make sure you have the latest version of 16-bit QuickTime installed. The version number can be obtained from the QuickTime control Panel. The version included on The Digital Frog 2 CD-ROM is 2.1.2.59. If the version that you have is earlier than this, make sure you update it. • Turn off video acceleration in your display control panel. This is usually found under “Control Panels: Display: Settings: Advanced Properties: Performance”. Drag the Acceleration slider from Full to None. • Ensure that you have the latest version of your video drivers. Check the web site of the manufacturer of your video card to download the latest driver. • Note: There have been some problems specifically with ATI Rage video drivers and QuickTime that have been fixed with the latest version of the ATI Rage drivers.)

How you can use the CD and workbook

The Digital Frog 2 can be integrated into the classroom in a variety of ways. It is intended for use by students individually or in small groups as a preparation for, follow up to, or in place of a real dissection. It can also be integrated into lessons as an accompanying visual aid, or used as a research tool for students doing independent research about frogs or anatomy.

It is unlikely you will require students to view every screen—or even every section—of The Digital Frog 2. One of the strengths of multimedia products is that users need access only the sections that are relevant or of interest to them. This is also true of books, but books don't include the incredible video, cool animations, interactive dissections, and hot-linked concepts that the CD uses to seamlessly tie everything together.

First Time Users

Students using The Digital Frog 2 for the first time might find it helpful to go through the on-screen Quick Tour. This can be accessed from the main menu screen, and shows users many of the program's features to help them get the most out of both the CD and the workbook. Context-sensitive help is also available at any time in the program by pressing "H" on the keyboard, or by clicking on "Help" from the Toolbar located in the upper left corner of every screen.

The Workbook

Students can use the Study Guide portion of the workbook as they go through The Digital Frog 2. It is broken down into modules covering different topic areas, corresponding with the modules on the CD. This allows you to customize the workbook for your lessons or curriculum.

Each Study Guide section includes several types of questions:

- Content questions based directly on The Digital Frog 2's screens. Each section normally starts with more basic and general questions, subsequently becoming increasingly advanced and specific. Suggested answers for these are provided in the Teacher's Guide.
- "For Further Thought" application questions, which require students to consider and discuss the implications of knowledge presented on the CD-ROM.
- "Independent Study Unit" questions, which pose questions or subjects for students to explore on their own, using resources beyond the CD-ROM.

Student Use in the Classroom

The Digital Frog 2 has been designed so that a student or small groups of students can be given the program and guide themselves through its many topic areas with a minimum amount of supervision. This also allows students to work through the CD at their own pace.

Virtually every word in The Digital Frog 2 has been defined, so students do not have to become bogged down with unfamiliar terminology. When the cursor displays an arrow with a small "T"

beside it, clicking on the word will display its definition. Many of the scientific terms also have spoken pronunciations, and often include more detailed information on the defined topic. Students can create a dictionary of terms that are new to them using the definitions and pronunciation to help them understand the terms used in *The Digital Frog 2*.

To guide students through the CD's content in a more directed fashion, give them sections or selected questions from the workbook to answer while they explore *The Digital Frog 2*. The workbook leads students through the program in a more linear fashion according to specific topic areas, posing questions to cover the major concepts taught on the CD. After students have worked through the workbook—or appropriate sections—answers can be marked or taken up to ensure they have covered the content. Once completed, the workbook can serve as a study guide suitable for review for tests and assignments.

This package includes a set of single-sided student workbook pages, suitable for photocopying. The CD includes all of the workbook's text and diagrams in a variety of formats for modification (see "Customizing The Workbook" below).

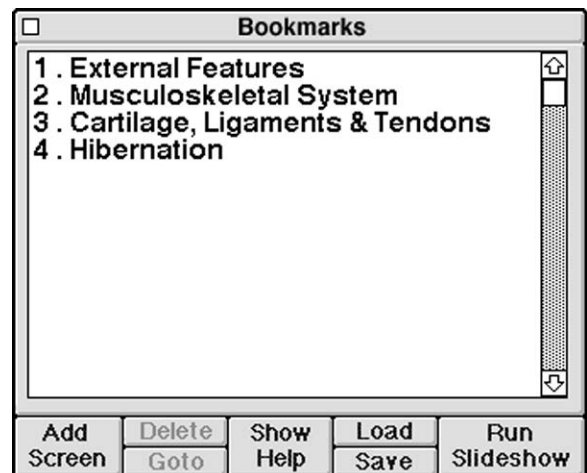
If classroom computer resources are limited, encourage students to only work through the content questions with the CD.

The 'For Further Thought' and "Independent Study Units" questions can also be used as discussion questions for students to work on independently, in small groups, or as a full class discussion. Many of these questions do not have absolute right and wrong answers, and lend themselves to these kind of discussions based on knowledge the students have gained from the CD.

As a Visual Aid in Lessons

The *Digital Frog 2* can also be used as a companion to in-class lessons or student presentations, along with a large monitor or an overhead projection panel. The CD's photographs, diagrams, videos and animations can be used as visual aids with any lesson relating to the concepts taught on the CD.

The Bookmark feature (accessed by pressing "B" at any time while using *The Digital Frog 2*) allows you to select screens that are appropriate for a given lesson. Bookmarks can be reorganized and saved, allowing multiple lessons to be prepared ahead of time and called up as needed. To organize a lesson, simply go to each screen you want to include, press "B", then press the "Add Screen" button. Once your list is complete, you can move bookmarks by dragging them to a different spot in the list. When you are done, you can save your bookmarks with the "Save" button. (Windows users must use the extension ".DFI")



To play back bookmarks as a slideshow, bring up the Bookmark controls, load your list if necessary and press the "Run Slideshow" button. This will display the first screen in your list of bookmarks. Press the down arrow on the keyboard to move to the next bookmark in your list. The up arrow will take you to the previous bookmark.

You can also use the graphics and text files within your handouts or overhead slides. When you find a screen or graphic you wish to use, use a screen-capture program to generate an image of the desired screen, or simply type “!” (Shift - 1) on the keyboard, and the path and filename for all displayed elements on that screen will appear. Using a graphics program or page-layout application, you can take those graphics and text files and use them in your handouts, overhead slides, tests, or modifications to the workbook.

As a Research Tool

The Digital Frog 2 can also be used as a resource for independent research. Students can work through the CD on their own, using it as they would any other resource for independent research. Used in this fashion, The Digital Frog 2 can also be incorporated as a supplement to lessons on specific body systems, dissection, frog or general anatomy, or even broader topics such as biology or ecology.

There are several methods to search for a specific topic within The Digital Frog 2. Students can use the menus or Map feature (by pressing “M” on the keyboard) to scan through screens until they find the topic they wish. Or, by pressing “F” on the keyboard, students can use the Find feature. Simply type in the desired term and click on “Okay”. The program will automatically take you to the appropriate screen.

The Workbook CD also contains all text from The Digital Frog 2 program, in the “CD_TEXT” directory . Use a word processor or page layout program to read these files.

Ancillary Materials

Customizing The Workbook

All of the files used to prepare this workbook are provided on the Workbook CD, under the “WORKBOOK” directory. The text files have been included in two formats: Microsoft Word 6 and Rich Text Format (RTF). These files can be opened in a variety of word processors and lay-out programs on both Macintosh and Windows machines. All of the diagrams used in the workbook have also been included in the “WORKBOOK” directory. As well, the formatted versions of the workbook are available as Pagemaker 6.0 and Adobe Acrobat (PDF) files on the CD.

You may use these files to print out additional copies of the workbook text, or to modify them for your class. If you have any problems, check our web page, WWW.DIGITALFROG.COM. If you still have problems or questions, contact us by e-mail at SUPPORT@DIGITALFROG.COM.

We are interested in hearing how you use The Digital Frog 2 in your classroom, especially if you have found a unique way to use the program with your curriculum or have modified the workbook. Any suggestions or ideas will be posted in a special area of our website for teachers such as yourself.

The CD Media

If you wish to use text from any screen in The Digital Frog 2, the contents of all the screens can be found in the “CD_TEXT” file on the CD. This file has been included as Microsoft Word, RTF and ASCII files.

You may also use photos and movies from the CD. Use a screen capture program, or to find out what text files, photos, diagrams, or movies are on a given screen, type “!” (Shift - 1) on the keyboard. A listing in the upper left corner of your screen will show the paths and filenames for all displayed media. You will require a graphics program or page layout program to use the media.

Beyond The Digital Frog 2

World Wide Web

There is an increasing wealth of information available over the Internet. Our World Wide Web site includes links to recommended sites, along with other helpful information. Visit our site at: [HTTP://WWW.DIGITALFROG.COM](http://www.digitalfrog.com).

Further Reading

The following is a list of some printed resources we found helpful in researching the CD. You will find these books useful as you explore beyond the information provided by The Digital Frog 2.

Brum, Gil, Larry McKane, and Gerry Karp. *Biology: Exploring Life*, 2nd ed.
New York: John Wiley & Sons, 1994.

Duellman, William, and Linda Trueb. *Biology of Amphibians*
Baltimore: John Hopkins University Press, 1994.

Ecker, A. *The Anatomy Of The Frog*
Oxford, England: Clarendon Press, 1889.

Elson, Lawrence. *The Zoology Coloring Book*.
Oakville, CA: Coloring Concepts, 1982.

Hickman, Cleveland, Larry Roberts, and Frances Hickman. *Biology of Animals*
St. Louis, MO: Times Mirror/Mosby College Publishing, 1986.

Holmes, S.J. *The Biology Of The Frog*
New York: Macmillan, 1912.

Mitchell, Lawrence, John Mutchmor, and Warren Dolphin. *Zoology*
Menlo Park, CA: The Benjamin/Cummings Publishing Company, 1988.

Moore, J.A. *Physiology of the Amphibia*, Vols. 1, 2, 3
New York: Academic Press, 1964.

Mulder, J.B. *The Laboratory Frog: a Programmed Booklet*.
East Lansing, MI: Mulder, 1975.

Rugh, R. *The Frog; Its Reproduction and Development*
New York: Mcgraw-Hill, 1951.

Savage, R.M. *The Ecology and Life History of the Common Frog (Rana temporaria)*
London, England: Pitman, 1961.

Stebbins, Robert, Nathan Cohen. *A Natural History of Amphibians*
Princeton, NJ: Princeton University Press, 1995.

Walker, W.F. *Dissection of The Frog*, 2nd ed.
San Francisco, CA: W.H. Freeman, 1981.

Wolfson, A. *The Frog*
Evanston, IL: Row, Peterson, c1955.

Wright, A.A. *Handbook of Frogs and Toads of the United States and Canada*, 3rd ed.
Ithaca, NY: Comstock Publishing Company, 1965.

Uberrtazzi, T. *The World of Amphibians and Reptiles*
New York, Gallery Books.

How to Contact Us

We would love to hear your comments or suggestions for this and future products.

You can reach us by:

Phone: 519-766-1097
Fax: 519-767-9994
Email: info@digitalfrog.com
Mail: Digital Frog International, Inc.
Trillium Place, 7377 Calfass Road
RR #2, Puslinch, ON
Canada
NOB 2J0
Web Site: [HTTP://WWW.DIGITALFROG.COM](http://www.digitalfrog.com)

Dissection



External Anatomy

- 1 a. What is special about the structure of a frog's feet?

Webbing

- b. How does this structure benefit frogs?

It increases the surface area of their feet, so they can swim better

- 2 a. What is the puckered opening between the legs called?

Cloaca

- b. What is this opening's purpose?

Exit for digestive and urogenital systems

- 3 a. Describe the frog's skin.

Possible answers: rubbery, tough, camouflaged, brown or black or green

- b. Why is patterned skin beneficial for frogs?

For camouflage, or to protect against predators

- 4 What's an easy way to help tell male and female frogs apart?

Look at their thumb pads; males have large thumb pads

- 5 What sensory organs are found on the head?

Eye, naris, tympanum, mouth, (skin)

Body Cavity

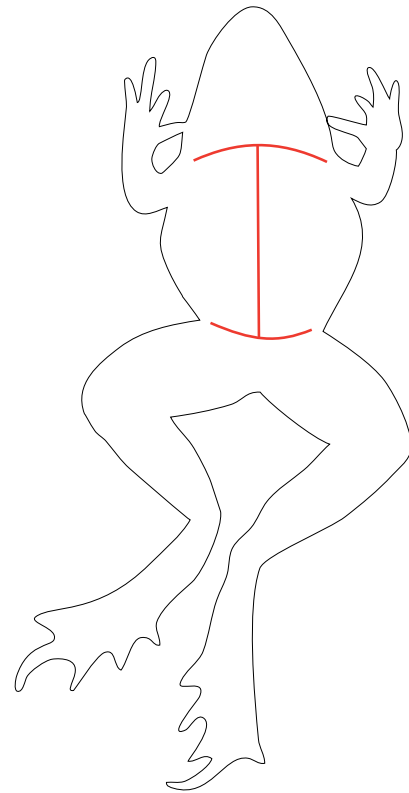
6 Draw the initial cuts you make to the skin on the diagram to the right:

7 What tools do you need to make these cuts?

Scissors (or scalpel) and something to hold the frog down

8 What do you see when you've made these cuts?

The muscle layer



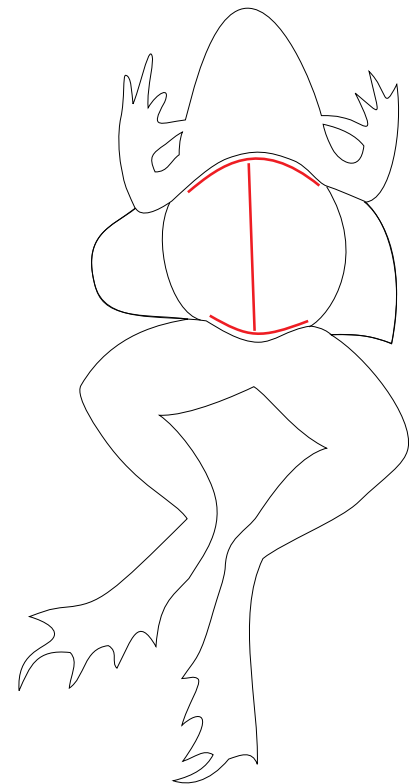
9 Draw the cuts needed for the muscle layer on the diagram to the right:

10 Why are scissors more appropriate than a scalpel for making these cuts?

A scalpel may cut through the organs underneath

11 Why should you make the vertical cut slightly off-center?

To avoid cutting the abdominal vein



- 12 Compare the internal organs of male and female frogs:

Male frog	Female frog with immature eggs	Female frog with mature eggs
<i>Organs fill body</i>	<i>Organs fill body</i>	<i>The eggs in ovaries push the organs out of the way.</i>

- 13 Which organ in the body cavity should you dissect first?

The heart

- 14 What is its purpose?

Pumps blood to the rest of the body

- 15 What external features can you see?

Ventricle

Atria

Conus arteriosus

Truncus arteriosii

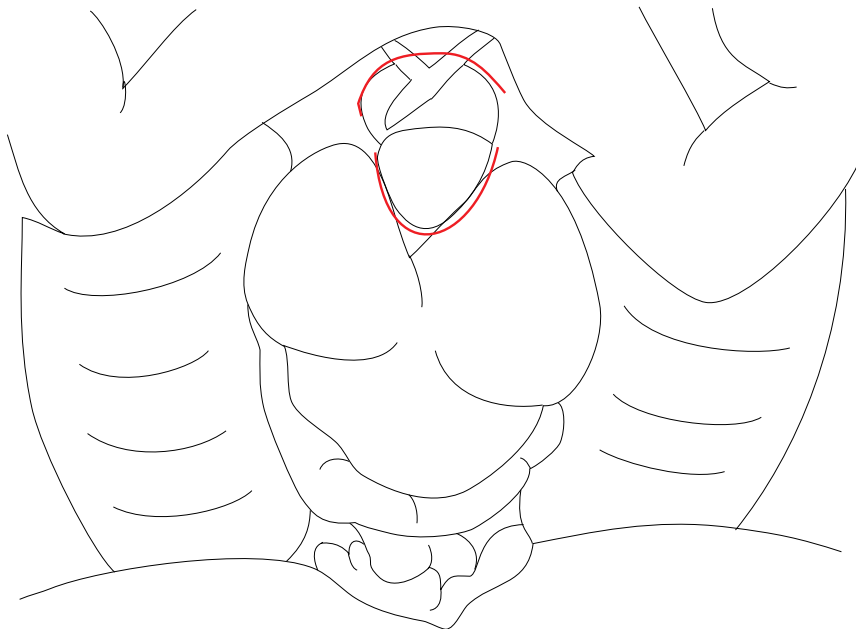
- 16 What must you remove before you can dissect this organ?

The pericardium

- 17 What does the pericardium look like?

A thin, whitish sac around the heart

- 18 On the diagram, draw the cuts needed to remove the heart from the body:



19 What does the inside of the heart look like?

A spongy, muscular ventricle, two atria (probably filled with blood), the left and right truncus arteriosii

20 What is the next organ to dissect after the heart?

The liver

21 What is its function?

Filters wastes

22 What must be cut to remove this organ?

Connective tissues and blood vessels around and under the heart

23 What major liver structures can you identify?

Left, right and median lobes, and the gall bladder

24 Why could you not remove the lungs before removing the liver?

The liver covered them

25 On the diagram, draw the cuts needed to remove the lungs:



26 Describe the interior of the lung:

Highly branched, looks spongy

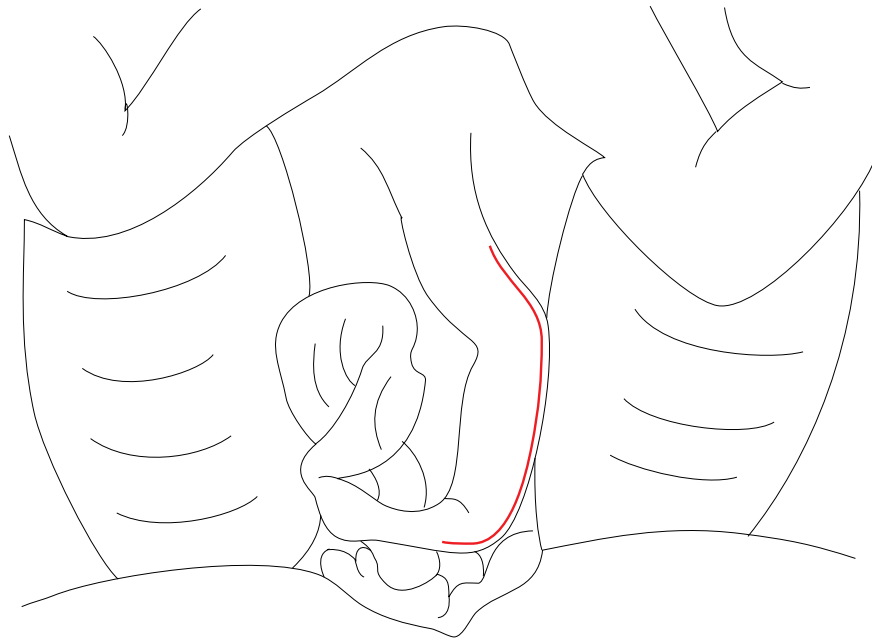
27 What should you dissect after the lungs?

The stomach

28 What is this organ's purpose?

Breaks down food

29 On the diagram, draw the cuts needed to dissect the stomach:



30 Describe the interior of the stomach:

Folded, with rugae along the length, and a tight pyloric sphincter at the lower end

For further thought...

What are the internal structures of the stomach called? Describe their purpose.

For further thought...

If you are dissecting a real frog, and the stomach has food in it, can you identify any of it? What was your frog's last meal?

31 What is the stomach attached to on each end?

The esophagus at one end, and the intestine at the other

32 What organ is dissected after the stomach?

The intestine

33 What is the function of the intestine?

To absorb food

34 Describe this organ's shape in the body cavity

Twisted and folded

35 If you are dissecting a real frog, stretch the intestine out. How long is it?

Students' answers will vary

For further thought...

Why do you think the intestines are so long?

36 Color the organs that are visible when the intestines are lifted.



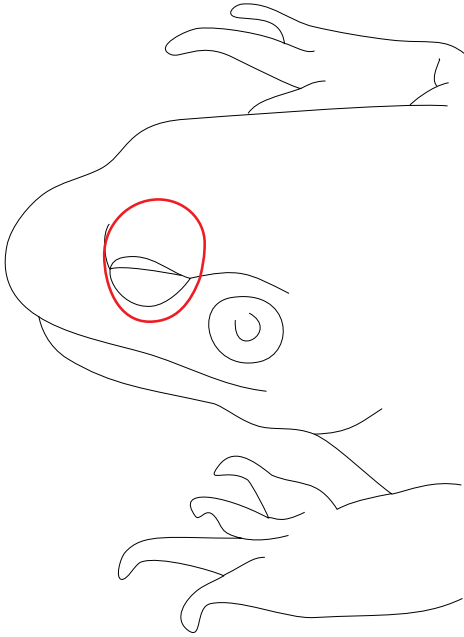
- Pancreas
- Spleen
- Kidney
- Urinary bladder
- Testis or ovary
- Fat bodies

37 What are the visible components of the urogenital system?

Male	Female
<p><i>Testis</i></p> <p><i>Renal veins</i></p> <p><i>Kidney</i></p> <p><i>Urinary bladder</i></p>	<p><i>Ovaries (possibly filled with eggs)</i></p> <p><i>Renal veins</i></p> <p><i>Kidney</i></p> <p><i>Urinary bladder</i></p>

Head Dissection

38 Draw the cuts needed to dissect the eye:



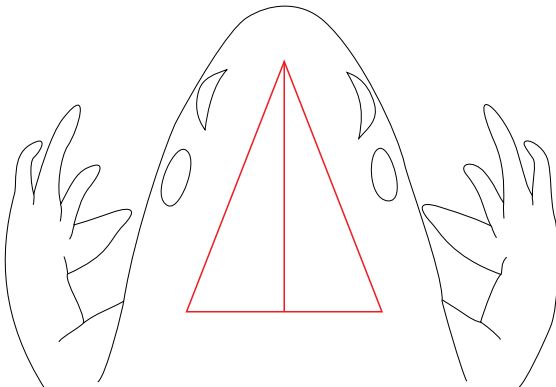
39 What frequently happens to the eyes of preserved frogs?

They disintegrate

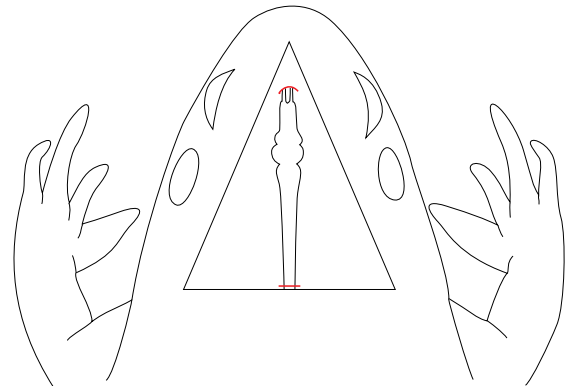
40 What might you have to cut to remove the eye?

The optic nerve

41 Draw the first cuts needed to expose the brain:



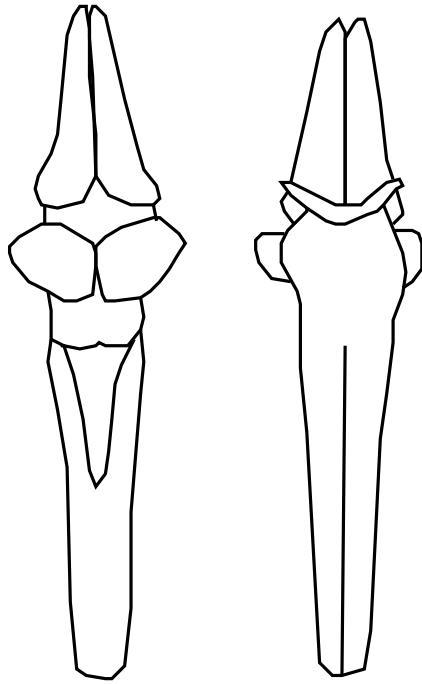
42 Draw the cuts needed to remove the brain:



43 What structures must be cut before removing the brain?

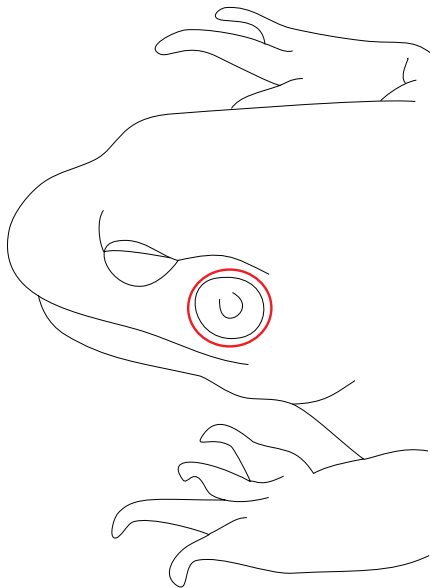
Skin, muscle, bone, spinal cord, nerves in front of olfactory lobe, cranial nerves

44 Color and label the visible parts of the brain:



- Optic lobes
- Thalamus
- Cerebral hemispheres
- Olfactory lobes
- Cerebellum
- Medulla oblongata
- Fourth ventricle
- Spinal cord
- Optic chiasma

45 Draw the cuts needed to dissect the tympanum:



46 What structures do you have to cut to expose the tympanic cavity?

Skin

Stapes

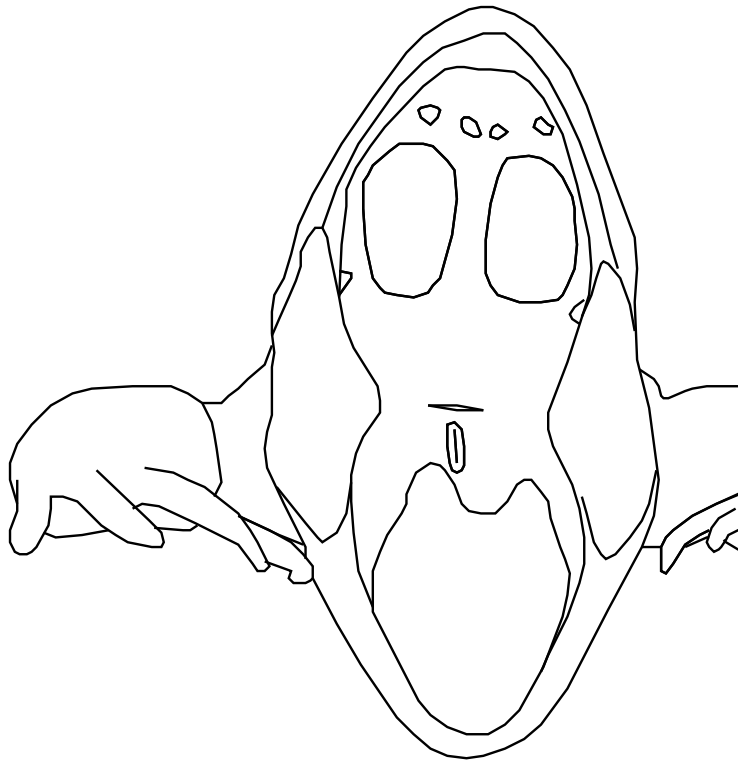
47 What bone is clearly visible after removing the tympanic membrane?

Stapes bone

48 What do you have to cut to dissect the mouth?

The jaw bone on either side of the head

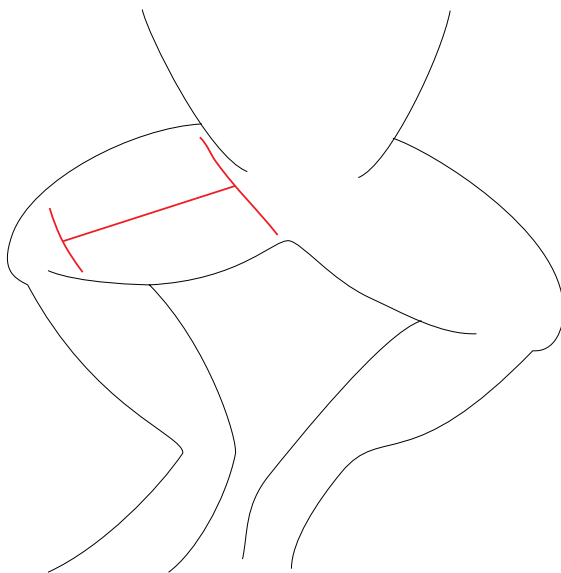
49 Color and label the visible structures of the mouth:



- Upper jaw (with maxillary teeth)
- Internal nares
- Vomerine teeth
- Floor of eye sockets
- Eustachian tubes
- Cut angle of the jaw
- Esophagus
- Glottis
- Tongue
- Lower jaw

Muscles/Leg Dissection

50 Draw the cuts needed to dissect the frog's leg:



51 Why does the skin on the frog's legs lift away so easily?

The skin is loosely attached to the muscles, with lymph sacs separating most of the skin and muscles

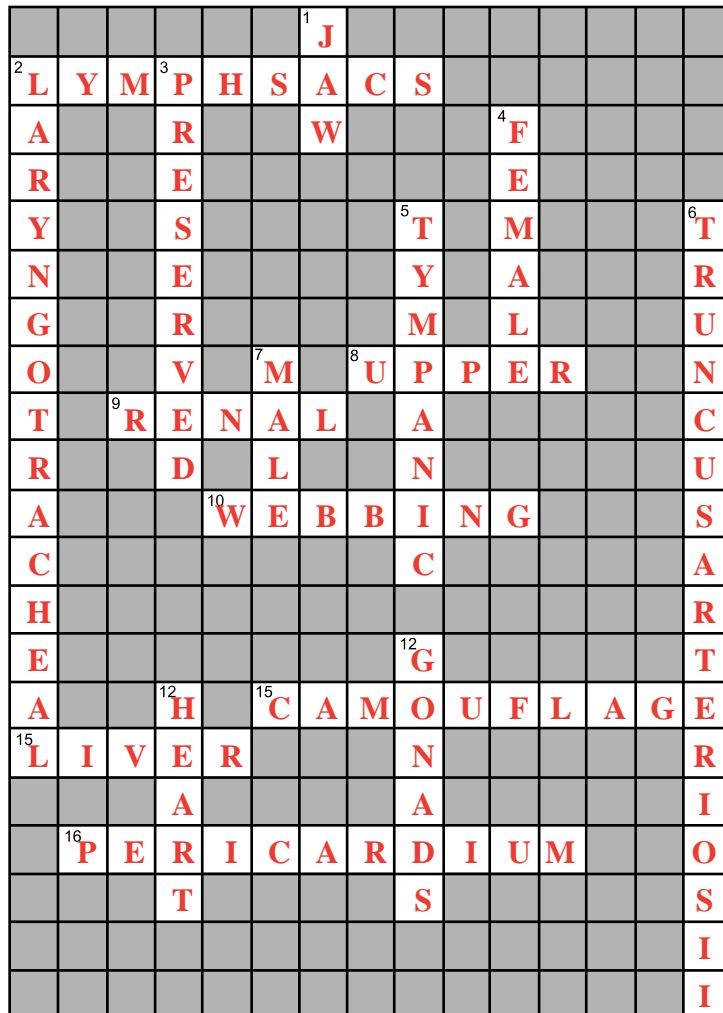
52 Describe the leg muscles.

Each muscle is well defined, and looks like it's made from separate fibers

53 What kind of muscles are found in the leg?

Skeletal muscle

The Crossword



ACROSS

- Skin is separated from the muscles by these (5, 4)
- Jaw containing maxillary teeth (5)
- Veins found in urogenital system (5)
- This increases the surface area of the feet for swimming (7)
- Reason for mottling on frog skin (10)
- Organ with right, left and median lobes (5)
- Sac-like membrane surrounding heart (11)

DOWN

- This is cut in dissection of the mouth (3)
- Chamber lungs are joined to (15)
- Kind of specimen in which lung is highly contracted (9)
- The _____ frog may have distorted internal organs (6)
- Cavity that is exposed upon dissection of the ear (8)
- The _____ frog has an enlarged thumb pad (4)
- Tubes cut to dissect the heart (7, 10)
- Organs that fat bodies are adjacent to (6)
- Organ dissected first in body cavity (5)

Circulatory System



1 In general terms, what is the function of the circulatory system?

Transports chemical substances around the body.

2 Describe the function of the following structures in the circulatory system:

Structure	Function
Blood	<i>Carries substances in the body</i>
Veins	<i>Transport blood from the lungs and body to the heart</i>
Capillaries	<i>Site of diffusion of substances between blood and tissues</i>
Arteries	<i>Transport blood from the heart to the rest of the body</i>
Heart	<i>Pumps blood</i>
Spleen	<i>Produces, stores and breaks down blood cells and filters lymph</i>
Lymphatic System	<i>Collects and filters interstitial fluid</i>

3 List the substances carried by the cells and plasma of blood:

Blood proteins

Inorganic salts

Nutrients

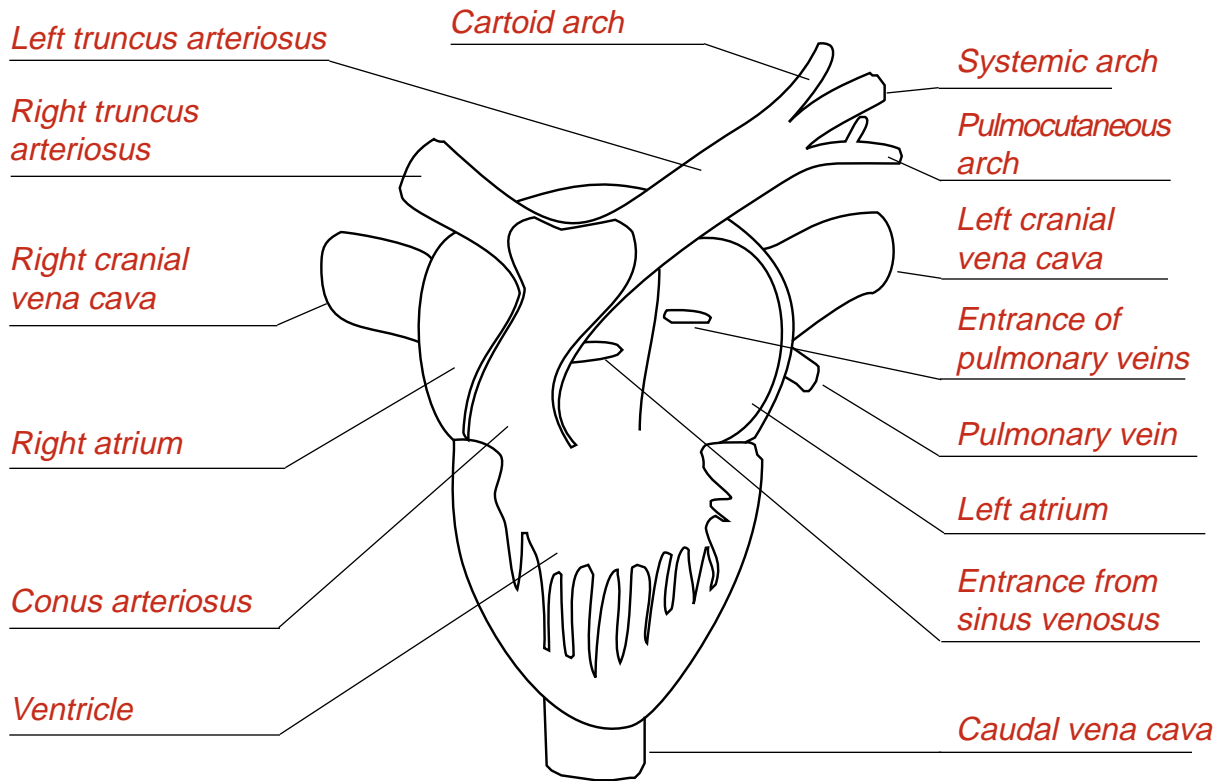
Metabolic waste

Hormones

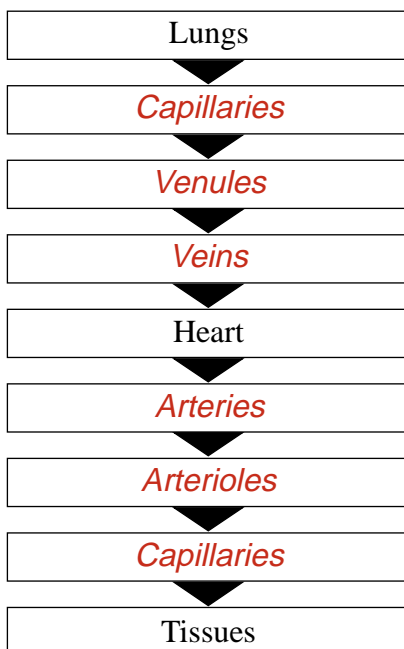
Oxygen

Carbon dioxide

- 4 The heart is a complex organ and the “heart” of the circulatory system. (It is interesting to note how the word has come to mean “center” or “most important part”.) Review the animated diagram and label the parts of the heart.



- 5 Specify the order of blood vessels an oxygen molecule entering the lungs would pass through on the way to the tissues:



- 6 a. Which veins carry oxygenated blood?
Pulmonary veins (from lungs to heart)

b. Which arteries carry deoxygenated blood?

Pulmonary arteries (from heart to lungs)

- 7 Consider the plumbing in your house. The water enters under pressure and the waste water is drained using gravity and a series of valves to prevent backflow. If you imagine the house is a frog’s body, this can be compared to the blood vessels.

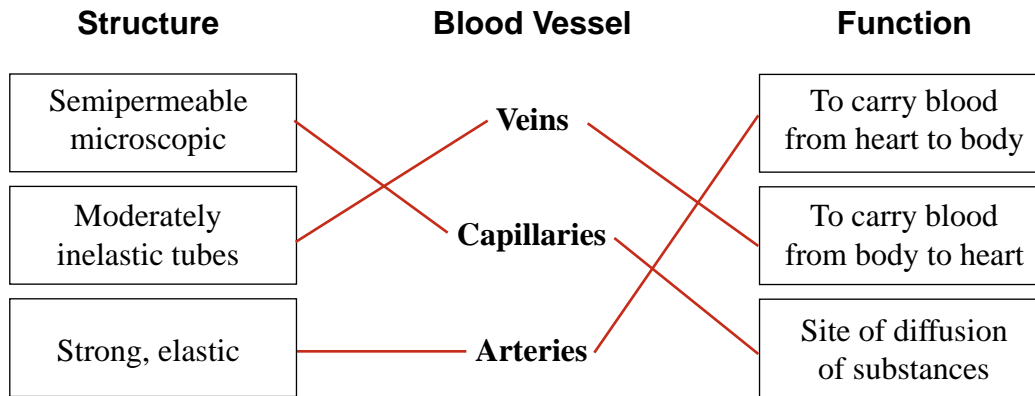
The incoming pipes can be compared to the:

Arteries

The drainage system is similar to the

Veins

- 8 Match the structures and functions to the corresponding blood vessel:



- 9 a. Capillaries are small and thin. Why is this beneficial?

To increase surface area and allow diffusion in and out.

- b. Why are arteries muscular?

Because blood in them is under high pressure

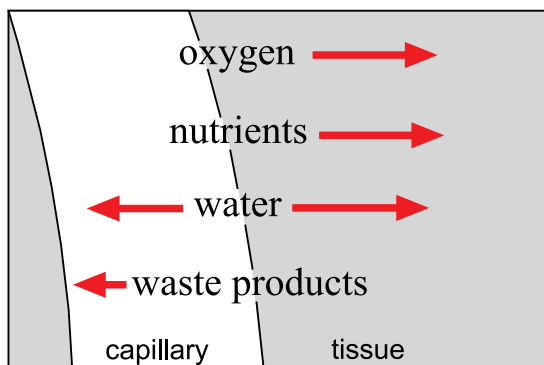
- c. Why do veins have valves?

Blood in them is under low pressure. Valves prevent backflow, helping to move blood back to the heart.

For further thought...

How does blood move through the veins?

- 10 In the following diagram, use arrow to illustrate the movement of the substances either into or out of the capillaries. (*Hint: Some may do both.*)



- 11 a. Which component of red blood cells provides the color?

Hemoglobin, which is red.

- b. What does is the function of this component of the blood?

Carry oxygen.

- c. What is the function of white blood cells?

Protect the frog from infection.

- 12 **Compare to human**



What is the primary difference between frog red blood cells and human red blood cells?

Red blood cells in humans are not nucleated.

13 a. What is hematopoiesis?

The production of blood cells.

b. Where does it occur in the adult frog?

In the spleen (and also in bone marrow)

14 Name the parts of the heart that fit the descriptions below:

Deoxygenated blood enters the heart through these two structures:

Cranial vena cava

Caudal vena cava

Oxygenated blood enters the heart through this:

Pulmonary vein

Deoxygenated blood leaves the heart through this:

Pulmocutaneous arch (or conus arteriosus)

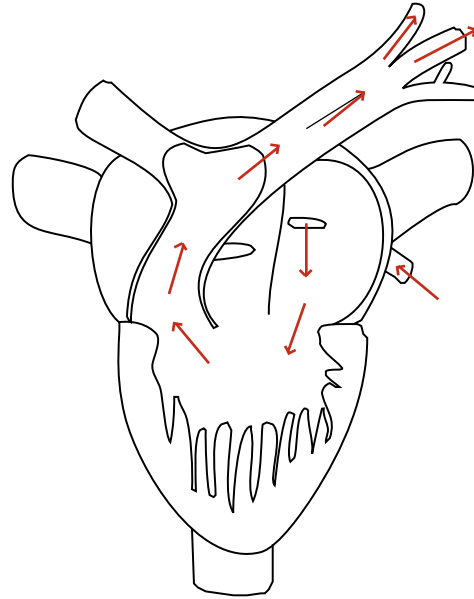
Highly oxygenated blood leaves the heart through this:

Carotid arch (or conus arteriosus)

Partly oxygenated blood leaves the heart through this:

Systemic arch (or conus arteriosus)

15 Trace the path of an oxygen molecule as it passes through the heart. (*Hint: the oxygen molecule comes from the lungs.*)



16 Why is a frog's three-chambered heart more efficient than a two-chambered heart?

Two separate circuits are needed to keep blood pressure high through the body and the lungs.

b. What secondary benefit does a frog gain from a three-chambered heart?

It can vary the amount of blood mixing, by using its skin (cutaneous) or lungs (pulmonary) more to suit its situation.

c. Why do humans need a four-chambered heart?

It prevents the mixing of oxygenated and deoxygenated blood, and humans don't use cutaneous respiration.

For further thought...

Where do the pulmocutaneous arch, the carotid arch and systemic arch lead?

Pulmocutaneous arch *Skin and lungs*

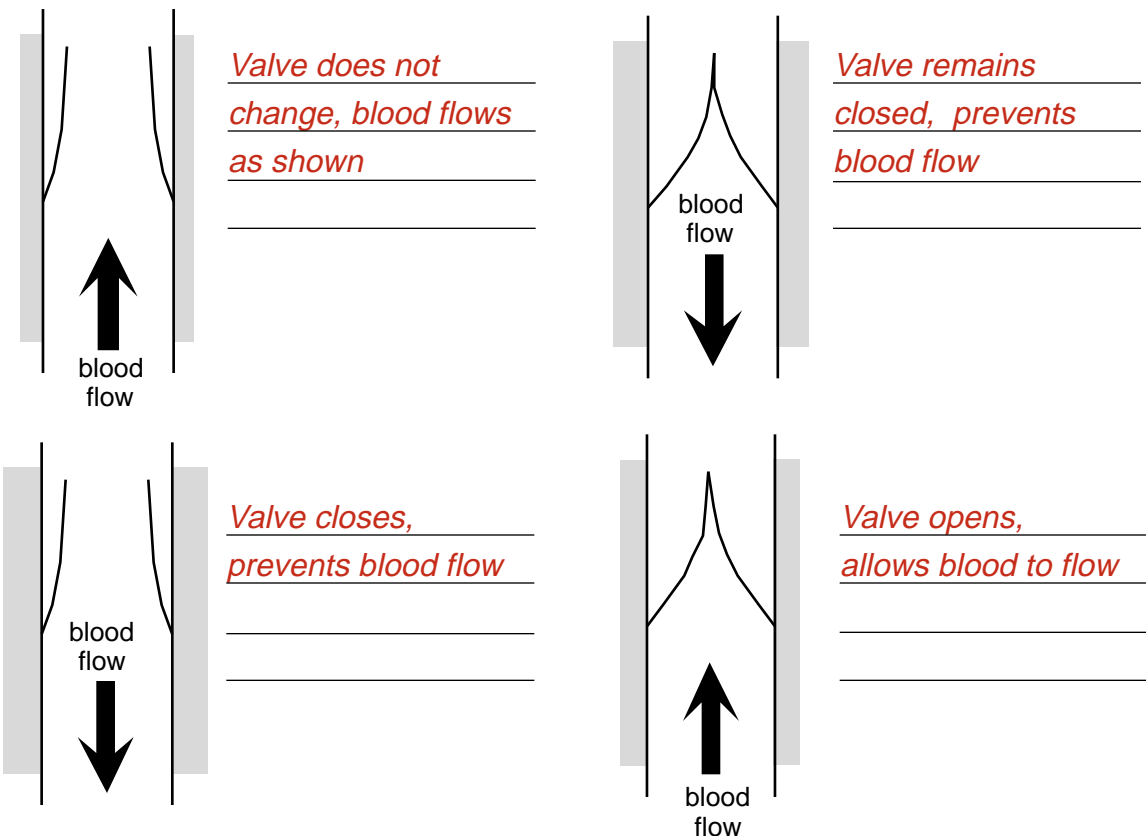
Carotid arch *Mouth, pharynx and brain*

Systemic arch *The rest of the body*

- 17** When you feel your pulse, what type of blood vessel are you feeling? What characteristics allow you to feel this?

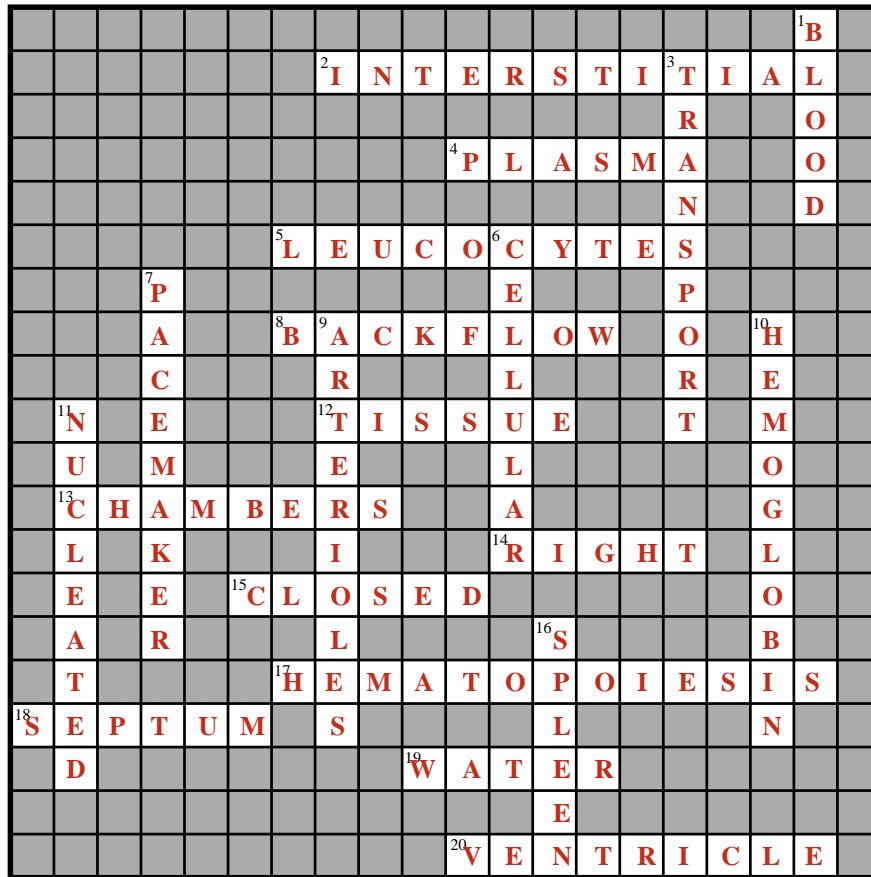
An artery. Arteries are more elastic and pulse more with the movement of blood. Plus they lead from the heart, so they show greater variances in pressure.

- 18** What will happen to each of the valves below when blood flows in the direction of the arrow?

**Independent Study Unit**

What are the major physical and chemical differences between the circulatory system of a human and the circulatory system of a frog?

The Crossword



ACROSS

2. The lymphatic system collects this fluid (12)
4. What the fluid component of blood is called (6)
5. Blood cells which are part of the immune system (10)
8. Valves in veins prevent this (8)
12. Blood is a fluid _____ (6)
13. The frog's heart has three _____ (8)
14. Blood from the body enters this atrium (5)
15. The circulatory system of the frog is a _____ system (6)
17. What the production of blood cells is called. (13)
18. Membrane that separates subcutaneous lymph spaces (6)
19. Plasma is mainly made up of this. (5)
20. The atria empty into this chamber (9)

DOWN

1. The primary method for transporting substances through the body (5)
3. This is the primary function of blood (9)
6. Blood has both a fluid and a _____ component (8)
7. Beating of the heart is controlled by this grouping of nerve cells (9)
9. Small arteries (10)
10. Red blood cells are red because they contain this substance (10)
11. Unlike human erythrocytes, frog erythrocytes are _____ (9)
16. Where red and white blood cells are produced (5)

Respiratory System



1 What are the functions of the respiratory system?

To transfer oxygen from the environment to body tissues.

To transfer waste carbon dioxide from the body to the environment.

2 Describe the specific functions of the following structures in the respiratory system:

Nose	<i>Is the main channel for passage of air to and from the lungs</i>
Mouth	<i>Allows the passage of air, and is also the site of buccopharyngeal respiration</i>
Lungs	<i>Are the main site of oxygen absorption in pulmonary respiration</i>
Skin	<i>Functions as respiratory membrane in cutaneous respiration</i>

3 What are the three types of respiration in the frog?

Pulmonary, cutaneous and buccopharyngeal

4

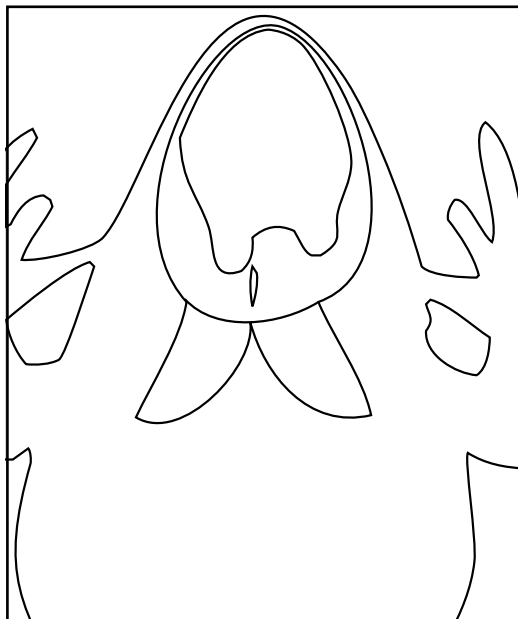


Compare to human

Of the three types of respiration, which is used by humans?

Pulmonary

5 Color the picture and legend to identify these parts of the respiratory system:



- Lungs
- Skin
- Mouth
- Tongue
- Glottis

For further thought...

What respiratory organ is not labeled in the picture?

(Hint: Look at the mouth screen.)

internal nares

6 Specify the type of respiration that occurs at each organ listed below:

Mouth	<i>Buccopharyngeal</i>
Lungs	<i>Pulmonary</i>
Skin	<i>Cutaneous</i>

7 List the two most important physical features of the lungs, and why they are important:
Balloon-like, flexible (or expandable)—hold large volume of air, can push air back out.
Pockets on interior surface—larger surface area is efficient for gas exchange.

8 What are three factors that make cutaneous respiration possible?

Skin is thin

Skin is moist

Large number of blood vessels

9 How are frogs able to alter the amount of cutaneous respiration that occurs?

By altering the amount of blood flow to the capillaries under the skin.

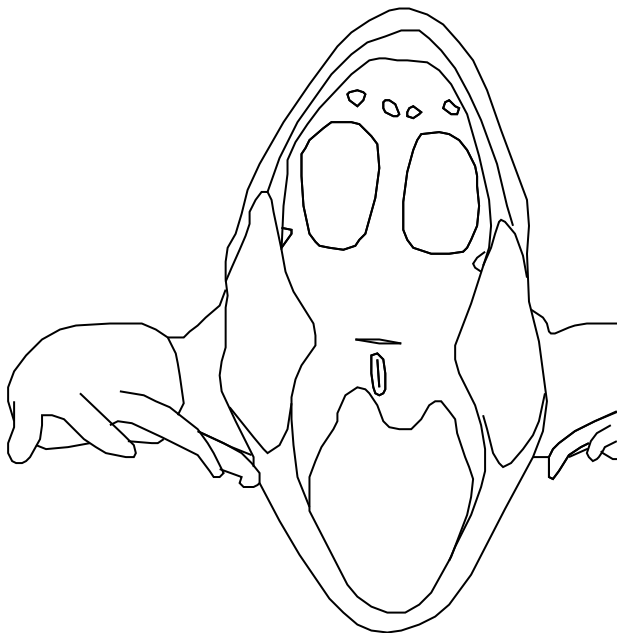
10 a. Buccopharyngeal respiration occurs along with what other type of respiration?

Pulmonary

b. When and how does it occur?

It occurs as air leaves the lungs. The mouth is closed, and air pumps in and out of the nares. Gas exchange occurs along the membrane lining of the mouth cavity.

11 On the picture below, identify, color and label the structures in the mouth that are involved in respiration. Specify the type(s) of respiration that occur with each structure.



- Nares
Buccopharyngeal, pulmonary
- Glottis
Buccopharyngeal, pulmonary
- Tongue
Buccopharyngeal, pulmonary
- Skin
Cutaneous

12 Put the following activities that take place in pulmonary respiration in the correct order:

- 4 The nares are sealed and the floor of the mouth cavity is raised
- 2 The frog forms a pocket of air under its tongue
- 1 The frog closes and lowers the floor of its mouth, pulling air through the nares.
- 3 The glottis opens, allowing the air in the lungs to exit
- 5 The air under the tongue is forced into the lungs

13  **Compare to human**

How does pulmonary respiration differ in humans?

Air is pulled into the lungs via contraction of the diaphragm. Air is expelled from the lungs through relaxation of the diaphragm.

14 Describe the movement of oxygen and carbon dioxide between the environment and the tissues of the body, using pulmonary respiration.

- *Oxygen is brought into the lungs through the mouth*
- *Oxygen diffuses across the lung membrane into the blood/capillaries*
- *Oxygen is carried by red blood cells through the body*
- *Oxygen diffuses from the blood to tissues*
- *Carbon dioxide diffuses from tissues to the blood*
- *Carbon dioxide is carried by blood to the lungs*
- *Carbon dioxide diffuses across the lung membrane*
- *Carbon dioxide is expelled from the lungs through the mouth*

15 Fill in the blanks in the following paragraph with the following words or phrases:

cellular respiration

respiration

gas exchange

Respiration is a sequence of events that transports oxygen from the environment to the body tissues, and removes waste carbon dioxide from the body tissues to the environment. One part of this process is the diffusion of oxygen and carbon dioxide into and out of the capillaries.

This is called gas exchange, and takes place primarily in the lungs and body tissues.

The oxygen acquired by the body is used to produce energy in the process of cellular respiration.

- 16 a. What is the primary type of breathing used by frogs in the water?

Cutaneous

- b. On land?

Pulmonary

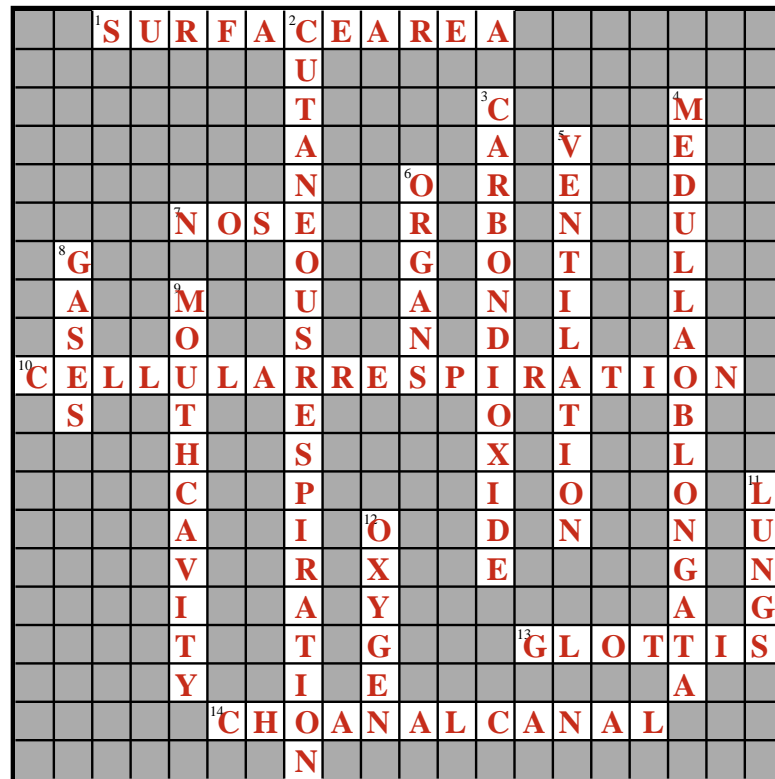
- c. While hibernating?

Cutaneous

Independent Study Unit

What are the major physical differences between the respiratory system of a human and the respiratory system of a frog?

The Crossword



ACROSS

- The pouches in the inner surface of the lung increase this. (7, 4)
- Organ that air passes through when entering the mouth cavity from the environment (4)
- This energy-producing mechanism uses oxygen as fuel (8, 11)
- Structure that air passes through when going to lungs from mouth (7)
- Name of canal that links internal and external nares (7, 5)

DOWN

- Respiration through the skin (9, 11)
- This waste gas is transferred from the blood to the environment by the respiratory system (6,7)
- Part of brain that controls pulmonary respiration (7, 9)
- The frog moves air in and out of the lungs in this process (11)
- The respiratory system is made up of a group of _____. (6)
- The function of the respiratory system is the transfer of these. (5)
- The site of buccopharyngeal respiration (5, 6)
- The site of pulmonary respiration (5)
- This gas is transferred from the environment to the blood by the respiratory system (6)

Digestive System



1 What are the general functions of the digestive system?

Ingestion, digestion and absorption of nutrients

2 Describe the specific functions of the following structures in the digestive system:

Mouth	<i>Engulfs and captures food, and acts as a passage into the esophagus</i>
Stomach	<i>Stores and digests food by breaking it down</i>
Pancreas	<i>Produces and releases enzymes into small intestine</i>
Liver	<i>Produces bile, glycogen and proteins from nutrients and ammonia</i>
Gall bladder	<i>Stores bile</i>
Small Intestine	<i>Completes the digestive process and absorbs nutrients</i>
Large Intestine	<i>Absorbs water</i>

3 Color the picture and the legend to identify the following organs:



- Large Intestine
- Small Intestine
- Liver
- Stomach
- Mouth
- Tongue

For further thought...

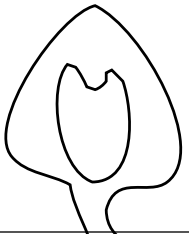
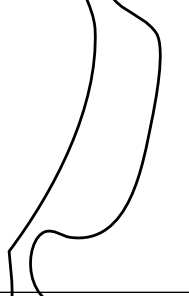
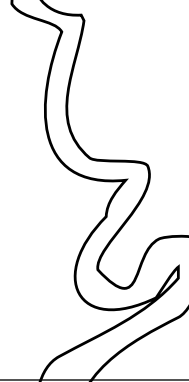
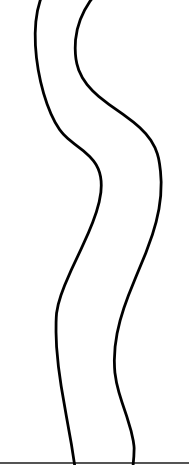
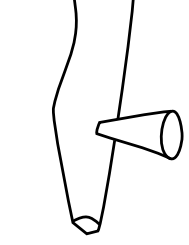
Why can't you find the gall bladder on the diagram?

It's under the liver

Why can't you see the pancreas on the diagram?

It's under the intestines

4 In the diagram below, list all the substances that are added to, or extracted from, the frog's digestive tract as food passes through. Also describe the state of the food at each stage.

	Substances added	Substances extracted	Physical-chemical state of food
Mouth 	<i>(Possible answer: food, saliva)</i>	<i>None</i>	<i>Unchanged (in frogs)</i>
Stomach 	<i>Acid, enzymes, mucus (Also acceptable: gastric juices, pepsinogen)</i>	<i>None</i>	<i>Smaller particles Acidified Some proteins broken down</i>
Small intestine 	<i>Bile and mucus, digestive enzymes, enzyme precursors</i>	<i>Nutrients (such as: proteins, fats, carbohydrates)</i>	<i>Even smaller particles Less acidic Proteins, fats and carbohydrates broken down</i>
Large intestine 	<i>(Possible answer: bacteria)</i>	<i>Water, vitamins B and K (plus other nutrients)</i>	<i>Semi-solid</i>
Cloaca 	<i>None</i>	<i>(Possible answer: waste)</i>	<i>Feces</i>

5 Food is digested in two ways. Mechanical digestion physically breaks down food into smaller particles, while chemical digestion uses chemicals to break down individual nutrients.

In the chart below, determine for both frogs and humans which types of digestion (chemical and/or mechanical) occur in each portion of the digestive tract.

	Humans	Frogs
Mouth	<i>Chemical Mechanical</i>	<i>None</i>
Stomach	<i>Chemical Mechanical</i>	<i>Chemical Mechanical</i>
Small intestine	<i>Chemical</i>	<i>Chemical</i>
Large intestine	<i>None, although there is some bacterial action</i>	<i>None, although there is some bacterial action</i>

6 In the frog’s mouth, what function do the vomerine teeth serve?

To hold or immobilize prey.

7 The stomach breaks down food in the following ways:

Muscular churning action

Pepsin

Hydrochloric acid

8 a. Where is pepsinogen produced?

Glands in the stomach lining

b. What changes it into pepsin?

Hydrochloric acid

c. What is the function of pepsin?

To break down proteins

9 What are the folds of the stomach lining called?

Rugae

10 How does the digestive system avoid digesting itself?

It produces mucus to protect the lining from enzymes and acid.

For further thought...

Why are some enzymes introduced into the digestive system in an inactive form?

11 a. How are nutrients passed from the small intestine to the liver?

Through the hepatic portal vein.

b. Why are these nutrients passed to the liver?

For storage.

For further thought...

A frog's intestine absorbs toxins, such as venom in insects, along with nutrients. The liver then filters these toxins out. Why is this filtering so important?

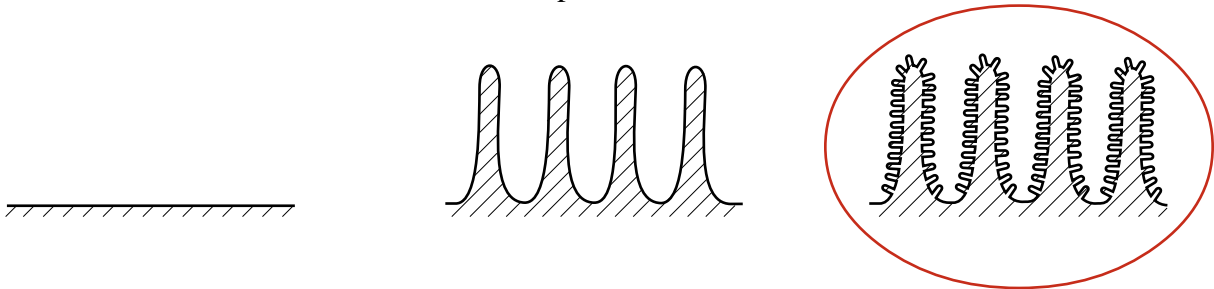
12 Which part of the small intestine do bile and enzymes from the liver and pancreas enter?

Duodenum

13 How do the secretions from the liver and pancreas interact with each other in the small intestine?

Bicarbonate activates enzymes.

14 a. Circle the most effective surface for absorption.



b. Why is this more effective than the others?

Because it has the greatest surface area

15 a. What does the pancreas produce?

Enzymes and enzyme precursors.

b. How do these products get into the small intestine?

Through the pancreatic duct and common bile duct.

16 How does bile get from the liver to the duodenum?

Through the hepatic ducts, cystic duct, common bile duct

17 What is the function of bile?

To emulsify fat, neutralize stomach acid and activate enzymes.

18



Compare to human

a. Where do feces exit in frogs?

Through the cloaca

b. In humans?

Through the rectum (or anus).

Independent Study Unit

Why are vitamins B and K produced by bacteria in the large intestine and not in the stomach?

Urogenital System



- 1 a. Name the two systems that form the urogenital system.

Excretory and reproductive systems.

- b. Describe the primary function of each.

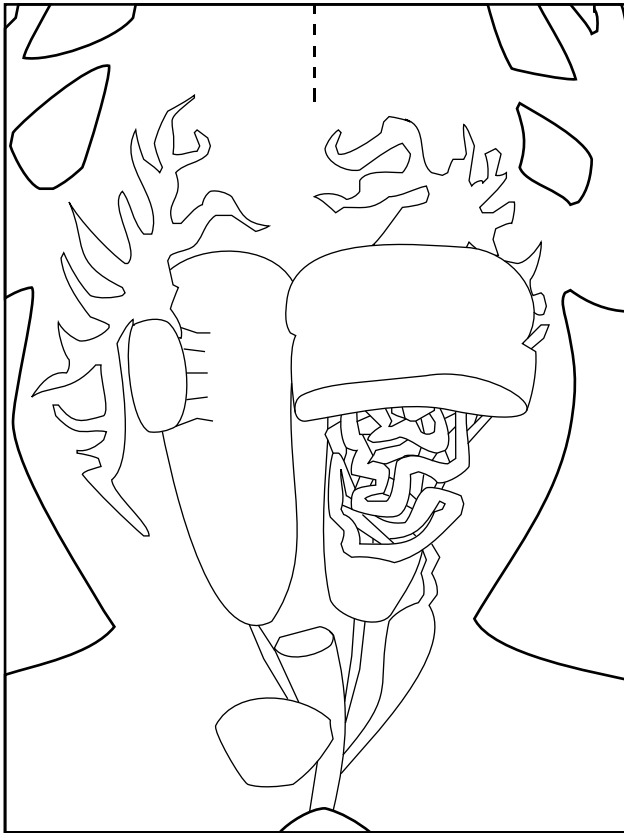
The excretory system eliminates waste materials

The reproductive system produces gametes.

- 2 Describe the specific functions of each of the following structures in the urogenital system:

Structure	Function
Kidneys	<i>Remove excess water and toxic wastes from body</i>
Bladder	<i>Stores urine, reabsorbs water and ions</i>
Cloaca	<i>Is exit for urine, feces and gametes</i>
Ovaries	<i>Produce ova, release hormones</i>
Oviducts	<i>Transfer ova from ovary to ovisac</i>
Ovisac	<i>Coats ova with jelly, stores until release</i>
Testes	<i>Produce sperm, release hormones</i>
Seminiferous tubules	<i>Form sperm</i>
Efferent ductules	<i>Transfer sperm to kidneys</i>
Mesonephric duct	<i>Transfer sperm and urine from kidneys to bladder and seminal vesicle</i>

3 Color the picture and the legend to identify the following organs:



- Testis
- Kidney
- Mesonephric duct
- Urinary bladder
- Fat bodies
- Ovary
- Oviduct
- Cloaca

4 Why does the frog need to excrete certain materials?

Metabolism produces toxic by-products that must be expelled from the body.

5 What organs make up the excretory system?

Kidneys, urinary bladder and cloaca.

6 a. What is the main substance removed from the body by frog kidneys ?

Excess water.

b. List four other functions of the kidneys.

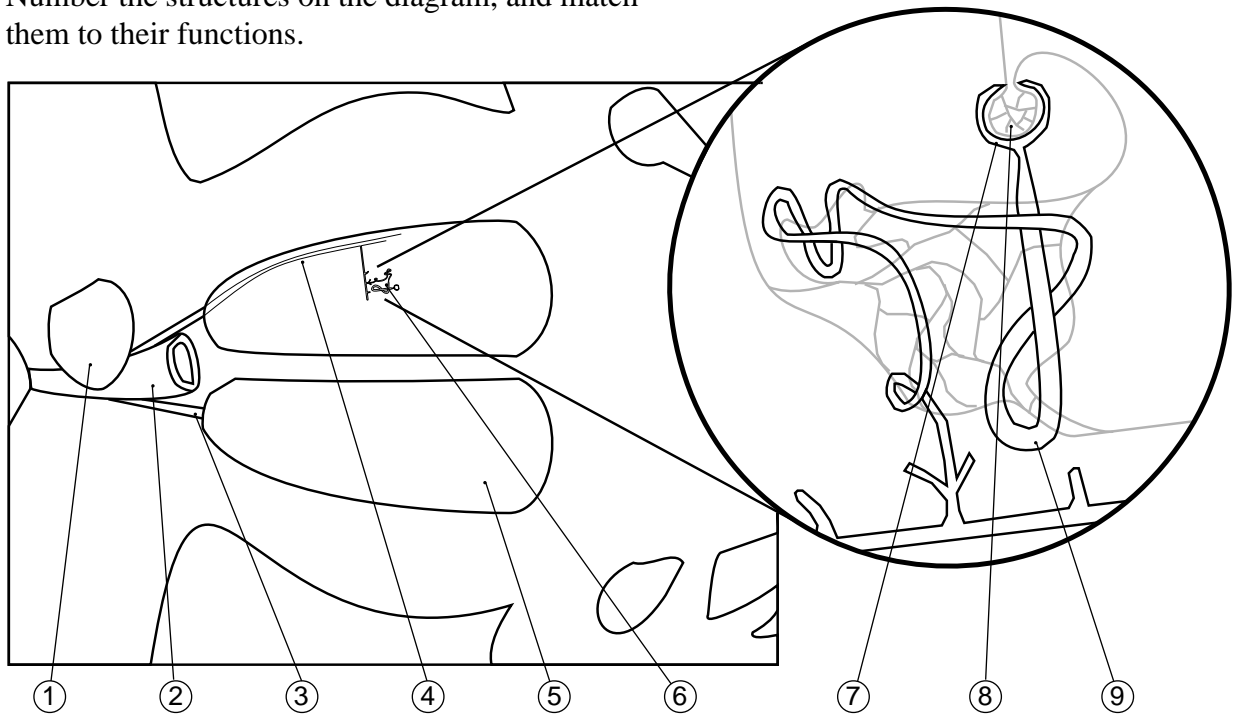
Control blood pH

Remove nitrogenous wastes

Control salt concentration in blood

Remove other toxic wastes

7 Number the structures on the diagram, and match them to their functions.



Number	Structure	Function
<u>5</u>	Kidney	Main duct from kidneys to cloaca
<u>6</u>	Nephron	Filters water out of the blood
<u>7</u>	Glomerulus	Wastes are excreted from body here
<u>8</u>	Bowman's capsule	Water enters nephron here
<u>9</u>	Tubular system of nephron	Urine is stored here, and reabsorption occurs
<u>4</u>	Collecting ducts	Reabsorption occurs here
<u>3</u>	Mesonephric duct	Creates urine by filtering toxins out of blood
<u>2</u>	Cloaca	Nephrons drain into these
<u>1</u>	Urinary bladder	Structures where process of filtration, reabsorption, and secretion takes place

For further thought...

How does the human kidney differ from that of a frog?

8 In the chart below, identify the structures through which the following substances exit the body in a frog, a human male and a human female.

	Frog	Human Male	Human Female
Urine	<i>Cloaca</i>	<i>Urethra</i>	<i>Urethra</i>
Gametes	<i>Cloaca</i>	<i>Urethra</i>	<i>Fallopian tubes, vagina (or are fertilized internally)</i>

9 What controls the opening of the cloaca?

A ring of muscle called a sphincter.

10 Fill in the blanks:

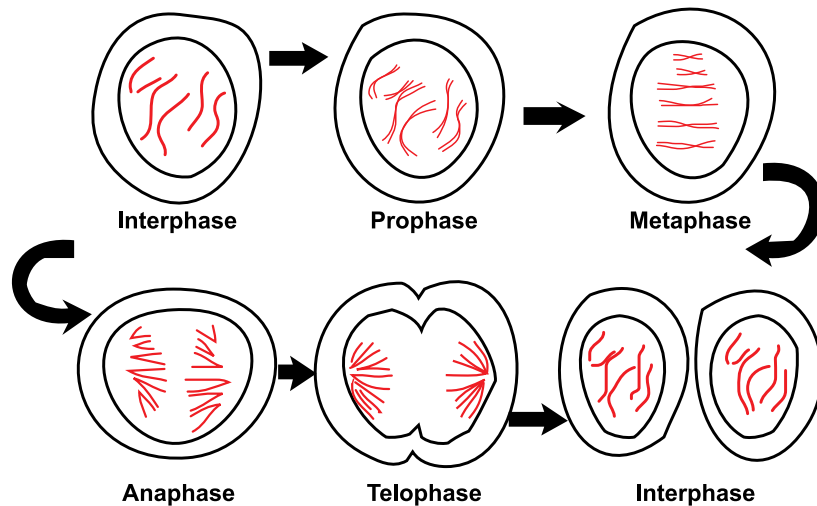
General Term	Male Frog	Female Frog
Gonads	<i>Testes</i>	<i>Ovaries</i>
Gametes	<i>Sperm</i>	<i>Ova</i>

For further thought...

How does gamete production and fertilization differ between frogs and humans?

11 This diagram represents one kind of cellular division. Identify it and draw the stages of chromosome replication for a cell with three pairs of chromosomes (six chromosomes in total).

Mitosis

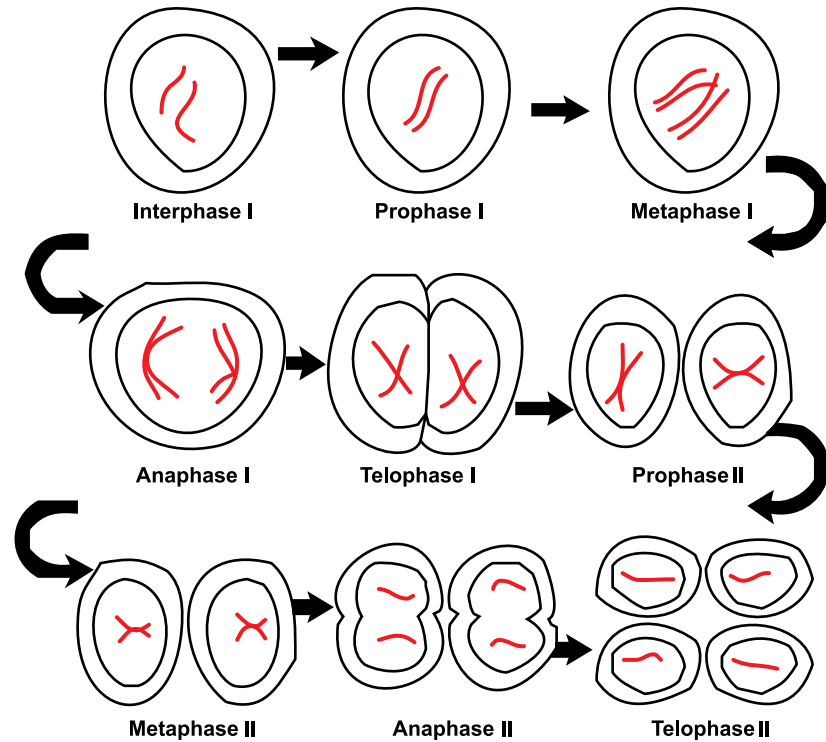


12 When does the above type of cell division take place?

During growth and tissue repair

- 13 This diagram represents another kind of cellular division. Identify it and draw the stages of chromosome replication for a cell with one pair of chromosomes.

Meiosis



- 14 When does this type of cell division take place?

During production of gametes.

- 15 Fill in the following chart.

Type of cellular division	Number of parent cell chromosomes	Number of daughter cells	Number of chromosomes in each daughter cell
Mitosis	6	2	6
Meiosis	6	4	3

Musculoskeletal System



1 a. What structures make up the musculoskeletal system?

Bones, muscles and connective tissues.

b. What is the function of the skeleton?

Provides the supportive framework for the soft tissues, allowing rigid posture and stance, and form levers for muscular force.

c. What is the function of the muscles?

Produce movement by contracting

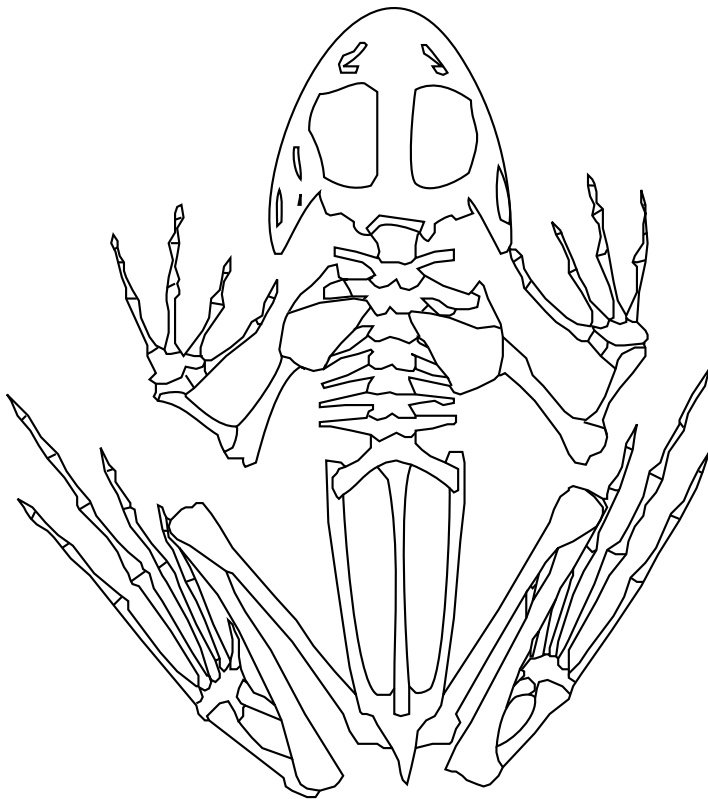
d. What is the function of the connective tissues?

Join muscles and bones at joints.

2 For each of the muscle types below, explain the function of the muscle in the muscular system, and give an example of where it would be found:

Smooth muscle	<i>Responsible for movement of organs under involuntary control; found in most internal organs of the body</i>
Skeletal muscle	<i>Responsible for movement of skeleton under voluntary control; found all through the body, associated with bones</i>
Cardiac muscle	<i>Responsible for movement of heart and blood flow under involuntary control; found only in the heart</i>

3 Color the picture and the legend to identify these parts of the skeleton:



- Skull
- Appendicular skeleton
- Vertebral column

For further thought...

What structure is formed by the skull and vertebral column?

The axial skeleton

4 Fill in the type(s) of muscle that best fit the statements below:

Muscle	Description
<i>Skeletal</i>	Under voluntary control
<i>Smooth</i>	Controlled by the autonomic nervous system
<i>Cardiac</i>	Controlled by specialized group of pacemaker cells
<i>Cardiac and smooth</i>	Transmit signals from one cell to another (2 types)
<i>Skeletal</i>	The most abundant muscle in vertebrates
<i>Smooth</i>	Capable of the greatest amount of contraction
<i>Skeletal</i>	Responsible for all movement of the skeleton
<i>Smooth</i>	Have very small, spindle-shaped cells
<i>Cardiac and skeletal</i>	Striated muscle (2 types)
<i>Cardiac</i>	Contains branched myofibers
<i>Smooth</i>	Found in the walls of blood vessels
<i>Smooth</i>	Found in most internal organs
<i>Cardiac</i>	Controls beating of the heart
<i>Skeletal</i>	Controls movement of the body
<i>Smooth</i>	Controls movement of food through the digestive system

5 What makes muscle striated?

The arrangement of actin and myosin in sarcomeres.

6 Why is it important that cardiac muscles have branched myofibers?

It allows the contractile signal to move from one muscle to another without nerves.

7 Place in descending order by size the following structures found in skeletal muscles.

- 3 Myofibrils
- 4 Sarcomeres
- 1 Fascicles
- 5 Actin and myosin
- 2 Myofibers

8 What is the function of the skeletal system?

Provides support, protection and locomotion.

9 The skeleton can be divided into two sections: the axial skeleton and the appendicular skeleton.

a. What is the main function of the axial skeleton?

Supports the main trunk of the body.

b. What is the main function of the appendicular skeleton?

Supports the limbs.

10 What four groups of bones make up the appendicular skeleton?

Pectoral girdle

Pelvic girdle

Forelimbs

Hindlimbs

11 a. Which groups of bones make up the axial skeleton?

Skull and vertebral column.

b. Which bones protect the brain?

The skull.

c. Which bones protect the spinal cord?

The vertebrae.

12 Which vertebrae does the spinal cord pass through?

The atlas, the seven trunk vertebrae, the sacrum. (It does not pass through the urostyle.)

13 Which two vertebrae are associated with joints that play a crucial part in jumping?

Sacrum

Urostyle

14 Place the vertebrae below in order leading from the brain:

4 Urostyle

1 Atlas

3 Sacrum

2 Seven trunk vertebrae

15 a. Describe the general structure of bone.

Rigid tissue of cells and fibers in a mineralized matrix.

b. Identify the 3 different layers of bone.

Compact bone, spongy bone, bone marrow (may also say periosteum)

16 What are the primary functions of bone?

Form the skeleton

Maintain blood calcium levels by absorbing and releasing calcium

Produce blood cells

17 What is the primary function of the dense outer layer of cortical bone?

Provides strength

18 What is housed and protected by the central region of spongy bone?

Bone marrow

19 How do muscles and bones work together to produce movement?

Bones provide the structure, muscles pull against them to provide the force.

20 Explain the concept of antagonistic pairs.

Because muscles can only pull, a pair of muscles is needed to allow movement of bones in opposite directions.

21 a. What is the function of cartilage?

Cushions bones.

b. What is the function of ligaments?

Join bone to bone.

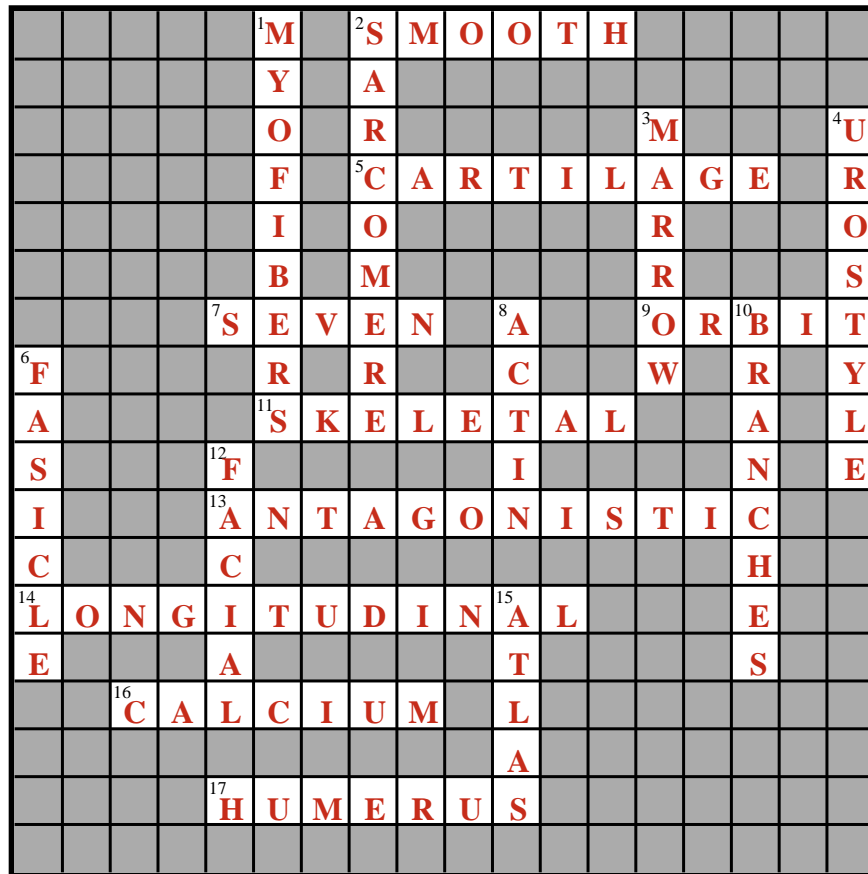
c. What is the function of tendons?

Join muscle to bone.

22 For each type of joint, describe the movement it allows and give an example of where it is found in the body.

Joint	Type of movement	Where found
Immovable	<i>No movement</i>	<i>Skull</i>
Slightly movable	<i>Small amount of movement</i>	<i>Between some vertebrae</i>
Ball and socket	<i>Rotational, bending in many planes</i>	<i>Shoulder, hip</i>
Hinge	<i>Bending or rotation about a single axis</i>	<i>Knee, elbow</i>
Pivot	<i>Rotational only</i>	<i>Some vertebrae</i>
Saddle	<i>Gliding along axis, rotation around the same axis</i>	<i>Base of thumbs</i>
Gliding	<i>Movement in single plane</i>	<i>Wrist, ankles, collar bones</i>
Ellipsoid	<i>Bonding movement or rotation around two perpendicular axes</i>	<i>Base of finger, toes</i>

The Crossword



ACROSS

2. Muscle type found in the iris of the eye (6)
5. The skeleton is made up of bones and this (9)
7. Number of trunk vertebrae (5)
9. The structure in the skull that houses the eyeball (5)
11. Muscle type under voluntary control (8)
13. Muscles that oppose each other are _____ (12)
14. Which axis does the axial skeleton lie on (12)
16. Bones help change the amount of _____ in the blood (7)
17. Bone that connects the radioulna to the pectoral girdle (7)

DOWN

1. Muscle cells (9)
2. The functional unit of muscle (9)
3. New blood cells are made in the bone _____ (6)
4. The tenth vertebra (8)
6. A bundle of myofibers in a muscle (7)
8. Contractile protein (5)
10. This property differentiates cardiac muscle cells from those of skeletal muscle cells (8)
12. The region of the skull that forms the jaw (6)
15. The first vertebra (5)

Control System



1 What is the primary function of the control systems?

To balance and coordinate the activities of all the body's systems

2 Describe the specific functions of these two systems:

Structure	Function
Endocrine system	<i>Secretes hormones to affect target cells in body Controls growth, development, metabolism, reproduction</i>
Nervous system	<i>Gathers and evaluates sensory information Monitors internal homeostasis Controls reflexes and other actions</i>

3 How does the endocrine system transmit information?

Releases hormones into the blood

4 How does the nervous system transmit information?

Sends electrical impulses through the nerves

For further thought...

Which system produces a more rapid response, and which produces a longer lasting response?

Nervous – rapid

Endocrine – longer lasting

Endocrine System

5 Describe the specific functions of the following endocrine system structures:

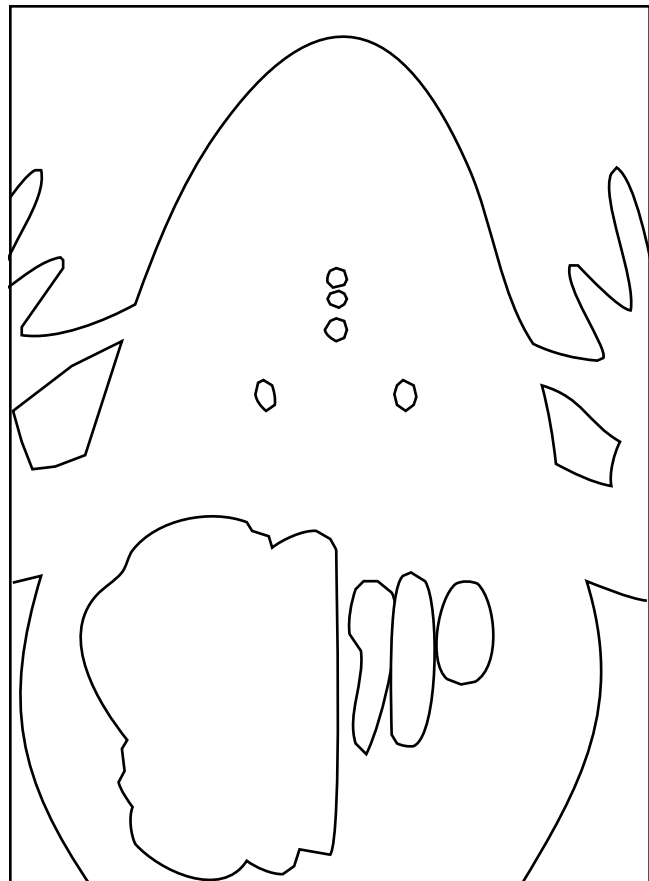
Structure	Function
Pituitary gland	<i>Regulates growth, water balance, and other endocrine glands</i>
Hypothalamus	<i>Homeostatic control center; controls pituitary & thus regulates autonomic nervous system and endocrine system</i>
Pineal gland	<i>Influences hypothalamus, assists in reproduction, produces melatonin, & helps maintain homeostasis;</i>
Thyroid gland	<i>Influences growth and metabolism, and parathyroid glands</i>
Adrenal glands	<i>Regulate metabolism, water and salt balance, carbohydrate and mineral metabolism, produce adrenaline</i>
Pancreas	<i>Maintains blood sugar balance</i>
Ovaries	<i>Influence egg maturation and release, and influence mating behavior</i>
Testes	<i>Responsible for development of secondary sex characteristics and mating behavior</i>

6 Color the picture and the legend to identify the following organs:

- Pineal complex
- Hypothalamus
- Pituitary
- Ovary
- Pancreas
- Adrenal gland
- Testes

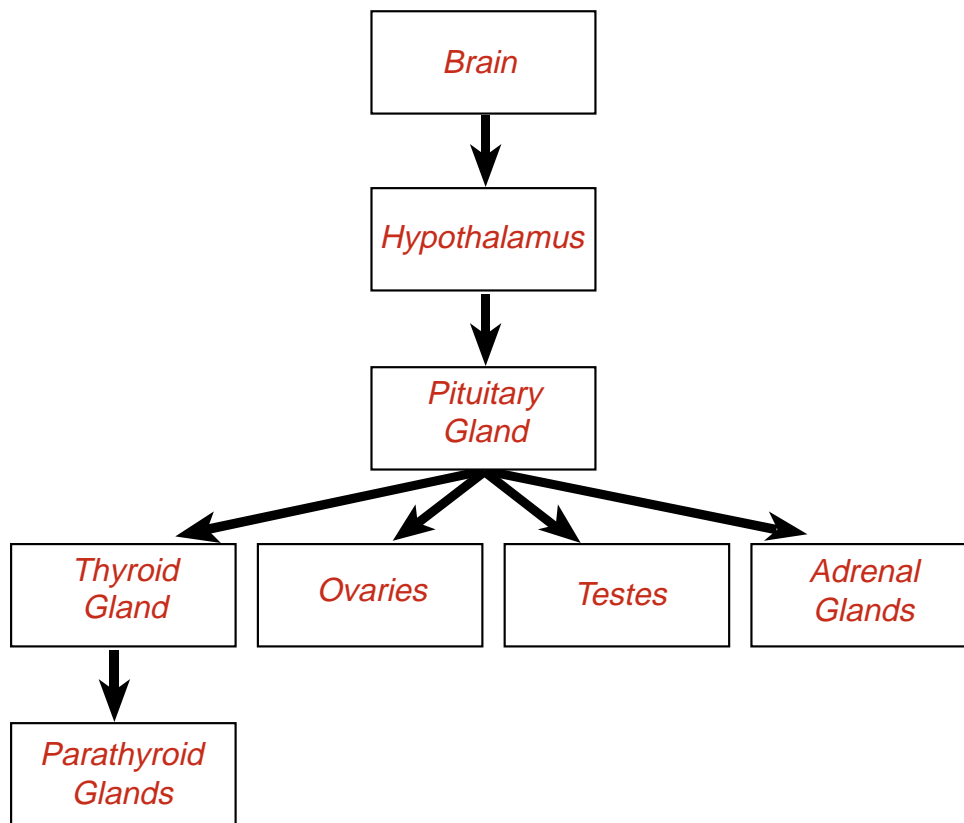
7 Which of the above organs in also have non-endocrine functions?

Testes, ovaries and pancreas



8 Fill the boxes below with the following terms, to show the control hierarchy of endocrine glands:

Ovaries, testes, pituitary gland, hypothalamus, thyroid gland, adrenal glands, parathyroid glands, brain



9 Determine which endocrine glands (adrenal glands, pituitary gland, thyroid gland or pancreas) best fit the following descriptions:

Controls actions of thyroid and adrenal glands	<i>Pituitary gland</i>
Involved in growth and metabolism	<i>Thyroid gland</i>
Involved in growth and water balance	<i>Pituitary gland</i>
Produces adrenaline	<i>Adrenal glands</i>
Primary storage site for iodine	<i>Thyroid gland</i>
Controls salt and water balance	<i>Adrenal glands</i>
Controls blood sugar balance	<i>Pancreas</i>
Controls carbohydrate and mineral metabolism	<i>Adrenal glands</i>
Contains islets of Langerhans	<i>Pancreas</i>
Secretes insulin and glucagon	<i>Pancreas</i>

10 a. What are hormones?

Chemical messengers used in the endocrine system

b. Hormones are carried by the blood, and circulate throughout the body. Would a frog have more testosterone in its brain or in its leg?

Neither; the concentration is the same

For further thought...

Why do you think it is beneficial for hormones to be effective at low concentrations?

11 Describe the two types of feedback loops:

Positive feedback loops – cause more hormones to be produced

Negative feedback loops –inhibit production of the hormone

For further thought...

a. What would happen if growth were controlled by a positive feedback loop?

Once you started to grow, you would keep growing at an accelerating rate

b. Why do you think the body almost exclusively uses negative feedback loops?

Negative feedback loops can effectively maintain homeostasis. If a hormone is produced to counteract a change in the body, a negative loop stops producing the hormone when this is achieved.

Independent Study Unit

Find examples of positive feedback loops in the body.

12 How do hormones produced by the gonads (e.g., the testes or ovaries) affect the gonads' non-endocrine functions?

They regulate the production of gametes, and mating behavior.

For further thought...

How are the endocrine and non-endocrine functions of the pancreas related?

The pancreas produces enzymes in the digestive system to help digest carbohydrates; the hormones produced by the pancreas maintain the levels of sugar (from digested carbohydrates) in the blood.

Nervous System

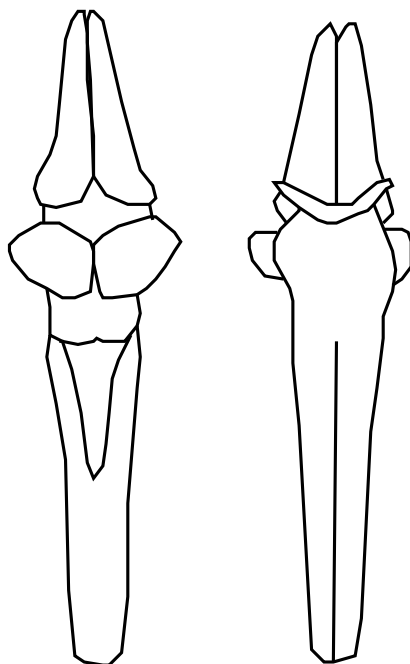
13 Describe the function of these two systems:

System	Function
Central nervous system	<i>Main control center Receives, evaluates and responds to stimuli and messages from peripheral nervous system</i>
Peripheral nervous system	<i>Coordinates transmission of information from internal and external environments to the central nervous system Transmits impulses from central nervous system to target organs and tissues</i>

14 Describe the functions of the following organs:

Structure	Function
Brain	<i>Processes, stores and responds to information from spinal cord and cranial nerves</i>
Spinal cord	<i>Connects the brain to the peripheral nervous system; Main conduit of information between these two</i>

15 Color the legend and the picture to identify these regions of the brain:



- Optic lobes
- Thalamus
- Cerebral hemispheres
- Olfactory lobes
- Cerebellum
- Medulla oblongata
- Fourth ventricle
- Spinal cord
- Optic chiasma

16 Name the part of the brain that matches the description:

Structure	Function
<i>Medulla oblongata</i>	Controls some involuntary processes, such as breathing and swallowing
<i>Optic lobes</i>	Processes optical and auditory information; involved in hunting and avoidance behaviors
<i>Thalamus</i>	Coordinates sensory information
<i>Cerebellum</i>	Coordinates body movement
<i>Olfactory lobes</i>	Filters information from nasal cavity
<i>Hypothalamus</i>	Is a control center for the autonomic nervous system
<i>Cerebral hemispheres</i>	Process olfactory information; involved in learned responses & aggressive and reproductive behaviors

17 a. What structure surrounds the spinal cord?

The vertebral column

b. What purpose does it serve?

To protect the spinal cord

18 Why is spinal damage so serious?

Because it is the main pathway for information to and from the brain; severing this pathway means the brain can't communicate with the rest of the body. Spinal damage could also affect reflex arcs

19 What is a reflex arc?

A nerve circuit of a reflex event. A link between a sensory organ and effector organ, which synapses in a nerve center (such as the spinal cord)

20 Why are reflex arcs efficient?

It's a short, simple pathway, and doesn't require brain power

21 Which of these actions is considered a reflex arc?

- Yes Pulling away from something hot
- No Slapping a biting mosquito
- No Ducking to avoid a ball
- No Heart beating
- Yes Sneezing when you sniff pepper

22 Describe the functions of the following structures in the peripheral nervous system:

Structure	Function
Nerves	<i>Carry information between central nervous system and structures of body</i>
Cranial nerves	<i>Carry information between brain and structures of body</i>
Spinal nerves	<i>Carry information between the spinal cord and structures of the body</i>
Sensory organs	<i>Sense changes in environment, transmit information to central nervous system</i>
Eye	<i>Gathers and focuses light on retina, for processing and transmission to central nervous system</i>
Ear	<i>Gathers auditory information; helps maintain balance</i>
Skin	<i>Senses chemical and tactile stimulation</i>
Nose	<i>Organ of smell</i>
Pineal complex	<i>Acts as photoreceptor, sensing light of day-night cycle</i>

23 Put these terms into proper order to describe the pathway of a stimulus from reception to processing by the brain, to response.

- | | | | |
|-----------|---------------|-----------|----------------|
| <u>4</u> | Dorsal root | <u>11</u> | Effector organ |
| <u>6</u> | Brain | <u>1</u> | Sensory organ |
| <u>2</u> | Sensory nerve | <u>8</u> | Ventral root |
| <u>10</u> | Motor nerve | <u>5</u> | Spinal cord |
| <u>3</u> | Spinal nerve | <u>7</u> | Spinal cord |
| <u>9</u> | Spinal nerve | | |

24 Name the pairs of cranial nerves which fit the descriptions below:

Structure	Function
<i>Optic nerves</i>	Contain sensory fibers from retina
<i>Trigeminal nerves</i>	Contain motor fibers for the jaw
<i>Facial nerves</i>	Contain motor fibers for the hyoid apparatus
<i>Olfactory nerves</i>	Contain sensory fibers from olfactory cells
<i>Vagus nerves</i>	Contain sensory fibers from internal organs
<i>Trigeminal nerves</i>	Contain sensory fibers from the skin of the head
<i>Oculomotor nerves</i>	Contain motor fibers for eye muscles; control pupil size
<i>Acoustic nerves</i>	Contain sensory fibers from ears
<i>Oculomotor nerves, Abducens nerves, Trochlear nerves</i>	Control some eye movement (3 pairs)
<i>Facial nerves glossopharyngeal nerves</i>	Contain sensory fibers from tongue (2 pairs)
<i>Optic nerves</i>	Cross at optic chiasma
<i>Glossopharyngeal nerves</i>	Fuse with vagus nerves
<i>Glossopharyngeal nerves, vagus nerves</i>	Contain motor fibers for throat muscles (2pairs)
<i>Oculomotor nerves</i>	Control pupil size
<i>Vagus nerves</i>	Contain motor fibers for internal organs
<i>Acoustic nerves</i>	Involved in balance and hearing

25 What is the path of light within the eye?
Through the cornea, the pupil, and the lens, to the retina.

26 What is the function of the autonomic nervous system?
Controls involuntary activity, such as glandular motor function, smooth muscle, cardiac muscle, and any organs not under conscious control.

For further thought...

What problems might arise if your heart rate was under conscious control?

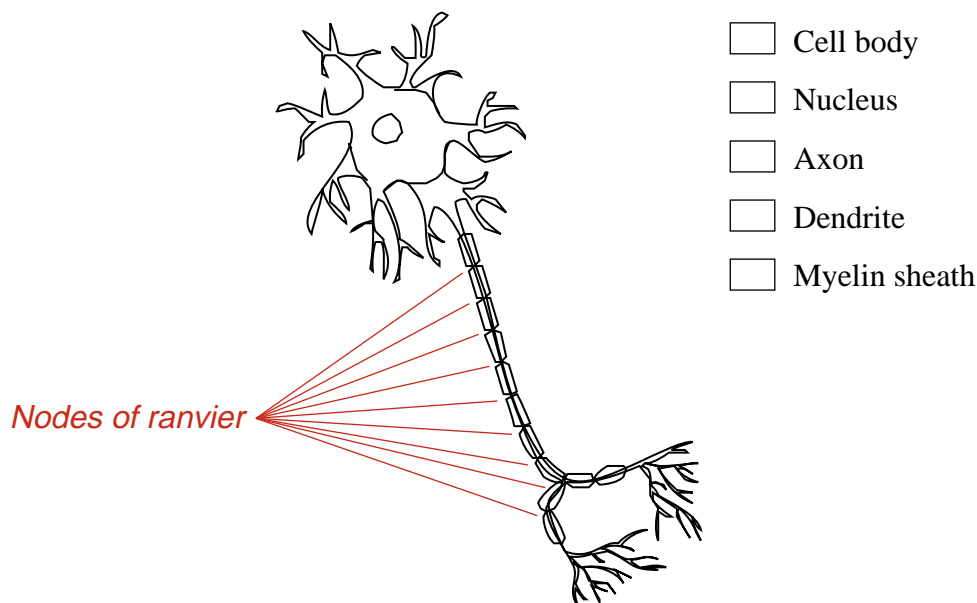
27 What are the differences between the sympathetic and parasympathetic divisions of the autonomic nervous system?
Sympathetic nervous system controls energy-intensive activities; prepares for fight-or-flight; generally speeds things up;
Parasympathetic nervous system counteracts the sympathetic division; slows body's activities down.

28 a. What is a neuron?
A nerve cell; the fundamental unit of the nervous system.

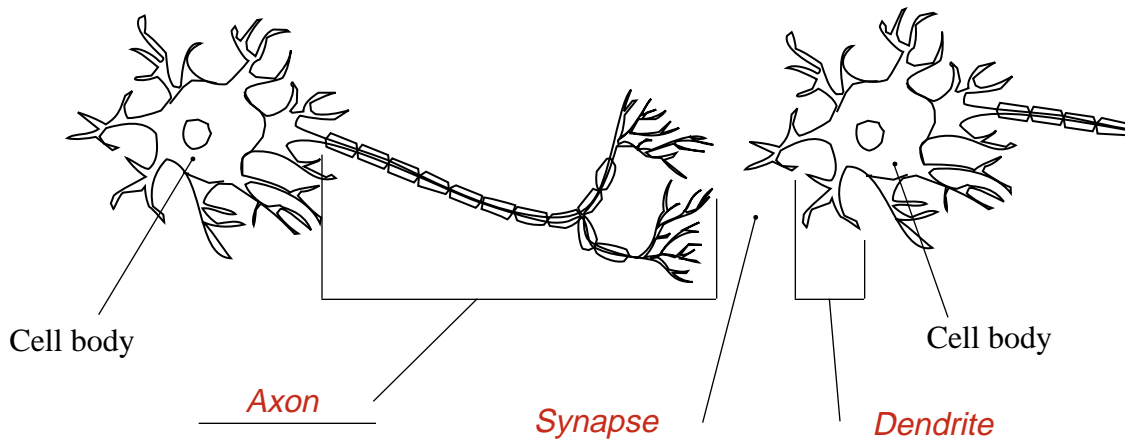
b. Where are neurons found?
In the brain, spinal cord, and nerves

c. What is their function?
Transmit messages by conducting impulses to other cells

29 Colour these structures on the picture below, and draw arrows to identify two nodes of ranvier:



- 30** Specify the pathway of a nerve impulse from the cell body of one neuron to the cell body of another:



- 31** a. In what form is an impulse passed along a neuron?
As an electrical impulse (a change in membrane potential)
- b. Which ions are involved?
Sodium and potassium
- 32** a. What is a resting potential?
The electrical potential of a (portion of) membrane when it is not carrying an impulse
- b. What is an action potential?
The electrical potential of a (portion of) membrane when it is carrying an impulse
- c. How quickly is an action potential completed?
In milliseconds
- 33** Determine the correct order for the transmission of an impulse across a synapse:
- 1 Electrical impulse reaches end of axon
 - 6 New electrical impulse is initiated
 - 2 Calcium ions enter the axon
 - 4 Vesicles release neurotransmitters into synaptic cleft
 - 3 Calcium ions stimulate vesicles to move to plasma membrane
 - 5 Neurotransmitters bind to receptor sites on target cell
- 34** a. What are neurotransmitters?
Molecules released by neurons to act on target cells.
- b. What do they do?
Transmit messages of the nervous system from one cell to another

- 35** Imagine that your body releases a hormone, and at the same time triggers a single nerve impulse. Put a checkmark for each of the statements below to show if the statement is more accurate for a hormone or for a nerve impulse:

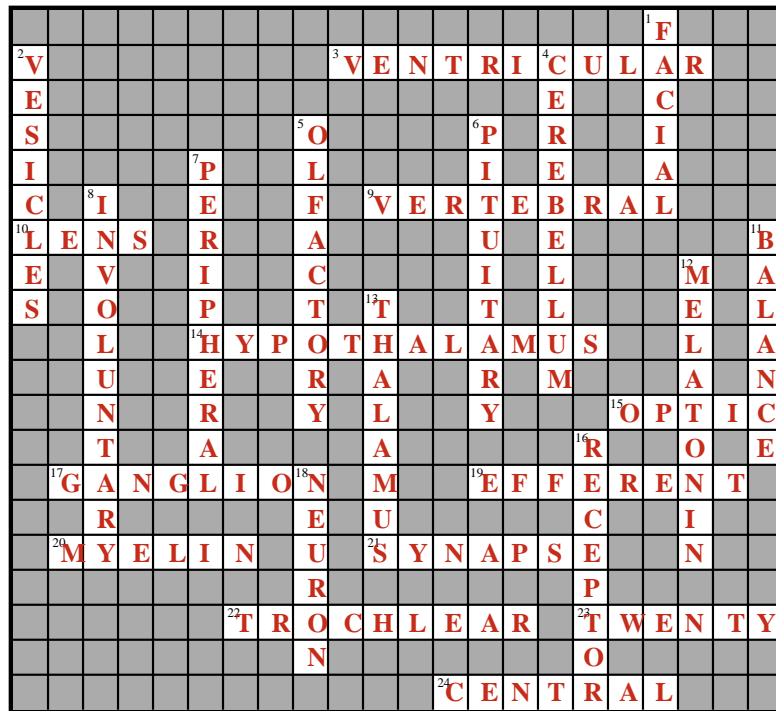
Response	Hormone	Nerve Impulse
Stays in system for extended periods of time	X	
Effect is short lived		X
Circulates in blood	X	
Effect is localized (affects only a few cells)		X
Distributed throughout the body (systemic)	X	
Possible to affect multiple organs at the same time	X	
Travels electrically		X
Faster (hormone or nerve impulse?)		X

For further thought...

What would happen if muscle contractions were controlled by hormones?

The message to contract would be sent to all muscles; contracting all your muscles at once would probably break many of your bones!

The Crossword



ACROSS

3. System that produces cerebrospinal fluid(11)
9. Column protecting the spinal cord (9)
10. This focuses light on the retina(4)
14. This contains the control center of the autonomic nervous system (12)
15. The mesencephalon is made up of these lobes (5)
17. The bulge of cell bodies on the dorsal root of spinal nerves (8)
19. Also known as motor nerves (8)
20. This makes “white matter” white (7)
21. The junction between nerve cells (7)
22. Nerve IV of the cranial nerves (9)
23. The number of spinal nerves (6)
24. Nervous system formed by brain and spinal cord (7)

DOWN

1. Nerve VII of the cranial nerves (6)
2. Structures in the axon that contain the neurotransmitter (8)
4. Also known as the metencephalon(10)
5. These lobes filter information from the nose(9)
6. This gland releases hormones (9)
7. Nervous System made up of the nerves of the body (10)
8. Actions of the Autonomic nervous system are _____(11)
11. The ear helps the frog do this, as well as hear (7)
12. This hormone regulates color change in the skin (9)
13. This part of the brain coordinates sensory information(8)
16. Neurotransmitters are taken up by _____ sites (8)
18. Fundamental unit of the nervous system (6)

Interacting Systems



- 1 Determine the function fulfilled by each system in the charts below:

How do frogs eat?

System	What it does
Circulatory system	<i>Carries nutrients and energy from digestive system to tissues</i>
Respiratory system	<i>Provides blood with needed oxygen Removes carbon dioxide from blood</i>
Digestive system	<i>Processes food into nutrients, energy and wastes</i>
Excretory system	<i>Removes metabolic wastes from blood</i>
Nervous system	<i>Senses prey Coordinates muscle movement</i>
Musculoskeletal system	<i>Moves frog to capture prey Contracts digestive organs</i>
Endocrine system	<i>Regulates blood sugar levels Plays a role in hunger</i>

How do frogs move?

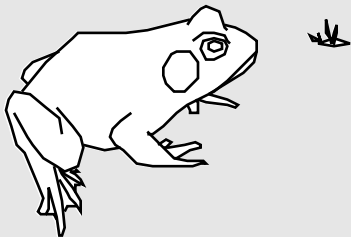
System	What it does
Circulatory system	<i>Provides tissues with needed nutrients Removes metabolic wastes from tissues</i>
Respiratory system	<i>Provides blood with needed oxygen Removes carbon dioxide from blood</i>
Digestive system	<i>Provides blood with nutrients and energy</i>
Excretory system	<i>Removes metabolic wastes from blood</i>
Nervous system	<i>Senses environment surrounding frog Coordinates muscle movement</i>
Musculoskeletal system	<i>Allows physical movement of frog</i>
Endocrine system	<i>Stimulates movement to warmer or colder areas, and to a breeding pond</i>

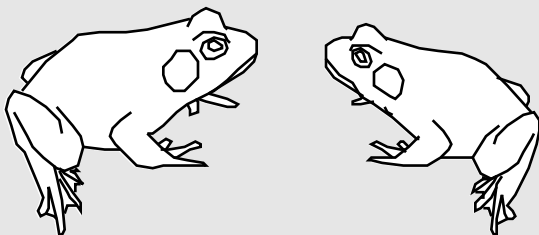
How do frogs reproduce?

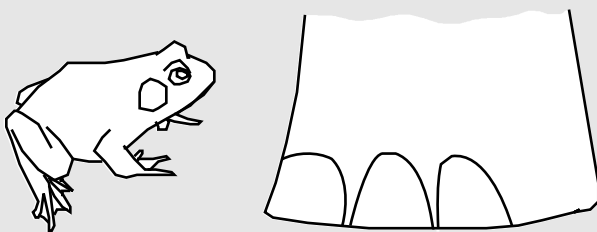
System	What it does
Circulatory system	<i>Provides tissues with needed nutrients Removes metabolic wastes from tissues</i>
Respiratory system	<i>Provides blood with needed oxygen Removes carbon dioxide from blood</i>
Digestive system	<i>Provides blood with nutrients and energy</i>
Excretory system	<i>Removes metabolic wastes from blood</i>
Nervous system	<i>Senses potential mate Coordinates muscle movement</i>
Musculoskeletal system	<i>Provides physical movement of frog</i>
Endocrine system	<i>Triggers movement to breeding pond Stimulates breeding behavior</i>
Reproductive system	<i>Produces gametes Facilitates fertilization and development</i>

For further thought...

For each situation below, write down what you think the frog's response to each stimulus will be. (*Hint: think about how the frog will first sense the stimulus.*)







Independent Study Unit

Choose a system of the body (or a part of a system), and imagine that it was destroyed. What effect would this have on all the other body's systems, and on the frog's ability to move, eat or mate?

Ecology



Biodiversity

1 What is a frog?

An amphibian with legs and no tail, with small forelimbs and strong large hindlimbs. They can jump well. Frogs are members of the order Anura.

2

2. What is a toad?

A frog of the family Bufonidae. They are generally dry, warty with broad heavy body and short back legs. They walk instead of jump.

For further thought...

Pick a frog species and research it. What are its characteristics? Where does it live? Does it have special features or behaviors to help it adapt to its habitat?

Niches

3 Why is water so important to frogs?

They need to keep their skin moist to facilitate cutaneous respiration and functional glands. They also lay eggs in water, and tadpoles are aquatic.

4 What habitats do frogs live in?

On land and in water, but also in trees, leaf litter, deserts, arctic

5 What animals eat frogs?

Wading birds (such as herons), water animals (such as fish and turtles), mammals (such as raccoons)

6 What do frogs eat?

Insects (ants, flies, beetles)

Other invertebrates (worms, slugs)

Some small vertebrates (rodents, small birds, other frogs)

Lifecycle

7 What are the four main stages in the life cycle of the frog?

Eggs

Tadpoles

Young frogs

Adult frogs

Hibernation

8 When do frogs hibernate and what causes this to happen?

When it is cold. Their low body temperature leads to inactivity.

9 What does poikilothermic mean?

Cold-blooded—internal body temperature varies with the temperature of the environment.

10 What do frogs use for energy when hibernating?

Fat stored in fat bodies.

11 How do frogs breathe when hibernating?

Through their skin (cutaneous respiration).

12 Where do frogs hibernate?

Under leaf-litter and logs; in holes created by animals or natural processes; in water that doesn't freeze.

Behavior

13 When are frogs more likely to hunt, and when are they more likely to eat passively?

Frogs hunt if it is warm or food is scarce. They feed passively if it is cold or food is plentiful.

14 Compare how frogs catch prey while on land with how they catch prey while in water:

On land, they use the tongue to catch prey. In water, they grab food directly with their mouth.

15 a. When do most frog species mate?

In the spring.

b. What environmental conditions play a part?

Wetness and temperature.

16 a. Frogs are normally solitary creatures. How do they find mates?

They make and respond to calls.

b. If you hear a frog's mating call, are you hearing a male or a female frog?

The male.

17 If a frog calls, but isn't trying to find a mate, what type of call might it be making? (3)

Release, territorial, distress

Environmental Concerns

18 Why do scientists consider frogs to be good bio-indicators?

They have permeable skin, live in land and water, and environmental problems affect them quickly.

19 a. What are the indications in frogs of environmental problems?

Declining populations

Deformities and mutations

b. What are possible causes of these problems?

Increased ultraviolet light

Chemicals and pollution

Habitat loss

Frog harvesting

c. Which of these possible causes has direct consequences for frogs alone?

Frog harvesting

20 What is probably the biggest single threat to frogs?

Habitat loss

For further thought...

Why haven't scientists discovered for certain why frog populations are declining?

For further thought...

Why should you not pick up a frog if you have bug spray on your hands? Why does it not affect you?