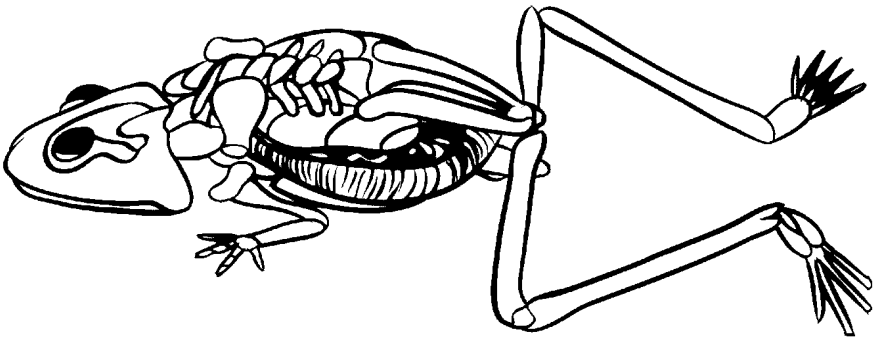
SMITHSONIAN

ITEM #749-08D
ITEM #7492-08
AGES 8 and UP

FROG LAB



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If we made an error and left something out of this set, or if something is damaged, we are sorry and wish to correct our error. Please do not return the set to the store where you purchased it, as the store does not have replacement parts. Instead, write us a letter giving us:

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2. Where Purchased
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5. Brief Description of Problem

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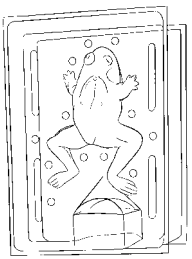
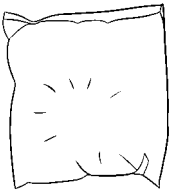
ITEM NO. 749-08D
MADE IN CHINA

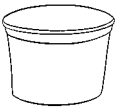
YOUR SET CONTAINS THE FOLLOWING ITEMS TO MAKE TWO FROGS:



TWO SIDED FROG MOLD



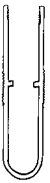
FROG LAB POWDER



CONTAINER

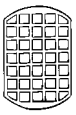
MEASURING CUP

SCALPEL

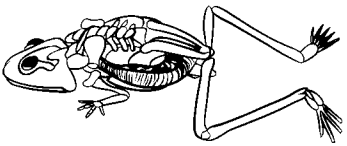


TWEEZERS

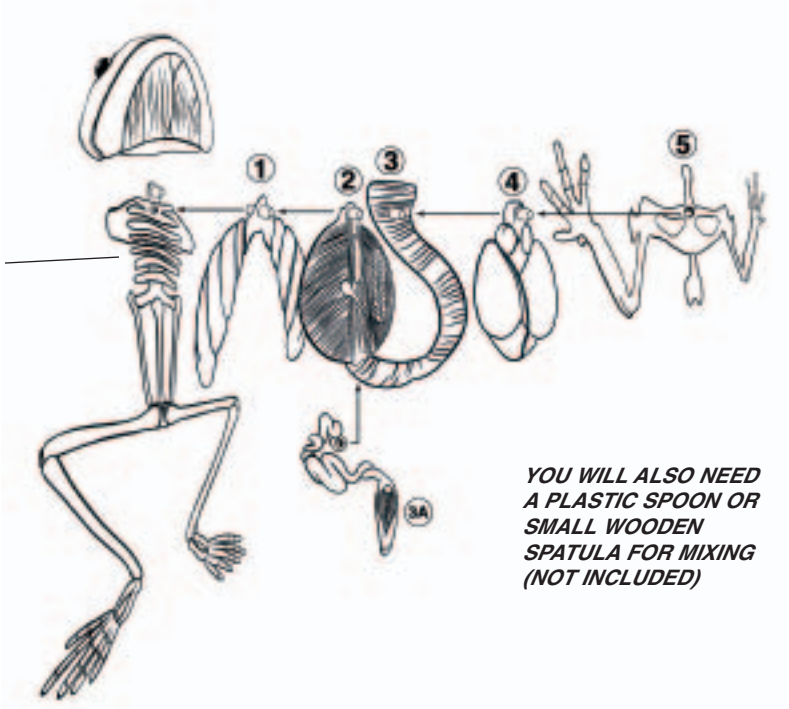
PROBE



FILTER



FROG INNARDS



YOU WILL ALSO NEED A PLASTIC SPOON OR SMALL WOODEN SPATULA FOR MIXING (NOT INCLUDED)

① LUNGS - They snap onto the TORSO. ② LIGHT BLUE COLORED BLOCK which contains the spleen, pancreas and gallbladder. This snaps onto ①.
③ STOMACH - This snaps onto ②. The lower part of ③ wraps around and snaps onto the back side of ②.

3A Caps onto ③ where this part snaps to the back side of ②. ④ LIVER AND HEART snaps onto ③. ⑤ snaps onto ④ and wraps around and connects to torso piece.

Introduction

Frogs have fascinated people since the beginning of civilization. They're everywhere: Frogs can be found on every continent in the world except Antarctica. And nearly everyone knows some famous fictional frog, whether it's the Frog Prince from folklore, or the beer-crazed bullfrogs of TV commercial fame.

Bullfrogs, with their rumbling foghorn calls and their long, flipping tongues, are the species of frog many Americans know best. You'll use this kit to simulate a bullfrog dissection.

But there are more than three thousand frog species, and the lives they lead are endlessly varied. There are tree frogs that never descend to earth: their eggs are laid in tiny pockets of water stored at the base of leaves. There are desert frogs that live part of their lives underground, where they stay cool and damp. Others dwell happily in icy mountain streams, or in the tropics, where they hatch their eggs in water as hot as 90 degrees F (32°C).

Amphibians

All frogs are amphibians. Amphibians are ancient animals: they've been around for at least 360 million years. Today, all the world's amphibians can be divided into three main groups: the *anurans*, which are the frogs and toads, the *caudates*, or tailed amphibians, which include salamanders, and the *caecilians*, or *apoda*, which are blind, legless creatures that primarily live underground or under water. The word "amphibian" comes from the Greek *amphibios*, meaning "with a double life," and amphibians all share a very important characteristic: they spend part of their life cycle on land and part in the water.

Most amphibians have something else in common: they undergo *metamorphosis*, a process of physical change that alters their anatomy to allow them to change from an exclusive water dweller in the larval stage to one that can breathe air as they grow from an egg into a mature adult.

Here is how metamorphosis works: Adult frogs lay eggs. After they are hatched from their eggs, they emerge as larvae called tadpoles. (After hatching, the tadpoles of most species swim independently, although there are a few species where tadpoles stay attached to their mother's bodies until they're ready to fend for themselves).

Tadpoles live entirely in water, and swim by beating a strong tail. They breathe through gills, much like a fish. Tadpoles are efficient eating machines, feeding on particles of plants, animal remains, and algae that they find in the water.

As tadpoles grow and mature into baby frogs (froglets) or toads (toadlets), their bodies undergo many changes. Legs sprout, allowing them to hop or walk about. The tails disappear, in a process known as "resorption." Their gills are also resorbed as they grow lungs and begin to breathe air. By the end of metamorphosis, the frogs are no longer just dependent on water-dwelling alone, but can spend time on land. The whole process can take a few days for some species, or as long as four or five years for the North American bullfrog.

We know a great deal about frogs, but some mysteries remain. One of the biggest is why frogs seem to be disappearing all over the world.

This decline in global amphibian populations seems to have begun around 10 years ago. The first evidence of a problem was anecdotal: people simply noticed there seemed to be fewer frogs around. But recently scientists have collected data to support this perception. Many frog species do seem to be in danger.

Why? One reason may be human activities that create dangerous pollution and which destroy the habitats that frogs need to live and grow. However, it is unlikely that a single cause would account for the serious decline of a wide variety of amphibian species all over the world. It may take years to solve this mystery. Meanwhile, we must all work to conserve and protect the natural environments where frogs live.

Frogs are an integral part of their ecosystem. We hope this toy will help you improve your knowledge of frog anatomy, and deepen your understanding of the biology which makes frogs such an important — and fascinating — part of the world's natural environment.

Bullfrogs

Bullfrogs, *Rana catesbiana*, are a very common species of frog in North America. They're large, measuring 100-175 mm, and highly aquatic: adults rarely travel far from rivers, lakes or ponds.

Bullfrogs hibernate during the winter, then emerge for the warm weather and begin calling at their breeding sites during the springtime. Bullfrog calls are instantly recognizable — they're the deep, foghorn-like calls that can sometimes be heard from as far as a kilometer away.

The males call to attract mates and to declare their territories. A single female bullfrog can lay 20,000 eggs at a time; the eggs hatch in four days or less in warm summer waters. However, bullfrog tadpoles develop slowly — it can take up to five years for them to reach maturity.

The bullfrog's appetite is legendary. They eat (or try to eat!) anything that moves, from bugs to baby ducks to snakes. The frogs in turn are preyed upon by snakes, raccoon, large birds, and many other predators.

A bullfrog can live 7 to 9 years in the wild, though the record for a frog in captivity is 16 years.

The frog you'll be dissecting had a much shorter life span, of course — 0 years from the day it was molded to the present. It's plastic. However, following the steps below and reading about the various organs inside the frog will help you learn about the complex biology of real bullfrogs.

Preparing the frog

To familiarize yourself with the preparation process, read steps 1 through 6 first, before actually preparing the frog.

Important Notice: Lay generous amounts of newspaper on the table that you are working on. Since preparing the frog can be messy, be sure to work on top of the newspaper.

1. Unpack the bag containing the frog

skeleton parts and internal organs. Lay aside the dissecting tools and plastic grid.

2. Now assemble the frog skeleton system and organs as shown in the sequence in the drawing below. After you have assembled the skeleton and internal organs, place the internal structure assembly into the cavity of the white frog mold tray. Be sure to place skeleton-organ assembly so that the ventral (underside) of this assembly faces upwards in the white mold tray (belly facing up).

3. Since some of the compound may ooze out, it is important to make sure that you are working over newspaper.

4. Assemble the mold halves. Make sure that the skeleton and organ systems are properly placed inside the white cavity half, carefully press the two halves together. Use solid pressure both thumbs work well to snap the round buttons of the clear mold half into the round wells of the white mold half. Install the square grid filter into the receptacle provided (see Fig. A). **Double Check!** Are the frog internal organs and skeleton in place? Are the two mold sections securely snapped together? If you do not have everything secured tightly, the wet skin mixture will seep out the sides and bottom of the mold sections. Make sure the completed mold is standing upright and the square grid filter is in its proper place in its receptacle at the top. (see Fig. B)

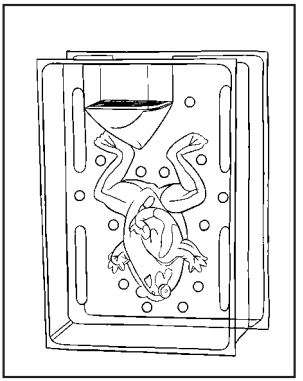


Figure A
Closed mold with innards, gasket and filter in place.

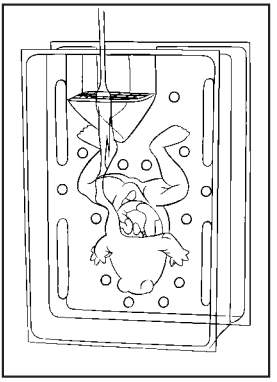


Figure B
With frog innards in place, stand the mold up with the filter at the top and pour the mixture in. NOTE: Make sure the two halves of the mold are securely snapped to each other before pouring.

5: Mixing the frog skin: You will need

both the large container and small plastic measuring cup provided to you in this set. You will also need a plastic spoon or wooden spatula (not included) for mixing. Take the bag of Frog Lab Powder and lay flat onto a table. Gently tap the bag to ensure the Frog Lab Powder lays flat and equally throughout the bag. Carefully holding from both sides lift from the centre of the bag separating the Frog material into two halves. Take a pair of scissors (not included) and with adult supervision carefully cut the bag in half. Using a rubber band (not included) tie around the open end of one of the bags for storage. Now take the open bag of Frog Lab Powder and empty it into the container. Using your measuring cup, carefully measure 280ml of warm water and pour it into the Frog Lab Powder with the help of an adult. The water should be at 122 degree F (50ºC) temperature. You may have to fill the measuring cup with water more than once. Using your spoon, stir the mixture for 5-10 minutes until the water and Frog Lab Powder are completely combined. Pour the mixture into the mold. Let mixture set for 1-2 hours before removing.

6. When the Frog Lab Powder has set up into a flesh-like plastic consistency, you can remove the clear mold section leaving the frog in the white mold half since this is your dissection tray. You may wish to cut off any excess material stuck to the edges of the frog where the molds came. Cut this excess away with your scalpel. See Fig. C.

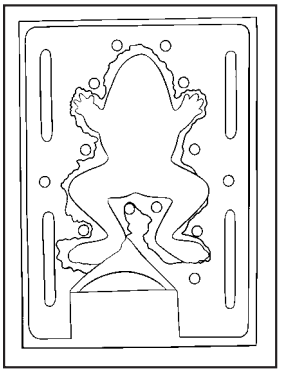


Figure C
Remove the excess material that has formed around the edges.

7. Now your frog is ready to dissect. Place the frog back into the white molded tray (your dissection tray). Since the frog is not real, it is not possible to dissect as a real frog. However using your scalpel and forceps (tweezers) and probe, cut sections of skin to reveal the internal organs and skeleton of your frog. Usually the first cut should be in the middle of the ventral side (underside) of the frog beginning just below (posterior) the back of the jaw all the way to the tail (caudal) end of the frog. Side incisions may be made to the side of this central (midline) incision toward each side (distally) to allow a flap of skin to be laid back to expose the position and location of the internal organs.

The organs

Here are the major organs of the frog which you will explore in your "dissection."

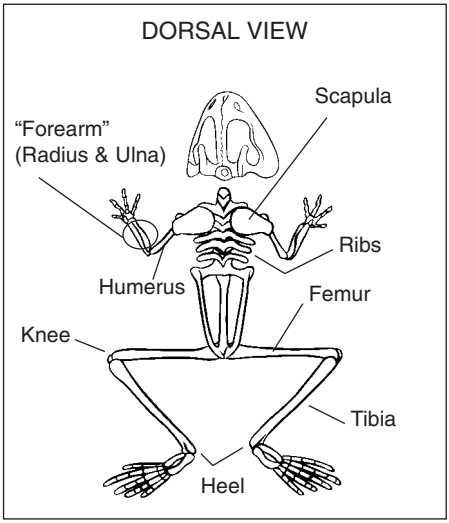


Figure 1

Skin

Try cutting through the artificial skin you've created. It's a lot like amphibian skin: very thin, much thinner than that of reptiles, birds, or mammals.

Frogs use their skin for many vital bodily functions. Many species can breathe through their skins, even when they are underwater. They don't need to drink with their mouths, since their skins absorb water.

Amphibians have glands in the skin to produce mucus. This mucus helps keep their bodies moist — that's why so many frogs and toads are "slimy" when you touch them.

Poisonous frogs and toads secrete toxins as a defense against predators. Usually, these toxins are mild: they might cause burning in the mouth or eyes of an attacker. But a few frogs are so poisonous as to be deadly. Native Americans in northwestern South America even arm their blowdarts for hunting with the toxins from Poison dart frogs.

Beneath the skin, you'll find the...
Skeletal System.

Like humans, frogs have a strong skeleton that provides the body's structure and supports and protects the internal organs.

The frog's skeleton is composed of bone and cartilage. Muscles attach to

the bones and enable the frog to move. As you inspect the skeletal structure, please note that many of the bones in a frog are very similar in structure and function to those in humans and other mammals; these include such bones as the scapula (shoulder blade), humerus (proximal arm bone), radius and ulna (forearm bones), femur (hip bone) and tibia (shin bone).

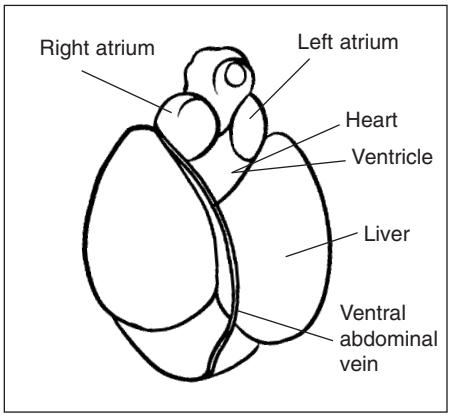


Figure 2

The skull protects the brain and eyes.

In the frog's chest is the heart.

The frog's heart is divided into three chambers: 2 atria and 1 ventricle. (Compare this to the four-chambered human heart with 2 atria and 2 ventricles).

The frog's heart circulates its blood throughout the body. Here is how the process works: blood passes through the vena cava and the ventral abdominal vein, and enters the right atrium of the heart. It's pumped into the right side of the ventricle by contraction of the atrium.

The ventricle then contracts, and the blood is sent through the pulmonary artery to the lungs, where carbon dioxide is removed and oxygen is replaced in the blood. This oxygen-rich blood then returns to the heart — to the left atrium, where it is pumped into the left side of the ventricle and then back out through the aorta to the rest of the body.

Now look for the lungs.

The lungs are divided into two lobes, the right and left.

When the frog breathes, it inhales oxygen into the lungs. This oxygen is exchanged for carbon dioxide in the

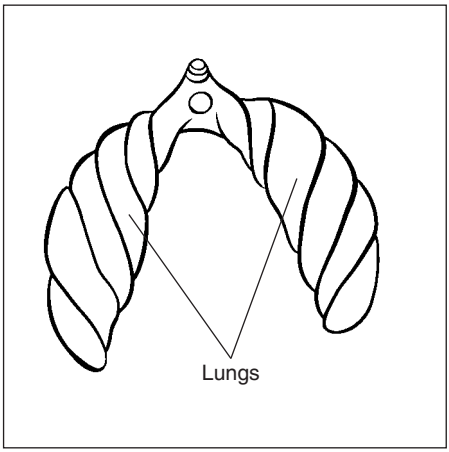


Figure 3

blood within the lung's tiny blood vessels known as capillaries. The carbon dioxide is expelled from the body when the frog exhales.

When frogs hibernate, their metabolism slows down and nearly comes to a halt: frogs stop breathing with their lungs, and absorb most of their oxygen through the skin.

Below the lungs is the liver.

The liver synthesizes or stores many of the vital substances used throughout the frog's body. (See Figure 2)

It also absorbs substances from the blood that may be toxic to the animal, and breaks them down into harmless components.

Liver cells produce *bile*, which is carried by a system of bile ducts to the *gallbladder*, where it is stored.

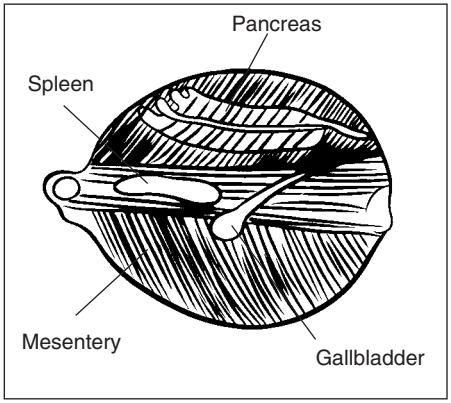


Figure 4A

Next comes the stomach.
Digestion begins here. Though as tadpoles they are usually vegetarian, all adult amphibians are carnivores: they eat other animals.

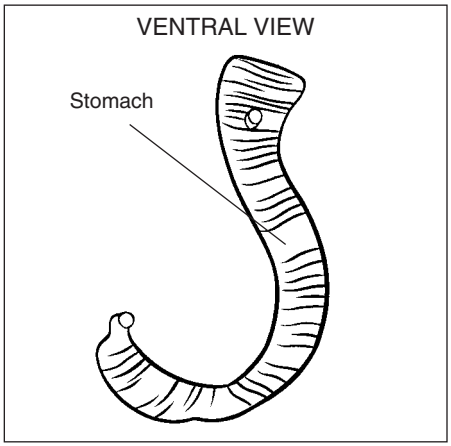


Figure 5

Most frogs eat insects, worms, and other invertebrates. Large frogs may also eat birds, mice, snakes, or even other frogs.

Although some species may have primitive forms of teeth, most amphibians don't have teeth and cannot chew their food. Prey is swallowed whole, often while it is still alive, and sent to the stomach.

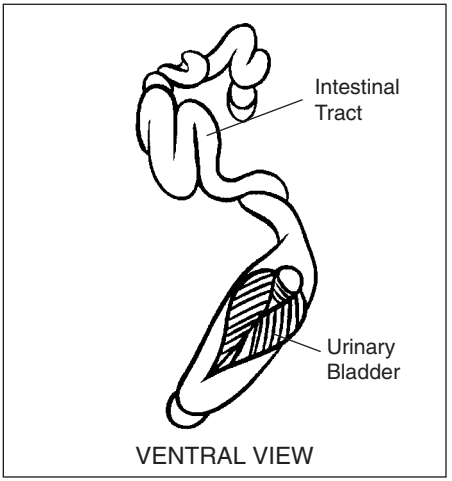


Figure 6A

Intestinal tract
Most digestion occurs in the small intestine. Partially digested food from the stomach enters the small intestine and mixes with powerful digestive enzymes secreted by the pancreas. (See Figure 4A) The enzymes break the food down into very small particles that can be absorbed by the intestinal walls. Then the particles are secreted into the blood stream and carried to the liver for processing.

The bile produced by the gallbladder (See Figure 4A) is released into the small intestine. Bile aids in digestion and helps the frog absorb fat.

Food material that is not broken down in the small intestine passes to the large intestine, or colon.

The colon contains many bacteria and protozoa which help to break the food down even more. The frog and the bacte-

ria and protozoa exist in a *symbiotic* relationship — the frog's body provides a home for these microscopic creatures, and in turn they help the frog digest its food.

Any material left in the colon is passed out of the body as feces though the *cloaca*.

Cloaca

The cloaca is the terminal part of three different body systems.

Feces from the intestinal tract is excreted here. So is urine from the urinary bladder.

During mating season, eggs are produced in the ovaries of the female frog (See Figure 4b) and pass into the oviducts. They are then released from her oviducts into the cloaca before being released into the environment for fertilization by the male frog.

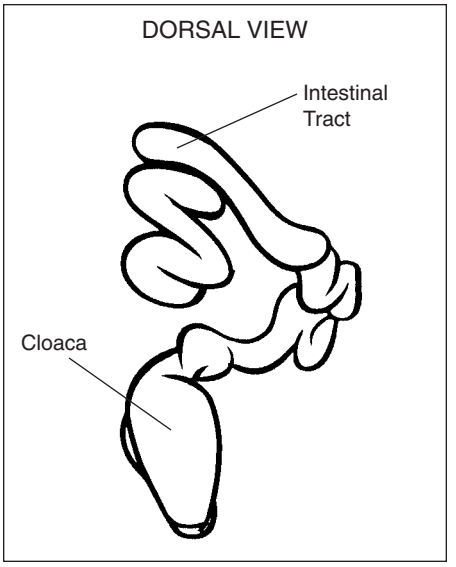


Figure 6b

Likewise, male frogs release semen though the cloaca.

Urinary bladder

Kidneys filter the blood and remove the by-products of metabolism by producing urine.

Urine is stored in the urinary bladder before being released from the body. (See Figure 6a)

Unlike most mammals, frogs and other

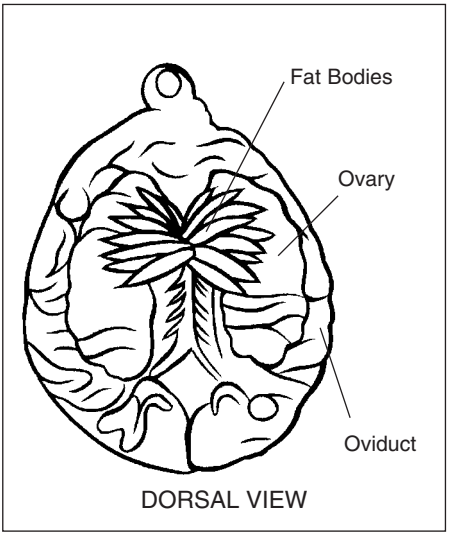


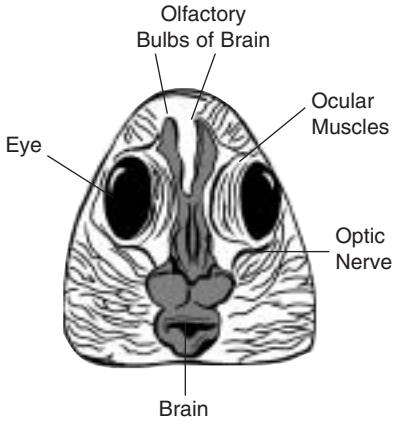
Figure 4b

amphibians have the ability to re-absorb much of the water in their bladders if it becomes necessary.

Frogs and toads may also empty their bladders as a defense mechanism against predators — as anybody who has ever caught a wild toad has surely experienced!

Brain and Eyes

Frogs do not have large brains. A large part of what they do have is devoted to sight. This helps them find food and avoid predators.



FROG EYES AND BRAIN

In conclusion

Next time you're in an area with ponds, streams or lakes, look and listen for frogs. You already know a good deal about their appearance, inside and out; with a little practice, you can learn to identify males from females, and bullfrogs from other species. You can even sort them out by their calls.

When you spy a frog or another amphibian, watch its behavior — how it interacts with the land and the water, how it breathes, how it swims, hops, eats and vocalizes.

Our appreciation of nature is heightened by our understanding of how different animals interact with their environment. And the more we discover about frogs and the environmental pressure they're experiencing, the more we learn how to help protect these animals, and all of nature, for the future.

The Smithsonian Institution

The Smithsonian Institution is home to more than 141 million objects, ranging in size from insects and diamonds to locomotives and spacecraft. It is the world's largest museum complex, comprising 15 museums and galleries and the National Zoo in Washington DC, and two additional museums in New York City. Millions of visitors each year visit the nation's capital to view such treasures as the Hope Diamond, the Star Spangled Banner, and the Wright Flyer. A broad range of exhibits ensures a fun and educational experience for young and old alike.

One of the world's leading scientific research centers, the Institution has facilities in eight states and the Republic of Panama. Research projects in the arts, history and science are carried out by the Smithsonian all over the world. Some of the Smithsonian's research centers include the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, the Smithsonian Marine Station at Link Port, in Florida, and the Smithsonian Tropical Research Institute, in Panama.

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History

James Smithson (1765 – 1829), a British scientist, drew up his will in 1826 naming his nephew, Henry James Hungerford, as beneficiary. Smithson stipulated that, should the nephew die without heirs (as he did in 1835), the estate would go to the United States to found "at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge…"

On July 1, 1836, Congress accepted the legacy bequeathed to the nation by James Smithson, and pledged the faith of the United States to the charitable trust. In 1838, following approval of the bequest by the British courts, the United States received Smithson's estate—bags of gold sovereigns—then the equivalent of $515,169. Eight years later, on August 10, 1846, an Act of Congress signed by President James K. Polk, established the Smithsonian Institution in its present form and provided for the administration of the trust, independent of the government itself, by a Board of Regents and Secretary of the Smithsonian.

SMITHSONIAN MUSEUMS, GALLERIES AND ZOOS

Smithsonian Institution Building ("Castle")
Anacostia Museum
Arthur M. Sackler Gallery
Arts and Industries Building
Cooper-Hewitt, National Design Museum
Freer Gallery of Art
Hirshhorn Museum and Sculpture Garden
National Air and Space Museum
National Museum of African Art
National Museum of American History, Behring Center
National Museum of the American Indian
National Museum of Natural History
National Portrait Gallery
National Postal Museum
National Zoological Park
Renwick Gallery
S. Dillon Ripley Center
Smithsonian American Art Museum